Georgia's State Implementation Plan For Regional Haze (Second Planning Period)

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Prepared by:

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Environmental Protection Division
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Executive Summary

Pursuant to the Clean Air Act (CAA) requirements contained in sections 169A and 169B and the subsequent implementing regulations contained in 40 CFR 51.308, the Georgia Environmental Protection Division (GA EPD), has developed a State Implementation Plan (SIP) revision to address regional haze. The SIP revision represents commitments and actions taken by the state to address the requirements of the CAA during the second implementation period, which includes the years 2019 to 2028, towards the goal of attaining natural visibility conditions in Georgia's designated Class I areas. Georgia has three Class I areas within its borders: Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area, as designated in 40 CFR Part 81 Subpart 408 where visibility has been determined to be an important value. To develop this proposed SIP revision, the state has relied heavily on the work of the Visibility Improvement States and Tribal Association of the Southeast (VISTAS). VISTAS is directed by the state air directors of ten southeastern states, including Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia.

The data and analyses necessary to meet the requirements of the federal regional haze regulations are considerable. The ten states, through VISTAS, completed most of the technical requirements using contracted resources. To help coordinate and direct the technical work, VISTAS created the Coordinating Committee, the Technical Analysis Workgroup, the Data Analysis Workgroup, and the SIP Template Workgroup. Each state had at least one representative participating in each group. These workgroups discussed and reviewed the work completed by the contractors used by VISTAS. These data and analyses produced by VISTAS form the technical basis for Georgia's proposed SIP revision. Throughout the technical work and SIP development process, VISTAS and the individual states provided updates to EPA Regions 3 and 4, the Federal Land Managers (or their representatives) from the National Park Service, the Fish and Wildlife Service, the Forest Service, industry representatives, and third-party groups.

Georgia's proposed regional haze SIP consists of a set of commitments, permit conditions, and plans addressing the requirements of the federal regulations, as well as supporting administrative and technical documentation. The required elements for the prehearing submittal for the second implementation period are contained in this document and Appendices A through H. The full Table of Appendices includes descriptions for each appendix and sub-appendix.

The regional haze rule requires states to demonstrate reasonable progress toward natural visibility conditions. Also, the rule directs states to determine a "uniform rate of progress," also known as the "glide path," from a 2000-2004 baseline toward natural conditions for each Class I area within their state. The tables below display the baseline visibility conditions and natural visibility conditions (expressed in deciviews) for the 20% most impaired and 20% clearest days for Georgia's Class I areas.

Natural Visibility Conditions for Georgia Class I Areas

Class I Areas	Average for 20% Most Impaired Days*	Average for 20% Clearest Days
Cohutta Wilderness Area	9.88 dv	4.42 dv
Okefenokee National Wilderness Area	9.45 dv	5.43 dv
Wolf Island National Wilderness Area[1]	9.45 dv	5.43 dv

Baseline Visibility Conditions for Georgia Class I Areas (2000-2004)

Class I Areas	Average for 20% Most Impaired Days	Average for 20% Clearest Days
Cohutta Wilderness Area	29.12 dv	13.73 dv
Okefenokee National Wilderness Area	25.34 dv	15.23 dv
Wolf Island National Wilderness Area[1]	25.34 dv	15.23 dv

GA EPD is responsible for establishing Reasonable Progress Goals (RPGs) for visibility improvement at each of the Georgia Class I areas, and a long-term strategy that will achieve those RPGs. 40 CFR 51.308(f) of the 1999 Rule requires states to submit periodic comprehensive revisions of their regional haze plans by July 31, 2018, and every ten years thereafter. On January 10, 2017, EPA revised, among other things, paragraph 40 CFR 51.308(f) of the regional haze rule to change the deadlines for submitting revisions and updates to regional haze plans for the second implementation period to July 31, 2021. This SIP was prepared for the second planning period, which includes years 2019 to 2028.

The 20 percent most impaired visibility days at the Cohutta Wilderness generally occur in the period between April and September. The peak hazy days occur in the summer under stagnant weather conditions with high relative humidity, high temperatures, and low wind speeds. The 20 percent clearest visibility days can occur at any time of year. At Wolf Island National Wilderness Area, Okefenokee National Wilderness Area, and other coastal sites, the 20 percent worst and best visibility days are distributed throughout the year.

States must include a monitoring strategy for measuring, characterizing, and reporting regional haze visibility impairment in their SIP. The long-term strategy includes enforceable emissions limitations, compliance schedules, and other measures as necessary to achieve the reasonable progress goals. States must also consider ongoing control programs, measures to mitigate construction activities, source retirement and replacement schedules, smoke management techniques for agriculture and forestry, and enforceability of specific measures. In developing this SIP, GA EPD considered emission sources outside Georgia that may affect visibility at Georgia Class I areas, and emission sources within Georgia that may affect visibility at Class I areas in neighboring states.

[1] There is no visibility monitor located at Wolf Island National Wilderness Area. Visibility at Wolf Island National Wilderness Area is assumed to be the same as the nearest Class I area, Okefenokee National Wilderness Area.

CONTROLS APPLIED IN THE SECOND PLANNING PERIOD

To determine reasonable progress goals, GA EPD evaluated additional control measures to determine which would be reasonable. It was determined that SO_2 emission reductions from electric generating units (EGUs) and non-EGU point sources in the VISTAS states would be the most effective sources to control to improve visibility at the Georgia Class I areas and non-Georgia Class I areas impacted by Georgia sources. GA EPD's review was conducted in a "top down" fashion. The VISTAS Area of Influence analysis was used to determine which major source categories and individual facilities had the highest visibility contribution to the Class I areas in 2028. The regional haze rule requires that states consider the following four factors and demonstrate how these factors were taken into consideration in selecting the reasonable progress goals:

- Costs of compliance
- Time necessary for compliance
- Energy and non-air quality environmental impacts of compliance, and
- Remaining useful life of any potentially affected sources.

Particulate Matter Source Apportionment Technology (PSAT) was used to model SO_2 and NOx contributions from groups of sources and individual facilities. Georgia EPD requested four-factor analyses from facilities identified to contribute 1.0% or more to the total visibility impairment caused by sulfate or nitrate at any Class I area in 2028. Analyses were requested and received for three facilities.

The following summarizes the proposed requirements for the three facilities that submitted four-factor analyses. International Paper (IP) – Savannah will no longer be allowed to burn coal in the No. 13 Power Boiler (PB13). Georgia Power – Plant Bowen found that no additional controls were reasonable. Plant Bowen will limit the Steam Generating Units (Emission IDs SG01, SG02, SG03 and SG04) to the MATS SO_2 emission limit of 0.20 lb/MMBtu based on a 30-day operating rolling average. Brunswick Cellulose is required to eliminate the firing of tire derived fuel (TDF) in the No. 4 Power Boiler, and to limit the firing of No. 6 fuel oil to times of natural gas curtailment with additional fuel oil firing allowed during adverse bark/wood fuel conditions to give the facility operational flexibility. The No. 4 Power Boiler will be limited to 15 tons per year of SO_2 emissions from firing fuel oil outside of periods of natural gas curtailment.

There are significant control programs being implemented between 2019 and 2028. These programs will all reduce the particulate emissions that affect visibility in the Class I areas, and include: the Cross State Air Pollution Rule (CSAPR), the Mercury and Air Toxics Standard (MATS), the 2010 sulfur dioxide (SO_2) National Ambient Air Quality Standard (NAAQS), the North Carolina Clean Smokestacks Act, Georgia Multi-Pollutant Rule, consent agreements with Tennessee Valley Authority (TVA), Lehigh Cement Company, Virginia Electric and Power

Company (VEPCO), and Anchor Glass Container, heavy duty diesel (2007) engine standard (for on-road trucks and buses), Tier 3 tailpipe standards for on-road vehicles, nonroad diesel rule, commercial marine vessel rule, and various Federal Maximum Achievable Control Technology (MACT) and New Source Performance Standard (NSPS) regulations.

REASONABLE PROGRESS GOALS

In accordance with the requirements of 40 CFR §51.308(f)(3), this Regional Haze Implementation Plan establishes reasonable progress goals for each Class I area in Georgia. To calculate the rate of progress represented by each reasonable progress goal, GA EPD compared baseline visibility conditions to natural visibility conditions in each Class I area and determined the uniform rate of progress (URP) in deciviews that would need to be maintained during each implementation period in order to attain natural visibility conditions by 2064. Georgia EPD summarized expected visibility improvements under existing Federal and State regulations, and any additional control measures found to be reasonable to implement in this review period. The impact of these controls were modeled using the Community Multiscale Air Quality (CMAQ) model. The modeling results were used to set reasonable progress goals (RPGs). The tables below display Georgia's 2028 reasonable progress goals for the 20 percent most impaired days and the 20 percent clearest days.

RPGs at Georgia Class I Areas – 20% Most Impaired Days Comparisons

Class I Area	2000-2004 Baseline Visibility (dv)	2028 Reasonable Progress Goals (dv)	2028 Uniform Rate of Progress (dv)	Natural Visibility (dv)
Cohutta Wilderness Area	29.12	14.90	21.42	9.88
Okefenokee National Wilderness Area	25.34	16.90	18.98	9.45
Wolf Island National Wilderness Area	25.34	16.90	18.98	9.45

RPGs at Georgia Class I Areas – 20% Clearest Day Comparisons

Class I Area	2000-2004 Baseline Visibility (dv)	2028 Reasonable Progress Goal (dv)
Cohutta Wilderness Area	13.73	9.15
Okefenokee National Wildlife RefugeWilderness Area	15.23	11.58
Wolf Island National Wilderness Area	15.23	11.58

Georgia EPD has determined that the 2028 RPGs will be significantly below the URP glide path for the 20% most impaired days at Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area. Also, the 2028 RPGs will be significantly below the 2000-2004 baseline visibility conditions for the 20% clearest days at Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area.

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List of Acronyms and Abbreviations

Acronym/Abbreviation	Meaning
AERR	Air Emission Reporting Rule
AFWA	Air Force Weather Agency
AIRMon	Atmospheric Integrated Research Monitoring Network
AMoN	Ammonia Monitoring Network
AoI	Area of Influence
AQS	Air Quality System network
ARW	Advanced Research WRF model
BART	best available retrofit technology
BEIS	Biogenic Emission Inventory System
BELD	Biogenic Emissions Land Use Database
b_{ext}	visibility impairment as extinction, Mm^{-1}
CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CAMD	Clean Air Markets Division
CAMx	Comprehensive Air Quality Model with Extensions
CAPP	Central Appalachian Coal
CASTNet	Clean Air Status and Trends Network
CENRAP	Central Regional Air Planning Association
CEM	continuous emissions monitoring
CM	course particle mass
CO	carbon monoxide
CONUS	continental U.S.
CoST	Control Strategy Tool
CPP	Clean Power Plan
CSA	North Carolina Clean Smokestacks Act
CSAPR	Cross State Air Pollution Rule
CTG	control technique guideline
CWT	concentration weighted trajectory
d	distance (kilometers)
dv	deciview
E_CM	extinction from coarse matter
EC	elemental carbon
EGU	Electric Generating unit
EIA	Energy Information Administration
EIS	Emissions Inventory System
EJ	Environmental Justice
EPA	United States Environmental Protection Agency
ERTAC	Eastern Regional Technical Advisory Committee
EWRT	extinction-weighted residence time
FAA	Federal Aviation Administration
FCCS	Fuel Characteristic Classification System
FDDA	Four-dimensional data assimilation
FGD	flue gas desulfurization

Acronym/Abbreviation	**Meaning**
FIA	Forest Inventory and Analysis
FLM	federal land manager
FS	Forest Service
FSL	Forecast Systems Laboratory
FWS	Fish and Wildlife Service
g/bhp-hr	grams per brake horsepower-hour
GPSC	Georgia Public Service Commission
HAP	hazardous air pollutant
HC	hydrocarbons
H_2SO_4	hydrogen sulfate
HMP	Hazard Mapping System
HNH_4SO_4	ammonium bisulfate
HYSPLIT	Hybrid Single Particle Lagrangian Integration Trajectory Model
IB	Illinois Basin Coal
ICI	industrial/commercial/institutional
IMPROVE	Interagency Monitoring of Protected Visual Environments
I/O API	Input/Output Applications Programming Interface
IPM	Integrated Planning Model
IRP	Integrated Resource Plan
km	kilometer
kW	kilowatts
LAC	light absorbing carbon
LADCO	Lake Michigan Air Directors Consortium
lbs/mmbtu	pounds per million British thermal units
LEV	California Low Emission Vehicle Standards
LTS	Long-term strategy
M	meters
m^2g^{-1}	meter squared per gram
MACT	maximum achievable control technology
MANE-VU	Mid-Atlantic/Northeast Visibility Union
MATS	Mercury and Air Toxics Standard
MB	mean bias
MDA8	maximum daily 8-hour average
mb	millibar
MJO	multi-jurisdictional organizations
Mm^{-1}	Inverse Megameters
mmbtu/hr	million British thermal units per hour
MOVES	Motor Vehicle Emission Simulator
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NaCl	sodium chloride, sea salt
NADP	National Acid Deposition Program
NAICS	North American Industry Classification System
NCAR	National Center for Atmospheric Research

Acronym/Abbreviation	**Meaning**
NCEP	National Centers for Environmental Prediction
NEI	National Emissions Inventory
NEEDS	National Electric Energy Database Systems
NESHAP	National Emission Standards for Hazardous Air Pollutants
NH_3	ammonia
NH_4^+	ammonium ion
NH_4NO_3	ammonium nitrate
$(NH_4)_2SO_4$	ammonium sulfate
NLCD	National Land Cover Database
NMB	normalized mean bias
NME	normalized mean error
NMHC	non-methane hydrocarbons
NMIM	National Mobile Inventory Model
NTN	National Trends Network
NO	nitric oxide
NO_3^-	nitrate ion
NOAA	National Oceanic and Atmospheric Administration
NODA	notice of data availability
NO_X	nitrogen oxides
NPS	National Park Service
NSPS	New Source Performance Standards
OAQPS	Office of Air Quality Planning and Standards
PM	particulate matter
PM_{10}	coarse particulate matter
$PM_{2.5}$	fine particles with a diameter smaller than 2.5 μg
POM	particulate organic matter
ppb	parts per billion
ppm	parts per million
ppmvd	parts per million volume dry
PRB	Powder River Basin Coal
PSAT	Particulate Matter Source Apportionment Technology
PTE	potential to emit
Q	emissions, tons per year
RAAP	Radford Army Arsenal Plant
RACT	reasonably available control technology
RBLC	RACT/BACT/LAER Clearinghouse
RFG	reformulated gasoline
RPG	reasonable progress goal
RPO	regional planning organization
RRF	relative reduction factor
RT	residence time
SAP	sulfuric acid plant
SOAP	secondary organic aerosol partitioning
SCC	source category code

Acronym/Abbreviation	**Meaning**
SCR	selective catalytic reduction
SIP	state implementation plan
SMAT-CE	EPA Software for Model Attainment Test – Community Edition
SMOKE	Sparse Matrix Operator Kernel Emissions model
SNCR	selective noncatalytic reduction
SO_2	sulfur dioxide
SO_4^{-2}	sulfate ion
TAF	Terminal Area Forecast System
TECO	Tampa Electric Company
tpOS	tons per ozone season
tpy	tons per year
URP	uniform rate of progress
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFS	United States Forest Service
VEPCO	Virginia Electric and Power Company
VISTAS	Visibility Improvement State and Tribal Association of the Southeast
VMT	vehicle miles traveled
VOC	volatile organic compound
WRF	Weather Research and Forecasting
µm	micrometer
$\mu g/m^3$	microgram per cubic meter

1. Introduction

1.1. What Is Regional Haze?

Regional haze is defined as visibility impairment that is caused by atmosphere-entrained air pollutants emitted from numerous anthropogenic and natural sources located over a wide geographic area. These emissions are often transported long distances. Haze is caused when sunlight is absorbed or scattered by airborne particles which, in turn, reduce the clarity, contrast, color, and viewing distance of what is seen. Regional haze refers to haze that impairs visibility in all directions uniformly.

Pollution from particulate matter (PM) is the major cause of reduced visibility (haze) in the United States, including many of our national parks, forests, and wilderness areas (including 156 mandatory federal Class I areas as defined in 40 CFR Part 81.400). PM affects visibility through the scattering and absorption of light, and fine particles – particles similar in size to the wavelength of light – are most efficient, per unit of mass, at reducing visibility. Fine particles are produced by a variety of natural and manmade sources. Fine particles may either be emitted directly or formed from emissions of precursors, the most significant of which are sulfur oxides such as sulfur dioxide (SO_2) and nitrogen oxides (NO_X). Reducing fine particles in the atmosphere is generally considered to be an effective method of reducing regional haze and thus improving visibility. Fine particles also adversely impact human health, especially respiratory and cardiovascular systems. The United States Environmental Protection Agency (EPA) has set national ambient air quality standards (NAAQS) for daily and annual levels of fine particles with a diameter less than or equal to 2.5 micrometers (μm) ($PM_{2.5}$). In the southeast, the most important sources of $PM_{2.5}$ and its precursors are coal-fired power plants, industrial boilers, process heaters, and other stationary combustion sources. Other significant contributors to $PM_{2.5}$ and visibility impairment include the following source categories: mobile, onroad, and non-road engine emissions; stationary non-combustion emissions (area sources); wildfires and prescribed burning emission; and wind-blown dust.

1.2. What Are The Requirements Under The Clean Air Act For Addressing Regional Haze?

In Section 169A of the 1977 Amendments to the Clean Air Act (CAA), Congress set forth a program for protecting visibility in Class I areas that calls for the "prevention of any future, and the remedying of any existing, impairment of visibility caused by anthropogenic (manmade) air pollution." On December 2, 1980, the EPA promulgated regulations to address visibility impairment (45 FR 80084) that is "reasonably attributable" to a single source or small groups of sources. These regulations represented the first phase in addressing visibility impairment and deferred action on regional haze that emanates from a variety of sources until monitoring, modeling, and scientific knowledge about the relationships between pollutants and visibility impairment improved.

In the 1990 Amendments to the CAA, Congress added section 169B and called on EPA to issue regional haze rules. The regional haze rule that EPA promulgated on July 1, 1999, (64 FR 35713) revised the existing visibility regulations to integrate provisions addressing regional haze impairment and established a comprehensive visibility protection program for mandatory federal Class I areas.[2] Each state was required to submit a state implementation plan (SIP) to the EPA by December 17, 2007, which set out that state's plan for complying with the regional haze rule for the first planning period from 2007 to 2018. Each state was required to consult and coordinate with other states and with Federal Land Managers (FLMs) in developing its SIP. Paragraph 40 CFR 51.308(f) of the 1999 rule required states to submit periodic comprehensive revisions of their regional haze plans by July 31, 2018, and every ten years thereafter. However, on January 10, 2017, EPA revised, among other things, paragraph 40 CFR 51.308(f) of the regional haze rule to change the deadlines for submitting revisions and updates to regional haze plans to July 31, 2021, July 31, 2028, and every 10 years thereafter. This SIP was prepared for the second planning period, which includes years 2021 to 2028.

The regional haze rule addressed the combined visibility effects of various pollution sources over a wide geographic region. This wide-reaching pollution net meant that many states – even those without mandatory federal Class I areas – would be required to participate in haze reduction efforts. Five regional planning organizations (RPOs) were formed to assist with the coordination and cooperation needed to address the visibility issue. These five RPOs are illustrated in Figure 1-1.[3] The Southeastern States Air Resource Managers, Inc. (SESARM) has been designated by EPA as the entity responsible for coordinating regional haze evaluations for the ten Southeastern states (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia), local air pollution control agencies, and tribal authorities. These parties collaborated through the organization known as Visibility Improvement - State and Tribal Association of the Southeast (VISTAS) to prepare the technical analyses and planning activities associated with visibility and related regional air quality issues supporting development of regional haze SIPs for the first and second planning periods. For the second planning period, local air pollution control agencies were represented by the Knox County, Tennessee local air pollution control agency and tribal authorities were represented by the Eastern Band of Cherokee Indians.

[2] The regional haze regulations were amended on July 6, 2005 (70 FR 39104), October 13, 2006 (71 FR 60612), June 7, 2012 (77 FR 33642), and January 10, 2017 (82 FR 3078).
[3] URL: https://www.epa.gov/visibility/visibility-regional-planning-organizations

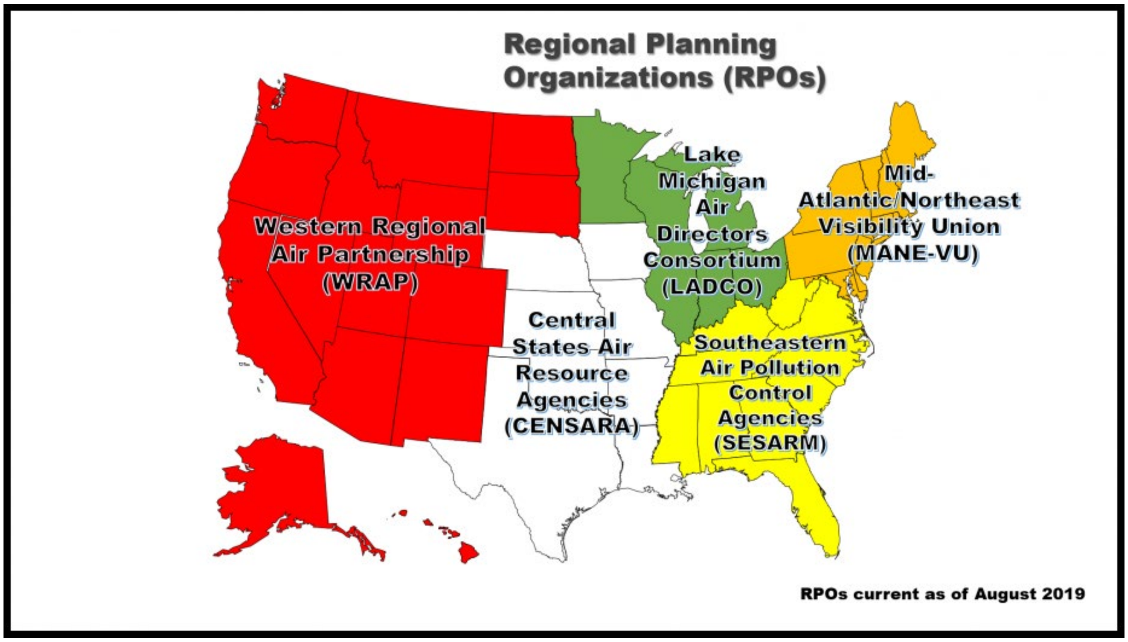

Figure 1-1: Geographical Areas of Regional Planning Organizations

1.3. General Overview of Regional Haze SIP Requirements

The regional haze rule at 40 CFR 51.308(f) requires all states to submit a SIP for regional haze to EPA by July 31, 2021, July 31, 2028, and every 10 years thereafter and requires each state to periodically revise and submit revisions to its regional haze SIP. All regional haze SIPs must include the following:

- Reasonable progress goals (RPGs) for each mandatory federal Class I area located within the state;
- Natural, baseline, and current visibility conditions for each mandatory federal Class I area within the state;
- A long-term strategy to address visibility for each mandatory federal Class I area within the state and for each mandatory federal Class I area located outside the state that may be affected by emissions from the state;
- A monitoring strategy for measuring, characterizing, and reporting data that is representative of all mandatory federal Class I areas within the state; and
- Other requirements and analyses.

The regional haze rule requires states to establish RPGs, expressed in deciviews (dv), for the end of each implementation period (approximately ten years) that reflect the visibility conditions that are projected to be achieved by the end of the applicable implementation period as a result of enforceable measures required by the regional haze rule and other requirements of the CAA (40 CFR 51.308(f)(3)). The goals must provide for reasonable progress towards achieving natural visibility conditions by providing for improvement in visibility for the most impaired days and ensuring no degradation in visibility for the clearest days over each ten-year period.

The regional haze rule requires states to compute natural visibility conditions for both the 20% most impaired days and the 20% clearest days (40 CFR 51.308(f)(1)). For the 20% most impaired days, the regional haze rule directs each state with a Class I area to determine the uniform rate of progress (URP or "glide path") that would need to be maintained during each implementation period to attain natural visibility conditions for the Class I area by 2064. Data from the Interagency Monitoring of Protected Visual Environments (IMPROVE) network are used to establish baseline and natural visibility metrics.[4] States are to establish baseline visibility conditions using a five-year average of monitoring data for 2000-2004 and natural visibility conditions for 2064. A line is drawn between the two data points to determine the URP for the most impaired days. Days with the lowest 20% annual values of the daily haze index are used to represent the clearest days. The requirement of the regional haze rule for 20% clearest days is to ensure that no degradation from the baseline (2000-2004) occurs. For 20% clearest days, the regulatory requirements do not rely on a comparison to the estimated 2064 natural background conditions.

For this second planning period, regional haze SIPs must include the current visibility conditions for the most impaired and clearest days, the actual progress made towards natural visibility since the baseline period, and the actual progress made during the previous implementation period. The period for calculating current visibility conditions is the most recent five-year period for which data are available. For this SIP, the current visibility conditions include data from years 2014 to 2018. The period for evaluating actual progress made is from the baseline period (2000 to 2004) up to and including the five-year period for calculating current visibility conditions (40 CFR 51.308(f)(1)(iii)-(iv)).

The 2028 RPGs for each Class I area must be met through measures contained in the state's long-term strategy. The long-term strategy must address regional haze visibility impairment for each mandatory federal Class I area within the state and for each mandatory federal Class I area located outside the state that may be affected by emissions from the state. The long-term strategy must include enforceable emissions limitations, compliance schedules, and other measures as necessary to make reasonable progress. Section 169B of the CAA requires a state to consider the four statutory factors (cost of compliance, time necessary for compliance, energy and non-air quality environmental impacts, and remaining useful life) when developing the long-term strategy upon which it bases the RPGs for each Class I area. States are also required to consider the following additional factors in developing their long-term strategies: ongoing air pollution control programs; measures to mitigate the impact of construction activities; source retirement and replacement schedules; smoke management programs for agriculture and forestry; and the anticipated net effect of visibility due to projected changes in point, area, and mobile source emissions over the period addressed by the long-term strategy (40 CFR 51.308(f)(2)(iv)).

[4] URL: http://vista.cira.colostate.edu/Improve/

States must include a monitoring strategy for measuring, characterizing, and reporting of regional haze visibility impairment data that is representative of all mandatory federal Class I areas within the state. The regional haze rule states that compliance with this requirement may be met through participation in the IMPROVE network (40 CFR 51.308(f)(6)).

The SIPs for this second planning period document long-term strategies for visibility improvement to the end of the second planning period (2028). States are required to evaluate progress toward meeting RPGs every five years to assure that emissions controls are on track with emissions reduction forecasts in each SIP. On January 10, 2017, EPA amended 40 CFR 51.308(f) so that the plan revision for the second planning period will also serve as a progress report and thus address the periodic report requirement specified in 40 CFR 51.308(g)(1) through (5). The next progress report will be due to EPA by January 31, 2025. If emissions controls are not on track to ensure reasonable progress, then states would need to take action to assure emissions controls installed and operational by 2028 will be consistent with the SIP or to revise the SIP to be consistent with the revised emissions forecast (40 CFR 51.308(f) and 40 CFR 51.308(g)).

The EPA provided several guidance documents listed below to assist the states in implementation of the regional haze rule requirements, including documents that specifically address the second implementation period. All VISTAS states followed these guidance documents in developing the technical analyses reported in this plan.

- Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule (EPA-454/B-03-005, September 2003)

- General Principles for 5-year Regional Haze Progress Reports for the Initial Regional Haze State Implementation Plans (Intended to Assist States and EPA Regional Offices in Development and Review of the Progress Reports) (EPA, April 2013)

- Technical Guidance for Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program (EPA, December 20, 2018)

- Guidance on Regional Haze State Implementation Plans for the Second Implementation Period (EPA, August 20, 2019)

- Technical Support Document for EPA’s 2028 Regional Haze Modeling (EPA, September 19, 2019)

- Recommendation for the Use of Patched and Substituted Data and Clarification of Data Completeness for Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program (EPA, June 3, 2020)

- Memorandum Titled Clarification Regarding Regional Haze State Implementation Plans for the Second Implementation Period (EPA, July 8, 2021)

1.4. Mandatory Federal Class I Areas in Georgia

Georgia has three mandatory Class I areas within its borders: Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area. The Georgia Environmental Protection Division (GA EPD) in the Georgia Department of Natural Resources is responsible for developing the Regional Haze SIP. This SIP establishes reasonable progress goals for visibility improvement at each of these mandatory federal Class I areas and a long-term strategy that will achieve those reasonable progress goals within the second regional haze planning period. Wolf Island National Wilderness Area does not contain an IMPROVE site; thus, the rate of progress for Okefenokee National Wilderness Area is considered representative of Wolf Island National Wilderness Area. These three Class I Areas for Georgia are described at 40 CFR 81.408 and are shown in Figure 1-2.

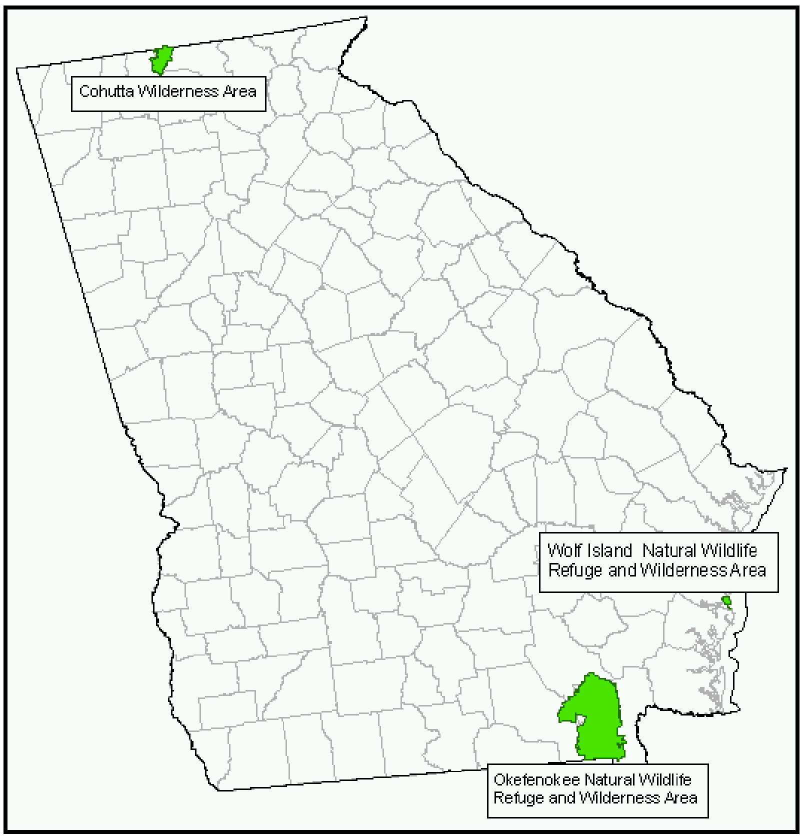

Figure 1-2: Georgia's Mandatory Federal Class I Areas

As required by the regional haze rule, GA EPD has also considered the impacts of emission sources outside of Georgia that may affect visibility at these Georgia Class I areas and emission sources within Georgia that may affect visibility at Class I areas in neighboring states. Through VISTAS, the southeastern states worked together to assess state-by-state contributions to visibility impairment in specific Class I areas, including those in Georgia and those affected by emissions from Georgia. This technical work is discussed further in Sections 5, 6, 7, and 7 below. Consultations to date between Georgia and other states are summarized in Section 10.

1.5. Regional Planning and Coordination

Successful implementation of a regional haze program involves long-term regional coordination among states. SESARM formed VISTAS in 2001 to coordinate technical work and long-range planning for addressing visibility impairment in each of the eighteen mandatory federal Class I areas in the VISTAS region (see Figure 1-3 and Table 1-1). Georgia participated as a member state in VISTAS during the first and second planning periods. The objectives of VISTAS are as follows:

- To coordinate and document natural, baseline, and current conditions for each Class I area in the Southeast;
- To develop base year and future year emission inventories to support air quality modeling;
- To develop methodologies for screening sources and groups of sources for reasonable progress analysis;
- To conduct photochemical grid modeling to support development of RPGs for each Class I area; and
- To share information to support each state in developing the long-term strategy for its SIP.

In addition, VISTAS states also coordinated with other RPOs to share information and undertake consultation as needed to address visibility impairment associated with sources affecting Class I areas in the VISTAS region and sources in the VISTAS region potentially affecting visibility impairment in another region.

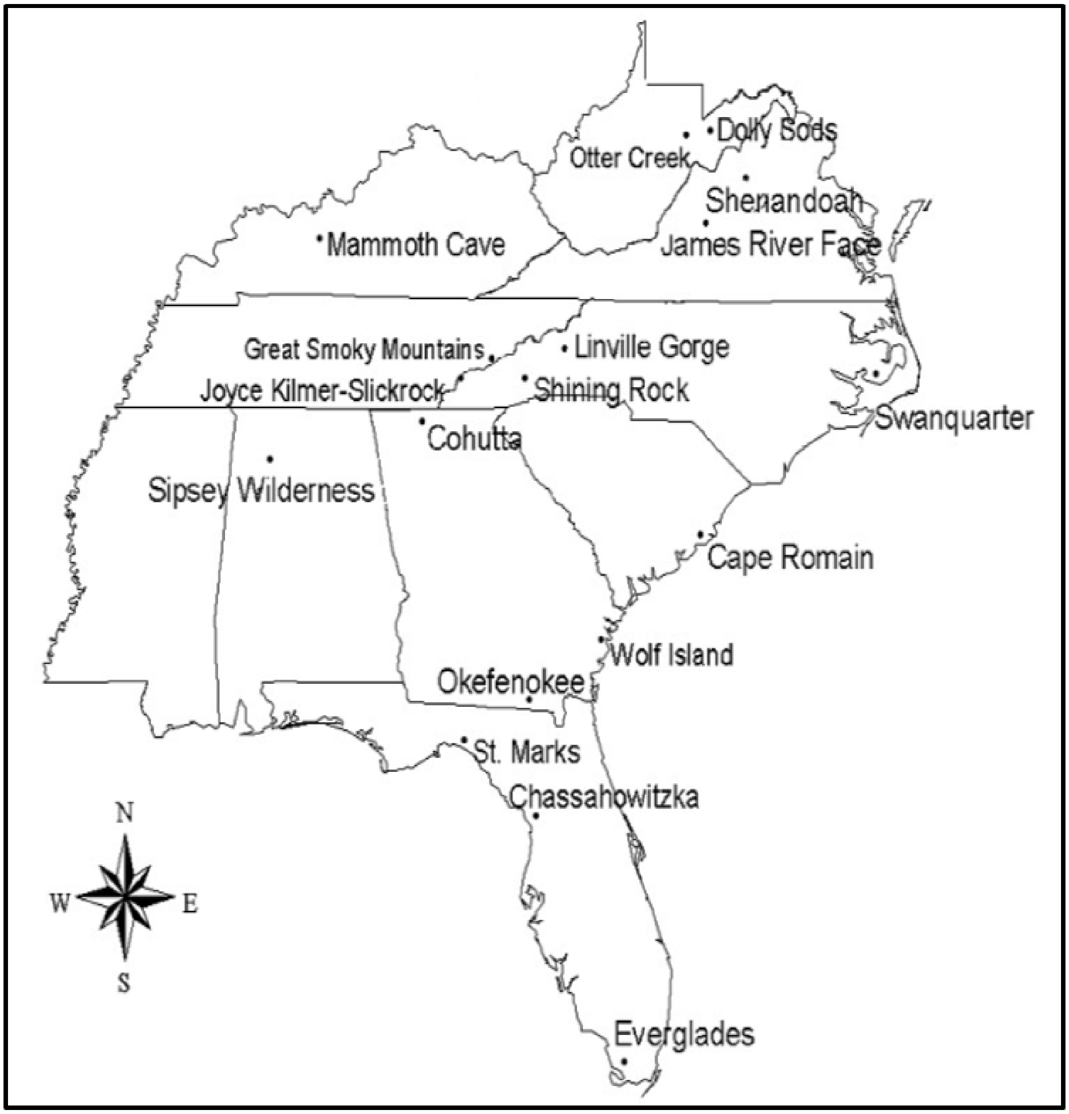

Figure 1-3: Mandatory Federal Class I Areas in the VISTAS Region

Table 1-1: Mandatory Federal Class I Areas in the VISTAS Region

State	Area Name	Acreage	Federal Land Manager
Alabama	Sipsey Wilderness Area	12,646	USDA-FS
Florida	Chassahowitzka Wilderness Area	23,360	USDI-FWS
Florida	Everglades National Park	1,397,429	USDI-NPS
Florida	St. Marks Wilderness Area	17,745	USDI-FWS
Georgia	Cohutta Wilderness Area	33,776	USDA-FS
Georgia	Okefenokee National Wilderness Area	343,850	USDI-FWS
Georgia	Wolf Island National Wilderness Area	5,126	USDI-FWS
Kentucky	Mammoth Cave National Park	51,303	USDI-NPS
North Carolina	Great Smoky Mountains National Park	273,551	USDI-NPS
North Carolina	Joyce Kilmer-Slickrock Wilderness Area	10,201	USDA-FS
North Carolina	Linville Gorge Wilderness Area	7,575	USDA-FS
North Carolina	Shining Rock Wilderness Area	13,350	USDA-FS
North Carolina	Swanquarter Wilderness Area	9,000	USDI-FWS
South Carolina	Cape Romain Wilderness Area	28,000	USDI-FWS
Tennessee	Great Smoky Mountains National Park	241,207	USDI-NPS
Tennessee	Joyce Kilmer-Slickrock Wilderness Area	3,832	USDA-FS
Virginia	James River Face Wilderness Area	8,703	USDA-FS
Virginia	Shenandoah National Park	190,535	USDI-NPS
West Virginia	Dolly Sods Wilderness Area	10,215	USDA-FS
West Virginia	Otter Creek Wilderness Area	20,000	USDA-FS

1.6. State and FLM Coordination

As required by 40 CFR 51.308(i), the regional haze SIP must include procedures for continuing consultation between the states and FLMs on the implementation of the visibility protection program. Continuing consultation should encompass development and review of periodic implementation plan revisions and five-year progress reports as well as the implementation of other programs having the potential to contribute to impairment of visibility in any Class I area within the state. The three FLMs are the United States Department of Interior (USDI) Fish and Wildlife Service (FWS), the National Park Service (NPS), and the United States Department of Agriculture (USDA) Forest Service (FS).

Coordination with the FLMs of Georgia's continuing obligations to periodically revise its regional haze SIP is also discussed in Section 11. GA EPD formally commits to follow the FLM consultation procedures as prescribed in 40 CFR 51.308(i) in making these future implementation plan reviews and revisions.

The FLMs were involved in the preparation of this regional haze SIP. Documentation of the formal comments made by the FLMs and GA EPD's response appears in Appendix H – Public Hearing Comment Summary and Agency Responses. More information on FLM consultation can be found in Section 10.3 and in Appendix F-3.

1.7. Cross-Reference to Regional Haze Regulatory Requirements

Table 1-2 identifies each section of the SIP that addresses regional haze rule requirements specified in 40 CFR 51.308(f), (g), and (i) for this second planning period.

Table 1-2: Cross-Reference of Sections in the SIP to Regional Haze Rule Requirements Specified in 40 CFR 51.308(f) and (g)

Rule Section	Chapter/Section in SIP	Description
(f)	11	Requirements for periodic comprehensive revisions of implementation plans for regional haze
(f)(1)	2.1, 2.2, 2.3, 2.4, 2.6, 3	Calculations of baseline, current, and natural visibility conditions; progress to date; and the uniform rate of progress
(f)(1)(i)	2.4	Baseline visibility conditions for the most impaired and clearest days
(f)(1)(ii)	2.3	Natural visibility conditions for the most impaired and clearest days
(f)(1)(iii)	2.6	Current visibility conditions for the most impaired and clearest days
(f)(1)(iv)	2.7	Progress to date for the most impaired and clearest days
(f)(1)(v)	2.7	Differences between current visibility condition and natural visibility condition
(f)(1)(vi)(A)	3	Uniform rate of progress
(f)(1)(vi)(B)	not applicable	Any adjustments to rate of progress
(f)(2)	7	Long-term strategy for regional haze
(f)(2)(i)	7	Emission reduction measures that are necessary to make reasonable progress
(f)(2)(ii)	10	Consult with those states that have emissions that are reasonably anticipated to contribute to visibility impairment in the mandatory federal Class I area
(f)(2)(ii)(A)	10	Demonstrate that it has included in its implementation plan all measures agreed to during state-to-state consultations
(f)(2)(ii)(B)	10	Consider the emission reduction measures identified by other states for their sources
(f)(2)(ii)(C)	10	In any situation in which a state cannot agree with another state on the emission reduction measures necessary to make reasonable progress in a mandatory federal Class I area, the state must describe the actions taken to resolve the disagreement
(f)(2)(iii)	2, 4, 5, 6, 7.2, 7.7, 7.8, 9, 10	Document the technical basis, including modeling, monitoring, cost, engineering, and emissions information, on which the State is relying to determine the emission reduction measures that are necessary to make reasonable progress in each mandatory federal Class I area
(f)(2)(vi)(A)	7.2	Emission reductions due to ongoing air pollution control programs, including measures to address reasonably attributable visibility impairment
(f)(2)(vi)(B)	7.9.2	Measures to mitigate the impacts of construction activities
(f)(2)(vi)(C)	7.2.2	Source retirement and replacement schedules
(f)(2)(vi)(D)	7.9.1	Basic smoke management practices for prescribed fire used for agricultural and wildland vegetation management purposes and smoke management programs
(f)(2)(vi)(E)	8	The anticipated net effect on visibility due to projected changes in point, area, and mobile source emissions over the period addressed by the long-term strategy
(f)(3)(i)	8	Reasonable progress goals – The state must establish reasonable progress goals (expressed in dv) that reflect the visibility conditions that are projected to be achieved by the end of the applicable implementation period as a result of those enforceable emissions limitations, compliance schedules, and other measures.

Rule Section	Chapter/Section in SIP	Description
(f)(3)(ii)(A)	not applicable	If a state in which a mandatory federal Class I area is located establishes a reasonable progress goal for the most impaired days that provides for a slower rate of improvement in visibility than the uniform rate of progress calculated under paragraph (f)(1)(vi) of this section, the state must demonstrate, based on the analysis required by paragraph (f)(2)(i) of this section, that there are no additional emission reduction measures for anthropogenic sources or groups of sources in the state that may reasonably be anticipated to contribute to visibility impairment in the Class I area that would be reasonable to include in the long-term strategy
(f)(3)(ii)(B)	7	If a state contains sources which are reasonably anticipated to contribute to visibility impairment in a mandatory federal Class I area in another state for which a demonstration by the other State is required under (f)(3)(ii)(A), the state must demonstrate that there are no additional emission reduction measures for anthropogenic sources or groups of sources in the State that may reasonably be anticipated to contribute to visibility impairment in the Class I area that would be reasonable to include in its own long-term strategy. The state must provide a robust demonstration, including documenting the criteria used to determine which sources or groups or sources were evaluated and how the four factors required by paragraph (f)(2)(i) were taken into consideration in selecting the measures for inclusion in its long-term strategy.
(f)(4)	not applicable	If the Administrator, Regional Administrator, or the affected Federal Land Manager has advised a state of a need for additional monitoring to assess reasonably attributable visibility impairment at the mandatory federal Class I area in addition to the monitoring currently being conducted, the State must include in the plan revision an appropriate strategy for evaluating reasonably attributable visibility impairment in the mandatory federal Class I area by visual observation or other appropriate monitoring techniques.
(f)(5)	13.5	An assessment of any significant changes in anthropogenic emissions within or outside of the state that have occurred since the period addressed in the most recent plan required under paragraph (f) of this section including whether or not these changes in anthropogenic emissions were anticipated in that most recent plan and whether they have limited or impeded progress in reducing pollutant emissions and improving visibility.
(f)(6)	9	Monitoring strategy and other implementation plan requirements – States must submit with the implementation plan a monitoring strategy for measuring, characterizing, and reporting of regional haze visibility impairment that is representative of all mandatory federal Class I areas within the state. Compliance with this requirement may be met through participation in the Interagency Monitoring of Protected Visual Environments network.
(f)(6)(i)	not applicable	The establishment of any additional monitoring sites or equipment needed to assess whether reasonable progress goals
(f)(6)(ii)	9	Procedures by which monitoring data and other information are used in determining the contribution of emissions from within the state
(f)(6)(iii)	not applicable	For a state with no mandatory Class I federal areas, procedures by which monitoring data and other information are used to in determining the contribution of emissions from within the State to regional haze visibility impairment at mandatory Class I federal areas in other states.
(f)(6)(iv)	9	The implementation plan must provide for the reporting of all visibility monitoring data to the Administrator at least annually for each mandatory federal Class I area in the state.
(f)(6)(v)	4, 7.2.3	A statewide inventory of emissions of pollutants that are reasonably anticipated to cause or contribute to visibility impairment in any mandatory federal Class I area

Rule Section	Chapter/Section in SIP	Description
(f)(6)(vi)	9	Other elements, including reporting, recordkeeping, and other measures, necessary to assess and report on visibility.
(g)(1)	13.3	Periodic progress reports must contain at a minimum the following elements: (1) A description of the status of implementation of all measures included in the implementation plan for achieving reasonable progress goals for mandatory federal Class I areas both within and outside the State.
(g)(2)	13.5	(2) A summary of the emissions reductions achieved throughout the state through implementation of the measures described in paragraph (g)(1) of this section.
(g)(3)	13.4	For each mandatory Class I Federal area within the State, the State must assess the following visibility conditions and changes, with values for most impaired, least impaired and/or clearest days as applicable expressed in terms of 5-year averages of these annual values. The period for calculating current visibility conditions is the most recent 5-year period preceding the required date of the progress report for which data are available as of a date 6 months preceding the required date of the progress report.
(g)(3)(i)(A)	13.4	Progress reports due before January 31, 2025. The current visibility conditions for the most impaired and least impaired days.
(g)(3)(i)(B)	not applicable	Progress reports due on and after January 31, 2025. The current visibility conditions for the most impaired and clearest days
(g)(3)(ii)(A)	13.4	Progress reports due before January 31, 2025. The difference between current visibility conditions for the most impaired and least impaired days and baseline visibility conditions.
(g)(3)(ii)(B)	not applicable	Progress reports due on and after January 31, 2025. The difference between current visibility conditions for the most impaired and clearest days and baseline visibility conditions.
(g)(3)(iii)(A)	13.4	Progress reports due before January 31, 2025. The change in visibility impairment for the most impaired and least impaired days over the period since the period addressed in the most recent plan required under paragraph (f) of this section.
(g)(3)(iii)(B)	not applicable	Progress reports due on and after January 31, 2025. The change in visibility impairment for the most impaired and clearest days over the period since the period addressed in the most recent plan required under paragraph (f) of this section.
(g)(4)	13.5	An analysis tracking the change over the period since the period addressed in the most recent plan required under paragraph (f) of this section in emissions of pollutants contributing to visibility impairment from all sources and activities within the State. Emissions changes should be identified by type of source or activity. With respect to all sources and activities, the analysis must extend at least through the most recent year for which the state has submitted emission inventory information to the Administrator in compliance with the triennial reporting requirements of subpart A of this part as of a date 6 months preceding the required date of the progress report. With respect to sources that report directly to a centralized emissions data system operated by the Administrator, the analysis must extend through the most recent year for which the Administrator has provided a State-level summary of such reported data or an internet-based tool by which the State may obtain such a summary as of a date 6 months preceding the required date of the progress report. The State is not required to backcast previously reported emissions to be consistent with more recent emissions estimation procedures and may draw attention to actual or possible inconsistencies created by changes in estimation procedures.

Rule Section	Chapter/Section in SIP	Description
(g)(5)	13.5	An assessment of any significant changes in anthropogenic emissions within or outside the State that have occurred since the period addressed in the most recent plan required under paragraph (f) of this section including whether or not these changes in anthropogenic emissions were anticipated in that most recent plan and whether they have limited or impeded progress in reducing pollutant emissions and improving visibility.
(i)	10.3	State and federal land manager coordination.

2. Natural Background Conditions and Assessment of Baseline, Modeling Base Period, and Current Conditions

The goal of the regional haze rule is to restore natural visibility conditions to the 156 Class I areas identified in the 1977 Clean Air Act Amendments. 40 CFR 51.301 contains the following definitions:

> *Natural conditions* reflect naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration, and may refer to the conditions on a single day or set of days. These phenomena include, but are not limited to, humidity, fire events, dust storms, volcanic activity, and biogenic emissions from soils and trees. These phenomena may be near or far from a Class I area and may be outside the United States.
>
> *Natural visibility* means visibility (contrast, coloration, and texture) on a day or days that would have existed under natural conditions. Natural visibility varies with time and location, is estimated or inferred rather than directly measured, and may have long-term trends due to long-term trends in natural conditions.
>
> *Natural visibility condition* means the average of individual values of daily natural visibility unique to each Class I area for either the most impaired days or the clearest days.

The regional haze SIPs must contain measures that make "reasonable progress" toward achieving natural visibility conditions by reducing anthropogenic, i.e., manmade emissions, that cause haze.

An easily understood measure of visibility to most people is visual range. Visual range is the greatest distance, in kilometers or miles, at which a dark object can be viewed against the sky. For evaluating the relative contributions of pollutants to visibility impairment, however, the most useful measure of visibility impairment is light extinction, which affects the clarity and color of objects being viewed.

The measure used by the regional haze rule is the deciview index, as required by 40 CFR 51.301. Deciviews are calculated directly from light extinction using the following logarithmic equation:

$$dv = 10 * \ln \left(\frac{b_{ext}}{10 * Mm^{-1}}\right)$$

In this equation, the atmospheric light extinction coefficient, b_{ext}, is expressed in units of inverse megameters (Mm^{-1}).[5] The dv units are useful for tracking progress in improving visibility because each dv change is an equal incremental change in visibility perceived by the human eye. Most people can detect a change in visibility at one dv.

For each Class I area, there are three metrics of visibility that are part of the determination of reasonable progress:

- natural conditions,
- baseline conditions, and
- current conditions.

Each of the three metrics includes the concentration data of the visibility-impairing pollutants as different terms in the IMPROVE light extinction algorithm, with respective extinction coefficients and relative humidity factors. Total light extinction when converted to dv is calculated for the average of the 20% clearest and 20% most impaired days. The terminology for these two sets of days changed for the second round of regional haze planning owing to a focus on anthropogenically-induced visibility impairment.[6]

"Natural" visibility is determined by estimating the natural concentrations of visibility pollutants and then calculating total light extinction. "Baseline" visibility is the starting point for the improvement of visibility conditions. Baseline visibility is calculated from the average of the IMPROVE monitoring data for 2000 through 2004. The comparison of initial baseline conditions from 2000-2004 to natural visibility conditions indicates the amount of improvement necessary to attain natural visibility by 2064. Each state must estimate natural visibility levels for Class I areas within its borders in consultation with FLMs and other states as required by 40 CFR 51.308(f)(1).

Another important set of visibility monitoring data is the base period used for air quality modeling projections, in this case monitoring data from years 2009 through 2013. These monitoring data are used in conjunction with inventory and meteorological data to project expected visibility parameters for each Class I area, as described in Section 5, Section 6, and Section 7.2.5.2.

"Current conditions" are assessed every five years as part of the regional haze planning process where actual progress in reducing visibility impairment is compared to the reductions delineated

[5] Colorado State University, "The IMPROVE Algorithm." URL: http://vista.cira.colostate.edu/Improve/haze-metrics-converter/

[6] EPA, "Technical Guidance on Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program", December 2018. URL: https://www.epa.gov/sites/production/files/2018-12/documents/technical_guidance_tracking_visibility_progress.pdf

in the SIP. The five-year period comprising current conditions in this SIP is 2014-2018, inclusive.

2.1. IMPROVE Algorithm

The IMPROVE algorithm for estimating light extinction was adopted by EPA as the basis for the regional haze metric used to track progress in reducing haze levels and estimates light extinction, which is then converted to the dv haze index.

The IMPROVE equation accounts for the effect of particle size distribution on light extinction efficiency of sulfate, nitrate, and organic carbon; the equation also accounts for light extinction by sea salt and light absorption by gaseous nitrogen dioxide. Site-specific values are used for Rayleigh scattering[7] to account for the site-specific effects of elevation and temperature. Separate relative humidity enhancement factors are used for small and large size distributions of ammonium sulfate and ammonium nitrate and for sea salt. A complete description of the terms in the IMPROVE equation is given on the IMPROVE website.[8]

The algorithm has been revised over the years to produce consistent estimates of light extinction for all remote-area IMPROVE aerosol monitoring sites. The individual particle component contributions to light extinction are separate estimates. The current IMPROVE equation includes contributions from sea salt and an increase in the multiplier for contributions from POM as compared to the previous IMPROVE algorithm.

In the IMPROVE algorithm, as described in the equation below, light extinction (b_{ext}) and Rayleigh scattering are described in units of Mm^{-1}. Dry mass extinction efficiency terms are in units of meter squared per gram (m^2g^{-1}). Water growth terms, *f(RH)*, are unitless. The total sulfate, nitrate, and organic compound concentrations are each split into two fractions, representing small and large size distributions of those components. For masses less than 20 $\mu g/m^3$, the fraction in the large mode is estimated by dividing the total concentration of the component by 20 $\mu g/m^3$. If the total concentration of a component exceeds 20 $\mu g/m^3$, all is assumed to be in the large mode. The small and large modes of sulfate and nitrate have relative humidity correction factors, $f_S(RH)$ and $f_L(RH)$, applied since these species are hygroscopic (i.e. absorb water), and their extinction efficiencies change with relative humidity.

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[7] Rayleigh scattering is the scattering of light by atoms, molecules, and particles that are much smaller than the wavelength of light (i.e., diameter of less than one nanometer).
[8] Colorado State University, "The IMPROVE Algorithm", URL: http://vista.cira.colostate.edu/Improve/the-improve-algorithm/.

$$b_{ext} \approx 2.2 \times f_S(RH) \times [Small\ Ammonium\ Sulfate] + 4.8 \times f_L(RH) \times [Large\ Ammonium\ Sulfate] + 2.4 \times f_S(RH) \times [Small\ Ammonium\ Nitrate] + 5.1 \times f_L(RH) \times [Large\ Ammonium\ Nitrate] + 2.8 \times [Small\ Organic\ Mass] + 6.1 \times [Large\ Organic\ Mass] + 10 \times [Elemental\ Carbon] + 1 \times [Final\ Soil] + 1.7 \times f_{SS}(RH) \times [Sea\ Salt] + 0.6 \times [Coarse\ Mass] + Rayleigh\ Scattering(Site\ Specific) + 0.33 \times [NO_2(ppb)]$$

More information on the IMPROVE algorithm may be found in Appendix E-1a and Appendix E-1b.

2.2. IMPROVE Monitoring Sites

Table 2-1 provides the VISTAS Class I areas and their associated monitoring site identification numbers. In certain instances, a Class I area may not have a monitoring site located within its boundaries. Such sites rely on data from nearby monitoring sites to act as surrogates within the analyses described in this SIP revision. For Class I areas in the Southeastern U.S., Joyce Kilmer-Slickrock Wilderness Area relies upon data from the Great Smoky Mountains National Park IMPROVE monitoring site (GRSM1), Otter Creek Wilderness Area relies on data from the Dolly Sods Wilderness Area IMPROVE monitoring site (DOSO1), and Wolf Island National Wilderness Area relies on data from the Okefenokee National Wilderness Area IMPROVE monitoring site (OKEF1). For the analyses described within this document, site-specific data such as elevation and location are used for these areas in combination with the monitoring data from the surrogate IMPROVE site. Table 2-1 provides the IMPROVE site identification number for the surrogate monitor in these situations.

Table 2-1: VISTAS Class I Areas and IMPROVE Site Identification Numbers

Class I Area	IMPROVE Site Identification Number
Cape Romain Wilderness Area	ROMA1
Chassahowitzka Wilderness Area	CHAS1
Cohutta Wilderness Area	COHU1
Dolly Sods Wilderness Area	DOSO1
Everglades National Park	EVER1
Great Smoky Mountains National Park	GRSM1
James River Face Wilderness Area	JARI1
Joyce Kilmer-Slickrock Wilderness Area	GRSM1
Linville Gorge Wilderness Area	LIGO1
Mammoth Cave National Park	MACA1
Okefenokee National Wilderness Area	OKEF1
Otter Creek Wilderness Area	DOSO1
Shenandoah National Park	SHEN1
Shining Rock Wilderness Area	SHRO1
Sipsey Wilderness Area	SIPS1
St. Marks Wilderness Area	SAMA1
Swanquarter Wilderness Area	SWAN1
Wolf Island National Wilderness Area	OKEF1

2.3. Estimating Natural Conditions for VISTAS Class I Areas

Natural background visibility, as defined in Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Program, EPA-454/B-03-005, September 2003,[9] is based on annual average concentrations of fine particle components. There are two separate methodologies to compute natural conditions: one methodology for the 20% clearest days and one for the 20% most impaired days. In the first round of regional haze planning as well as the first mid-course review, these days were referred to as the 20% best and 20% worst days, respectively. These terms were updated to "clearest" and "most impaired" as part of two recent actions by EPA: a rule amending requirements for state plans finalized in January 2017,[10] and EPA guidance that updates recommended methodologies for tracking visibility impairment, issued in December 2018.[11] Also, as part of EPA's 2018 guidance, the recommended methodology for computing natural conditions for the 20% most impaired days changed, while no change was made for the 20% clearest days.

Natural background conditions using the current IMPROVE equation are calculated separately for each Class I area, and the methodology for calculating background conditions for the 20%

[9] U.S. EPA. "Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Program", EPA-454/B-03-005, September 2003. URL: http://vista.cira.colostate.edu/Improve/wp-content/uploads/2016/04/RHRNaturalConditions.pdf
[10] Final Rule: Protection of Visibility: Amendments to Requirements for State Plans, 82 FR 3078, January 10, 2017.
[11] EPA, "Technical Guidance on Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program", December 2018. URL: https://www.epa.gov/sites/production/files/2018-12/documents/technical_guidance_tracking_visibility_progress.pdf

most impaired days and the 20% clearest days are discussed in the preceding sections. Broadly speaking, however, the new calculation of natural background allows Rayleigh scattering to vary with elevation. Secondly, natural conditions are adjusted (as with the 20% most impaired days) to reflect impacts of natural events heretofore unrecognized in the computation of visibility under natural background conditions.

2.3.1. Natural Background Conditions on 20% Clearest Days

EPA's 2018 guidance memo notes that days with the lowest 20% annual values of the daily haze index are used to represent the clearest days and are not selected based on the lowest anthropogenic impairment. The requirements of the regional haze rule for 20% clearest days is to ensure that no degradation from the baseline (2000-2004) occurs and do not rely on a comparison to the estimated natural background conditions on the 20% clearest days.

2.3.2. Natural Background Conditions on 20% Most Impaired Days

The methodology for computing natural background values for the 20% most impaired days separates observed visibility impairment into natural and anthropogenic contributions. The days with the highest anthropogenic visibility impairment contribution are what now comprise the 20% most impaired days, as opposed to the entirety of the visibility impairment portfolio that comprised the 20% haziest days previously. The reason for this change was to separate visibility impairment associated with significant natural events such as wildfires and dust storms, over which states have no control, from visibility impairment associated with anthropogenic emissions sources, which states may control. Further, the EPA notes that visibility conditions have never been measured without any anthropogenic impairment whatsoever, and so such conditions must be estimated.

Within these 20% most impaired days at a given Class I site, the natural visibility impairment for each day measured at said Class I site from 2000 to 2014, inclusive, are aggregated. That average value then becomes the natural background endpoint for the 20% most impaired days at the given Class I site. The 2018 EPA guidance (p. 15) notes that these new natural background visibility values are "consistently" lower than the prior natural values for 20% haziest days. The natural background conditions computed and utilized by VISTAS for the 20% most impaired days at Class I sites follow the 2018 EPA guidance without exception.

2.3.3. Summary of Natural Background Conditions for VISTAS Class I Areas

Table 2-2 provides a summary of the natural background conditions for VISTAS Class I areas.

Table 2-2: Average Natural Background Conditions for VISTAS Class I Areas

Class I Areas	Average for 20% Most Impaired Days*	Average for 20% Clearest Days*
Cape Romain Wilderness Area	9.79 dv	5.93 dv
Chassahowitzka Wilderness Area	9.03 dv	6.00 dv
Cohutta Wilderness Area	9.88 dv	4.42 dv
Dolly Sods Wilderness Area	8.92 dv	3.64 dv
Everglades National Park	8.33 dv	5.22 dv
Great Smoky Mountains National Park	10.05 dv	4.62 dv
James River Face Wilderness Area	9.47 dv	4.39 dv
Joyce Kilmer-Slickrock Wilderness Area	10.05 dv	4.62 dv
Linville Gorge Wilderness Area	9.70 dv	4.07 dv
Mammoth Cave National Park	9.80 dv	5.00 dv
Okefenokee National Wilderness Area	9.45 dv	5.43 dv
Otter Creek Wilderness Area	8.92 dv	3.64 dv
Shenandoah National Park	9.52 dv	3.15 dv
Shining Rock Wilderness Area	10.25 dv	2.49 dv
Sipsey Wilderness Area	9.62 dv	5.03 dv
St. Marks Wilderness Area	9.13 dv	5.37 dv
Swanquarter Wilderness Area	10.01 dv	5.71 dv
Wolf Island National Wilderness Area	9.45 dv	5.43 dv

* Data taken from Table 1 in the EPA memorandum with subject: Technical addendum including updated visibility data through 2018 for the memo titled, "Recommendation for the use of Patched and Substituted Data and Clarification of Data Completeness for Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program."[12]

2.4. Baseline Conditions

Baseline visibility conditions at each Georgia Class I area are estimated using sampling data collected at IMPROVE monitoring sites at two of the three Class I areas in Georgia. A five-year average (2000 to 2004) was calculated for the 20% clearest days as well as the 20% most impaired days at each Class I site in accordance with 40 CFR 51.308(f)(1); Guidance for Tracking Progress Under the Regional Haze Rule, EPA-454-03-004, September 2003; and the 2018 EPA guidance. IMPROVE data records for Okefenokee for the period 2000 to 2004 meet the EPA requirements for data completeness (75% for the year and 50% for each quarter). Cohutta did not meet completeness criteria in 2000, 2001, and 2003. Data records for 2001 and 2003 were filled using data substitution procedures, but there was too little data in 2000 to perform data filling. IMPROVE does not operate a monitor at Wolf Island National Wilderness Area and considers the IMPROVE monitor at Okefenokee National Wilderness Area to be representative of visibility at Wolf Island National Wilderness Area.

[12] URL: https://www.epa.gov/sites/production/files/2020-06/documents/memo_data_for_regional_haze_technical_addendum.pdf

2.4.1. Baseline Conditions for 20% Clearest and 20% Most Impaired Days for VISTAS Class I Areas

Table 2-3 provides a summary of the baseline conditions (2000-2004) for the 20% clearest and 20% most impaired days at VISTAS Class I areas. The baseline dv index values for the 20% most impaired and 20% clearest days at these Class I areas are based on data included in Table 1 in the EPA memorandum with subject: Technical addendum including updated visibility data through 2018 for the memo titled, "Recommendation for the use of Patched and Substituted Data and Clarification of Data Completeness for Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program."[13]

Table 2-3: Baseline Visibility Conditions for VISTAS Class I Areas (2000-2004)

Class I Areas	Average for 20% Most Impaired Days	Average for 20% Clearest Days
Cape Romain Wilderness Area	25.25 dv	14.29 dv
Chassahowitzka Wilderness Area Refuge	24.52 dv	15.60 dv
Cohutta Wilderness Area	29.12 dv	13.73 dv
Dolly Sods Wilderness Area	28.29 dv	12.28 dv
Everglades National Park	19.52 dv	11.69 dv
Great Smoky Mountains National Park	29.11 dv	13.58 dv
James River Face Wilderness Area	28.08 dv	14.21 dv
Joyce Kilmer-Slickrock Wilderness Area	29.11 dv	13.58 dv
Linville Gorge Wilderness Area	28.05 dv	11.11 dv
Mammoth Cave National Park	29.83 dv	16.51 dv
Okefenokee National Wilderness Area	25.34 dv	15.23 dv
Otter Creek Wilderness Area	28.29 dv	12.28 dv
Shenandoah National Park	28.32 dv	10.93 dv
Shining Rock Wilderness Area	28.13 dv	7.70 dv
Sipsey Wilderness Area	27.69 dv	15.57 dv
St. Marks Wilderness Area	24.68 dv	14.34 dv
Swanquarter Wilderness Area	23.79 dv	12.34 dv
Wolf Island National Wilderness Area	25.34 dv	15.23 dv

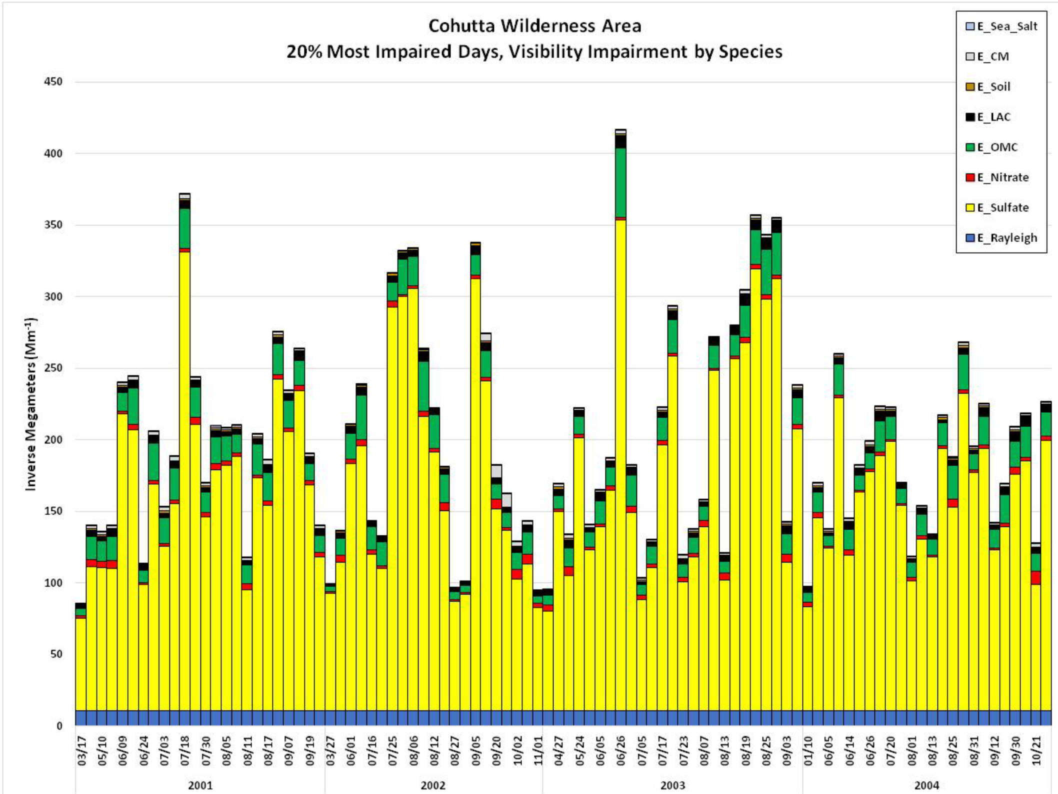
2.4.2. Pollutant Contributions to Visibility Impairment (2000-2004 Baseline Data)

The 20% most impaired visibility days at the Southern Appalachian sites (in Georgia: only the Cohutta Wilderness Area is part of the Southern Appalachian sites) during the baseline period generally occurred in the period April to September, with sulfate being the largest component. To illustrate this, Figure 2-1 (top) displays the 2000 – 2004 reconstructed extinction for the 20% most impaired days for Cohutta Wilderness Area. Similar plots for the other VISTAS Class I areas can be found in Appendix C-2. During the baseline period, the peak visibility impairment days occur in the summer under stagnant weather conditions with high relative humidity, high temperatures, and low wind speeds. The 20% clearest days at the Southern Appalachian sites can occur at any time of year. At Okefenokee National Wilderness Area (Figure 2-1, bottom),

[13] URL: https://www.epa.gov/sites/production/files/2020-06/documents/memo_data_for_regional_haze_technical_addendum.pdf

Wolf Island National Wilderness Area, and other coastal sites, the 20% most impaired and clearest visibility days are distributed throughout the year.

Figure 2-2 displays the average light extinction for the 20% most impaired days during the baseline period (2000-2004) for each VISTAS Class I area and for nearby Class I areas. Figure 2-3 displays the average light extinction for the 20% clearest during the baseline period (2000-2004) for each VISTAS Class I area and for nearby Class I areas.



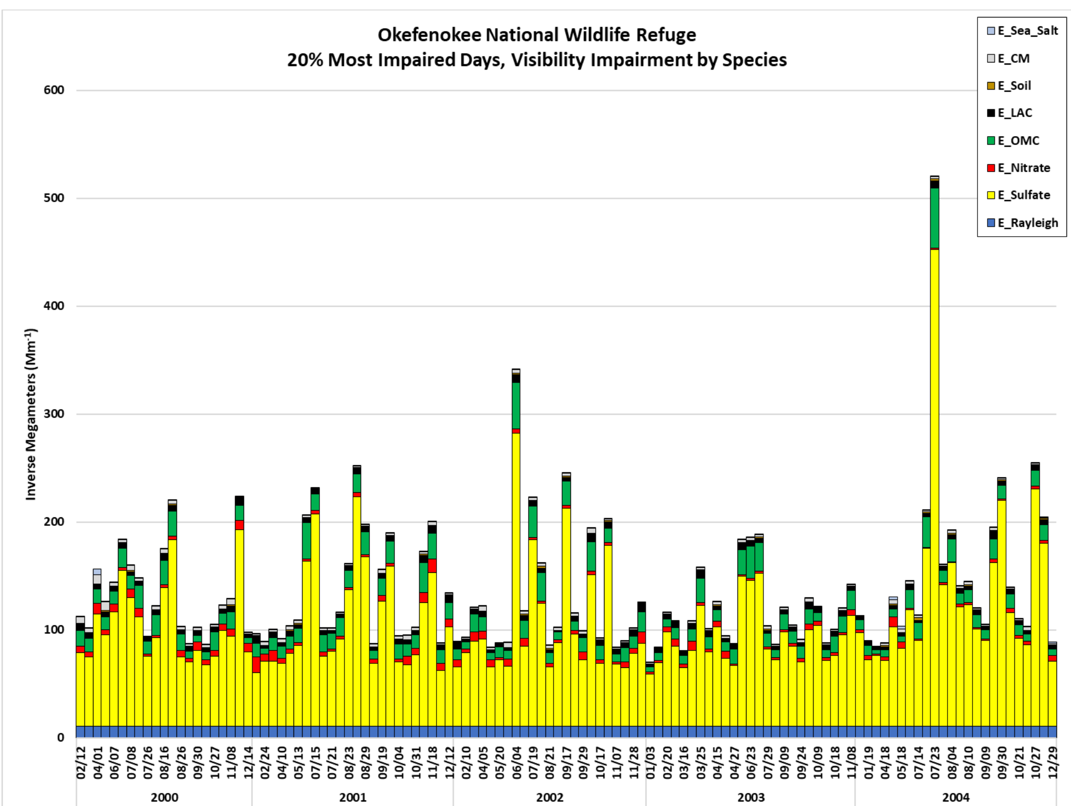


Figure 2-1: 2000-2004 Reconstructed Extinction for the 20% Most Impaired Days at Cohutta Wilderness Area (top) and Okefenokee National Wilderness Area (bottom)

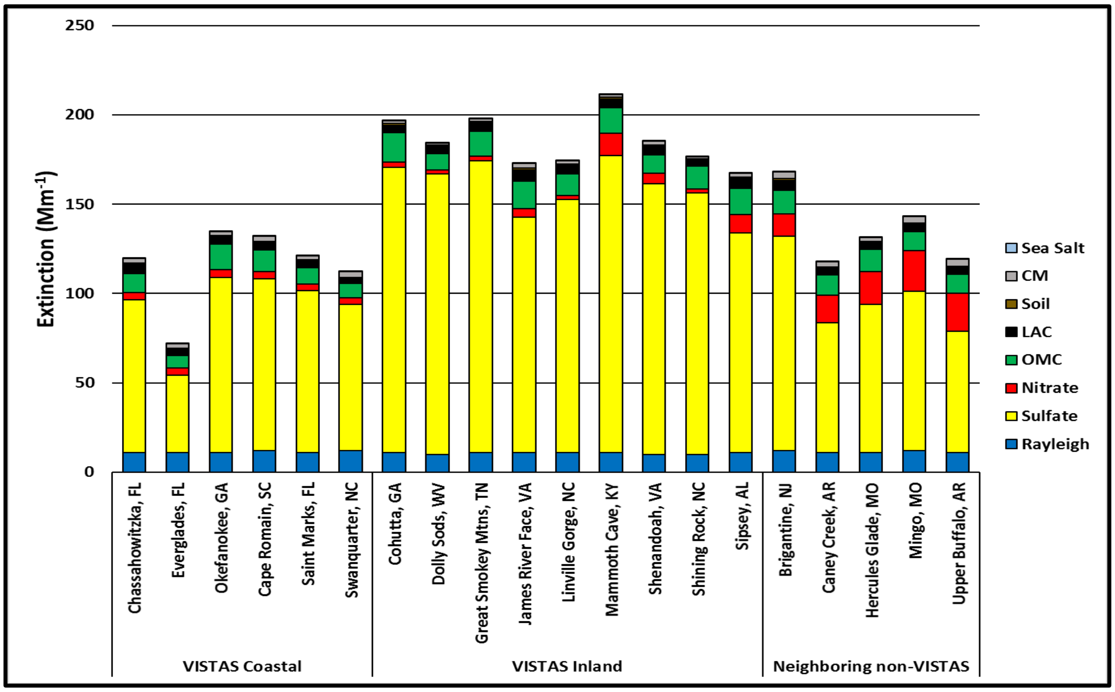


Figure 2-2: Average Light Extinction, 20% Most Impaired Days, 2000-2004, VISTAS and Neighboring Class I Areas

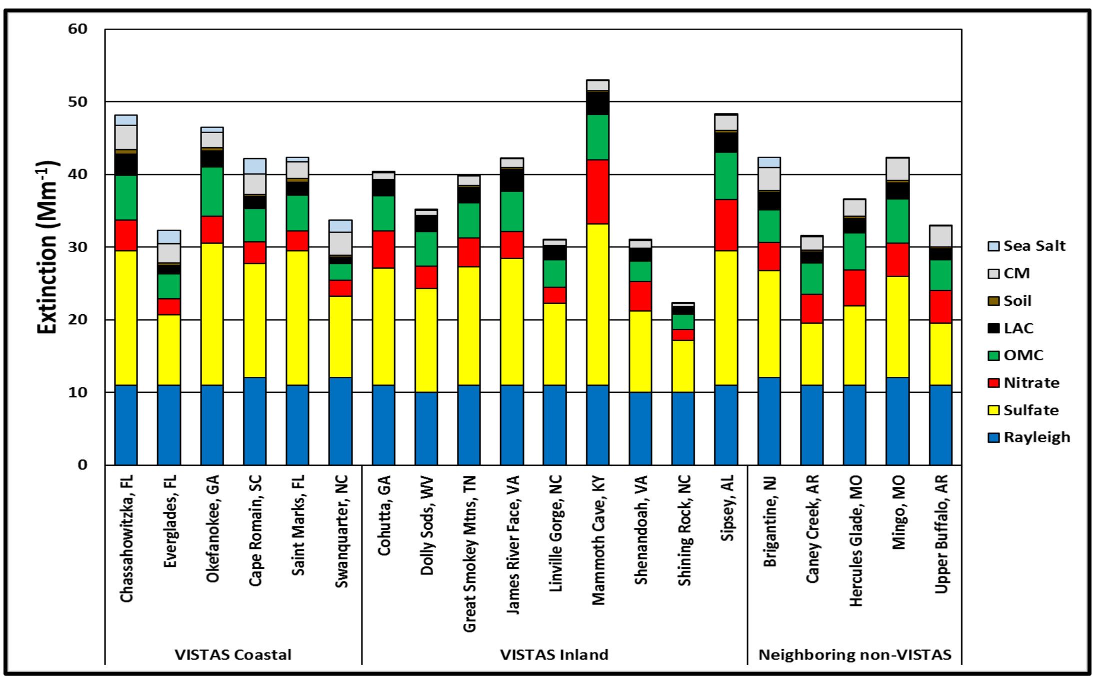


Figure 2-3: Average Light Extinction, 20% Clearest Days, 2000-2004, VISTAS and Neighboring Class I Areas

These bar charts (Figure 2-1, Figure 2-2, and Figure 2-3) are based on the IMPROVE data file called sia_impairment_daily_budgets_10_18.zip and have not been updated with the patching and substitution algorithms described in EPA's June 3, 2020, guidance memorandum entitled, "Recommendation for the Use of Patched and Substituted Data and Clarification of Data Completeness for Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program."[14] Changes to the daily data from the application of these routines is expected to be slight and will not change the conclusions of this SIP.

Sulfate is the most important contributor to visibility impairment and fine particle mass on the 20% most impaired and 20% clearest visibility days at all the Georgia Class I areas during the baseline period. During this period, sulfate levels on the 20% most impaired days accounted for 60% to 70% of anthropogenically-driven visibility impairment. Sulfate particles are formed in the atmosphere from SO_2 emissions. Sulfate particles occur as hydrogen sulfate, H_2SO_4; ammonium bisulfate, HNH_4SO_4; and ammonium sulfate, $(NH_4)_2SO_4$, depending on the availability of ammonia, NH_3, in the atmosphere.

Across the VISTAS region, sulfate levels are higher at the Southern Appalachian sites than at the coastal sites (Figure 2-2). On the 20% clearest days, sulfate levels are more uniform across the region (Figure 2-3). [Note that in these two figures, levels at Great Smoky Mountains National Park are considered to be representative of levels at Joyce Kilmer-Slickrock Wilderness Area, levels at Okefenokee National Wilderness Area are considered representative of Wolf Island National Wilderness Area, and levels at Dolly Sods Wilderness are considered representative of levels at Otter Creek Wilderness.]

The best average visibility and lowest sulfate values on the clearest days occurred at Shining Rock. Shining Rock, at 1621 meters elevation, and is likely influenced on the clearest days by regional transport of air masses above the boundary layer.

Particulate Organic Matter (POM) is shown as organic matter carbon (OMC) in the figures. POM is the second most important contributor to fine particle mass and light extinction on the 20% most impaired and the 20% clearest days at the Georgia Class I areas during the baseline period. Days for which visibility impairment is associated with elevated levels of POM and elemental carbon are associated with natural events such as wildland fires and are largely removed from the 20% most impaired days because they are regarded as natural sources. In the fall, winter, and spring, more of the carbon is attributable to wood burning while in the summer months more of the carbon mass is attributable to biogenic emissions from vegetation. Biogenic carbon emissions at Cape Romain, South Carolina, a coastal site similar to Wolf Island National Wilderness Area, Georgia, were lower than emissions at the forested mountain sites.

[14] URL: https://www.epa.gov/visibility/memo-and-technical-addendum-ambient-data-usage-and-completeness-regional-haze-program

Ammonium nitrate (NH_4NO_3) is formed in the atmosphere by reaction of ammonia (NH_3) and NO_X. In the VISTAS region, nitrate formation is limited by availability of ammonia and by temperature. Ammonia preferentially reacts with SO_2 and sulfate before reacting with NO_X. Particle nitrate is formed at lower temperatures; at elevated temperatures nitric acid remains in gaseous form. For this reason, particle nitrate levels are very low in the summer and a minor contributor to visibility impairment during the baseline period of 2000-2004. Particle nitrate concentrations are higher on winter days and are more important for the coastal sites where the 20% most impaired days occur during the winter months.

Elemental Carbon (EC) is shown as light absorbing carbon (LAC) in this section's figures. EC is a comparatively minor contributor to visibility impairment in the baseline period. Sources include agriculture, prescribed, wildland, and wildfires and incomplete combustion of fossil fuels. EC levels are higher at urban monitors than at the Class I areas and suggest controls of primary PM at fossil fuel combustion sources would be more effective to reduce $PM_{2.5}$ in urban areas than to improve visibility in Class I areas

Soil fine particles are minor contributors to visibility impairment at most southeastern sites on most days in the baseline period. Occasional episodes of elevated fine soil can be attributed to Saharan dust episodes, particularly at Everglades, Florida, but rarely are seen in other VISTAS Class I areas; these contributions are now largely teased out as natural routine events. Due to its small contribution to anthropogenic visibility impairment in southeastern Class I areas, fine soil control strategies to improve visibility would not be effective.

Sea salt (NaCl) is observed at the coastal sites. During the baseline period, sea salt contributions to visibility impairment are most important on the 20% clearest days when sulfate and POM levels are low. Sea salt levels do not contribute significantly to visibility on the 20% most impaired visibility days. The new IMPROVE equation uses Chloride ion, Cl^-, from routine IMPROVE measurements to calculate sea salt levels. VISTAS used Cl^- to calculate sea salt contributions to visibility following IMPROVE guidance.

Coarse mass (CM) are particles with diameters between 2.5 and 10 microns. This component has a relatively small contribution to visibility impairment because the light extinction efficiency of coarse mass is very low compared to the extinction efficiency for sulfate, nitrate, and carbon.

Rayleigh scattering is the scattering of sunlight off the molecules of the atmosphere and varies with the elevation of the monitoring site. For VISTAS monitoring sites, this value varies from 10 to 12 Mm^{-1}.

2.5. Modeling Base Period (2009-2013)

Visibility projections discussed in Sections 5, 6, and 7.2.5.2 use IMPROVE data from 2009-2013 to estimate future year visibility at Class I areas. For each Class I area, estimated anthropogenic impairment observations from each IMPROVE site for the five-year period surrounding the 2011 modeling base year comprise the data representing the modeling base period. The year 2011 was selected as the modeling base year because the VISTAS 2028 emissions inventory is based on the 2011 Version 6 EPA modeling platform, which at the commencement of the VISTAS second round of planning for regional haze was the most current, complete modeling platform available. For the analyses in this SIP, this period consists of those years surrounding 2011 (i.e. 2009-2013). While not required by the regional haze regulation, examination of these data provides insight into the future year visibility projections for the VISTAS Class I areas

2.5.1. Modeling Base Period (2009-2013) for 20% Clearest and 20% Most Impaired Days for VISTAS Class I Areas

Table 2-4 provides a summary of the conditions for the 20% clearest and 20% most impaired days at VISTAS Class I areas during 2009-2013, the period used as the modeling basis for this SIP revision's projection analysis described in Sections 5, 6, and 7. The baseline light extinction and dv index values for the 20% most impaired and 20% clearest days at the Class I areas are based on data and calculations included in Appendix E-6 of this SIP (Task 9a, APP_C_SESARM_2028elv5_URP_20200903.xlsx).

Table 2-4: Modeling Base Period (2009-2013) Conditions for VISTAS Class I Areas

Class I Areas	Average for 20% Most Impaired Days	Average for 20% Clearest Days
Cape Romain Wilderness Area	21.48 dv	13.59 dv
Chassahowitzka Wilderness Area	19.96 dv	13.76 dv
Cohutta Wilderness Area	21.19 dv	10.94 dv
Dolly Sods Wilderness Area	21.59 dv	9.03 dv
Everglades National Park	16.30 dv	11.23 dv
Great Smoky Mountains National Park	21.39 dv	10.63 dv
James River Face Wilderness Area	21.37 dv	11.79 dv
Joyce Kilmer-Slickrock Wilderness Area	21.39 dv	10.63 dv
Linville Gorge Wilderness Area	20.39 dv	9.70 dv
Mammoth Cave National Park	24.04 dv	13.69 dv
Okefenokee National Wilderness Area	20.70 dv	13.34 dv
Otter Creek Wilderness Area	21.59 dv	9.03 dv
Shenandoah National Park	20.72 dv	8.60 dv
Shining Rock Wilderness Area*	20.39 dv	9.70 dv
Sipsey Wilderness Area	21.67 dv	12.84 dv
St. Marks Wilderness Area	20.11 dv	13.34 dv
Swanquarter Wilderness Area	19.76 dv	11.76 dv
Wolf Island National Wilderness Area	20.70 dv	13.34 dv

* The IMPROVE monitoring data at Shining Rock Wilderness Area is missing complete data for 2010 and 2011. After consultation with North Carolina, a three-year average of 2009, 2012, and 2013 IMPROVE data was used to calculate the visibility (dv) for both the 20% clearest and 20% most impaired days at Shining Rock.

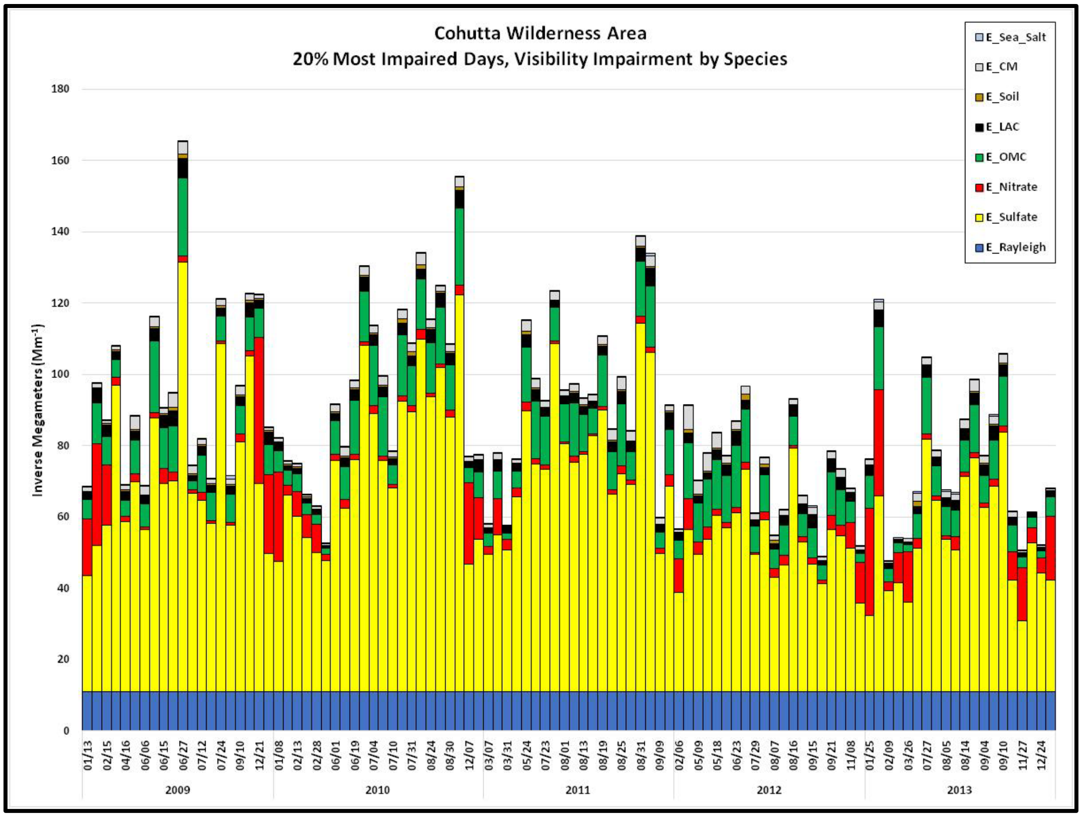
2.5.2. Pollutant Contributions to Visibility Impairment (2009-2013 Modeling Base Period Data)

Figure 2-4 shows the 2009 – 2013 reconstructed extinction for the 20% most impaired days for the Cohutta Wilderness Area and Okefenokee National Wilderness Area. Similar plots for the other VISTAS Class I areas can be found in Appendix C-2. During the modeling base period, the peak visibility impairment days continue to occur in the summer although winter episodes became more prevalent. On nearly all days, sulfate continues to be the dominant visibility impairing pollutant. Nitrate impacts become more significant on some of the 20% most impaired days. The figure also shows the improvement in visibility impairment when compared to Figure 2-1. While maximum values in Figure 2-1 are in the range of 400-500 Mm^{-1}, maximum values in Figure 2-4 are in the 160-200 Mm^{-1} range, highlighting the impact of the many control programs implemented during the intervening period.

Figure 2-5 displays the average light extinction for the 20% most impaired days during the modeling base period (2009-2013) for each VISTAS Class I area and for nearby Class I areas. Figure 2-5 shows that for the VISTAS Class I areas, sulfate continues to be the driver for 20% worst visibility days. In all VISTAS Class I areas except Mammoth Cave, organic matter is the second leading cause of visibility impairment on average for the 20% most impaired days. At Mammoth Cave, nitrate is the second leading cause of visibility impairment on average for the 20% most impaired days.

Figure 2-6 displays the average light extinction for the 20% clearest days during the modeling base period (2009-2013) for each VISTAS Class I area and for nearby Class I areas. On the 20% clearest days, sulfate continues to be the main component of visibility impairing pollution for VISTAS and nearby Class I areas. Comparison to Figure 2-3 shows that no degradation of visibility occurs between the 2000-2004 and 2009-2013 data sets, and in most cases improvement on the 20% clearest days occurs.

These bar charts (Figure 2-4, Figure 2-5, Figure 2-6) are based on the IMPROVE data file called sia_impairment_daily_budgets_10_18.zip and therefore have not been updated with the patching and substitution algorithms described in EPA's 2020 guidance memo. Changes to the daily data from the application of these routines is expected to be slight and will not change the conclusions of this SIP.



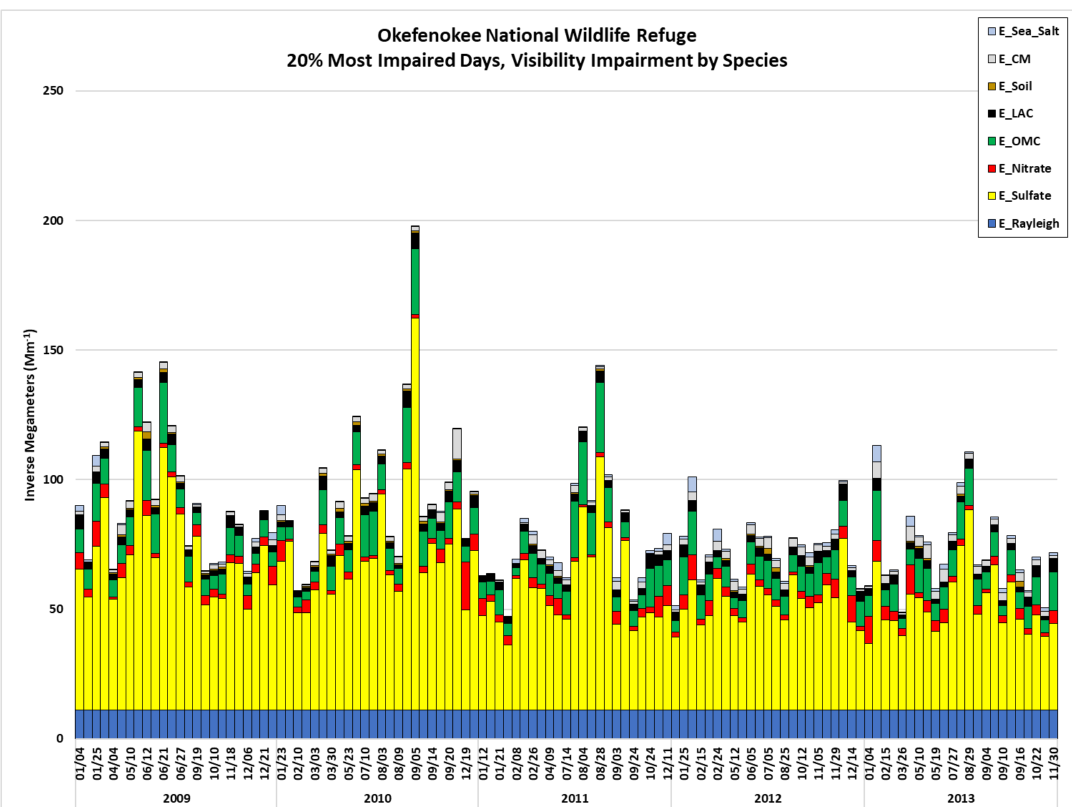


Figure 2-4: 2009-2013 Reconstructed Extinction for the 20% Most Impaired Days at Cohutta Wilderness Area (top) and Okefenokee National Wilderness Area (bottom)

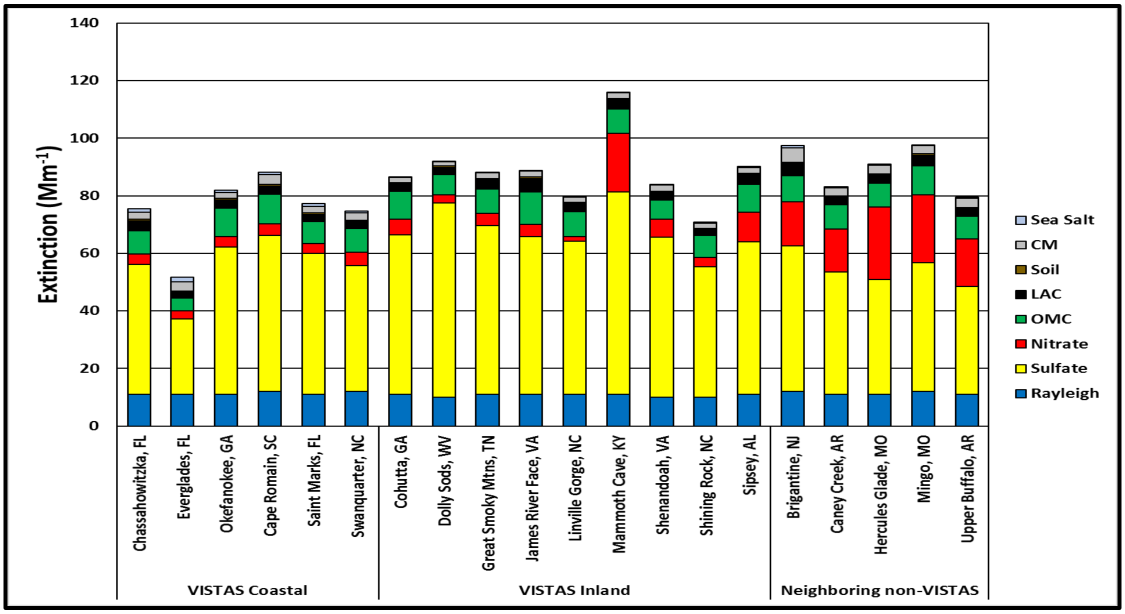


Figure 2-5: Average Light Extinction, 20% Most Impaired Days, 2009-2013, VISTAS and Neighboring Class I Areas

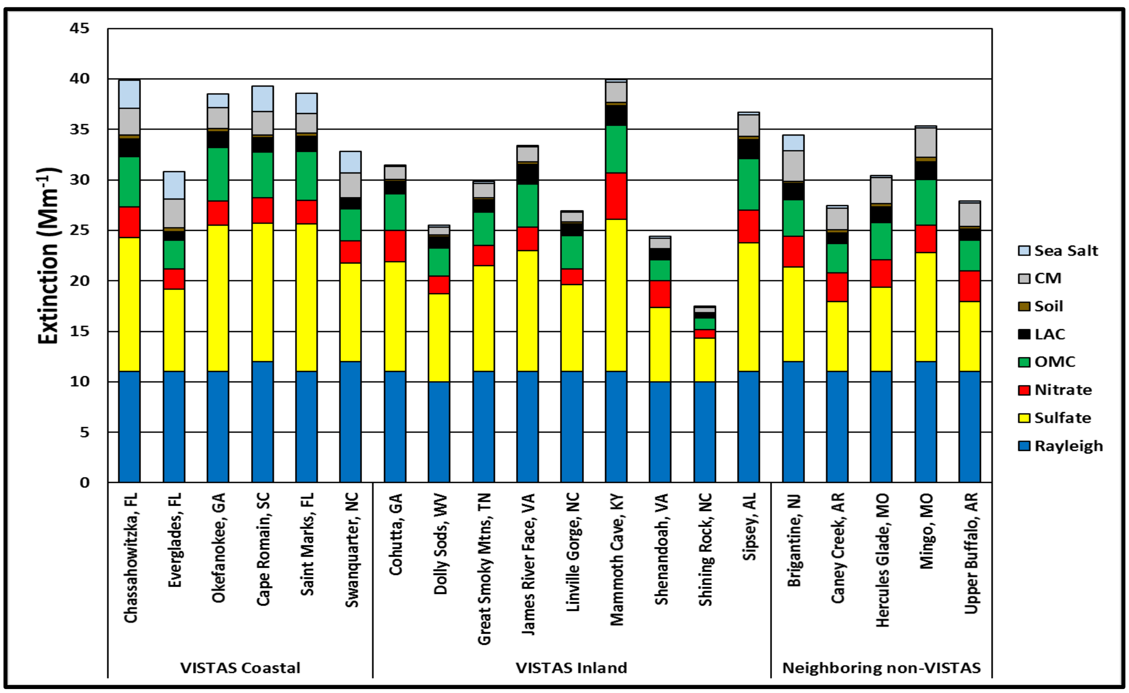


Figure 2-6: Average Light Extinction, 20% Clearest Days, 2009-2013, VISTAS and Neighboring Class I Areas

2.6. Current Conditions

The current visibility estimates are comprised of measurements from the five-year period between 2014 and 2018, inclusive.

2.6.1. Current Conditions (2014-2018) for 20% Clearest and 20% Most Impaired Days for VISTAS Class I Areas

Table 2-5 provides a summary of the current conditions (2014-2018) for the 20% clearest and 20% most impaired days at VISTAS Class I areas. These data reflect values included in Table 1 on the EPA memorandum with subject: Technical addendum including updated visibility data through 2018 for the memo titled, "Recommendation for the use of Patched and Substituted Data and Clarification of Data Completeness for Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program."[15]

Table 2-5: Current Conditions (2014-2018) for VISTAS Class I Areas

Class I Areas	Average for 20% Most Impaired Days	Average for 20% Clearest Days
Cape Romain Wilderness Area	17.67 dv	11.80 dv
Chassahowitzka Wilderness Area	17.41 dv	12.41 dv
Cohutta Wilderness Area	17.37 dv	8.10 dv
Dolly Sods Wilderness Area	17.65 dv	6.68 dv
Everglades National Park	14.90 dv	10.37 dv
Great Smoky Mountains National Park	17.21 dv	8.35 dv
James River Face Wilderness Area	17.89 dv	9.47 dv
Joyce Kilmer-Slickrock Wilderness Area	17.21 dv	8.35 dv
Linville Gorge Wilderness Area	16.42 dv	7.61 dv
Mammoth Cave National Park	21.02 dv	11.31 dv
Okefenokee National Wilderness Area	17.39 dv	11.57 dv
Otter Creek Wilderness Area	17.65 dv	6.68 dv
Shenandoah National Park	17.07 dv	6.85 dv
Shining Rock Wilderness Area*	15.49 dv	4.40 dv
Sipsey Wilderness Area	19.03 dv	10.76 dv
St. Marks Wilderness Area	17.39 dv	11.15 dv
Swanquarter Wilderness Area	16.30 dv	10.61 dv
Wolf Island National Wilderness Area	17.39 dv	11.57 dv

2.6.2. Pollutant Contributions to Visibility Impairment (2014-2018 Current Data)

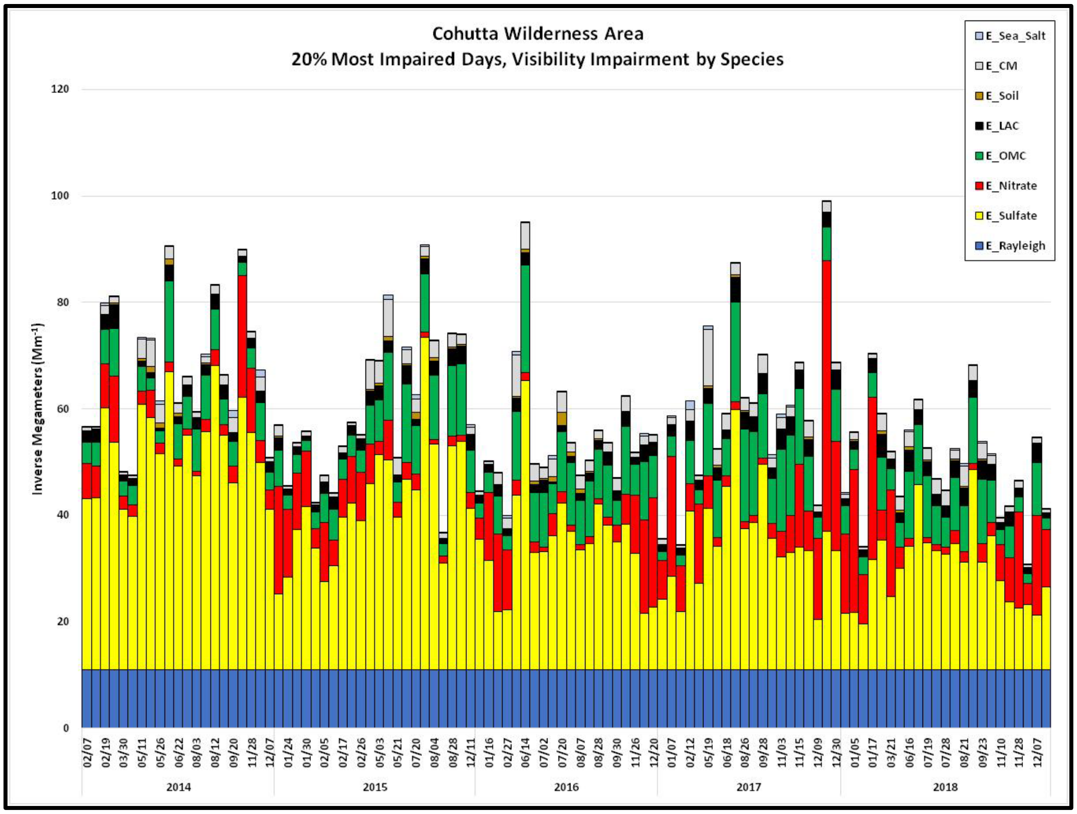
Figure 2-7 displays the 2014 – 2018 reconstructed extinction for the 20% most impaired days for the Cohutta Wilderness Area and Okefenokee National Wilderness Area. Similar plots for the other VISTAS Class I areas can be found in Appendix C-2. For the VISTAS region and neighboring Class I areas, Figure 2-8 and Figure 2-9 show light extinction averaged from 2014-2018 IMPROVE data for the 20% most impaired and clearest days, respectively. These bar charts (Figure 2-7, Figure 2-8, and Figure 2-9) are based on the IMPROVE data file called "sia_impairment_daily_budgets_10_18.zip" for data through 2017. For 2018 data, the IMPROVE data file called "sia_impairment_daily_budgets_4_20_2.zip" was used. The data through 2017 have not been updated with the patching and substitution algorithms described in

[15] URL: https://www.epa.gov/sites/production/files/2020-06/documents/memo_data_for_regional_haze_technical_addendum.pdf

EPA's 2020 guidance memo. Changes to the daily data from the application of these routines are expected to be slight and will not change the conclusions of this SIP.

These figures continue to demonstrate improved visibility when compared to the 2009-2013 data or the 2000-2004 data. Emissions of SO_2 and other visibility impairing pollutants are reducing, as discussed in Section 7, and these reductions are resulting in better visibility.

Figure 2-8 presents average data for 20% most impaired days and shows that on average sulfate continues to be the predominant visibility impairing pollutant. The data in Figure 2-7, which is daily monitoring values, shows that occasionally nitrate is the predominant visibility impairing pollutant on certain days, generally in winter months.



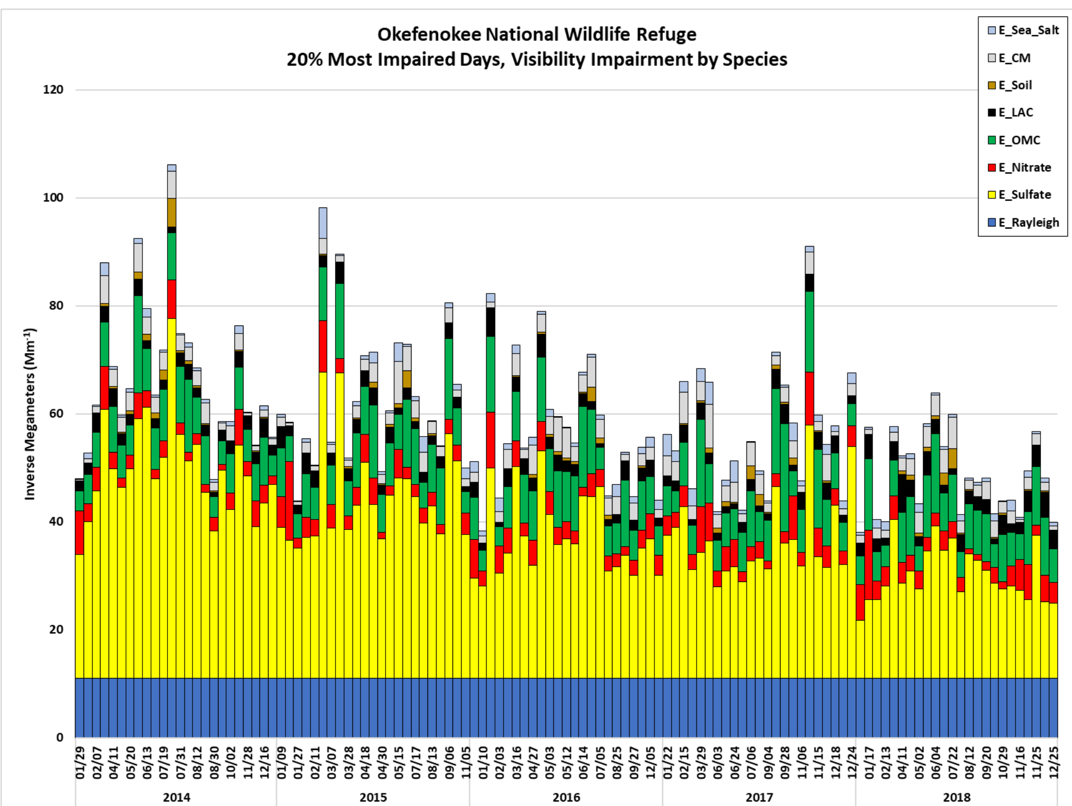


Figure 2-7: 2014-2018 Reconstructed Extinction for the 20% Most Impaired Days at Cohutta Wilderness Area (top) and Okefenokee National Wilderness Area (bottom)

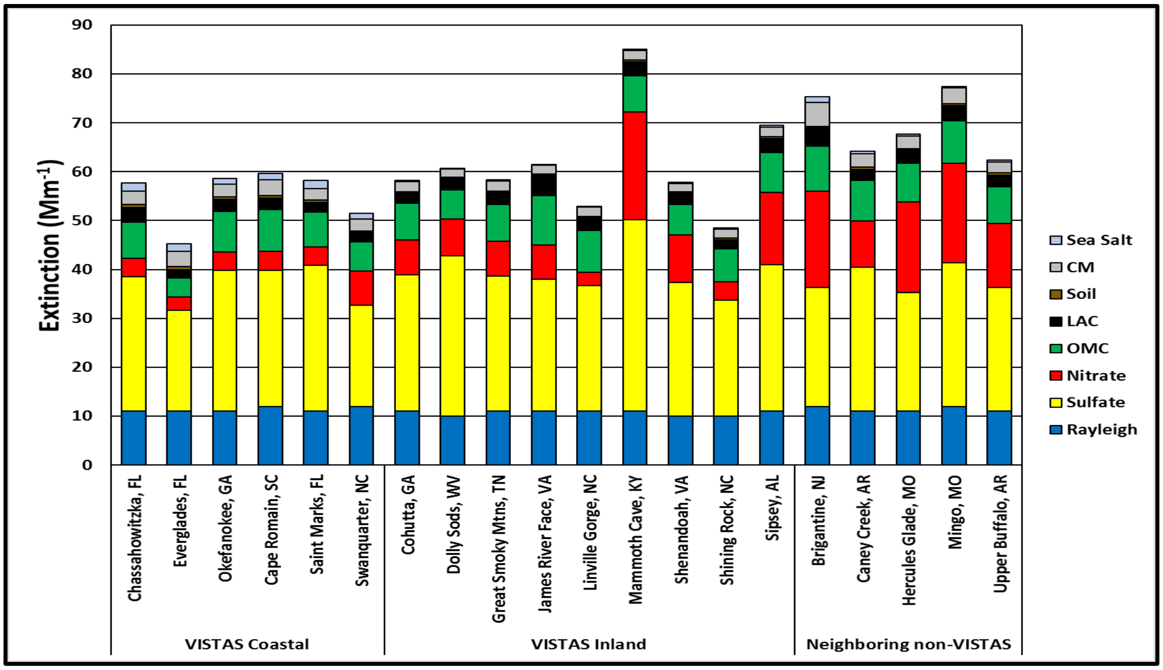


Figure 2-8: Average Light Extinction, 20% Most Impaired Days, 2014-2018, VISTAS and Neighboring Class I Areas

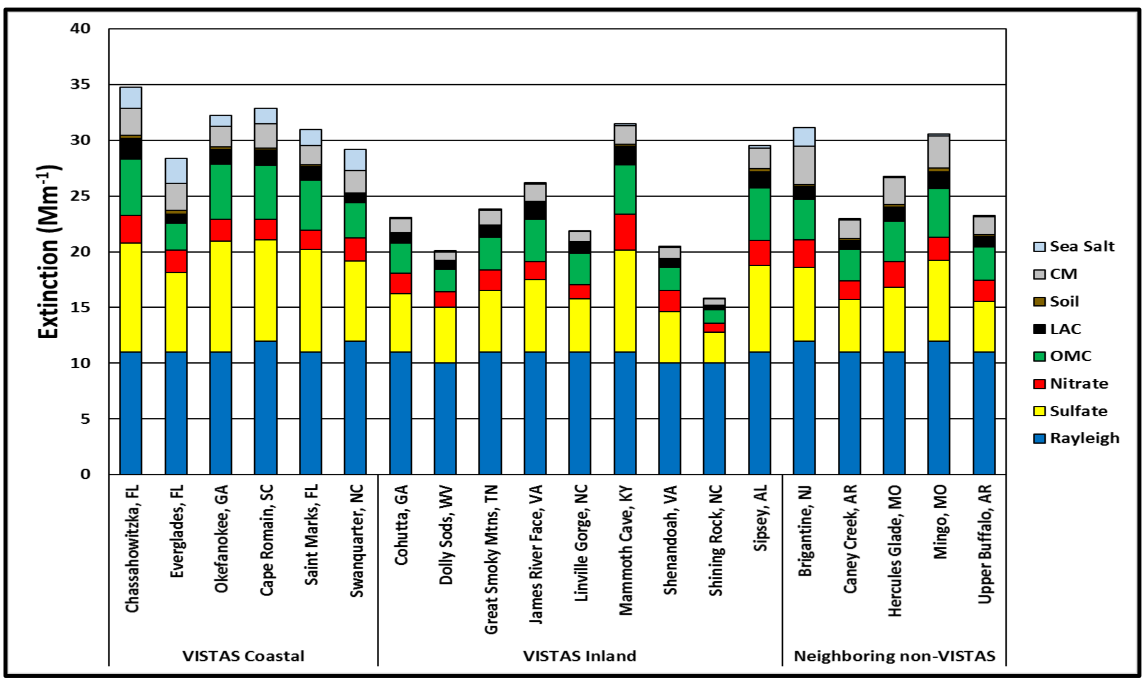


Figure 2-9: Average Light Extinction, 20% Clearest Days, 2014-2018, VISTAS and Neighboring Class I Areas

2.7. Comparisons of Baseline, Current, and Natural Background Visibility

The regional haze rule requires that SIPs include an evaluation of progress made since the baseline period toward improving visibility on the 20% most impaired days and 20% clearest days for each state's Class I areas (40 CFR 51.308(f)(1)(iv)). The rule also requires that the SIP enumerate the deciview value by which the current visibility condition exceeds the natural visibility condition, for each state's Class I areas on the 20% most impaired days and the 20% clearest days (40 CFR 51.308(f)(1)(v)). Table 2-6 summarizes this data for each Class I area located in VISTAS for the 20% most impaired days. On 20% most impaired days, data for current conditions show that significant progress has been made as compared to baseline conditions. In many cases, the improvement in visibility from baseline conditions demonstrated by the 2014-2018 visibility data is more than half of the improvement needed to achieve natural conditions.

Table 2-6: Comparison of Baseline, Current, and Natural Conditions for 20% Most Impaired Days

Class I Areas	2000-2004 Baseline Conditions	2014-2018 Current Conditions	Change in Visibility, Baseline to Current	Natural Background Conditions	Difference Between Current Conditions and Natural Background
Cape Romain Wilderness Area	25.25 dv	17.67 dv	7.58 dv	9.79 dv	7.88 dv
Chassahowitzka Wilderness Area	24.52 dv	17.41 dv	7.11 dv	9.03 dv	8.38 dv
Cohutta Wilderness Area	29.12 dv	17.37 dv	11.75 dv	9.88 dv	7.49 dv
Dolly Sods Wilderness Area	28.29 dv	17.65 dv	10.64 dv	8.92 dv	8.73 dv
Everglades National Park	19.52 dv	14.90 dv	4.62 dv	8.33 dv	6.57 dv
Great Smoky Mountains National Park	29.11 dv	17.21 dv	11.90 dv	10.05 dv	7.16 dv
James River Face Wilderness Area	28.08 dv	17.89 dv	10.19 dv	9.47 dv	8.42 dv
Joyce Kilmer-Slickrock Wilderness Area	29.11 dv	17.21 dv	11.90 dv	10.05 dv	7.16 dv
Linville Gorge Wilderness Area	28.05 dv	16.42 dv	11.63 dv	9.70 dv	6.72 dv
Mammoth Cave National Park	29.83 dv	21.02 dv	8.81 dv	9.80 dv	11.22 dv
Okefenokee National Wilderness Area	25.34 dv	17.39 dv	7.95 dv	9.45 dv	7.94 dv
Otter Creek Wilderness Area	28.29 dv	17.65 dv	10.64 dv	8.92 dv	8.73 dv
Shenandoah National Park	28.32 dv	17.07 dv	11.25 dv	9.52 dv	7.55 dv
Shining Rock Wilderness Area	28.13 dv	15.49 dv	12.64 dv	10.25 dv	5.24 dv
Sipsey Wilderness Area	27.69 dv	19.03 dv	8.66 dv	9.62 dv	9.41 dv
St. Marks Wilderness Area	24.68 dv	17.39 dv	7.29 dv	9.13 dv	8.26 dv
Swanquarter Wilderness Area	23.79 dv	16.30 dv	7.49 dv	10.01 dv	6.29 dv
Wolf Island National Wilderness Area	25.34 dv	17.39 dv	7.95 dv	9.45 dv	7.94 dv

Table 2-7 summarizes this data for each Class I area located in VISTAS for the 20% clearest days. On 20% clearest days, data for current conditions show that visibility on these days has improved from the baseline conditions for all VISTAS Class I areas.

Table 2-7: Comparison of Baseline, Current, and Natural Conditions for 20% Clearest Days

Class I Areas	2000-2004 Baseline Conditions	2014-2018 Current Conditions	Change in Visibility, Baseline to Current	Natural Background Conditions	Difference Between Current Conditions and Natural Background
Cape Romain Wilderness Area	14.29 dv	11.801 dv	2.49 dv	5.93 dv	5.87 dv
Chassahowitzka Wilderness Area	15.60 dv	12.41 dv	3.19 dv	6.00 dv	6.41 dv
Cohutta Wilderness Area	13.73 dv	8.10 dv	5.63 dv	4.42 dv	3.68 dv
Dolly Sods Wilderness Area	12.28 dv	6.68 dv	5.60 dv	3.64 dv	3.04 dv
Everglades National Park	11.69 dv	10.37 dv	1.32 dv	5.22 dv	5.15 dv
Great Smoky Mountains National Park	13.58 dv	8.35 dv	5.23 dv	4.62 dv	3.73 dv
James River Face Wilderness Area	14.21 dv	9.47 dv	4.74 dv	4.39 dv	5.08 dv
Joyce Kilmer-Slickrock Wilderness Area	13.58 dv	8.35 dv	5.23 dv	4.62 dv	3.73 dv
Linville Gorge Wilderness Area	11.11 dv	7.61 dv	3.50 dv	4.07 dv	3.54 dv
Mammoth Cave National Park	16.51 dv	11.31 dv	5.20 dv	5.00 dv	6.31 dv
Okefenokee National Wilderness Area	15.23 dv	11.57 dv	3.66 dv	5.43 dv	6.14 dv
Otter Creek Wilderness Area	12.28 dv	6.68 dv	5.60 dv	3.64 dv	3.04 dv
Shenandoah National Park	10.96 dv	6.85 dv	4.11 dv	3.15 dv	3.70 dv
Shining Rock Wilderness Area	7.70 dv	4.40 dv	3.30 dv	2.49 dv	1.91 dv
Sipsey Wilderness Area	15.57 dv	10.76 dv	4.81 dv	5.03 dv	5.73 dv
St. Marks Wilderness Area	14.34 dv	11.15 dv	3.19 dv	5.37 dv	5.78 dv
Swanquarter Wilderness Area	12.34 dv	10.61 dv	1.73 dv	5.71 dv	4.90 dv
Wolf Island National Wilderness Area	15.23 dv	11.57 dv	3.66 dv	5.43 dv	6.14 dv

3. Glide Paths to Natural Conditions in 2064

In accordance with 40 CFR 51.308(f)(1)(vi)(A), each state must calculate a uniform rate of progress (URP), also known as a "glide path," for each mandatory federal Class I area located within that state. Starting with the baseline period of 2000-2004, states must analyze and determine the consistent rate of progress over time. States must compare the baseline visibility conditions (2000-2004) for the most impaired days to the natural visibility condition for the most impaired days to determine the uniform rate of visibility improvements needed to attain the natural visibility conditions by the end of 2064.

Glide paths were developed for each mandatory federal Class I area in the VISTAS region. The glide paths were developed in accordance with the EPA's guidance for tracking progress[16] and used data collected from the IMPROVE monitoring sites as described in Section 2 of this document. Glide paths are one of the indicators used in setting reasonable progress goals.

Figure 3-1 shows the glide path for the 20% most impaired days for Cohutta Wilderness Area assuming a uniform rate of progress toward natural conditions. Natural background visibility for the most impaired days at Cohutta Wilderness Area is calculated to be 9.88 dv.

Figure 3-2 shows the glide path for the 20% most impaired days for Okefenokee National Wilderness Area assuming a uniform rate of progress toward natural conditions. Natural background visibility for the most impaired days at Okefenokee National Wilderness Area is calculated to be 9.45 dv. Note that the rate of progress for Okefenokee National Wilderness Area is considered representative of Wolf Island National Wilderness Area.

The data in Figure 3-1 and Figure 3-2 is derived from Table 1 in the EPA memorandum with subject: Technical addendum including updated visibility data through 2018 for the memo titled, "Recommendation for the use of Patched and Substituted Data and Clarification of Data Completeness for Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program."[17]

[16] URL: https://www.epa.gov/sites/production/files/2018-12/documents/technical_guidance_tracking_visibility_progress.pdf
[17] URL: https://www.epa.gov/sites/production/files/2020-06/documents/memo_data_for_regional_haze_technical_addendum.pdf

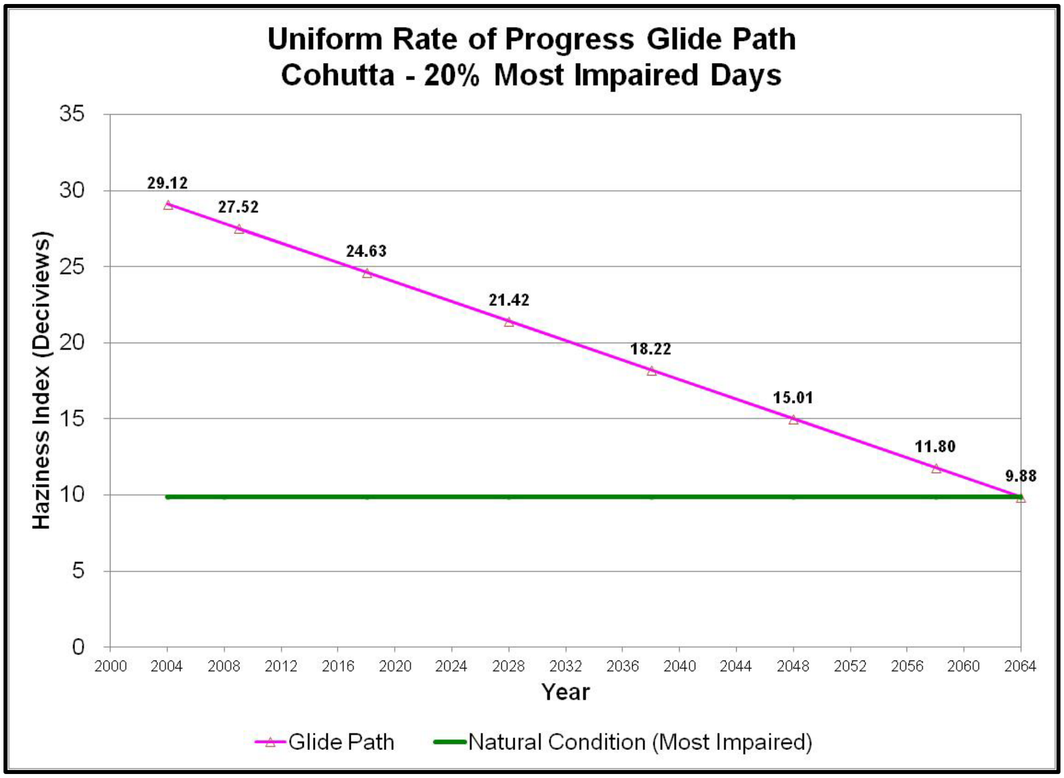


Figure 3-1: Uniform Rate of Progress Glide Path for 20% Most Impaired Days at Cohutta Wilderness Area

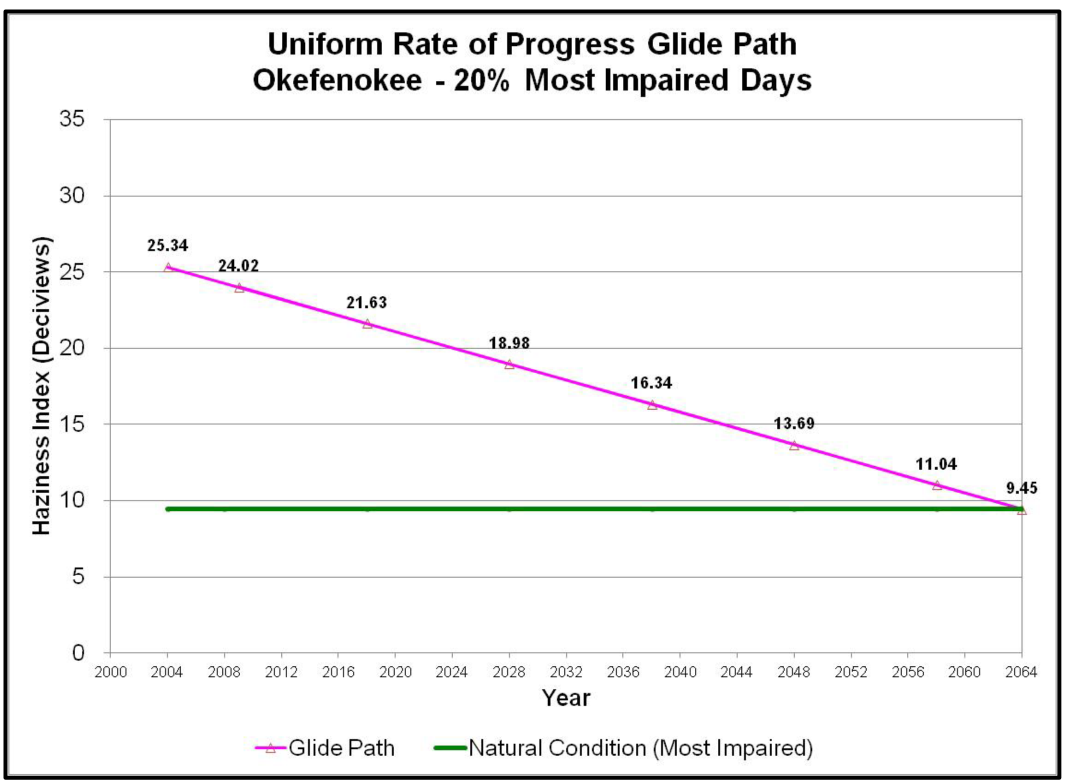


Figure 3-2: Uniform Rate of Progress Glide Path for 20% Most Impaired Days at Okefenokee National Wilderness Area

4. Types of Emissions Impacting Visibility Impairment in Georgia Class I Areas

4.1. Baseline Emissions Inventory

Section 51.308(f)(6)(v) of the regional haze rule requires a statewide emissions inventory of pollutants that are reasonably anticipated to cause or contribute to visibility impairment in any mandatory Class I area. The inventory must include emissions for the most recent year for which data are available and estimates of future projected emissions. Georgia complies with the Air Emission Reporting Requirements (AERR) by submitting the required triennial and annual inventories to EPA. Section 13.5.1 shows National Emission Inventory (NEI) data for 2014 and 2017 and Clean Air Markets Division (CAMD) data for 2018 and 2019. The same regional haze rule provision also requires states to commit to update the inventory periodically, which Georgia commits to do. This section describes how the projected emissions inventory for 2028 was developed, and Section 7.2.3 shows the 2028 projected emissions data. For the inventory, VISTAS used a baseline year of 2011 and projected future year of 2028. The emission inventories include carbon monoxide[18] (CO), volatile organic compounds (VOCs), NOx, $PM_{2.5}$, coarse particulate matter (PM_{10}), NH_3, and SO_2.

VISTAS contracted with ERG to perform emission inventory work as part of the air quality modeling analysis. ERG was directed by VISTAS to use EPA's 2011el-based air quality modeling platform, which includes emissions, meteorology, and other inputs for 2011, as the base year for the modeling described in EPA's TSD entitled "Documentation for the EPA's Preliminary 2028 Regional Haze Modeling."[19] EPA has projected the 2011 base year emissions[20] to a 2028 future year base case scenario. These data were the foundation of the revised emissions used for this analysis as described elsewhere. The 2011 modeling platform and projected 2028 emissions were used to drive the 2011 base year and 2028 base case air quality model simulations. As noted in EPA's TSD, the 2011 base year emissions and methods for projecting these emissions to 2028 are similar to the data and methods used by EPA in the final Cross-State Air Pollution Rule (CSAPR) Update[21] and the subsequent notice of data availability (NODA)[22] to support ozone transport for the 2015 ozone NAAQS. Appendix B-1a and Appendix B-2a contain complete reports from ERG detailing the emission inventory work.

There are six different emission inventory source classifications: stationary point sources, nonpoint (formerly called "stationary area") sources, non-road and onroad mobile sources,

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[18] CO is not a visibility impairing pollutant, and thus, CO data was not evaluated for this regional haze plan.
[19] EPA OAQPS, *Documentation for the EPA's Preliminary 2028 Regional Haze Modeling,* October 2017.
[20] URL: https://www.epa.gov/air-emissions-modeling/2011-version-63-technical-support-document
[21] URL: https://www.epa.gov/airmarkets/final-cross-state-air-pollution-rule-update
[22] URL: https://www.epa.gov/airmarkets/notice-data-availability-preliminary-interstate-ozone-transport-modeling-data-2015-ozone

biogenic sources, and point fires.[23] Stationary point sources are those sources that emit greater than a specified tonnage per year, with data provided at the facility level. Electric generating utilities and industrial sources are the major categories for stationary point sources. Nonpoint sources are those sources whose individual emissions are relatively small, but due to the large number of these sources, the collective emissions from the source category could be significant (e.g., dry cleaners, service stations, combustion of fuels for heating, and agricultural sources). These types of emissions are estimated on a countywide level. Non-road mobile sources are equipment that can move but do not use the roadways (e.g., lawn mowers, construction equipment, and railroad locomotives). The emissions from these sources, like nonpoint sources, are estimated on a countywide level. Onroad mobile sources include passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks, and buses that are normally operated on public roadways. The emissions from these sources are estimated by vehicle type and road type and are summed to the countywide level. Biogenic sources are the natural sources of emissions like trees, crops, grasses, and natural decay of plants. The emissions from these sources are estimated on a countywide level. The point fire sector includes both prescribed fires and wildfires.

4.1.1. Stationary Point Sources

Point source emissions are emissions from individual sources having a fixed location. Generally, these sources must have permits to operate, and their emissions are inventoried on a regular schedule and provided at the facility level. Large sources emitting at least 100 tons per year (tpy) of a criteria pollutant are inventoried every three years. The largest sources have been inventoried annually. Some state and local agencies conduct emission inventories more frequently, use lower thresholds, and include HAPs. Smaller sources have been inventoried less frequently. The point source emissions data can be grouped as electricity generating unit (EGU) sources and other industrial point sources called non-EGUs. Airport-related sources; including aircraft, airport ground support equipment, and jet refueling; are also part of the point source sector. In previous modeling platforms, airport-related sources were included in the non-road sector.

4.1.1.1. Electricity Generating Units

The electricity generation unit (EGU) sector contains emissions from EGUs in the 2011 NEI v2 point inventory that could be matched to units found in the National Electric Energy Database System (NEEDS) v5.15. In most cases, the base year 2011 inventory for the EGU sources used 2011 continuous emissions monitoring (CEM) data reported to the EPA's CAMD. These data provide hourly emissions profiles for SO_2 and NO_X that can be used in air quality modeling. Emissions profiles are used to estimate emissions of other pollutants (VOCs, CO, NH_3, $PM_{2.5}$) based on measured emissions of SO_2 and NO_X. The NEEDS database of units includes many

[23] Note that prescribed fires and wildfires are designated events in the National Emissions Inventory.

smaller emitting EGUs that are not included in the CAMD hourly CEMS programs. Thus, there are more units in the NEEDS database than have CEMS data. Emissions from EGUs vary daily and seasonally as a function of variability in energy demand, utilization, and outage schedules. The temporalization of EGU units matched to CEMS is based on the base year CEMS data for those units, whereas regional profiles are used for the remaining units.

For projected year 2028 EGU point sources, the VISTAS states considered the EPA 2028el, the EPA 2023en, or 2028 emissions from the Eastern Regional Technical Advisory Committee (ERTAC) EGU projection tool from the most recent CONUS 2.7 run. The EPA 2028el emissions inventory for EGUs were created by the Integrated Planning Model (IPM) version 5.16. This scenario represents the implementation of the Cross-State Air Pollution Rule (CSAPR) Update, CSAPR, Mercury and Air Toxics Standards (MATS), Clean Power Plan (CPP) and the final actions the EPA has taken to implement the Regional Haze Rule, the Cooling Water Intakes Rule, and Combustion Residuals from Electric Utilities (CCR). The CPP was later vacated. The CPP assumed that coal-fired EGUs would be shut down and replaced by natural gas-fired EGUs which means that the EPA 2028el projected emissions for EGU emissions are not reflective of probable emissions for 2028. The ERTAC EGU emissions did not consider the impacts of the CPP. After evaluating the different projection options, each VISTAS state determined the estimated emissions for each EGU for the projected year 2028. Appendix B contains a summary of the action items provided by each VISTAS state in preparing the 2028 EGU emissions inventory. For non-VISTAS states, the EPA 2028el EGU emissions were replaced with the 2028 ERTAC 2.7 EGU emissions. Georgia used EPA's 2023en emissions for projected 2028 EGU emissions.

4.1.1.2. Other Industrial Point Sources and Airport-Related Sources

The non-EGU sector uses annual emissions contained in the 2011 NEIv2. These emissions are temporally allocated to month, day, and hour using source category code (SCC)-based allocation factors. The Control Strategy Tool (CoST) was used to apply most non-EGU projection/growth factors, controls, and facility/unit/stack-level closures to the 2011 NEI-based emissions modeling inventories to create future year inventory for 2028. Similar to the EGU sector, each state was able to make adjustments to the 2028 non-EGU inventory based on their knowledge of each facility. Airport-related source emissions for the base year 2011 were developed from the 2011 NEIv2. Aircraft emissions for 2011 are projected to future year 2028 by applying activity growth using data on itinerant operations at airports. The itinerate operations are defined as aircraft take-offs or aircraft landings. The EPA used projected itinerate information available from the Federal Aviation Administration's (FAA) Terminal Area Forecast (TAF) System.

4.1.2. Nonpoint Sources

Nonpoint sources are those sources whose individual emissions are relatively small, but due to the large number of these sources, the collective emissions from the source category could be significant (e.g., dry cleaners, service stations, combustion of fuels for heating, and agricultural sources). Emissions are estimated by multiplying an emission factor by some known indicator of collective activity, such as fuel usage, number of households, or population. Nonpoint source emissions are estimated at the countywide level. The base year 2011 nonpoint source inventory was developed from the 2011NEIv2. The CoST was used to apply most nonpoint projection/growth factors, controls and facility/unit/stack-level closures to the 2011 NEI-based emissions modeling inventories to create future year inventory for 2028.

4.1.3. Non-Road Mobile Sources

Non-road mobile sources are equipment that can move but do not use the roadways, such as construction equipment, railroad locomotives, commercial marine vessels, and lawn equipment. The emissions from these sources, like nonpoint sources, are estimated at the county level. For the majority of the non-road mobile sources, the emissions for 2011 were estimated using the EPA's National Mobile Inventory Model (NMIM, 2005). For the two source categories not included in the NMIM, i.e., railroad locomotives and commercial marine, more traditional methods of estimating the emissions were used.

For the source categories estimated using the EPA's NMIM model, the model growth assumptions were used to create the 2028 future year inventory. The NMIM model takes into consideration regulations affecting emissions from these source categories. The 2028 future-year commercial marine vessels and railroad locomotives emissions account for increased fuel consumption based on Energy Information Administration (EIA) fuel consumption projections for freight, and emissions reductions resulting from emissions standards from the Final Locomotive-Marine rule.

4.1.4. Onroad Mobile Sources

Onroad mobile sources include passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks, and buses that are normally operated on public roadways. The emissions from these sources are estimated at the county level. For onroad vehicles, the Motor Vehicle Emissions Simulator (MOVES) model (MOVES2014a) was used to develop base year 2011 emissions. Key inputs for MOVES include information on the age of vehicles on the roads, vehicle miles traveled, the average speeds on the roads, the mix of vehicles on the roads, any programs in place in an area to reduce emissions for motor vehicles (e.g., emissions inspection programs), and temperature. The MOVES model takes into consideration regulations that affect emissions from this source sector. The MOVES model then was run for 2028 inventory using input data reflective of that year.

4.1.5. Biogenic Sources

Biogenic sources are natural sources of emissions like trees, crops, grasses, and natural decay of plants. The emissions from these sources are estimated at the county level. Biogenic emissions for 2011 were developed using the Biogenic Emission Inventory System version 3.61 (BEIS3.61) within the Sparse Matrix Operator Kernel Emissions (SMOKE). BEIS3.61 creates gridded, hourly, model-species emissions from vegetation and soil. BEIS3.61 includes the incorporation of Version 4.1 of the Biogenic Emissions Land use Database (BELD4) and the incorporation of a canopy model to estimate leaf-level temperatures. BELD version 4.1 is based on an updated version of the USDA-United States Forest Service (USFS) Forest Inventory and Analysis (FIA) vegetation speciation-based data from 2001 to 2014 in the FIA version 5.1. Canopy coverage is based on the Landsat satellite National Land Cover Database (NLCD) product from 2011. The 2011 biogenic emissions are used for the 2028 future year without any changes.

4.1.6. Point Fires

The point fires sector includes emissions from both prescribed fires and wildfires. The point fire sector excludes agricultural burning and other open burning sources that are included in the nonpoint sector. Fire emissions are specified at geographic coordinates (point locations) and have daily emissions values. Emissions are day-specific and include satellite-derived latitude/longitude of the fire's origin and other parameters associated with the emissions such as acres burned and fuel load, which allow estimation of plume rise.

Fire emissions for the base year 2011 were taken from the 2011NEIv2. The point source day-specific emission estimates for 2011 fires rely on SMARTFIRE 2, which uses the National Oceanic and Atmospheric Administration's (NOAA's) Hazard Mapping System (HMS) fire location information as input. Additional inputs include the CONSUMEv3.0 software application and the Fuel Characteristic Classification System (FCCS) fuel-loading database to estimate fire emissions from wildfires and prescribed burns on a daily basis. SMARTFIRE 2 estimates were used directly for all states except Georgia and Florida. For Georgia, the satellite-derived emissions were removed from the fire inventory and replaced with a separate state-supplied fire inventory. Adjustments were also made to Florida to rescale their emissions to match the total acres burned that Florida reported in the NEI. The 2011 fire emissions are used for the 2028 future year without any changes.

4.1.7. Summary 2011 Baseline Emissions Inventory for Georgia

Table 4-1 is a summary of the 2011 baseline emission inventory for Georgia. The complete inventory and discussion of the methodology is contained in Appendix B. It should be noted that the emissions in Table 4-1 may be different than those in the 2011 National Emissions Inventory version 2 (NEIv2) because the "afdust" sector emissions for air quality modeling are adjusted downward to account for the effects of precipitation and the amount of emissions that are transported by physical forces (e.g., wind, vehicle traffic). The emissions summaries for other VISTAS states can also be found in Appendix B.

Table 4-1: 2011 Emissions Inventory Summary for Georgia (tpy)

Sector	CO	NH_3	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC
EGU	12,146	899	54,911	8,921	6,189	186,799	1,140
Non-EGU Point	64,554	5,809	48,234	15,671	12,471	28,999	27,437
Nonpoint	290,246	92,275	42,536	772,828	125,942	7,005	143,814
Onroad	1,018,645	4,492	223,223	12,518	6,829	1,088	109,005
Non-Road	452,457	61	44,449	4,732	4,503	125	58,581
Point-Fires	983,659	8,170	38,964	153,155	133,137	10,684	75,128
Total	**2,821,707**	**111,706**	**452,317**	**967,825**	**289,071**	**234,700**	**415,105**

4.1.8. Emissions Inventory Improvements Prior to Remodeling 2028 Future Year

The VISTAS initial emission inventory was completed in June 2018. The VISTAS initial modeling for the future year 2028 was completed in October 2019. VISTAS compared the VISTAS' emission inventory information to EPA's modeling inventory, which was released in September 2019. EPA used a base year of 2016 and a future year of 2028. One main difference between the VISTAS and EPA modeling is that VISTAS used a base year of 2011 while EPA used a base year of 2016. This is an important difference since the future year 2028 emissions are generally projected from the base year. VISTAS noted large differences in SO_2 and NO_X emissions, with EPA's emissions being much lower. One reason for this difference was that VISTAS initial modeling used an older version of ERTAC, which did not account for many coal-fired EGU retirements and fuel switches. Table 4-2 below compares the 2028 point emissions used by VISTAS versus the latest 2028fh[24] emissions used by EPA (projected from 2016). The emissions in Table 4-2 are extracted from the VISTAS12 modeling domain, which covers the eastern US. As shown in Table 4-2, EPA's SO_2 emissions are 45.61% lower than VISTAS' estimates, and EPA's NOx emissions are 20.19% lower than VISTAS' estimates.

[24] The "f" represents the base year emissions modeling platform iteration, which shows that it is 2014 NEI based (whereas for 2011 NEI-based platforms, this letter was "e"); and the "h" stands for the eighth configuration of emissions modeling for a 2014-NEI based modeling platform).

Table 4-2: VISTAS 2028 versus New EPA 2028

Pollutant	VISTAS 2028 (tpy)	New EPA 2028 (tpy)	Difference (tpy)	Difference (%)
NO_X	2,641,463.83	2,108,115.50	533,348.33	20.19%
SO_2	2,574,542.02	1,400,287.10	1,174,254.92	45.61%

The two tables below compare the SO_2 and NO_X emissions for the older version of ERTAC (2.7opt) and the newer version of ERTAC (16.0), with the newer version of ERTAC having much lower emissions. The older version of ERTAC was used in the VISTAS modeling in the non-VISTAS states. As explained in Section 4.1.1 above, each VISTAS state determined the estimated emissions for each EGU in their state for the projected year 2028.

Table 4-3: SO_2 Old ERTAC (2.7opt) versus SO_2 New ERTAC (16.0)

RPO	16.0 2028 (tpy)	2.7opt 2028 (tpy)	Difference (tpy)	Difference (%)
CENSARA	367,683.7	760,828.2	-393,144.5	-51.67%
LADCO	266,047.0	379,577.5	-113,530.5	-29.91%
MANE-VU	78,657.0	196,672.6	-118,015.6	-60.01%
VISTAS	161,502.5	273,582.1	-112,079.6	-40.97%
Total	**976,471.2**	**1,783,376.5**	**-806,905.3**	**-45.25%**

Table 4-4: NO_X Old ERTAC (2.7opt) versus NO_X New ERTAC (16.0)

RPO	16.0 2028 (tpy)	2.7opt 2028 (tpy)	Difference (tpy)	Difference (%)
CENSARA	244,499.3	354,795.1	-110,295.8	-31.09%
LADCO	166,429.4	198,966.9	-32,537.4	-16.35%
MANE-VU	56,315.3	83,432.5	-27,117.2	-32.50%
VISTAS	200,791.1	270,615.7	-69,824.6	-25.80%
Total	840,973.6	1,166,663.1	-325,689.5	-27.92%

The Regional Haze rule and guidance indicate that future year projections should be as accurate as possible. Thus, after consulting with EPA, VISTAS decided to model the future year 2028 again in order to have more accurate visibility projections. VISTAS made several improvements to the 2028 emissions inventory before remodeling the 2028 future year. These inventory improvements are detailed in the VISTAS emissions inventory report in Appendix B-2a. Each VISTAS state was given the opportunity to adjust any point source emissions in the 2028 inventory. For EGUs in the non-VISTAS states, ERTAC 2.7 emissions were replaced with the ERTAC 16.0 emissions, except for the LADCO states where ERTAC 2.7 emissions were replaced with ERTAC 16.1 emissions.

4.2. Summary of the 2028 Emissions Inventory and Assessment of Relative Contributions from Specific Pollutants and Source Categories

As noted in Section 2.4 for the years 2000-2004 and Section 2.6 for years 2014-2018, ammonium sulfate is the largest contributor to visibility impairment at the Georgia Class I areas, and reduction of SO_2 emissions would be the most effective means of reducing ammonium sulfate. As illustrated in Figure 4-1, 91.2% of 2011 SO_2 emissions in the VISTAS states are attributable to electric generating facilities and industrial point sources. Similarly, in Georgia the stationary point sources, consisting mostly of electric generating facilities and industrial point sources, contribute 91.9% of SO_2 emissions in the state (see Table 4-5).

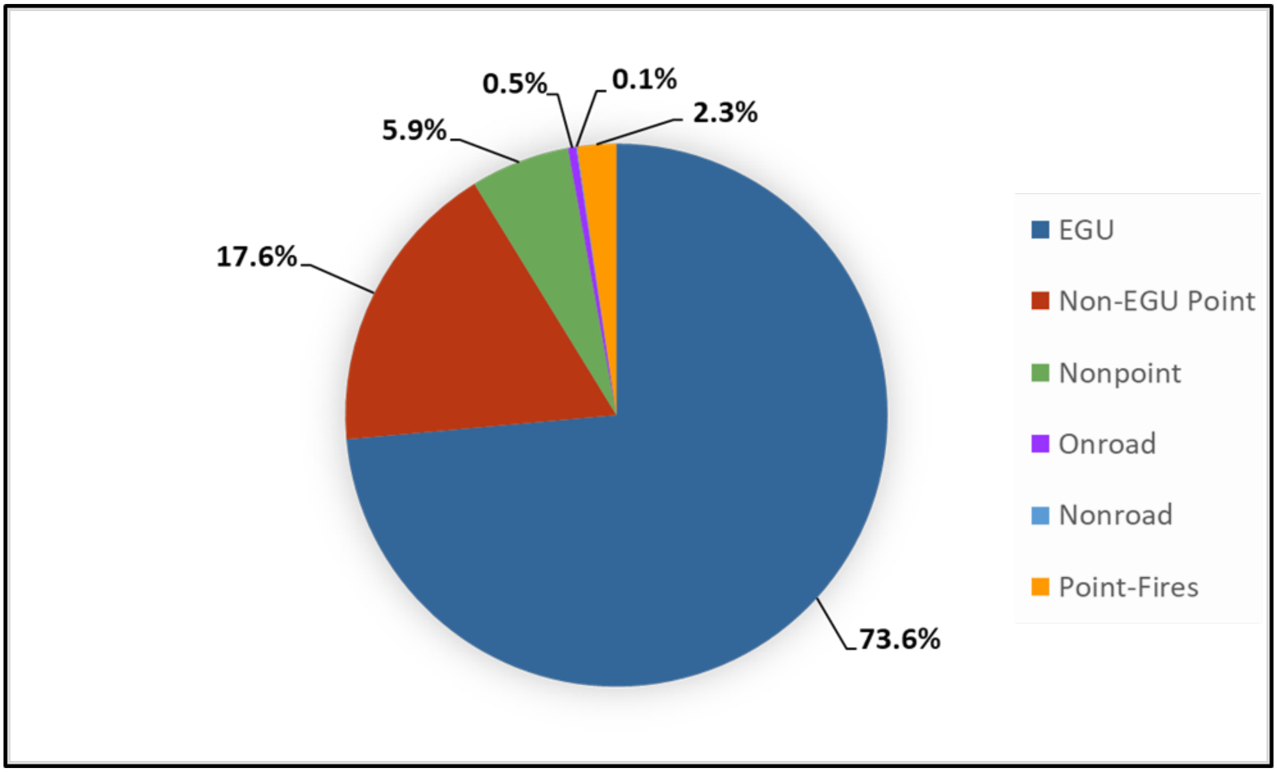

Figure 4-1: 2011 SO_2 Emissions in the VISTAS States

Table 4-5: 2011 SO_2 Emissions for Georgia, tpy

Sector	SO_2, tpy	Percentage
Point	215,798	91.9%
Nonpoint	7,005	3.0%
Onroad	1,088	0.5%
Non-Road	125	0.1%
Point-Fires	10,684	4.6%
Total	234,700	100.0%

Since the largest source of SO_2 emissions comes from the stationary point sources, the focus of potential controls and the impacts for those controls was on this source sector. In Georgia, the types of sources emitting SO_2, and thus contributing to the visibility impairment of the Class I areas, were predominately coal fired utilities and industrial boilers.

5. Regional Haze Modeling Methods and Inputs

Modeling for regional haze was performed by VISTAS for the ten southeastern states, including Georgia. The following sections outline the methods and inputs used by VISTAS for the regional modeling. Additional details are provided in Appendix E.

5.1. Analysis Method

The modeling analysis is a complex technical evaluation that begins by selection of the modeling system. For the most part, the modeling analysis approach for regional haze followed EPA's 2011el-based air quality modeling platform, which includes emissions, meteorology, and other inputs for 2011 as the base year for the modeling described in their regional haze TSD (EPA, 2017). EPA projected the 2011 base year emissions to a 2028 future year base case scenario. EPA's work is the foundation of the emissions used in the VISTAS analysis, except that VISTAS provided significant revisions to 2028 EGU and non-EGU point emissions as described in Appendix B. As noted in EPA's documentation, the 2011 base year emissions and methods for projecting these emissions to 2028 are in large part similar to the data and methods used by EPA in the final CSAPR Update[25] and the subsequent NODA[26] to support ozone transport mandates for the 2015 ozone NAAQS. VISTAS decided to use the following modeling systems:

- Meteorological Model: The Weather Research and Forecasting (WRF) model is a mesoscale numerical weather prediction system designed to serve both operational forecasting and atmospheric research needs (Skamarock, 2004; 2006; Skamarock et al., 2005). The Advanced Research WRF (ARW) version of WRF was used in this regional haze analysis study. It features multiple dynamical cores, a three-dimensional variational (3DVAR) data assimilation system, and a software architecture allowing for computational parallelism and system extensibility. WRF is suitable for a broad spectrum of applications across scales ranging from meters to thousands of kilometers.

- Emissions Model: Emissions processing was completed using the SMOKE model for most source categories. The exceptions include EGUs for certain areas, as well as the biogenic and mobile sectors. For certain areas in the modeling domain, the ERTAC EGU Forecasting Tool[27] was used to grow base year hourly EGU emissions inventories into future projection years. The tool uses base year hourly EPA CAMD data, fuel specific growth rates, and other information to estimate future emissions. The BEIS model was used for biogenic emissions. Special processors were used for fires, windblown dust, lightning, and sea salt emissions. The 2014 MOVES onroad mobile source emissions

[25] URL: https://www.epa.gov/airmarkets/final-cross-state-air-pollution-rule-update
[26] URL: https://www.epa.gov/airmarkets/notice-data-availability-preliminary-interstate-ozone-transport-modeling-data-2015-ozone
[27] URL: https://marama.org/technical-center/ertac-egu-projection-tool/

model was used by EPA with SMOKE-MOVES to generate onroad mobile source emissions with EPA generated vehicle activity data provided in the 2028 regional haze analysis.

- Air Quality Model: The Comprehensive Air Quality Model with Extensions (CAMx) Version 6.40 was used in this study, with the secondary organic aerosol partitioning (SOAP) algorithm module as the default. The CAMx photochemical grid model, which supports two-way grid nesting was used. The setup is based on the same WRF/SMOKE/CAMx modeling system used in the EPA 2011/2028el platform modeling. The Particulate Source Apportionment Technology (PSAT) tool of CAMx was selected to develop source contribution and significant contribution calculations.

Episode selection is an important component of any modeling analysis. EPA guidance recommends choosing time periods that reflect the variety of meteorological conditions representing visibility impairment on the 20% clearest and 20% most impaired days in the Class I areas being modeled. This is best accomplished by modeling a full year. For this analysis, VISTAS performed modeling for the full 2011 calendar year with 10 days of model spin-up in 2010.

Once base year model performance was deemed adequate, the future year emissions were processed. The air quality modeling results were used to determine a relative reduction in future visibility impairment, which was used to determine future visibility conditions and reasonable progress goals.

The complete modeling protocol used for this analysis can be found in Appendix E-1b.

5.2. Model Selection

To ensure that a modeling study is defensible, care must be taken in the selection of the models to be used. The models selected must be scientifically appropriate for the intended application and be freely accessible to all stakeholders. "Scientifically appropriate" means that the models address important physical and chemical phenomena in sufficient detail, using peer-reviewed methods. "Freely accessible" means that model formulations and coding are freely available for review and that the models are available to stakeholders, and their consultants, for execution and verification at no or low cost.

The following sections outline the criteria for selecting a modeling system that is both defensible and capable of meeting the study's goals. These criteria were used in selecting the modeling system for this modeling demonstration.

5.2.1. Selection of Photochemical Grid Model

5.2.1.1. Criteria

For a photochemical grid model to qualify as a candidate for use in a regional haze SIP, a state needs to show that it meets the same general criteria as a model for a NAAQS attainment demonstration. EPA's current modeling guidelines lists the following criteria for model selection (EPA, 2018):

- It should not be proprietary;
- It should have received a scientific peer review;
- It should be appropriate for the specific application on a theoretical basis;
- It should be used with databases that are available and adequate to support its application;
- It should be shown to have performed well in past modeling applications;
- It should be applied consistently with an established protocol on methods and procedures;
- It should have a User's Guide and technical description;
- The availability of advanced features (e.g., probing tools or science algorithms) is desirable; and
- When other criteria are satisfied, resource considerations may be important and are a legitimate concern.

5.2.1.2. Overview of CAMx

The CAMx model[28] is a state-of-science "One-Atmosphere" photochemical grid model capable of addressing ozone, PM, visibility, and acid deposition at a regional scale for periods up to one year (Ramboll Environ, 2016). CAMx is a publicly-available open-source computer modeling system for the integrated assessment of gaseous and particulate air pollution and meets all the photochemical grid model criteria above. Built on today's understanding that air quality issues are complex, interrelated, and reach beyond the urban scale, CAMx is designed to: (a) simulate air quality over many geographic scales; (b) treat a wide variety of inert and chemically active pollutants including ozone, inorganic and organic $PM_{2.5}$ and PM_{10}, mercury, and toxics; (c) provide source-receptor, sensitivity, and process analyses; and (d) be computationally efficient and easy to use. EPA has approved the use of CAMx for numerous ozone, PM, and regional haze SIPs throughout the U.S. and has used this model to evaluate regional mitigation strategies including those for most recent regional-scale rules such as CSAPR.

[28] URL: http://www.camx.com

5.2.2. Selection of Meteorological Model

5.2.2.1. Criteria

Meteorological models, either through objective, diagnostic, or prognostic analysis, extend available information about the state of the atmosphere to the grid upon which photochemical grid modeling is to be carried out. The criteria for selecting a meteorological model are based on both the model's ability to accurately replicate important meteorological phenomena in the region of study and the model's ability to interface with the rest of the modeling systems – particularly the photochemical grid model. With these issues in mind, the following criteria were established for the meteorological model to be used in this study:

- Non-hydrostatic formulation;
- Reasonably current, peer reviewed formulation;
- Simulates cloud physics;
- Publicly available at no or low cost;
- Output available in Input/Output Applications Programming Interface (I/O API) format;
- Supports four-dimensional data assimilation (FDDA); and
- Enhanced treatment of planetary boundary layer heights for air quality modeling.

5.2.2.2. Overview of WRF

The WRF[29] model is a mesoscale numerical weather prediction system designed to serve both operational forecasting and atmospheric research needs (Skamarock, 2004; 2006; Skamarock et al., 2005). The ARW version of WRF was used in this regional haze analysis study and meets all the meteorological model criteria above. It features multiple dynamical cores, a three-dimensional variational data assimilation system, and a software architecture allowing for computational parallelism and system extensibility. WRF is suitable for a broad spectrum of applications across scales ranging from meters to thousands of kilometers. The effort to develop WRF has been a collaborative partnership, principally among the National Center for Atmospheric Research (NCAR), NOAA, the National Centers for Environmental Prediction (NCEP) and the Forecast Systems Laboratory (FSL), the Air Force Weather Agency (AFWA), the Naval Research Laboratory, the University of Oklahoma, and the FAA. WRF allows researchers the ability to conduct simulations reflecting either real data or idealized configurations. WRF is a model that provides operational weather forecasting. It is flexible and computationally efficient while offering the advances in physics, numerics, and data assimilation contributed by the research community.

The configuration used for this modeling demonstration, as well as a more detailed description of the WRF model, can be found in the EPA's meteorological modeling report (EPA, 2014d).

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[29] URL: http://www.wrf-model.org/index.php

5.2.3. Selection of Emissions Processing System

5.2.3.1. Criteria

The principal criterion for an emissions processing system is that it accurately prepares emissions files in a format suitable for the photochemical grid model being used. The following list includes clarification of this criterion and additional desirable criteria for effective use of the system.

- File system compatibility with the I/O API;
- File portability;
- Ability to grid emissions on a Lambert conformal projection;
- Report capability;
- Graphical analysis capability;
- MOVES mobile source emissions;
- BEIS version 3;
- Ability to process emissions for the proposed domain in a reasonable amount of time;
- Ability to process control strategies;
- No or low cost for acquisition and maintenance; and
- Expandable to support other species and mechanisms.

5.2.3.2. Overview of SMOKE

The SMOKE[30] modeling system is an emissions modeling system that generates hourly gridded speciated emission inputs of mobile, non-road, nonpoint area, point, fire and biogenic emission sources for photochemical grid models (Coats, 1995; Houyoux et al., 1999) and meets all the emissions processing system criteria above. As with most "emissions models," SMOKE is principally an emissions processing system; its purpose is to provide an efficient modern tool for converting existing base emissions inventory data into the hourly gridded speciated formatted emission files required by a photochemical grid model. For biogenic, mobile, and EGU sources, external emission models/processors were used to prepare SMOKE inputs. MOVES2014 is EPA's latest onroad mobile source emissions model and was first released in July 2014 (EPA, 2014a; 2014b; 2014c). MOVES2014 includes the latest onroad mobile source emissions factor information. Emission factors developed by EPA were used in this analysis. SMOKE-MOVES uses an emissions factor look-up table from MOVES, county-level gridded vehicle miles travelled (VMT) and other activity data, and hourly gridded meteorological data (typically from WRF) to generate hourly gridded speciated onroad mobile source emissions inputs. The ERTAC EGU Forecasting Tool[31] was developed through a collaborative effort to improve emission inventories among the Northeastern, Mid-Atlantic, Southeastern, and Lake Michigan area states;

[30] URL: https://www.cmascenter.org/smoke/
[31] URL: https://marama.org/technical-center/ertac-egu-projection-tool/

other member states; industry representatives; and multi-jurisdictional organization (MJO) representatives. The tool was used for some states to grow base year hourly EGU emissions inventories into future projection years. The tool uses base year hourly EPA CAMD data, fuel specific growth rates, and other information to estimate future emissions. Biogenic emissions were modeled by EPA using version 3.61 of BEIS. First developed in 1988, BEIS estimates VOC emissions from vegetation and nitric oxide (NO) emissions from soils. Because of resource limitations, recent BEIS development has been restricted to versions that are built within the SMOKE system. Additional information about the SMOKE model is contained in Appendix E.

5.3. Selection of the Modeling Year

A crucial step to SIP modeling is the selection of the period of time to model so that air quality conditions may be well represented and so that changes in air quality in response to changes in emissions may be projected.

EPA's most recent regional haze modeling guidance (EPA, 2018) contains recommended procedures for selecting modeling episodes. The VISTAS regional haze modeling used the annual calendar year 2011 modeling period. Calendar year 2011 satisfies the criteria in EPA's modeling guidance episode selection discussion and is consistent with the base year modeling platform. Specifically, EPA's guidance recommends choosing a time period which reflects the variety of meteorological conditions that represent visibility impairment on the 20% clearest and 20% most-impaired days in the Class I areas being modeled (high and low concentrations necessary). This is best accomplished by modeling a full calendar year.

In addition, the 2011/2028 modeling platform was the most recent available platform when VISTAS started their modeling work. EPA's 2016-based platform became available at a later date after VISTAS had already invested a considerable amount of time and money into the modeling analysis. Using the 2016-based platform was not feasible from a monetary perspective, nor could such work be done in a timely manner.

5.4. Modeling Domains

5.4.1. Horizontal Modeling Domain

The VISTAS modeling used a 12-kilometer (km) continental U.S. (CONUS_12 or 12US2) domain. The 12-km nested grid modeling domain (Figure 5-1) represents the CAMx 12-km air quality and SMOKE/BEIS emissions modeling domain. As shown in EPA's meteorological model performance evaluation document, the WRF meteorological modeling was run on a larger 12-km modeling domain than the 12-km domain that was used for CAMx (EPA, 2014d). The WRF meteorological modeling domains are defined larger than the air quality modeling domains because meteorological models can sometimes produce artifacts in the meteorological variables near the boundaries as the prescribed boundary conditions come into dynamic balance with the coupled equations and numerical methods in the meteorological model.

An additional VISTAS_12 domain was prepared that is a subset of the CONUS_12 domain. Development of the VISTAS_12 domain (also presented in Figure 5-1) requires the EPA CONUS_12 simulation to be run using CAMx Version 6.40 modeling saving 3-dimensional concentration fields for extraction using the CAMx BNDEXTR program. Dimensions for both VISTAS_12 and CONUS_12 domains are provided in Table 5-1.

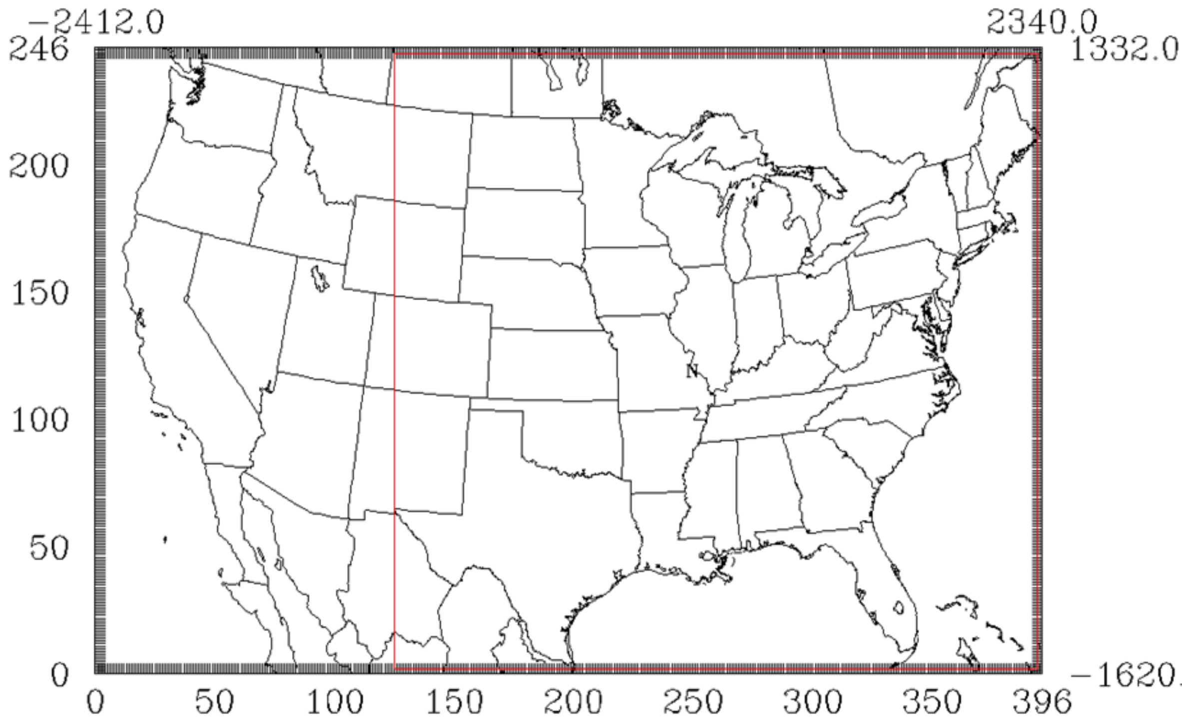


Figure 5-1: Map of 12-km CAMx Modeling Domains; VISTAS_12 Domain Represented as Inner Red Domain

Table 5-1: VISTAS II Modeling Domain Specifications

Domain	Columns	Rows	Vertical Layers	X Origin (km)	Y Origin (km)
CONUS_12	396	246	25	-2,412	-1,620
VISTAS_12	269	242	25	-912	-1,596

5.4.2. Vertical Modeling Domain

The CAMx vertical structure is primarily defined by the vertical layers used in the WRF meteorological modeling. The WRF model employs a terrain following coordinate system defined by pressure, using multiple layer interfaces that extend from the surface to 50 millibar (mb) (approximately 19 km above sea level). EPA ran WRF using 35 vertical layers. A layer averaging scheme is adopted for CAMx simulations whereby multiple WRF layers are combined into one CAMx layer to reduce the air quality model computational time. Table 5-2 displays the approach for collapsing the 35 vertical layers in WRF to 25 vertical layers in CAMx. This approach is consistent with EPA's draft 2028 regional haze modeling.[32]

Table 5-2: WRF and CAMx Layers and Their Approximate Height Above Ground Level

CAMx Layer	WRF Layers	Sigma P	Pressure (mb)	Approximate Height (meters above ground level)
25	35	0.00	50.00	17,556
25	34	0.05	97.50	14,780
24	33	0.10	145.00	12,822
24	32	0.15	192.50	11,282
23	31	0.20	240.00	10,002
23	30	0.25	382.50	7,064
22	29	0.30	335.00	7,932
22	28	0.35	382,50	7,064
21	27	0.40	430.00	6,275
21	26	0.45	477.50	5,553
20	25	0.50	525.00	4,885
20	24	0.55	572.50	4,264
19	23	0.60	620.00	3,683
18	22	0.65	667.50	3,136
17	21	0.70	715.00	2,619
16	20	0.74	753.00	2,226
15	19	0.77	781.50	1,941
14	18	0.80	810.00	1,665
13	17	0.82	829.00	1,485
12	16	0.84	848.00	1,308
11	15	0.86	867.00	1,134
10	14	0.88	886.00	964
9	13	0.90	905.00	797
9	12	0.91	914.50	714
8	11	0.92	924.00	632
8	10	0.93	933.50	551
7	9	0.94	943.00	470
7	8	0.95	952.50	390
6	7	0.96	962.00	311
5	6	0.97	971.50	232
4	5	0.98	981.00	154
4	4	0.99	985.75	115
3	3	0.99	985.75	115
2	2	1.00	995.25	38
1	1	1.00	997.63	19

[32] Table 2-2, EPA, 2017.

6. Model Performance Evaluation

The VISTAS 2011 modeling platform (VISTAS2011) used meteorological modeling files developed by EPA. The evaluation of the meteorological modeling can be found in the EPA's document titled, "Meteorological Model Performance for Annual 2011 WRF v3.4 Simulation."[33] Overall, the meteorological modeling was deemed acceptable for regulatory applications.

In keeping with the one-atmosphere objective of the CAMx modeling platform, model performance was evaluated for ozone, fine particles, and acid deposition. For the model performance analysis, model predictions were paired in space and time with observational data from various monitoring networks. Modeled 8-hour ozone concentrations were compared to observations from the EPA's Air Quality System (AQS) network. Modeled 24-hour speciated PM concentrations were compared to observations from IMPROVE, CSN, and Clean Air Status and Trends Network (CASTNet) monitoring networks. Modeled weekly speciated wet and dry deposition species were compared to observations from the National Acid Deposition Program (NADP) and CASTNet.

6.1. Ozone Model Performance Evaluation

As indicated by the statistics in Table 6-1, bias and error for maximum daily 8-hour average (MDA8) ozone are relatively low in the region. Mean bias (MB) for MDA8 ozone ≥ 60 parts per billion (ppb) during each month (May through September) was within ±5 ppb at AQS sites in the VISTAS states, ranging from -0.13 ppb (September) to 3.79 ppb (July). The mean error (ME) is less than 10 ppb in all months. Normalized mean bias (NMB) is within ±5% for AQS sites in all months except July (5.63%). The mean bias and normalized mean bias statistics indicate a tendency for the model to over predict MDA8 ozone concentrations in the months of May through August and slightly under predict MDA8 ozone concentrations in September for AQS sites. The normalized mean error (NME) is less than 15% in the region across all months.

Table 6-1: Performance Statistics for MDA8 Ozone ≥ 60 ppb by Month for VISTAS States Based on Data at AQS Network Sites

Region	Month	# of Obs	MB (ppb)	ME (ppb)	NMB (%)	NME (%)
VISTAS	May	838	2.48	6.11	3.79	9.34
VISTAS	Jun	2028	1.73	7.11	2.57	10.55
VISTAS	Jul	1233	3.79	8.88	5.63	13.21
VISTAS	Aug	1531	2.38	6.94	3.59	10.48
VISTAS	Sep	681	-0.13	6.09	-0.19	9.08

[33] URL: https://www.epa.gov/sites/production/files/2020-10/documents/met_tsd_2011_final_11-26-14.pdf

Figure 6-1 through Figure 6-4 show the spatial variability in bias and error at monitor locations. Mean bias, as seen from Figure 6-1, is within ±5 ppb at most sites across the VISTAS12 domain with a maximum under-prediction of 23.44 ppb at one site (AQS monitor 550030010) in Ashland County, Wisconsin and a maximum over-prediction of 17.95 ppb in York County, South Carolina (AQS monitor 450910006); both with small sample sizes (n=1 and n=7, respectively). A positive mean bias is generally seen in the range of 5 to 10 ppb with regions of 10 to 15 ppb over-prediction seen scattered throughout the domain. The model has a tendency to underestimate in the western portion of the domain and overestimate in the eastern portion of the domain.

Figure 6-2 indicates that the normalized mean bias for days with observed MDA8 ozone ≥ 60 ppb is within ± 10% at the vast majority of monitoring sites across the VISTAS12 modeling domain. Monitors in Ashland County, Wisconsin and York County, South Carolina again bookend the NMB range with 38.03% and 27.44%, respectively. There are regional differences in model performance, as the model tends to over predict at most sites in the eastern region of the VISTAS12 domain and generally under predict at sites in and around the western and northwestern borders of the domain.

The ME, as seen from Figure 6-3, is generally 10 ppb or less at most of the sites across the VISTAS12 modeling domain although the Ashland, Wisconsin and York County, South Carolina monitors show much higher ME of 23.44 and 17.95 ppb, respectively. VISTAS states show less than 10% of their monitors above 10 ppb model error, with the majority of those within this value. Figure 6-4 indicates that the NME for days with observed MDA8 ozone ≥ 60 ppb is less than 15% at the vast majority of monitoring sites across the VISTAS12 modeling domain. Noted exceptions seen are monitors 450910006 (York County, South Carolina), 470370011 (Davidson County, Tennessee), and 120713002 (Lee County, Florida) with NMEs of 27.44%, 25.4%, and 23.07%, respectively. Somewhat elevated NMEs (> 15%) are seen in and around many of the VISTAS state metro areas.

Additional details on the ozone model performance evaluation can be found in Appendix E-5.

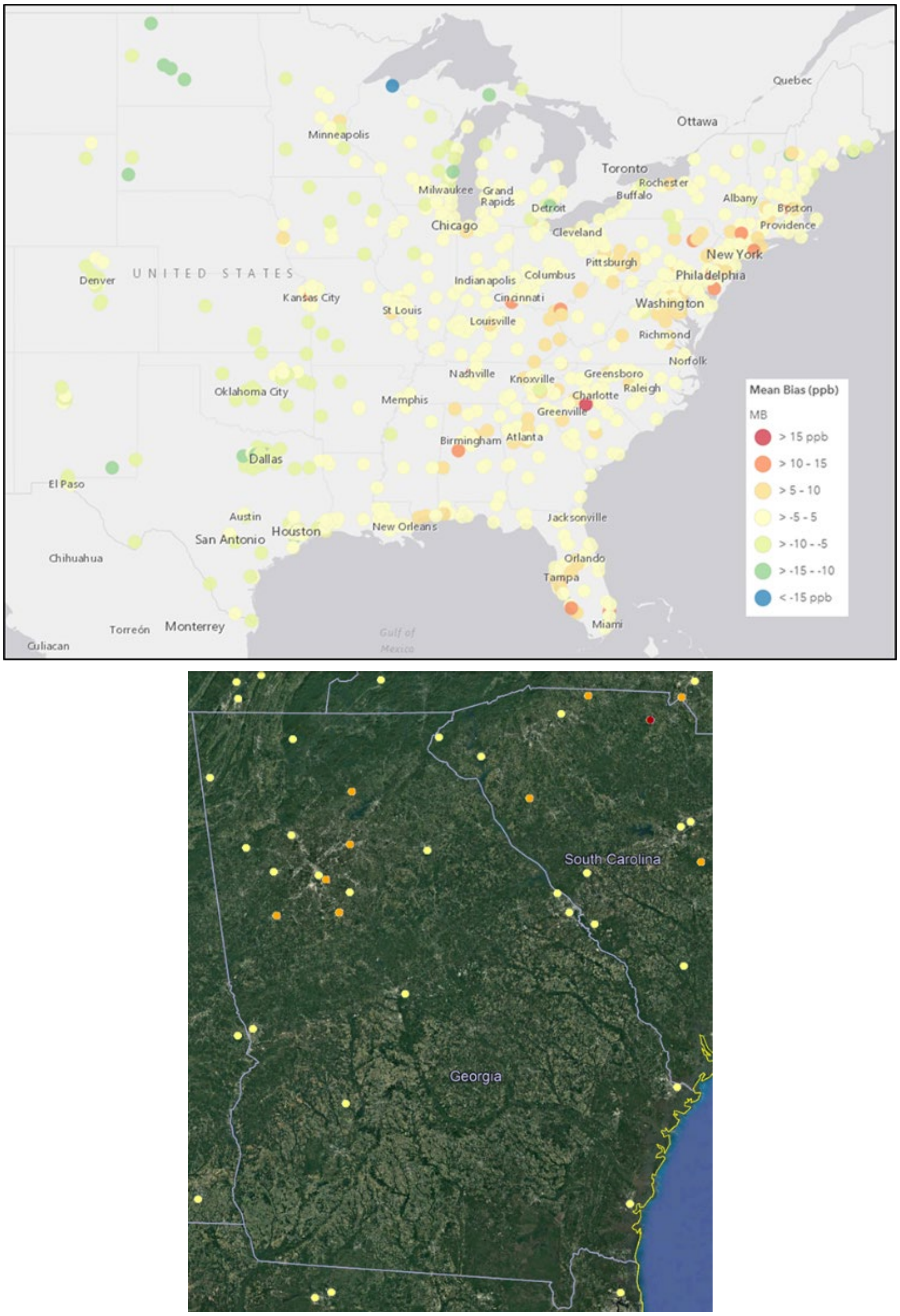
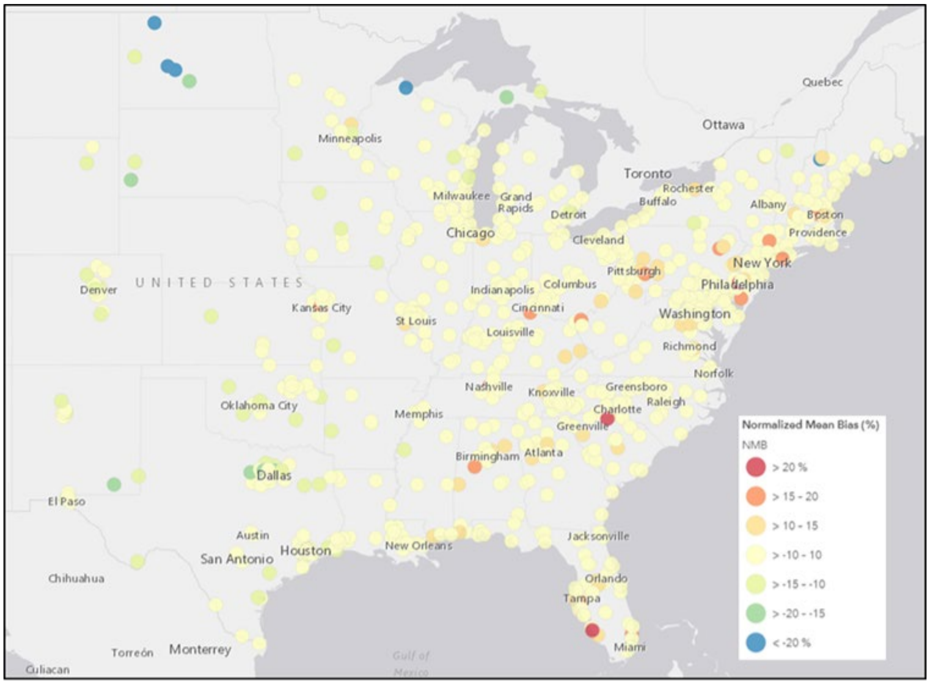


Figure 6-1: Mean Bias (ppb) of MDA8 Ozone ≥ 60 ppb Over the Period May-September 2011 at AQS Monitoring Sites in VISTAS12 Domain (top) and in Georgia (bottom)



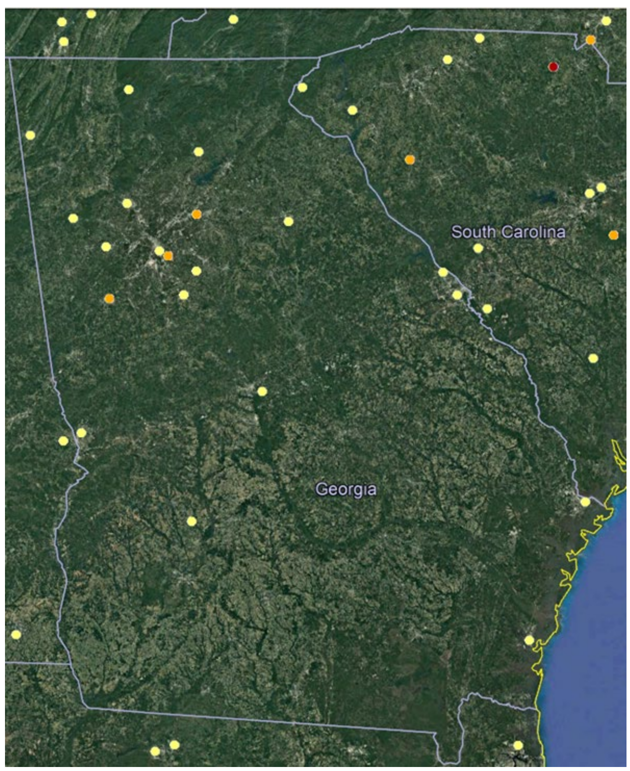


Figure 6-2: Normalized Mean Bias (%) of MDA8 Ozone ≥ 60 ppb Over the Period May-September 2011 at AQS Monitoring Sites in VISTAS12 Domain (top) and in Georgia (bottom)

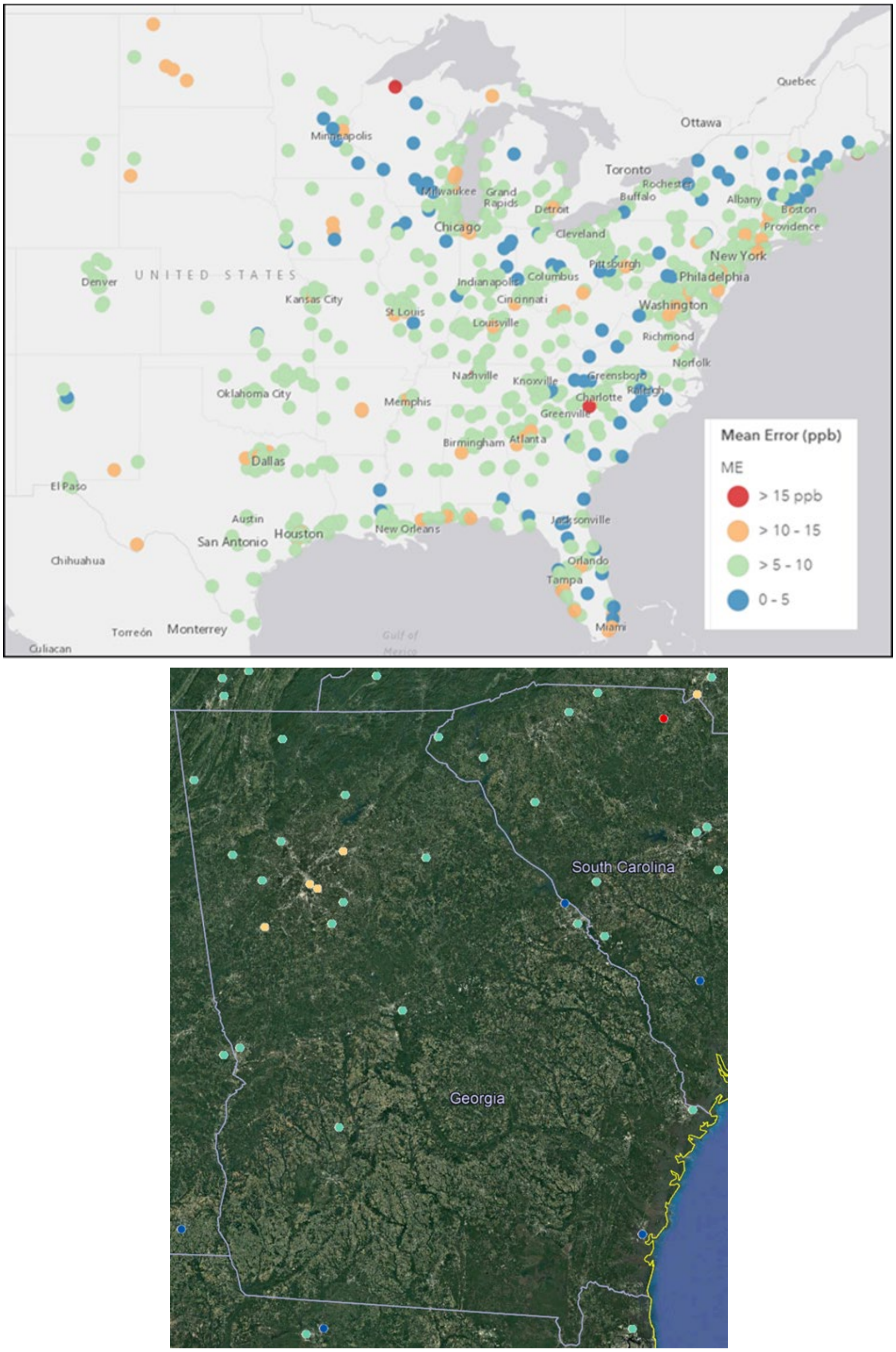
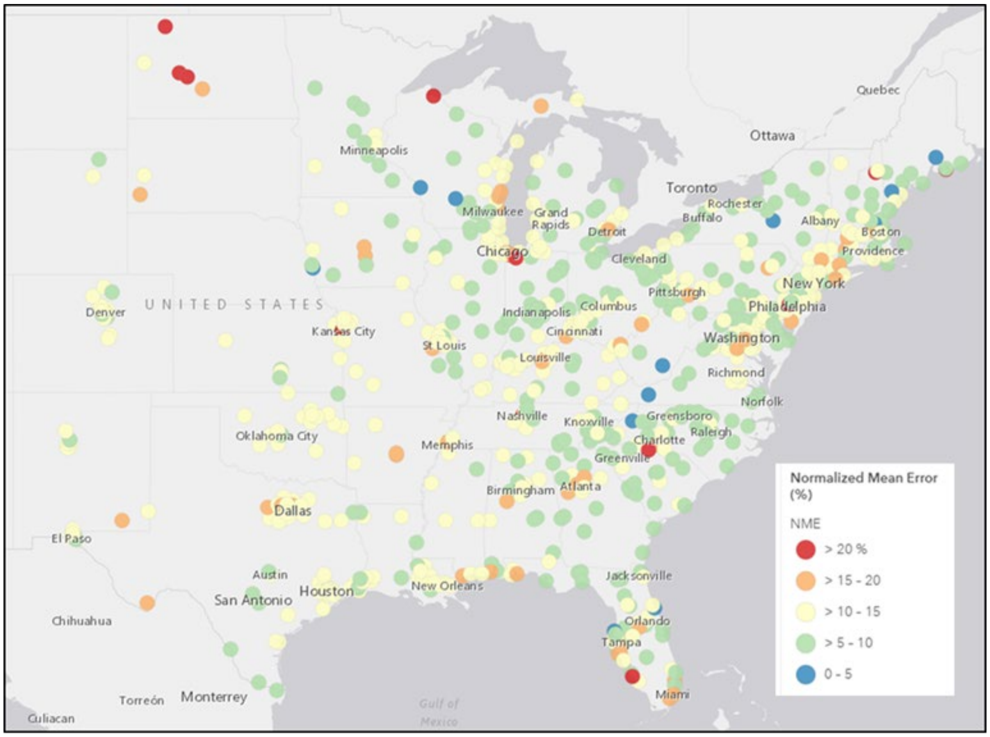


Figure 6-3: ME (ppb) of MDA8 Ozone ≥ 60 ppb Over the Period May-September 2011 at AQS Monitoring Sites in VISTAS12 Domain (top) and in Georgia (bottom)



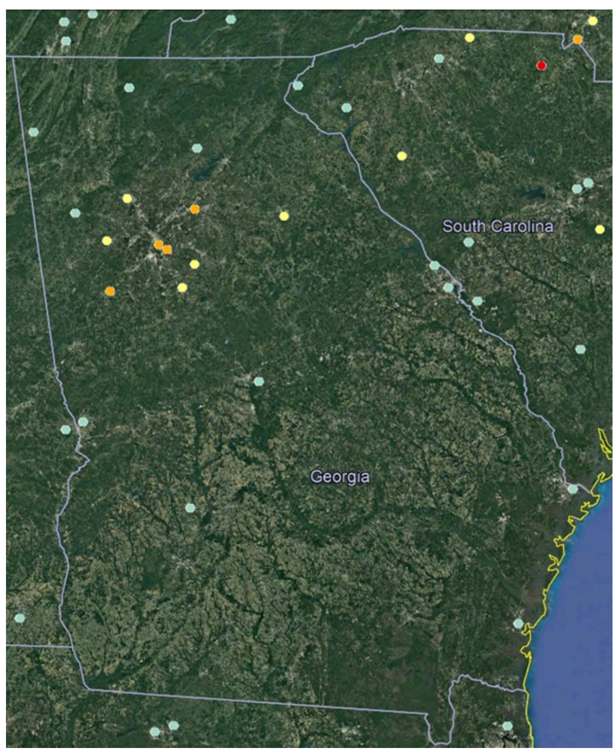


Figure 6-4: NME (%) of MDA8 Ozone ≥ 60 ppb Over the Period May-September 2011 at AQS Monitoring Sites in VISTAS12 Domain (top) and in Georgia (bottom)

6.2. Acid Deposition Model Performance Evaluation

The primary source for deposition data is the National Atmospheric Deposition Program (NADP).[34] The NADP monitoring networks used in this evaluation include:

- National Trends Network (NTN)
- Atmospheric Integrated Research Monitoring Network (AIRMon)
- Ammonia Monitoring Network (AMoN)

Dry deposition information is also available from CASTNet. The data from NTN and AIRMon were used in the wet deposition MPE, and the data from CASTNET and AMoN were used for dry deposition MPE. The MPE focused on the monitors from these networks within the VISTAS 12-km modeling domain (Figure 6-5).

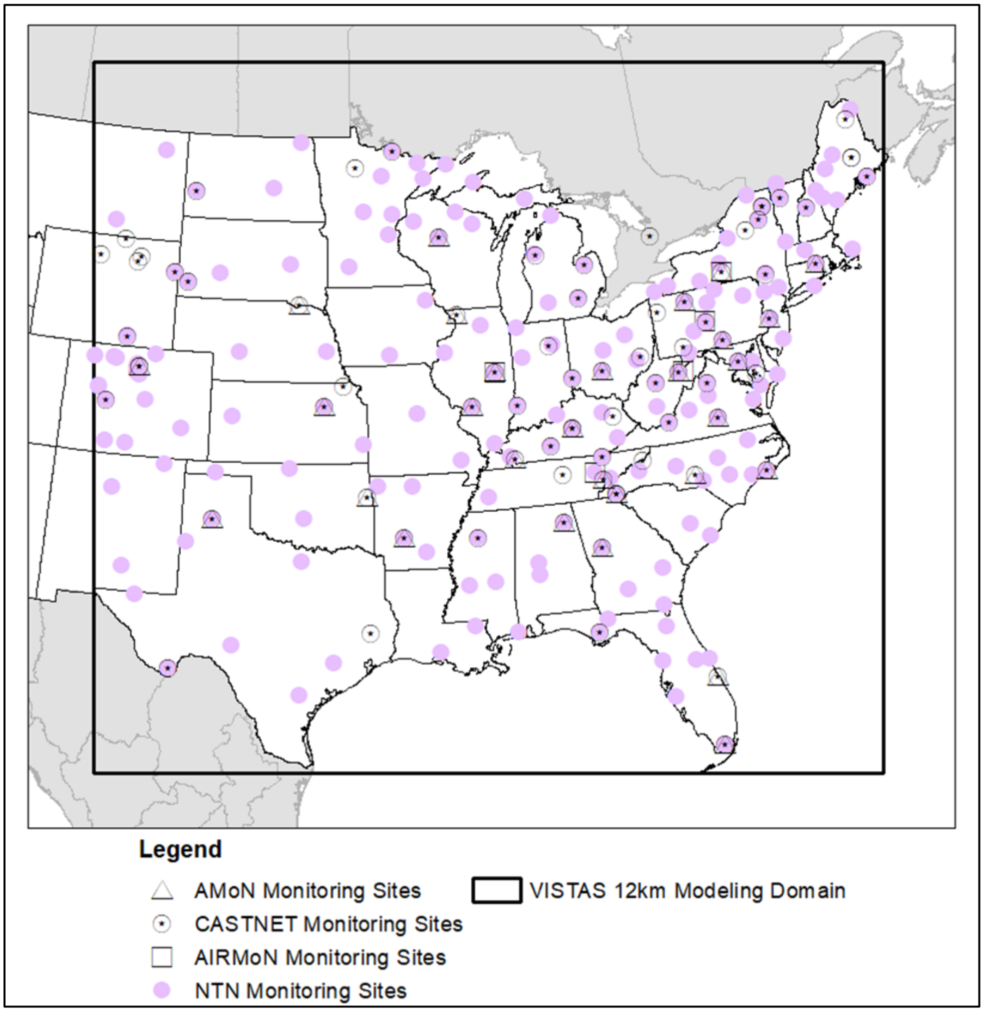


Figure 6-5: Deposition Monitors Included in the VISTAS 12 Domain

[34] National Atmospheric Deposition Program (NRSP-3). 2018. NADP Program Office, Wisconsin State Laboratory of Hygiene, 465 Henry Mall, Madison, WI 53706. URL: http://nadp.slh.wisc.edu/

Table 6-2 summarizes the aggregated weekly MPE metrics for wet deposition in the VISTAS 12-km domain. The model demonstrates a negative mean bias for the ammonium ion (NH_4^+) and the sulfate ion (SO_4^{-2}) and a positive mean bias for the nitrate ion (NO_3^-) compared to the weekly NTN observations. The AIRMon sites have a larger positive mean bias for all pollutants.

Table 6-2: Weekly Wet Deposition MPE Metrics for NADP Sites in the VISTAS 12-km Domain

Network	Pollutant	n	MB (kg/ha)	ME (kg/ha)	NMB (%)	NME (%)	r (unitless)	MFB (%)	MFE (%)	RMSE (unitless)
NTN	NH_4^+	3,404	-0.025	0.045	-32%	58%	0.629	-19%	34%	0.092
NTN	NO_3^-	3,404	0.024	0.123	12%	62%	0.642	6%7	29%	0.242
NTN	SO_4^{-2}	3,404	-0.001	0.118	0%	57%	0.681	0%	29%	0.245
AIRMon	NH_4^+	158	-0.003	0.020	-31%	76%	0.534	-7%	41%	0.041
AIRMon	NO_3^-	158	0.051	0.097	67%	127%	0.398	25%	47%	0.192
AIRMon	SO_4^{-2}	158	0.018	0.091	20%	100%	0.352	9%	46%	0.197

When considering the total accumulated wet deposition for the calendar year, there is still under prediction of NH_4^+ and SO_4^{2-}, and a slight over prediction of NO_3^-. However, continued improvement is seen from the seasonal accumulated performance with respect to the NME and r values, as presented in Table 6-3.

Table 6-3: Accumulated Annual Wet Deposition MPE Metrics for NADP Sites in the VISTAS 12-km Domain

Pollutant	n	MB (kg/ha)	MGE (kg/ha)	NMB (%)	NME (%)	r (unitless)	MFB (%)	MFE (%)	RMSE (unitless)
NH_4^+	99	-1.245	1.246	-38%	38%	0.861	-23%	23%	1.536
NO_3^-	99	0.134	1.453	2%	17%	0.901	1%	8%	1.933
SO_4^{2-}	99	-0.585	1.604	-7%	18%	0.916	-3%	9%	2.142

The weekly dry deposition MB and ME presented in Table 6-4 would seem to suggest relatively good model performance for the CASTNET sites. The higher normalized mean and mean fractional bias and error values are due to small values in the denominator.

Table 6-4: Weekly Dry Deposition MPE Metrics for CASTNet Sites in the VISTAS 12-km Domain

Network	Pollutant	n	MB (kg/ha)	ME (kg/ha)	NMB (%)	NME (%)	r (unitless)	MFB (%)	MFE (%)	RMSE (unitless)
CASTNet	Cl^-	965	-0.001	0.001	-87%	89%	0.796	-77%	79%	0.004
CASTNet	NH_4^+	965	0.001	0.003	13%	51%	0.603	6%	24%	0.004
CASTNet	SO_4^{2-}	965	0.0004	0.007	3%	43%	0.650	1%	21%	0.009
CASTNet	SO_2	965	-0.031	0.031	-96%	96%	0.656	-93%	93%	0.052
CASTNet	NO_3^-	965	0.001	0.004	12%	80%	0.601	6%	37%	0.006
CASTNet	HNO_3	965	-0.062	0.062	-95%	95%	0.612	-90%	90%	0.077
AMoN	NH_3	355	-0.007	0.007	-95%	95%	0.463	%91	91%	0.013

As presented in Table 6-5, most pollutants, except for NO_3, are under predicted, based on the total accumulated dry deposition. SO_2 and HNO_3 have the worst under prediction of all the pollutants, followed by Cl^-.

Table 6-5: Accumulated Annual Wet Deposition MPE Metrics for CASTNet Sites in the VISTAS 12-km Domain

Pollutant	n	MB (kg/ha)	MGE (kg/ha)	NMB (%)	NME (%)	r (unitless)	MFB (%)	MFE (%)	RMSE (unitless)
Cl^-	19	-0.054	0.054	-88%	88%	0.981	-78%	78%	0.156
NH_4^+	19	-0.002	0.077	-1%	27%	0.688	0%	14%	0.090
SO_4^{2-}	19	-0.067	0.219	-8%	27%	0.537	-4%	14%	0.268
SO_2	19	-1.616	1.616	-97%	97%	0.869	-94%	94%	2.221
NO_3^-	19	0.001	0.113	1%	46%	0.572	0%	23%	0.154
HNO_3	19	-3.272	3.272	-95%.4	95%	0.607	-91%	91%	3.688

Additional details on the wet and dry acid deposition model performance evaluation can be found in Appendix E-4.

6.3. PM Model Performance Goals and Criteria

Because $PM_{2.5}$ is a mixture, the current EPA PM modeling guidance[35] recommends that a meaningful performance evaluation should include an assessment of how well the model is able to predict individual chemical components that constitute $PM_{2.5}$. Consistent with EPA's performance evaluation of the regional haze 2028 analysis, in addition to total $PM_{2.5}$, the following components of $PM_{2.5}$ were also examined.

- Sulfate ion (SO_4^{2-})
- Nitrate ion (NO_3^-)
- Ammonium ion (NH_4^+)
- Elemental Carbon (EC)
- Organic Carbon (OC) and/or Organic Carbon Mass (OCM)
- Crustal (weighted average of the most abundant trace elements in ambient air)
- Sea salt constituents (Na^+ and Cl^-)

Recommended benchmarks for photochemical model performance statistics (Boylan, 2006; Emery, 2017) were used to assess the applicability of the VISTAS modeling platform for Regional Haze SIP purposes. The goal and criteria values noted in Table 6-6 below were used for this modeling. The original publication notes that the temporal scales for the 24-hour total and speciated PM should not exceed 3 months (or 1 season) and the spatial scales should range from urban to less than or equal to 1000 kilometers. This indicates that model performance should be evaluated based on the entire domain, as modeling discussed in Section 6.4, and not based on individual monitor performance as presented for Great Smoky Mountains National Park, as presented in Section 6.5.

[35] URL: https://www.epa.gov/sites/production/files/2020-10/documents/o3-pm-rh-modeling_guidance-2018.pdf

Table 6-6: Fine Particulate Matter Performance Goals and Criteria

Species	NMB, Goal	NMB, Criteria	NME, Goal	NME, Criteria	FB, Goal	FB, Criteria	FE, Goal	FE, Criteria	r, Goal	r, Criteria
24-hr $PM_{2.5}$ and sulfate	<± 10%	<± 30%	< 35%	< 50%	<± 30%	<± 60%	<50%	<75%	>0.75	>0.50
24-hr nitrate	<± 10%	<± 65%	< 65%	< 115%	<± 30%	<± 60%	<50%	<75%	>0.75	>0.40
24-hr OC	<± 15%	<± 50%	< 45%	< 65%	<± 30%	<± 60%	<50%	<75%	None	None
24-hr EC	<± 20%	<± 40%	< 50%	< 75%	<± 30%	<± 60%	<50%	<75%	None	None

The mapping of the CAMx species into the observed species are presented in Table 6-7.

Table 6-7: Species Mapping from CAMx into Observation Network

Network	Observed Species	CAMx Species
IMPROVE	NO_3	PNO3
IMPROVE	SO_4	PSO4
IMPROVE	NH_4	PNH4
IMPROVE	OM = 1.8*OC	SOA1+SOA2+SOA3+SOA4 +SOPA+SOPB+POA
IMPROVE	EC	PEC
IMPROVE	SOIL	FPRM+FCRS
IMPROVE	$PM_{2.5}$	PSO4+PNO3+PNH4+SOA1+SOA2+SOA3+SOA4 +SOPA+SOPB+POA+PEC+FPRM+FCRS+NA+PCL
CSN	$PM_{2.5}$	PSO4+PNO3+PNH4+SOA1+SOA2+SOA3+SOA4 +SOPA+SOPB+POA+PEC+FPRM+FCRS+NA+PCL
CSN	NO_3	PNO3
CSN	SO_4	PSO4
CSN	NH_4	PNH4
CSN	OM = 1.4*OC	SOA1+SOA2+SOA3+SOA4 +SOPA+SOPB+POA
CSN	EC	PEC

Several graphic displays of model performance were prepared, including:

- Performance goal plots ("soccer plots") that summarize model performance by species, region, and season.
- Concentration performance plots ("bugle plots") that display fractional bias or error as a function of concentration by species, region, monitoring network, and month.
- Scatter plots of predicted and observed concentrations by species, monitoring network, and month.
- Time series plots of predicted and observed concentrations by species, monitoring site, and month.
- Spatially averaged time series plots.
- Time series plots of monthly fractional bias and error by species, region, and network.

Both soccer plots and bugle plots offer a convenient way to examine model performance with respect to set goals and criteria. The bugle plots have the added benefit of adjusting the goals and criteria to consider the concentration of the species. Analysis of bugle plots generally suggests that greater emphasis should be placed on performance of those components with the greatest contribution to PM mass and visibility impairment (e.g., sulfate and organic carbon) and that greater bias and error could be accepted for components with smaller contributions to total PM mass (e.g., elemental carbon, nitrate, and soil).

6.4. PM Model Performance Evaluation for the VISTAS Modeling Domain

Further discussion of model performance in this document will focus on the comparison of observational data from the CASTNET, CSN, and IMPROVE monitors (Table 6-8) in the VISTAS12 modeling domain and model output data from the VISTAS2011 annual air quality modeling.

Table 6-8: Overview of Utilized Ambient Data Monitoring Networks

Monitoring Network	Chemical Species Measured	Sampling Period
IMPROVE	Speciated $PM_{2.5}$ and PM_{10}; light extinction data	1 in 3 days; 24-hour average
CASTNET	Speciated $PM_{2.5}$, and O_3	1-week average
CSN	Speciated $PM_{2.5}$	24-hour average

The evaluation primarily focused on the air quality model's performance with respect to individual components of fine particulate matter, as good model performance of the component species will dictate good model performance of total or reconstituted fine particulate matter. Model performance of the total fine particulate matter and the resulting total light extinction was also examined as a means to discuss the overall model performance. A full list of model performance statistics is found in Appendix E-3.

The soccer plots for all VISTAS and non-VISTAS monitors are included here for summary purposes. Plots have been developed for the monthly average performance statistics for the most significant light scattering component species (i.e. sulfate, nitrate, organic carbon, and elemental carbon).

The soccer plots of monthly concentrations show values for $PM_{2.5}$ (Figure 6-6) at CSN, IMPROVE monitors and sulfate (Figure 6-7), nitrate (Figure 6-8), organic carbon (Figure 6-9), and elemental carbon (Figure 6-10) at CSN, IMPROVE, CASTNET monitors in VISTAS and non-VISTAS states in the modeling domain. $PM_{2.5}$ is mostly inside the NMB and NME criteria for CSN/VISTAS, CSN/non-VISTAS, IMPROVE/VISTAS, and IMPROVE/non-VISTAS. Sulfate is mostly inside the NMB and NME criteria for CSN/VISTAS, CSN/non-VISTAS, IMPROVE/VISTAS, and IMPROVE/non-VISTAS; but mostly outside the NMB and NME criteria for CASTNet/VISTAS and CASTNet/non-VISTAS. Nitrate is mostly inside the NMB and NME criteria for CASTNet/VISTAS, CASTNet/non-VISTAS, CSN/VISTAS, CSN/non-VISTAS, IMPROVE/VISTAS, and IMPROVE/non-VISTAS. Organic carbon is mostly inside the NMB and NME criteria for IMPROVE/VISTAS and IMPROVE/non-VISTAS; but mostly outside the NMB and NME criteria for CSN/VISTAS and CSN/non-VISTAS. Elemental carbon is mostly inside the NMB and NME criteria for CSN/VISTAS, IMPROVE/VISTAS, and

IMPROVE/non-VISTAS; but mostly outside the NMB and NME criteria for and CSN/non-VISTAS.

Figure 6-6 contains soccer plots of NMB and NME for total $PM_{2.5}$ at CSN and IMPROVE monitors. Most CSN values are within the NMB and NME criteria. For IMPROVE, four months are outside the NMB and NME criteria for the VISTAS states and six months are outside the NMB and NME criteria for the non-VISTAS states.

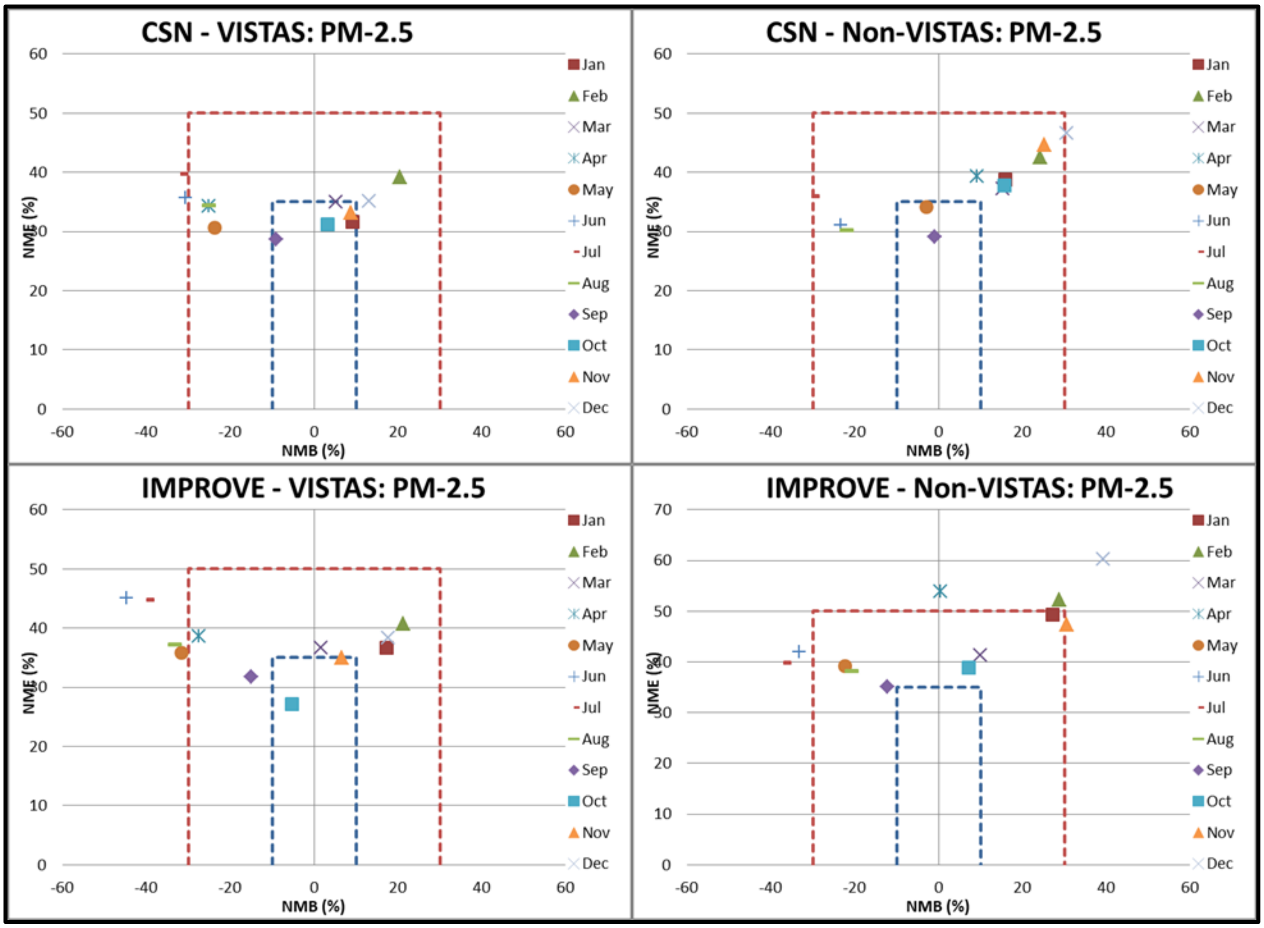


Figure 6-6: Soccer Plots of Total $PM_{2.5}$ by Network and Month for VISTAS and Non-VISTAS Sites

Figure 6-7 contains soccer plots of NMB and NME for sulfate at CASTNET, CSN, and IMPROVE monitors. For CASTNet, seven months are outside the NMB and NME criteria for the VISTAS states and seven months are outside the NMB and NME criteria for the non-VISTAS states. Most CSN values are within the NMB and NME criteria. For IMPROVE, two months are outside the NMB and NME criteria for the VISTAS states and no months are outside the NMB and NME criteria for the non-VISTAS states.

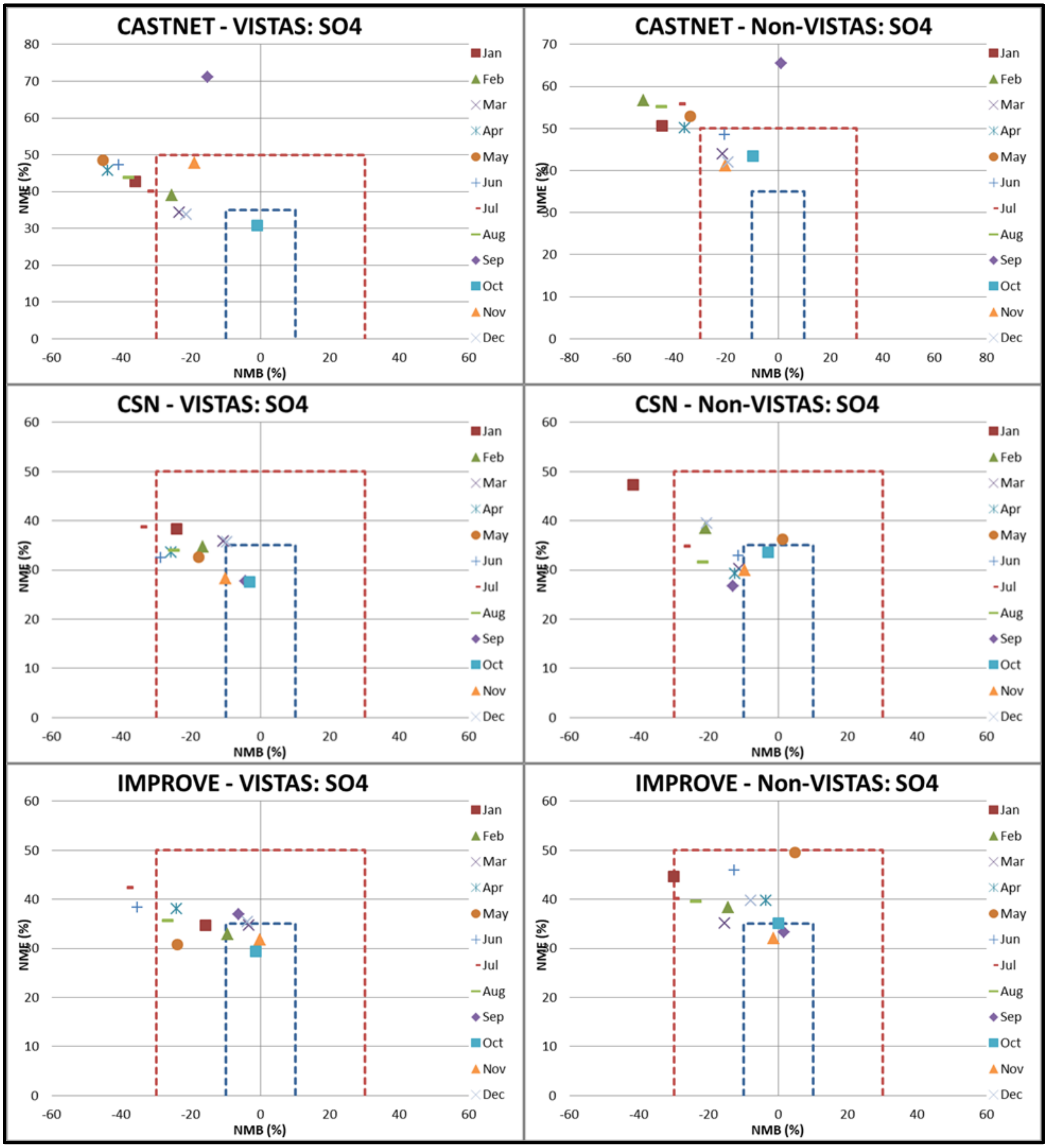


Figure 6-7: Soccer Plots by Network and Month for VISTAS and Non-VISTAS Sites

Figure 6-8 contains soccer plots of NMB and NME for nitrate at CASTNET, CSN, and IMPROVE monitors. Most CASTNet and CSN values are within the NMB and NME criteria. For IMPROVE, two months are outside the NMB and NME criteria for the VISTAS states and one month is outside the NMB and NME criteria for the non-VISTAS states.

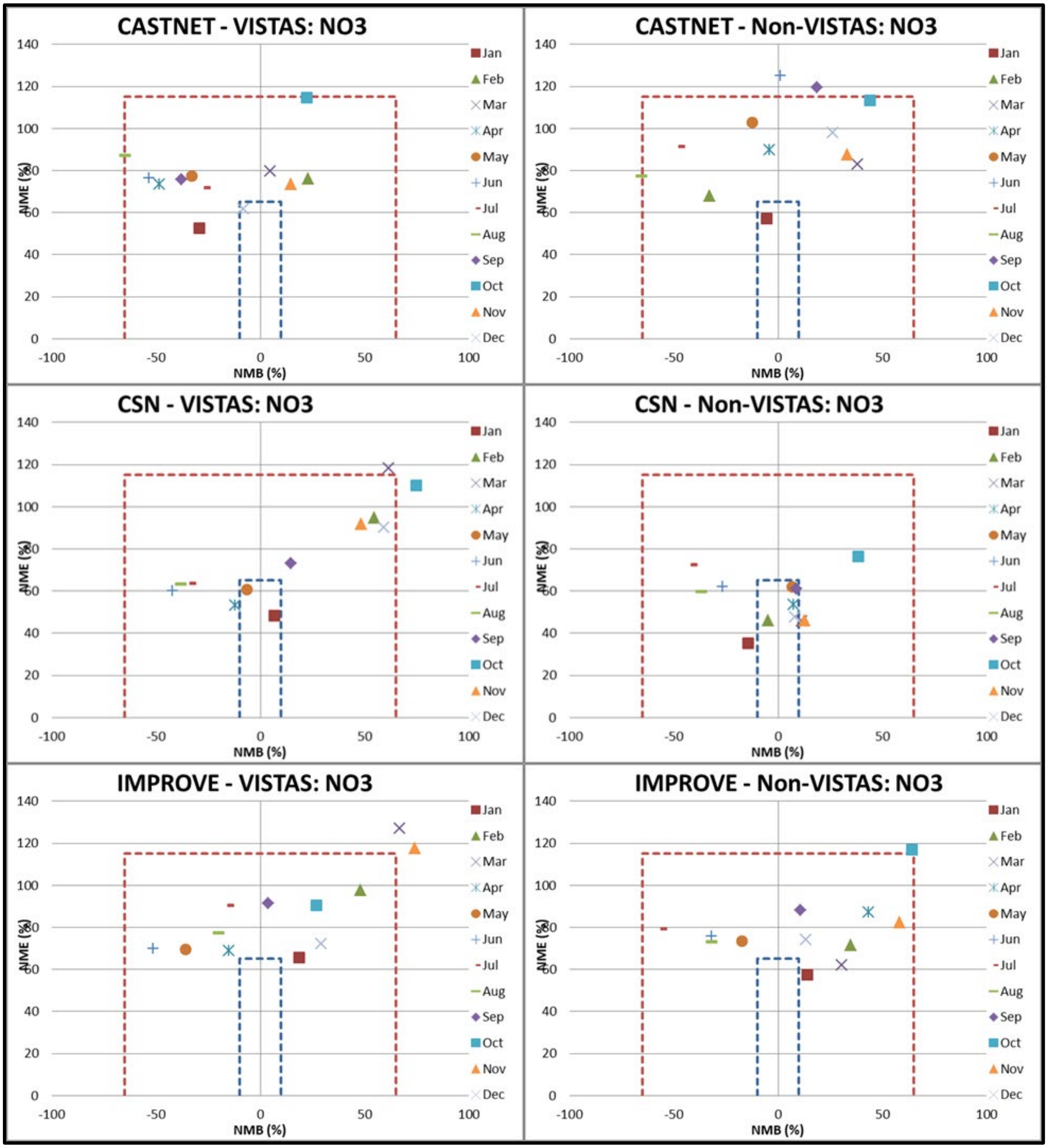


Figure 6-8: Soccer Plots of Nitrate by Network and Month for VISTAS and Non-VISTAS Sites

Figure 6-9 contains soccer plots of NMB and NME for organic carbon at CASTNET, CSN, and IMPROVE monitors. Most CSN values are outside the NMB and NME criteria. For IMPROVE, no months are outside the NMB and NME criteria for the VISTAS states and four months are outside the NMB and NME criteria for the non-VISTAS states.

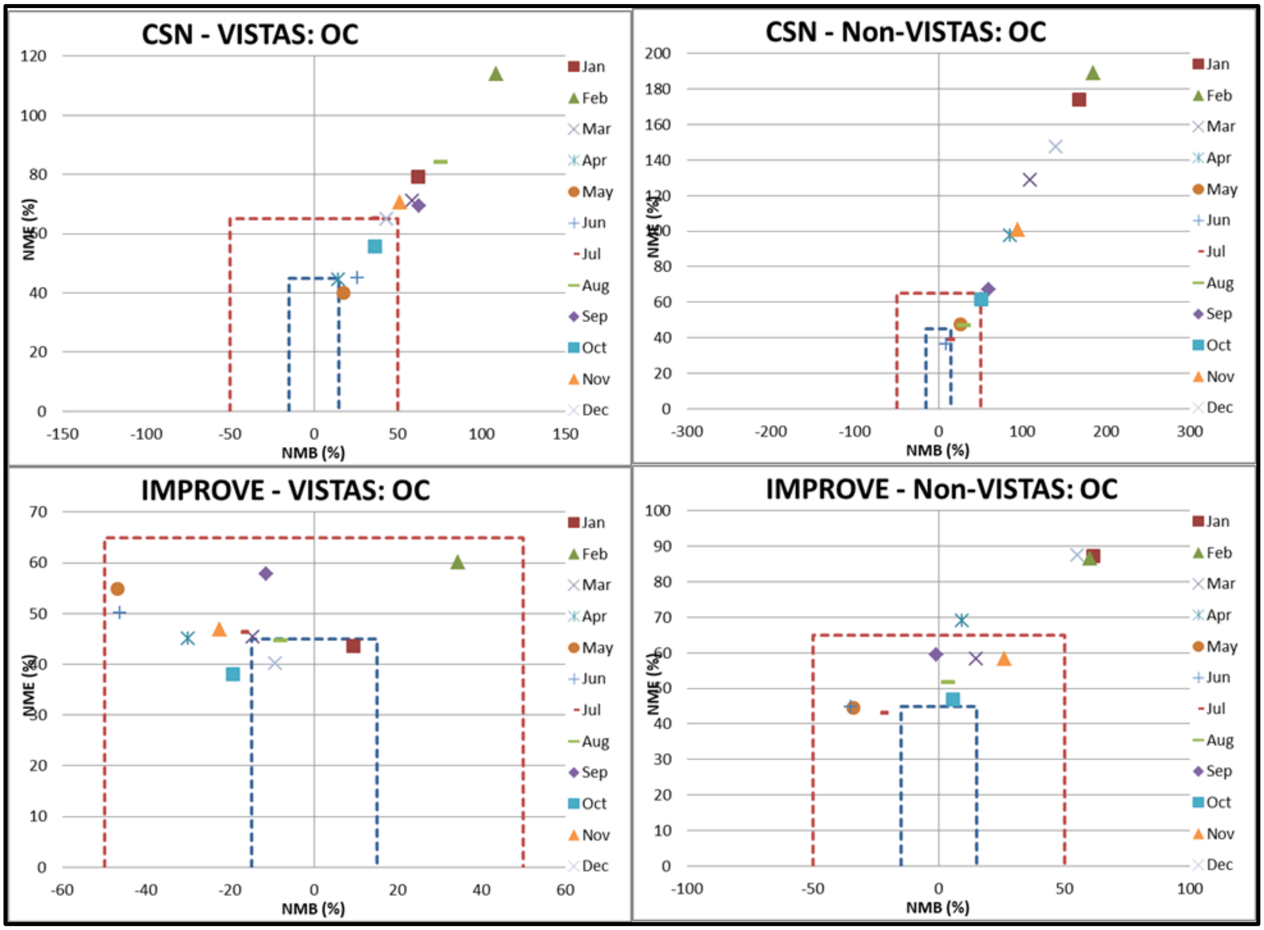


Figure 6-9: Soccer Plots of OC by Network and Month for VISTAS and Non-VISTAS Sites

Figure 6-10 contains soccer plots of NMB and NME for elemental carbon at CASTNET, CSN, and IMPROVE monitors. For CSN, two months are outside the NMB and NME criteria for the VISTAS states and six months are outside the NMB and NME criteria for the non-VISTAS states. For IMPROVE, one month is outside the NMB and NME criteria for the VISTAS states and five months are outside the NMB and NME criteria for the non-VISTAS states.

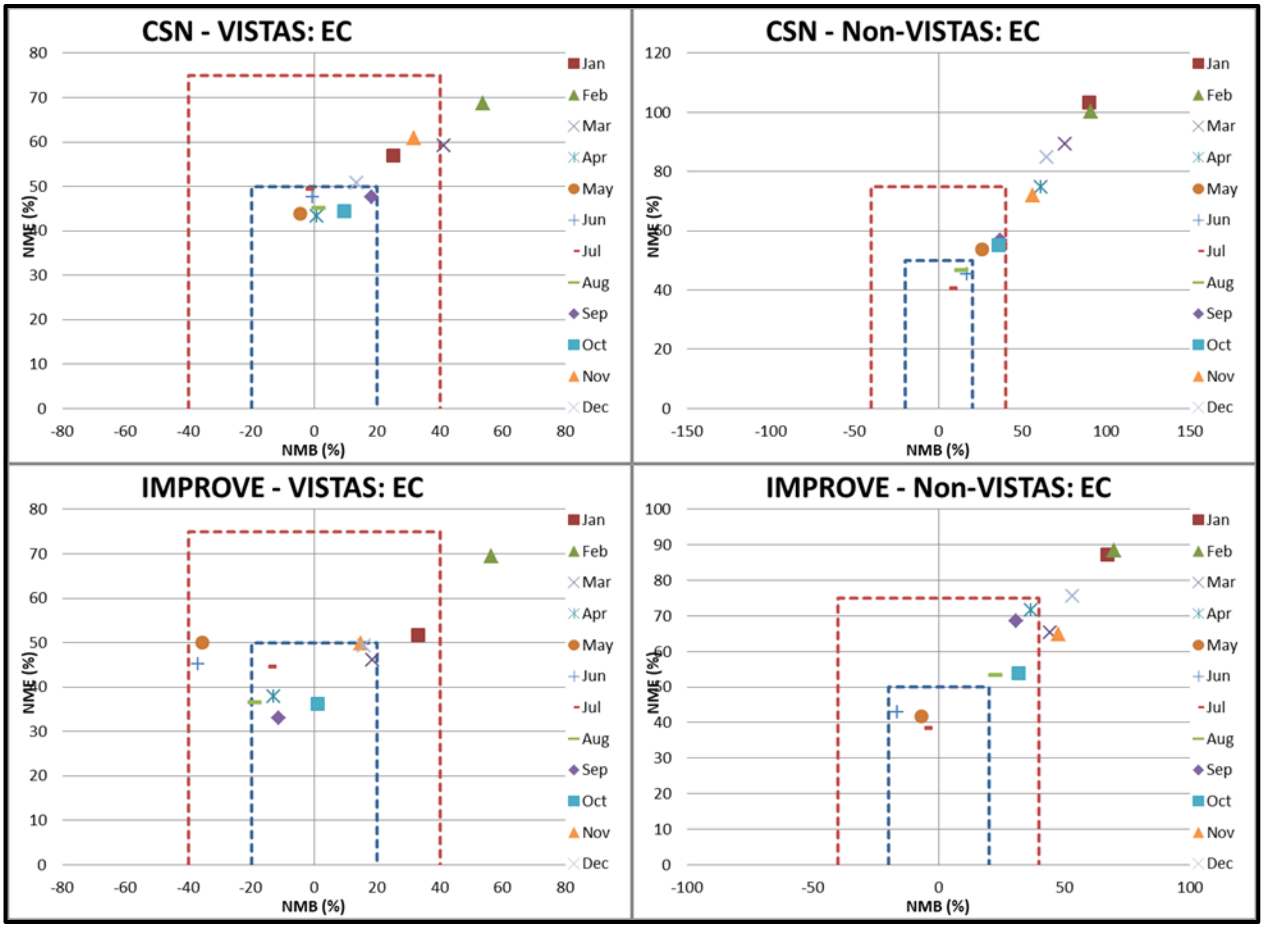


Figure 6-10: Soccer Plots of EC by Network and Month for VISTAS and Non-VISTAS Sites

Spatial plots summarizing IMPROVE observations and model NMB on the 20% most-impaired days are shown in Figure 6-11 through Figure 6-16. In each figure the top graphic presents the observed concentration and the bottom graphic presents the NMB.

For sulfate (Figure 6-11), predictions on the 20% most-impaired days are biased low across all regions, with the most significant percentage under predictions occurring in the southwest quarter of the VISTAS12 modeling domain. Some isolated over predictions are observed in a few Class I areas near the outer domain boundaries and in the northeast.

Predictions of nitrate (Figure 6-12) on the 20% most-impaired days in the VISTAS12 modeling domain are mixed with a high positive bias in the north and a mix of negative and positive bias in the southeast.

A general positive bias of OC (Figure 6-13) is observed across the region on the 20% most-impaired days. In the SESARM states the OC has approximately the same NMB at monitors with high observed concentrations as monitors with lower observed concentrations. For EC

(Figure 6-14) the model shows a slight under prediction at monitors in the northern portion of the SESARM states and a positive bias at monitors in the southern SESARM region.

On the 20% most-impaired days, model performance for total $PM_{2.5}$ (Figure 6-15) is overall biased low across most quadrants of the VISTAS12 modeling domain (corresponding closely to the sulfate performance). A slight over prediction of $PM_{2.5}$ on those days is observed in the Northern Plains and Upper Midwest, primarily along the Canadian border (corresponding closely to high nitrate concentrations and performance).

Sea salt (Figure 6-16) is generally over predicted along boundaries with ocean water bodies (Atlantic Ocean and Gulf of Mexico) and is expectedly under predicted across the rest of the VISTAS12 modeling domain.

Table 6-9 shows model performance statistics for the Class I Areas in VISTAS and closely surrounding VISTAS. The criteria for each statistic is listed in the first row. These criteria are listed in Table 6-6. The values in red text in Table 6-9 indicate that the criteria was not met. As stated previously, the model performance statistics should be looked for all of the VISTAS Class I Areas collectively. As such, the averages of the statistics were calculated. The second to last row of Table 6-9 shows the average of all the Class I Areas in the table and the last row shows the average of all the VISTAS Class I Areas. Of the five statistics listed in the table, only one (NMB) average did not meet the criteria and it was only slightly above the criteria. The other four statistics meet the criteria.

The EPA guidance states that it is not appropriate to assign "bright line" criteria that distinguish between adequate and inadequate model performance with a single model performance test.[36] The EPA guidance recommends that a "weight of evidence" approach be used to determine whether a particular modeling application is acceptable for use in regulatory demonstrations. The EPA recommends that air agencies conduct a variety of performance tests and weigh them qualitatively to assess model performance.

For the most part, modeled and observed PM2.5 concentrations and light extinctions at each Class I area match reasonably well on both 20% most-impaired days and clearest days. Although model performance for sulfate at each Class I area is biased low on the 20% most-impaired days, the model performance statistics for sulfate are reasonable for regulatory modeling. Additionally, the future year sulfate concentrations are not based on the absolute modeled values, but instead the model is applied in a relative sense through calculation of relative response factors (RRFs). The RRF is the relative change in sulfates between the base year modeled value and future year modeled value. The future year sulfate concentrations are then estimated by multiplying the base

[36] EPA Modeling Guidance for Demonstrating Air Quality Goals for Ozone, PM2.5 and Regional Haze, November 2018

year actual monitored value by the RRF. Factors causing bias in the base case will also affect the future case; therefore, using the modeling in a relative sense resolves any problems posed by the underprediction of sulfates, and will not lead to an under-estimation of source contributions.

Overall, based on the weight of evidence approach recommended by EPA's guidance document, GA EPD found model performance to fall within acceptable limits. In conclusion, performance assessed at the "one atmosphere" level was deemed acceptable for ozone, wet/dry deposition, and particulate matter at various monitoring sites. GA EPD further asserts the one atmosphere modeling performed by the VISTAS contractors is representative of conditions in the southeastern states and is acceptable for use in regulatory modeling applications for ozone, particulate matter, and regional haze.

Table 6-9: Sulfate Model Performance Criteria for 20% Most Impaired Days in 2011

Class I Area	# Obs.	NMB (<±30%)	MFB (<±60%)	NME (<50%)	MFE (<75%)	r (>0.4)
Breton	22	-41.83	-60.47	47.93	65.77	0.27
Brigantine	23	-32.93	-39.18	32.93	39.18	0.79
Caney Creek	11	-46.01	-70.2	52.63	75.57	0.49
Cape Romain	24	-28.85	-36.98	36.03	44.17	0.62
Chassahowitzka	24	-39.37	-48.96	44.06	54.49	-0.06
Cohutta	18	-28.18	-32.67	33.06	38.07	0.14
Dolly Sods	24	-27.18	-30.24	34.55	37.86	0.63
Everglades	14	-12.14	-19.56	38.62	43.1	0.2
Great Smoky Mountains	23	-36.92	-46.25	41.47	51.74	0.22
Hercules - Glade	20	-31.75	-41.93	37.76	47.55	0.7
James River Face	24	-36.62	-44.57	36.89	44.88	0.52
Linville Gorge	23	-16.32	-19.66	30.87	35.2	0.49
Mammoth Cave	23	-38.26	-48.89	38.27	48.91	0.8
Mingo	19	-31.4	-38.96	31.88	39.67	0.64
Okefenokee	22	-41.42	-58.55	43.98	61.54	0.52
Saint Marks	22	-40.16	-56.91	48.3	65.37	0.37
Shenandoah	24	-24.34	-30.57	29.31	35.53	0.74
Shining Rock[37]	0	--	--	--	--	--
Sipsey	19	-35.37	-43.37	35.37	43.37	0.75
Swanquarter	22	-25.28	-32.13	31.56	37.56	0.6
Upper Buffalo	23	-17	-27.18	30.66	37.22	0.71
AVERAGE - ALL	**424**	**-31.82**	**-40.97**	**37.27**	**46.7**	**0.62**
AVERAGE - VISTAS	**306**	**-31.33**	**-39.76**	**36.93**	**45.95**	**0.63**

[37] Shining Rock did not have valid monitoring data for 2011

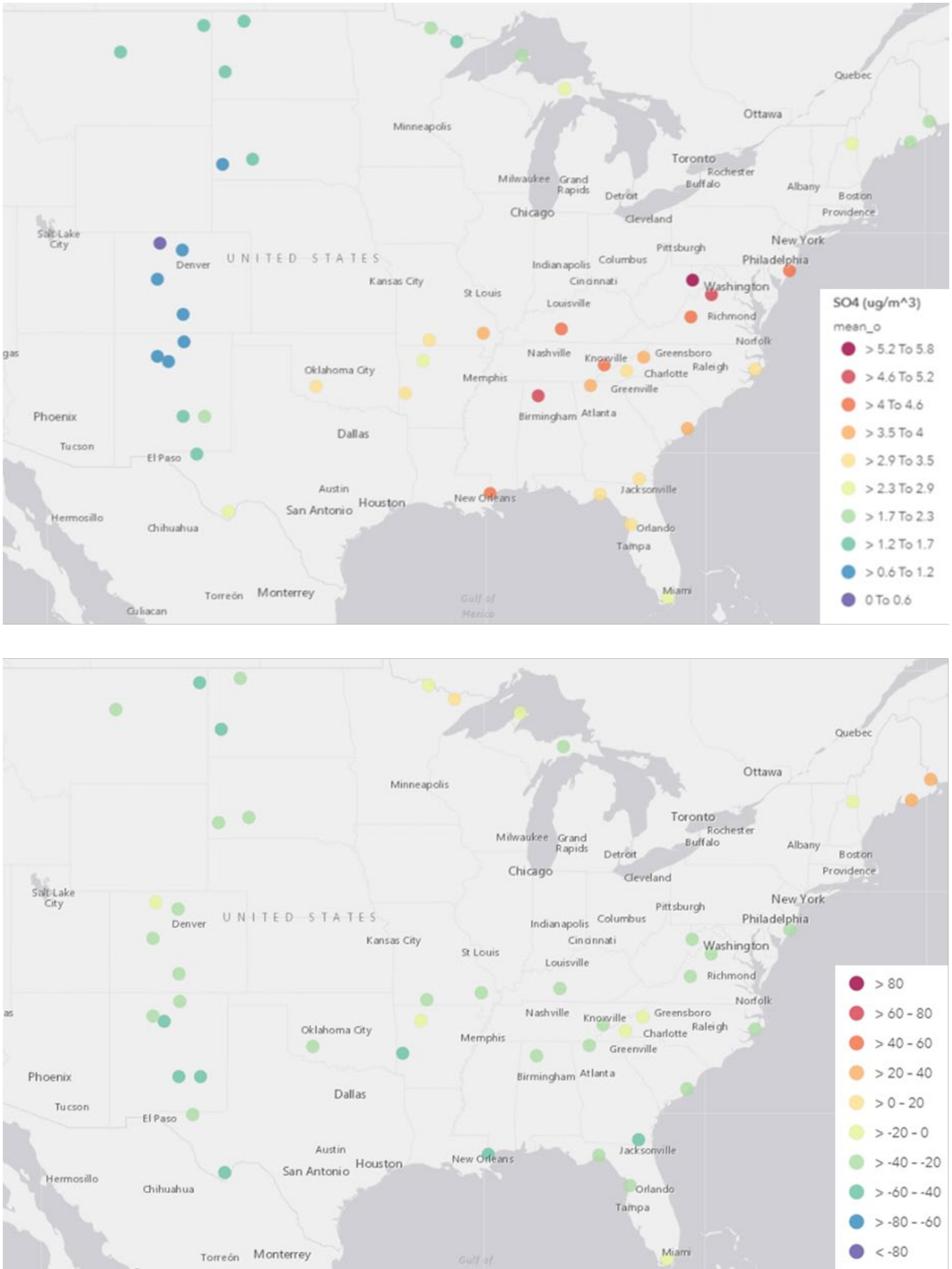
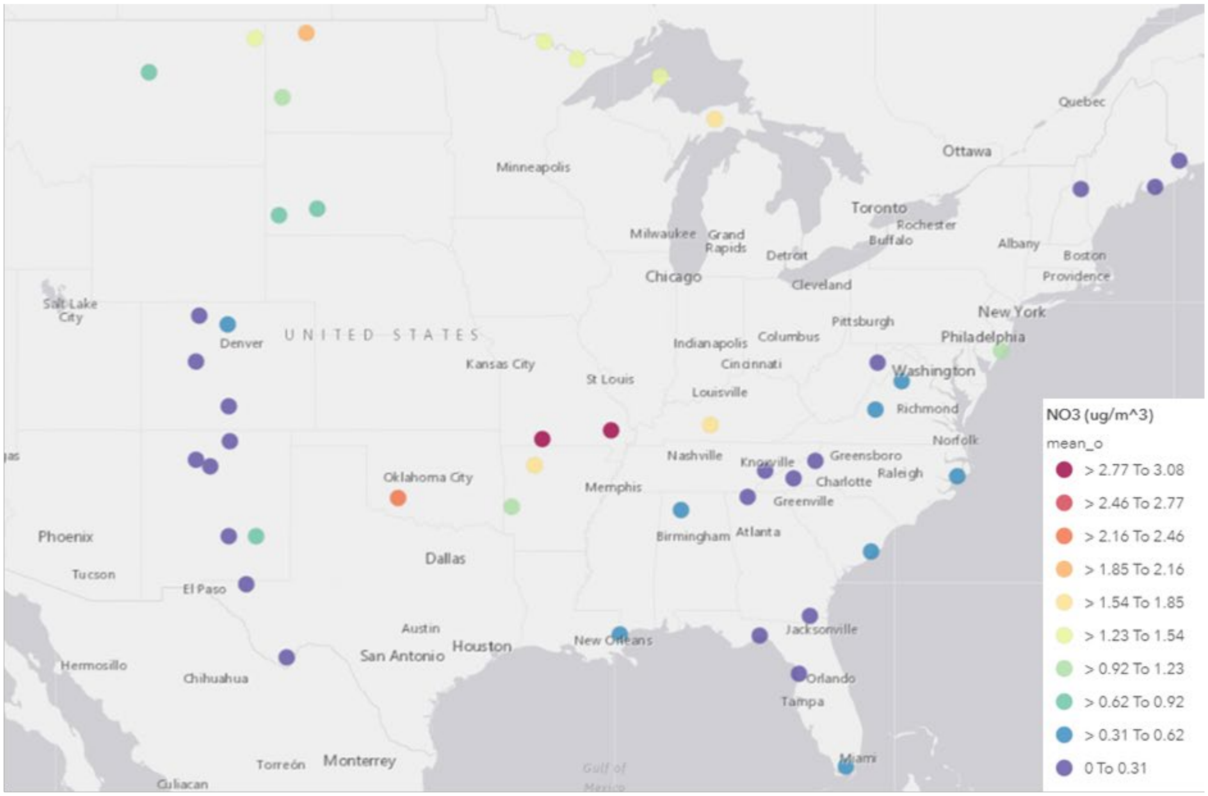


Figure 6-11: Observed Sulfate (Top) and Modeled NMB (Bottom) for Sulfate on the 20% Most-Impaired Days at IMPROVE Monitor Locations



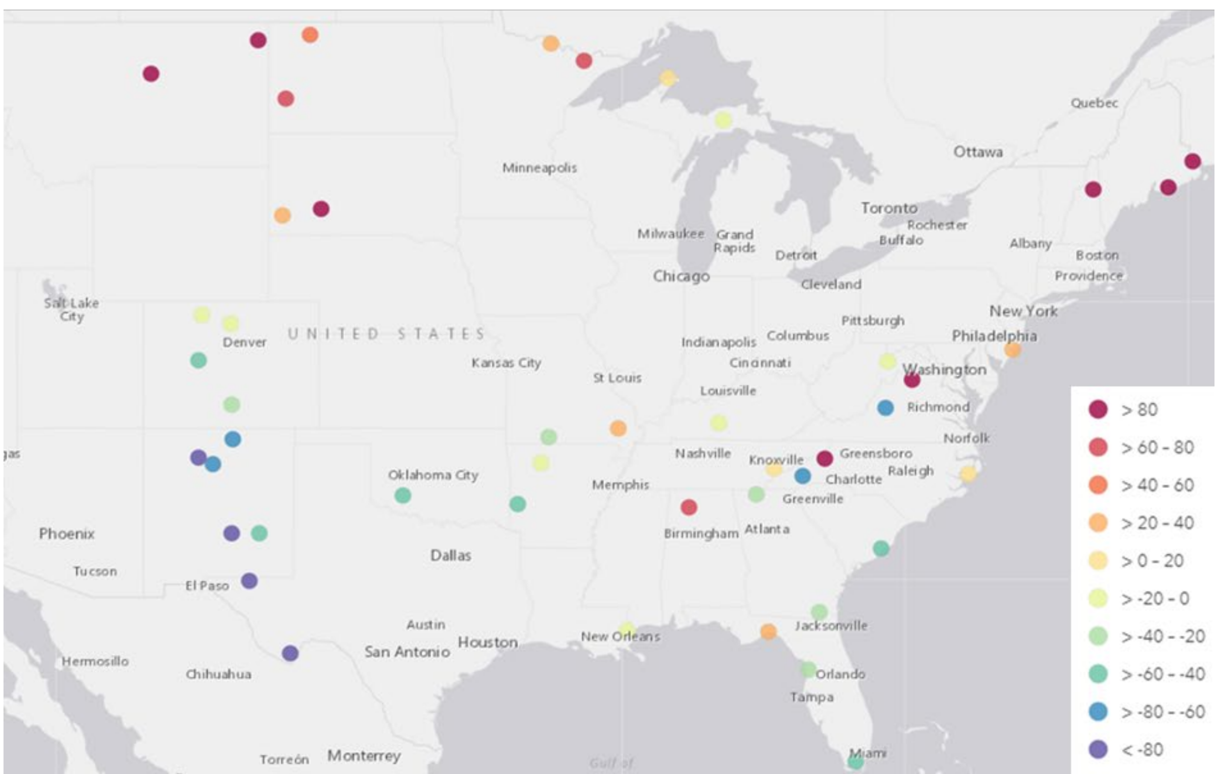
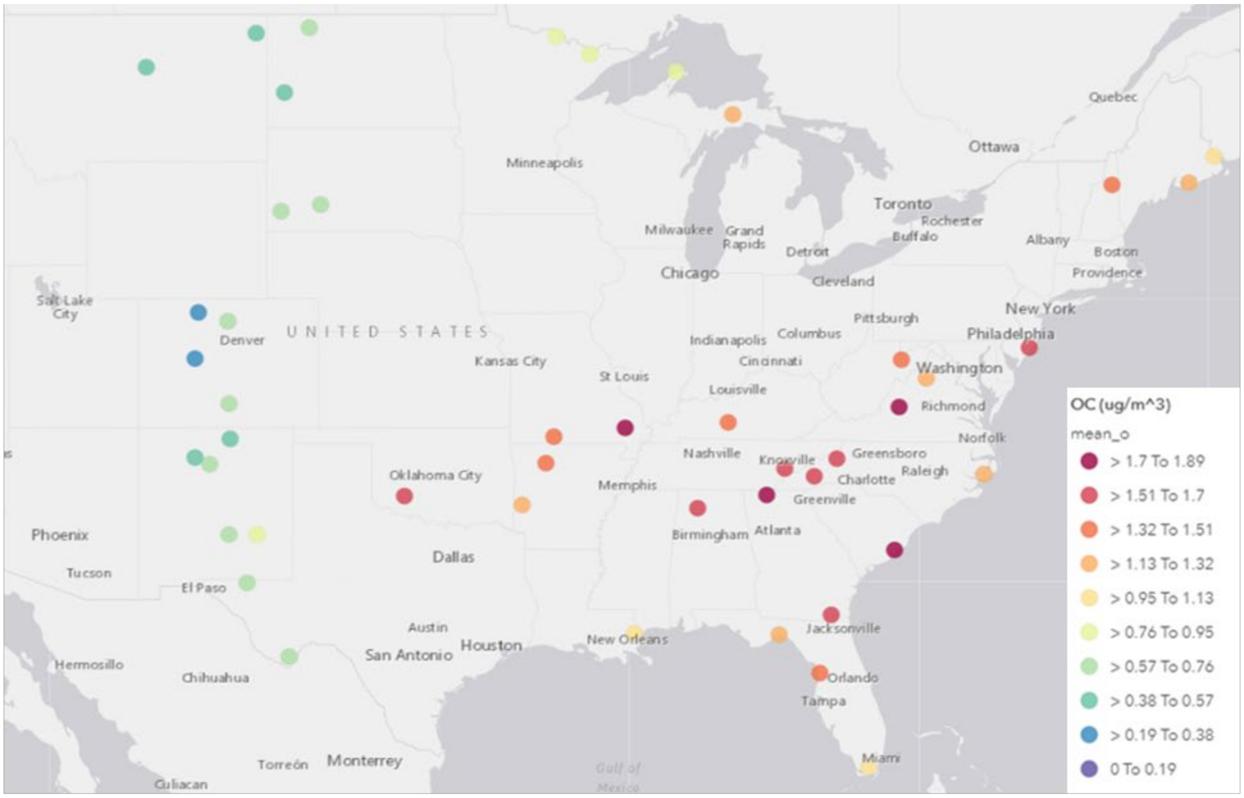


Figure 6-12: Observed Nitrate (Top) and Modeled NMB (Bottom) for Nitrate on the 20% Most Impaired Days at Improve Monitor Locations



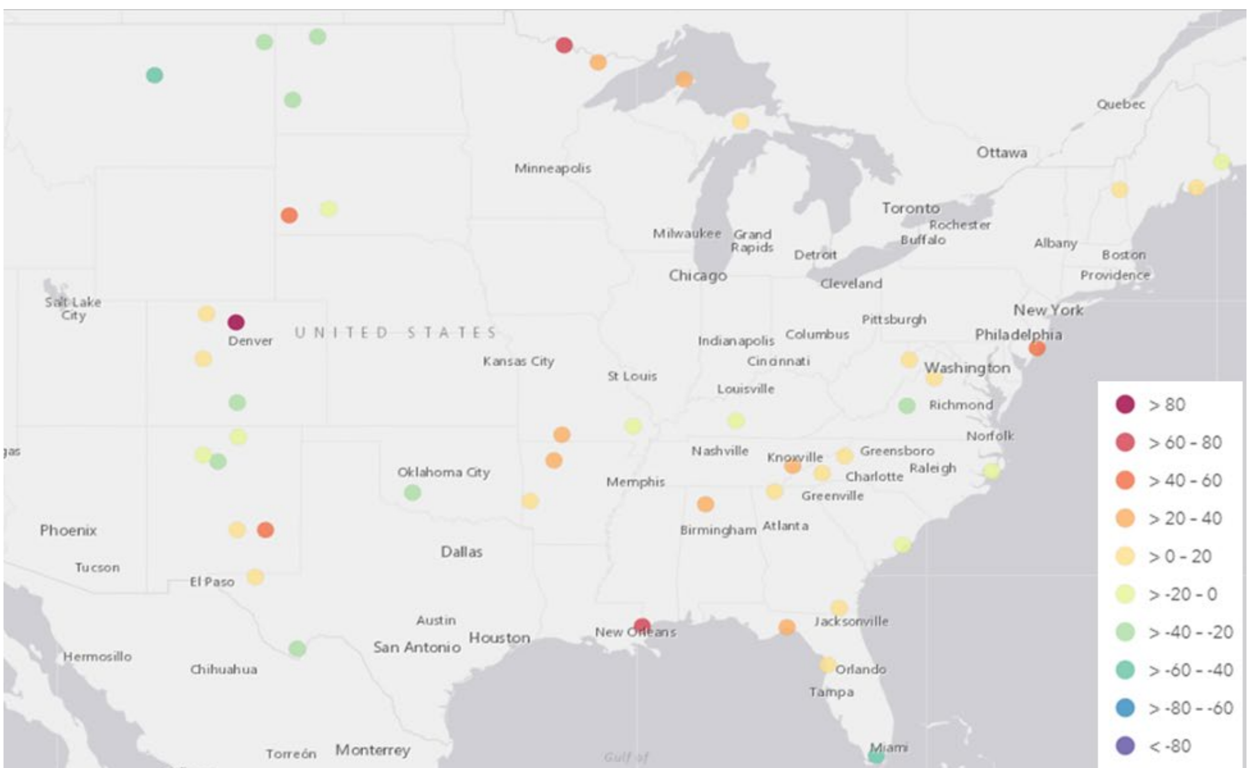


Figure 6-13: Observed OC (Top) and Modeled NMB (Bottom) for OC on the 20% Most-Impaired Days at IMPROVE Monitor Locations

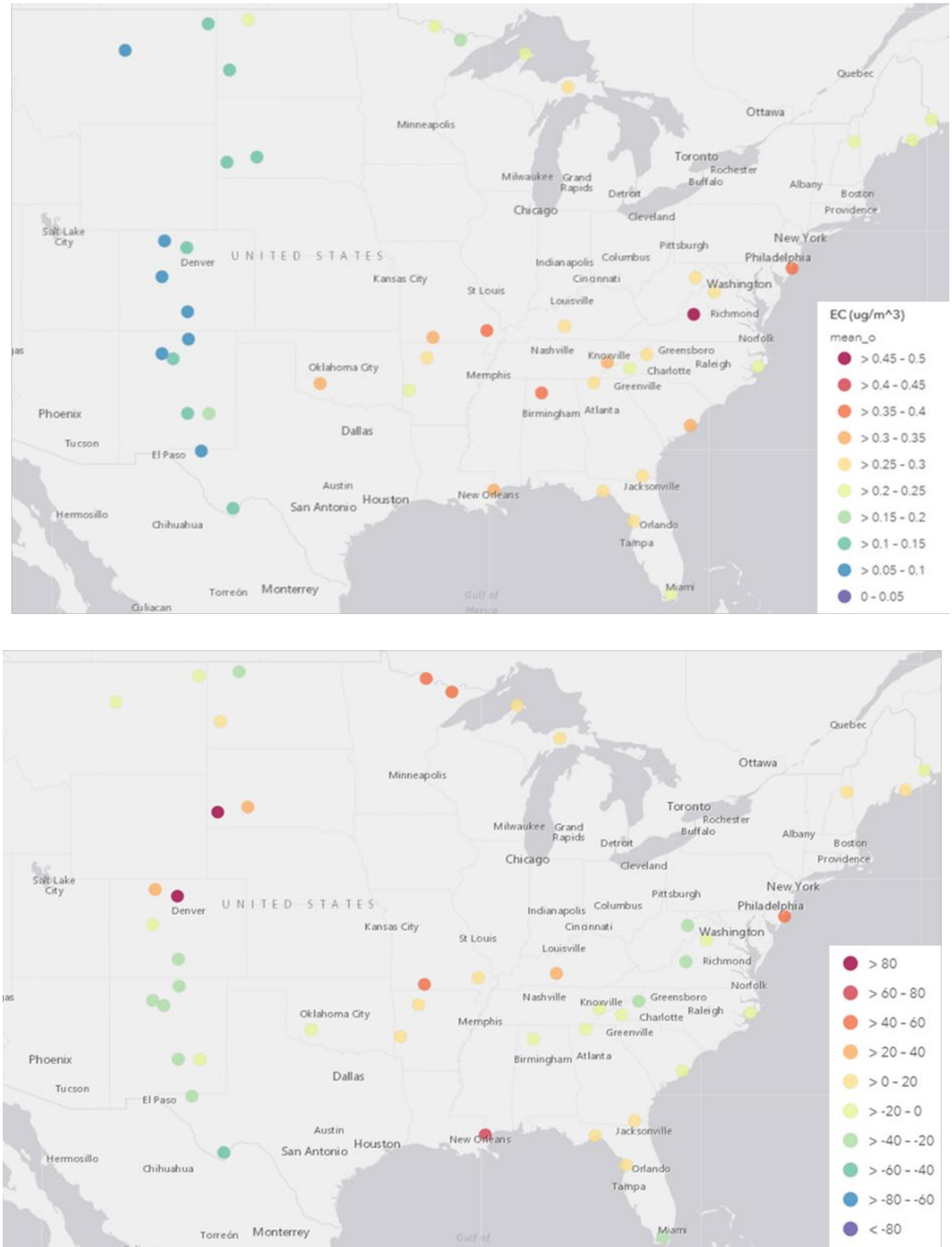


Figure 6-14: Observed EC (Top) and Modeled NMB (Bottom) for EC on the 20% Most-Impaired Days at IMPROVE Monitor Locations

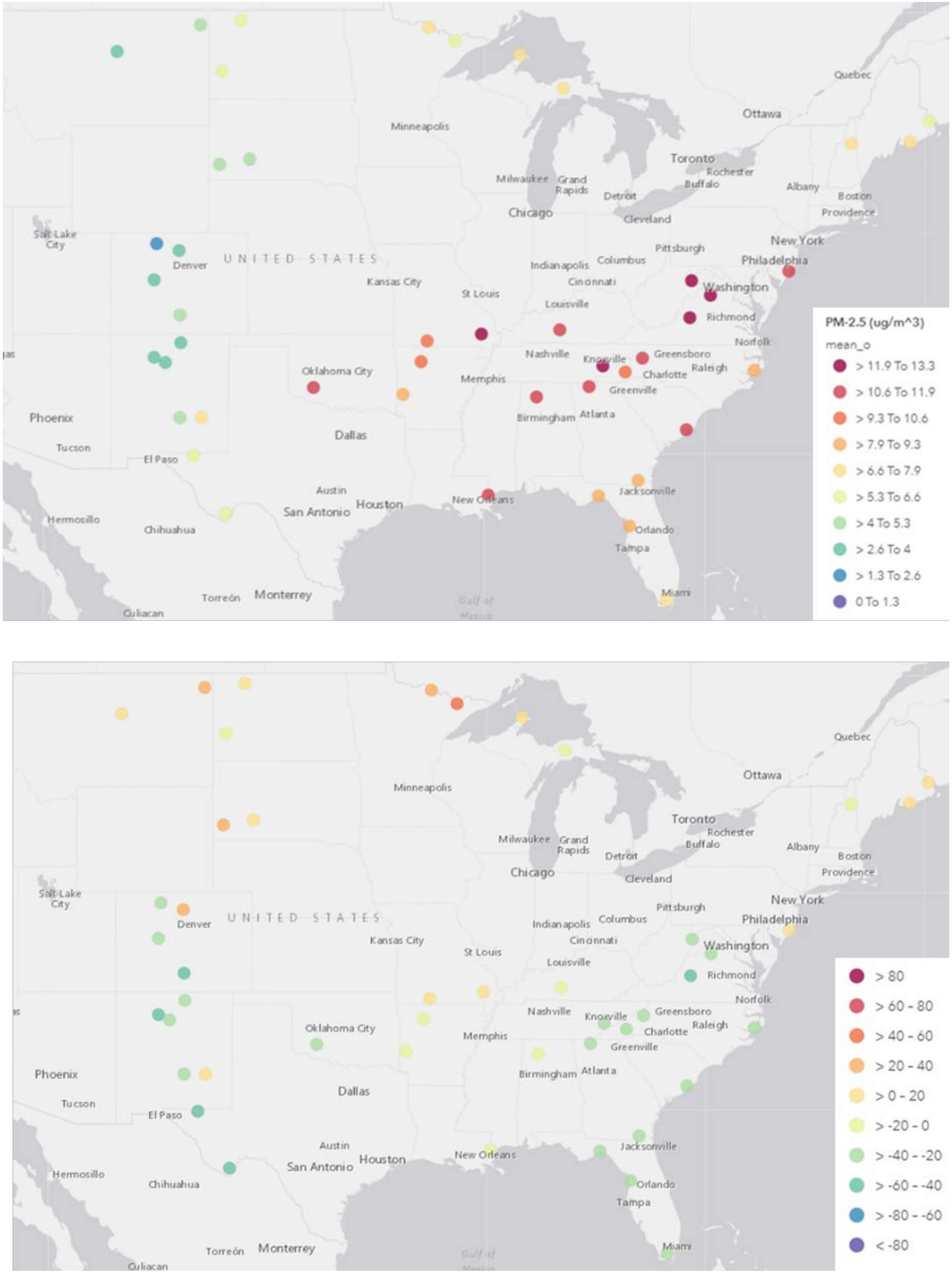
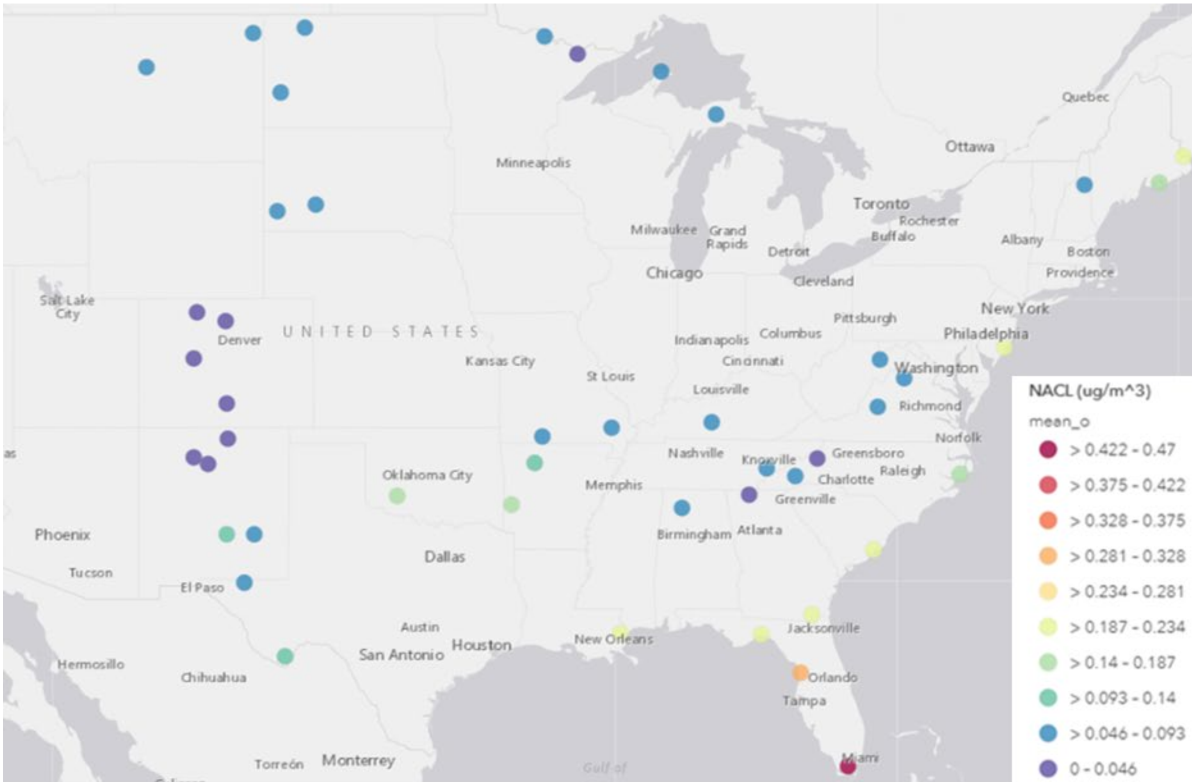


Figure 6-15: Observed Total $PM_{2.5}$ (Top) and Modeled NMB (Bottom) for Total $PM_{2.5}$ on the 20% Most-Impaired Days at IMPROVE Monitor Locations



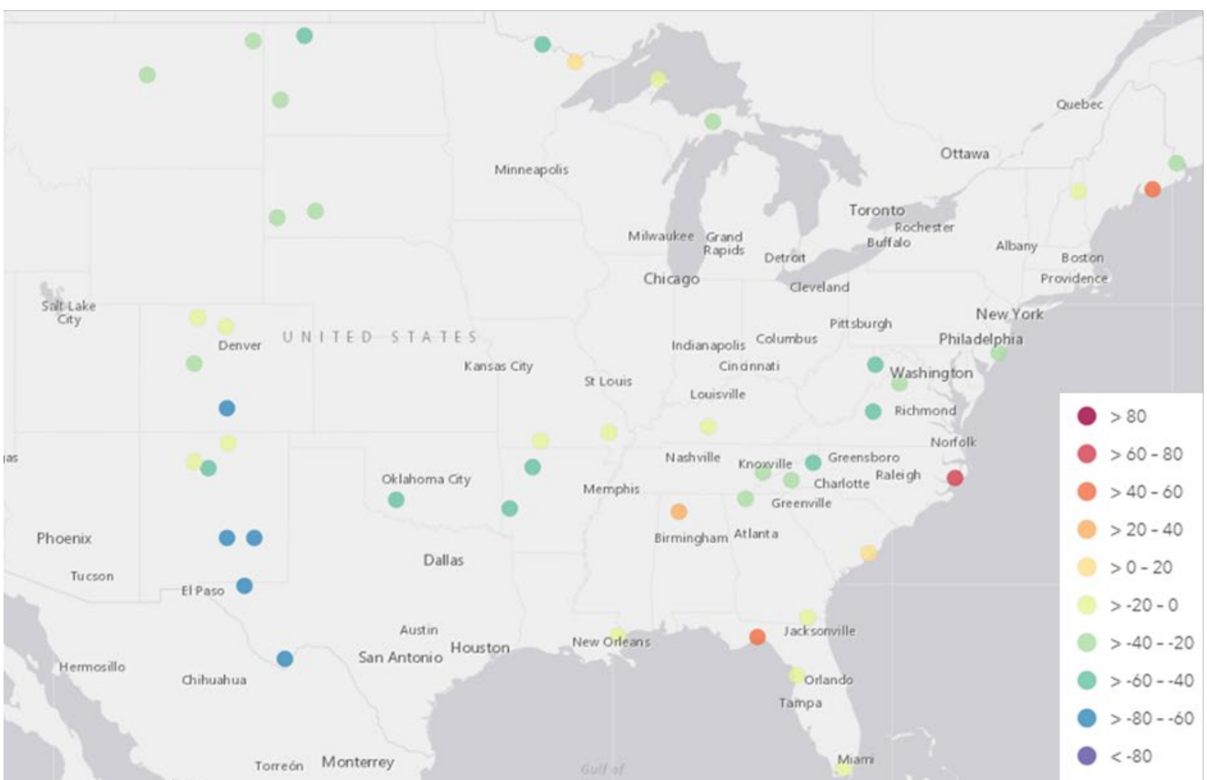


Figure 6-16: Observed Sea Salt (Top) and Modeled NMB (Bottom) for Sea Salt on the 20% Most-Impaired Days at IMPROVE Monitor Locations

6.5. PM Model Performance Evaluation for Class I Areas in Georgia

The following section provides a detailed model performance evaluation for Cohutta Wilderness Area and Okefenokee National Wilderness Area. This evaluation includes average stacked bar charts, day-by-day stacked bar charts, scatter plots, soccer plots, and bugle plots for the 20% most-impaired days and 20% clearest days.

Figure 6-17 through Figure 6-20 contain the average stacked bar charts for Cohutta Wilderness Area and Okefenokee National Wilderness Area. These figures include (1) observed and modeled mass concentrations of particulate matter constituents and (2) observed and modeled light extinctions constituents on the 20% most-impaired days and the 20% clearest days. The color codes for the stacked bars are:

- Yellow = mass concentrations of or light extinction due to sulfates
- Red = mass concentrations of or light extinction due to nitrates
- Green = mass concentrations of or light extinction due to organic carbon
- Black = mass concentrations of or light extinction due to elemental carbon
- Brown = mass concentrations of or light extinction due to soil
- Blue = mass concentrations of or light extinction due to sea salt
- Gray = mass concentrations of or light extinction due to coarse mass

Overall, modeled and observed $PM_{2.5}$ concentrations and light extinctions at Cohutta and Okefenokee match reasonably well on both 20% most-impaired days and clearest days. Model performance for sulfate at Cohutta and Okefenokee is biased low on 20% most-impaired days.

Figure 6-21 through Figure 6-24 and Figure 6-25 through Figure 6-28 contain the day-by-day stacked bar charts for Cohutta Wilderness Area and Okefenokee National Wilderness Area, respectively. These charts allow a side-by-side comparison of observed and modeled speciated PM concentrations and speciated light extinctions on each 20% most-impaired and 20% clearest days. The speciated components are presented in the same order for both the observations (left bar) and modeled data (right bar) to help identify specific days when the predicted mass concentrations or light extinction for the components differ from the observed values. The total height of the bar provides the total particulate matter mass concentrations or the total reconstructed light extinction values. It should be noted that values used for these stacked bar charts are from the grid cell where each IMPROVE monitor is located.

According to Figure 6-17 through Figure 6-28, sulfates and organic carbon are the largest contributors to light extinction in the Georgia Class I areas on both the 20% most-impaired days and the 20% clearest days. The stacked bar charts also suggest that nitrates can be important on the 20% clearest days. Model performance discussion for individual species were further examined with scatter plots.

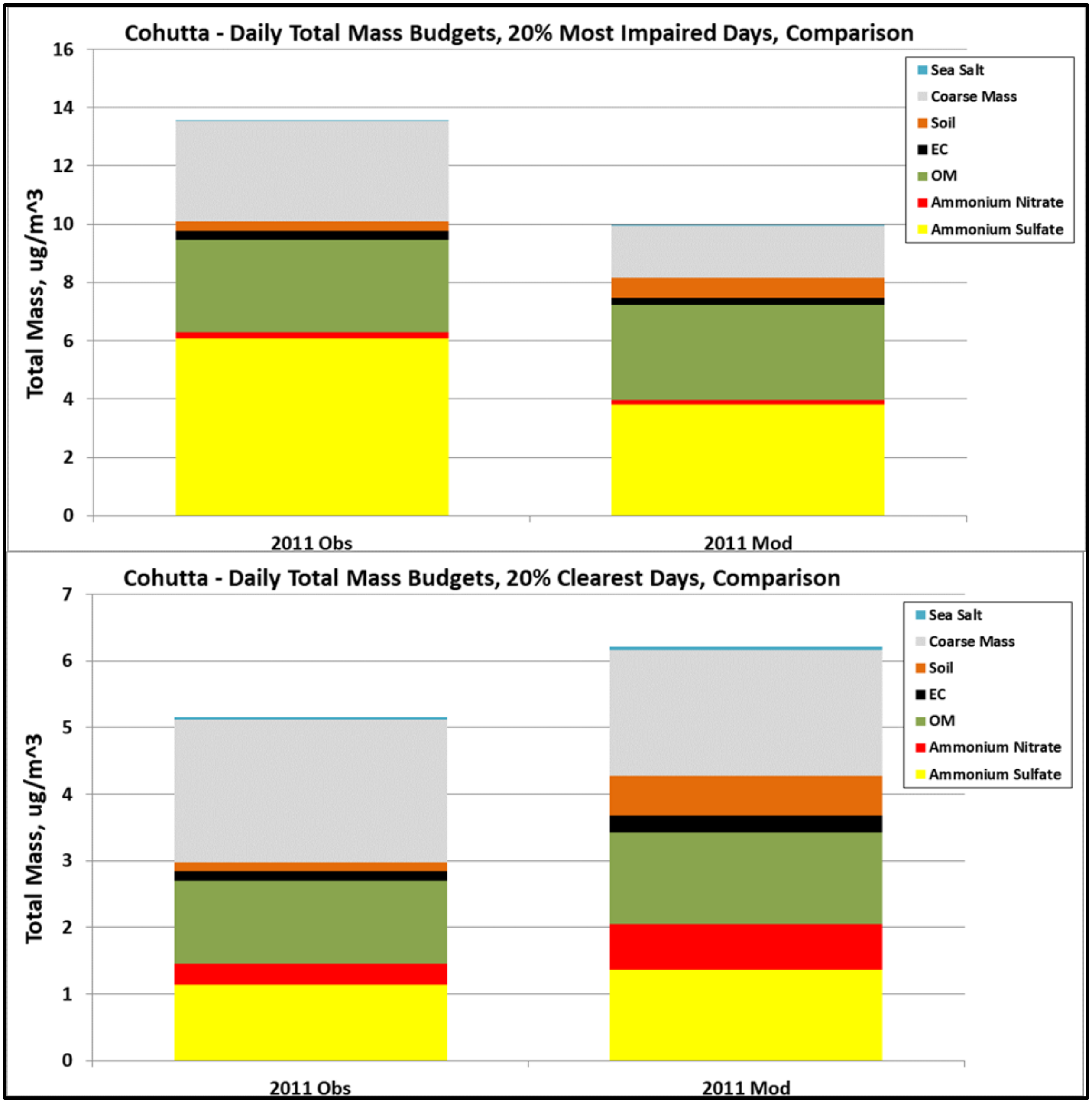


Figure 6-17: Stacked Bar Charts for Average $PM_{2.5}$ Concentrations on the 20% Most Impaired Days (top) and 20% Clearest Days (bottom) at Cohutta Wilderness Area

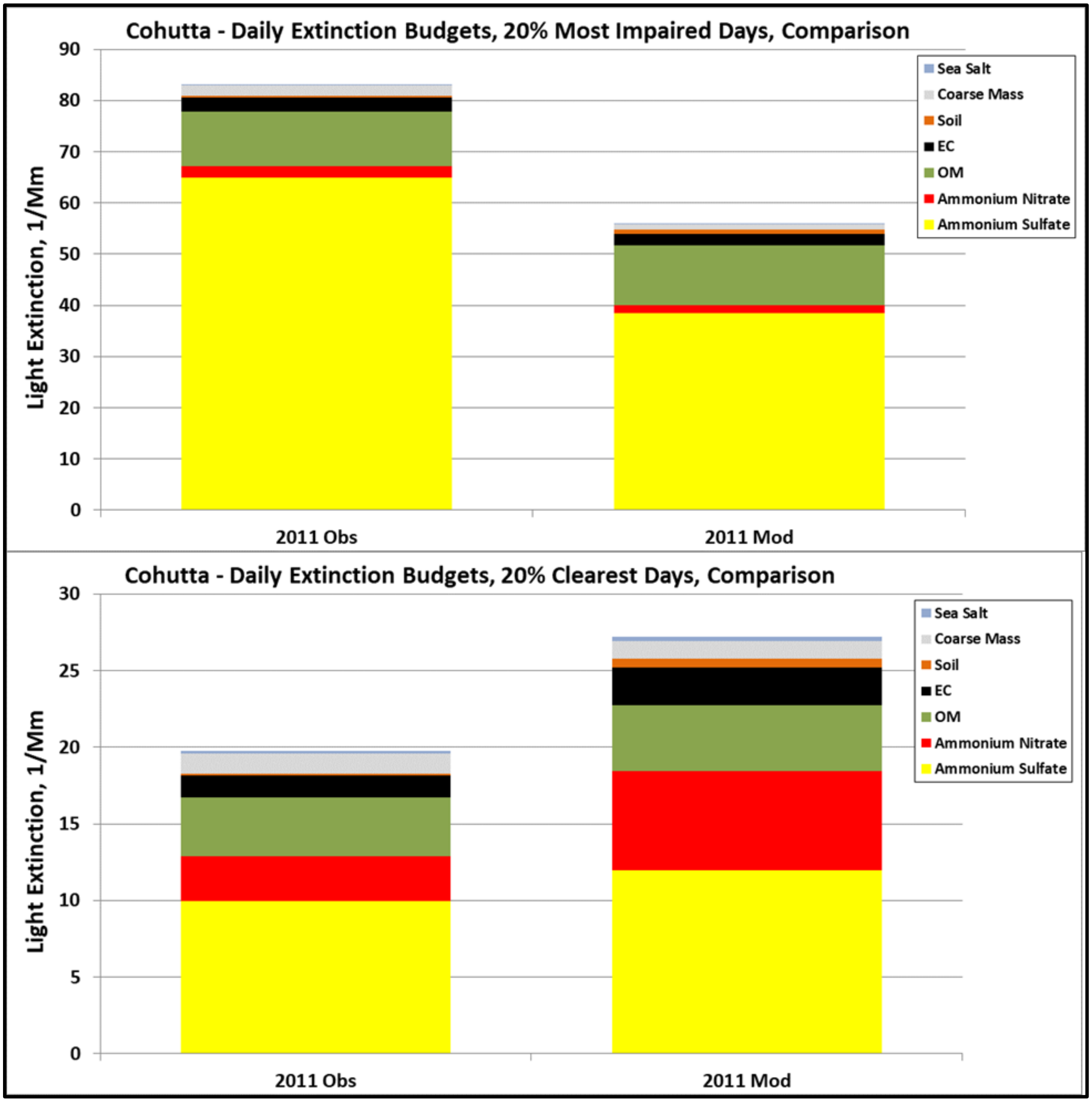


Figure 6-18: Stacked Bar Charts for Average Light Extinction on the 20% Most Impaired Days (top) and 20% Clearest Days (bottom) at Cohutta Wilderness Area

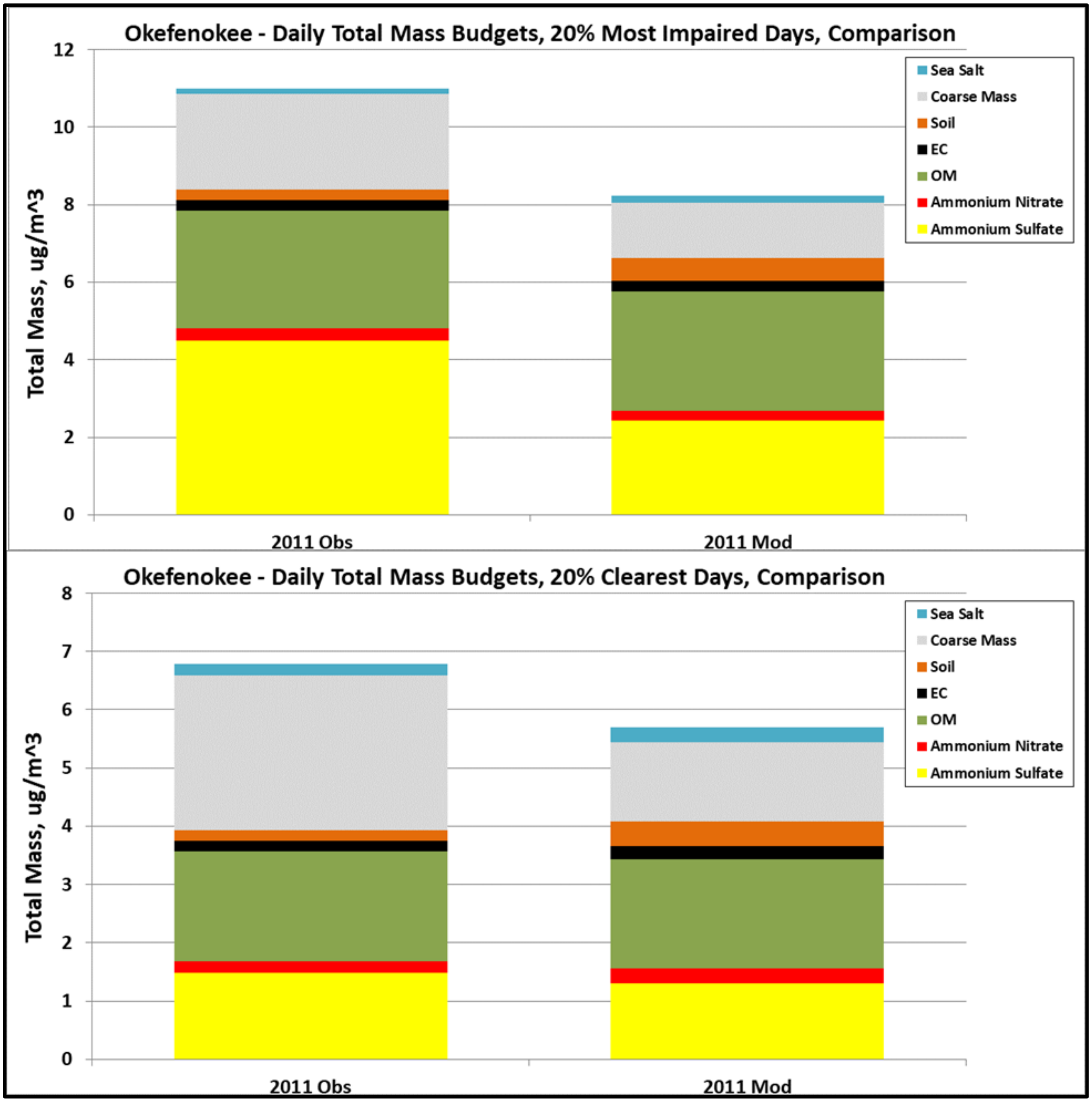


Figure 6-19: Stacked Bar Charts for Average $PM_{2.5}$ Concentrations on the 20% Most Impaired Days (top) and 20% Clearest Days (bottom) at Okefenokee National Wilderness Area

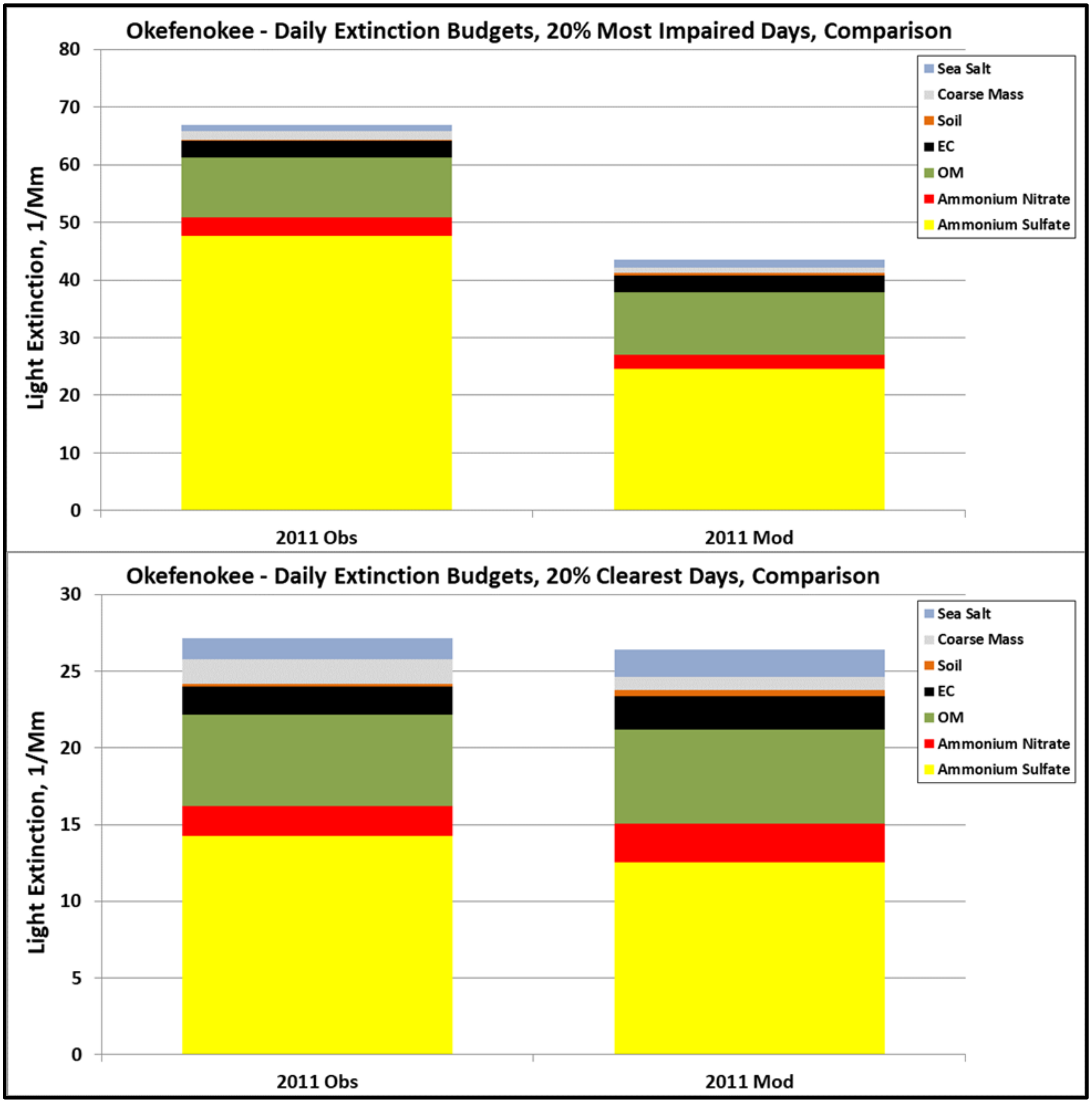


Figure 6-20: Stacked Bar Charts for Average Light Extinction on the 20% Most Impaired Days (top) and 20% Clearest Days (bottom) at Okefenokee National Wilderness Area

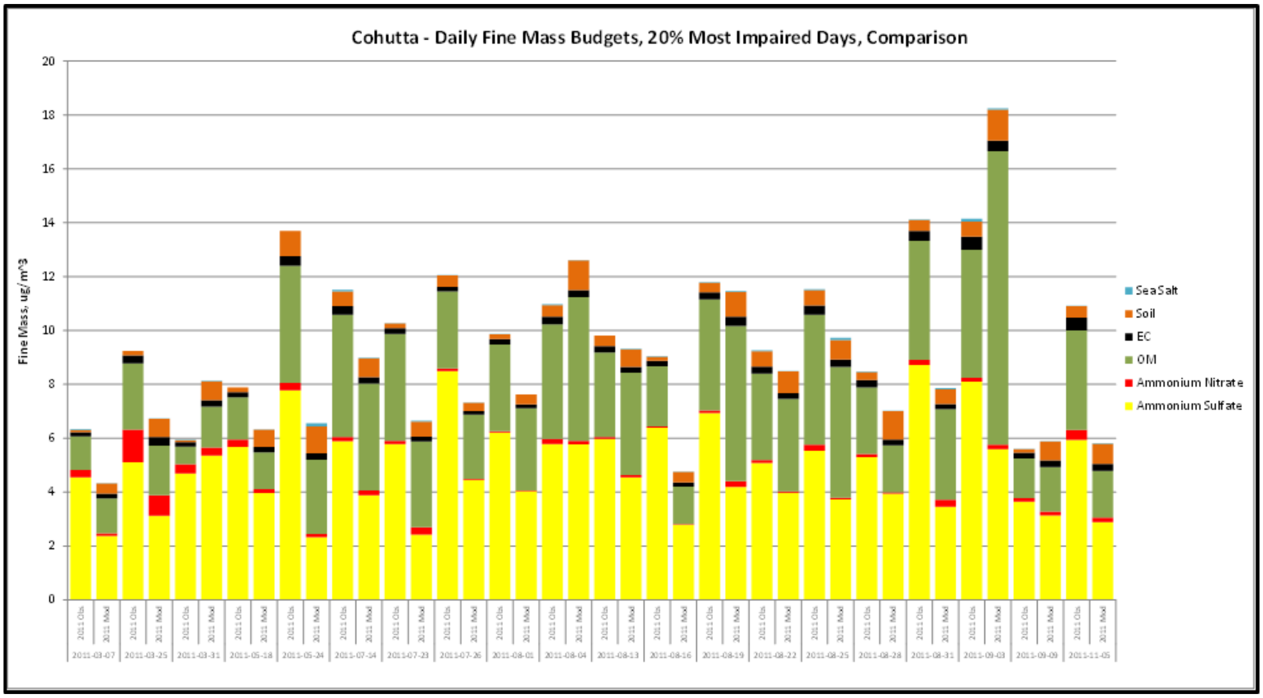


Figure 6-21: Stacked Bar Charts for Daily $PM_{2.5}$ Concentrations at Cohutta Wilderness Area on the 20% Most Impaired Days: Observation (left) and Modeled (Right)

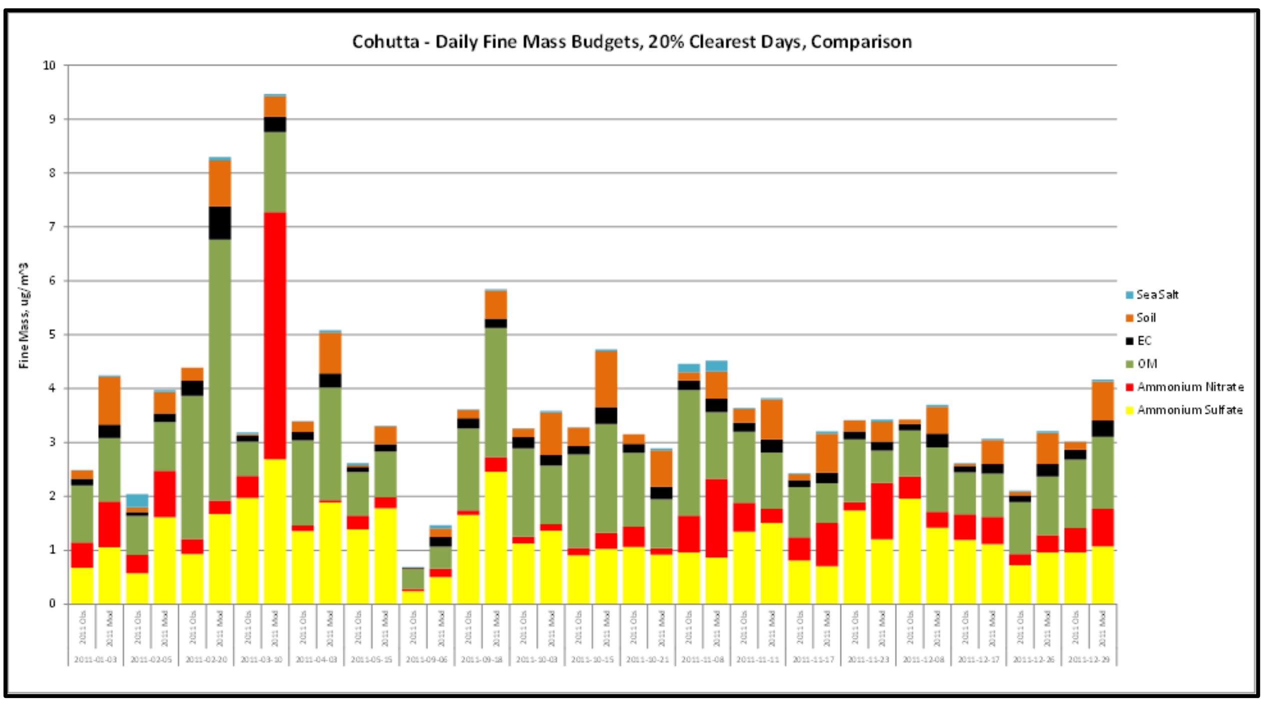


Figure 6-22: Stacked Bar Charts for Daily $PM_{2.5}$ Concentrations at Cohutta Wilderness Area on the 20% Clearest Days: Observation (left) and Modeled (Right)

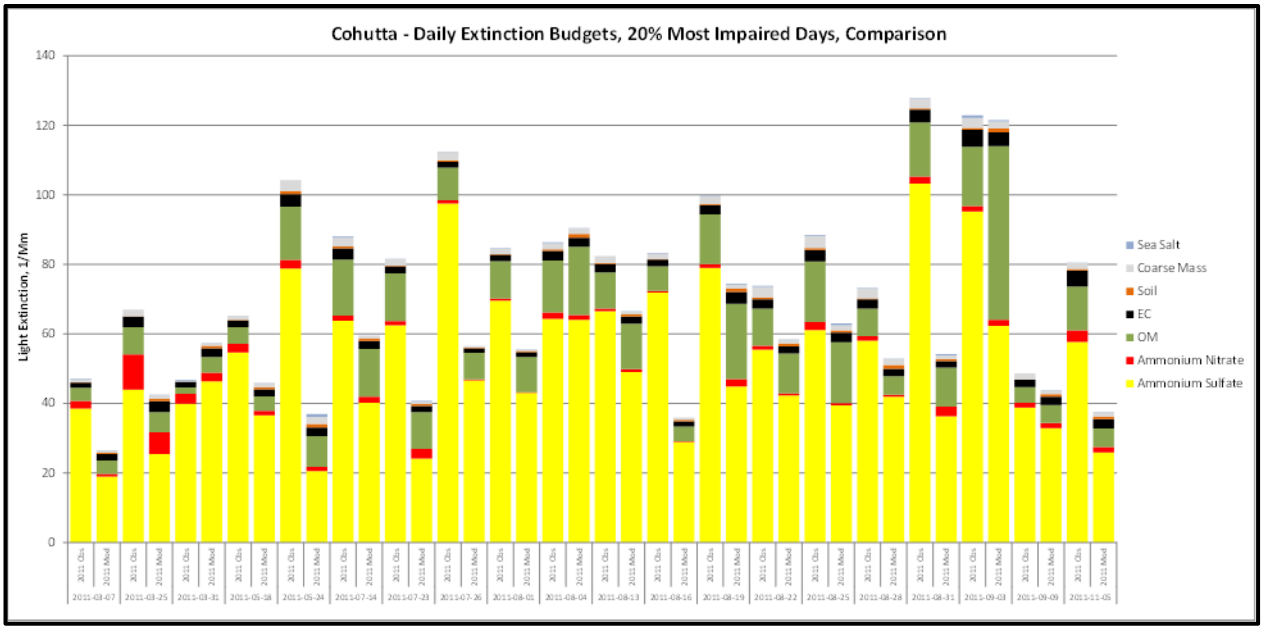


Figure 6-23: Stacked Bar Charts for Light Extinction at Cohutta Wilderness Area on the 20% Most-Impaired Days: Observation (left) and Modeled (Right)

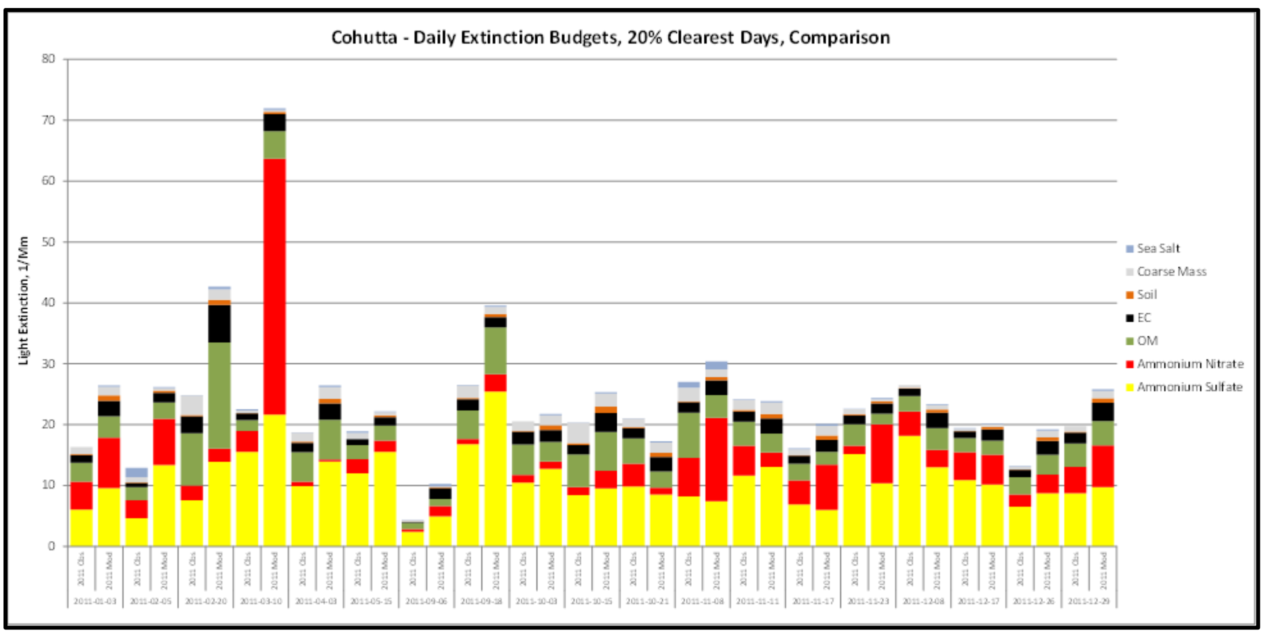


Figure 6-24: Stacked Bar Charts for Light Extinction at Cohutta Wilderness Area on the 20% Clearest Days: Observation (left) and Modeled (Right)

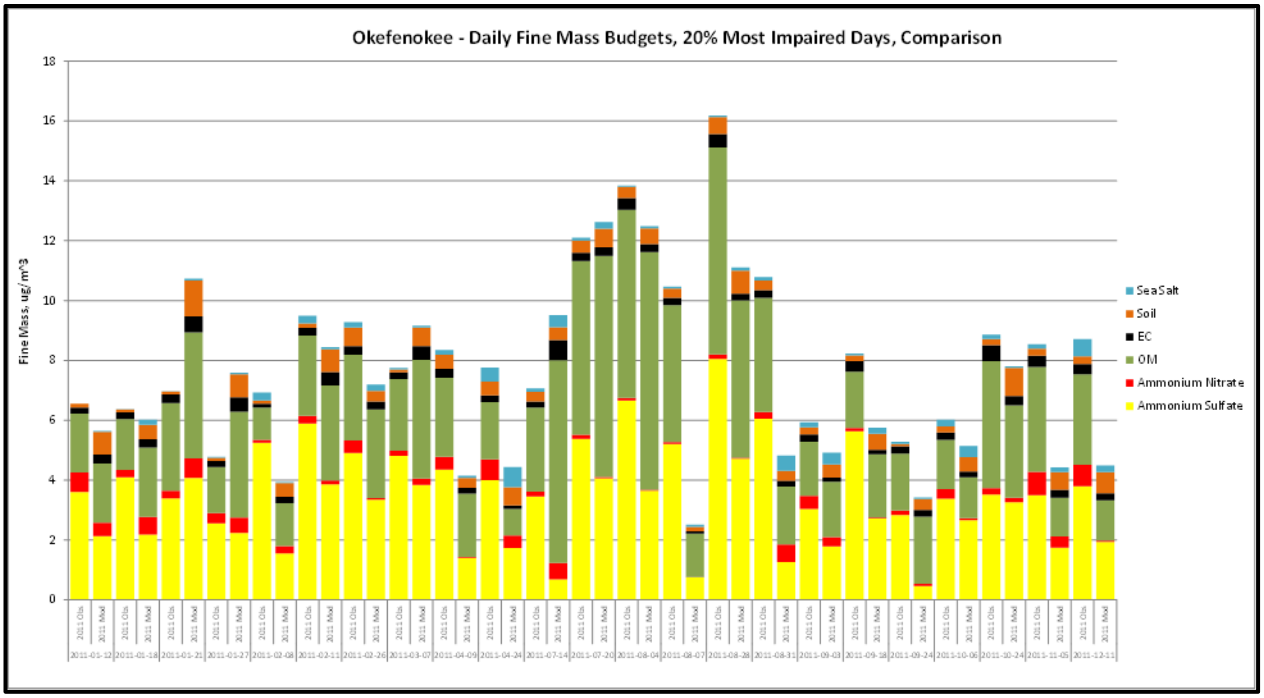


Figure 6-25: Stacked Bar Charts for Daily $PM_{2.5}$ Concentrations at Okefenokee National Wilderness Area on the 20% Most-Impaired Days: Observation (left) and Modeled (Right)

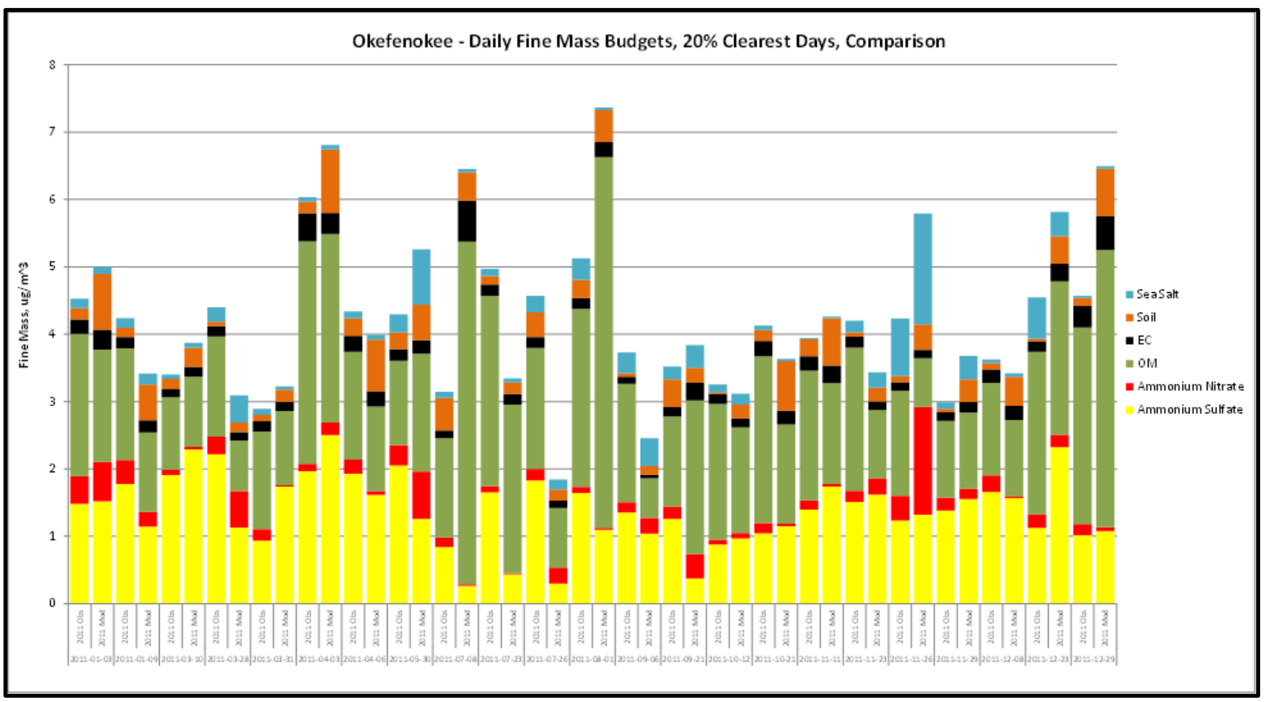


Figure 6-26: Stacked Bar Charts for Daily $PM_{2.5}$ Concentrations at Okefenokee National Wilderness Area on the 20% Clearest Days: Observation (left) and Modeled (Right)

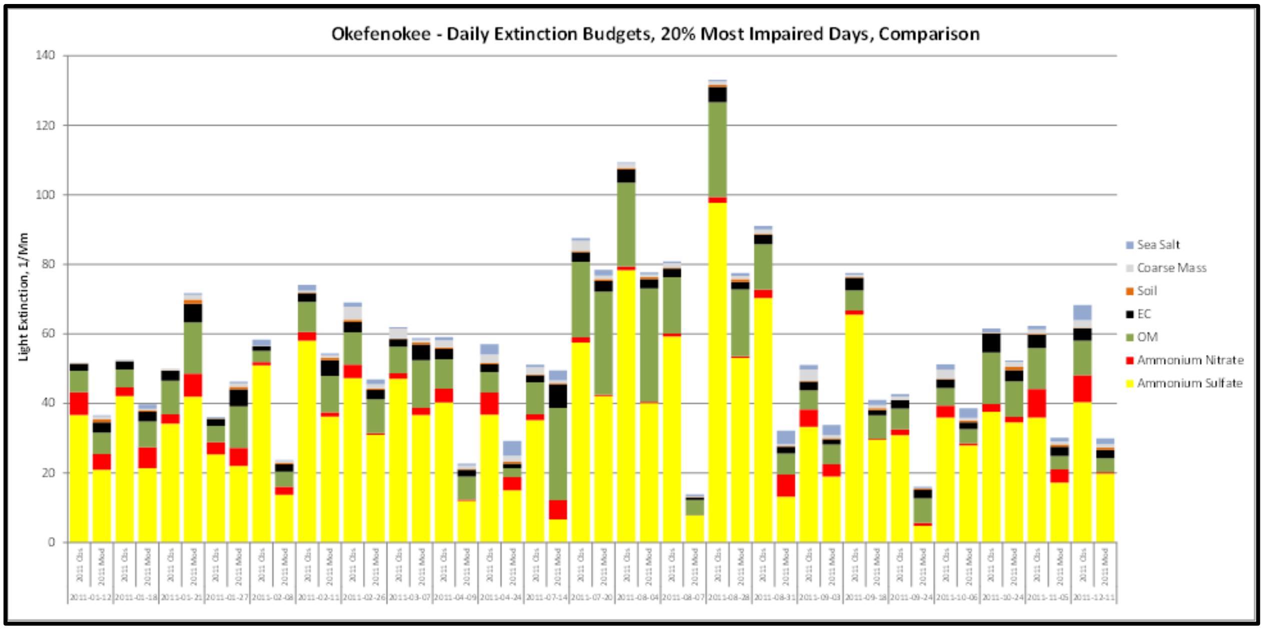


Figure 6-27: Stacked Bar Charts for Light Extinction at Okefenokee National Wilderness Area on the 20% Most-Impaired Days: Observation (left) and Modeled (Right)

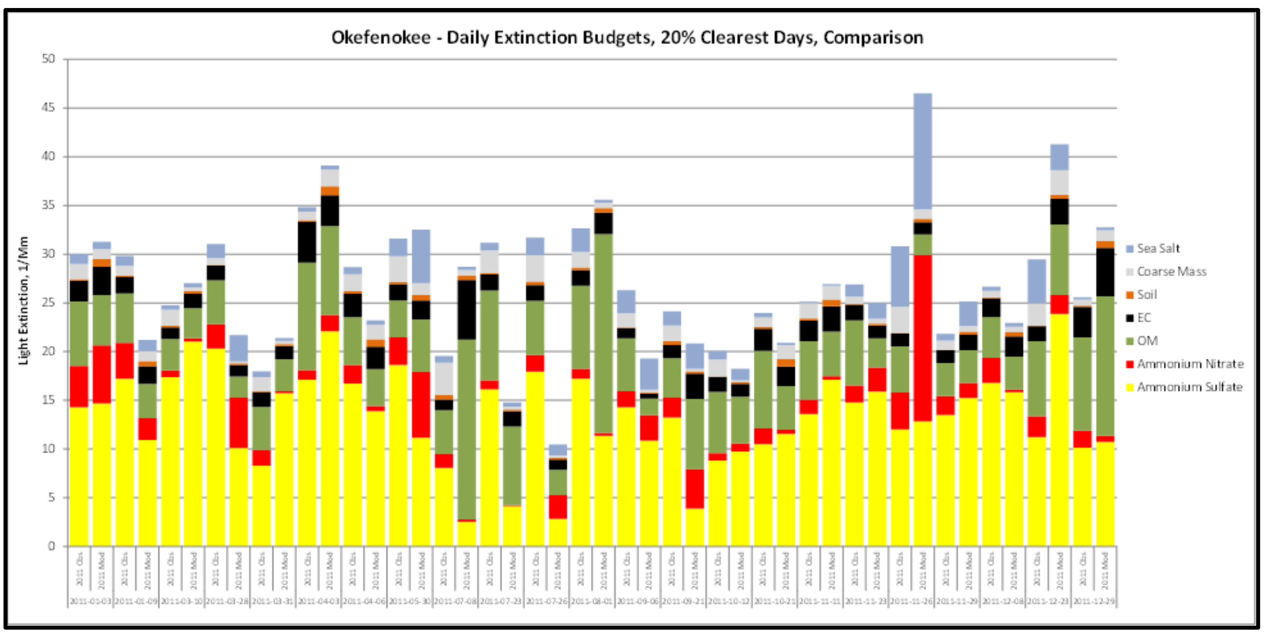


Figure 6-28: Stacked Bar Charts for Light Extinction at Okefenokee National Wilderness Area on the 20% Clearest Days: Observation (left) and Modeled (Right)

Figure 6-29 and Figure 6-30 contain scatter plots of daily observations vs. modeled concentration for $PM_{2.5}$, sulfate, nitrate, organic carbon, elemental carbon, crustal (labeled as soil), sea salt, and coarse mass for Cohutta on the 20% most-impaired days. $PM_{2.5}$, sulfate, nitrate, and coarse mass (labeled as PMC) were generally under predicted while crustal was generally over predicted. Organic carbon, elemental carbon, and sea salt show both over predictions and under predictions.

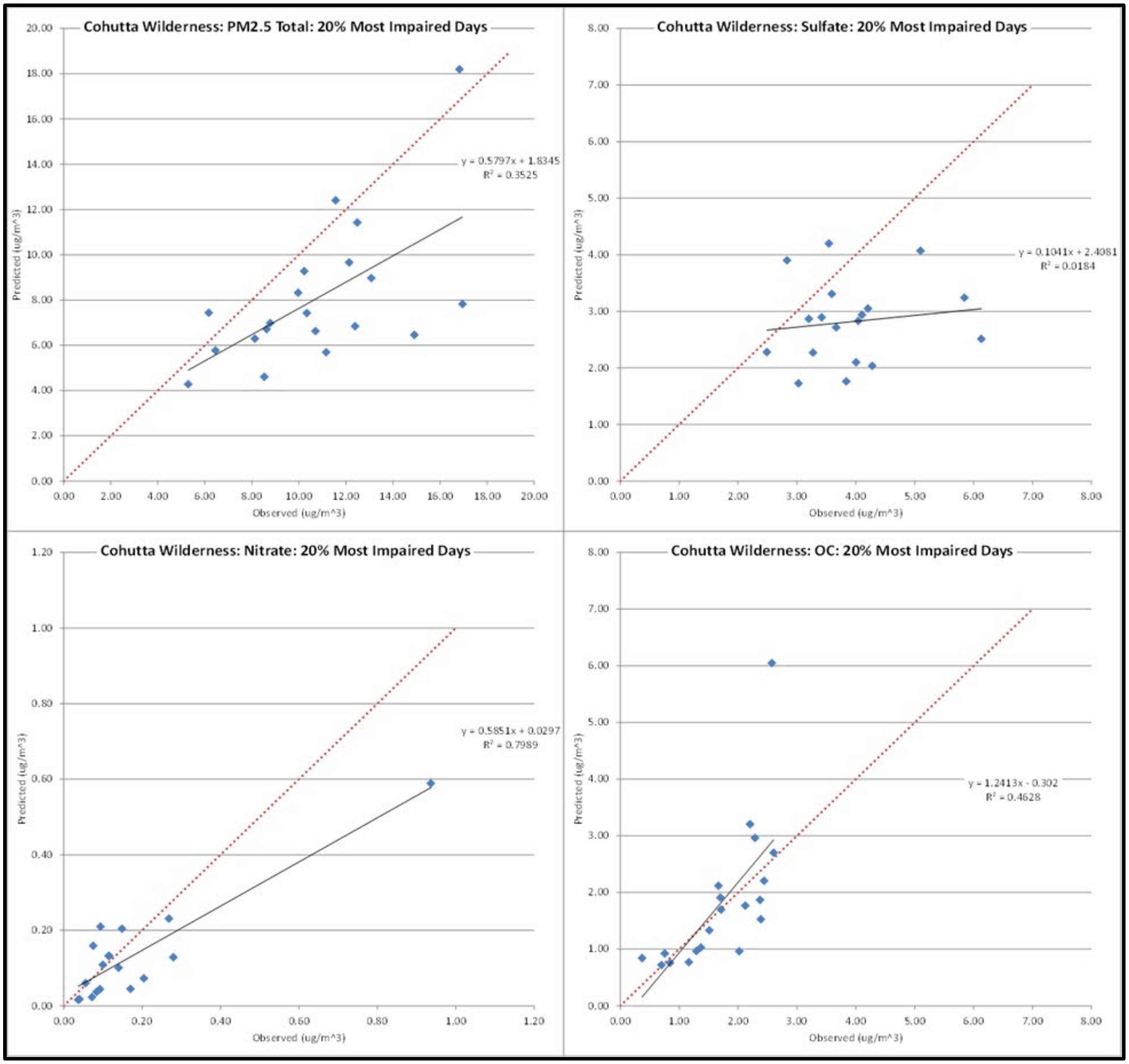


Figure 6-29: Scatter Plot for Daily $PM_{2.5}$ (top left), Sulfate (top right), Nitrate (bottom left), and Organic Carbon (bottom right) Concentrations at Cohutta Wilderness Area on the 20% Most Impaired Days

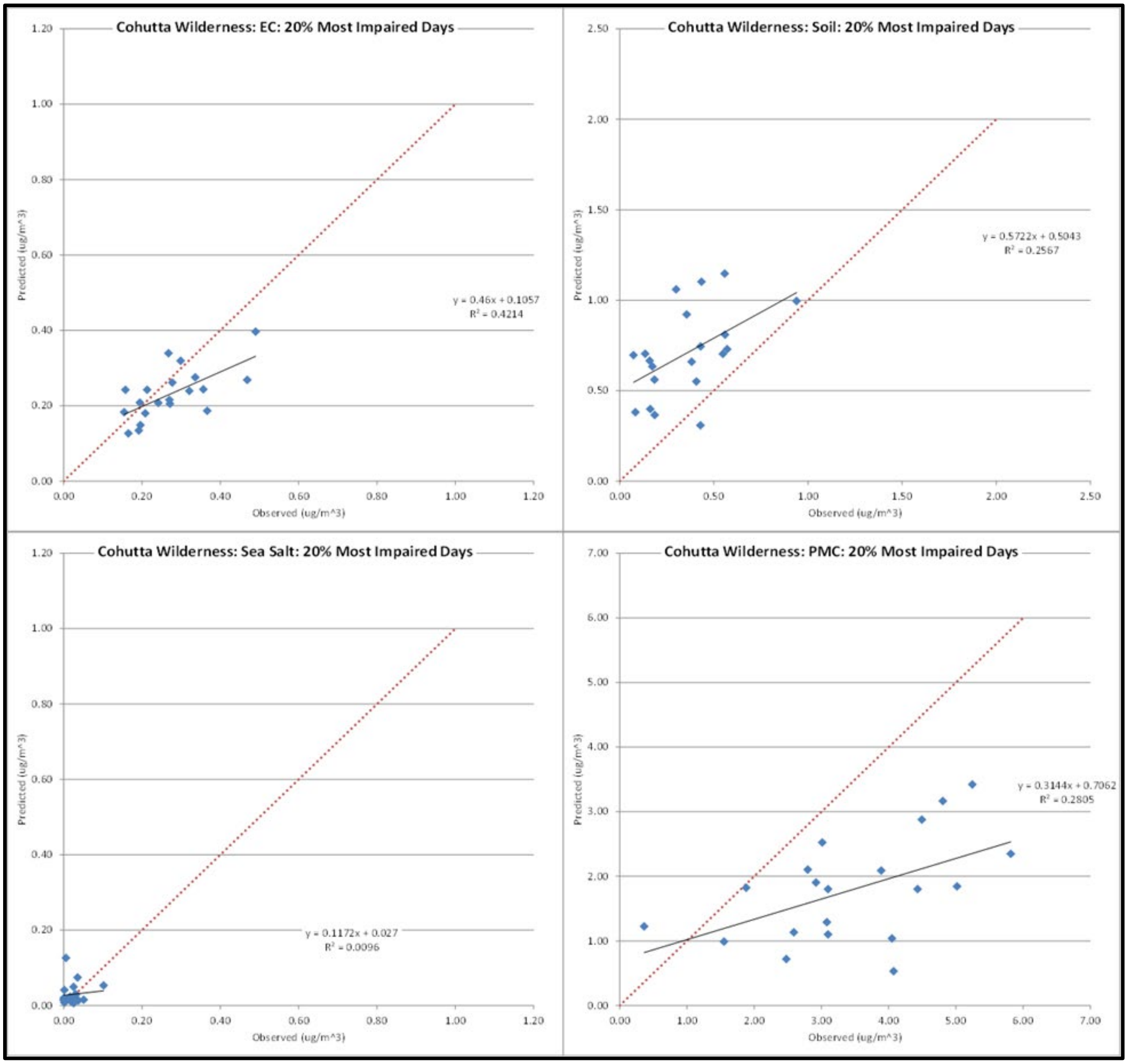


Figure 6-30: Scatter Plot for Daily Elemental Carbon (top left), Crustal (top right), Sea Salt (bottom left), and Coarse Mass (bottom right, labeled as PMC) Concentrations at Cohutta Wilderness Area on the 20% Most Impaired Days

Figure 6-31 and Figure 6-32 contain scatter plots of daily observations vs. modeled concentration for $PM_{2.5}$, sulfate, nitrate, organic carbon, elemental carbon, crustal (labeled as soil), sea salt, and coarse mass (labeled as PMC) for Cohutta on the 20% clearest days. $PM_{2.5}$, sulfate, elemental carbon, and crustal were generally over predicted. Nitrate, organic carbon, sea salt, and coarse mass show both over predictions and under predictions.

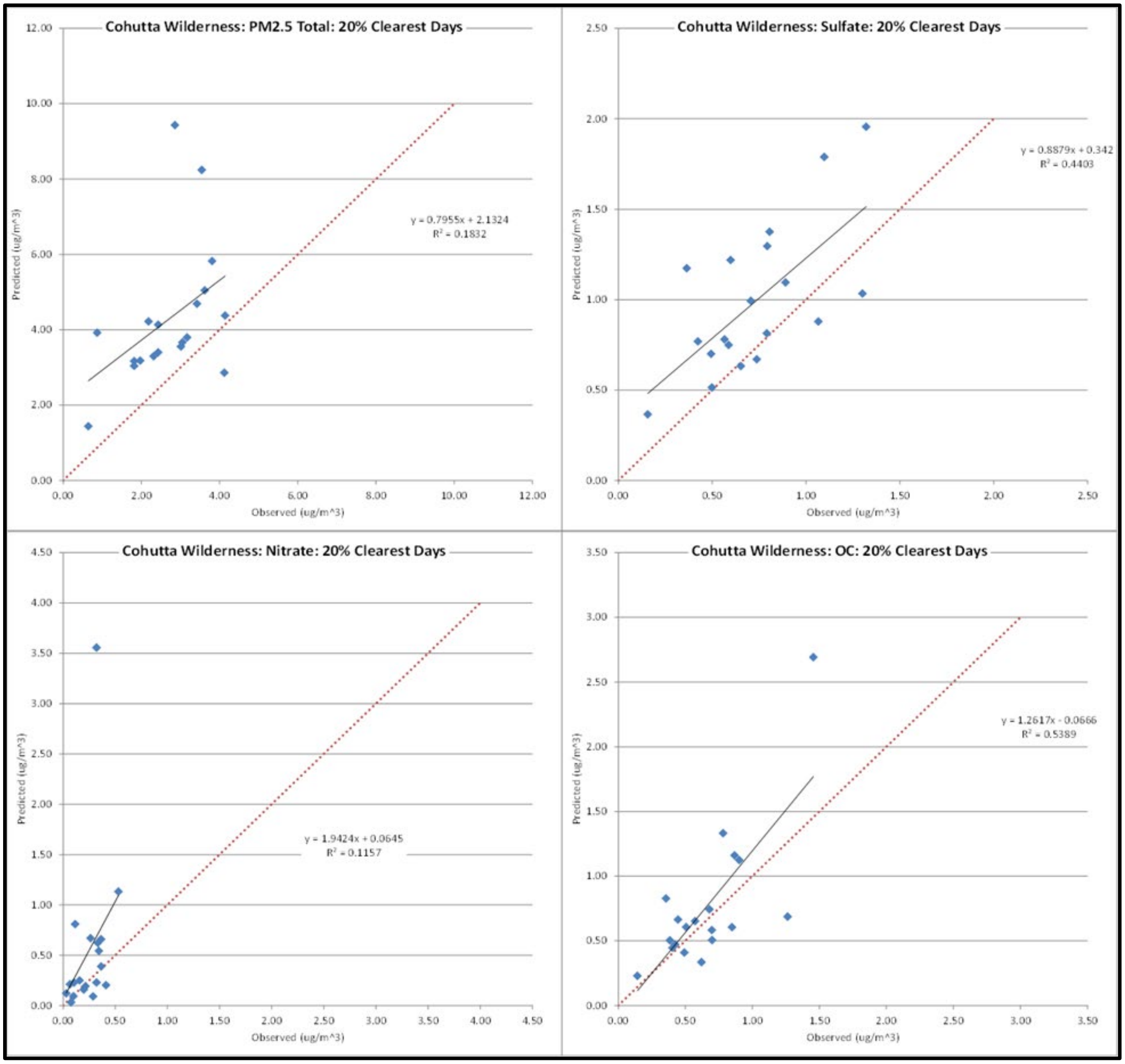


Figure 6-31: Scatter Plot for Daily $PM_{2.5}$ (top left), Sulfate (top right), Nitrate (bottom left), and Organic Carbon (bottom right) Concentrations at Cohutta Wilderness Area on the 20% Clearest Days.

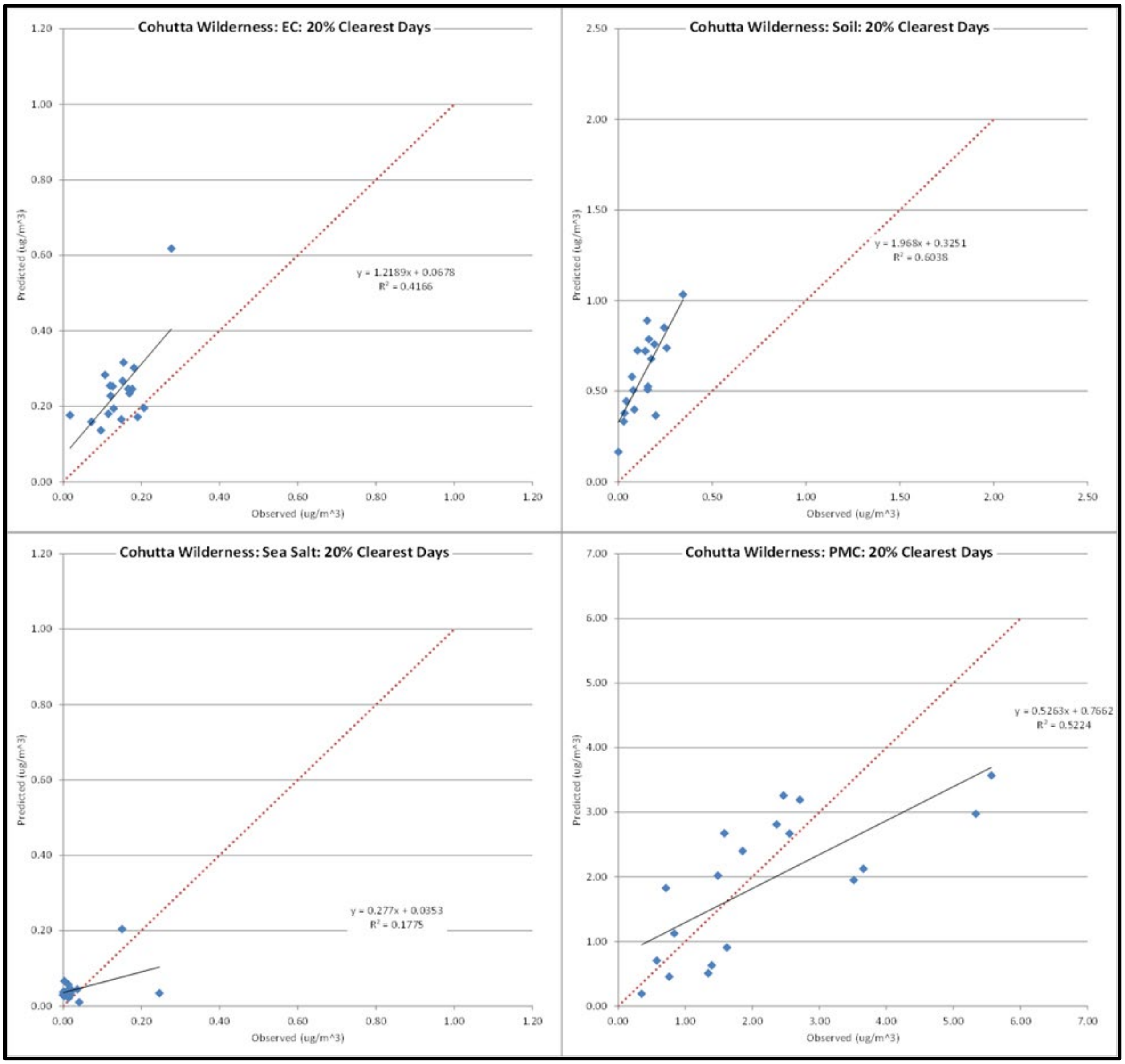


Figure 6-32: Scatter Plot for Daily Elemental Carbon (top left), Crustal (top right), Sea Salt (bottom left), and Coarse Mass (bottom right, labeled as PMC) Concentrations at Cohutta Wilderness Area on the 20% Clearest Days

Figure 6-33 and Figure 6-34 contain scatter plots of daily observations vs. modeled concentration for $PM_{2.5}$, sulfate, nitrate, organic carbon, elemental carbon, crustal (labeled as soil), sea salt, and coarse mass (labeled as PMC) for Okefenokee on the 20% most impaired days. Sulfate was generally under predicted while soil was generally over predicted. $PM_{2.5}$, nitrate, organic carbon, elemental carbon, sea salt, and coarse mass show both over predictions and under predictions.

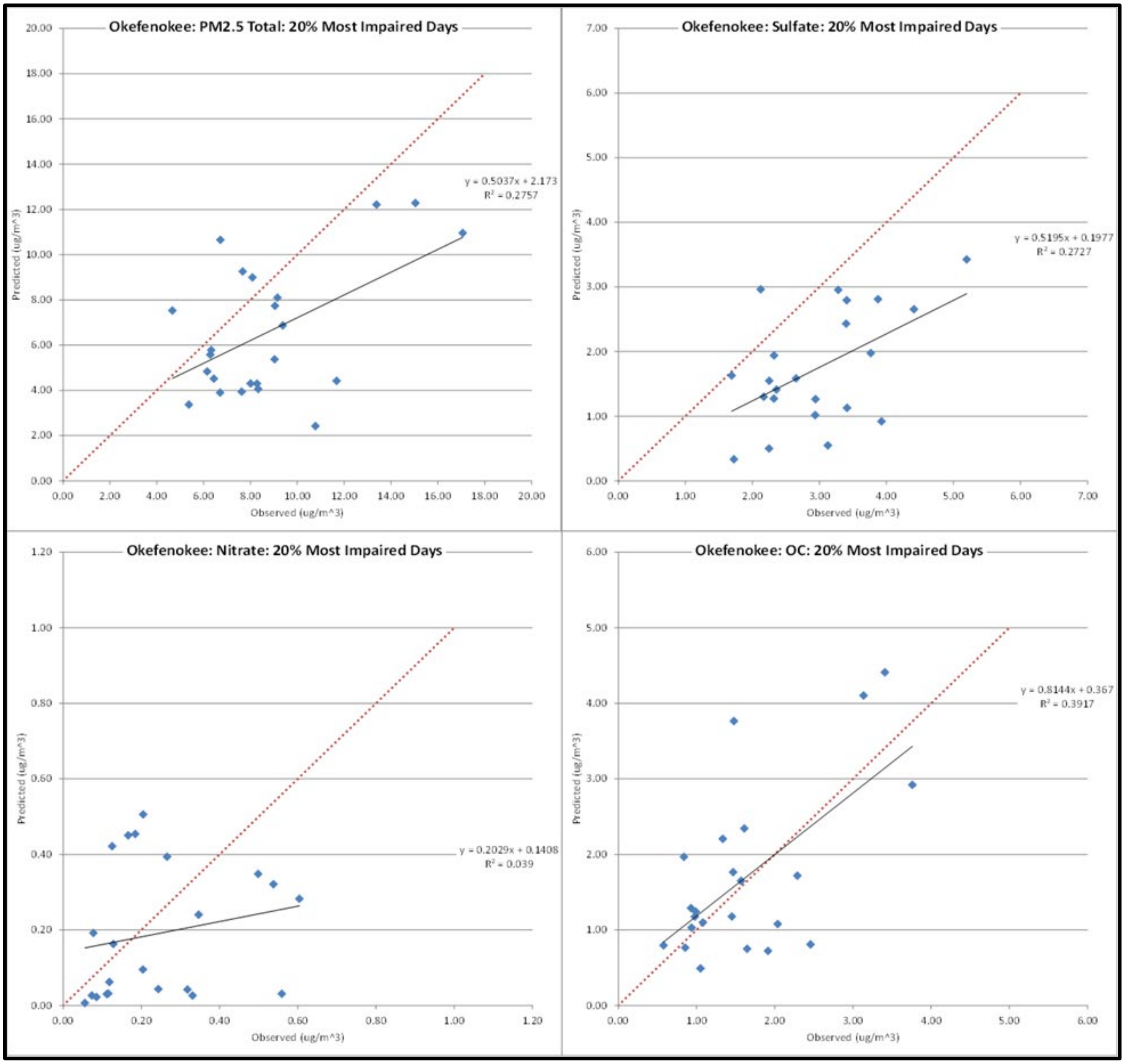


Figure 6-33: Scatter Plot for Daily $PM_{2.5}$ (top left), Sulfate (top right), Nitrate (bottom left), and Organic Carbon (bottom right) Concentrations at Okefenokee National Wilderness Area on the 20% Most Impaired Days

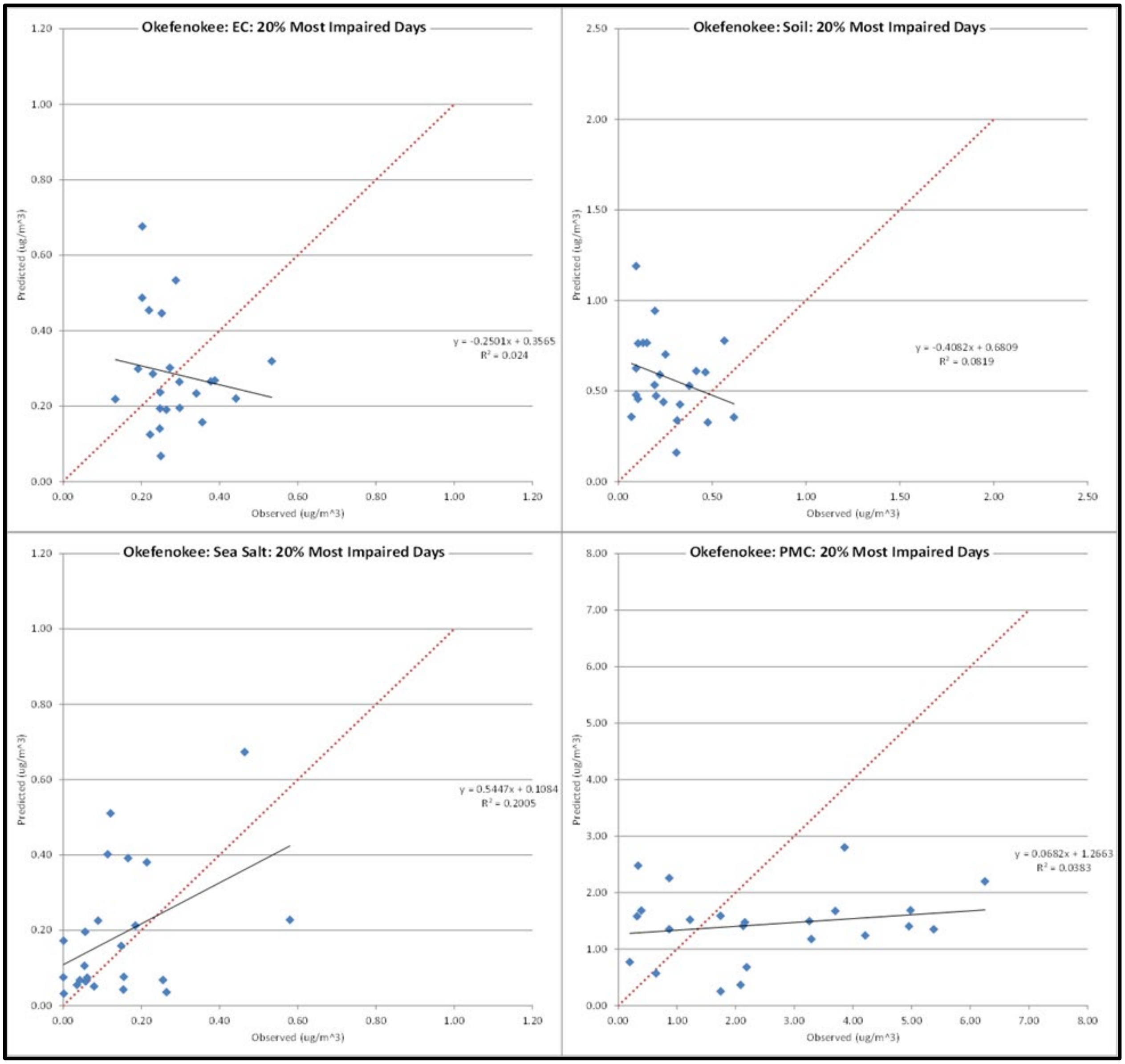


Figure 6-34: Scatter Plot for Daily Elemental Carbon (top left), Crustal (top right), Sea Salt (bottom left), and Coarse Mass (bottom right) Concentrations at Okefenokee National Wilderness Area on the 20% Most Impaired Day

Figure 6-35 and Figure 6-36 contain scatter plots of daily observations vs. modeled concentration for $PM_{2.5}$, sulfate, nitrate, organic carbon, elemental carbon, crustal (labeled as soil), sea salt, and coarse mass (labeled as PMC) for Okefenokee on the 20% clearest days. Coarse mass was generally under predicted while crustal was generally over predicted. $PM_{2.5}$, sulfate, nitrate, organic carbon, elemental carbon, and sea salt show both over predictions and under predictions.

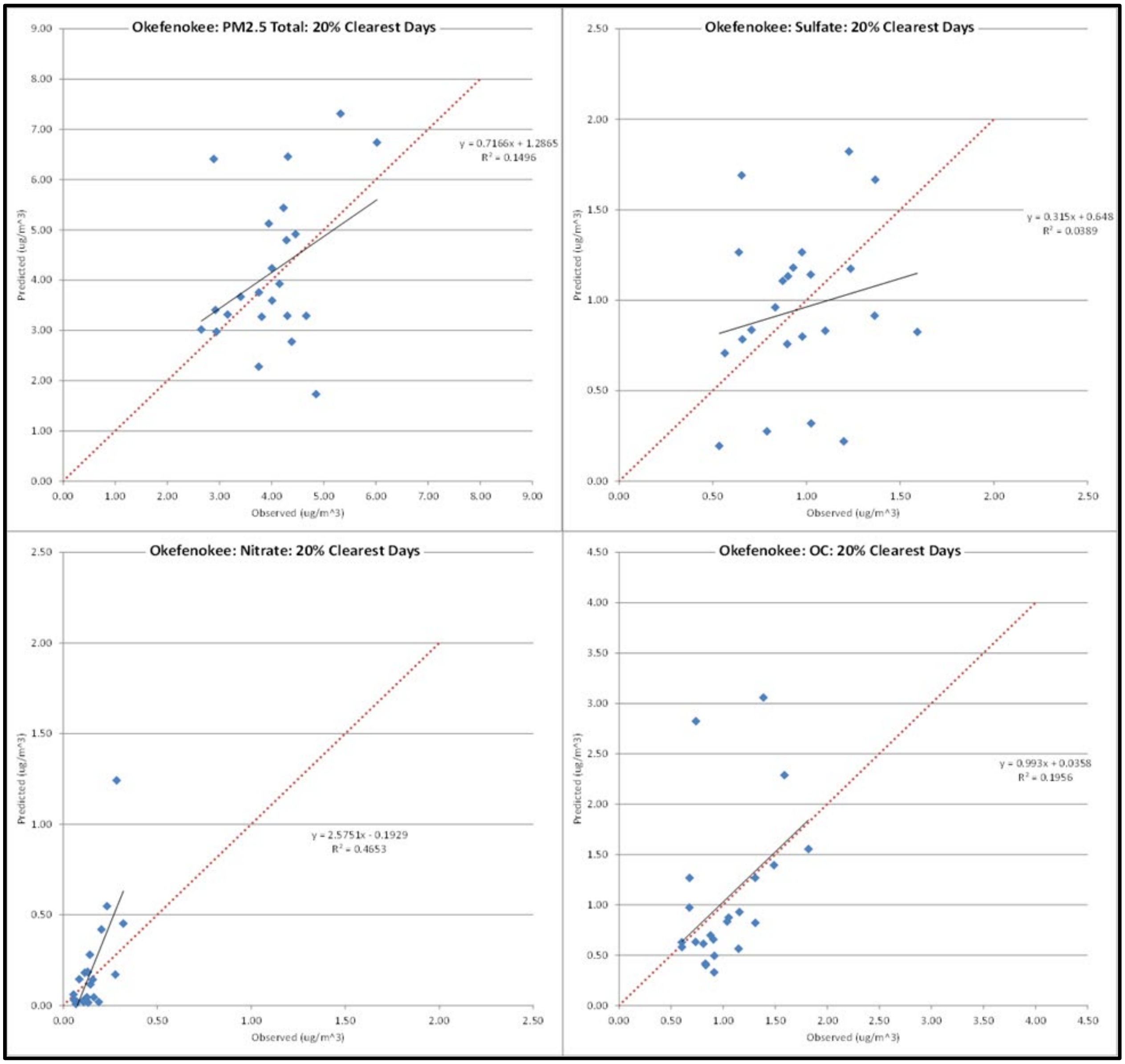


Figure 6-35: Scatter Plot for Daily $PM_{2.5}$ (top left), Sulfate (top right), Nitrate (bottom left), and Organic Carbon (bottom right) Concentrations at Okefenokee National Wilderness Area on the 20% Clearest Days

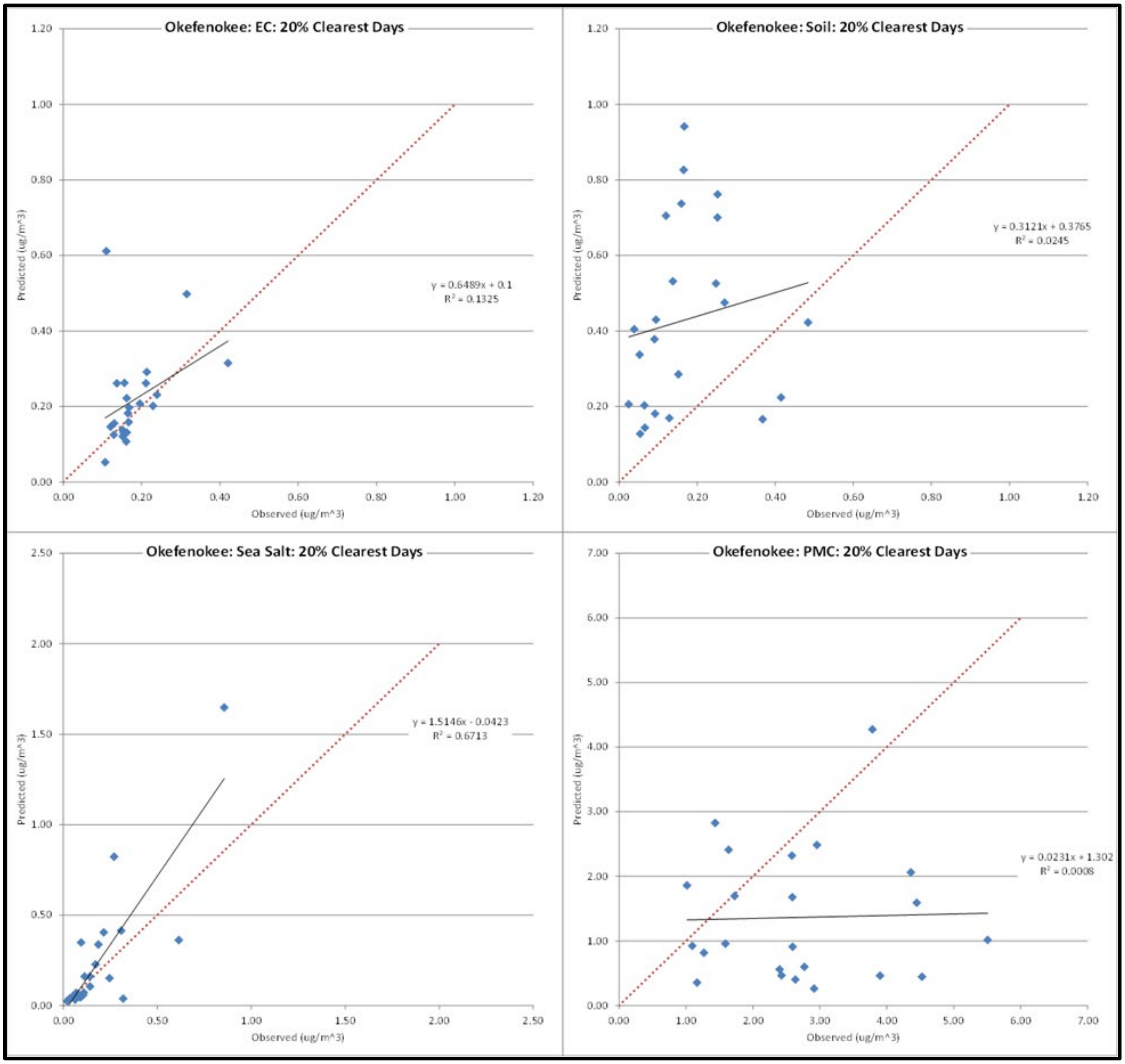


Figure 6-36: Scatter Plot for Daily Elemental Carbon (top left), Crustal (top right), Sea Salt (bottom left), and Coarse Mass (bottom right, labeled as PMC) Concentrations at Okefenokee National Wilderness Area on the 20% Clearest Days

Figure 6-37 through Figure 6-40 are soccer plots showing NMB and NME for modeled sulfate, nitrate, organic carbon, elemental carbon, crustal, and coarse mass for Cohutta and Okefenokee on the 20% most impaired days and the 20% clearest days. For Cohutta on the 20% most impaired days, sulfate, nitrate, organic carbon, elemental carbon, and coarse mass meet the NMB and NME criteria while crustal does not. For Cohutta on the 20% clearest days, sulfate, organic carbon, and coarse mass meet the NMB and NME criteria while nitrate, elemental carbon, and crustal do not. For Okefenokee on the 20% most impaired days, sulfate, nitrate, organic carbon, elemental carbon, and coarse mass meet the NMB and NME criteria while crustal does not. For

Okefenokee on the 20% clearest days, sulfate, nitrate, organic carbon, elemental carbon, and coarse mass meet the NMB and NME criteria while crustal does not.

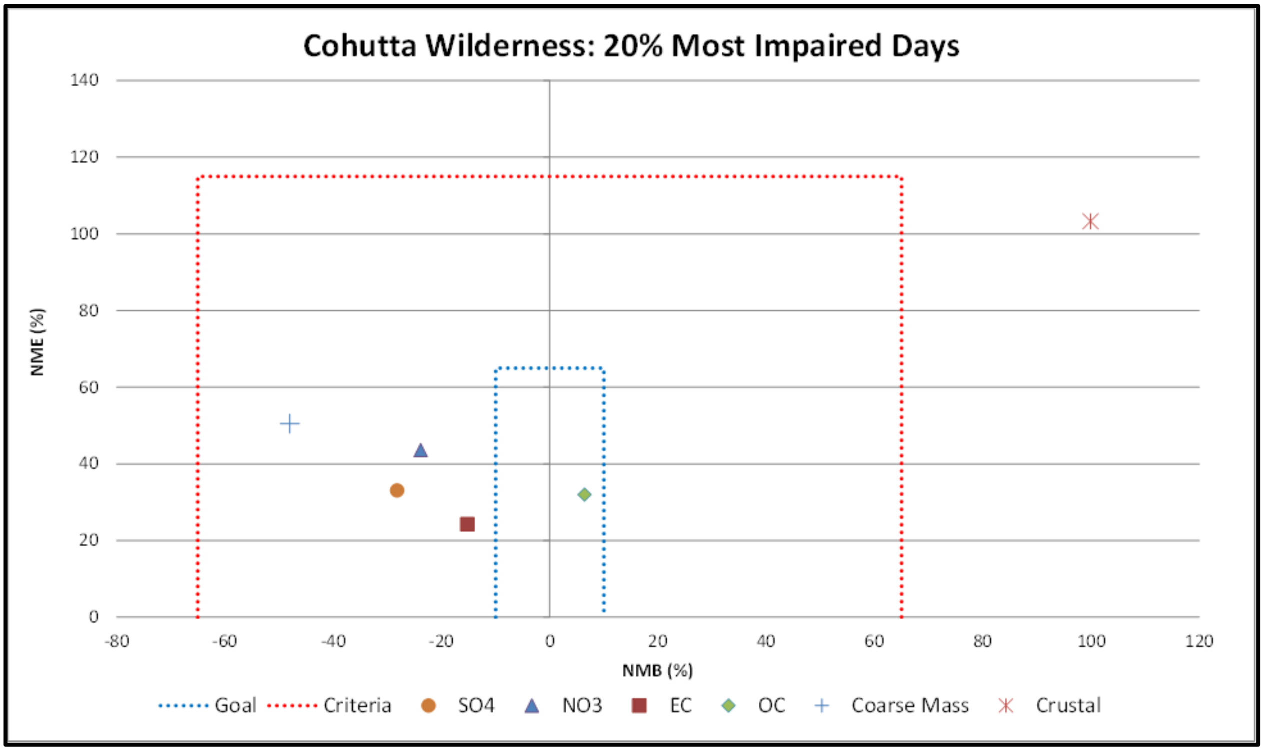


Figure 6-37: Soccer Plot for Sulfate, Nitrate, Elemental Carbon, Organic Carbon, Coarse Mass, and Crustal Concentrations on the 20% Most Impaired Days at Cohutta Wilderness Area

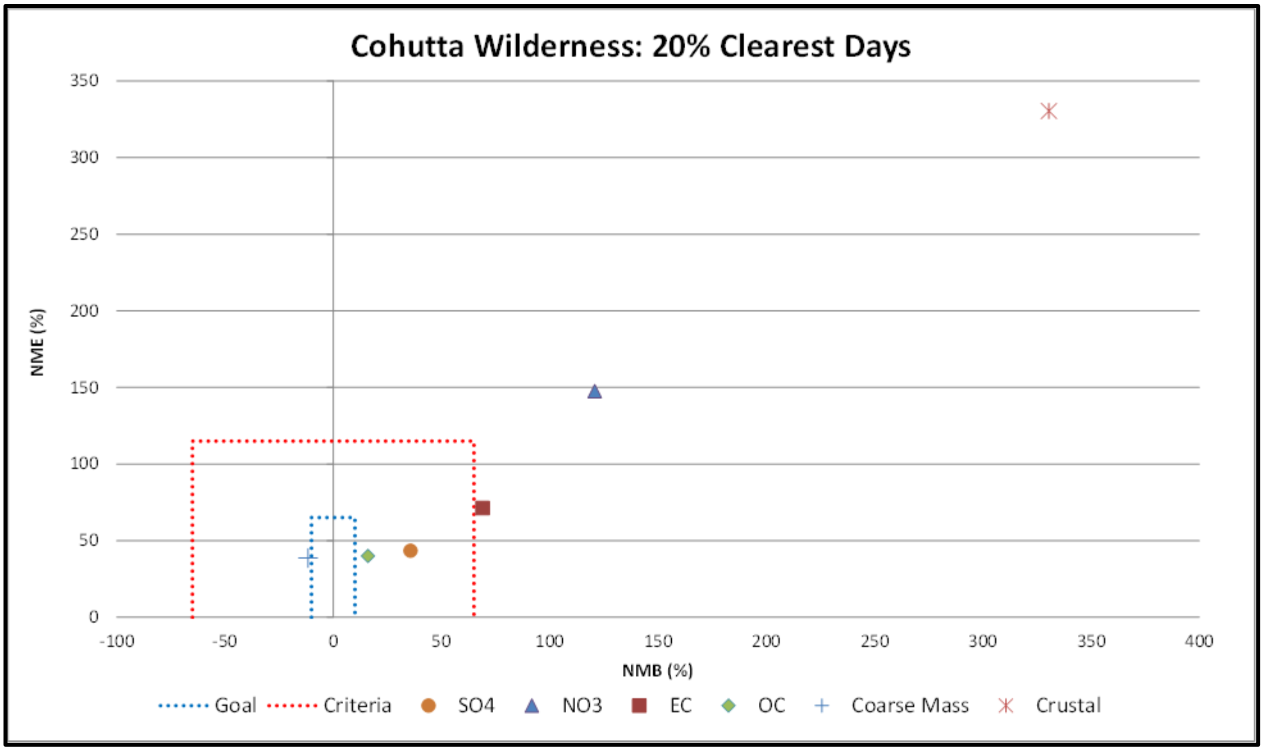


Figure 6-38: Soccer Plot for Sulfate, Nitrate, Elemental Carbon, Organic Carbon, Coarse Mass, and Crustal Concentrations on the 20% Clearest Days at Cohutta Wilderness Area

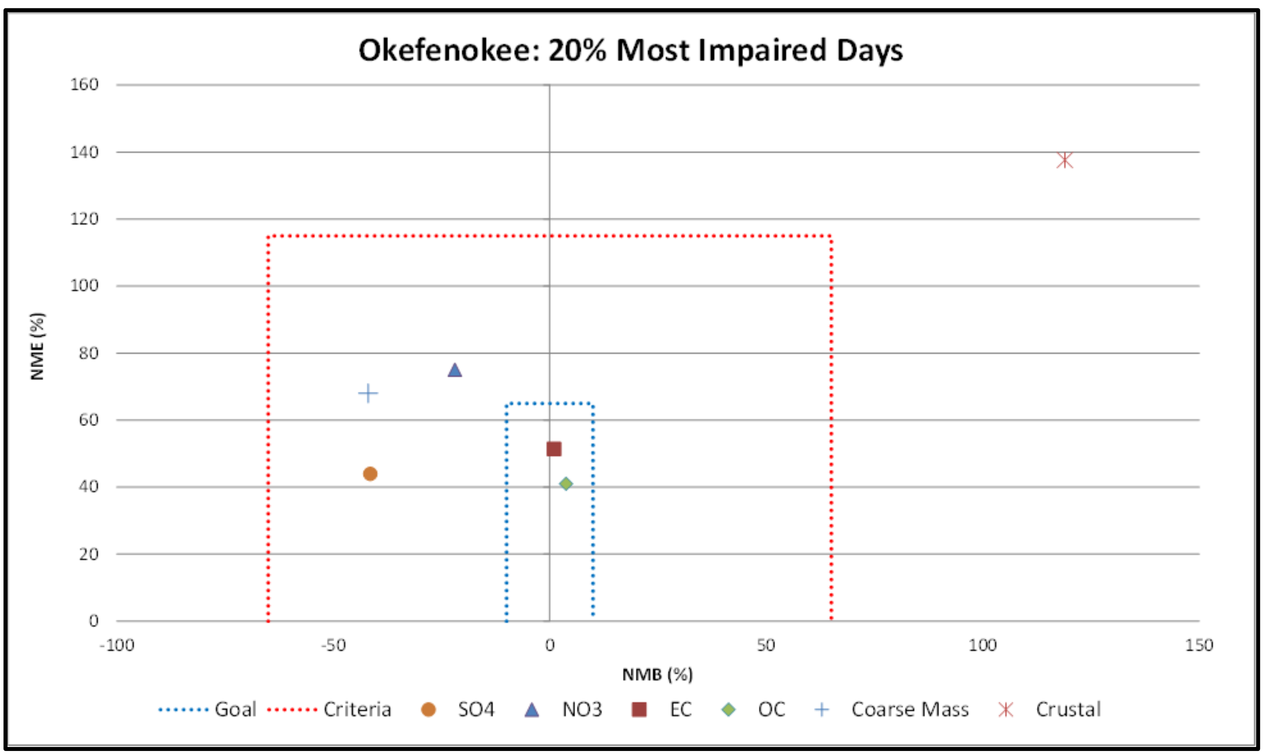


Figure 6-39: Soccer Plot for Sulfate, Nitrate, Elemental Carbon, Organic Carbon, Coarse Mass, and Crustal Concentrations on the 20% Most Impaired Days at Okefenokee National Wilderness Area

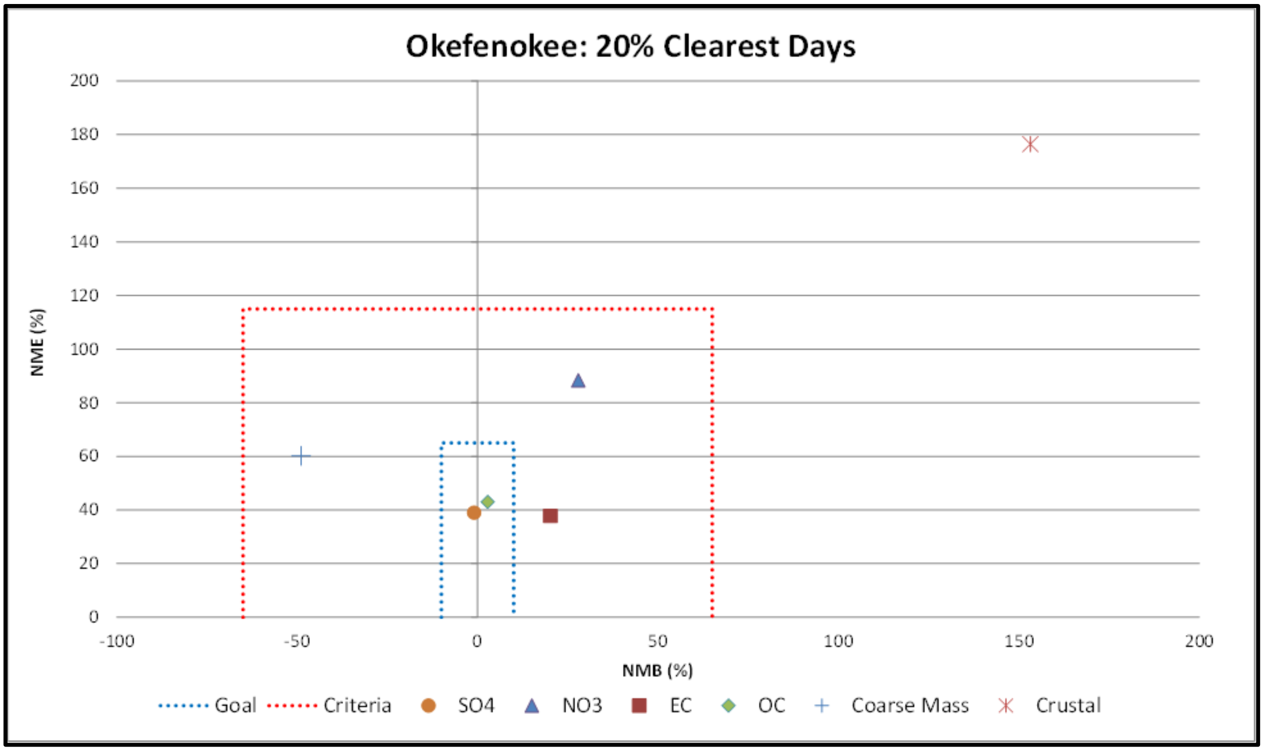


Figure 6-40: Soccer Plot for Sulfate, Nitrate, Elemental Carbon, Organic Carbon, Coarse Mass, and Crustal Concentrations on the 20% Clearest Days at Okefenokee National Wilderness Area

Figure 6-41 and Figure 6-42 are bugle plots showing MFB and MFE for modeled sulfate, nitrate, organic carbon, elemental carbon, crustal, and coarse mass for Cohutta on the 20% most impaired days and the 20% clearest days. On the 20% most impaired days and the 20% clearest days, all species meet the MFB and MFE criteria (red line). On the 20% most impaired days and the 20% clearest days, all species (except coarse mass MFB on 20% most impaired days) meet the MFB and MFE goal (green line).

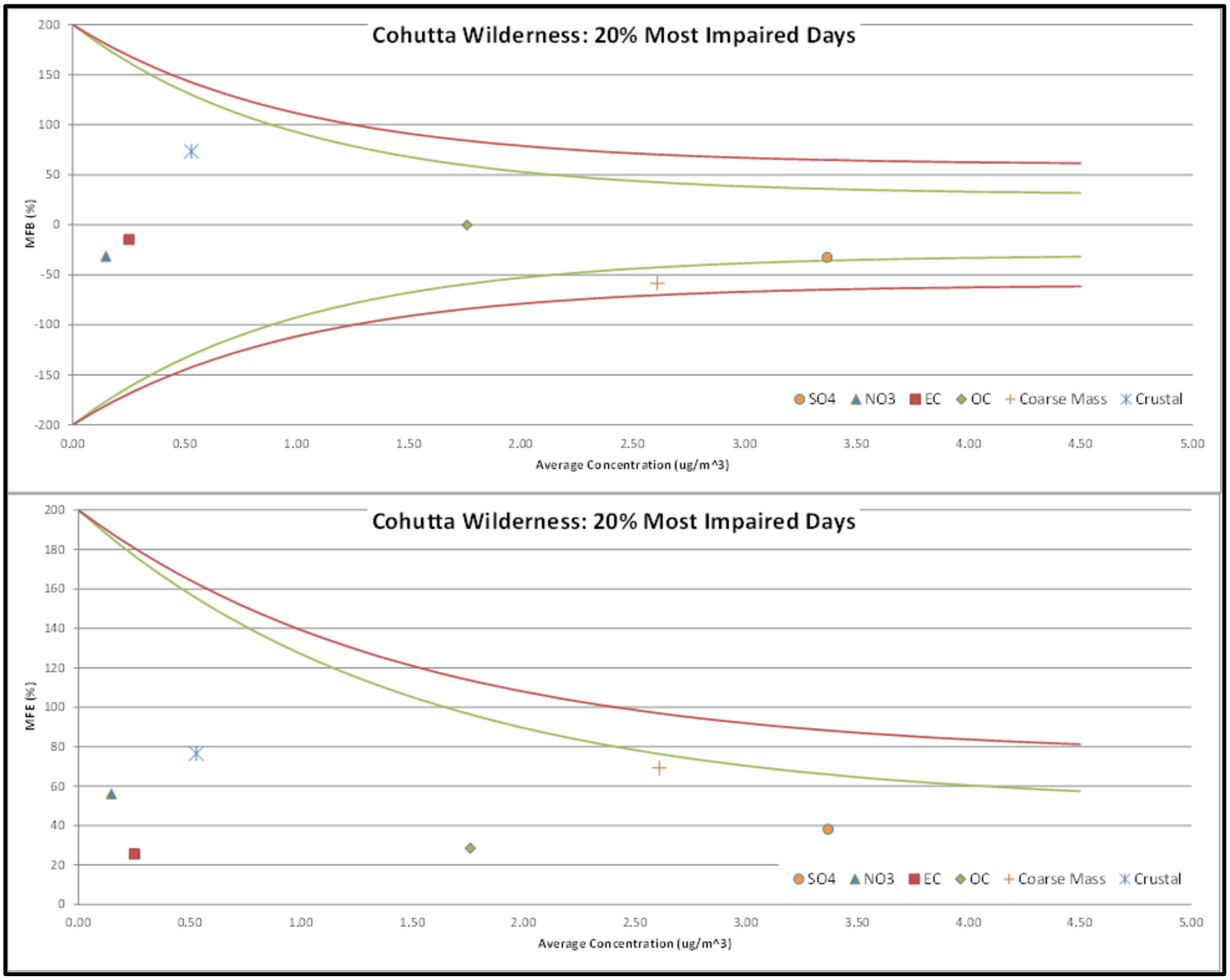


Figure 6-41: Bugle Plots of MFB (top) and MFE (bottom) for Sulfate, Nitrate, Elemental Carbon, Organic Carbon, Coarse Mass, and Crustal Concentrations on the 20% Most Impaired Days at Cohutta Wilderness Area

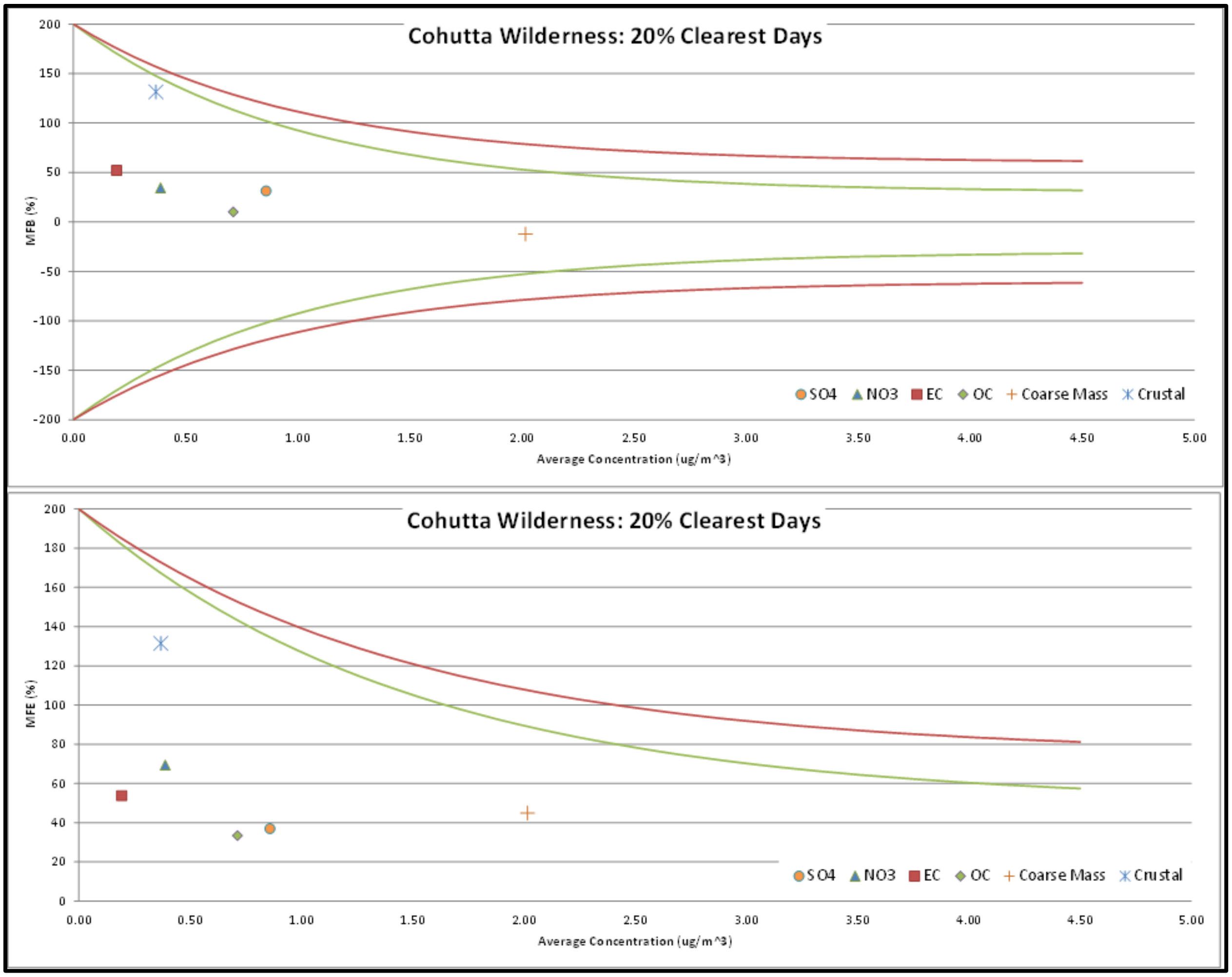


Figure 6-42: Bugle Plots of MFB (top) and MFE (bottom) for Sulfate, Nitrate, Elemental Carbon, Organic Carbon, Coarse Mass, and Crustal Concentrations on the 20% Clearest Days at Cohutta Wilderness Area

Figure 6-43 and Figure 6-44 are bugle plots showing MFB and MFE for modeled sulfate, nitrate, organic carbon, elemental carbon, crustal, and coarse mass for Okefenokee on the 20% most impaired days and the 20% clearest days. On the 20% most impaired days and the 20% clearest days, all species meet the MFB and MFE criteria (red line). On the 20% most impaired days and the 20% clearest days, all species (except sulfate MFB on 20% most impaired days and coarse mass MFB on 20% clearest days) meet the MFB and MFE goal (green line).

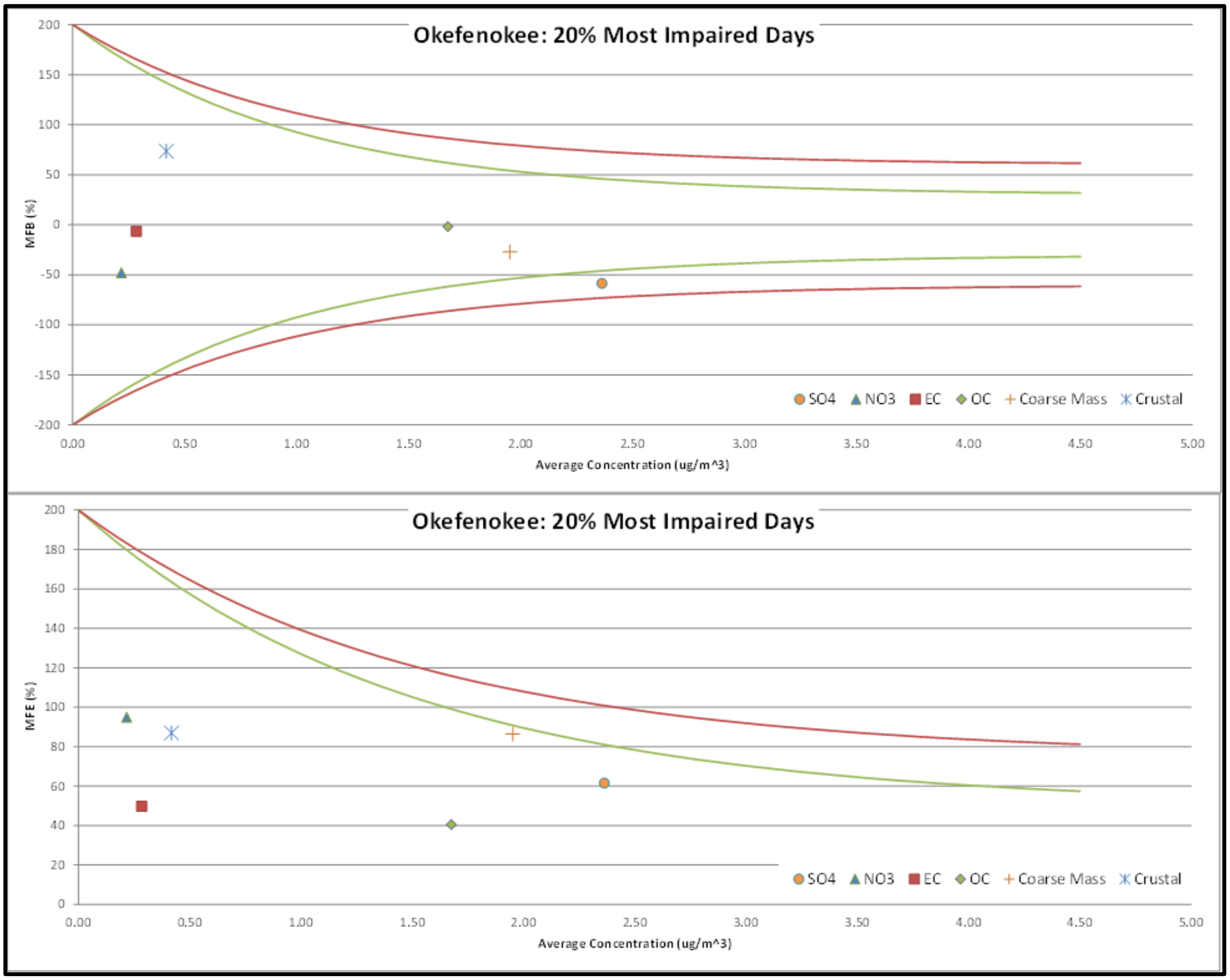


Figure 6-43: Bugle Plots of MFB (top) and MFE (bottom) for Sulfate, Nitrate, Elemental Carbon, Organic Carbon, Coarse Mass, and Crustal Concentrations on the 20% Most Impaired Days at Okefenokee National Wilderness Area

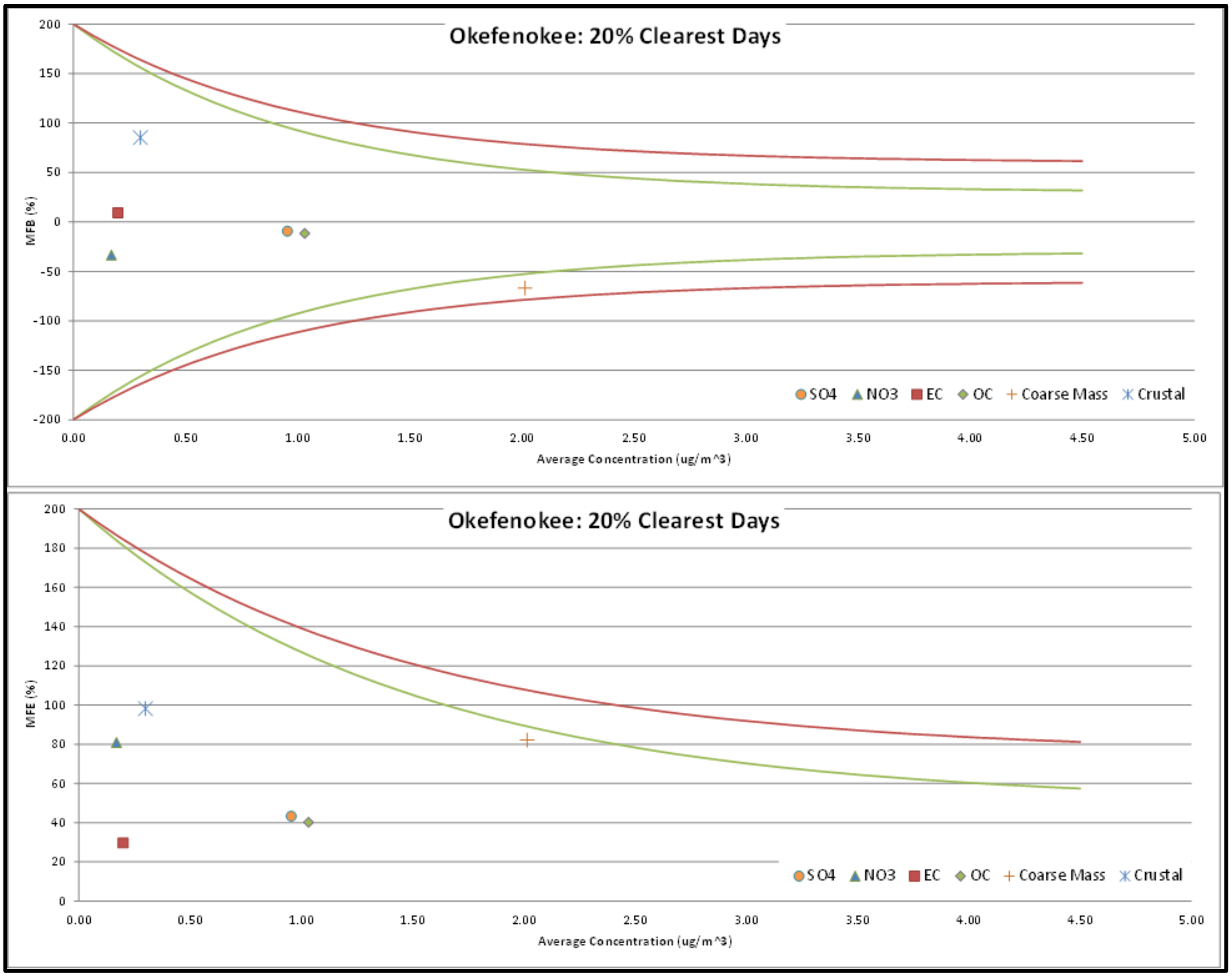


Figure 6-44: Bugle Plots of MFB (top) and MFE (bottom) for Sulfate, Nitrate, Elemental Carbon, Organic Carbon, Coarse Mass, and Crustal Concentrations on the 20% Clearest Days at Okefenokee National Wilderness Area

Overall, Georgia found model performance to fall within acceptable limits. Georgia further asserts the one atmosphere modeling performed by the VISTAS contractors is representative of conditions in the southeastern states and is acceptable for use in regulatory demonstrations to support Georgia's Regional Haze SIP.

7. Long-Term Strategy

The regional haze regulation under 40 CFR 51.308(f)(2) requires states to submit a long-term strategy (LTS) addressing regional haze visibility impairment for each mandatory federal Class I area within the state and for each mandatory federal Class I area located outside the state that may be affected by emissions from the state. The long-term strategy must include enforceable emissions limitations, compliance schedules, and other measures that are necessary to make reasonable progress. The regional haze regulation also requires, under 40 CFR 51.308(f)(3), that states containing mandatory federal Class I areas must establish RPGs expressed in deciviews. These RPGs must reflect the visibility conditions that are projected to be achieved by the end of the applicable implementation period as a result of those enforceable emission limitations, compliance schedules, and other measures established as part of the long-term strategy as well as the implementation of other CAA requirements. The RPGs, while not directly federally enforceable, must be met through measures contained in the state's long-term strategy through the year 2028. This section discusses development of Georgia's long-term strategy. Section 7.8 specifies measures in the LongTerm Strategy (LTS) that the GA EPD deems necessary for reasonable progress and proposes that these measures be incorporated into the regulatory portion of the SIP. The GA EPD proposes that all other measures in the LTS not be incorporated into the regulatory portion of the SIP.

7.1. Overview of the Long-Term Strategy Development Process

The monitor data and the modeling analyses included with the first regional haze SIP established that, for the VISTAS region, the key contributors to regional haze in the 2000-2004 baseline timeframe were large stationary sources of SO_2 emissions. Figure 2-1 show the daily visibility data for 20% most impaired days during the baseline period for Cohutta Wilderness Area and Okefenokee National Wilderness Area. Sulfate accounts for the vast majority of the pollutant impairing species on these days. Visibility data for the baseline period for most VISTAS Class I areas showed this same trend.

More current speciation data for years 2014 through 2018 show significant visibility improvement on the 20% most impaired days. As shown in Figure 2-7 for Cohutta Wilderness Area and Okefenokee National Wilderness Area, sulfate continues to be the predominant visibility impairing species. However, there are some days where organic matter and/or nitrate can have large impacts at these Class I areas. The organic matter components on poor visibility days are associated with episodic events while the nitrate components are associated with anthropogenic emissions. The 2014 to 2018 IMPROVE data for other VISTAS Class I areas, provided in Appendix C-2, show similar trends. Therefore, reducing SO_2 emissions continues to be important for generating further visibility improvements. Keeping this conclusion in mind, this section addresses the following questions:

- Assuming implementation of existing federal and state air regulatory requirements in Georgia and the VISTAS region, how much visibility improvement, compared to the glide path, is expected at Cohutta Wilderness Area and Okefenokee National Wilderness Area by 2028?
- Which mandatory federal Class I areas located outside of Georgia are significantly impacted by visibility impairing pollutants originating from within Georgia?
- If additional emission reductions were needed, from what pollutants and source categories would the greatest visibility benefits be realized by 2028?
- Where are these pollutants and source categories located?
- Which specific individual sources in those geographic locations have the greatest visibility impacts at a given mandatory federal Class I area?
- What additional emission controls represent reasonable progress for those specific sources?

7.2. Expected Visibility in 2028 for Georgia Class I Areas Under Existing and Planned Emissions Controls

Several significant control programs reduce emissions of visibility impairing pollutants between the base year 2011 and the future year projection year of 2028. These programs are described in more detail below.

7.2.1. Federal Control Programs Included in the 2028 Projection Year

Federal control programs impacting onroad and off-road engines as well as industrial and EGU facilities have reduced, and will continue to reduce, emissions of SO_2 and NO_X. The reductions from these programs, as described below, are included in the 2028 future year estimates upon which visibility projections are based.

7.2.1.1. Federal EGU and Industrial Unit Trading Programs

The CAA requires each upwind state to ensure that it does not interfere with either the attainment of a NAAQS or continued compliance with a NAAQS at any downwind monitor. This section of the CAA, § 110(a)(2)(D)(i)(I), is called the "Good Neighbor" provision. The EPA has implemented a number of rules enforcing the Good Neighbor provision for a variety of NAAQS.

The EPA finalized CSAPR on August 8, 2011 (76 FR 48208). This rule required 28 states to reduce SO_2, annual NO_X, and ozone season NO_X from fossil fuel-fired EGUs in support of the 1997 and 2006 $PM_{2.5}$ NAAQS and the 1997 ozone NAAQS. CSAPR relied on a trading program to achieve these reductions and became effective January 1, 2015, as set forth in an October 23, 2014, decision by the U.S. Court of Appeals for the D.C. Circuit. Phase 1 of the program began January 2015 for annual programs and May 2015 for the ozone season program. Phase 2 began January 2017 for the annual programs and May 2017 for the ozone season program. Total emissions allowed in each compliance period under CSAPR equals the sum of the affected state emission budgets in the program. The 2017 budgets for these programs, exclusive of new unit set asides and tribal budgets, are:

- SO_2 Group 1 – 1.37 million tons,
- SO_2 Group 2 – 892,000 tons,
- Annual NO_X – 1.21 million tons, and
- Ozone Season NO_X – 586,000 tons

EPA published revised CSAPR ozone season NO_X budgets to address the 2008 ozone NAAQS on October 26, 2016 (81 FR 74504). This rule, called the CSAPR Update, reduced state budgets for NO_X during the ozone season to 325,645 tons in 2017 and 330,526 tons in 2018 and later years, exclusive of new unit set asides and tribal budgets. This rule applies to all VISTAS states except North Carolina, South Carolina, Georgia, and Florida and continues to encourage NO_X emissions reductions from fossil fuel-fired EGUs. The U.S. Court of Appeals for the D.C. Circuit remanded, but did not vacate, the CSAPR Update to EPA to address the court's holding that the rule unlawfully allows significant contributions to continue beyond downwind attainment deadlines. The amended CSAPR Update Rule was published in the Federal Register on April 30, 2021. EPA will issue new or amended FIPs for 12 states to replace their existing CSAPR NOx Ozone Season Group 2 emissions budgets for EGUs with revised budgets under a new CSAPR NOx Ozone Season Group 3 Trading Program. Implementation of the revised emission budgets is required beginning with the 2021 ozone season. The final rule includes state-by-state adjusted ozone season emission budgets for 2021 through 2024. Emission reductions are required at power plants in the 12 states based on optimization of existing, already-installed selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) controls beginning in the 2021 ozone season, and installation or upgrade of state-of-the-art NOx combustion controls beginning in the 2022 ozone season. EPA estimates the Revised CSAPR Update will reduce summertime NOx emissions from power plants in the 12 linked upwind states by 17,000 tons in 2021 compared to projections without the rule.

7.2.1.2. MATS Rule

On February 16, 2012 (77 FR 9304), EPA promulgated the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units. This rule is often called the Mercury and Air Toxics Standard (MATS). The standard applies to EGUs burning fossil fuel and sets standards for certain HAP emissions, many of which are acid gases. Control of acid gas emissions often have the co-benefit of reducing SO_2 emissions. Sources had until April 16, 2015, to comply with the rule unless granted a one-year extension for control installation or an additional extension for reliability reasons.

7.2.1.3. 2010 SO_2 NAAQS

On June 22, 2010 (75 FR 35520), EPA finalized a new primary NAAQS for SO_2. This regulation significantly strengthened the short-term requirements by lowering the standard to 75 ppb on a one-hour basis. Using inventory and other technical data as support, EPA determined that anthropogenic SO_2 emissions originate chiefly from point sources, with fossil fuel combustion at electric utilities accounting for 66% and fossil fuel combustion at other industrial facilities accounting for 29% of total anthropogenic SO_2 emissions. EPA simultaneously revised ambient air monitoring requirements for SO_2, combining air quality modeling and monitoring to determine compliance with the new standard. This hybrid approach put more emphasis on the evaluation of point source emissions. To ensure compliance with the 2010 SO_2 NAAQS, reductions in SO_2 emissions have occurred.

7.2.1.4. Onroad and Non-Road Programs

The CAA authorizes the EPA to establish emission standards for motor vehicles under § 202 and the authority to establish fuel controls under § 211. The CAA generally prohibits states other than California from enacting emission standards for motor vehicles under § 209(a) and for non-road engines under § 209(e). States may choose to adopt California requirements or meet federal requirements. Federal programs to reduce emissions from onroad and non-road engines are therefore critical to improving both visibility and air quality.

Several of the programs discussed below address SO_2 emissions by reducing allowable sulfur contents in various fuels. As well as reducing SO_2 emissions, reduced sulfur content improves the efficiency of NO_X controls on existing engines and facilitates the use of state-of-the-art NO_X controls on new engines.

7.2.1.4.1. 2007 Heavy-Duty Highway Rule

In Subpart P of 40 CFR Part 86, EPA set limitations for heavy-duty engines, which became effective between 2007 and 2010. This rule limited NO_X to 0.20 grams per brake horsepower-hour (g/bhp-hr) and limited non-methane hydrocarbons to 0.14 g/bhp-hr. The rule also required that the sulfur content of diesel fuel not exceed 0.0015% by weight to facilitate the use of modern air pollution control technology on these engines. These standards continue to provide benefit as older vehicles are replaced with newer models.

7.2.1.4.2. Tier 3 Motor Vehicle Emissions and Fuel Standards

The federal Tier 3 program under Subpart H of 40 CFR Part 80, 40 CFR Part 85, and 40 CFR Part 86 reduces tailpipe and evaporative emissions from passenger cars, light-duty trucks, medium-duty passenger vehicles, and some heavy-duty vehicles. The tailpipe standards include different phase-in schedules that vary by vehicle class and begin to apply between model years 2017 and 2025. The Tier 3 gasoline sulfur standard, which reduced the allowable sulfur content to 10 parts per million (ppm) in 2017, allows manufacturers to comply across the fleet with the more stringent Tier 3 emission standards. Reduced sulfur content in gasoline will also enable the air pollution control devices on vehicles already in use to operate more effectively. The non-methane organic gases and NO_X tailpipe standards for light duty vehicles resulted in a 80% reduction based onthe fleet average at the time of promulgation. The heavy-duty tailpipe standards resulted in a 60% reduction .

7.2.1.4.3. Non-Road Diesel Emissions Programs

EPA promulgated a series of control programs in 40 CFR Part 89, Part 90, Part 91, Part 92, and Part 94 that implemented limitations by 2012 on compression ignition engines, spark-ignition non-road engines, marine engines, and locomotive engines. Environmental benefits will continue as consumers replace older engines with newer engines that have improved fuel economy and more stringent emissions standards. These regulations also required the use of cleaner fuels.

7.2.1.4.4. Emission Control Area Designation and Commercial Marine Vessels

On April 4, 2014, new standards for ocean-going vessels became effective and applied to ships constructed after 2015. These standards are found in MARPOL Annex VI,[38] the international convention for the prevention of pollution from ocean-going ships. These requirements also mandate the use of significantly cleaner fuels by all large ocean-going vessels when operated near the coastlines. The cleaner fuels lower SO_2 emission rates as well as emissions of other criteria pollutants since the engines operate more efficiently on the cleaner fuel. These requirements apply to vessels operating in waters of the United States as well as ships operating within 200 nautical miles of the coast of North America, also known as the North American Emission Control Area.

7.2.2. State Control Programs Included in the 2028 Projection Year

Under the North Carolina Clean Smokestacks Act, coal-fired power plants in North Carolina were required to achieve a 77% cut in NO_X emissions by 2009 and a 73% cut in SO_2 emissions by 2013.

Georgia Rule 391-3-1-.02(2)(sss) "Multi-Pollutant Control for Electric Utility Generating Units" established a schedule for the installation and operation of NO_X and SO_2 pollution control systems on many of the coal-fired power plants in Georgia. This rule, adopted in 2007, required controls for all affected units to be in place before June 1, 2015. The rule reduced SO_2 emissions by approximately 90%, NO_X emissions by approximately 85%, and mercury emissions by approximately 79%.

[38] URL: https://www.epa.gov/sites/production/files/2016-09/documents/resolution-mepc-251-66-4-4-2014.pdf

A number of consent agreements also impose specific controls that were included in this inventory development process:

- Lehigh Cement Company/Lehigh White Cement Company (US District Court, Eastern District of Pennsylvania): EPA reached a settlement with these companies on December 3, 2019, to settle alleged violations of the CAA. The settlement will reduce emissions of NO_X and SO_2 and applied to facilities located in serval states, including Alabama.

- VEPCO (US District Court, Eastern District of Virginia): Virginia Electric and Power Company (also known as Virginia-Dominion Power) agreed to spend $1.2 billion by 2013 to eliminate 237,000 tons of SO_2 and NO_X emissions each year from eight coal-fired electricity generating plants in Virginia and West Virginia.

- Anchor Glass Container (US District Court for the Middle District of Florida): On August 3, 2018, Anchor agreed to convert six of its furnaces to oxyfuel furnaces and will meet NO_X emission limits at these furnaces that are consistent or better than best available control technology. On remaining furnaces, Anchor agreed to install oxygen enriched air staging and meet more stringent emission limits. To control SO_2, Anchor agreed to install dry or semi-dry scrubber systems on two furnaces. Remaining furnaces must achieve batch optimization and meet enforceable emissions limits. Anchor also agreed to install NO_X and SO_2 continuous emissions monitoring systems at all furnaces. The expected emission reductions from the agreement are 2,000 tpy of NO_X and 700 tpy of SO_2 at facilities located in Florida, Georgia, Indiana, Minnesota, New York and Oklahoma.

7.2.2.1. Georgia Power EGU Retirements and Fuel Conversions

Since 2007, Georgia Power Company has retired over 4,500 MW of fossil fuel EGUs that fire coal, oil, and gas. The coal fired EGUs that have retired include Plant McDonough, Plant Branch, Plant Mitchell, Plant Kraft, Plant Yates (units 1-5), Plant Hammond, and Plant Mcintosh. These plants, except for Plant Hammond, did not operate SO_2 controls. Plant Hammond was equipped with a wet scrubber or Flue Gas Desulfurization (FGD) that reduced SO_2 emissions by 95%. Plant Yates units 6 and 7 were converted from firing coal to firing natural gas by 2015.

As a part of the 2022 Georgia Public Service Commission (PSC) Integrated Resource Plan (IRP), Georgia Power submitted a list of retirements since 2007 which include the following:

- 21 coal fired units
- 10 oil fired units (boilers and combustion turbines)
- 2 gas fired units (combustion turbines)

On July 21, 2022, the PSC approved the retirements of the following coal fired EGUs:

- Wansley 1 and 2 (August 2022)
- Scherer unit 3 (December 2028)
- Gaston (Alabama) Units 1-4 (December 2028) - 50% owned by Georgia Power

7.2.3. Projected VISTAS 2028 Emissions Inventory

The VISTAS emissions inventory for 2028 account for post-2011 emission reductions from promulgated federal, state, local, and site-specific control programs, many of which are described in Section 7.2.1 and Section 7.2.2. The VISTAS 2028 emissions inventory is based on EPA's 2028el emissions inventory data sets.[39] Onroad and non-road mobile source emissions were created for 2028 using the MOVES model. Nonpoint area source emissions were prepared using growth and control factors simulating changes in economic conditions and environmental regulations anticipated to be fully implemented by calendar year 2028. For EGU sources in projected year 2028, VISTAS states considered the EPA 2028el, the EPA 2023en, or 2028 emissions from the ERTAC EGU projection tool CONUS2.7 run and CONUS16.0 run. The EPA 2028el emissions inventory for EGUs considered the impacts of the CPP, which was later vacated. Additionally, the EPA 2028el EGU emissions inventory used results from IPM. IPM assumes units may retire or sit idle in future years based solely on economic decisions determined within the tool. Impacts of the CPP, IPM economic retirements, and IPM economic idling resulted in many coal-fired EGUs being shut down. Thus, the EPA 2028el projected emissions for EGU are not reflective of probable emissions for 2028. The ERTAC EGU tool outputs do not consider the impacts of the CPP. Georgia used EPA's 2023en emissions for projected 2028 EGU emissions. For states outside of VISTAS, EGU estimates were derived from CONUS16.0 and CONUS16.1 outputs. For non-EGU point source projections to year 2028, VISTAS states considered the EPA 2023en and EPA 2028el emissions and in some cases supplied their own emissions data. Georgia used 2016 emissions (or 2014 emissions if 2016 was not available) to represent 2028 emissions for the 33 non-EGU facilities with over 100 tpy of SO_2 in 2011, exclusive of Hartsfield-Jackson Atlanta International Airport. These facility-level emissions were adjusted to the process-level for all pollutants using process-level emission proportions from EPA 2023en.

These updates for 2028 are documented in the ERG emissions inventory reports included in Appendix B-2a.

Figure 7-1 and Figure 7-2 show the expected decrease in emissions of SO_2 and NO_X, respectively, across the VISTAS states from 2011 to 2028.

[39] URL: https://www.epa.gov/air-emissions-modeling/updates-2011-and-2028-emissions-version-63-technical-support-document

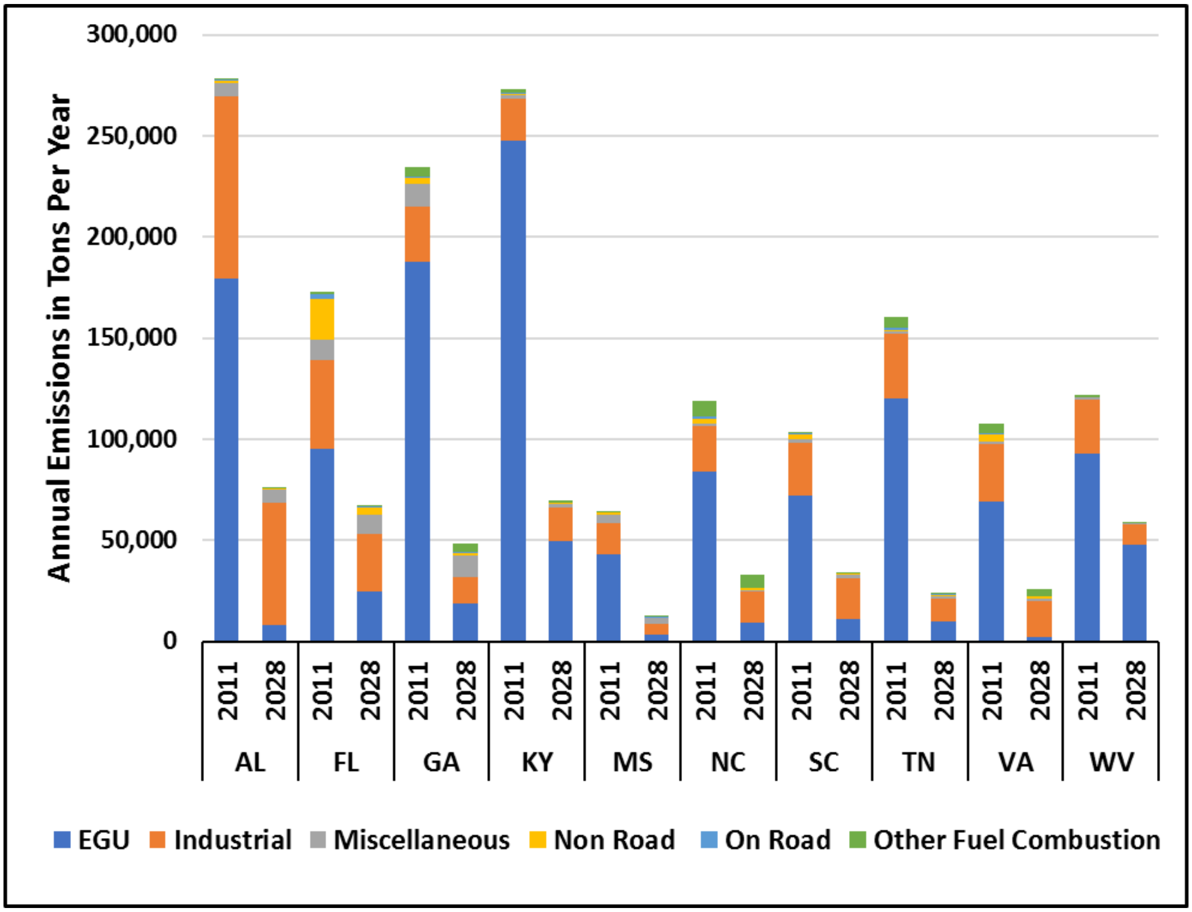


Figure 7-1: SO_2 Emissions for 2011 and 2028 for VISTAS States

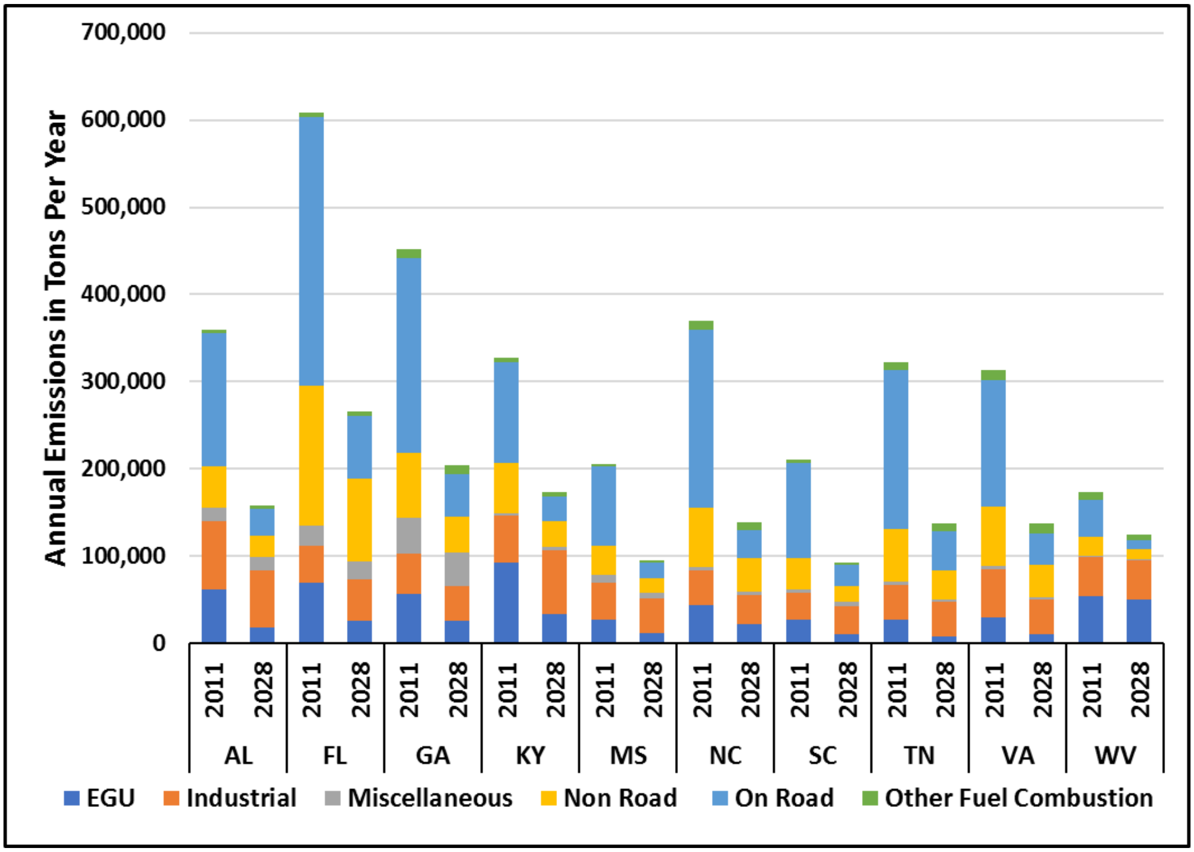


Figure 7-2: NO_X Emissions for 2011 and 2028 for VISTAS States

For SO_2 emissions, which are the largest contributors to haze, emissions across VISTAS are expected to decrease from 1,633,000 tons in 2011 to 448,000 tons in 2028, a 73% decrease. The EGU sector accounts for most of the reductions although in some states industrial SO_2 emissions are also expected to decrease significantly. Emissions of NO_X in VISTAS are projected to drop from 3,343,000 tons in 2011 to 1,528,000 tons in 2028, a 54% reduction. The majority of these reductions come from the onroad sector, and such reductions are heavily dependent on federal control programs due to the CAA prohibition regarding state regulation of engine controls. The NO_X reductions from the EGU sector are also expected to continue although NO_X from EGUs now make up a much smaller portion of the overall anthropogenic NO_X inventory as compared to inventories from prior the planning period. The expected SO_2 and NO_X emission reductions are due to state and federal control programs, the construction and operation of renewable energy sources, very efficient combined cycle generating units, the use of cleaner burning fuels, and other factors.

Figure 7-3 and Figure 7-4 show the 2011 and 2028 emissions for SO_2 and NO_X, respectively, in other areas of the country. These data show significant drops in both pollutants from all other RPOs. For Class I areas that are disproportionately impacted by emissions from states in RPOs other than VISTAS, these reductions will help improve visibility impairment by 2028.

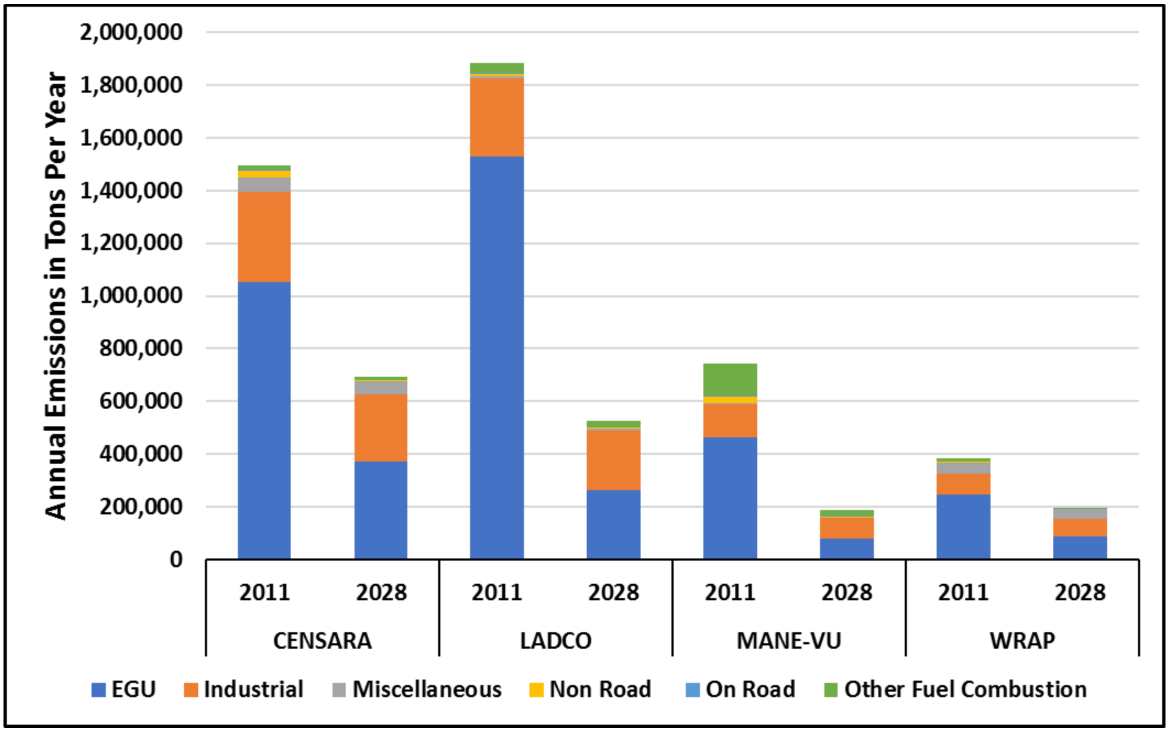


Figure 7-3: SO_2 Emissions for 2011 and 2028 for Other RPOs

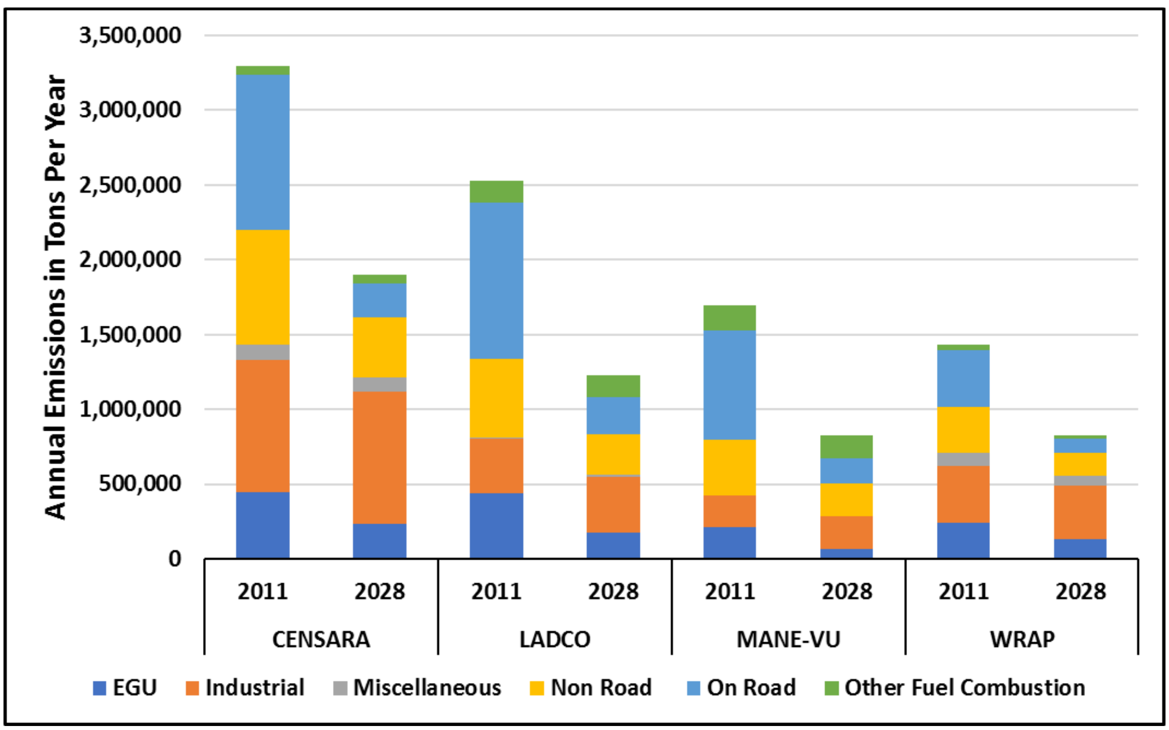


Figure 7-4: NOx Emissions for 2011 and 2028 for Other RPOs

Table 7-1 summarizes criteria pollutant emissions by state and Tier 1 NEI source sector from the 2011 and 2028 emissions inventories. The complete inventories and discussion of the methodology are contained in Appendix B-2a.

Table 7-1: 2011 and 2028 Criteria Pollutant Emissions, VISTAS States

State	Tier 1 Sector	2011 CO (tpy)	2028 CO (tpy)	2011 NO_X (tpy)	2028 NO_X (tpy)	2011 PM_{10} (tpy)	2028 PM_{10} (tpy)	2011 $PM_{2.5}$ (tpy)	2028 $PM_{2.5}$ (tpy)	2011 SO_2 (tpy)	2028 SO_2 (tpy)	2011 VOC (tpy)	2028 VOC (tpy)
AL	Chemical & Allied Product Mfg	3,123	3,122	2,411	2,409	704	704	650	650	6,559	6,583	1,629	1,576
AL	Fuel Comb. Elec. Util.	9,958	6,748	61,687	18,098	7,323	1,714	4,866	1,190	179,323	7,965	1,152	910
AL	Fuel Comb. Industrial	71,865	73,890	35,447	27,842	46,274	47,304	34,664	39,088	41,322	18,806	3,283	3,413
AL	Fuel Comb. Other	12,104	11,352	4,229	4,100	1,689	1,584	1,654	1,549	417	193	2,038	1,796
AL	Highway Vehicles	701,397	182,602	152,732	30,113	8,001	4,984	4,611	1,322	683	262	75,523	15,013
AL	Metals Processing	10,991	10,759	5,947	5,434	5,359	4,326	4,647	3,844	13,298	13,072	1,843	1,550
AL	Miscellaneous	670,765	666,279	14,735	14,567	445,039	494,515	108,297	113,981	6,746	6,679	159,034	158,720
AL	Off-Highway	261,788	253,400	47,801	25,355	3,584	1,781	3,369	1,653	1,074	193	43,396	22,709
AL	Other Industrial Processes	19,708	18,908	21,546	20,732	17,032	16,269	8,749	8,095	9,569	15,773	14,327	13,927
AL	Petroleum & Related Industries	14,882	9,353	11,226	7,416	373	310	354	292	19,196	3,365	22,103	15,109
AL	Solvent Utilization	124	119	135	120	83	74	61	54	1	1	46,790	46,658
AL	Storage & Transport	65	65	51	51	870	823	653	604	2	2,767	18,726	12,302
AL	Waste Disposal & Recycling	45,712	45,712	1,876	1,876	7,885	7,885	6,531	6,531	175	175	3,620	3,620
AL	**Subtotals:**	1,822,482	1,282,309	359,823	158,113	544,216	582,273	179,106	178,853	278,365	75,834	393,464	297,303
FL	Chemical & Allied Product Mfg	117	117	1,393	1,279	415	337	348	295	21,948	14,260	1,231	1,230
FL	Fuel Comb. Elec. Util.	36,344	25,254	69,049	26,425	11,621	8,680	9,607	7,973	95,087	24,565	1,931	1,497
FL	Fuel Comb. Industrial	72,200	78,811	31,291	29,867	33,061	38,121	28,979	33,504	15,715	8,477	4,576	3,617
FL	Fuel Comb. Other	25,015	23,851	4,601	4,590	3,498	3,278	3,448	3,248	1,183	303	4,330	3,860
FL	Highway Vehicles	1,784,678	679,511	308,752	72,019	21,329	19,834	9,377	4,412	2,104	823	183,609	51,019
FL	Metals Processing	742	480	80	80	199	192	165	159	337	31	62	49
FL	Miscellaneous	992,515	960,190	22,844	21,346	384,091	466,941	129,258	138,297	10,473	9,727	231,259	228,825
FL	Off-Highway	1,120,490	1,125,776	159,796	94,782	14,009	6,737	13,181	6,231	20,051	2,973	166,582	88,560
FL	Other Industrial Processes	13,065	13,065	8,885	12,313	28,504	28,693	11,836	12,042	4,338	4,315	14,485	14,315
FL	Petroleum & Related Industries	802	828	279	293	92	93	63	64	211	211	2,847	2,252
FL	Solvent Utilization	3	3	2	2	34	33	30	30	<0.5	<0.5	151,477	151,367
FL	Storage & Transport	104	104	154	154	1,177	971	592	528	29	29	101,966	68,391
FL	Waste Disposal & Recycling	27,944	28,108	1,240	2,301	4,151	4,199	3,492	3,534	1,224	1,265	2,707	2,734
FL	**Subtotal:**	4,074,019	2,936,098	608,366	265,451	502,181	578,109	210,376	210,317	172,700	66,979	867,062	617,716

State	Tier 1 Sector	2011 CO (tpy)	2028 CO (tpy)	2011 NO_X (tpy)	2028 NO_X (tpy)	2011 PM_{10} (tpy)	2028 PM_{10} (tpy)	2011 $PM_{2.5}$ (tpy)	2028 $PM_{2.5}$ (tpy)	2011 SO_2 (tpy)	2028 SO_2 (tpy)	2011 VOC (tpy)	2028 VOC (tpy)
GA	Chemical & Allied Product Mfg	502	476	959	931	476	406	408	353	1,580	1,054	2,571	2,399
GA	Fuel Comb. Elec. Util.	13,543	10,611	56,037	25,481	9,061	5,150	6,298	4,242	188,009	18,411	1,195	1,016
GA	Fuel Comb. Industrial	21,837	19,771	22,274	17,788	3,198	2,672	2,752	2,311	21,358	9,769	1,737	1,618
GA	Fuel Comb. Other	20,021	19,536	11,233	10,857	2,204	1,998	2,152	1,950	4,660	4,187	3,056	2,730
GA	Highway Vehicles	1,018,645	305,264	223,223	48,973	12,518	8,914	6,829	2,289	1,088	443	109,005	25,629
GA	Metals Processing	344	344	149	149	156	156	82	82	92	92	57	57
GA	Miscellaneous	1,022,524	984,133	40,646	39,003	858,861	998,804	220,258	232,719	11,424	10,688	78,048	75,220
GA	Off-Highway	471,960	477,533	74,217	40,838	5,923	2,974	5,594	2,769	2,562	967	60,843	36,837
GA	Other Industrial Processes	24,548	17,280	15,893	13,130	47,506	45,021	17,925	15,808	3,705	2,268	22,763	20,583
GA	Petroleum & Related Industries	6	6	none reported	none reported	23	22	11	13	none reported	none reported	132	131
GA	Solvent Utilization	25	24	30	28	31	31	30	30	<0.5	<0.5	84,352	83,997
GA	Storage & Transport	49	49	21	21	1,015	1,014	511	502	none reported	none reported	33,985	23,439
GA	Waste Disposal & Recycling	227,703	227,696	7,636	7,628	26,852	26,851	26,222	26,221	223	222	17,363	17,361
GA	**Subtotals:**	**2,821,707**	**2,062,723**	**452,318**	**204,827**	**967,824**	**1,094,013**	**289,072**	**289,289**	**234,701**	**48,101**	**415,107**	**291,017**
KY	Chemical & Allied Product Mfg	62	62	241	241	817	816	708	708	1,663	393	2,202	2,189
KY	Fuel Comb. Elec. Util.	15,547	12,253	92,756	33,258	13,874	7,409	9,495	5,781	247,556	49,728	1,749	1,067
KY	Fuel Comb. Industrial	10,848	10,870	20,009	17,876	2,247	2,505	1,981	2,214	5,774	4,819	1,422	1,031
KY	Fuel Comb. Other	48,175	43,582	5,765	5,477	6,891	6,158	6,781	6,072	1,868	1,166	8,390	7,183
KY	Highway Vehicles	498,702	157,636	115,685	27,819	5,480	3,448	3,345	1,015	502	209	50,326	12,938
KY	Metals Processing	61,446	61,446	1,611	1,611	4,151	4,111	3,402	3,383	6,021	3,200	2,081	2,081
KY	Miscellaneous	190,510	180,432	3,486	3,034	204,775	230,661	44,517	47,310	1,742	1,528	43,514	42,725
KY	Off-Highway	201,625	193,150	56,646	29,793	3,573	1,557	3,392	1,464	641	402	31,999	17,094
KY	Other Industrial Processes	4,985	4,992	5,682	5,662	26,177	25,483	9,042	8,737	6,468	6,465	31,759	31,489
KY	Petroleum & Related Industries	31,312	67,128	24,707	47,426	683	2,795	633	2,745	522	1,561	31,085	44,846
KY	Solvent Utilization	3	3	5	5	83	81	73	72	<0.5	<0.5	44,118	44,031
KY	Storage & Transport	23	23	6	6	2,005	1,804	484	427	3	3	22,606	16,169
KY	Waste Disposal & Recycling	25,288	25,288	1,156	1,156	5,335	5,330	4,532	4,527	161	161	2,352	2,352
KY	**Subtotals:**	**1,088,526**	**756,865**	**327,755**	**173,364**	**276,091**	**292,158**	**88,385**	**84,455**	**272,921**	**69,635**	**273,603**	**225,195**

State	Tier 1 Sector	2011 CO (tpy)	2028 CO (tpy)	2011 NO_X (tpy)	2028 NO_X (tpy)	2011 PM_{10} (tpy)	2028 PM_{10} (tpy)	2011 $PM_{2.5}$ (tpy)	2028 $PM_{2.5}$ (tpy)	2011 SO_2 (tpy)	2028 SO_2 (tpy)	2011 VOC (tpy)	2028 VOC (tpy)
MS	Chemical & Allied Product Mfg	7,477	7,454	1,864	1,841	487	481	430	428	1,377	49	1,317	1,316
MS	Fuel Comb. Elec. Util.	6,154	4,172	26,602	12,229	2,084	1,457	1,627	1,120	43,259	3,237	487	416
MS	Fuel Comb. Industrial	14,794	16,135	32,381	27,363	3,448	3,458	2,935	2,820	6,397	1,631	3,428	3,253
MS	Fuel Comb. Other	7,450	7,009	2,885	2,848	1,029	967	997	935	50	50	1,200	1,056
MS	Highway Vehicles	433,332	117,589	91,026	17,788	4,491	3,100	2,538	814	405	165	46,084	9,317
MS	Metals Processing	1,313	2,021	381	1,446	549	371	546	364	124	1,366	127	156
MS	Miscellaneous	372,960	325,044	9,080	6,803	996,316	1,211,587	142,022	160,523	4,248	3,165	81,272	77,346
MS	Off-Highway	153,473	143,429	33,132	16,707	2,493	1,074	2,353	999	1,029	143	29,662	14,770
MS	Other Industrial Processes	5,127	5,046	3,204	2,591	8,129	7,605	5,372	4,901	678	652	10,915	10,632
MS	Petroleum & Related Industries	4,592	5,412	3,641	4,105	257	322	200	270	6,240	1,407	28,840	24,313
MS	Solvent Utilization	31	30	39	37	115	113	105	104	<0.5	<0.5	38,358	37,486
MS	Storage & Transport	368	368	71	71	109	103	70	66	42	42	29,068	20,947
MS	Waste Disposal & Recycling	42,760	42,760	1,591	1,591	6,657	6,657	5,392	5,392	91	91	3,780	3,843
MS	**Subtotals:**	1,049,831	676,469	205,897	95,420	1,026,164	1,237,295	164,587	178,736	63,940	11,998	274,538	204,851
NC	Chemical & Allied Product Mfg	7,188	693	1,286	879	738	1,184	472	462	5,507	5,056	2,756	3,712
NC	Fuel Comb. Elec. Util.	32,828	10,563	43,911	21,401	8,790	3,190	6,921	2,867	83,925	8,976	934	1,095
NC	Fuel Comb. Industrial	16,197	14,319	24,394	16,775	3,828	2,910	2,899	2,430	12,354	5,139	1,500	1,172
NC	Fuel Comb. Other	29,163	28,846	9,652	9,791	4,724	4,604	4,323	4,246	7,757	5,970	4,611	4,302
NC	Highway Vehicles	1,145,623	252,167	204,008	30,968	10,447	6,512	5,510	1,646	1,082	311	112,173	21,709
NC	Metals Processing	2,675	2,122	324	454	355	547	308	471	556	433	1,493	1,005
NC	Miscellaneous	101,890	86,087	4,047	3,500	195,376	221,483	45,672	49,500	1,068	956	7,851	6,672
NC	Off-Highway	479,335	471,127	68,433	39,379	5,742	2,994	5,435	2,798	2,472	1,055	63,283	37,520
NC	Other Industrial Processes	5,731	11,412	10,261	12,529	14,515	18,192	6,970	8,780	3,279	4,105	15,218	20,374
NC	Petroleum & Related Industries	773	1,007	263	305	249	295	160	263	432	412	306	354
NC	Solvent Utilization	53	79	72	103	145	177	121	165	31	8	95,419	110,199
NC	Storage & Transport	2,174	278	125	128	590	654	306	412	7	11	24,731	15,117
NC	Waste Disposal & Recycling	66,928	67,028	2,720	2,772	11,151	11,153	9,386	9,420	251	213	5,613	5,800
NC	**Subtotals:**	1,890,558	945,728	369,496	138,984	256,650	273,895	88,483	83,460	118,721	32,645	335,888	229,031

State	Tier 1 Sector	2011 CO (tpy)	2028 CO (tpy)	2011 NO_X (tpy)	2028 NO_X (tpy)	2011 PM_{10} (tpy)	2028 PM_{10} (tpy)	2011 $PM_{2.5}$ (tpy)	2028 $PM_{2.5}$ (tpy)	2011 SO_2 (tpy)	2028 SO_2 (tpy)	2011 VOC (tpy)	2028 VOC (tpy)
SC	Chemical & Allied Product Mfg	1,217	1,217	165	165	132	131	77	76	9	4	2,110	1,843
SC	Fuel Comb. Elec. Util.	16,809	13,527	26,752	10,993	10,851	3,290	8,604	2,672	71,899	10,762	607	573
SC	Fuel Comb. Industrial	19,560	21,191	17,924	17,505	10,314	11,286	8,273	9,498	15,748	9,386	1,103	1,117
SC	Fuel Comb. Other	12,508	11,800	3,283	3,351	1,701	1,580	1,660	1,546	339	309	2,128	1,867
SC	Highway Vehicles	475,876	155,913	109,374	23,263	6,618	4,504	3,766	1,152	504	215	51,164	12,546
SC	Metals Processing	53,733	53,811	780	861	572	581	480	489	5,139	5,182	457	457
SC	Miscellaneous	214,147	200,969	4,602	4,033	280,281	341,123	51,363	56,686	1,978	1,902	48,908	47,771
SC	Off-Highway	240,507	233,340	35,569	19,154	3,036	1,477	2,856	1,369	2,268	360	35,104	19,097
SC	Other Industrial Processes	17,912	17,827	10,251	11,697	7,581	7,311	4,149	3,897	5,223	5,724	15,036	14,754
SC	Petroleum & Related Industries	none reported	none reported	none reported	none reported	none reported	none reported	none reported	none reported	none reported	none reported	31	29
SC	Solvent Utilization	7	7	1	1	14	14	13	12	<0.5	<0.5	41,039	39,341
SC	Storage & Transport	39	39	26	26	346	282	139	119	1	1	30,397	21,258
SC	Waste Disposal & Recycling	48,668	48,667	1,817	1,806	7,055	7,042	5,746	5,735	140	139	4,073	4,059
SC	**Subtotals:**	1,100,983	758,308	210,544	92,855	328,501	378,621	87,126	83,251	103,248	33,984	232,157	164,712
TN	Chemical & Allied Product Mfg	14,866	14,862	811	804	755	755	426	426	492	489	4,412	4,397
TN	Fuel Comb. Elec. Util.	5,529	3,771	27,156	8,006	5,191	2,618	4,172	2,444	120,170	10,059	769	585
TN	Fuel Comb. Industrial	18,910	22,671	27,988	25,234	10,632	12,293	9,018	10,691	27,778	8,076	1,129	1,239
TN	Fuel Comb. Other	25,945	23,479	9,207	8,441	3,470	3,044	3,182	2,928	5,441	779	5,168	4,906
TN	Highway Vehicles	739,041	233,423	182,796	44,927	9,927	6,734	5,778	1,811	769	338	80,463	20,483
TN	Metals Processing	5,066	5,066	611	611	1,492	1,492	1,251	1,251	572	681	2,923	2,923
TN	Miscellaneous	133,301	124,792	2,840	2,450	150,164	165,066	36,986	39,404	1,347	1,162	31,052	30,344
TN	Off-Highway	309,062	298,569	60,384	33,596	4,242	2,032	4,010	1,898	767	625	46,292	25,501
TN	Other Industrial Processes	5,668	6,244	7,449	8,189	11,527	11,224	6,034	5,779	2,550	1,468	15,672	14,828
TN	Petroleum & Related Industries	2,706	4,956	1,812	3,193	189	307	160	278	243	149	3,559	3,517
TN	Solvent Utilization	72	72	84	84	328	328	288	288	15	15	67,091	67,091
TN	Storage & Transport	56	56	37	29	520	393	238	184	5	4	29,921	19,812
TN	Waste Disposal & Recycling	26,959	26,959	1,392	1,392	5,710	5,710	4,813	4,813	174	137	2,549	2,839
TN	**Subtotals:**	1,287,181	764,920	322,567	136,956	204,147	211,996	76,356	72,195	160,323	23,982	291,000	198,465

State	Tier 1 Sector	2011 CO (tpy)	2028 CO (tpy)	2011 NO_X (tpy)	2028 NO_X (tpy)	2011 PM_{10} (tpy)	2028 PM_{10} (tpy)	2011 $PM_{2.5}$ (tpy)	2028 $PM_{2.5}$ (tpy)	2011 SO_2 (tpy)	2028 SO_2 (tpy)	2011 VOC (tpy)	2028 VOC (tpy)
VA	Chemical & Allied Product Mfg	83	83	7,707	1,734	169	169	73	73	203	203	486	485
VA	Fuel Comb. Elec. Util.	4,984	6,232	30,213	10,677	5,794	3,858	1,157	1,456	69,077	1,903	742	448
VA	Fuel Comb. Industrial	13,713	11,294	22,048	13,962	5,883	5,071	4,817	4,376	14,349	5,776	950	871
VA	Fuel Comb. Other	77,919	74,900	11,470	11,034	11,302	10,748	11,002	10,507	4,884	3,264	12,940	11,877
VA	Highway Vehicles	566,315	232,611	145,507	35,427	7,106	4,302	4,368	1,309	711	279	63,152	18,550
VA	Metals Processing	3,016	3,016	812	812	859	858	724	723	5,196	5,196	270	270
VA	Miscellaneous	167,730	164,877	3,186	3,077	141,777	156,214	33,384	36,128	1,487	1,439	39,308	39,107
VA	Off-Highway	383,506	391,290	67,844	37,836	5,029	2,576	4,747	2,398	3,355	892	48,417	30,266
VA	Other Industrial Processes	5,644	7,256	12,766	10,337	12,394	12,839	5,001	5,400	7,028	5,294	6,937	7,107
VA	Petroleum & Related Industries	12,445	12,993	9,618	9,748	406	541	284	424	59	65	8,525	12,152
VA	Solvent Utilization	<0.5	0	<0.5	0	66	68	61	63	<0.5	<0.5	85,760	93,969
VA	Storage & Transport	5	6	2	2	351	353	286	301	<0.5	<0.5	23,556	16,224
VA	Waste Disposal & Recycling	33,103	33,192	2,283	2,305	5,745	5,758	4,925	4,932	1,469	1,483	4,317	4,380
VA	**Subtotals:**	1,268,463	937,750	313,456	136,951	196,881	203,355	70,829	68,090	107,818	25,794	295,360	235,706
WV	Chemical & Allied Product Mfg	247	249	402	278	330	296	246	229	145	106	2,000	1,036
WV	Fuel Comb. Elec. Util.	10,106	8,663	54,289	49,885	11,066	6,822	9,100	5,462	93,080	47,746	1,011	1,162
WV	Fuel Comb. Industrial	4,424	3,896	16,592	10,820	1,977	1,291	1,086	492	16,306	6,241	540	581
WV	Fuel Comb. Other	19,471	18,115	8,661	6,695	2,893	2,751	2,803	2,671	760	677	4,059	3,472
WV	Highway Vehicles	185,437	55,258	41,840	10,124	2,101	1,273	1,269	375	179	72	20,493	5,208
WV	Metals Processing	24,179	24,088	1,806	1,839	1,468	1,362	1,046	973	2,069	1,956	520	499
WV	Miscellaneous	86,791	86,171	1,296	1,277	76,122	76,051	15,876	15,810	684	677	20,396	20,356
WV	Off-Highway	89,194	89,372	22,397	11,934	1,428	696	1,341	649	204	35	15,934	8,932
WV	Other Industrial Processes	2,726	2,616	2,464	1,941	21,016	20,439	3,655	3,664	1,983	1,350	1,283	1,443
WV	Petroleum & Related Industries	27,645	42,008	22,041	29,242	692	1,514	594	1,511	6,144	191	47,734	130,121
WV	Solvent Utilization	<0.5	<0.5	<0.5	none reported	13	2	13	2	<0.5	none reported	14,315	13,610
WV	Storage & Transport	2	2	4	21	465	220	182	74	<0.5	<0.5	8,621	5,687
WV	Waste Disposal & Recycling	31,785	31,786	1,152	1,152	4,840	4,840	3,981	3,981	63	63	2,622	2,606
WV	**Subtotals:**	482,007	362,224	172,944	125,208	124,411	117,557	41,192	35,893	121,617	59,114	139,528	194,713
VISTAS	**Totals:**	16,885,757	11,483,394	3,343,166	1,528,129	4,427,066	4,969,272	1,295,512	1,284,539	1,634,354	448,066	3,517,707	2,658,709

7.2.4. EPA Inventories

EPA created a 2016 base year emissions inventory for modeling purposes in a collaborative effort with states and RPOs. The 2016 emissions inventory data for the point source and EGU sectors originated with state submissions to the EIS and, for those units subject to 40 CFR Part 75 monitoring requirements, unit level reporting to CAMD. Other source sector data were estimated by EPA, through emissions inventory tools, or estimates based upon state supplied input. This data set includes a full suite of 2016 base year inventories and projection year data for 2023 and 2028.[40] The 2023 and 2028 projections from 2016 relied upon IPM for estimates of EGU activity and emissions. EPA has provided emission summaries of this information at state and SCC levels for both the 2016 base year and EPA's previous 2014 base year. EPA used the 2014 NEI data to create the 2014 base year data set. Point source and EGU sector information for the 2014 NEI originated with state submissions or from unit level reporting to CAMD. Other sectors in the 2014 NEI were created by EPA based on tool inputs supplied by state staff, contractor estimates, and additional sources. Evaluation of these data sets show trends that are similar to those in the VISTAS emissions inventory.

EPA has also prepared and published the 2017 NEI[41] based on point source and EGU sector data that originated with state EIS submissions or unit level reporting to CAMD. EPA developed other emissions sectors of the 2017 NEI using state-supplied input files for emission estimation tools, contractor estimates, and additional sources of data. These data represent the January 2021 version of this database, which includes all sectors and pollutants for emissions across the United States.

Figure 7-5 provides the estimated actual SO_2 emissions within the EPA inventories for 2014, 2016, and 2017 by Tier 1 category within the ten VISTAS states; the emissions inventories for years 2023 and 2028, projected from the base year 2016 data by EPA; and the 2011 and 2028 VISTAS inventories used in the RPG modeling. The 2011 and 2014 data show that SO_2 emissions were predominantly emitted from electric utility fuel combustion and industrial fuel combustion within the VISTAS region. Significant SO_2 reductions occurred by 2016, and additional reductions occurred in 2017. These SO_2 reductions are most pronounced in the electric utility fuel combustion category. EPA's 2023 and 2028 data forecast continued declines in SO_2 emissions from this category. The VISTAS 2028 data also project additional SO_2 emission reductions across the VISTAS states although these projections are higher than the EPA 2028 projections.

Figure 7-6 provides the estimated actual NO_X emissions within the EPA inventories for 2014, 2016, and 2017 by Tier 1 category within the ten VISTAS states; the emissions inventories for

[40] URL: https://www.epa.gov/air-emissions-modeling/2016v1-platform
[41] URL: https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data

years 2023 and 2028, projected from the base year 2016 data by EPA; and the 2011 and 2028 VISTAS inventories used in the RPG modeling. The 2011, 2014, and 2016 data show that NO_X emissions were predominantly emitted from onroad and off-highway source sectors. Significant reductions in NO_X occurred by 2016 as compared to 2011. During this time period reductions in emissions from onroad and off-highway source sectors as well as the electrical utility fuel combustion sector contributed to this drop. EPA's 2023 and 2028 projections forecast continued declines in NO_X emissions, most notably from the onroad and off-highway source sectors. The VISTAS 2028 data also project additional NO_X emission reductions across the VISTAS states although the estimated reductions are not as great as those from EPA.

The VISTAS 2028 data is higher than the EPA 2028 projections largely due to differences in projection methodologies for EGUs and some non-EGUs. For example, EPA relied upon IPM results that generally have lower SO_2 and NO_X emissions than ERTAC results. The IPM tool may retire or idle coal fired EGUs and certain coal fired industrial boilers that occasionally provide electricity to the grid due to economic assumptions within the model. ERTAC projections does not use economic decisions to forecast retirements or idling of units in future years. Rather, states provide estimated retirement dates based on information provided by the facility owners, consent decrees, permits, or other types of documentation. The ERTAC projections, therefore, tend to be more conservative.

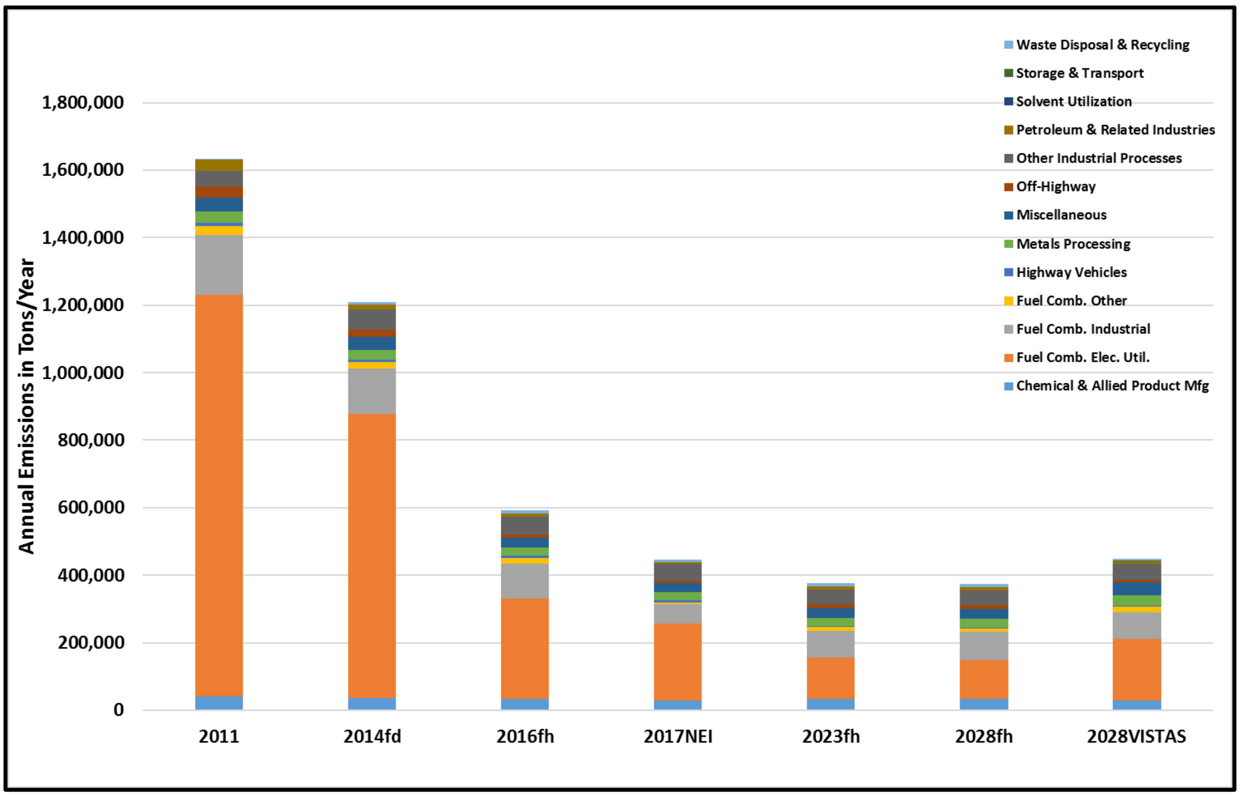


Figure 7-5: SO_2 Emissions from VISTAS States

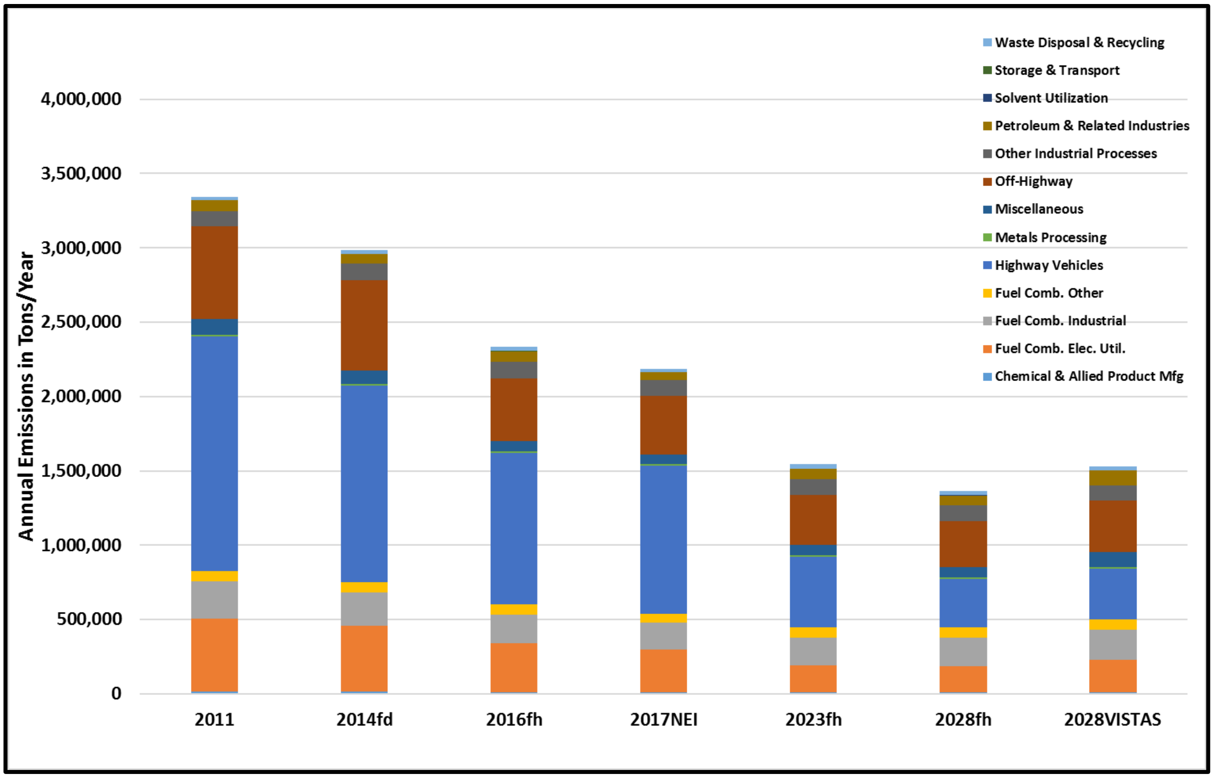


Figure 7-6: NO_X Emissions from VISTAS States

The data for Georgia in the EPA inventories also forecast significant declines in both SO_2 and NO_X emissions. Figure 7-7 provides EPA's estimates of Georgia's actual SO_2 emissions from 2011, 2014, 2016, and 2017 as well as EPA's projected values for 2023 and 2028 and the VISTAS projected value for 2028. EPA estimated about 234,700 tons of SO_2 emissions from Georgia in 2011. EPA expects that SO_2 emissions in Georgia will drop to about 42,700 tons by 2028, an 81.8% reduction. The VISTAS projection for Georgia shows that emissions of SO_2 should drop to just over 48,000 tons by 2028, a 79.5% reduction.

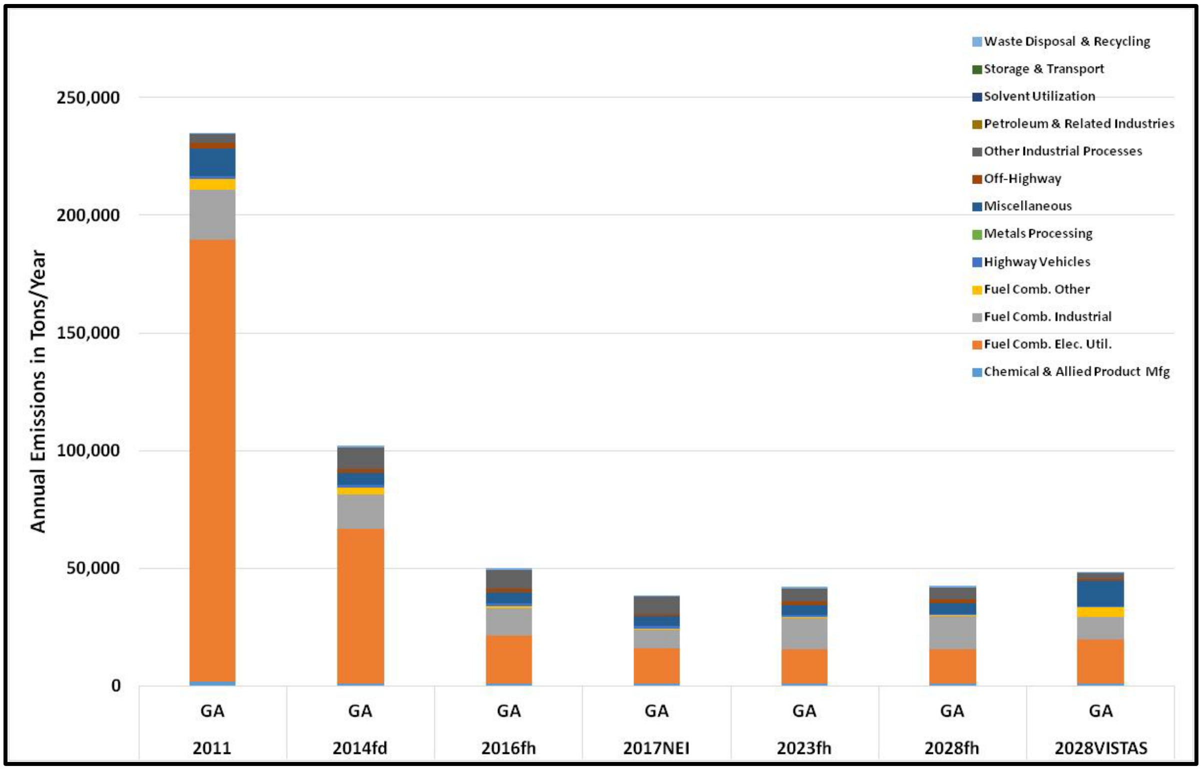


Figure 7-7: Georgia SO_2 Emissions

Figure 7-8 provides EPA's estimates of actual NO_X emissions in Georgia from 2011, 2014, 2016, and 2017. The figure also shows EPA's projected values for 2023 and 2028, using 2016 as the base year, and the VISTAS projections for 2028. EPA estimated about 452,300 tons of NO_X emissions from Georgia in 2011. EPA expects that NO_X emissions in Georgia will drop to just under 173,400 tons by 2028, a 61.7% reduction. The VISTAS projections estimate that Georgia NO_X emissions will drop to about 204,800 tons by 2028, a 54.7% reduction.

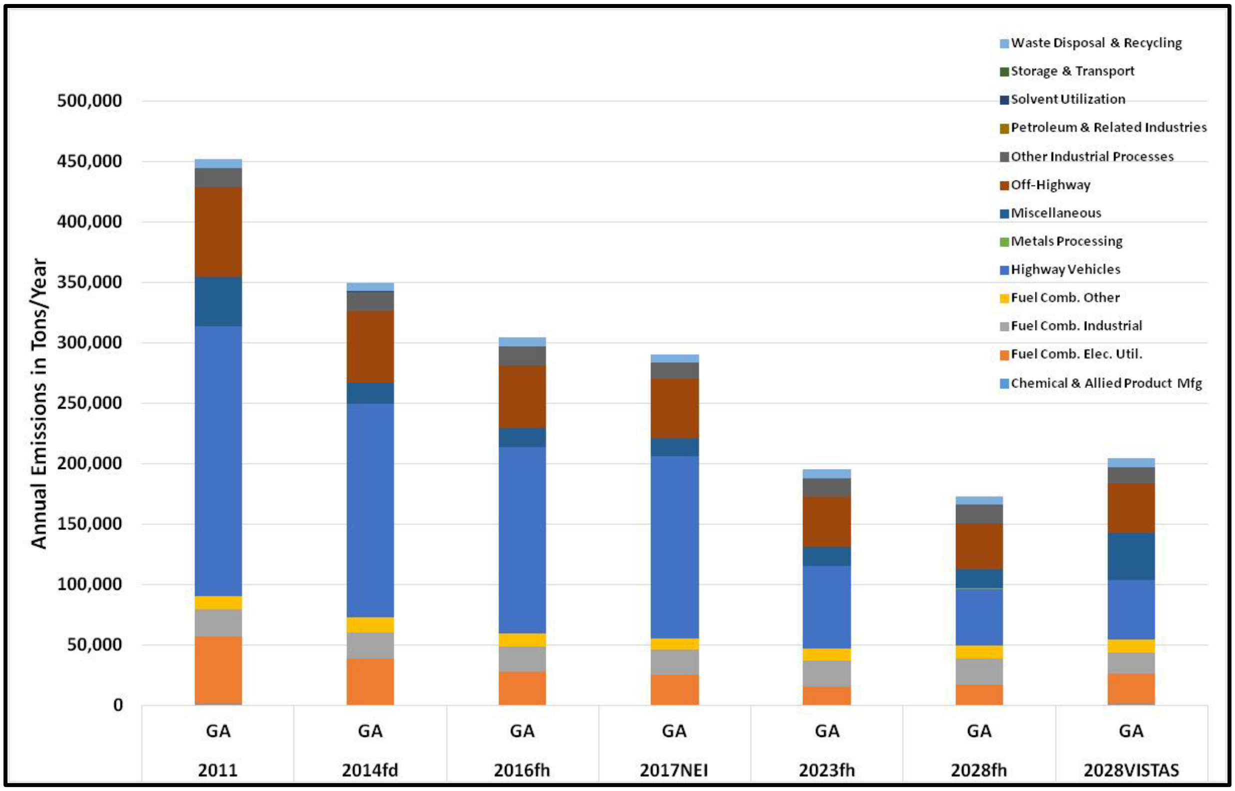


Figure 7-8: Georgia NOx Emissions

The VISTAS 2028 projections do not include reductions from programs noted in Section 8.2 so that the estimates are likely conservative and actual 2028 emissions of SO_2 and NO_X should be lower than those noted.

7.2.5. VISTAS 2028 Model Projections

VISTAS states used emissions modeling, as described in Section 5 and Section 6, to project visibility in 2028 using a 2028 emissions inventory as described in Section 4. The EPA Software for Model Attainment Test – Community Edition (SMAT-CE) tool was used to calculate 2028 deciview values on the 20% most impaired and 20% clearest days at each Class I area IMPROVE monitoring site. SMAT-CE[42] is an EPA software tool that implements the procedures in the "Modeling Guidance for Demonstrating Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze," (SIP modeling guidance)[43] to project visibility in the future year. The SMAT-CE tool outputs individual year and five-year average base year and future year deciview values on the 20% most impaired days and the 20% clearest days.

[42] URL: https://www.epa.gov/scram/photochemical-modeling-tools

[43] URL: https://www.epa.gov/sites/production/files/2020-10/documents/o3-pm-rh-modeling_guidance-2018.pdf

7.2.5.1. Calculation of 2028 Visibility Estimates

The visibility projections follow the procedures in Section 5 of the SIP modeling guidance. Based on recommendations in the SIP modeling guidance, the observed base period visibility data is linked to the modeling base period. In this case, for a base modeling year of 2011, the 2009-2013 IMPROVE data for the 20% most impaired days and 20% clearest days were used as the basis for the 2028 projections. Section 2.5 discusses the IMPROVE monitoring data during the modeling base period of 2009-2013.

The visibility calculations use the IMPROVE equation discussed in Section 2.1. As noted in Section 2.1, the IMPROVE algorithm uses PM species concentrations and relative humidity data to calculate visibility impairment as extinction (b_{ext}) in units of inverse megameters.

The 2028 future year visibility on the 20% most impaired days and the 20% clearest days at each Class I area is estimated by using the observed IMPROVE data from years 2009-2013 and the relative percent modeled change in PM species between 2011 and 2028. The following steps describe the process. The SIP modeling guidance contains more detailed description and examples.

- Step 1 - For each Class I area (i.e., IMPROVE site), estimate anthropogenic impairment (Mm^{-1}) on each day using observed speciated $PM_{2.5}$ data plus PM_{10} data (and other information) for each of the five years comprising the modeling base period (2009-2013) and rank the days on this indicator.[44] This ranking will determine the 20% most impaired days. For each Class I area, also rank observed visibility (in deciviews) on each day using observed speciated $PM_{2.5}$ data plus PM_{10} data for each of the five years comprising the modeling base period. This ranking will determine the 20% clearest days.

- Step 2 - For each of the five years comprising the base period, calculate the mean deciviews for the 20% most impaired days and the 20% clearest days. For each Class I area, calculate the five-year mean deciviews for the 20% most impaired and the 20% clearest days from the five year-specific values.

- Step 3 - Use an air quality model to simulate air quality with base period (2011) emissions and future year (2028) emissions. Use the resulting information to develop monitor site-specific relative response factors (RRFs) for each component of PM identified in the "revised" IMPROVE equation. The RRFs are an average percent change in species concentrations based on the measured 20% most impaired days and 20% clearest days from 2011 to 2028. The calendar days from 2011 identified from the IMPROVE data above are matched by day to the modeled days. RRFs are calculated

[44] EPA, "Technical Guidance on Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program", December 2018. URL: https://www.epa.gov/sites/production/files/2018-12/documents/technical_guidance_tracking_visibility_progress.pdf

separately for sulfate, nitrate, organic carbon mass, elemental carbon, fine soil mass, and coarse mass. The observed sea salt is primarily from natural sources that are not expected to be year-sensitive, and the modeled sea salt is uncertain. Therefore, the sea salt RRF for all monitor sites is assumed to be 1.0.

- Step 4 – For each monitor site, multiply the species-specific RRFs by the measured daily species concentration data during the 2009-2013 base period for each day in the measured 20% most impaired day data set and each day in the 20% clearest day data set. This results in daily future year 2028 PM species concentration data.

- Step 5 - Using the results in Step 4 and the IMPROVE algorithm described in Section 2.1, calculate the future daily extinction coefficients for the previously identified 20% most impaired days and 20% clearest days in each of the five base years.

- Step 6 - Calculate daily deciview values (from total daily extinction) and then compute the future year (2028) average mean deciviews for the 20% most impaired days and 20% clearest days for each year. Average the five years together to get the final future mean deciview values for the 20% most impaired days and 20% clearest days.

In cases where an IMPROVE monitor is located within a Class I area, the five-year average modeling base period visibility is used with modeled concentrations from the grid cell containing the IMPROVE monitor to calculate future year RRFs and visibility results. In cases within VISTAS states where an IMPROVE monitor is not located within a Class I Area, surrogate IMPROVE monitors are assigned to establish modeling base period visibility values. See Section 2.2 for a description and listing of these sites. When using a surrogate IMPROVE monitor site, the five-year average modeling base period visibility from the surrogate location is used with modeled concentrations from the actual modeled grid cell at the centroid of the Class I area to calculate future year RRFs and visibility results. In Class I areas outside of the VISTAS states, surrogate monitor modeling base period data and RRFs are used to project future year visibility.

7.2.5.2. 2028 Visibility Projection Results

Table 7-2 provides the 2028 visibility projections for VISTAS Class I areas and nearby Class I areas. More information on these projections may be found in Appendix E-6.

Table 7-2: 2028 Visibility Projections for VISTAS and Nearby Class I Areas

Class I Area	Site ID	State	2028 20% Clearest Days dv)	2028 20% Clearest Days (Mm^{-1})	2028 20% Most Impaired Days (dv)	2028 20% Most Impaired Days (Mm^{-1})
Cape Romain Wilderness Area	ROMA1	SC	12.11	33.87	16.64	53.81
Chassahowitzka Wilderness Area	CHAS1	FL	12.54	35.28	16.79	54.50
Cohutta Wilderness Area	COHU1	GA	9.15	25.51	14.90	45.63
Dolly Sods Wilderness Area	DOSO1	WV	7.55	21.79	15.29	47.82
Everglades National Park	EVER1	FL	10.64	29.13	15.52	47.87
Great Smoky Mountains National Park	GRSM1	TN	8.96	25.02	15.03	46.08
James River Face Wilderness Area	JARI1	VA	9.80	27.13	15.87	50.46
Joyce Kilmer-Slickrock Wilderness Area	GRSM1	TN	8.97	25.02	14.88	45.36
Linville Gorge Wilderness Area	LIGO1	NC	8.21	23.06	14.25	42.61
Mammoth Cave National Park	MACA1	KY	11.66	32.50	19.27	70.87
Okefenokee National Wilderness Area	OKEF1	GA	11.58	32.14	16.90	55.59
Otter Creek Wilderness Area	DOSO1	WV	7.55	21.80	15.26	47.66
Shenandoah National Park	SHEN1	VA	7.27	21.20	14.47	44.02
Shining Rock Wilderness Area	SHRO1	NC	4.54	15.74	13.31	37.86
Sipsey Wilderness Area	SIPS1	AL	11.11	30.75	16.62	54.13
St. Marks Wilderness Area	SAMA1	FL	11.59	32.18	16.43	53.05
Swanquarter Wilderness Area	SWAN1	NC	10.77	29.61	15.27	47.42
Wolf Island National Wilderness Area	OKEF1	GA	11.55	32.05	16.75	54.71
Breton Wilderness	BRIS1	LA	12.13	34.21	18.39	65.06
Brigantine Wilderness Area	BRIG1	NJ	11.07	30.54	18.40	65.20
Caney Creek Wilderness Area	CACR1	AR	8.79	24.75	18.32	64.25
Hercules Glade Wilderness Area	HEGL1	MO	9.75	26.88	18.80	67.92
Mingo Wilderness Area	MING1	MO	11.14	30.87	19.69	74.03
Upper Buffalo Wilderness Area	UPBU1	AR	8.93	25.07	17.82	60.73

7.2.6. Model Results for the VISTAS 2028 Inventory Compared to the URP Glide Paths for Georgia Class I Areas

Using 2000 through 2004 IMPROVE monitoring data, the dv values for the 20% clearest days in each year were averaged together, producing a single average dv value for the clearest days during that time period. Similarly, the dv values for the 20% most impaired days in each year were averaged together, producing a single average dv value for the days with the most anthropogenic visibility impairment during that time period. These values form the base line for visibility at each Class I area and are used to gauge improvements. In this second round of visibility planning, 2011 represents the base year for air quality modeling projections. To develop an average 2011 impairment suitable for use in air quality projections, 2009 through 2013 IMPROVE monitoring data were used. The dv values for the 20% clearest days in each year are averaged together to produce a single average dv value for the clearest days. The 20% most impaired days were also averaged from this timeframe to produce a single value for the 20% most impaired days.

Figure 7-9 and Figure 7-10 illustrate the predicted visibility improvement on the 20% most impaired days by 2028, compared to the URP glide paths for Cohutta Wilderness Area and Okefenokee National Wilderness Area, respectively. The pink lines represent the URP at each Class I area. The URP starts at the 2000-2004 average of the 20% most impaired days and ends in 2064 at the estimated natural condition value for each Class I area. This line shows a uniform, linear progression between the 2000-2004 baseline and the target natural condition in 2064. The model projections shown in blue triangles start at 2011 (the observed 2009-2013 average of the visibility on the 20% most impaired days) and end at the 2028 projected visibility values for the 20% most impaired days based on existing and planned emissions controls during the period of the long-term strategy associated with this round of planning. Blue diamonds on these figures represent IMPROVE monitoring data on the 20% most impaired days at each Class I area, and the brown lines denote the five-year rolling average of each set of IMPROVE monitoring data.

At both Cohutta Wilderness Area and Okefenokee National Wilderness Area, visibility improvements on the 20% most impaired days are expected to be significantly better than the uniform rate of progress glide path by 2028.

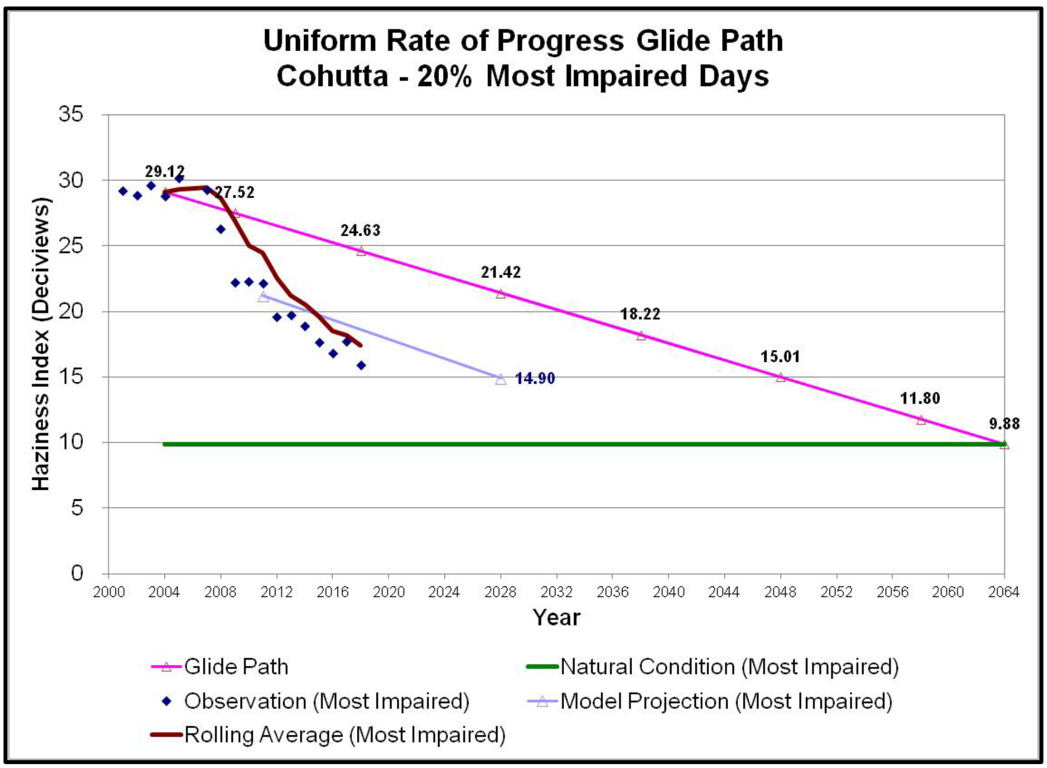


Figure 7-9: Cohutta Wilderness Area URP on the 20% Most Impaired Days

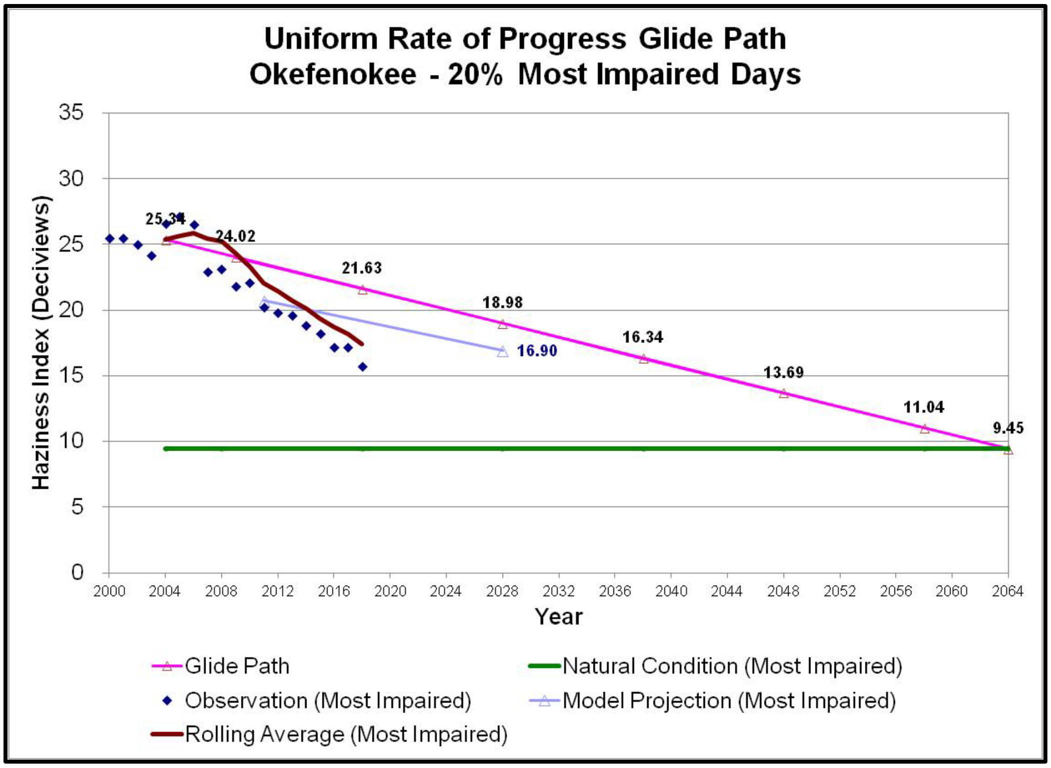


Figure 7-10: Okefenokee National Wilderness Area URP on the 20% Most Impaired Days

As illustrated in Figure 7-11, visibility improvements at all the VISTAS Class I areas except the Everglades are projected to be better than the uniform rate of progress through 2028. In Figure 7-11, the percentage displayed represents the difference between the 2028 projected visibility value from the VISTAS modeling analyses and the expected visibility improvement by 2028 on the URP Because this calculation is based on the level of haze in dv, negative percentages indicate that the 2028 projected visibility value is better than the expected visibility by 2028 on the URP while positive percentages indicate that the 2028 projected visibility value is worse than the expected visibility by 2028 on the URP. For example, haze in Cohutta Wilderness Area is projected to be 30% lower than the expected visibility for 2028 on the URP. Likewise, for Okefenokee National Wilderness Area, haze is projected to be 11% lower than the expected visibility for 2028 on the URP. For these areas, visibility improvements are well ahead of the timeline noted on the URP.

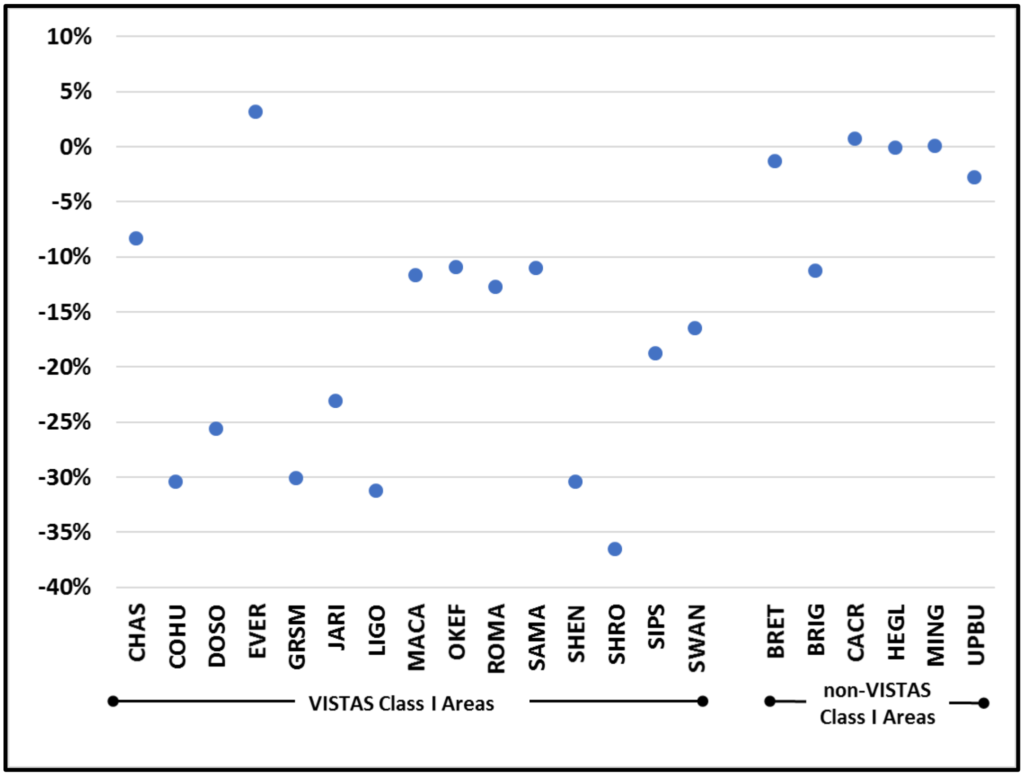


Figure 7-11: Percent of URP in 2028

Figure 7-12 illustrates the visibility improvement in 20% most impaired days. The figures show scenery at Cohutta Wilderness Area impacted at levels equivalent to the 2000-2004 baseline conditions on the 20% most impaired days, the 2028 projections based on the VISTAS inventory, and natural conditions.

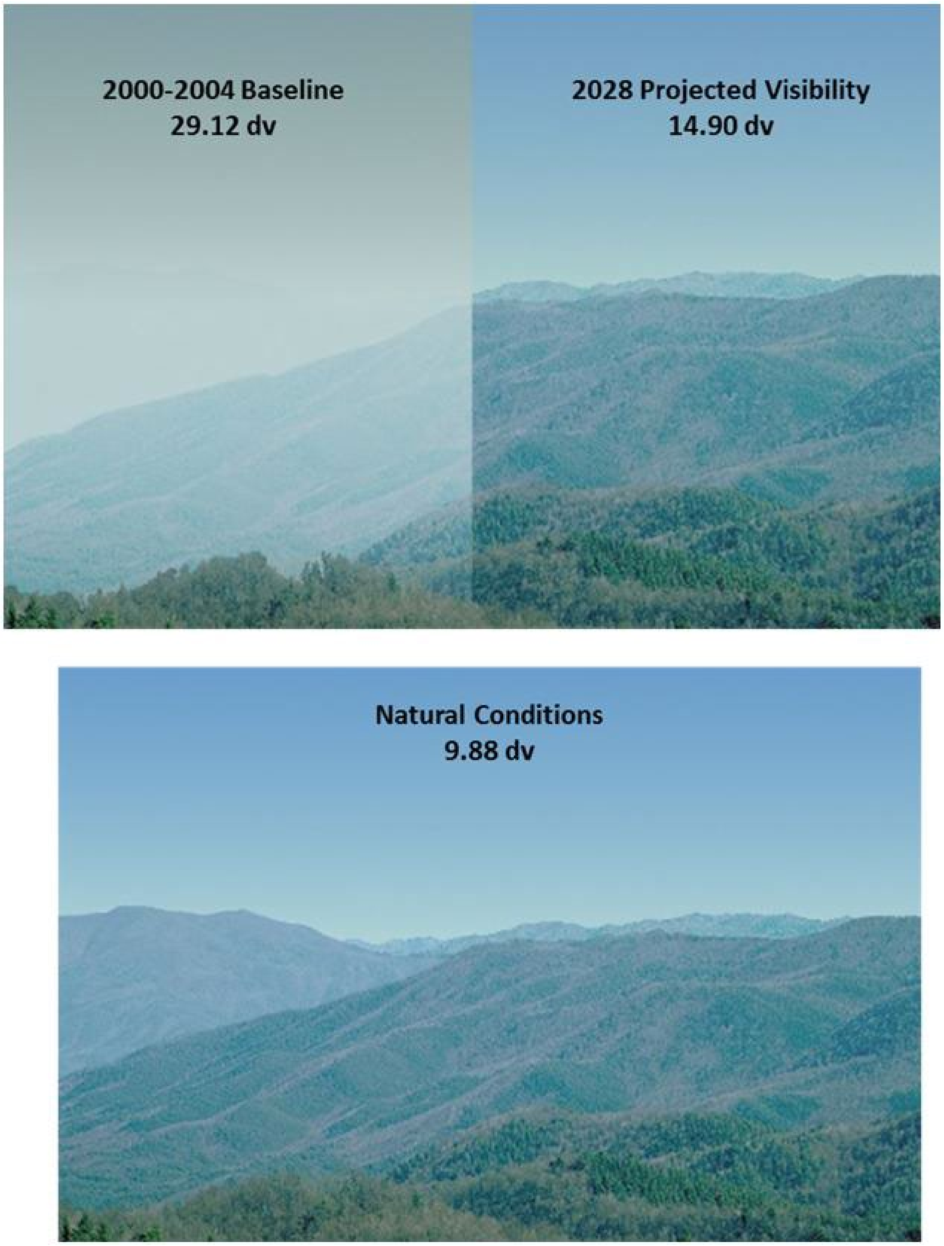


Figure 7-12: Cohutta 20% Most Impaired Days in 2000-2004, 20% Most Impaired Days in 2028, and Natural Conditions

In addition to improving visibility on the 20% most impaired visibility days, states are also required to protect visibility on the 20% clearest days at the Class I areas to ensure no degradation of visibility on these clearest days occurs. Figure 7-13 and Figure 7-14 show the improvements expected on the 20% clearest visibility days using the VISTAS emissions inventory and associated reductions at Cohutta Wilderness Area and Okefenokee National Wilderness Area, respectively. The pink line represents the 2000-2004 average baseline conditions for the 20% clearest days. The model projections shown in blue triangles start at 2011 (the observed 2009-2013 average of the visibility on the 20% clearest days) and end at the

2028 projected visibility values for the 20% clearest days based on existing and planned emissions controls during the period of the long-term strategy associated with this round of planning. Blue diamonds depict IMPROVE monitoring data values, and the gray lines denote IMPROVE monitoring data five-year averages. As noted in these figures, visibility conditions in 2028 on the 20% clearest visibility days are expected to continue to improve at both Cohutta Wilderness Area and Okefenokee National Wilderness Area.

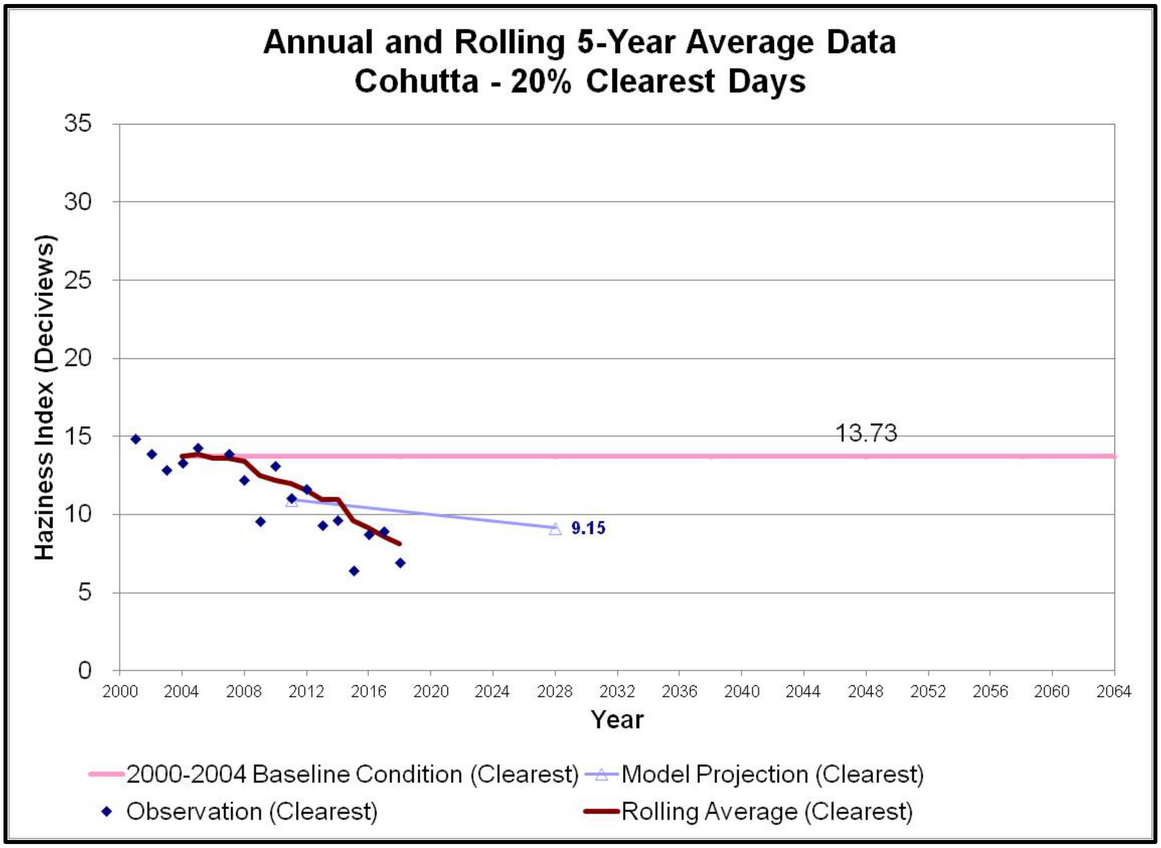


Figure 7-13: 20% Clearest Days Rate of Progress for Cohutta Wilderness Area

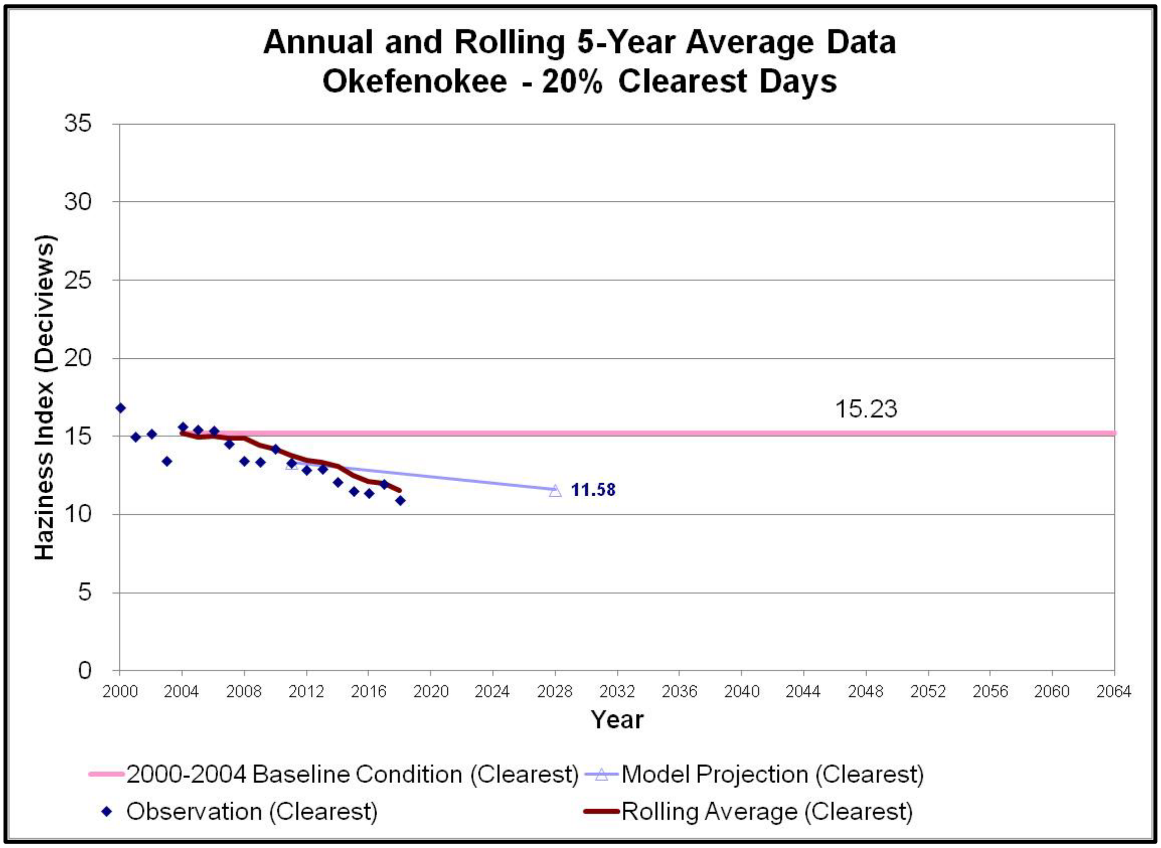


Figure 7-14: 20% Clearest Days Rate of Progress for Okefenokee National Wilderness Area

As illustrated in Figure 7-15, visibility on the 20% clearest days is projected to improve in 2028 at all VISTAS and non-VISTAS Class I areas as a result of the emission control programs included in the VISTAS 2028 emissions inventory. In this figure, a zero percent change indicates no change in visibility. A negative percentage indicates improvement in projected visibility while a positive change indicates visibility degradation. The percent improvement on 20% clearest days is projected to be -33.4% for Cohutta Wilderness Area and -24% for Okefenokee National Wilderness Area.

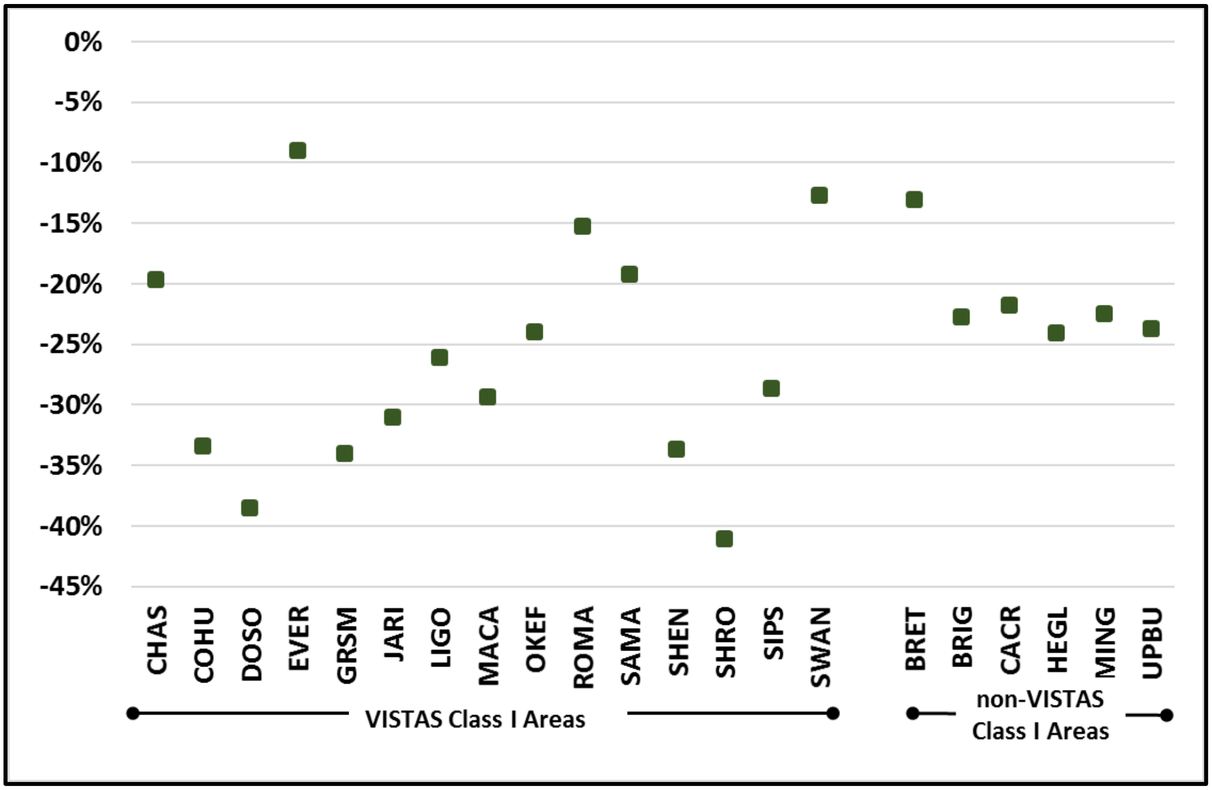


Figure 7-15: Percent Visibility Improvement on 20% Clearest Days

7.3. Relative Contribution from International Emissions to Visibility Impairment in 2028 at VISTAS Class I Areas

International anthropogenic emissions are beyond the control of states preparing regional haze SIPs. Therefore, the regional haze rule at 40 CFR 51.308(f)(1)(vi)(B) allows states to optionally propose an adjustment of the 2064 uniform rate of progress endpoint to account for international anthropogenic impacts, if the adjustment has been developed using scientifically valid data and methods. On September 19, 2019, EPA released Technical Support Document for EPA's Updated 2028 Regional Haze Modeling.[45] This document provides the results of EPA's updated 2028 visibility modeling analyses and includes projections of both domestic and international source contributions. EPA used source apportionment results to calculate the estimated source contribution of international anthropogenic emissions to visibility impairment at Class I areas on the 20% most impaired days. EPA used these estimated contributions to derive adjusted glide path endpoints for each federal Class I area.

In this study, EPA used the CAMx PSAT tool to tag certain sectors. EPA processed each sector through the SMOKE model and tracked each sector in PSAT as an individual source tag. EPA tracked sulfate, nitrate, ammonium, secondary organic aerosols, and primary PM in this manner. International anthropogenic emissions within this study include anthropogenic emissions from

[45] https://www.epa.gov/visibility/technical-support-document-epas-updated-2028-regional-haze-modeling

Canada and Mexico, C3 commercial marine emissions outside of the emissions control area as described in Section 7.2.1.4.4, and international anthropogenic boundary conditions.

Results from this study show that international anthropogenic boundary conditions account for a sizable fraction of sulfate concentrations in the west in certain months, and to a lesser extent nitrate. Estimated international anthropogenic visibility impairment ranges from 3.0 Mm^{-1} to 19.7 Mm^{-1}. For Class I areas located in VISTAS, total international anthropogenic emissions impacts range from 4.10 Mm^{-1} to 8.80 Mm^{-1}. Table 7-3 provides the estimated international anthropogenic visibility impacts to VISTAS Class I area from EPA's study.

Table 7-3: VISTAS Class I Area International Anthropogenic Emissions 2028 Impairment, Mm^{-1}

Class I Area Name	State	Site ID	Non-US C3 Marine	Canada	Mexico	Boundary International	Total International Anthropogenic
Cape Romain Wilderness Area	SC	ROMA	0.50	0.81	1.24	3.68	6.23
Chassahowitzka Wilderness Area	FL	CHAS	1.30	0.62	1.01	3.81	6.75
Cohutta Wilderness Area	GA	COHU	0.10	1.31	0.68	3.20	5.29
Dolly Sods Wilderness Area	WV	DOSO	0.05	2.11	0.53	2.31	4.99
Everglades National Park	FL	EVER	2.28	0.48	0.36	4.65	7.77
Great Smoky Mountains National Park	NC/TN	GRSM	0.09	1.38	0.54	2.83	4.48
James River Face Wilderness Area	VA	JARI	0.04	2.01	0.38	2.56	4.99
Joyce Kilmer-Slickrock Wilderness Area	NC/TN	JOYC	0.09	1.38	0.54	2.83	4.84
Linville Gorge Wilderness Area	NC	LIGO	0.04	1.42	0.39	2.26	4.10
Mammoth Cave National Park	KY	MACA	0.02	3.34	0.30	3.28	6.94
Okefenokee National Wilderness Area	GA	OKEF	0.99	0.98	2.23	4.60	8.80
Otter Creek Wilderness Area	WV	OTCR	0.05	2.11	0.53	2.31	4.99
Shenandoah National Park	VA	SHEN	0.02	1.98	0.30	2.42	4.72
Shining Rock Wilderness Area	NC	SHRO	0.09	1.01	1.00	2.61	4.70
Sipsey Wilderness Area	AL	SIPS	0.09	1.45	0.74	2.83	5.12
St. Marks Wilderness Area	FL	SAMA	0.59	0.76	1.43	3.78	6.57
Swanquarter Wilderness Area	NC	SWAN	0.16	1.91	0.65	2.42	5.13
Wolf Island National Wilderness Area	GA	WOLF	0.99	0.98	2.23	4.60	8.80

Georgia's Class I areas are expected to be well beneath the 2028 uniform rate of progress goal based on VISTAS modeling, which includes current and forthcoming control programs. The estimated international emissions impact for Cohutta Wilderness Area is 5.29 Mm^{-1} and the estimated international emissions impact for Okefenokee National Wilderness Area is 8.80 Mm^{-1}. Adjustments to the 2028 uniform rate of progress goal based on these estimated visibility impairment contributions of international anthropogenic emissions would not change the conclusion that these areas will experience visibility improvements that are significantly better than those on the uniform rate of progress. Therefore, in this round of regional haze planning, Georgia is not updating the 2028 uniform rate of progress goals based on EPA's contribution study of international anthropogenic emissions.

7.4. Relative Contributions to Visibility Impairment: Pollutants, Source Categories, and Geographic Areas

To determine what areas and emissions source sectors impact VISTAS mandatory federal Class I areas, VISTAS relied on PSAT results examining the impacts of sulfate and nitrate from the following geographic areas and emissions sectors:

- Total SO_2 and NO_X emissions from each VISTAS state;
- Total SO_2 and NO_X emissions from the CENRAP, MANE-VU, and LADCO regional planning organizations;
- Total SO_2 and NO_X emissions from EGUs from each VISTAS state;
- Total SO_2 and NO_X emissions from EGUs from CENRAP, MANE-VU, and LADCO regional planning organizations;
- Total SO_2 and NO_X emissions from non-EGU point sources from each VISTAS state; and
- Total SO_2 and NO_X emissions from non-EGU point sources from CENRAP, MANE-VU, and LADCO regional planning organizations.

Visibility impacts in 2028 estimated by PSAT for each region (10 individual VISTAS states plus three RPOs), emission sector (total, EGU, and non-EGU), and pollutant (SO_2 and NO_X) at each mandatory federal Class I area are available for comparison.

Figure 7-16 shows the 2028 nitrate impairment from each region at mandatory federal Class I areas within VISTAS. Most mandatory federal Class I areas in VISTAS show contributions of less than 4 Mm^{-1} from nitrate in 2028, with the exceptions being Mammoth Cave National Park, Sipsey Wilderness Area, Cape Romain Wilderness Area, and Swanquarter Wilderness Area. Most of the mandatory federal Class I areas in VISTAS show total contributions to nitrate impairment from the CENRAP, LADCO, and the MANE-VU sources (dark grey, medium grey, and light grey, respectively) that are larger than home state contributions, with the exceptions being Everglades National Park and Okefenokee National Wilderness Area.

Figure 7-17 shows the 2028 sulfate impairment from each region at mandatory federal Class I areas within VISTAS. All areas, with the exception of Everglades National Park, show sulfate impacts of at least 10 Mm^{-1}. Mandatory federal Class I areas in VISTAS show contributions to sulfate impairment from CENRAP, LADCO, and MANE-VU sources (dark grey, medium grey, and light grey, respectively) that are larger than home state contributions, with the exception of Everglades National Park.

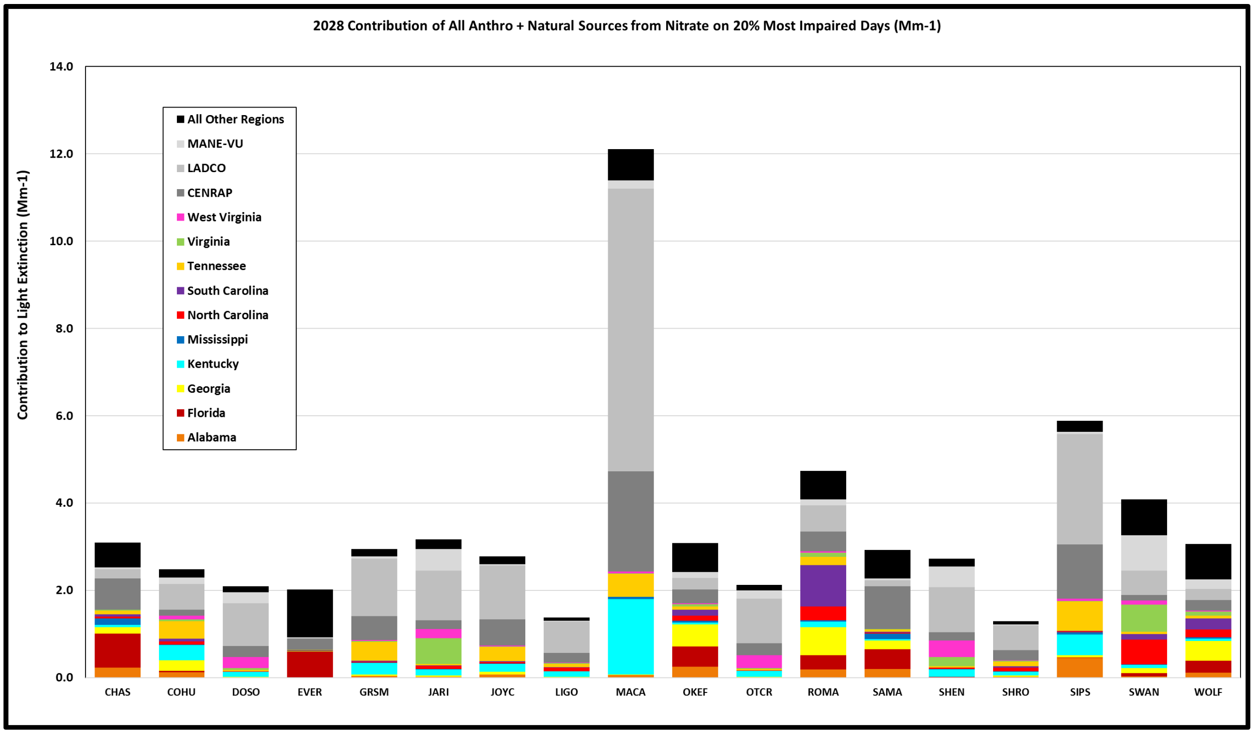


Figure 7-16: 2028 Nitrate Visibility Impairment, 20% Most Impaired Days, VISTAS Class I Areas

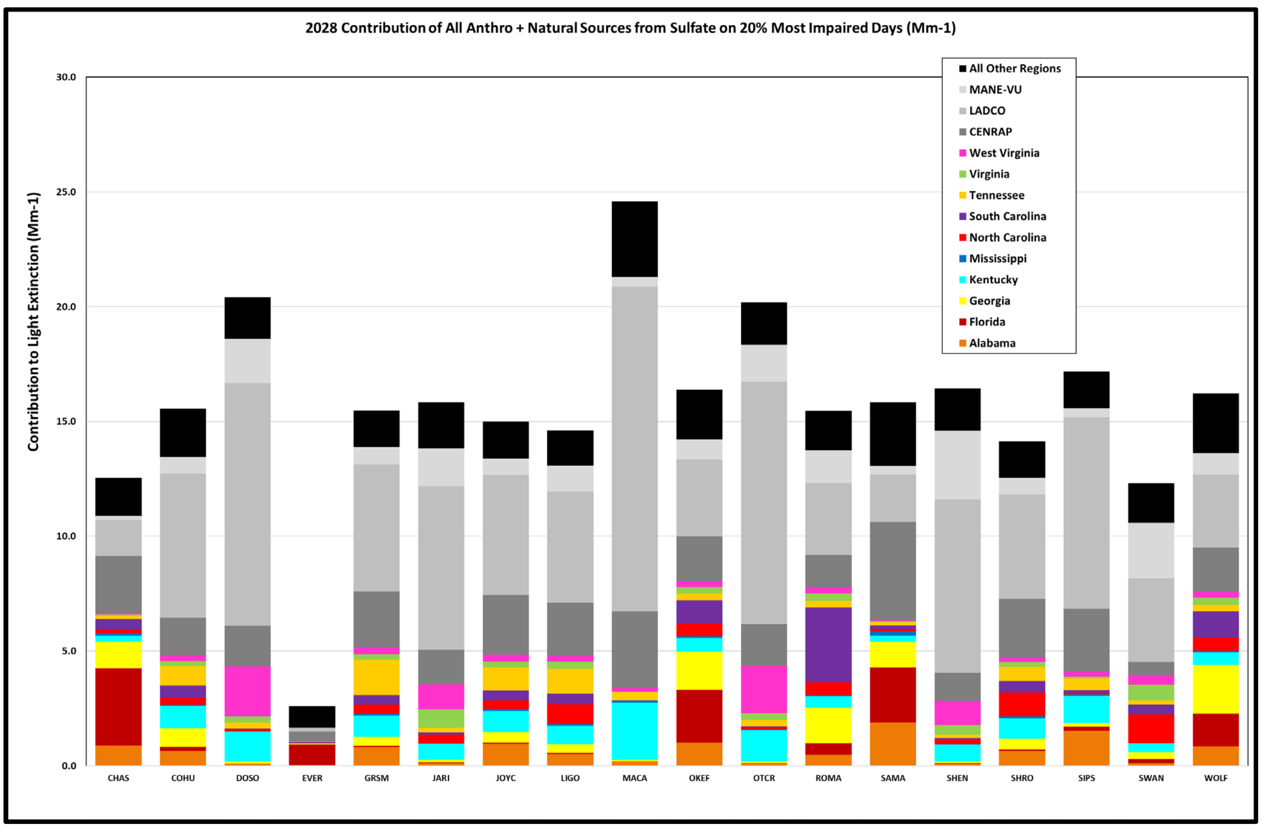


Figure 7-17: 2028 Sulfate Visibility Impairment, 20% Most Impaired Days, VISTAS Class I Areas

These figures indicate that sulfate continues to be the primary driver of visibility impairment in most mandatory federal VISTAS Class I areas. These figures also show that emissions from sources located outside of the home state and outside of VISTAS have a significant impact on visibility in mandatory federal VISTAS Class I areas.

Figure 7-18 and Figure 7-19 provide comparisons of projected light extinction from sulfate and nitrate in 2028 at mandatory federal Class I areas in VISTAS. These figures show the light extinction associated with all emissions within the pollutant inventory (does not include contributions from boundary conditions), the light extinction caused by emissions from the EGU sector, and light extinction caused by emissions from the non-EGU point source sector.

Figure 7-18 shows these data for sulfate visibility impairment. Comparison of bar heights in this figure demonstrates that sulfate visibility impairment from the EGU and non-EGU point source sectors comprise the majority of the total sulfate visibility impairment at mandatory federal Class I areas within VISTAS except Everglades National Park. Figure 7-18 also shows that for some VISTAS mandatory federal Class I areas, visibility impairment due to sulfate from the EGU sector is significantly higher than visibility impairment due to sulfate from the non-EGU sector. Exceptions to this observation are Everglades National Park, Okefenokee National Wilderness Area, Cape Romain Wilderness Area, St. Marks Wilderness Area, and Wolf Island National Wilderness Area. In the case of Everglades National Park, total sulfate impairment in 2028 is expected to be less than 5 Mm^{-1}, and EGU and non-EGU sulfate contributions are minimal. Projections for Okefenokee, Cape Romain, St. Marks, and Wolf Island show that EGU and non-EGU sulfate contributions are the majority of sulfate impairment and that the relative impacts from each sector are similar.

Figure 7-19 provides nitrate light extinction data in 2028 for mandatory federal Class I areas in VISTAS. In all but four cases, the total nitrate light extinction estimated for 2028 is well beneath 4 Mm^{-1}. In the case of Mammoth Cave National Park, Cape Romain Wilderness Area, Sipsey Wilderness Area, and Swanquarter Wilderness Area, total nitrate impairment is more than 4 Mm^{-1}, but the contributions from the EGU and non-EGU point source sectors are well under half of the total nitrate contribution.

Figure 7-18 and Figure 7-19 show that sulfates generally contribute more to light extinction in 2028 at VISTAS mandatory federal Class I areas than nitrates and that sulfates from EGU and non-EGU (NEGU) point source sectors contribute the majority of the sulfate light extinction at most of these areas. Results in Figure 7-19 also show that the majority of nitrate light extinction is not caused by NO_X emissions from EGU and non-EGU point sources.

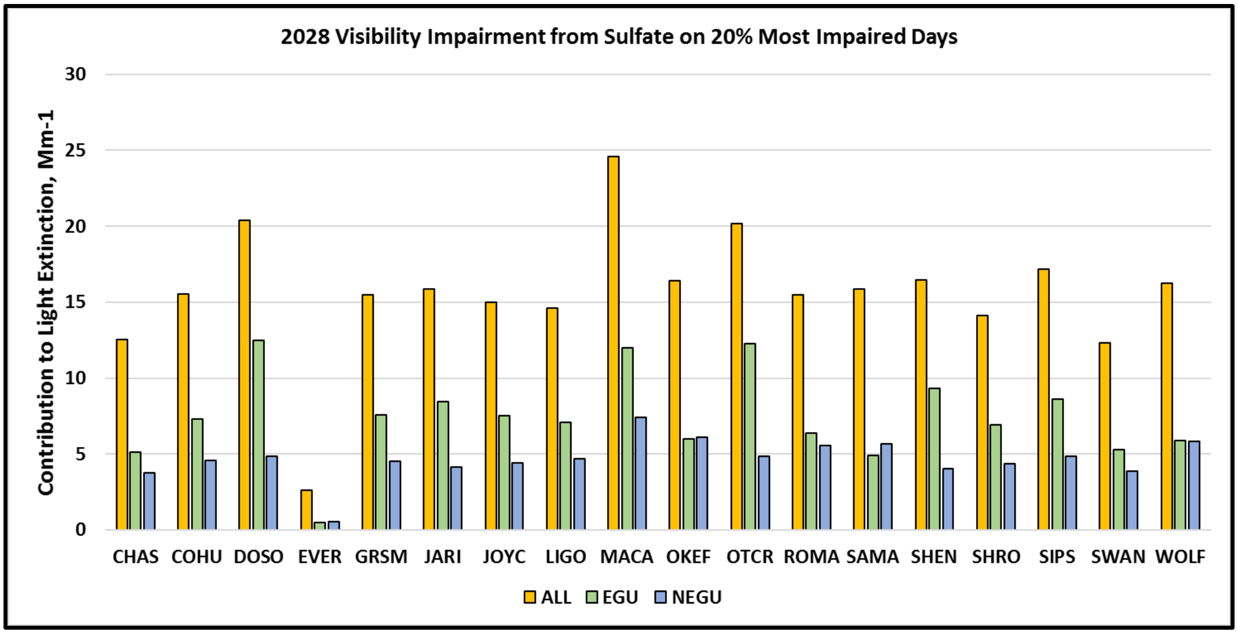


Figure 7-18: 2028 Visibility Impairment from Sulfate on 20% Most Impaired Days, VISTAS Class I Areas

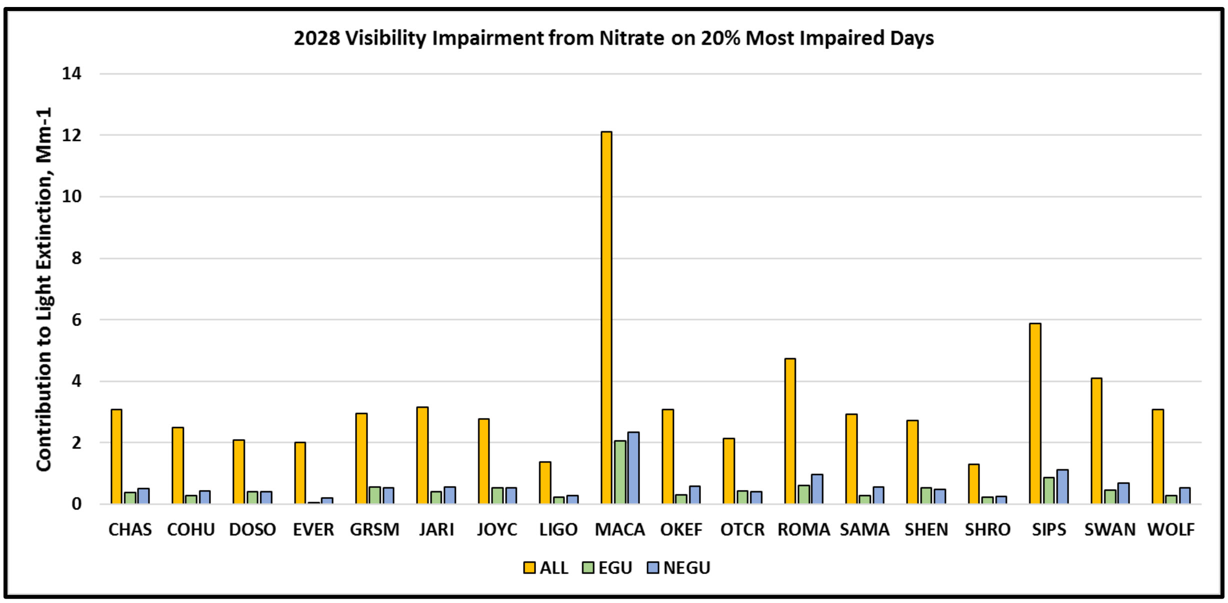


Figure 7-19: 2028 Visibility Impairment from Nitrate on 20% Most Impaired Days, VISTAS Class I Areas

These PSAT analyses support the following conclusions concerning the visibility impairing emissions, the source categories responsible for these emissions, and the locations of the pollutant emitting activities:

- Sulfate will generally be a much larger contributor to visibility impairment in 2028 at VISTAS mandatory federal Class I areas than nitrates.

- Emissions from other regional planning organizations (MANE-VU, LADCO, and CENRAP) generally have higher contributions to 2028 visibility impairment at mandatory federal Class I areas in VISTAS than the emissions from the home state.

- Emissions from EGUs and non-EGU point sources contribute the majority of the total sulfate contributions to visibility impairment in 2028 at mandatory Class I areas in VISTAS.

Figure 7-20, Figure 7-21, and Figure 7-22 provide more detailed comparisons for Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area. These figures show that projected light extinction in 2028 from total sulfate is significantly larger than light extinction from total nitrate. At Cohutta Wilderness Area, projected total sulfate extinction is approximately 19 Mm^{-1} while total projected nitrate extinction is less than 3 Mm^{-1}. At Okefenokee National Wilderness Area, projected total sulfate extinction is greater than 25 Mm^{-1} while total projected nitrate extinction is less than 4 Mm^{-1}. At Wolf Island National Wilderness Area, projected total sulfate extinction is 24.5 Mm^{-1} while total projected nitrate extinction is less than 4 Mm^{-1}. These figures also show that sulfate from EGUs and non-EGUs account for the majority of the total sulfate impact at these mandatory federal Class I areas in Georgia. At Cohutta Wilderness Area, the 2028 sulfate extinction from EGUs and non-EGU point sources is 11.9 Mm^{-1} while the total sulfate extinction is 18.9 Mm^{-1}. Therefore, EGU and non-EGU point sources account for 63% of the total sulfate impact at Cohutta Wilderness Area. At Okefenokee National Wilderness Area, the 2028 sulfate extinction from EGUs and non-EGU point sources is 12.1 Mm^{-1} while the total sulfate extinction is 25.2 Mm^{-1}. Therefore, EGU and non-EGU point sources account for 48% of the total sulfate impact at Okefenokee National Wilderness Area. At Wolf Island National Wilderness Area, the 2028 sulfate extinction from EGUs and non-EGU point sources is 11.7 Mm^{-1} while the total sulfate extinction is 24.5 Mm^{-1}. Therefore, EGU and non-EGU point sources account for 48% of the total sulfate impact at Wolf Island National Wilderness Area. Lastly, these figures show that sulfates originating in the LADCO region contribute substantially to the estimated 2028 sulfate impairment at these mandatory federal Class I areas in Georgia. At Cohutta Wilderness Area, sulfates originating within LADCO contribute 6.3 Mm^{-1} to visibility impairment in 2028, or 33% of the total sulfate impact. At Okefenokee National Wilderness Area, sulfates originating within LADCO contribute 3.3 Mm^{-1} to visibility impairment in 2028, or 13% of the total sulfate impact. At Wolf Island National Wilderness Area, sulfates originating within LADCO contribute 3.2 Mm^{-1} to visibility impairment in 2028, or 13% of the total sulfate impact.

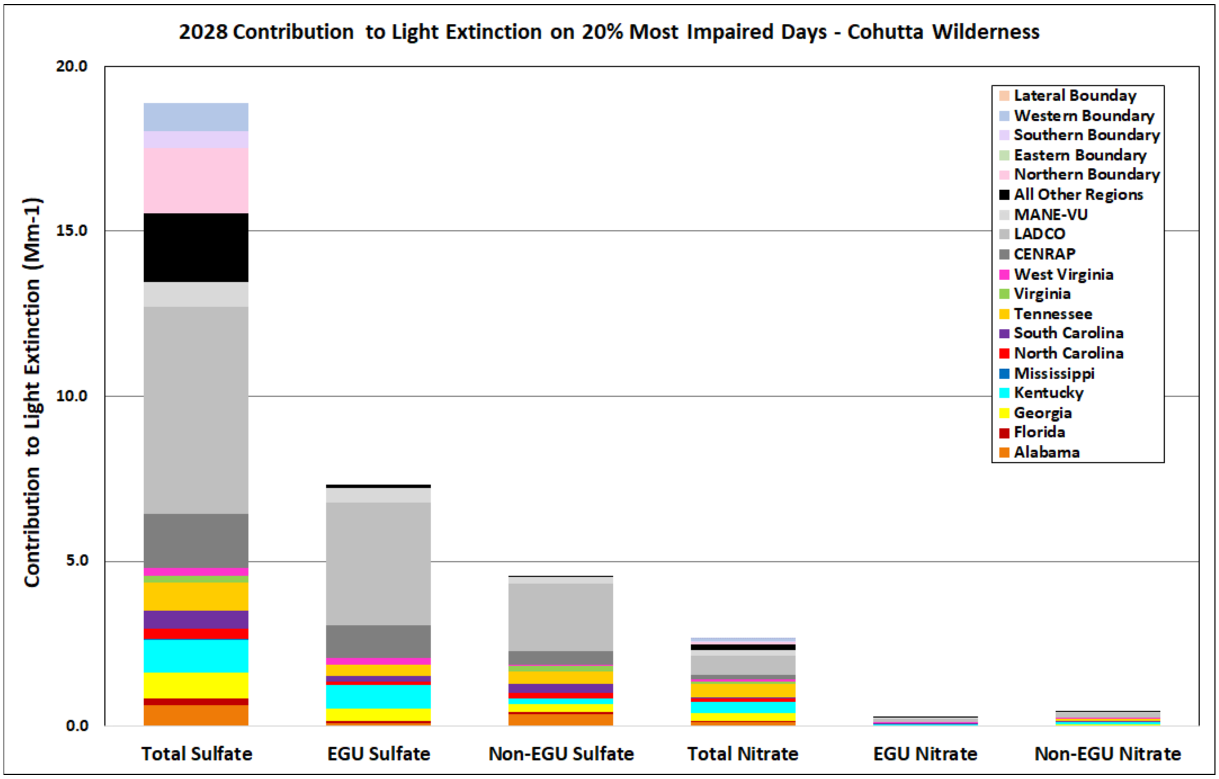


Figure 7-20: 2028 Contribution to Light Extinction on the 20% Most Impaired Days at Cohuttta Wilderness Area

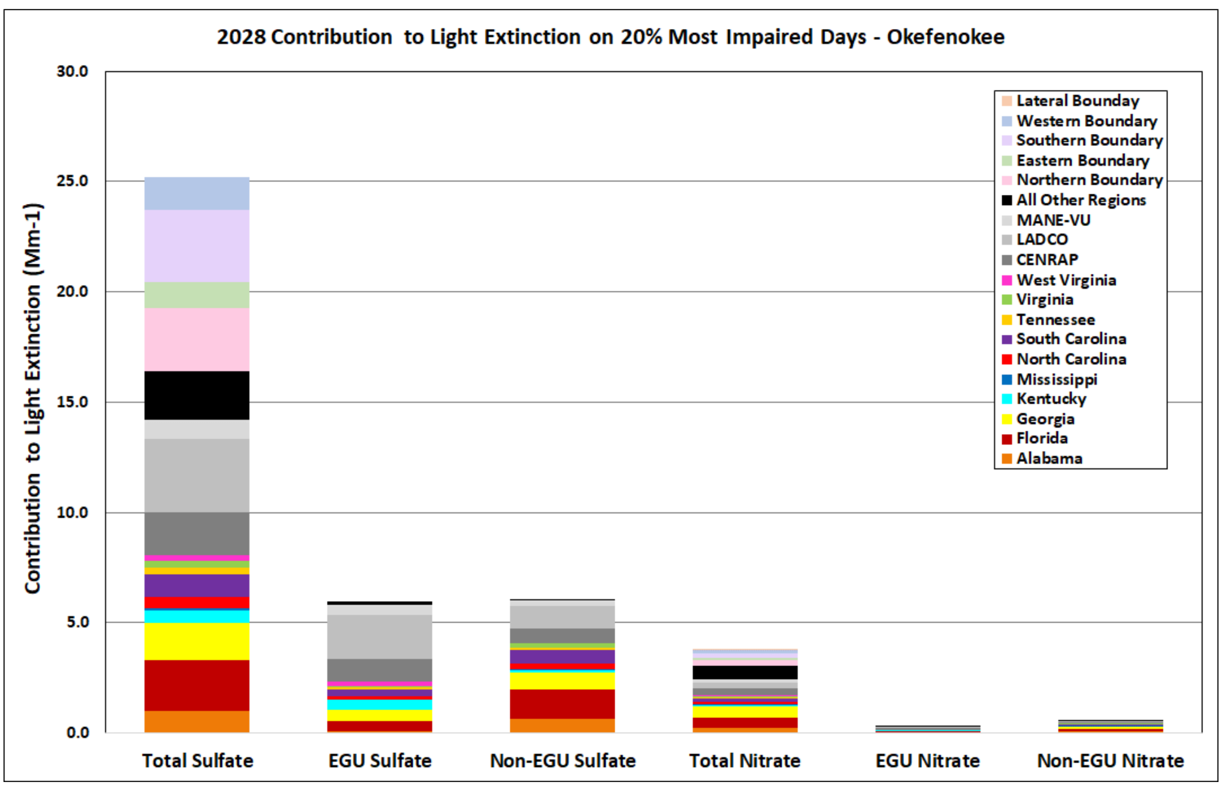


Figure 7-21: 2028 Contribution to Light Extinction on the 20% Most Impaired Days at Okefenokee National Wilderness Area

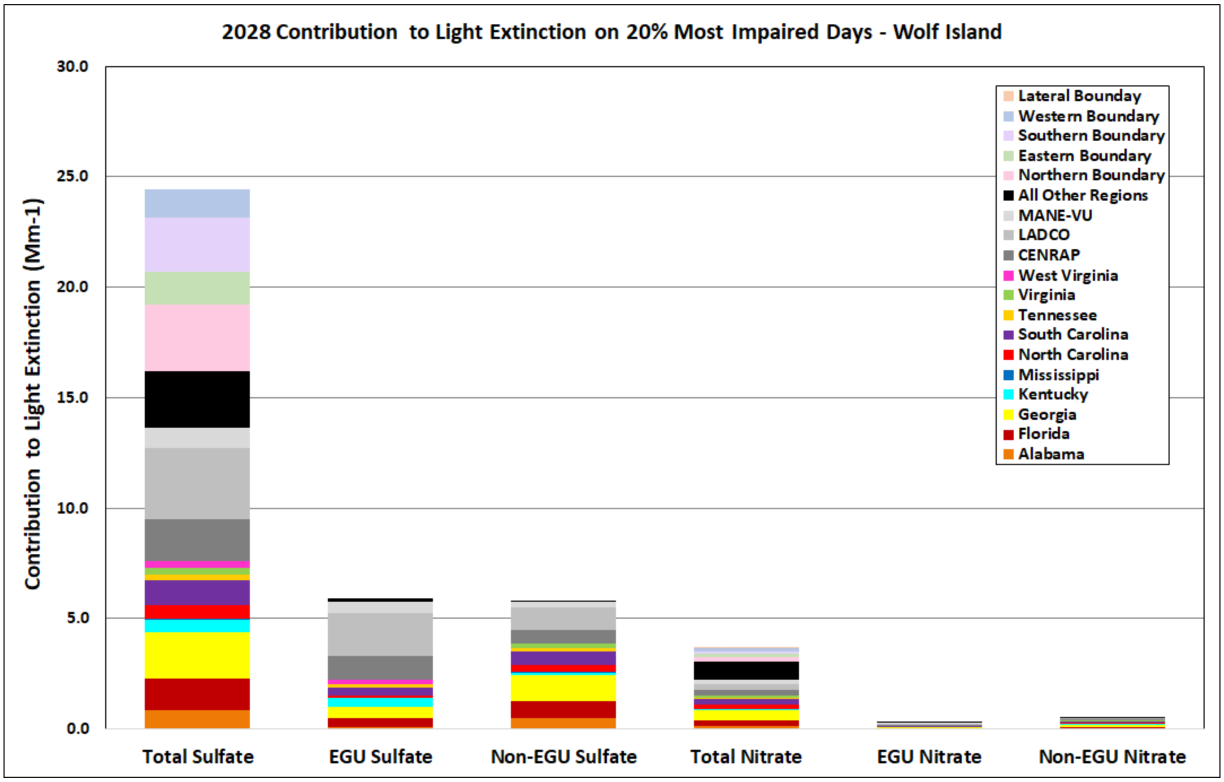


Figure 7-22: 2028 Contribution to Light Extinction on the 20% Most Impaired Days at Wolf Island National Wilderness Area

EPA released an updated 2028 visibility air quality modeling study in September 2019.[46] The goal of this effort was to project 2028 visibility conditions for each mandatory federal Class I area. This effort used EPA's 2016 modeling platform as the basis for the 2028 projections. EPA provided VISTAS an output file from the SMAT-CE tool showing visibility impairment at each Class I area by visibility impairing species. Figure 7-23 provides these outputs graphically for the VISTAS mandatory federal Class I area with an IMPROVE monitoring site. This figure, based on EPA's September 2019 modeling study, also shows that sulfates will continue to be the prevailing visibility impairing species in 2028 at VISTAS Class I areas and is consistent with a similar analysis of baseline conditions shown in Figure 2-2 and of current conditions shown in Figure 2-8. Figure 7-23 shows that sulfates, depicted by the yellow bars, have more than double the impact at each VISTAS Class I area as compared to nitrates, the next most prevalent species and depicted by the red bars, in all cases except Mammoth Cave National Park. At Mammoth Cave National Park, the projected 2028 sulfate to nitrate ratio is just under 2.0. These results corroborate the findings of the VISTAS study and indicate that focusing resources on the control of SO_2 is appropriate for this round of regional haze planning. Appendix E-8 provides the data supplied by EPA from their 2019 modeling study.

[46] URL: https://www.epa.gov/visibility/technical-support-document-epas-updated-2028-regional-haze-modeling

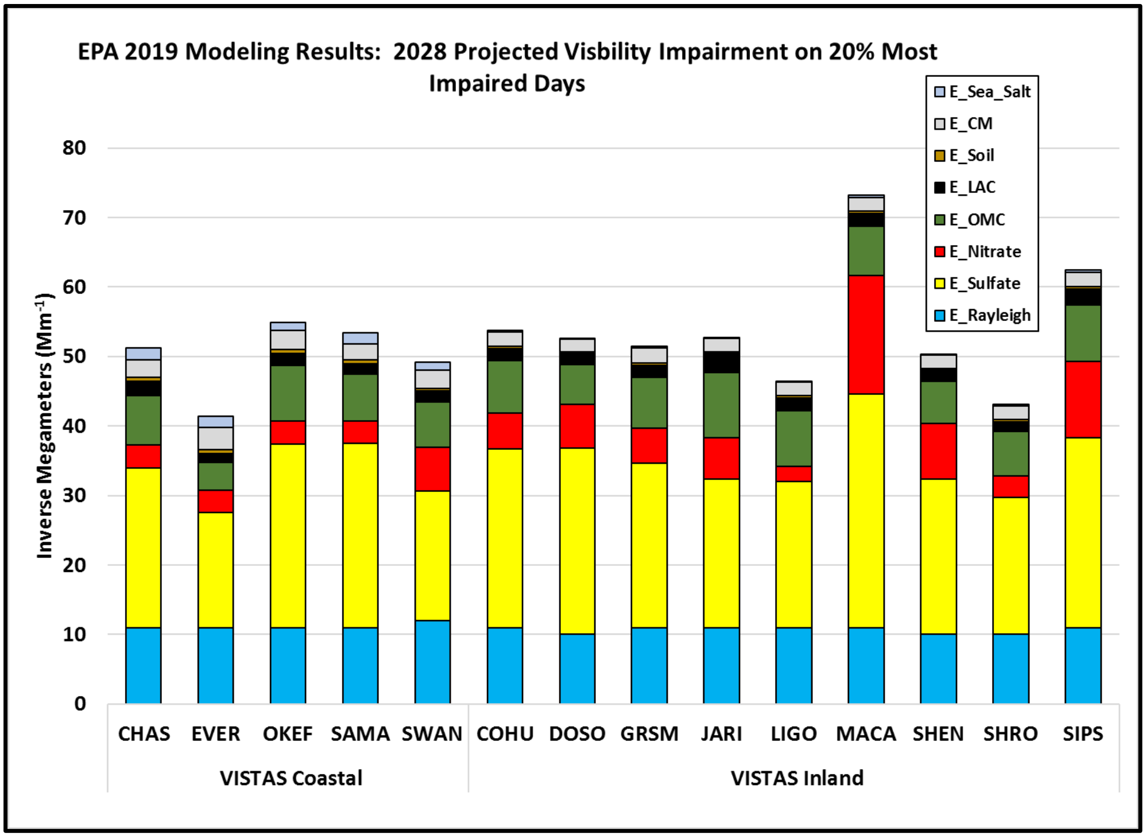


Figure 7-23: 2028 Projected Visibility Impairment by Pollutant Species, EPA 2019 Modeling Results

In accordance with 40 CFR 51.308(f)(2), the GA EPD used the results of the PSAT analysis to determine how Georgia's state-wide emissions may affect Class I areas outside of Georgia. In the PSAT analysis, VISTAS tagged statewide emissions of SO_2 and NOx. Although PM is another pollutant that can contribute to visibility impairment, VISTAS did not tag PM emissions in the PSAT analysis after concluding that SO_2 and NOx emissions, particularly from point sources, are projected to have the largest impact on visibility impairment in 2028.

Table 7-4 presents the results of PSAT modeling VISTAS conducted to estimate the impact of statewide SO_2 and NOx emissions in 2028 on total light extinction for the 20% most impaired days in all Class I areas in the VISTAS modeling domain (see Section 5.4 of this SIP). The results show total impairment for each Class I area and the state and RPO in which the Class I area is located. The statewide contribution to total impairment is provided in the fifth column in the table followed by the combined contribution from the nine remaining VISTAS states and the states located in CENRAP, LADCO, and MANE-VU. The last column in the table represents the contribution from the portion of the WRAP region that falls within the VISTAS modeling domain (see Figure 5-1). Contributions to visibility impairment that come from outside of the VISTAS modeling domain, including the remainder of the WRAP region, are accounted for via the boundary contributions which are provided in Appendix E-7a. Georgia EPD determined that emissions occurring in Georgia are reasonably anticipated to contribute to visibility impairment in the following Class I Federal areas: Cohutta Wilderness Area (GA), Okefenokee National Wilderness Area (GA), Wolf Island National Wilderness Area (GA), Chassahowitzka Wilderness Area (FL), St. Marks Wilderness Area (FL), Cape Romain Wilderness Area (SC), and Joyce Kilmer-Slick Rock Wilderness Area (NC/TN). Georgia EPD consulted with all the VISTAS states throughout the SIP development process. As discussed in Section 10.1, Georgia EPD has consulted with Florida, South Carolina, North Carolina, and Tennessee about specific facilities in Georgia. Georgia EPD did not use a threshold to determine if statewide emissions were reasonably anticipated to contribute to visibility impairment in Class I areas.

It should be noted that the values in columns five through ten in Table 7-4 do not add up to the total impairment value in column four because columns five through ten do not include international emissions and boundary contributions. As detailed in Section 10.2, the VISTAS states participated in national conferences and consultation meetings with other states, RPOs, FLMs, and EPA throughout the SIP development process to share this information.

Table 7-4: Georgia Statewide Contributions of 2028 SO_2 and NOx Emissions for all Source Sectors to Visibility Impairment for the 20% Most Impaired Days for Class I Areas in the VISTAS Modeling Domain (Mm-1)

RPO	State	Class I Area	Projected 2028 20% Most Impaired Days	GA	All other VISTAS states	CENRAP Region	LADCO Region	MANE-VU Region	WRAP Region within VISTAS Modeling Domain
CENRAP	AR	CACR	63.2	0.07	0.82	16.80	3.10	0.06	2.20
CENRAP	AR	UPBU	60.59	0.27	0.89	15.29	3.22	0.09	2.94
CENRAP	LA	BRET2	63.36	0.22	4.04	11.34	4.40	0.08	3.40
CENRAP	MO	HEGL	65.88	0.06	1.13	18.92	6.89	0.09	3.46
CENRAP	MO	MING	70.75	0.15	3.20	11.67	14.70	0.18	3.31
CENRAP	OK	WIMO	62.62	0.03	0.24	15.27	1.24	0.01	4.38
CENRAP	TX	BIBE	41.72	0.00	0.05	1.96	0.07	0.00	5.77
CENRAP	TX	CAVE	34.39	0.01	0.09	2.71	0.09	0.00	5.38
CENRAP	TX	GUMO	34.39	0.01	0.09	2.71	0.09	0.00	5.38
LADCO	MI	ISLE	47.51	0.00	0.36	6.19	7.88	0.20	2.89
LADCO	MI	SENE	56.63	0.04	0.89	4.63	14.63	0.70	3.29
LADCO	MN	BOWA	42.54	0.01	0.19	8.72	3.65	0.11	2.66
MANEVU	ME	ACAD	45.5	0.03	0.65	0.51	1.45	2.96	2.44
MANEVU	ME	MOOS	43.29	0.01	0.36	0.45	1.24	1.96	1.75
MANEVU	ME	ROCA	43.29	0.01	0.36	0.45	1.24	1.96	1.75
MANEVU	NH	GRGU	35.56	0.02	0.69	1.13	3.18	1.91	3.20
MANEVU	NH	PRRA	35.56	0.02	0.69	1.13	3.18	1.91	3.20
MANEVU	NJ	BRIG	63.05	0.03	1.98	1.63	8.48	9.96	4.08
MANEVU	VT	LYBR2	42.3	0.08	1.33	1.39	4.67	5.10	3.77
VISTAS	AL	SIPS	52.88	0.21	5.72	3.98	10.86	0.46	1.86
VISTAS	FL	CHAS	53.92	1.31	6.90	3.21	1.76	0.22	2.22
VISTAS	FL	EVER	47.7	0.04	1.67	0.68	0.17	0.03	2.05
VISTAS	FL	SAMA	52.91	1.31	6.15	5.26	2.21	0.39	3.44
VISTAS	GA	COHU	45.28	1.04	5.19	1.76	6.88	0.87	2.30
VISTAS	GA	OKEF	54.66	2.17	7.57	2.27	3.60	1.01	2.84
VISTAS	GA	WOLF	53.59	2.57	6.56	2.15	3.44	1.15	3.41
VISTAS	KY	MACA	68.18	0.06	5.77	5.61	20.62	0.63	4.01
VISTAS	NC	LIGO	42.52	0.39	4.75	2.55	5.54	1.15	1.62
VISTAS	NC	SHRO	42.09	0.49	4.60	2.80	5.11	0.75	1.67
VISTAS	NC	SWAN	46.39	0.41	5.29	0.72	4.19	3.23	2.56
VISTAS	NC/TN	GRSM	45.75	0.43	5.62	2.96	6.84	0.82	1.76
VISTAS	NC/TN	JOYC	45.12	0.52	5.04	3.21	6.46	0.76	1.78
VISTAS	SC	ROMA	52.82	2.19	8.47	1.87	3.74	1.57	2.36
VISTAS	VA	JARI	49.09	0.12	4.53	1.70	8.26	2.15	2.24
VISTAS	VA	SHEN	43.05	0.08	3.58	1.43	8.57	3.48	2.02
VISTAS	WV	DOSO	46.13	0.07	4.71	2.03	11.56	2.20	1.92

VISTAS	WV	OTCR	46	0.08	4.80	2.08	11.58	1.81	1.98
WRAP	CO	EANE	17.23	0.00	0.00	0.04	0.00	0.00	0.47
WRAP	CO	FLTO	17.23	0.00	0.00	0.04	0.00	0.00	0.47
WRAP	CO	GRSA	23.22	0.00	0.01	0.41	0.01	0.00	1.22
WRAP	CO	MABE	17.23	0.00	0.00	0.04	0.00	0.00	0.47
WRAP	CO	MOZI	17.64	0.00	0.00	0.07	0.00	0.00	0.79
WRAP	CO	RAWA	17.64	0.00	0.00	0.07	0.00	0.00	0.79
WRAP	CO	ROMO	23.72	0.00	0.00	0.48	0.00	0.00	2.19
WRAP	CO	WEEL	17.23	0.00	0.00	0.04	0.00	0.00	0.47
WRAP	MT	MELA	51.88	0.00	0.00	1.12	0.52	0.02	10.05
WRAP	MT	ULBE	32.66	0.00	0.00	0.37	0.39	0.00	2.47
WRAP	ND	THRO	46.07	0.00	0.00	1.49	0.50	0.02	8.12
WRAP	NM	BAND	25.33	0.00	0.00	0.68	0.02	0.00	1.28
WRAP	NM	BOAP	30.33	0.00	0.02	0.93	0.01	0.00	1.60
WRAP	NM	PECO	19.67	0.00	0.00	0.54	0.01	0.00	0.78
WRAP	NM	SACR	46.02	0.00	0.04	4.48	0.06	0.00	8.06
WRAP	NM	SAPE	19.58	0.00	0.00	0.29	0.01	0.00	0.57
WRAP	NM	WHIT	28.18	0.01	0.05	1.50	0.06	0.00	2.79
WRAP	NM	WHPE	19.67	0.00	0.00	0.54	0.01	0.00	0.78
WRAP	SD	BADL	37.55	0.00	0.02	4.32	1.03	0.01	3.73
WRAP	SD	WICA	31.66	0.00	0.00	2.37	0.31	0.00	4.39

7.5. Area of Influence Analyses for Georgia Class I Areas

Once the key pollutants and source categories contributing to visibility impairment at each Class I area have been identified, it is necessary to focus on the greatest contributing sources. Facility-level SO_2 and NO_X area of influence (AoI) analyses were performed for each Class I area to determine the relative visibility impact from each facility. Then, these facilities were ranked by their sulfate and nitrate visibility contribution at each Class I area. In addition, county-level AoI analyses were performed to confirm that SO_2 emissions from EGU and non-EGU point sources are the greatest contributors to visibility impairment at VISTAS Class I areas. The following sections contain a broad overview of the steps in the AoI analyses. See Appendix D for a more detailed discussion of these analyses and plots for additional Class I areas.

7.5.1. Back Trajectory Analyses

The first step was to generate Hybrid Single Particle Lagrangian Integration Trajectory (HYSPLIT)[47] back trajectories for IMPROVE monitoring sites in Georgia and neighboring Class I areas for 2011-2016 on the 20% most impaired days. Back trajectory analyses use interpolated measured or modeled meteorological fields to estimate the most likely central path of air masses that arrive at a receptor at a given time. The method essentially follows a parcel of air backward in hourly steps for a specified length of time.

47 Stein, A. F., Draxler, R. R., Rolph, G. D., Stunder, B. J. B., Cohen, M. D., and Ngan, F., (2015). NOAA's HYSPLIT atmospheric transport and dispersion modeling system, Bull. Amer. Meteor. Soc., 96, 2059-2077, http://dx.doi.org/10.1175/BAMS-D-14-00110.1

The HYSPLIT runs included starting heights of 100 meters (m), 500 m, 1,000 m, and 1,500 m. Trajectories were run 72 hours backwards in time for each height at each location. Trajectories were run with start times of 12:00 a.m. (midnight of the start of the day), 6:00 a.m., 12:00 p.m., 6:00 p.m., and 12:00 a.m. (midnight at the end of the day) local time.

Figure 7-24 contains the 100-meter back trajectories for the 20% most impaired visibility days (2011-2016) at Cohutta Wilderness Area. Figure 7-25 contains the 100-meter back trajectories by season for the 20% most impaired visibility days (2011-2016) Cohutta Wilderness Area. Figure 7-26 contains the 100-meter, 500-meter, 1000-meter, and 1500-meter back trajectories for the 20% most impaired visibility days (2011-2016) at Cohutta Wilderness Area. These back trajectories for the 20% most impaired days were then used to develop residence time (RT) plots.

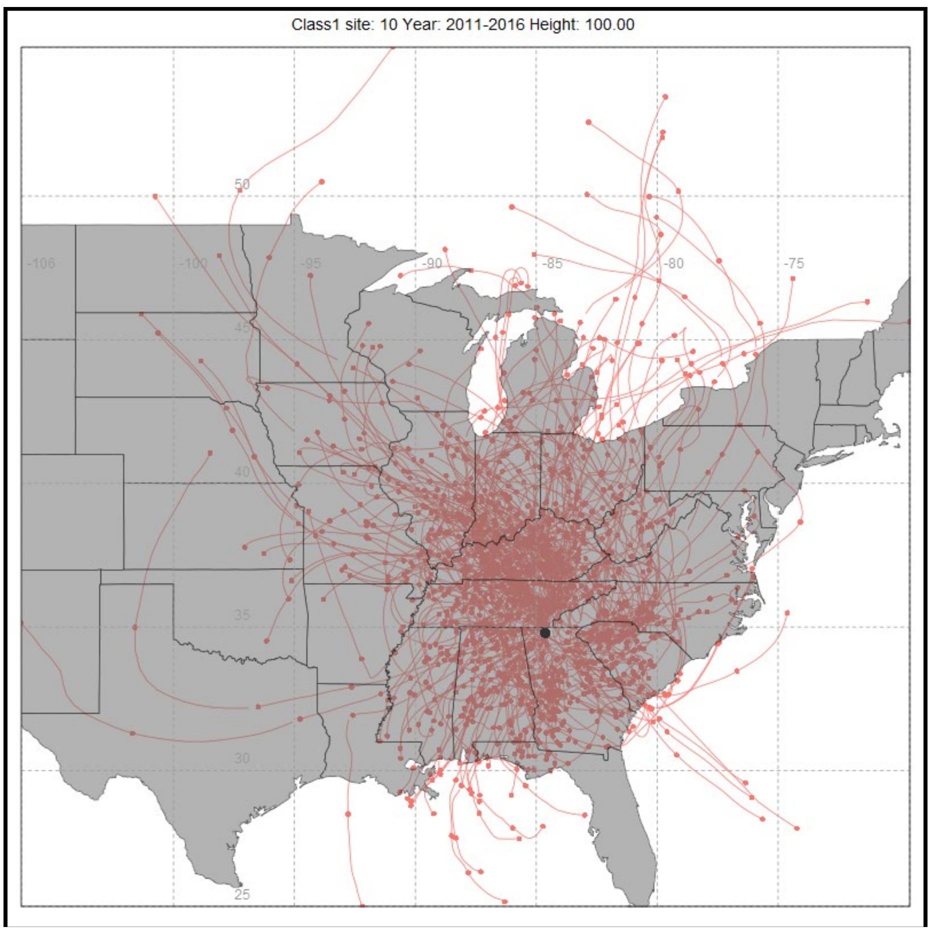


Figure 7-24: 100-Meter Back Trajectories for the 20% Most Impaired Visibility Days (2011-2016), from Cohutta Wilderness Area

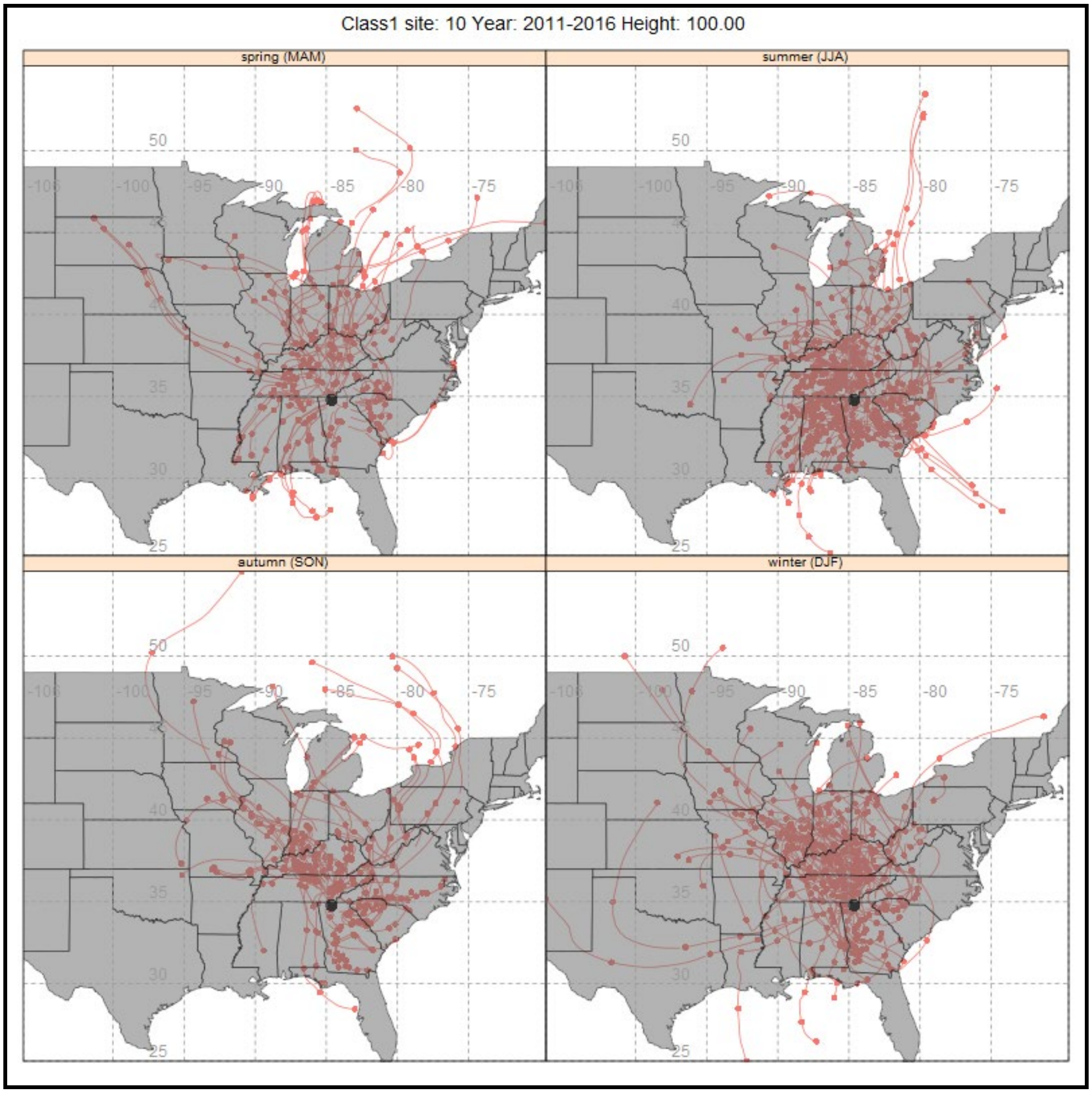


Figure 7-25: 100-Meter Back Trajectories by Season for the 20% Most Impaired Visibility Days (2011-2016) from Cohutta Wilderness Area

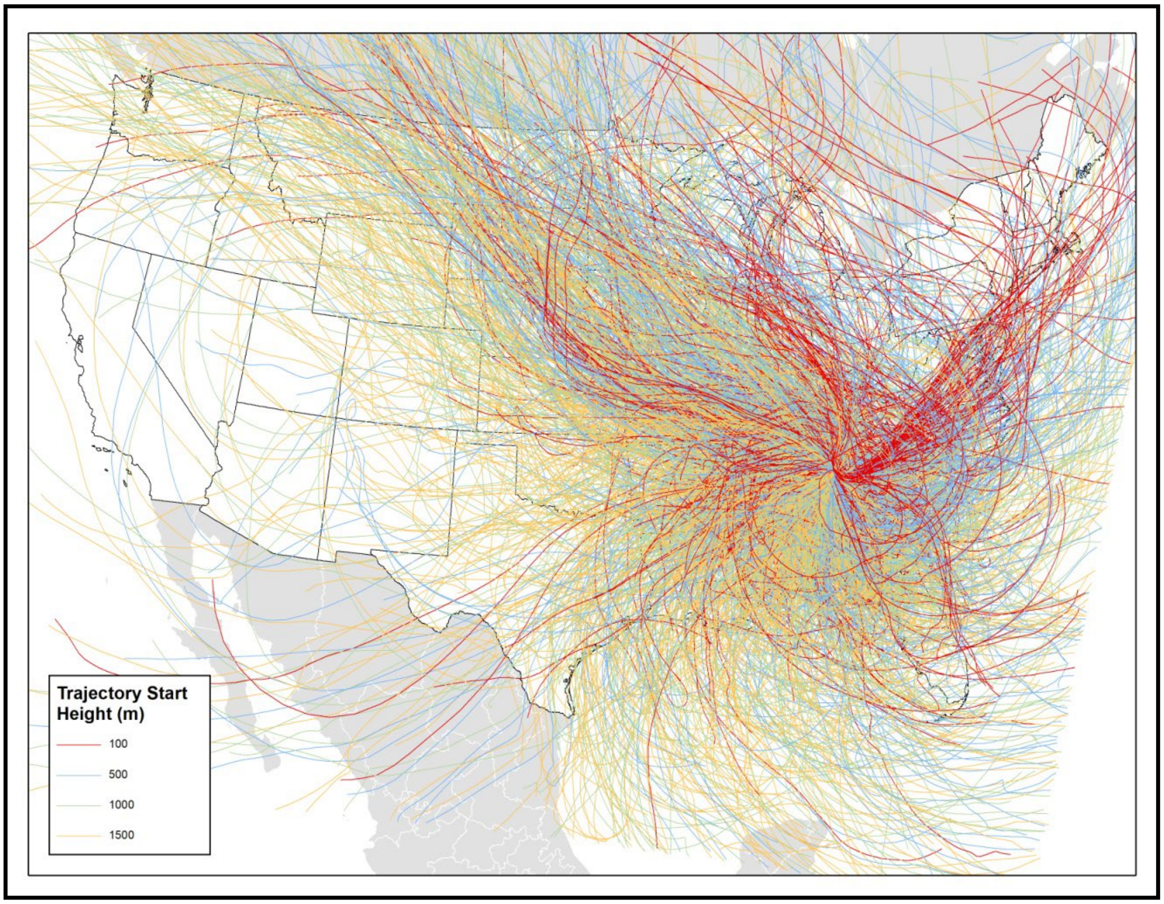


Figure 7-26: 100-Meter, 500-Meter, 1000-Meter, and 1500-Meter Back Trajectories for the 20% Most Impaired Days (2011-2016) from Cohutta Wilderness Area

Figure 7-27 contains the 100-meter back trajectories for the 20% most impaired visibility days (2011-2016) at Okefenokee National Wilderness Area. Figure 7-28 contains the 100-meter back trajectories by season for the 20% most impaired visibility days (2011-2016) Okefenokee National Wilderness Area. Figure 7-29 contains the 100-meter, 500-meter, 1000-meter, and 1500-meter back trajectories for the 20% most impaired visibility days (2011-2016) at Okefenokee National Wilderness Area. These back trajectories for the 20% most impaired days were then used to develop residence time (RT) plots.

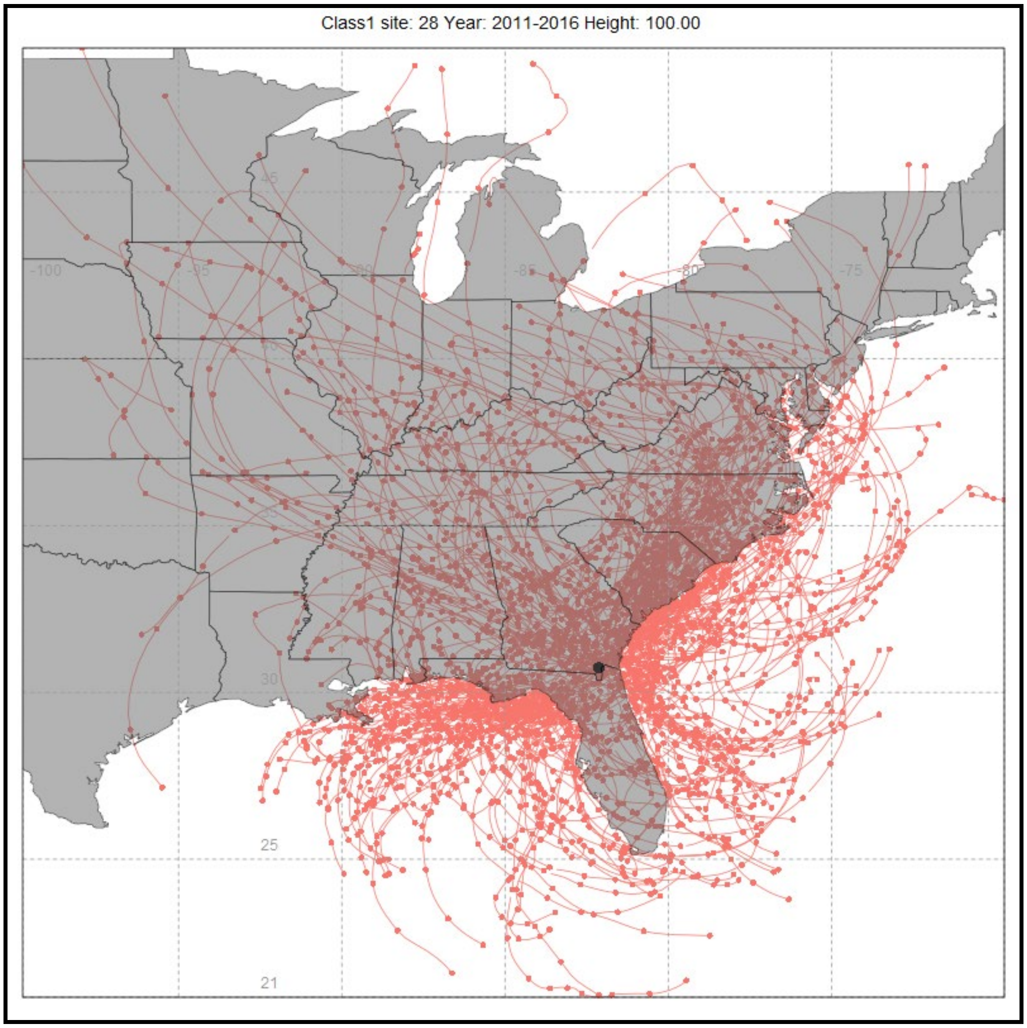


Figure 7-27: 100-Meter Back Trajectories for the 20% Most Impaired Visibility Days (2011-2016), from Okefenokee National Wilderness Area

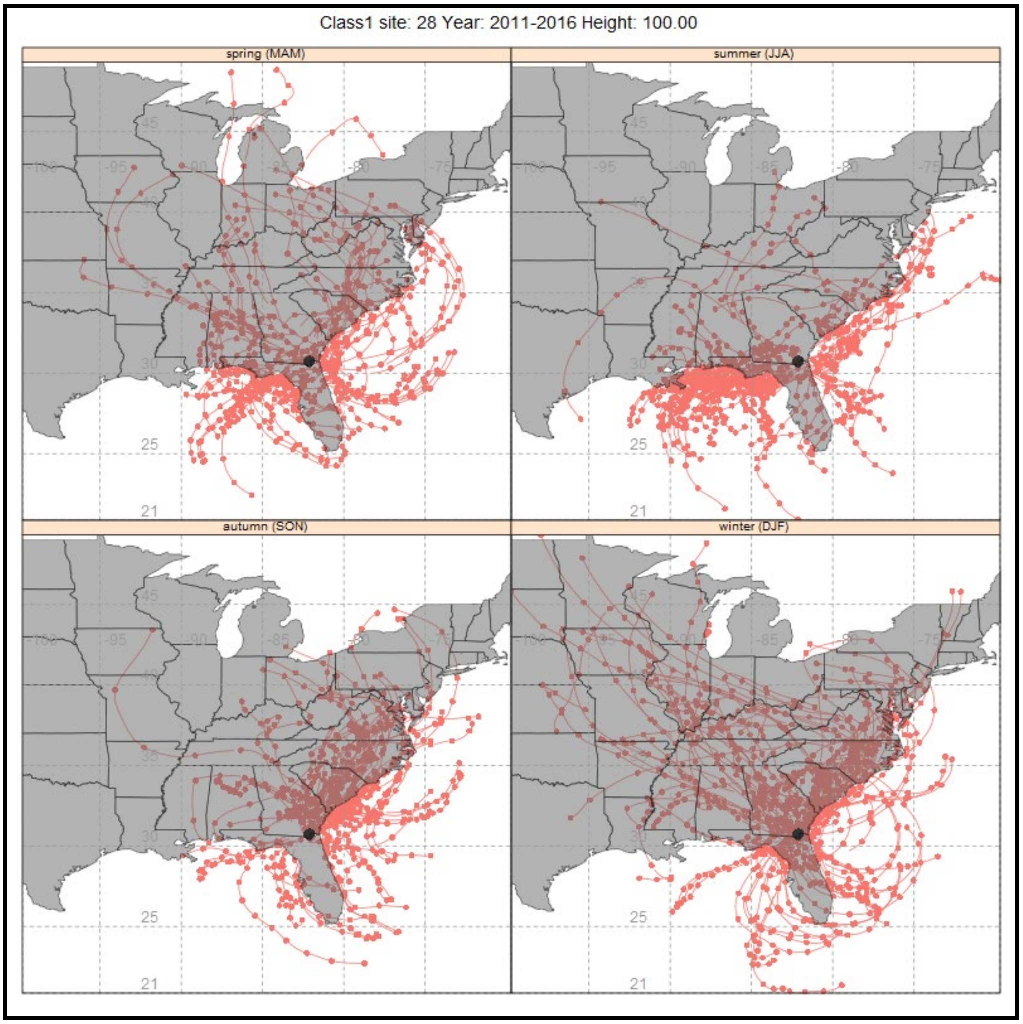


Figure 7-28: 100-Meter Back Trajectories by Season for the 20% Most Impaired Visibility Days (2011-2016) from Okefenokee National Wilderness Area

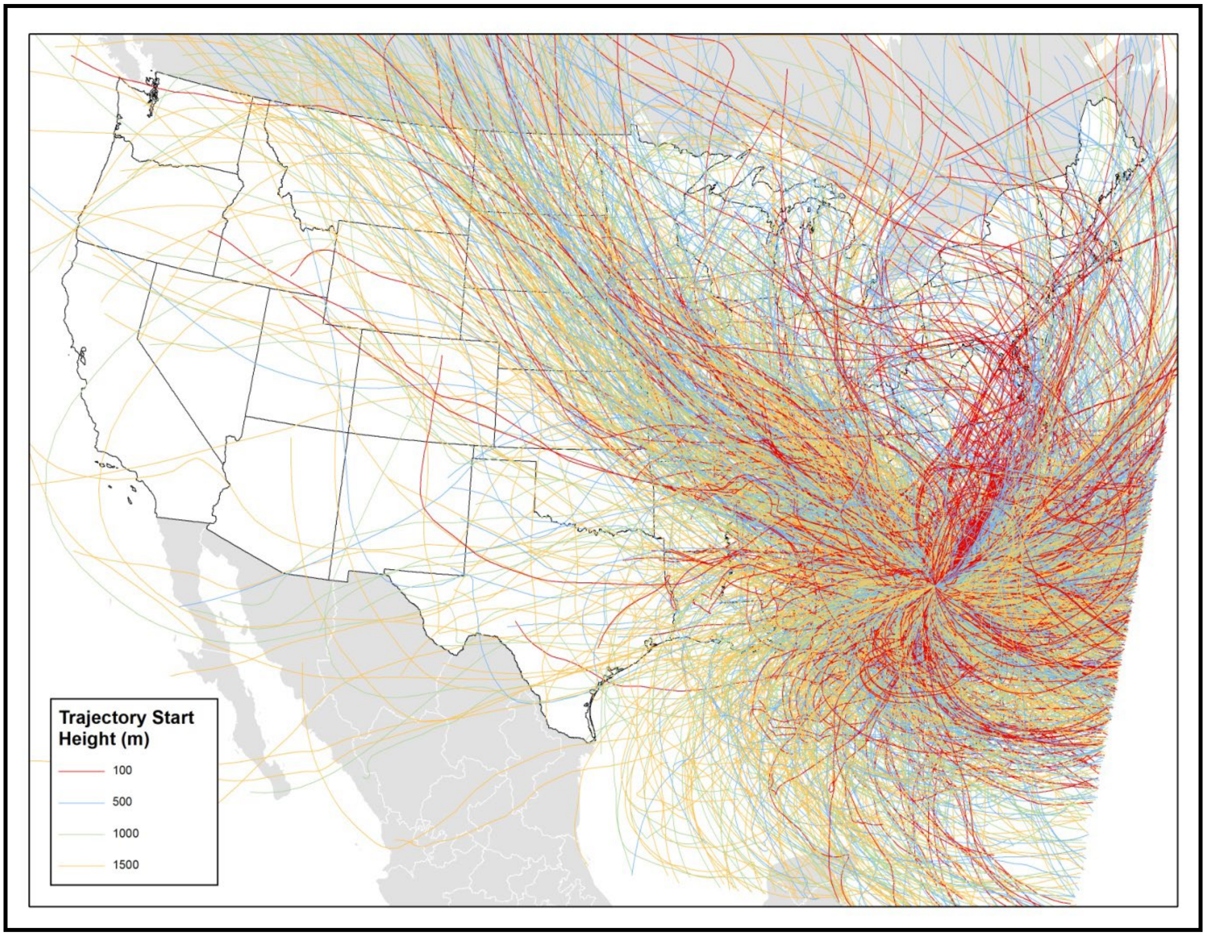


Figure 7-29: 100-Meter, 500-Meter, 1000-Meter, and 1500-Meter Back Trajectories for the 20% Most Impaired Days (2011-2016) from Okefenokee National Wilderness Area

7.5.2. Residence Time Plots

The next step was to plot residence time (RT) for each Class I area using six years of back trajectories for the 20% most impaired visibility days in 2011-2016. Residence time is the frequency that winds pass over a specific geographic area (model grid cell or county) on the path to a Class I area. Residence time plots include all trajectories for each Class I area.

Figure 7-30 contains the RT (counts per 12-km modeling grid cell) for Cohutta Wilderness Area. Figure 7-31 contains the residence time (percent of total counts per 12-km modeling grid cell) for Cohutta Wilderness Area. As illustrated in these figures, winds influencing Cohutta Wilderness Area on the 20% most impaired days come from all directions and there is no single predominant wind direction influencing the 20% most impaired visibility days.

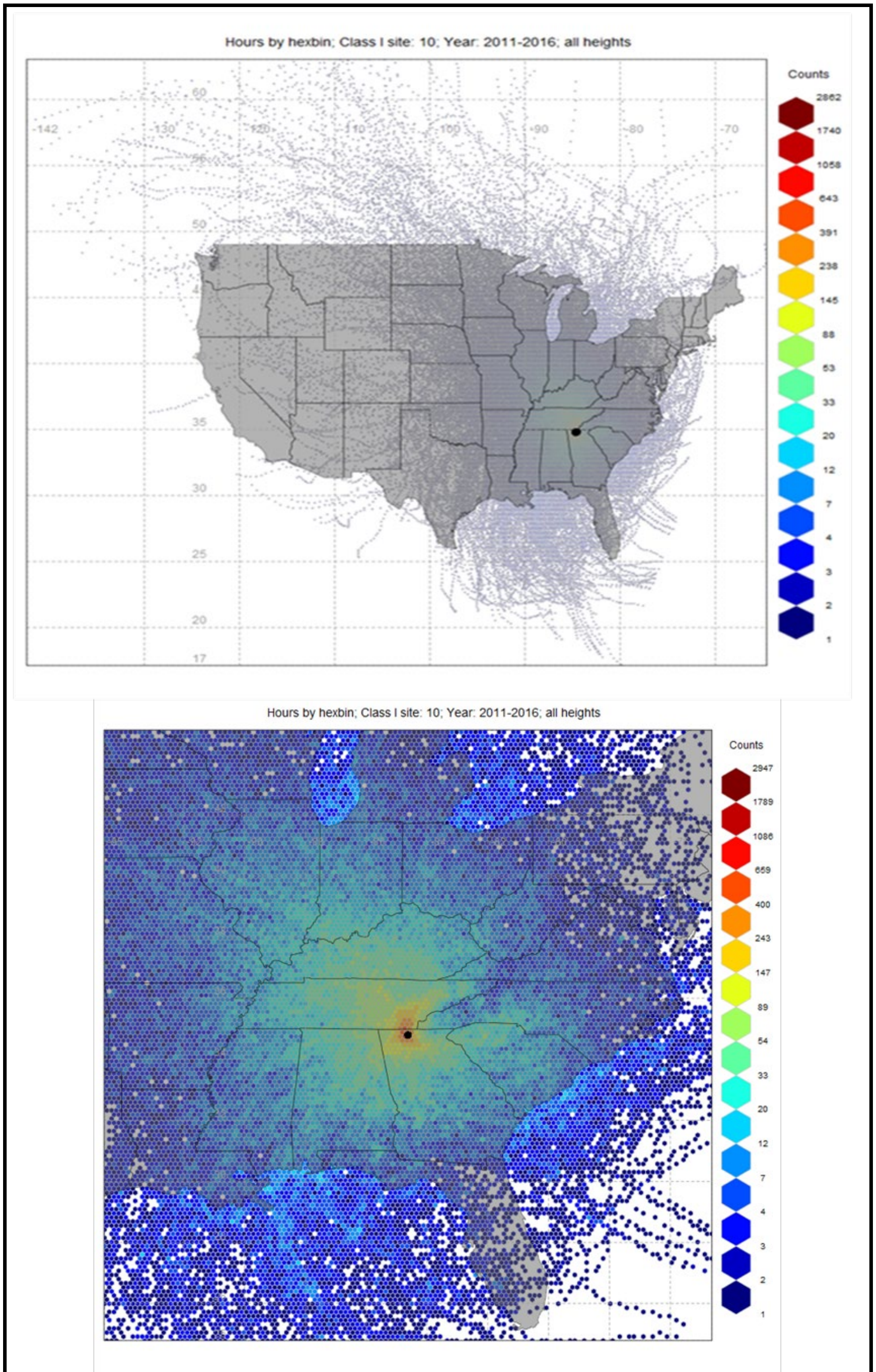


Figure 7-30: Residence Time (Counts per 12km Modeling Grid Cell) for Cohutta Wilderness Area – Full View (top) and Class I Zoom (bottom)

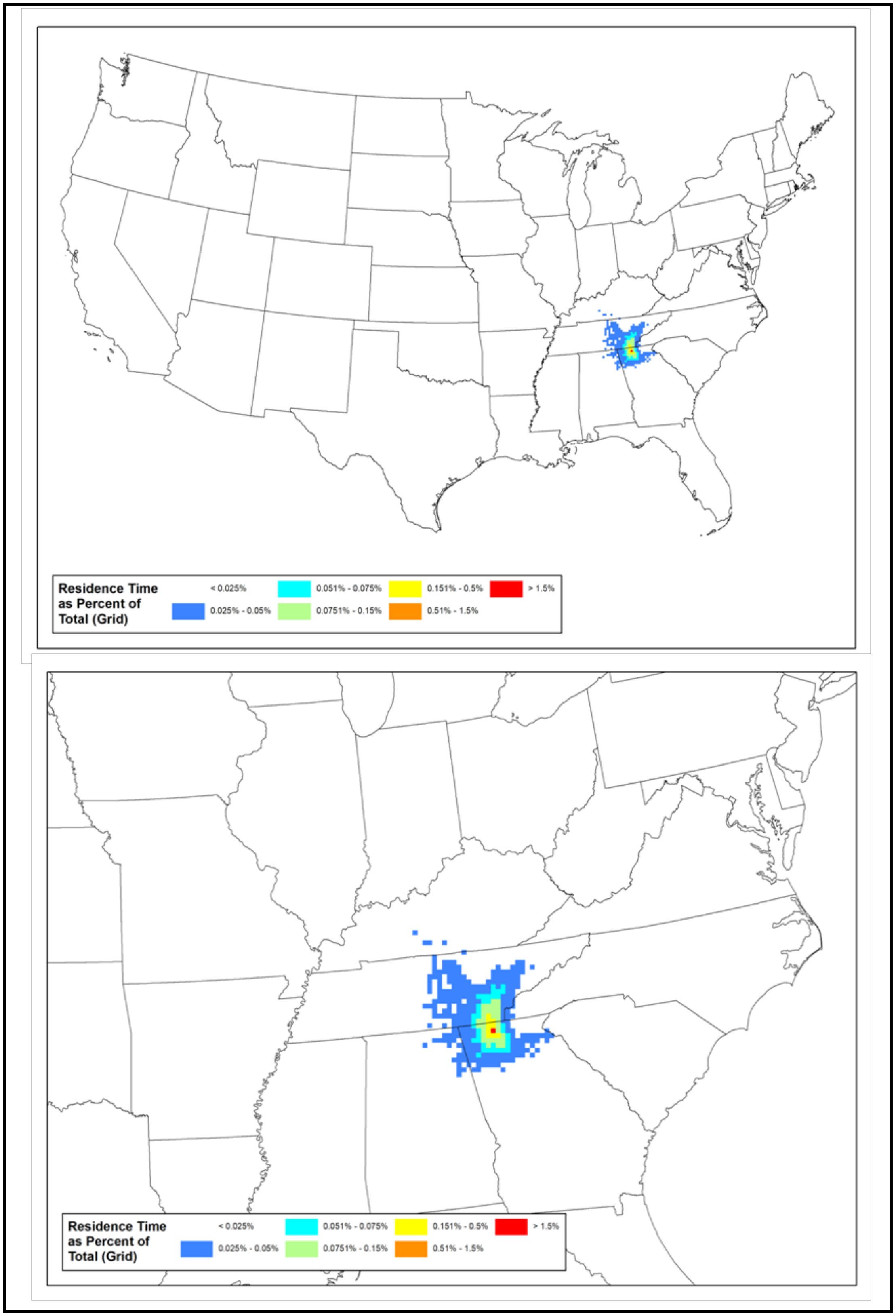


Figure 7-31: Residence Time (% of Total Counts per 12km Modeling Grid Cell for Cohutta Wilderness Area – Full View (top) and Class I Zoom (bottom)

Figure 7-32 contains the RT (counts per 12-km modeling grid cell) for Okefenokee National Wilderness Area. Figure 7-33 contains the residence time (percent of total counts per 12-km modeling grid cell) for Okefenokee National Wilderness Area. As illustrated in these figures, winds influencing Okefenokee National Wilderness Area on the 20% most impaired days come from all directions and there is no single predominant wind direction influencing the 20% most impaired visibility days.

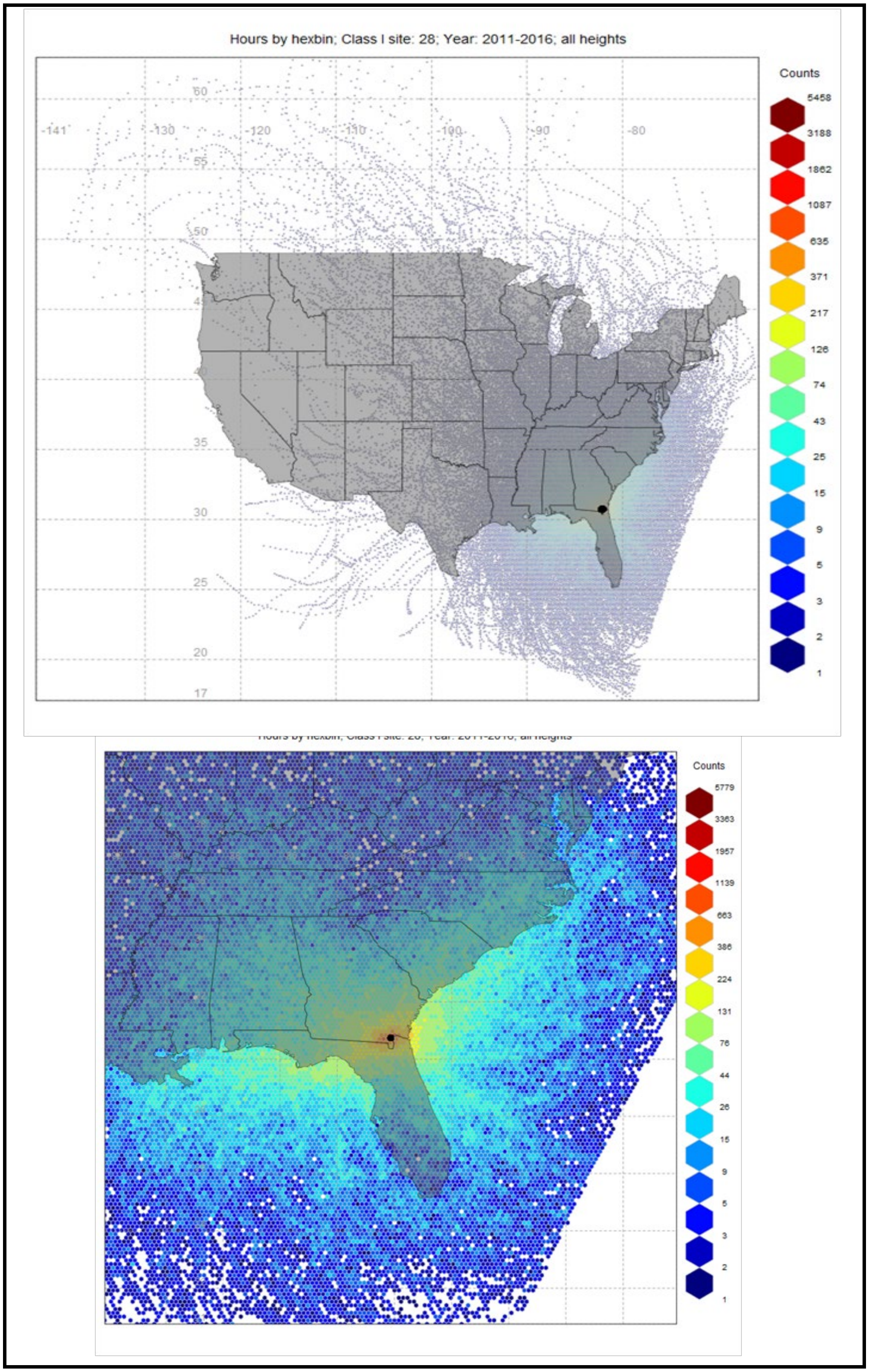


Figure 7-32: Residence Time (Counts per 12km Modeling Grid Cell) for Okefenokee National Wilderness Area – Full View (top) and Class I Zoom (bottom)

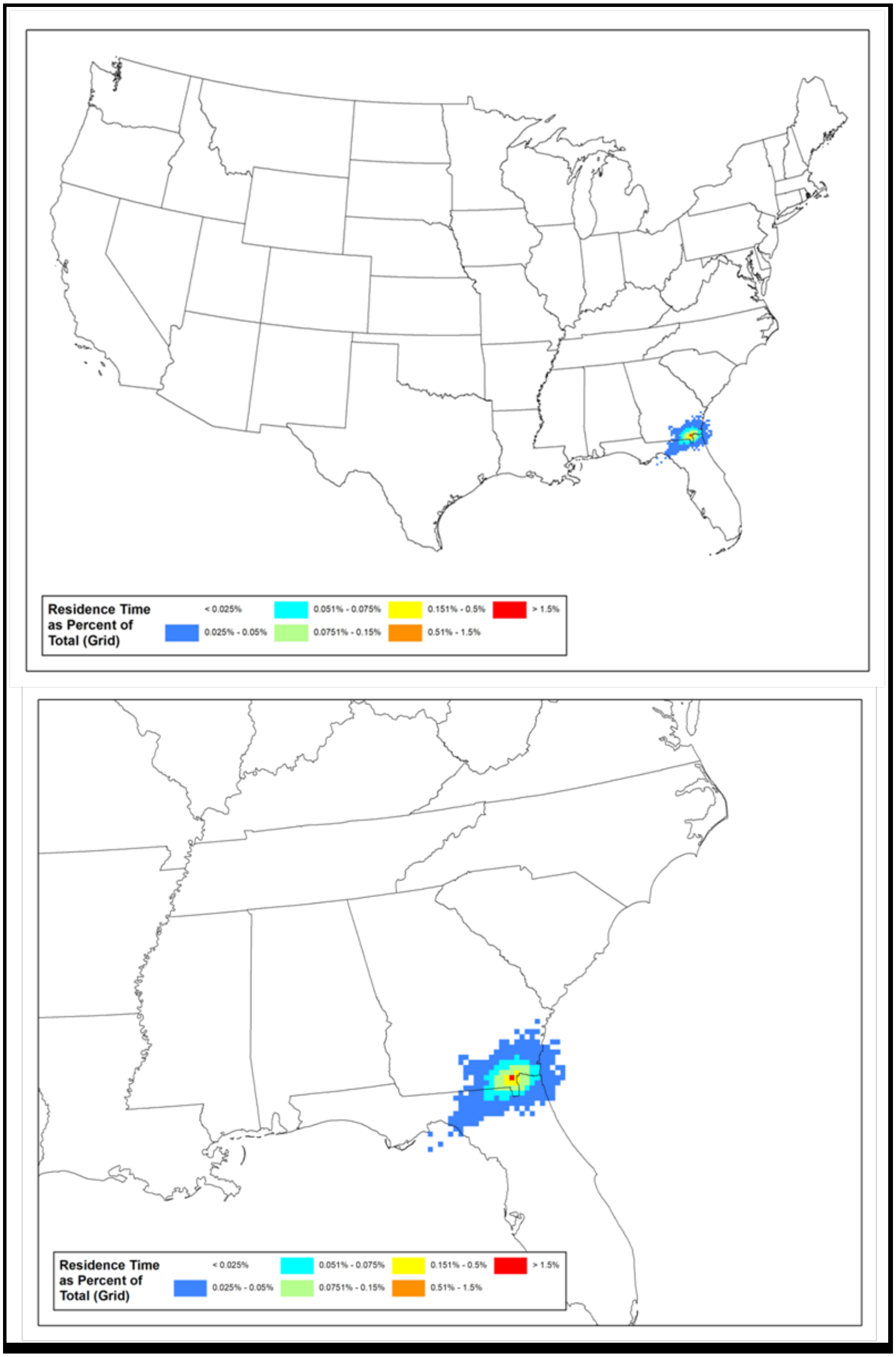


Figure 7-33: Residence Time (% of Total Counts per 12km Modeling Grid Cell for Okefenokee National Wilderness Area – Full View (top) and Class I Zoom (bottom)

7.5.3. Extinction-Weighted Residence Time Plots

The next step was to develop sulfate and nitrate extinction-weighted residence time (EWRT) plots. Each back trajectory was weighted by ammonium sulfate and ammonium nitrate extinction for that day and used to produce separate sulfate and nitrate EWRT plots. This allows separate analyses for sulfate and nitrate.

The concentration weighted trajectory (CWT)[48] approach was used to develop the EWRT, substituting the extinction values for the concentration. The extinction attributable to each pollutant is paired with the trajectory for that day. The mean weighted extinction of the pollutant species for each grid cell is calculated according to the following formula:

$$\overline{E}ij = EWRT = \frac{1}{\sum_{k=1}^{N} \tau_{ijk}} \sum_{k=1}^{N} (bext_k)\tau_{ijk}$$

Where:

- i and j are the indices of the grid;
- k is the index of the trajectory;
- N is the total number of trajectories used in the analysis;
- b_{ext} is the 24-hour extinction attributed to the pollutant measured upon arrival of trajectory k; and
- τ_{ijk} is the number of trajectory hours that pass through each grid cell (i, j), where i is the row and j is the column.

The higher the value of the EWRT ($\overline{E}_{ij}$), the more likely that the air parcels passing over cell (i, j) would cause higher extinction at the receptor site for that light extinction species. Since this method uses the extinction value for weighting, trajectories passing over large sources are more discernible than those passing over moderate sources.

Figure 7-34 contains the sulfate extinction weighted residence time (sulfate EWRT per 12-km modeling grid cell) for Cohutta Wilderness Area for the 20% most impaired days from 2011 to 2016. Figure 7-35 contains the nitrate extinction weighted residence time (nitrate EWRT per 12-km modeling grid cell) for Cohutta Wilderness Area for the 20% most impaired days from 2011 to 2016. It should be noted that the sulfate extinction weighted residence times are significantly higher than the nitrate extinction weighted residence times, demonstrating the importance of focusing on SO_2 emission reductions.

48 Hsu, Y.-K., T. M. Holsen and P. K. Hopke (2003). "Comparison of hybrid receptor models to locate PCB sources in Chicago". In: Atmospheric Environment 37.4, pp. 545–562. DOI: 10.1016/S1352-2310(02)00886-5

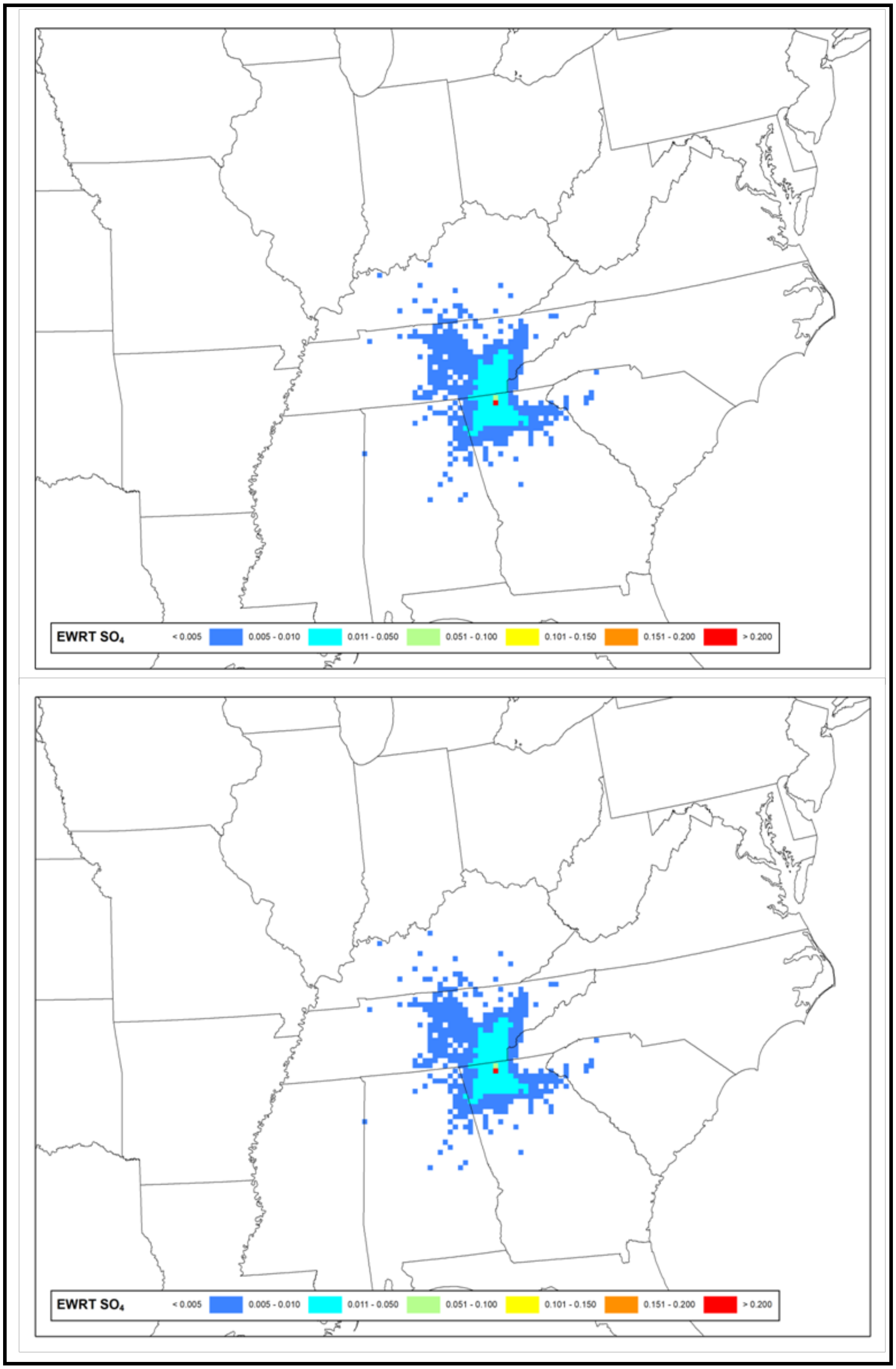


Figure 7-34: Sulfate Extinction Weighted Residence Time (Sulfate EWRT per 12km Modeling Grid Cell) for Cohutta Wilderness Area - Full View (top) and Class I Zoom (bottom)

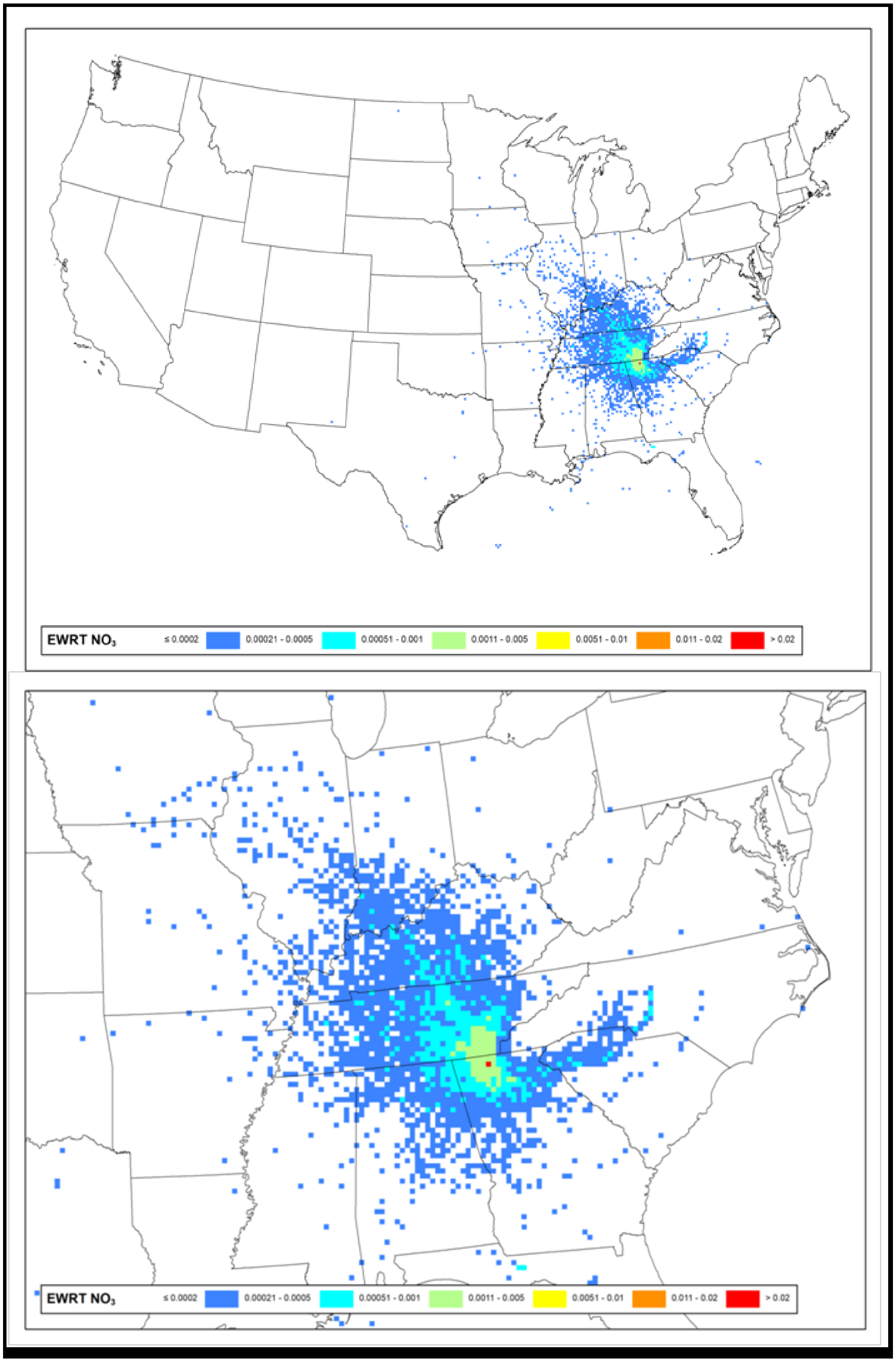


Figure 7-35: Nitrate Extinction Weighted Residence Time (Nitrate EWRT per 12-km Modeling Grid Cell) for Cohutta Wilderness Area - Full View (top) and Class I Zoom (bottom)

Figure 7-36 contains the sulfate extinction weighted residence time (sulfate EWRT per 12-km modeling grid cell) for Okefenokee National Wilderness Area for the 20% most impaired days from 2011 to 2016. Figure 7-37 contains the nitrate extinction weighted residence time (nitrate EWRT per 12-km modeling grid cell) for Okefenokee National Wilderness Area for the 20% most impaired days from 2011 to 2016. It should be noted that the sulfate extinction weighted residence times are significantly higher than the nitrate extinction weighted residence times, demonstrating the importance of focusing on SO_2 emission reductions.

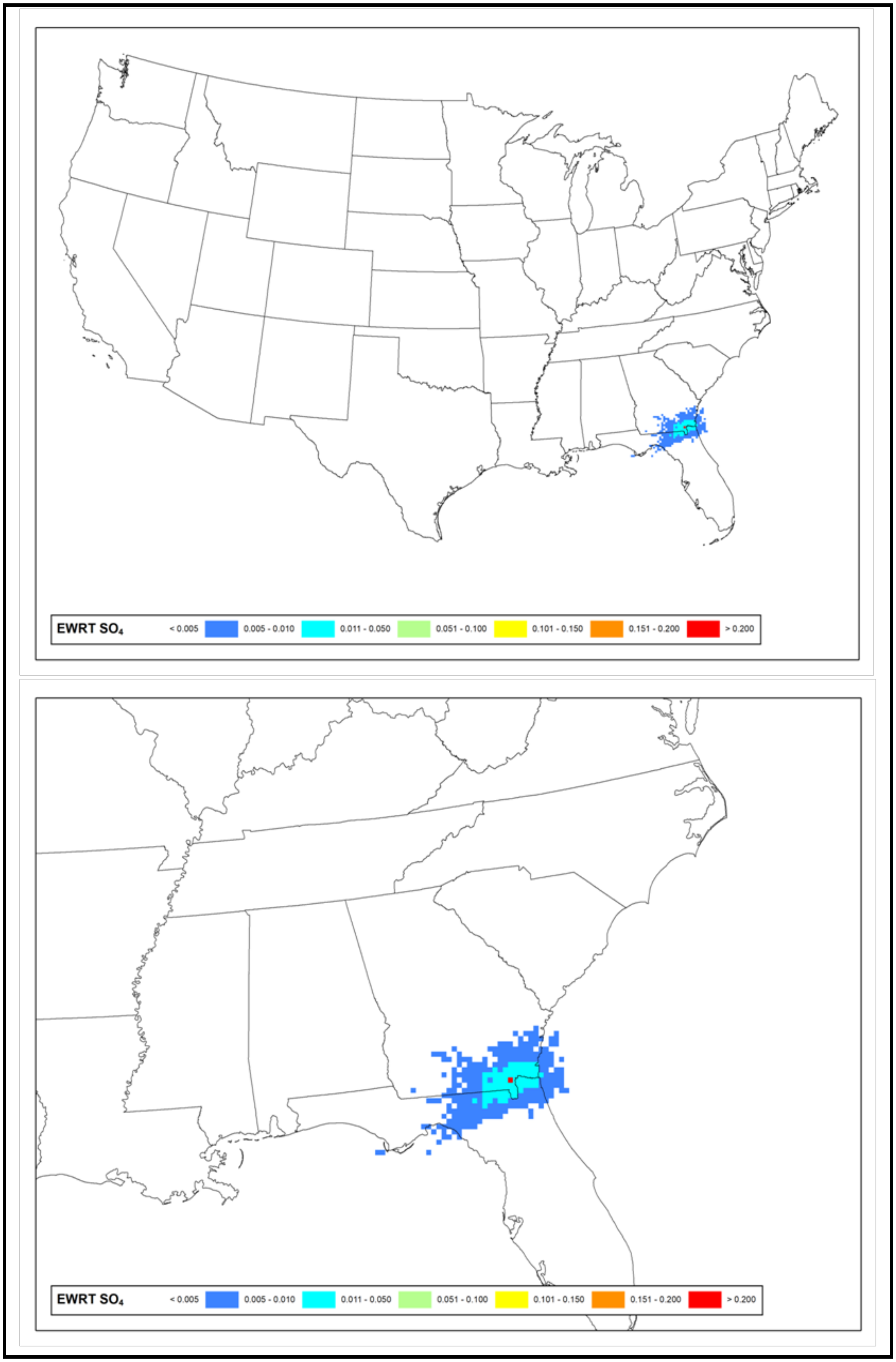


Figure 7-36: Sulfate Extinction Weighted Residence Time (Sulfate EWRT per 12km Modeling Grid Cell) for Okefenokee National Wilderness Area - Full View (top) and Class I Zoom (bottom)

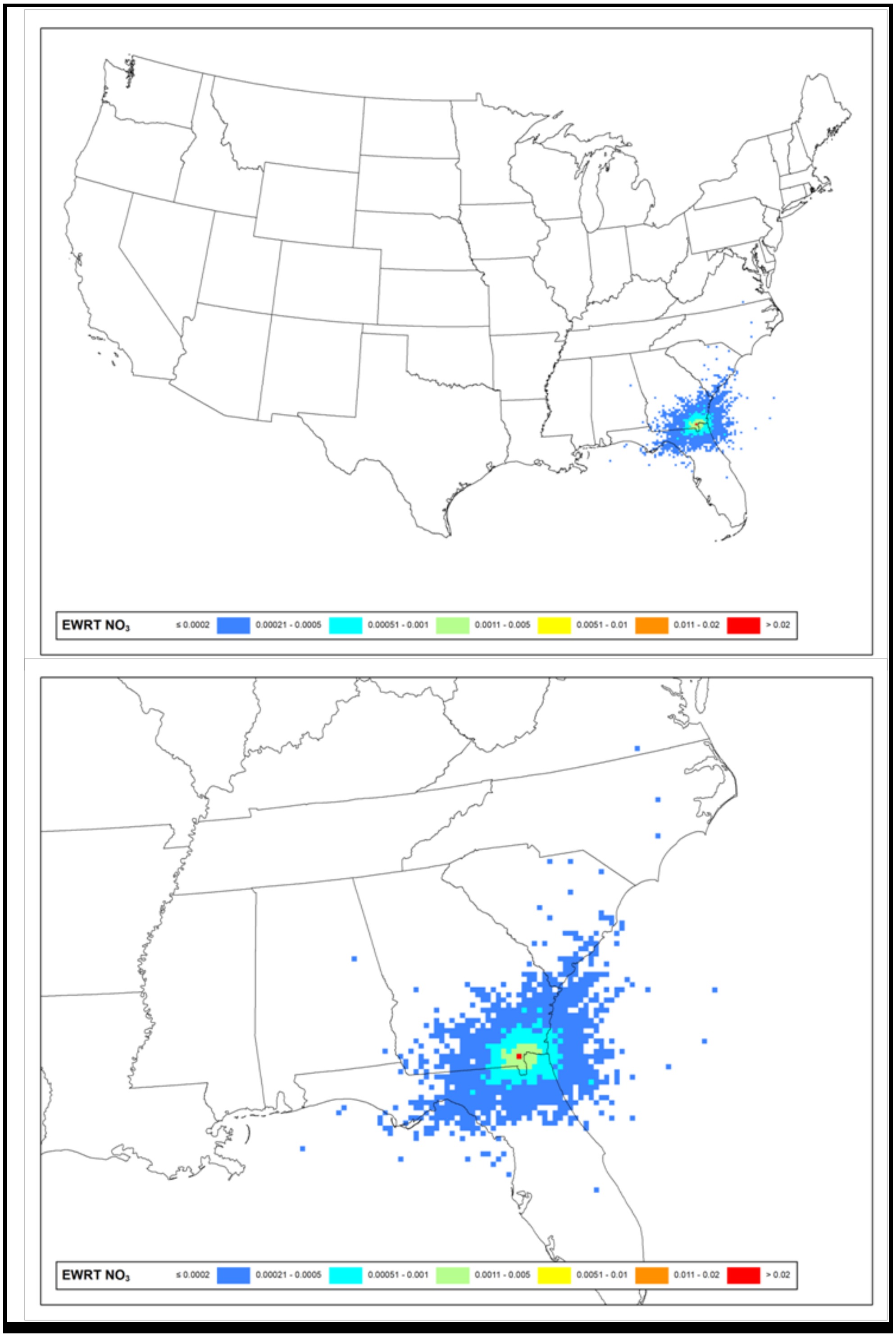


Figure 7-37: Nitrate Extinction Weighted Residence Time (Nitrate EWRT per 12-km Modeling Grid Cell) for Okefenokee National Wilderness Area - Full View (top) and Class I Zoom (bottom)

7.5.4. Emissions/Distance Extinction Weighted Residence Time Plots

Extinction weighted residence times were then combined with 12-km gridded SO_2 and NOx emissions from the 2028 emissions inventory. As a way of incorporating the effects of transport, deposition, and chemical transformation of point source emissions along the path of the trajectories, these data were weighted by 1/d, where d was calculated as the distance, in kilometers, between the center of the grid cell in which a source is located and the center of the grid cell in which the IMPROVE monitor is located. For Class I areas without an IMPROVE monitor (WOLF, JOYC, and OTCR), the grid cell for the centroid of the Class I area was used.

The grid cell total point SO_2 or NO_X emissions (Q, in tons per year) were divided by the distance (d, in kilometers) to the trajectory origin; for a final value (Q/d). This value was then multiplied by the sulfate or nitrate EWRT grid values (i.e., EWRT*(Q/d)) on a grid cell by grid cell basis. Next, the sulfate and nitrate EWRT *(Q/d) values were normalized by the domain-wide total and displayed as a percentage. This information allows the individual facilities to be ranked from highest to lowest based on sulfate and/or nitrate contributions. It should be noted that if non-normalized EWRT*(Q/d) values had been used to rank facilities from highest to lowest, the order would have been identical to the ranking from the normalized EWRT*(Q/d) values.

Figure 7-38 contains the sulfate emissions/distance extinction weighted residence time (percent of total Q/d*EWRT per 12-km modeling grid cell) for Cohutta Wilderness Area. Figure 7-39 contains the nitrate emissions/distance extinction weighted residence time (percent of total Q/d*EWRT per 12-km modeling grid cell) Cohutta Wilderness Area. These maps help visualize where the sources of the largest visibility impacts are located. Figure 7-38 and Figure 7-39 illustrate the relative importance of Georgia sources of SO_2 and NO_X, respectively, compared to sources in neighboring states.

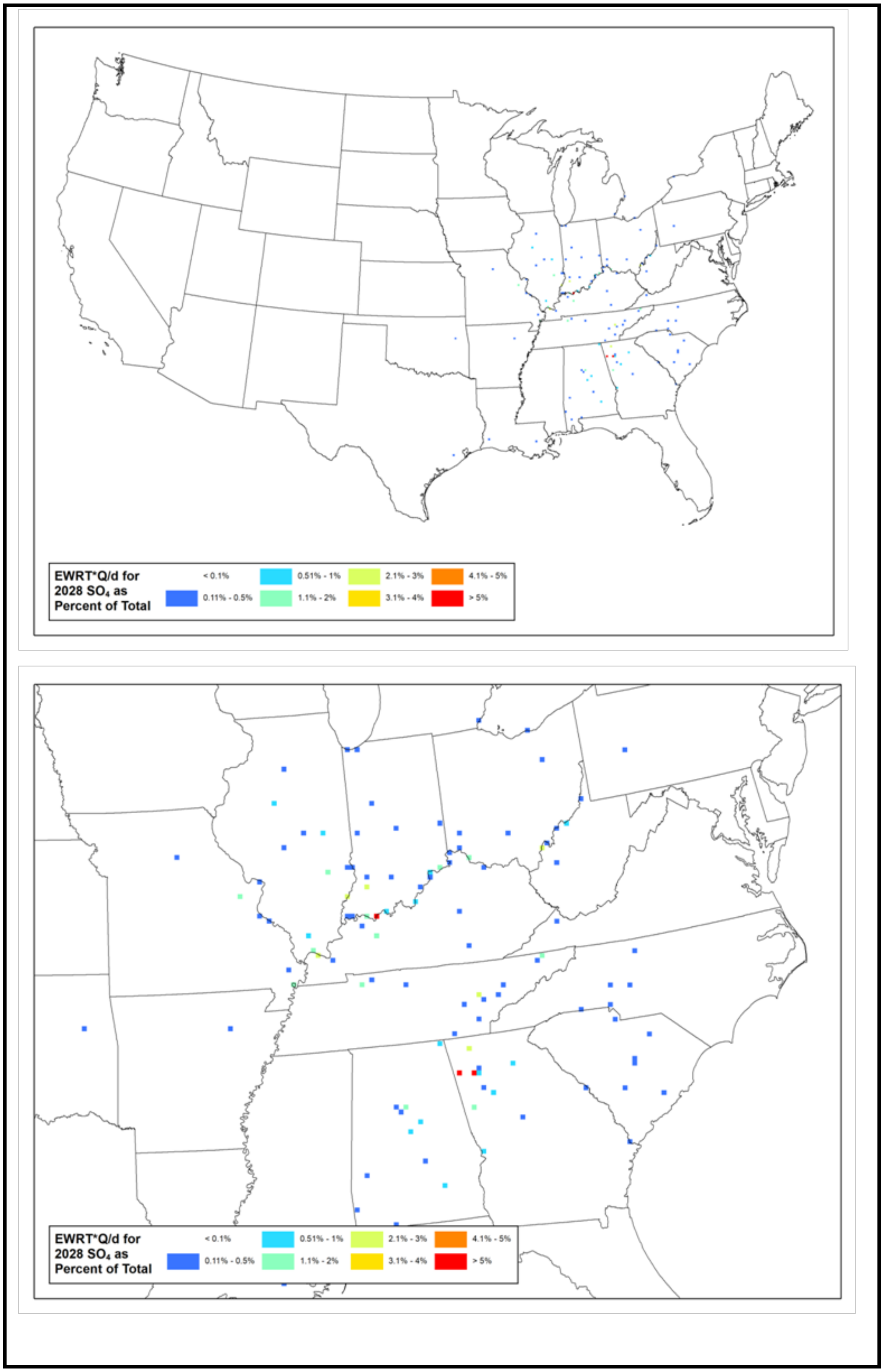
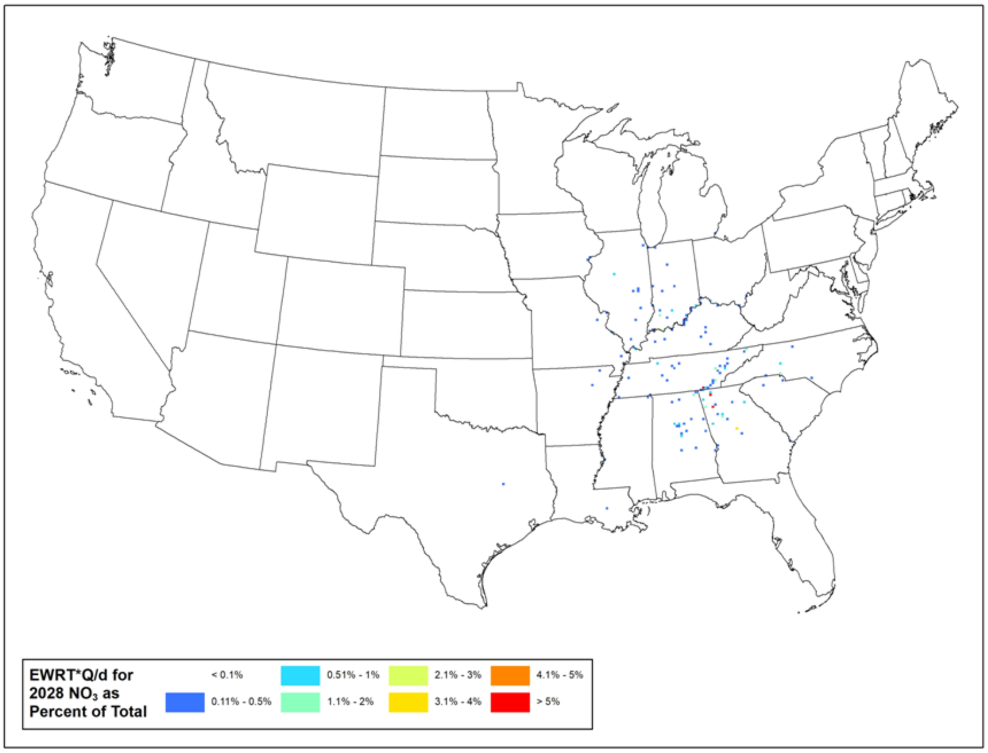


Figure 7-38: Sulfate Emissions/Distance Extinction Weighted Residence Time (% of Total Q/d*EWRT per 12km Modeling Grid Cell) for Cohutta Wilderness Area – Full View (top) and Class I Zoom (bottom)



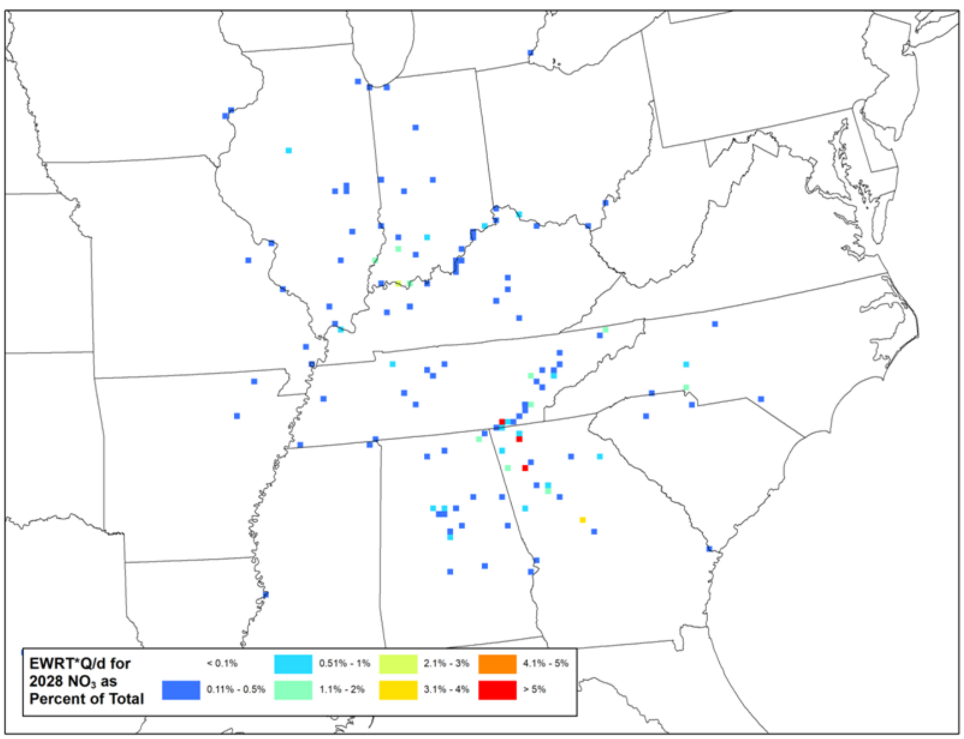


Figure 7-39: Nitrate Emissions/Distance Extinction Weighted Residence Time (% of Total Q/d*EWRT per 12km Modeling Grid Cell) for Cohutta Wilderness Area – Full View (top) and Class I Zoom (bottom)

Figure 7-40 contains the sulfate emissions/distance extinction weighted residence time (percent of total Q/d*EWRT per 12-km modeling grid cell) for Okefenokee National Wilderness Area. Figure 7-41 contains the nitrate emissions/distance extinction weighted residence time (percent of total Q/d*EWRT per 12-km modeling grid cell) Okefenokee National Wilderness Area. These maps help visualize where the sources of the largest visibility impacts are located. Figure 7-40 and Figure 7-41 illustrate the relative importance of Georgia sources of SO_2 and NO_X, respectively, compared to sources in neighboring states.

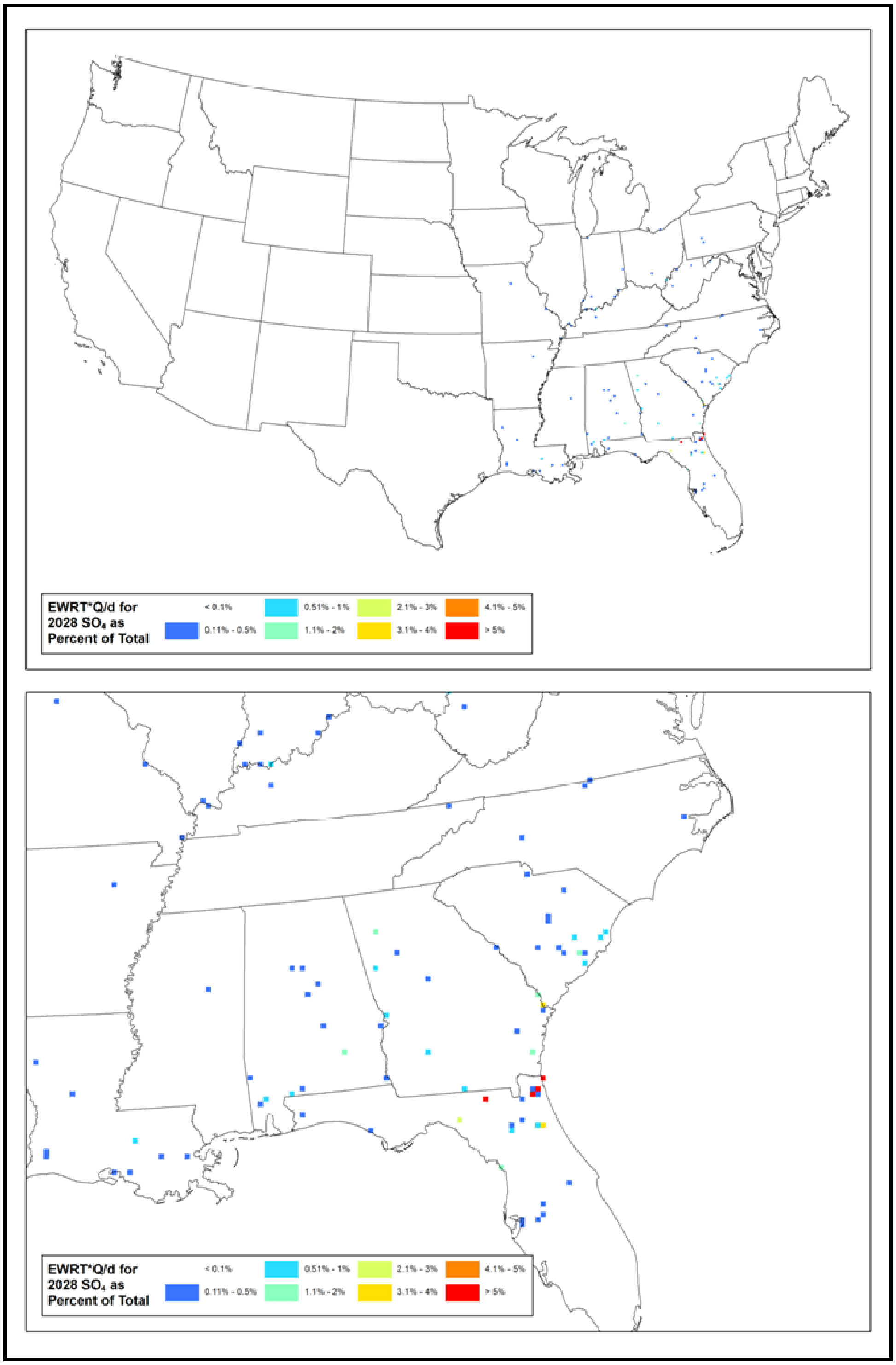


Figure 7-40: Sulfate Emissions/Distance Extinction Weighted Residence Time (% of Total Q/d*EWRT per 12km Modeling Grid Cell) for Okefenokee National Wilderness Area – Full View (top) and Class I Zoom (bottom)

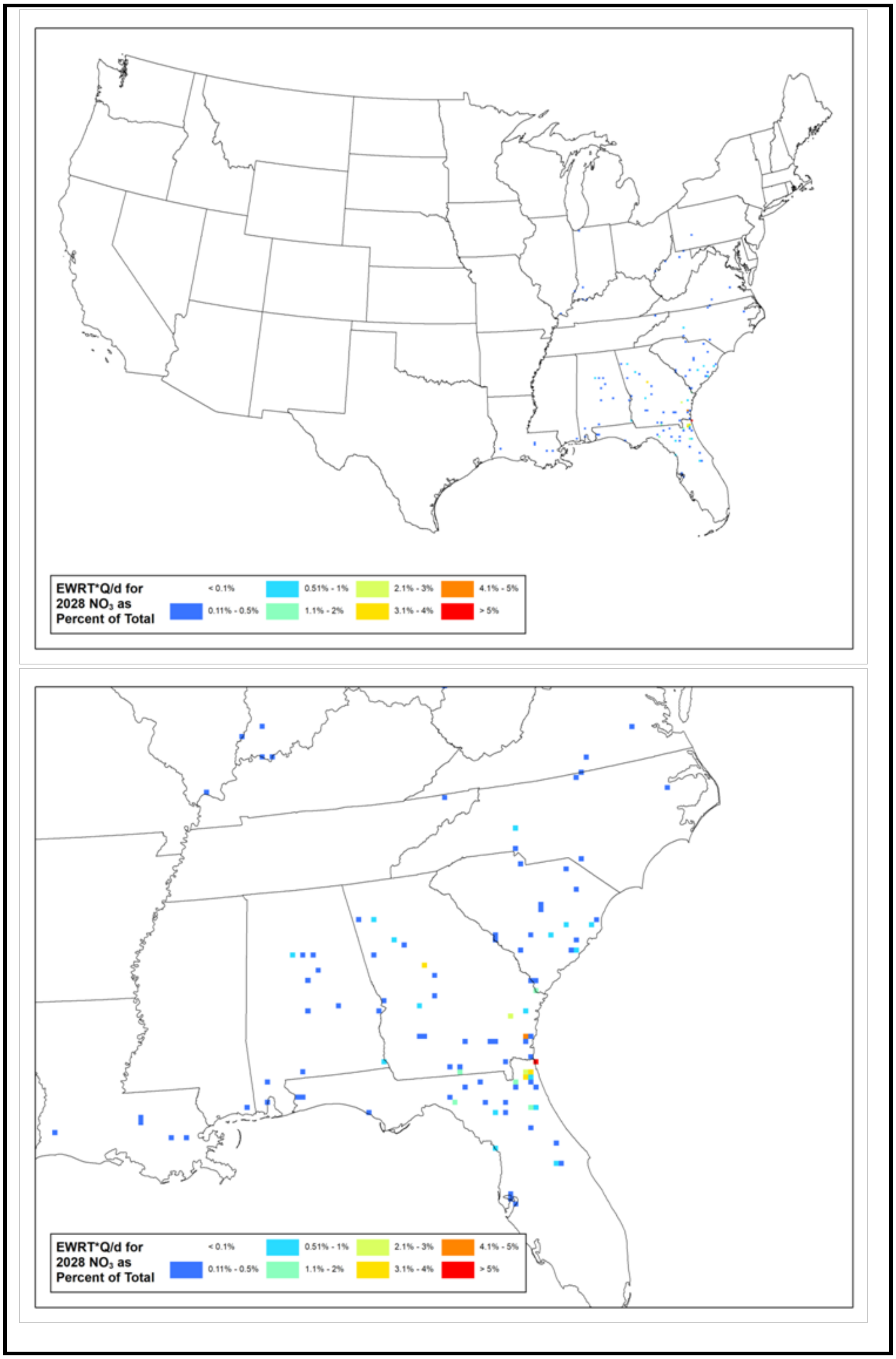


Figure 7-41: Nitrate Emissions/Distance Extinction Weighted Residence Time (% of Total Q/d*EWRT per 12km Modeling Grid Cell) for Okefenokee National Wilderness Area – Full View (top) and Class I Zoom (bottom)

7.5.5. Ranking of Sources for Georgia Class I Areas

The Q/d*EWRT data was further paired with additional point source metadata that defined the facility. Such data included facility identification numbers, facility names, state and county of location, Federal Information Processing Standard (FIPS) codes, North American Industry Classification System (NAICS) codes, and industry description. Spreadsheets for individual Class I areas were then exported from the database for further analysis by the states. This information allows the individual facilities to be ranked from highest to lowest based on sulfate and/or nitrate contributions.

It should be noted that while point sources account for most of the sulfate extinction, these sources only account for a portion of the nitrate extinction. Much of the nitrate extinction is attributable to the onroad and nonpoint sectors. As such, a similar analysis for county level data was conducted, that included county total point source contributions. This allows the point source contribution to be directly compared to the other source categories.

Similar analyses were conducted to rank SO_2 and NO_X emissions contributions for the county-level sources (nonpoint, onroad, non-road, fires, and total point source sectors). The process was similar to the process for point sources previously described, except calculations of RT and EWRT were completed at the county-level as opposed to grid cells. The calculation of "d" was from the centroid of the county to the trajectory origin, in km. Similar to point sources, the final spatial join was made between the county-level EWRT, emissions, and source information for each sector.

Table 7-5 contains the NO_X and SO_2 source contributions to visibility impairment on the 20% most impaired days at Cohutta Wilderness Area. Table 7-6 contains the NO_X and SO_2 source contributions to visibility impairment on the 20% most impaired days at Okefenokee National Wilderness Area. Table 7-7 contains the NO_X and SO_2 source contributions to visibility impairment on the 20% most impaired days at Wolf Island National Wilderness Area. Based on these contributions, it is clear that SO_2 from point sources is the dominant source category at Cohutta Wilderness Area (67.03%), Okefenokee National Wilderness Area (62.94%), and Wolf Island National Wilderness Area (67.85%).

Table 7-5: NO_x and SO_2 Source Contributions to Visibility Impairment on the 20% Most Impaired Days at Cohutta Wilderness Area

Category	NO_X	SO_2	Total
Nonpoint	3.24%	5.11%	8.35%
Non-Road, MAR	3.36%	0.10%	3.47%
Non-Road, Other	2.47%	0.18%	2.65%
Onroad	6.61%	0.63%	7.24%
Point	8.10%	67.03%	75.13%
Pt_Fires_Prescribed	0.53%	2.63%	3.16%
Total	**24.30%**	**75.70%**	**100.00%**

Table 7-6: NOx and SO_2 Source Contributions to Visibility Impairment on the 20% Most Impaired Days at Okefenokee National Wilderness Area

Category	NO_X	SO_2	Total
Nonpoint	1.72%	1.99%	3.71%
Non-Road, MAR	5.99%	0.65%	6.64%
Non-Road, Other	1.73%	0.15%	1.88%
Onroad	4.48%	0.51%	4.99%
Point	5.90%	62.94%	68.84%
Pt_Fires_Prescribed	2.56%	11.39%	13.94%
Total	**22.38%**	**77.62%**	**100.00%**

Table 7-7: NOx and SO_2 Source Contributions to Visibility Impairment on the 20% Most Impaired Days at Wolf Island National Wilderness Area

Category	NO_X	SO_2	Total
Nonpoint	1.67%	2.77%	4.44%
Non-Road, MAR	2.91%	1.54%	4.44%
Non-Road, Other	3.30%	0.28%	3.58%
Onroad	5.66%	0.71%	6.37%
Point	7.32%	67.85%	75.17%
Pt_Fires_Prescribed	0.90%	5.09%	5.99%
Total	**21.76%**	**78.24%**	**100.00%**

In order to compare the contributions from counties on a relative basis, an additional analysis was conducted by adding new columns to normalize the EWRT*(Q/d) by the area of each county to develop a metric to compare the contributions from counties on a relative basis. The previous calculation (prior to being normalized by area) had a propensity to attribute higher contributions to larger counties simply because they typically contained more emission sources and more hourly trajectory end points. Normalizing the contribution by the area of the county (i.e., EWRT*(Q/d) per square kilometer) provides a sense of the source emission density within the county. This allows county contributions to be directly compared, without large counties being weighted more heavily by simply having more emission sources and more hourly trajectory end points. County contributions (normalized or non-normalized by area) can be found in Appendix D.

All county and emissions source identifying information were joined in an Access database with calculations of Q/d, EWRT, EWRT*(Q/d), fraction and sum contributions, and any other source information. The database was then used to generate individual spreadsheets for each Class I area.

Table 7-8 contains the AoI NO_X and SO_2 facility contributions to visibility impairment on the 20% most impaired days at Cohutta Wilderness Area. Table 7-9 contains the AoI NO_X and SO_2 facility contributions to visibility impairment on the 20% most impaired days at Okefenokee National Wilderness Area. Table 7-10 contains the AoI NO_X and SO_2 facility contributions to visibility impairment on the 20% most impaired days at Wolf Island National Wilderness Area.

These tables only show the facilities contributing more than 1.00% sulfate + nitrate. The full list of all facilities can be found in Appendix D. The lists of individual facilities identified by the AoI analysis for each Class I area were used to determine which facilities were tagged in the PSAT source contribution analysis.

Table 7-8: AoI NOx and SO_2 Facility Contributions to Visibility Impairment on the 20% Most Impaired Days at Cohutta Wilderness Area.

State	Facility ID	Facility Name	Distance (km)	2028 NOx (tpy)	2028 SO_2 (tpy)	Nitrate (%)	Sulfate (%)	Sulfate + Nitrate (%)
GA	13015-2813011	Ga Power Company - Plant Bowen	78.0	6,643.3	10,453.4	1.15%	19.58%	20.74%
GA	13115-539311	TEMPLE INLAND	87.4	1,773.4	1,791.0	0.18%	4.66%	4.84%
IN	18147-8017211	INDIANA MICHIGAN POWER DBA AEP ROCKPORT	410.1	8,806.8	30,536.3	0.13%	4.68%	4.81%
IN	18051-7363111	Gibson	487.1	12,280.3	23,117.2	0.10%	2.31%	2.41%
IN	18125-7362411	INDIANAPOLIS POWER & LIGHT PETERSBURG	477.0	10,665.3	18,141.9	0.16%	2.18%	2.34%
TN	47145-4979111	TVA KINGSTON FOSSIL PLANT	124.0	1,687.4	1,886.1	0.13%	2.17%	2.30%
KY	21145-6037011	Tennessee Valley Authority (TVA) - Shawnee Fossil Plant	457.2	7,007.3	19,504.7	0.07%	2.18%	2.25%
OH	39053-8148511	General James M. Gavin Power Plant (0627010056)	512.0	8,122.5	41,595.8	0.02%	1.71%	1.73%
TN	47161-4979311	TVA CUMBERLAND FOSSIL PLANT	327.0	4,916.5	8,427.3	0.09%	1.38%	1.48%
KY	21041-5198511	KY Utilities Co - Ghent Station	441.5	7,939.9	10,169.3	0.08%	1.05%	1.13%
OH	39025-8294311	Duke Energy Ohio, Wm. H. Zimmer Station (1413090154)	454.6	7,150.0	22,133.9	0.06%	1.05%	1.12%
GA	13149-7415011	Ga Power Company - Plant Wansley	156.8	2,052.5	4,856.0	0.04%	1.05%	1.09%
GA	13313-9784111	Mohawk Industries Inc	32.0	66.5	77.1	0.07%	1.02%	1.09%
KY	21183-5561611	Big Rivers Electric Corp - Wilson Station	369.0	1,151.9	6,934.2	0.01%	1.07%	1.08%
TN	47163-3982311	EASTMAN CHEMICAL COMPANY	269.8	6,900.3	6,420.2	0.09%	0.99%	1.08%
IL	17127-7808911	Joppa Steam	466.9	4,706.3	20,509.3	0.02%	1.04%	1.06%

Note: Green highlight indicates facilities that were selected by Georgia EPD for PSAT tagging.

Table 7-9: AoI NOx and SO_2 Facility Contributions to Visibility Impairment on the 20% Most Impaired Days at Okefenokee National Wilderness Area.

State	Facility ID	Facility Name	Distance (km)	2028 NOx (tpy)	2028 SO_2 (tpy)	Nitrate (%)	Sulfate (%)	Sulfate + Nitrate (%)
FL	12047-769711	WHITE SPRINGS AGRICULTURAL CHEMICALS,INC	71.5	112.4	2,745.0	0.03%	14.63%	14.67%
FL	12089-753711	ROCK TENN CP, LLC	64.8	2,316.8	2,606.7	0.88%	12.82%	13.71%
FL	12031-640211	JEA	65.6	651.8	2,094.5	0.18%	6.60%	6.78%
FL	12089-845811	RAYONIER PERFORMANCE FIBERS LLC	63.4	2,327.1	562.0	0.90%	2.82%	3.73%
FL	12107-2474411	SEMINOLE ELECTRIC COOPERATIVE, INC.	121.4	917.8	3,713.4	0.07%	3.25%	3.32%
FL	12031-770211	IFF CHEMICAL HOLDINGS, INC.	56.8	37.7	898.9	0.01%	3.25%	3.26%
GA	13051-3679811	International Paper - Savannah	178.9	1,560.7	3,945.4	0.08%	2.81%	2.89%
FL	12123-752411	BUCKEYE FLORIDA, LIMITED PARTNERSHIP	153.5	1,830.7	1,520.4	0.14%	2.18%	2.32%
FL	12031-640111	RENESSENZ LLC	59.8	66.3	569.5	0.02%	1.96%	1.98%
FL	12017-640611	DUKE ENERGY FLORIDA, INC. (DEF)	205.0	2,489.8	5,306.4	0.06%	1.40%	1.46%
GA	13127-3721011	Brunswick Cellulose Inc	75.3	1,554.5	294.2	0.34%	1.01%	1.35%
AL	01109-985711	Sanders Lead Co	384.6	121.7	7,951.1	0.00%	1.11%	1.11%
GA	13015-2813011	Ga Power Company - Plant Bowen	458.1	6,643.3	10,453.4	0.05%	1.02%	1.07%
GA	13103-536311	Georgia-Pacific Consumer Products LP (Savannah River Mill)	197.2	351.5	1,860.2	0.01%	1.05%	1.06%

Note: Green highlight indicates facilities that were selected by Georgia EPD for PSAT tagging.

Table 7-10: AoI NOx and SO_2 Facility Contributions to Visibility Impairment on the 20% Most Impaired Days at Wolf Island National Wilderness Area.

State	Facility ID	Facility Name	Distance (km)	2028 NOx (tpy)	2028 SO_2 (tpy)	Nitrate (%)	Sulfate (%)	Sulfate + Nitrate (%)
GA	13127-3721011	Brunswick Cellulose Inc	27.9	1,554.5	294.2	2.94%	8.84%	11.78%
FL	12089-753711	ROCK TENN CP, LLC	74.9	2,316.8	2,606.7	0.39%	8.56%	8.95%
GA	13051-3679811	International Paper - Savannah	85.9	1,560.7	3,945.4	0.24%	7.53%	7.77%
FL	12031-640211	JEA	105.1	651.8	2,094.5	0.09%	4.43%	4.52%
GA	13103-536311	Georgia-Pacific Consumer Products LP (Savannah River Mill)	109.9	351.5	1,860.2	0.03%	2.65%	2.68%
FL	12089-845811	RAYONIER PERFORMANCE FIBERS LLC	77.4	2,327.1	562.0	0.38%	1.79%	2.17%
FL	12047-769711	WHITE SPRINGS AGRICULTURAL CHEMICALS,INC	173.6	112.4	2,745.0	0.01%	1.97%	1.98%
SC	45015-4834911	ALUMAX OF SOUTH CAROLINA	223.0	108.1	3,751.7	0.00%	1.84%	1.84%
FL	12107-2474411	SEMINOLE ELECTRIC COOPERATIVE, INC.	181.4	917.8	3,713.4	0.02%	1.77%	1.79%
OH	39053-8148511	General James M. Gavin Power Plant (0627010056)	845.3	8,122.5	41,595.8	0.02%	1.71%	1.73%
SC	45015-4120411	SANTEE COOPER CROSS GENERATING STATION	251.0	3,273.5	4,281.2	0.09%	1.59%	1.68%
GA	13051-3678011	Southern States Phosphate & Fertilizer	84.1	1.0	597.1	0.00%	1.55%	1.55%
FL	12017-640611	DUKE ENERGY FLORIDA, INC. (DEF)	296.6	2,489.8	5,306.4	0.04%	1.19%	1.22%
FL	12031-770211	IFF CHEMICAL HOLDINGS, INC.	118.5	37.7	898.9	0.00%	1.22%	1.22%
GA	13051-3678111	Savannah Sugar Refinery	89.9	521.6	582.0	0.08%	1.06%	1.14%
GA	13015-2813011	Ga Power Company - Plant Bowen	458.1	6,643.3	10,453.4	0.03%	1.08%	1.11%
GA	13127-3721111	Ga Power Company - Plant McManus	27.1	72.2	30.1	0.14%	0.93%	1.07%
SC	45079-4801411	INTERNATIONAL PAPER EASTOVER	288.7	1,780.3	3,212.9	0.05%	0.95%	1.00%

Note: Green highlight indicates facilities that were selected by Georgia EPD for PSAT tagging.

7.6. Screening of Sources for Reasonable Progress Analysis

In order to gain a better understanding of the source contributions to modeled visibility, VISTAS used CAMx PSAT modeling. PSAT uses multiple tracer families to track the fate of both primary and secondary PM. PSAT allows emissions to be tracked (tagged) for individual facilities as well as various combinations of sectors and geographic areas (e.g., by state).

VISTAS states used the NO_X and SO_2 facility contributions from the AoI analysis to help select sources to be tagged with PSAT. Each state submitted their list of facilities to be tagged. In the end, SO_2 and NO_X emissions for 87 individual facilities were tagged and the visibility contributions (Mm^{-1}) for the 20% most impaired days were determined at all Class I areas in the VISTAS_12 domain. In addition, PSAT tags previously discussed in Section 7.4 include total sulfate and nitrate contributions from EGU + non-EGU point sources at each Class I area. This allows a percent contribution (individual facility contribution divided by the total sulfate and nitrate contributions from EGU + non-EGU point sources) to be determined for each facility at each Class I area. If the sulfate contribution was greater than or equal to 1.00%, then the facility was considered for an SO_2 reasonable progress analysis. If the nitrate contribution was greater than or equal to 1.00%, then the facility was considered for a NO_X reasonable progress analysis. Details of the PSAT modeling can be found in Appendix E-7a and details of the percent contribution calculations can be found in Appendix E-7b.

7.6.1. Selection of Sources for PSAT Tagging

Georgia used the NOx and SO_2 facility contributions from the AoI analysis to help select sources to be tagged with PSAT. Georgia requested that all Georgia facilities with an AoI contribution of 2% or more be tagged with PSAT. Also, Georgia requested that all facilities outside Georgia with an AoI contribution of 4% or more be tagged with PSAT. Georgia feels that this approach captures a reasonable set of sources, including the most important in-state sources as well as any large sources outside Georgia. Based on these criteria, Georgia selected the sources listed in Table 7-11 for PSAT tagging.

Table 7-11: Facilities Selected by Georgia for PSAT Tagging.

State	Facility ID	Facility Name
GA	13015-2813011	Ga Power Company - Plant Bowen
GA	13115-539311	TEMPLE INLAND
GA	13051-3679811	International Paper - Savannah
GA	13127-3721011	Brunswick Cellulose Inc
GA	13103-536311	Georgia-Pacific Consumer Products LP (Savannah River Mill)
FL	12047-769711	WHITE SPRINGS AGRICULTURAL CHEMICALS,INC
FL	12089-753711	ROCK TENN CP, LLC
FL	12031-640211	JEA
IN	18147-8017211	INDIANA MICHIGAN POWER DBA AEP ROCKPORT

In addition, other VISTAS states selected sources for PSAT tagging. The detailed PSAT selection process for each VISTAS state is provided in their individual regional haze SIPs.

Based on the sources selected by Georgia and the other VISTAS states, VISTAS selected 87 facilities for SO_2 and NO_X PSAT tagging. Some of the 87 facilities were selected by multiple states. Table 7-12 lists PSAT tags selected for facilities in AL and FL. Table 7-13 lists PSAT tags selected for facilities in GA, KY, MS, NC, SC, and TN. Table 7-14 lists PSAT tags selected for facilities in VA and WV. Table 7-15 lists PSAT tags selected for facilities in AR, MO, PA, IL, IN, and OH. The contributions from all 87 PSAT tags were evaluated at all Class I areas in the VISTAS_12 domain.

A detailed description of the PSAT modeling and post-processing for creating PSAT contributions for Class I areas is contained in Appendix E-7a and Appendix E-7b.

Table 7-12: PSAT Tags Selected for Facilities in AL and FL.

State	RPO	Facility ID	Facility Name	SO_2 (TPY)	NOx (TPY)
AL	VISTAS	01097-949811	Akzo Nobel Chemicals Inc	3,335.72	20.71
AL	VISTAS	01097-1056111	Ala Power - Barry	6,033.17	2,275.76
AL	VISTAS	01129-1028711	American Midstream Chatom, LLC	3,106.38	425.87
AL	VISTAS	01073-1018711	DRUMMOND COMPANY, INC.	2,562.17	1,228.55
AL	VISTAS	01053-7440211	Escambia Operating Company LLC	18,974.39	349.32
AL	VISTAS	01053-985111	Escambia Operating Company LLC	8,589.60	149.64
AL	VISTAS	01103-1000011	Nucor Steel Decatur LLC	170.23	331.24
AL	VISTAS	01109-985711	Sanders Lead Co	7,951.06	121.71
AL	VISTAS	01097-1061611	Union Oil of California - Chunchula Gas Plant	2,573.15	349.23
FL	VISTAS	12123-752411	BUCKEYE FLORIDA, LIMITED PARTNERSHIP	1,520.42	1,830.71
FL	VISTAS	12086-900111	CEMEX CONSTRUCTION MATERIALS FL. LLC.	29.51	910.36
FL	VISTAS	12017-640611	DUKE ENERGY FLORIDA, INC. (DEF)	5,306.41	2,489.85
FL	VISTAS	12086-900011	FLORIDA POWER & LIGHT (PTF)	13.05	170.61
FL	VISTAS	12033-752711	GULF POWER - Crist	2,615.65	2,998.39
FL	VISTAS	12086-3532711	HOMESTEAD CITY UTILITIES	0.00	97.09
FL	VISTAS	12031-640211	JEA	2,094.48	651.79
FL	VISTAS	12105-717711	MOSAIC FERTILIZER LLC	7,900.67	310.42
FL	VISTAS	12057-716411	MOSAIC FERTILIZER, LLC	3,034.06	159.71
FL	VISTAS	12105-919811	MOSAIC FERTILIZER, LLC	4,425.56	141.02
FL	VISTAS	12089-845811	RAYONIER PERFORMANCE FIBERS LLC	561.97	2,327.10
FL	VISTAS	12089-753711	ROCK TENN CP, LLC	2,606.72	2,316.77
FL	VISTAS	12005-535411	ROCKTENN CP LLC	2,590.88	1,404.89
FL	VISTAS	12129-2731711	TALLAHASSEE CITY PURDOM GENERATING STA.	2.86	121.46
FL	VISTAS	12057-538611	TAMPA ELECTRIC COMPANY (TEC)	6,084.90	2,665.03
FL	VISTAS	12086-899911	TARMAC AMERICA LLC	9.38	879.70
FL	VISTAS	12047-769711	WHITE SPRINGS AGRICULTURAL CHEMICALS,INC	3,197.77	112.41

Table 7-13: PSAT Tags Selected for Facilities in GA, KY, MS, NC, SC, and TN.

State	RPO	Facility ID	Facility Name	SO_2 (TPY)	NOx (TPY)
GA	VISTAS	13127-3721011	Brunswick Cellulose Inc	294.20	1,554.51
GA	VISTAS	13015-2813011	Ga Power Company - Plant Bowen	10,453.41	6,643.32
GA	VISTAS	13103-536311	Georgia-Pacific Consumer Products LP (Savannah River Mill)	1,860.18	351.52
GA	VISTAS	13051-3679811	International Paper – Savannah	3,945.38	1,560.73
GA	VISTAS	13115-539311	TEMPLE INLAND	1,791.00	1,773.35
KY	VISTAS	21183-5561611	Big Rivers Electric Corp - Wilson Station	6,934.16	1,151.95
KY	VISTAS	21091-7352411	Century Aluminum of KY LLC	5,044.16	197.66
KY	VISTAS	21177-5196711	Tennessee Valley Authority - Paradise Fossil Plant	3,011.01	3,114.52
KY	VISTAS	21145-6037011	Tennessee Valley Authority (TVA) - Shawnee Fossil Plant	19,504.75	7,007.34
MS	VISTAS	28059-8384311	Chevron Products Company, Pascagoula Refinery	741.60	1,534.12
MS	VISTAS	28059-6251011	Mississippi Power Company, Plant Victor J Daniel	231.92	3,829.72
NC	VISTAS	37087-7920511	Blue Ridge Paper Products - Canton Mill	1,127.07	2,992.37
NC	VISTAS	37117-8049311	Domtar Paper Company, LLC	687.45	1,796.49
NC	VISTAS	37035-8370411	Duke Energy Carolinas, LLC - Marshall Steam Station	4,139.21	7,511.31
NC	VISTAS	37013-8479311	PCS Phosphate Company, Inc. - Aurora	4,845.90	495.58
NC	VISTAS	37023-8513011	SGL Carbon LLC	261.64	21.69
SC	VISTAS	45015-4834911	ALUMAX OF SOUTH CAROLINA	3,751.69	108.08
SC	VISTAS	45043-5698611	INTERNATIONAL PAPER GEORGETOWN MILL	2,767.52	2,031.26
SC	VISTAS	45019-4973611	KAPSTONE CHARLESTON KRAFT LLC	1,863.65	2,355.82
SC	VISTAS	45015-4120411	SANTEE COOPER CROSS GENERATING STATION	4,281.17	3,273.47
SC	VISTAS	45043-6652811	SANTEE COOPER WINYAH GENERATING STATION	2,246.86	1,772.53
SC	VISTAS	45015-8306711	SCE&G WILLIAMS	392.48	992.73
TN	VISTAS	47093-4979911	Cemex - Knoxville Plant	121.47	711.50
TN	VISTAS	47163-3982311	EASTMAN CHEMICAL COMPANY	6,420.16	6,900.33
TN	VISTAS	47105-4129211	TATE & LYLE, Loudon	472.76	883.25
TN	VISTAS	47001-6196011	TVA BULL RUN FOSSIL PLANT	622.54	964.16
TN	VISTAS	47161-4979311	TVA CUMBERLAND FOSSIL PLANT	8,427.33	4,916.52
TN	VISTAS	47145-4979111	TVA KINGSTON FOSSIL PLANT	1,886.09	1,687.38

Table 7-14: PSAT Tags Selected for Facilities in VA and WV.

State	RPO	Facility ID	Facility Name	SO_2 (TPY)	NOx (TPY)
VA	VISTAS	51027-4034811	Jewell Coke Company LLP	5,090.95	520.17
VA	VISTAS	51580-5798711	Meadwestvaco Packaging Resource Group	2,115.31	1,985.69
VA	VISTAS	51023-5039811	Roanoke Cement Company	2,290.17	1,972.97
WV	VISTAS	54033-6271711	ALLEGHENY ENERGY SUPPLY CO, LLC-HARRISON	10,082.94	11,830.88
WV	VISTAS	54049-4864511	AMERICAN BITUMINOUS POWER-GRANT TOWN PLT	2,210.25	1,245.10
WV	VISTAS	54079-6789111	APPALACHIAN POWER COMPANY - JOHN E AMOS PLANT	10,984.24	4,878.10
WV	VISTAS	54023-6257011	Dominion Resources, Inc. - MOUNT STORM POWER STATION	2,123.64	1,984.14
WV	VISTAS	54041-6900311	EQUITRANS - COPLEY RUN CS 70	0.10	511.06
WV	VISTAS	54083-6790711	FILES CREEK 6C4340	0.15	643.35
WV	VISTAS	54083-6790511	GLADY 6C4350	0.11	343.29
WV	VISTAS	54093-6327811	KINGSFORD MANUFACTURING COMPANY	16.96	140.88
WV	VISTAS	54061-16320111	LONGVIEW POWER	2,313.73	1,556.57
WV	VISTAS	54051-6902311	MITCHELL PLANT	5,372.40	2,719.62
WV	VISTAS	54061-6773611	MONONGAHELA POWER CO.- FORT MARTIN POWER	4,881.87	13,743.32
WV	VISTAS	54073-4782811	MONONGAHELA POWER CO-PLEASANTS POWER STA	16,817.43	5,497.37
WV	VISTAS	54061-6773811	MORGANTOWN ENERGY ASSOCIATES	828.64	655.58

Table 7-15: PSAT Tags Selected for Facilities in AR, MO, PA, IL, IN, and OH.

State	RPO	Facility ID	Facility Name	SO_2 (TPY)	NOx (TPY)
AR	CENRAP	05063-1083411	ENTERGY ARKANSAS INC-INDEPENDENCE PLANT	32,050.48	14,133.10
MO	CENRAP	29143-5363811	NEW MADRID POWER PLANT-MARSTON	16,783.71	4,394.10
MD	MANE-VU	24001-7763811	Luke Paper Company	22,659.84	3,607.00
PA	MANE-VU	42005-3866111	GENON NE MGMT CO/KEYSTONE STA	56,939.25	6,578.47
PA	MANE-VU	42063-3005211	HOMER CITY GEN LP/ CENTER TWP	11,865.70	5,215.96
PA	MANE-VU	42063-3005111	NRG WHOLESALE GEN/SEWARD GEN STA	8,880.26	2,254.64
IL	Midwest RPO	17127-7808911	Joppa Steam	20,509.28	4,706.35
IN	Midwest RPO	18173-8183111	Alcoa Warrick Power Plt Agc Div of AL	5,071.28	11,158.55
IN	Midwest RPO	18051-7363111	Gibson	23,117.23	12,280.34
IN	Midwest RPO	18147-8017211	INDIANA MICHIGAN POWER DBA AEP ROCKPORT	30,536.33	8,806.77
IN	Midwest RPO	18125-7362411	INDIANAPOLIS POWER & LIGHT PETERSBURG	18,141.88	10,665.27
IN	Midwest RPO	18129-8166111	Sigeco AB Brown South Indiana Gas & Ele	7,644.70	1,578.59
OH	Midwest RPO	39081-8115711	Cardinal Power Plant (Cardinal Operating Company) (0641050002)	7,460.79	2,467.31
OH	Midwest RPO	39031-8010811	Conesville Power Plant (0616000000)	6,356.23	9,957.87
OH	Midwest RPO	39025-8294311	Duke Energy Ohio, Wm. H. Zimmer Station (1413090154)	22,133.90	7,149.97
OH	Midwest RPO	39053-8148511	General James M. Gavin Power Plant (0627010056)	41,595.81	8,122.51
OH	Midwest RPO	39053-7983011	Ohio Valley Electric Corp., Kyger Creek Station (0627000003)	3,400.14	9,143.84

7.6.2. PSAT Contributions at Georgia Class I Areas

The original PSAT results were determined based on the initial 2028 SO_2 and NO_X point emissions, which may be found in Appendix B-1a and Appendix B-1b. As described in Section 4.1.8 and Section 7.2.3, the 2028 EGU and non-EGU point emissions were updated for a new 2028 model run (Task 2B and Task 3B reports), but the original PSAT runs were not redone. Details of the updated emissions may be found in Appendix B-2a and Appendix B-2b. Instead, the original PSAT results were linearly scaled to reflect the updated 2028 emissions. The details of the PSAT adjustments can be found in Appendix E-7b.

The adjusted PSAT results were used to calculate the percent contribution of each tagged facility to the total sulfate and nitrate point source (EGU + non-EGU) contribution at each Class I area. Then, the facilities were sorted from highest impact to lowest impact.

Table 7-16 contains PSAT results for Cohutta Wilderness Area. Eight (8) facilities where sulfate contributions are above 1.00% are included in the table and address more than 12.0% of the entire sulfate plus nitrate point source visibility impact in 2028. Table 7-17 contains PSAT results for Okefenokee National Wilderness Area. Nine (9) facilities where sulfate contributions are above 1.00% are included in the table and address more than 14.3% of the entire sulfate plus nitrate point source visibility impact in 2028. Table 7-18 contains PSAT results for Wolf Island National Wilderness Area. Nine (9) facilities where sulfate contributions are above 1.00% are included in the table and address more than 14.7% of the entire sulfate plus nitrate point source visibility impact in 2028. Georgia feels that this approach captures a reasonable set of sources, including the most important in-state sources as well as any large sources outside Georgia.

Table 7-19 through Table 7-25 contain the PSAT results for Georgia facilities significantly impacting (sulfate contributions of at least 1.00%) Chassahowitzka Wilderness Area (FL), St Marks Wilderenss Area (FL), Linville Gorge Wilderness Area (NC), Shining Rock Wilderness Area (NC), Swanquarter Wilderness Area (NC), Cape Romain Wilderness Area (SC), and Joyce Kilmer-Slickrock Wilderness Area (TN and NC), respectively.

GA Power Company – Plant Bowen (13015-23813011) impacts ten Class I areas (three inside Georgia and seven outside Georgia), International Paper – Savannah (13051-3679811) impacts three Class I areas (two inside Georgia and one outside Georgia), and Brunswick Cellulose Inc (13127-3721011) impacts one Georgia Class I area.

The full list of tagged facilities and their contributions to each Class I area can be found in Appendix E-7b.

Table 7-16: PSAT Results for Cohutta Wilderness Area.

State	Facility ID	Facility Name	DISTANCE_km	FINAL Revised Sulfate PSAT Mm^{-1}	FINAL Revised EGU + NEGU Mm^{-1}	FINAL Revised Sulfate PSAT %	FINAL Revised Nitrate PSAT Mm^{-1}	FINAL Revised EGU + NEGU Mm^{-1}	FINAL Revised Nitrate PSAT %
OH	39053-8148511	General James M. Gavin Power Plant (0627010056)	512.0	0.322	13.229	2.44%	0.009	13.229	0.07%
GA	**13015-2813011**	**Ga Power Company - Plant Bowen**	**78.0**	**0.282**	**13.229**	**2.13%**	**0.005**	**13.229**	**0.04%**
KY	21145-6037011	Tennessee Valley Authority (TVA) - Shawnee Fossil Plant	457.2	0.190	13.229	1.44%	0.002	13.229	0.02%
IN	18147-8017211	INDIANA MICHIGAN POWER DBA AEP ROCKPORT	410.1	0.181	13.229	1.37%	0.005	13.229	0.04%
OH	39025-8294311	Duke Energy Ohio, Wm. H. Zimmer Station (1413090154)	454.6	0.173	13.229	1.31%	0.005	13.229	0.04%
TN	47163-3982311	EASTMAN CHEMICAL COMPANY	269.8	0.165	13.229	1.25%	0.012	13.229	0.09%
PA	42005-3866111	GENON NE MGMT CO/KEYSTONE STA	801.1	0.137	13.229	1.04%	0.002	13.229	0.01%
IN	18051-7363111	Gibson	487.1	0.137	13.229	1.03%	0.002	13.229	0.02%

Note: **Red bold** indicates that the facility is located in Georgia. Yellow highlight indicates that sulfate or nitrate contributions are ≥ 1.00%.

Table 7-17: PSAT Results for Okefenokee National Wilderness Area.

State	Facility ID	Facility Name	DISTANCE_km	FINAL Revised Sulfate PSAT Mm^{-1}	FINAL Revised EGU + NEGU Mm^{-1}	FINAL Revised Sulfate PSAT %	FINAL Revised Nitrate PSAT Mm^{-1}	FINAL Revised EGU + NEGU Mm^{-1}	FINAL Revised Nitrate PSAT %
FL	12047-769711	WHITE SPRINGS AGRICULTURAL CHEMICALS,INC	71.5	0.372	13.400	2.77%	0.002	13.400	0.01%
GA	**13015-2813011**	**Ga Power Company - Plant Bowen**	**458.1**	**0.308**	**13.400**	**2.30%**	**0.007**	**13.400**	**0.05%**
FL	12123-752411	BUCKEYE FLORIDA, LIMITED PARTNERSHIP	153.5	0.289	13.400	2.16%	0.019	13.400	0.14%
OH	39053-8148511	General James M. Gavin Power Plant (0627010056)	909.1	0.203	13.400	1.51%	0.002	13.400	0.01%
FL	12089-753711	ROCK TENN CP, LLC	64.8	0.176	13.400	1.31%	0.020	13.400	0.15%
SC	45015-4120411	SANTEE COOPER CROSS GENERATING STATION	348.1	0.158	13.400	1.18%	0.006	13.400	0.04%
GA	**13051-3679811**	**International Paper - Savannah**	**178.9**	**0.140**	**13.400**	**1.04%**	**0.008**	**13.400**	**0.06%**
KY	21145-6037011	Tennessee Valley Authority (TVA) - Shawnee Fossil Plant	939.4	0.138	13.400	1.03%	0.006	13.400	0.04%
PA	42005-3866111	GENON NE MGMT CO/KEYSTONE STA	1,129.0	0.137	13.400	1.02%	0.002	13.400	0.01%

Note: **Red bold** indicates that the facility is located in Georgia. Yellow highlight indicates that sulfate or nitrate contributions are ≥ 1.00%.

Table 7-18: PSAT Results for Wolf Island National Wilderness Area.

State	Facility ID	Facility Name	DISTANCE_km	FINAL Revised Sulfate PSAT Mm^{-1}	FINAL Revised EGU + NEGU Mm^{-1}	FINAL Revised Sulfate PSAT %	FINAL Revised Nitrate PSAT Mm^{-1}	FINAL Revised EGU + NEGU Mm^{-1}	FINAL Revised Nitrate PSAT %
FL	12089-753711	ROCK TENN CP, LLC	74.9	0.304	12.957	2.35%	0.018	12.957	0.14%
GA	**13015-2813011**	**Ga Power Company - Plant Bowen**	**458.1**	**0.302**	**12.957**	**2.33%**	**0.007**	**12.957**	**0.05%**
GA	**13127-3721011**	**Brunswick Cellulose Inc**	**27.9**	**0.228**	**12.957**	**1.76%**	**0.017**	**12.957**	**0.13%**
OH	39053-8148511	General James M. Gavin Power Plant (0627010056)	845.3	0.224	12.957	1.73%	0.003	12.957	0.02%
GA	**13051-3679811**	**International Paper - Savannah**	**85.9**	**0.200**	**12.957**	**1.54%**	**0.012**	**12.957**	**0.09%**
SC	45015-4120411	SANTEE COOPER CROSS GENERATING STATION	251.0	0.168	12.957	1.30%	0.011	12.957	0.08%
FL	12031-640211	JEA	105.1	0.167	12.957	1.29%	0.008	12.957	0.06%
SC	45015-4834911	ALUMAX OF SOUTH CAROLINA	223.0	0.162	12.957	1.25%	0.001	12.957	0.01%
PA	42005-3866111	GENON NE MGMT CO/KEYSTONE STA	1,048.6	0.149	12.957	1.15%	0.002	12.957	0.01%

Note: **Red bold** indicates that the facility is located in Georgia. Yellow highlight indicates that sulfate or nitrate contributions are ≥ 1.00%.

Table 7-19: PSAT Results for Georgia Facilities Significantly Impacting Chassahowitzka Wilderness Area (FL)

State	Facility ID	Facility Name	Distance (km)	Final Revised Sulfate PSAT (Mm^{-1})	Final Revised EGU+NEG (Mm^{-1})	Final Revised Sulfate PSAT, %	Final Revised Nitrate PSAT (Mm^{-1})	Final Revised EGU+NEG (Mm^{-1})	Final Revised Nitrate PSAT, %
GA	13015-2813011	Ga Power Company - Plant Bowen	637.2	0.230	10.092	2.28%	0.003	10.092	0.03%

Table 7-20: PSAT Results for Georgia Facilities Significantly Impacting St Marks Wilderness Area (FL)

State	Facility ID	Facility Name	Distance (km)	Final Revised Sulfate PSAT (Mm^{-1})	Final Revised EGU+NEG (Mm^{-1})	Final Revised Sulfate PSAT, %	Final Revised Nitrate PSAT (Mm^{-1})	Final Revised EGU+NEG (Mm^{-1})	Final Revised Nitrate PSAT, %
GA	13015-2813011	Ga Power Company - Plant Bowen	452.9	0.574	11.729	4.89%	0.004	11.729	0.03%

Table 7-21: PSAT Results for Georgia Facilities Significantly Impacting Linville Gorge Wilderness Area (NC)

State	Facility ID	Facility Name	Distance (km)	Final Revised Sulfate PSAT (Mm^{-1})	Final Revised EGU+NEG (Mm^{-1})	Final Revised Sulfate PSAT, %	Final Revised Nitrate PSAT (Mm^{-1})	Final Revised EGU+NEG (Mm^{-1})	Final Revised Nitrate PSAT, %
GA	13015-2813011	Ga Power Company - Plant Bowen	340.9	0.146	12.884	1.13%	0.000	12.884	0.00%

Table 7-22: PSAT Results for Georgia Facilities Significantly Impacting Shining Rock Wilderness Area (NC)

State	Facility ID	Facility Name	Distance (km)	Final Revised Sulfate PSAT (Mm^{-1})	Final Revised EGU+NEG (Mm^{-1})	Final Revised Sulfate PSAT, %	Final Revised Nitrate PSAT (Mm^{-1})	Final Revised EGU+NEG (Mm^{-1})	Final Revised Nitrate PSAT, %
GA	13015-2813011	Ga Power Company - Plant Bowen	241.6	0.159	12.313	1.29%	0.001	12.313	0.01%

Table 7-23: PSAT Results for Georgia Facilities Significantly Impacting Swanquarter Wilderness Area (NC)

State	Facility ID	Facility Name	Distance (km)	Final Revised Sulfate PSAT (Mm^{-1})	Final Revised EGU+NEG (Mm^{-1})	Final Revised Sulfate PSAT, %	Final Revised Nitrate PSAT (Mm^{-1})	Final Revised EGU+NEG (Mm^{-1})	Final Revised Nitrate PSAT, %
GA	13015-2813011	Ga Power Company - Plant Bowen	810.6	0.112	10.894	1.03%	0.003	10.894	0.03%

Table 7-24: PSAT Results for Georgia Facilities Significantly Impacting Cape Romain Wilderness Area (SC)

State	Facility ID	Facility Name	Distance (km)	Final Revised Sulfate PSAT (Mm^{-1})	Final Revised EGU+NEG (Mm^{-1})	Final Revised Sulfate PSAT, %	Final Revised Nitrate PSAT (Mm^{-1})	Final Revised EGU+NEG (Mm^{-1})	Final Revised Nitrate PSAT, %
GA	13015-2813011	Ga Power Company - Plant Bowen	506.2	0.495	14.028	3.53%	0.019	14.028	0.14%
GA	13051-3679811	International Paper – Savannah	166.1	0.180	14.028	1.28%	0.009	14.028	0.06%

Table 7-25: PSAT Results for Georgia Facilities Significantly Impacting Joyce Kilmer-Slickrock Wilderness Area (TN and NC)

State	Facility ID	Facility Name	Distance (km)	Final Revised Sulfate PSAT (Mm^{-1})	Final Revised EGU+NEG (Mm^{-1})	Final Revised Sulfate PSAT, %	Final Revised Nitrate PSAT (Mm^{-1})	Final Revised EGU+NEG (Mm^{-1})	Final Revised Nitrate PSAT, %
GA	13015-2813011	Ga Power Company - Plant Bowen	166.2	0.152	13.694	1.11%	0.001	13.694	0.01%

7.6.3. AoI versus PSAT Contributions

After the PSAT modeling was completed, a comparison was made of PSAT results to AoI results. The PSAT results used in this comparison did not incorporate any PSAT adjustments discussed in Appendix E-7b to better match the emissions used in the AoI analysis. Only PSAT contributions greater than or equal to 1.00% were included in the analysis. Figure 7-42 shows the ratio of AoI/PSAT contributions for sulfate as a function of distance from the facility to the Class I area. Figure 7-43 shows the fractional bias for sulfate as a function of distance from the facility to the Class I area. Fraction bias (FB) is equal to 2*(AoI – PSAT)/(AoI + PSAT). Fractional bias gives equal weight to over predictions and under predictions. If FB equals 100%, then the AOI contribution is three times higher than the PSAT contribution

Based on Figure 7-42 and Figure 7-43, AoI tends to significantly overestimate impacts for facilities near the Class I area. In fact, if the facility is less than 100 km from the Class I area, the AoI results are always at least 2.75 times higher than the PSAT results. As a result, some sources near a Class I area were tagged for PSAT but were found to not have a significant contribution to visibility impairment. PSAT is the most reliable modeling tool for tracking facility contributions to visibility impairment at Class I areas. Therefore, AoI impacts for nearby sources can be adjusted downward to remove the systematic bias in the contributions. Also, AoI tends to underestimate impacts for facilities in other states that are far away from the Class I area. Although AoI may underestimate the impact of some far away sources, the visibility impairment of those sources are likely included in the PSAT analysis and found to be significantly contributing to visibility impairment in the Class I area because they were tagged for PSAT analysis by states with Class I areas that are closer to those sources.

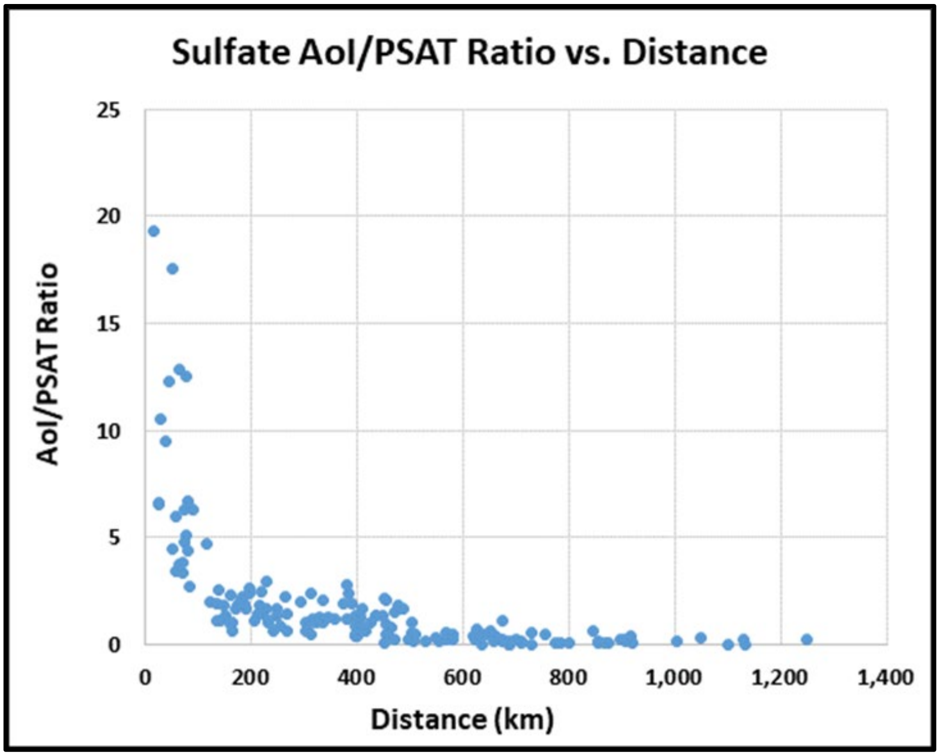


Figure 7-42: Ratio of AoI/PSAT % Contributions for Sulfate as a Function of Distance from the Facility to the Class I Area

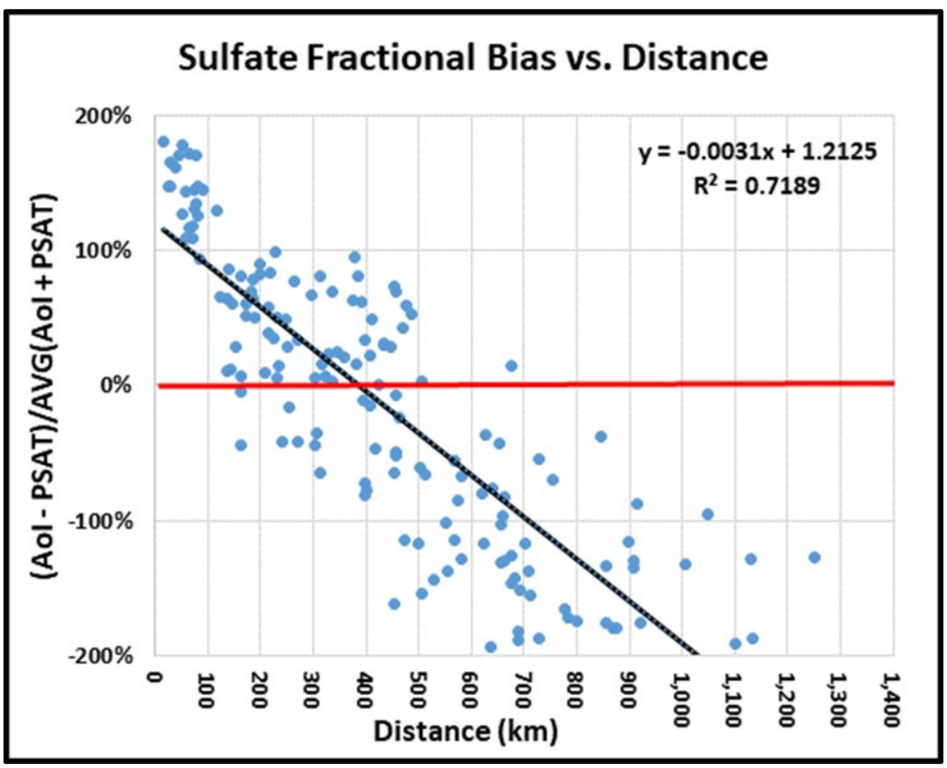


Figure 7-43: Fractional Bias for Sulfate as a Function of Distance from the Facility to the Class I Area

Although many facilities were tagged with PSAT, there are some facilities identified by AoI with a sulfate contribution over 1% that were not tagged.

Table 7-26 shows AoI NO_X and SO_2 facility contributions to visibility impairment on the 20% most impaired days at Cohutta Wilderness Area. There are three facilities in the table that were not tagged with PSAT. Table 7-27 shows AoI NOx and SO_2 facility contributions to visibility impairment on the 20% most impaired days at Okefenokee National Wilderness Area. There are three facilities in the table that were not tagged with PSAT. Table 7-28 shows AoI NOx and SO_2 facility contributions to visibility impairment on the 20% most impaired days at Wolf Island National Wilderness Area. There are six facilities in the table that were not tagged with PSAT.

Table 7-26: AoI NOx and SO_2 Facility Contributions to Visibility Impairment on the 20% Most Impaired Days at Cohutta Wilderness Area.

State	Facility ID	Facility Name	Distance (km)	2028 NOx (tpy)	2028 SO_2 (tpy)	Nitrate (%)	Sulfate (%)	Sulfate + Nitrate (%)
GA	13015-2813011	Ga Power Company - Plant Bowen	78.0	6,643.3	10,453.4	1.15%	19.58%	20.74%
GA	13115-539311	TEMPLE INLAND	87.4	1,773.4	1,791.0	0.18%	4.66%	4.84%
IN	18147-8017211	INDIANA MICHIGAN POWER DBA AEP ROCKPORT	410.1	8,806.8	30,536.3	0.13%	4.68%	4.81%
IN	18051-7363111	Gibson	487.1	12,280.3	23,117.2	0.10%	2.31%	2.41%
IN	18125-7362411	INDIANAPOLIS POWER & LIGHT PETERSBURG	477.0	10,665.3	18,141.9	0.16%	2.18%	2.34%
TN	47145-4979111	TVA KINGSTON FOSSIL PLANT	124.0	1,687.4	1,886.1	0.13%	2.17%	2.30%
KY	21145-6037011	Tennessee Valley Authority (TVA) - Shawnee Fossil Plant	457.2	7,007.3	19,504.7	0.07%	2.18%	2.25%
OH	39053-8148511	General James M. Gavin Power Plant (0627010056)	512.0	8,122.5	41,595.8	0.02%	1.71%	1.73%
TN	47161-4979311	TVA CUMBERLAND FOSSIL PLANT	327.0	4,916.5	8,427.3	0.09%	1.38%	1.48%
KY	21041-5198511	KY Utilities Co - Ghent Station	441.5	7,939.9	10,169.3	0.08%	1.05%	1.13%
OH	39025-8294311	Duke Energy Ohio, Wm. H. Zimmer Station (1413090154)	454.6	7,150.0	22,133.9	0.06%	1.05%	1.12%
GA	13149-7415011	Ga Power Company - Plant Wansley	156.8	2,052.5	4,856.0	0.04%	1.05%	1.09%
GA	13313-9784111	Mohawk Industries Inc	32.0	66.5	77.1	0.07%	1.02%	1.09%
KY	21183-5561611	Big Rivers Electric Corp - Wilson Station	369.0	1,151.9	6,934.2	0.01%	1.07%	1.08%
TN	47163-3982311	EASTMAN CHEMICAL COMPANY	269.8	6,900.3	6,420.2	0.09%	0.99%	1.08%
IL	17127-7808911	Joppa Steam	466.9	4,706.3	20,509.3	0.02%	1.04%	1.06%

***Yellow highlight** indicates that those facilities were not tagged with PSAT. All other facilities were tagged with PSAT.*

Table 7-27: AoI NOx and SO_2 Facility Contributions to Visibility Impairment on the 20% Most Impaired Days at Okefenokee National Wilderness Area.

State	Facility ID	Facility Name	Distance (km)	2028 NOx (tpy)	2028 SO_2 (tpy)	Nitrate (%)	Sulfate (%)	Sulfate + Nitrate (%)
FL	12047-769711	WHITE SPRINGS AGRICULTURAL CHEMICALS,INC	71.5	112.4	2,745.0	0.03%	14.63%	14.67%
FL	12089-753711	ROCK TENN CP, LLC	64.8	2,316.8	2,606.7	0.88%	12.82%	13.71%
FL	12031-640211	JEA	65.6	651.8	2,094.5	0.18%	6.60%	6.78%
FL	12089-845811	RAYONIER PERFORMANCE FIBERS LLC	63.4	2,327.1	562.0	0.90%	2.82%	3.73%
FL	12107-2474411	SEMINOLE ELECTRIC COOPERATIVE, INC.	121.4	917.8	3,713.4	0.07%	3.25%	3.32%
FL	12031-770211	IFF CHEMICAL HOLDINGS, INC.	56.8	37.7	898.9	0.01%	3.25%	3.26%
GA	13051-3679811	International Paper - Savannah	178.9	1,560.7	3,945.4	0.08%	2.81%	2.89%
FL	12123-752411	BUCKEYE FLORIDA, LIMITED PARTNERSHIP	153.5	1,830.7	1,520.4	0.14%	2.18%	2.32%
FL	12031-640111	RENESSENZ LLC	59.8	66.3	569.5	0.02%	1.96%	1.98%
FL	12017-640611	DUKE ENERGY FLORIDA, INC. (DEF)	205.0	2,489.8	5,306.4	0.06%	1.40%	1.46%
GA	13127-3721011	Brunswick Cellulose Inc	75.3	1,554.5	294.2	0.34%	1.01%	1.35%
AL	01109-985711	Sanders Lead Co	384.6	121.7	7,951.1	0.00%	1.11%	1.11%
GA	13015-2813011	Ga Power Company - Plant Bowen	458.1	6,643.3	10,453.4	0.05%	1.02%	1.07%
GA	13103-536311	Georgia-Pacific Consumer Products LP (Savannah River Mill)	197.2	351.5	1,860.2	0.01%	1.05%	1.06%

Yellow highlight indicates that those facilities were not tagged with PSAT. All other facilities were tagged with PSAT.

Table 7-28: AoI NOx and SO_2 Facility Contributions to Visibility Impairment on the 20% Most Impaired Days at Wolf Island National Wilderness Area.

State	Facility ID	Facility Name	Distance (km)	2028 NOx (tpy)	2028 SO_2 (tpy)	Nitrate (%)	Sulfate (%)	Sulfate + Nitrate (%)
GA	13127-3721011	Brunswick Cellulose Inc	27.9	1,554.5	294.2	2.94%	8.84%	11.78%
FL	12089-753711	ROCK TENN CP, LLC	74.9	2,316.8	2,606.7	0.39%	8.56%	8.95%
GA	13051-3679811	International Paper - Savannah	85.9	1,560.7	3,945.4	0.24%	7.53%	7.77%
FL	12031-640211	JEA	105.1	651.8	2,094.5	0.09%	4.43%	4.52%
GA	13103-536311	Georgia-Pacific Consumer Products LP (Savannah River Mill)	109.9	351.5	1,860.2	0.03%	2.65%	2.68%
FL	12089-845811	RAYONIER PERFORMANCE FIBERS LLC	77.4	2,327.1	562.0	0.38%	1.79%	2.17%
FL	12047-769711	WHITE SPRINGS AGRICULTURAL CHEMICALS,INC	173.6	112.4	2,745.0	0.01%	1.97%	1.98%
SC	45015-4834911	ALUMAX OF SOUTH CAROLINA	223.0	108.1	3,751.7	0.00%	1.84%	1.84%
FL	12107-2474411	SEMINOLE ELECTRIC COOPERATIVE, INC.	181.4	917.8	3,713.4	0.02%	1.77%	1.79%
OH	39053-8148511	General James M. Gavin Power Plant (0627010056)	845.3	8,122.5	41,595.8	0.02%	1.71%	1.73%
SC	45015-4120411	SANTEE COOPER CROSS GENERATING STATION	251.0	3,273.5	4,281.2	0.09%	1.59%	1.68%
GA	13051-3678011	Southern States Phosphate & Fertilizer	84.1	1.0	597.1	0.00%	1.55%	1.55%
FL	12017-640611	DUKE ENERGY FLORIDA, INC. (DEF)	296.6	2,489.8	5,306.4	0.04%	1.19%	1.22%
FL	12031-770211	IFF CHEMICAL HOLDINGS, INC.	118.5	37.7	898.9	0.00%	1.22%	1.22%
GA	13051-3678111	Savannah Sugar Refinery	89.9	521.6	582.0	0.08%	1.06%	1.14%
GA	13015-2813011	Ga Power Company - Plant Bowen	458.1	6,643.3	10,453.4	0.03%	1.08%	1.11%
GA	13127-3721111	Ga Power Company - Plant McManus	27.1	72.2	30.1	0.14%	0.93%	1.07%
SC	45079-4801411	INTERNATIONAL PAPER EASTOVER	288.7	1,780.3	3,212.9	0.05%	0.95%	1.00%

Yellow highlight indicates that those facilities were not tagged with PSAT. All other facilities were tagged with PSAT.

7.6.4. Selection of Sources for Reasonable Progress Evaluation

EPA has made clear that each state has the authority to select the sources to evaluate for reasonable progress analysis and to determine the factors used in making such selection as long as the factors used in the process are explained and justified in the state's plan. Subsection 169A(b) requires EPA to "provide guidelines to the **States**" [emphasis added] and "require **each applicable implementation plan for a State**" [emphasis added] to address reasonable progress including the requirement for long-term strategies. In promulgating its regional haze rules, EPA stated that "**The State must include in its implementation plan a description of the criteria it used to determine which sources or groups of sources** it evaluated and how the four factors were taken into consideration in selecting the measures for inclusion in its long-term strategy." [emphasis added] EPA's August 20, 2019, guidance on Regional Haze SIPs for the second implementation period, goes on to clearly state that the selection of emission sources for analysis is the responsibility of the state. The EPA guidance states the following:

> The Regional Haze Rule does not explicitly list factors that a state must or may not consider when selecting the sources for which it will determine what control measures are necessary to make reasonable progress. A state opting to select a set of its sources to analyze must reasonably choose factors and apply them in a reasonable way given the statutory requirement to make reasonable progress towards natural visibility. Factors could include, but are not limited to, baseline source emissions, baseline source visibility impacts (or a surrogate metric for the impacts), the in-place emission control measures and by implication the emission reductions that are possible to achieve at the source through additional measures, the four statutory factors (to the extent they have been characterized at this point in SIP development), potential visibility benefits (also to the extent they have been characterized at this point in SIP development), and the five additional required factors listed in 40 CFR 51.308(f)(2)(iv).

The 2019 EPA guidance goes on to discuss which pollutants to consider. The 2019 EPA guidance discusses methods for estimating baseline visibility impacts for selected sources, including residence time analysis and photochemical modeling, both of which were used by Georgia and other VISTAS states. The selection of pollutants to consider and the residence time analysis are discussed in Section 7.4 and Section 7.5 of this SIP. The use of photochemical modeling to better understand source contribution to modeled visibility and further refine the sources selected is discussed in Section 7.6.

The EPA guidance also discussed using estimates of visibility impacts to select sources including the use of a visibility impact threshold level for selecting sources. Georgia, as well as the other VISTAS states, have used a two-step process for selecting sources. The first step was a screening analysis using the NO_X and SO_2 source category and facility contributions from the AoI analysis described in Section 7.5. The second step was CAMx PSAT modeling of the sources selected in step 1. Sources were then selected for reasonable progress analysis. This two-step process was used to select sources that have the largest contribution to visibility impairment, and thus, greatest opportunity for reasonable progress improvement at Class I areas. This process also resulted in selecting sources that Georgia, and states that contribute to Georgia Class I areas, could analyze with the resources available to the state. Sources selected for analysis by Georgia include sources that contribute to visibility impairment in both Georgia and non-Georgia Class I areas. Thresholds selected by Georgia for each of the steps are discussed in this document. As explained in Section 7.6.3, PSAT modeling resulted in significantly different results than the AoI analysis. Therefore, it is appropriate to have different percentage thresholds for these two steps in the selection process. EPA's guidance states, "Whatever threshold is used, the state must justify why the use of that threshold is a reasonable approach…" The justification for the thresholds used in both steps of the selection process are described in this plan.

In the regional haze SIPs developed for the first round of planning, many VISTAS states used the AoI approach and a 1% threshold by unit. In this second round of planning for regional haze SIPs, all VISTAS states are using the AOI/PSAT approach and a ≥ 1.00% PSAT threshold by facility for screening sources for reasonable progress evaluation. Using a facility basis for emission estimates will pull in more facilities as compared to a unit basis for emission estimates. In the regional haze SIPs developed in the first round of planning, 2018 emissions were used as the starting point and 2018 Class I visibility impacts were used in the denominator of the percent contribution calculations. In this second round of planning for regional haze, VISTAS states are using 2028 SO_2 and NOx emissions in the denominator of the percent contribution calculations. As a result, more facilities with smaller visibility impacts (in Mm^{-1}) were examined as compared to the first round of regional haze planning. Overall, the VISTAS screening approach results in a reasonable number of sources that can be evaluated with limited state resources and focuses on the sources and pollutants with the largest impacts.

Based on the PSAT results presented in Table 7-16, Table 7-17, and Table 7-18, all facilities with a ≥ 1.00% PSAT threshold for sulfate or nitrate will be examined for reasonable progress (eight facilities for Cohutta Wilderness Area, nine facilities for Okefenokee National Wilderness Area, and nine facilities for Wolf Island National Wilderness Area).

In addition, facilities listed in Table 7-26, Table 7-27, and Table 7-28 that were not tagged with PSAT are discussed below.

Georgia

- **Ga Power Company - Plant Wansley (13149-7415011)** – This facility is 156.8 km from the Cohutta Wilderness Area and the AoI sulfate contribution is 1.05%. SO_2 emissions used in the AoI analysis was 4,856.0 tpy. The SO_2 emissions for the past three years were 2,720.78 tpy (2017), 2,134.03 tpy (2018), and 1,656.01 tpy (2019) and the average over this period was 2,170.27 tpy. Due to Georgia Power's plans to shift from coal to natural gas and renewable energy, these emissions are more reasonable for future operations of this facility. Plant Wansley has not become subject to any new emissions limits or installed any new controls during this time period. Scaling the AoI sulfate contribution of 1.05% by the ratio of current to 2028 SO_2 emissions (2,170.27/4,856.0) results in a revised AoI sulfate contribution of 0.47%; therefore, this facility will be screened out due to insignificant visibility impacts at the Cohutta Wilderness Area. Additionally, the PSC approved the retirement of Plant Wansley in August 2022.

- **Mohawk Industries Inc (13313-9784111)** – This facility is 32.0 km from the Cohutta Wilderness Area and the AoI sulfate contribution is 1.02%. According to Section 7.6.3, if a facility is less than 100 km from the Class I area, the AoI results are always at least 2.75x higher than the PSAT results. Reducing the AoI sulfate contribution by a conservative factor of 2.75 results in a revised AoI sulfate contribution is 0.37%; therefore, this facility will be screened out due to insignificant visibility impacts at the Cohutta Wilderness Area. In addition, this facility removed their coal-fired boilers in 2016 and 2017 leading to lower SO_2 emissions than was used in this analysis.

- **Southern States Phosphate & Fertilizer, now Seagate Terminals Savannah (13051-3678011)** – This facility is 84.1 km from the Wolf Island National Wilderness Area and the AoI sulfate contribution is 1.55%. According to Section 7.6.3, if a facility is less than 100 km from the Class I area, the AoI results are always at least 2.75x higher than the PSAT results. Reducing the AoI sulfate contribution by a conservative factor of 2.75 results in a revised AoI sulfate contribution is 0.56%; therefore, this facility will be screened out due to insignificant visibility impacts at the Wolf Island National Wilderness Area.

- **Savannah Sugar Refinery, now Imperial-Savannah, LP (13051-3678111)** – This facility is 89.9 km from the Wolf Island National Wilderness Area and the AoI sulfate contribution is 1.06%. According to Section 7.6.3, if a facility is less than 100 km from the Class I area, the AoI results are always at least 2.75x higher than the PSAT results. Reducing the AoI sulfate contribution by a conservative factor of 2.75 results in a revised AoI sulfate contribution is 0.39%; therefore, this facility will be screened out due to insignificant visibility impacts at the Wolf Island National Wilderness Area.

- **Ga Power Company - Plant McManus (13127-3721111)** – The AoI sulfate and nitrate contributions are both below 1%; therefore, this facility will be screened out due to insignificant visibility impacts at the Wolf Island National Wilderness Area.

Florida

- **SEMINOLE ELECTRIC COOPERATIVE, INC. (12107-2474411)** – This facility is 121.4 km from the Okefenokee National Wilderness Area and the AoI sulfate contribution is 3.25%. Also, this facility is 181.4 km from Wolf Island National Wilderness Area and the AoI sulfate contribution is 1.77%. This facility can't be screened out by any additional analyses. Therefore, this facility will be added to Georgia's reasonable progress evaluation list.

- **IFF CHEMICAL HOLDINGS, INC. (12031-770211)** – This facility is 56.8 km from the Okefenokee National Wilderness Area and the AoI sulfate contribution is 3.25%. Also, this facility is 118.5 km from the Wolf Island National Wilderness Area and the AoI sulfate contribution is 1.22%. SO_2 emissions used in the AoI analysis was 898.9 tpy. The SO_2 emissions for the past three years were 494.12 tpy (2017), 634.37 tpy (2018), and 403.51 tpy (2019) and the average over this period was 510.67 tpy. Scaling the AoI sulfate contribution of 3.25% and 1.22% by the ratio of current to 2028 SO_2 emissions (510.67/898.9) results in a revised AoI sulfate contribution of 1.85% for the Okefenokee National Wilderness Area and 0.69% for the Wolf Island National Wilderness Area. According to Section 7.6.3, if a facility is less than 100 km from the Class I area, the AoI results are always at least 2.75x higher than the PSAT results. Reducing the AoI sulfate contribution at Okefenokee National Wilderness Area by a conservative factor of 2.75 results in a revised AoI sulfate contribution is 0.67%. Therefore, this facility will be screened out due to insignificant visibility impacts at the Okefenokee National Wilderness Area and the Wolf Island National Wilderness Area.

- **RENESSENZ LLC (12031-640111)** – This facility is 59.8 km from the Okefenokee National Wilderness Area and the AoI sulfate contribution is 1.96%. According to Section 7.6.3, if a facility is less than 100 km from the Class I area, the AoI results are always at least 2.75x higher than the PSAT results. Reducing the AoI sulfate contribution by a conservative factor of 2.75 results in a revised AoI sulfate contribution is 0.71%; therefore, this facility will be screened out due to insignificant visibility impacts at the Wolf Island National Wilderness Area.

<u>Kentucky</u>

- **KY Utilities Co - Ghent Station (21041-5198511)** – This facility is 441.5 km from the Cohutta Wilderness Area and the AoI sulfate contribution is 1.05%. SO_2 emissions used in the AoI analysis was 10,169.3 tpy. The SO_2 emissions for the past three years were 8,633.7 tpy (2017), 10,620.7 tpy (2018), and 8,546.4 tpy (2019) and the average over this period was 9,266.9 tpy. Scaling the AoI sulfate contribution of 1.05% by the ratio of current to 2028 SO_2 emissions (9,266.9/10,169.3) results in a revised AoI sulfate contribution of 0.96%; therefore, this facility will be screened out due to insignificant visibility impacts at the Cohutta Wilderness Area.

<u>South Carolina</u>

- **INTERNATIONAL PAPER EASTOVER (45079-4801411)** – The AoI sulfate and nitrate contributions are both below 1%; therefore, this facility will be screened out due to insignificant visibility impacts at the Wolf Island National Wilderness Area.

Based on the analysis above, 17 facilities were identified to evaluate additional controls for reasonable progress for Georgia's Class I areas.

Table 7-29 contains a list of facilities in Georgia selected for reasonable progress analysis. GA Power Company – Plant Bowen (13015-2813011) impacts ten Class I areas (three inside Georgia and seven outside Georgia), International Paper – Savannah (13051-3679811) impacts three Class I areas (two inside Georgia and one outside Georgia), and Brunswick Cellulose Inc (13127-3721011) impacts one Georgia Class I area. Table 7-30 contains a list of facilities in VISTAS states (not including Georgia) selected for reasonable progress analysis. Table 7-31 contains a list of facilities in non-VISTAS states selected for reasonable progress analysis.

Table 7-29: Facilities in Georgia Selected for Reasonable Progress Analysis.

State	Facility ID	Facility Name
GA	13015-2813011	Ga Power Company – Plant Bowen
GA	13051-3679811	International Paper – Savannah
GA	13127-3721011	Brunswick Cellulose Inc

Table 7-30: Facilities in VISTAS States (not including Georgia) Selected for Reasonable Progress Analysis.

State	Facility ID	Facility Name
FL	12031-640211	JEA
FL	12047-769711	WHITE SPRINGS AGRICULTURAL CHEMICALS, INC
FL	12089-753711	ROCK TENN CP, LLC
FL	12107-2474411	SEMINOLE ELECTRIC COOPERATIVE, INC.
FL	12123-752411	BUCKEYE FLORIDA, LIMITED PARTNERSHIP
KY	21145-6037011	Tennessee Valley Authority (TVA) - Shawnee Fossil Plant
SC	45015-4120411	SANTEE COOPER CROSS GENERATING STATION
SC	45015-4834911	ALUMAX OF SOUTH CAROLINA
TN	47163-3982311	EASTMAN CHEMICAL COMPANY

Table 7-31: Facilities in non-VISTAS States Selected for Reasonable Progress Analysis.

State	Facility ID	Facility Name
IN	18051-7363111	Gibson
IN	18147-8017211	INDIANA MICHIGAN POWER DBA AEP ROCKPORT
OH	39025-8294311	Duke Energy Ohio, Wm. H. Zimmer Station (1413090154)
OH	39053-8148511	General James M. Gavin Power Plant (0627010056)
PA	42005-3866111	GENON NE MGMT CO/KEYSTONE STA

The three Georgia facilities listed in Table 7-29 were contacted on July 10, 2020, and asked to perform a reasonable progress analysis. The states of Florida, Kentucky, South Carolina, and Tennessee were contacted on November 24, 2020, and asked to perform a reasonable progress analysis for the facilities listed in Table 7-30.Table 7-30: Facilities in VISTAS States (not including Georgia) Selected for Reasonable Progress Analysis.

The states of Indiana, Ohio, and Pennsylvania were contacted on June 22, 2020, and asked to perform a reasonable progress analysis for the facilities listed in Table 7-31.[49] A copy of these letters can be found in Appendix F.

7.6.5. Evaluation of Recent Emission Inventory Information

The regional haze rule at 40 CFR 51.308(f)(2)(iii) requires the state to document the emissions information on which the state is relying to determine the emission reduction measures that are necessary to make reasonable progress in each mandatory federal Class I area it affects. The emissions information must include, but need not be limited to, information on emissions in a year at least as recent as the most recent year for which the state has submitted emission inventory information to the EPA Administrator in compliance with the triennial reporting requirements.

Georgia examined the 2017, 2018, and 2019 emission information that has been reported to EPA and compared these emissions to the 2028 emissions that were used in the modeling. Table 7-32 shows all the facilities with SO_2 emissions greater than 100 tpy in 2017, and Table 7-33 shows all the facilities with NO_X emissions greater than 100 tpy in 2017. Table 7-32 is sorted from highest SO_2 in 2017 to lowest. Table 7-33 is sorted from highest NO_X in 2017 to lowest. In addition to 2017 emissions, the tables have 2018 and 2019 emissions, if available. Projected emissions for 2028 are also shown. One column has the 2028 original value that was used in the first run on the model, and another column has the 2028 remodel value that was used in the second run of the model. The last three column show the difference between the 2028 remodel value and 2017, 2018, and 2019 values, respectively.

49 VISTAS sent letters to IN, OH, and PA. URL: https://www.metro4-sesarm.org/content/consultation-non-vistas-states

Table 7-32: SO_2 Emissions Comparison Between 2017, 2018, 2019, and 2028

EIS Facility ID	Facility	SO_2 2017 (tpy)	SO_2 2018 (tpy)	SO_2 2019 (tpy)	SO_2 2028 Original (tpy)	SO_2 2028 Remodel (tpy)	SO_2 2028 Remodel minus 2017 (tpy)	SO_2 2028 Remodel minus 2018 (tpy)	SO_2 2028 Remodel minus 2019 (tpy)
2757511	Burgess Pigment Company	N/A	N/A	147	51	51	N/A	N/A	-96
3711211	Ga Power Co Plt McIntosh	N/A	130	N/A	127	0	N/A	-130	N/A
3713211	Ga Power Company - Plant Hammond	N/A	133	N/A	772	0	N/A	-133	N/A
7414811	Graphic Packaging Macon Mill	N/A	N/A	113	27	27	N/A	N/A	-86
2813011	Ga Power Company - Plant Bowen	9,451	10,169	9,231	10,453	10,453	1002	284	1222
3679811	International Paper - Savannah	5,186	5,730	3,936	3,945	3,945	-1241	-1785	9
7415011	Ga Power Company - Plant Wansley	2,721	2,134	1,656	4,856	4,856	2135	2722	3200
536311	Georgia-Pacific Consumer Operations LLC - Savannah River Mill	2,012	2,089	2,178	1,860	1,860	-152	-229	-318
539311	International Paper Co Rome Linerboard (Temple Inland)	1,429	1,225	1,475	1,791	1,791	362	566	316
8354711	Ga Power Company - Plant Scherer	1,355	1,143	1,221	1,985	1,985	630	842	764
2533311	Thermal Ceramics	1,150	1,580	1,643	1,606	1,606	456	26	-37
17678111	Green Power Solutions of Georgia, LLC	1,079	3,129	1,842	N/A	N/A	N/A	N/A	N/A
552911	Chemical Products Corporation	750	721	637	514	514	-236	-207	-123
3678011	Southern States Phosphate & Fertilizer	581	581	N/A	597	597	16	16	N/A
9748811	Hartsfield-Jackson Atlanta International Airport	563	563	N/A	704	704	141	141	N/A
3679111	Weyerhaeuser NR Port Wentworth	524	491	265	430	430	-94	-61	165
931711	Georgia-Pacific Cedar Springs LLC	512	414	479	510	510	-2	96	31
555311	PCA Valdosta Mill	471	493	501	486	486	15	-7	-15
2654311	Anchor Glass Container Corporation	325	305	N/A	317	317	-8	12	N/A
2550711	C-E Minerals Plants 1,2 and 6	292	288	252	244	244	-48	-44	-8
3721011	Brunswick Cellulose LLC	281	331	396	294	294	13	-37	-102
536111	Owens Brockway Glass Container Inc.	273	273	N/A	282	282	9	9	N/A
556211	Graphic Packaging International (IP - Augusta Mill)	253	609	875	303	303	50	-306	-572
2775311	BASF Corporation, Edgar Plant	230	216	213	205	205	-25	-11	-8
3678111	Imperial-Savannah, L.P. (Savannah Sugar Refinery)	191	191	N/A	582	582	391	391	N/A
930611	Savannah Acid Plant LLC (Tronox Pigments Inc. - Savannah)	163	163	N/A	125	125	-38	-38	N/A
2613811	SP Fiber Technologies Southeast, LLC (SP Newsprint Company, LLC)	153	N/A	N/A	61	61	-92	N/A	N/A
2654111	CEMEX Southeast, LLC	127	131	142	262	262	135	131	120

Table 7-33: NOx Emissions Comparison Between 2017, 2018, 2019, and 2028

EIS Facility ID	Facility	NOx 2017 (tpy)	NOx 2018 (tpy)	NOx 2019 (tpy)	NOx 2028 Original (tpy)	NOx 2028 Remodel (tpy)	NOx 2028 Remodel minus 2017 (tpy)	NOx 2028 Remodel minus 2018 (tpy)	NOx 2028 Remodel minus 2019 (tpy)
536511	Delta Air Lines Inc - Technical Operations Center	N/A	N/A	108	65	65	N/A	N/A	-43
1801611	Interfor U.S. Inc. - Thomaston	N/A	108	115	19	19	N/A	-89	-96
3563311	CertainTeed Corporation	N/A	N/A	100	115	115	N/A	N/A	15
8354711	Ga Power Company - Plant Scherer	10,787	12,852	10,068	12,747	12,747	1,961	-104	2,679
2813011	Ga Power Company - Plant Bowen	8,771	7,493	5,742	6,643	6,643	-2,128	-850	902
9748811	Hartsfield-Jackson Atlanta International Airport	5,845	5,845	N/A	5,782	5,782	-62	-62	N/A
931711	Georgia-Pacific Cedar Springs LLC	2,605	2,596	2,482	2,884	2,884	279	288	402
7415011	Ga Power Company - Plant Wansley	1,951	1,602	987	2,053	2,053	102	451	1,066
539311	International Paper Company (Rome Linerboard Mill)	1,665	1,558	1,634	1,773	1,773	109	216	139
556211	Graphic Packaging International, LLC	1,463	1,553	1,728	1,593	1,593	131	40	-134
3721011	Brunswick Cellulose LLC	1,445	1,473	1,509	1,555	1,555	110	81	46
3679811	International Paper - Savannah	1,309	1,438	1,357	1,561	1,561	251	123	204
2653511	Transcontinental Gas Pipe Line Company, LLC - Compressor Station 120	1,297	1,594	1,074	1,067	1,067	-229	-527	-7
7414811	Graphic Packaging Macon Mill	1,265	1,319	1,246	1,249	1,249	-16	-70	3
556611	Rayonier Performance Fibers, LLC	1,262	1,306	1,333	1,376	1,376	115	71	44
8352311	International Paper - Flint River Mill	1,117	1,111	1,078	1,218	1,218	101	107	140
2550711	C-E Minerals Plants 1,2 and 6	1,056	1,047	912	879	879	-177	-167	-32
555311	PCA Valdosta Mill	1,016	1,017	1,016	1,033	1,033	16	16	17
2654111	CEMEX Southeast, LLC	968	1,507	662	811	811	-157	-696	149
3709911	Procter & Gamble Paper Products Company	826	862	811	1,280	1,280	455	418	470
3679111	Weyerhaeuser NR Port Wentworth	756	894	919	922	922	166	28	3
535811	PCS Nitrogen Fertilizer, L.P.	754	876	824	815	815	61	-62	-9
2803411	Transcontinental Gas Pipe Line Company, LLC - Compressor Station 130	636	1,347	604	1,423	1,423	787	75	819
553111	Interstate Paper LLC	616	480	479	672	672	56	192	193
12282711	DOBBINS AIR RESERVE BASE (ATLANTA NAS)	487	487	N/A	0	0	-487	-487	N/A
2814411	Southern Natural Gas Company, L.L.C.- Ocmulgee Comp. Station	478	478	N/A	329	329	-148	-148	N/A
2654311	Anchor Glass Container Corp	463	451	N/A	540	540	77	89	N/A

EIS Facility ID	Facility	NOx 2017 (tpy)	NOx 2018 (tpy)	NOx 2019 (tpy)	NOx 2028 Original (tpy)	NOx 2028 Remodel (tpy)	NOx 2028 Remodel minus 2017 (tpy)	NOx 2028 Remodel minus 2018 (tpy)	NOx 2028 Remodel minus 2019 (tpy)
12111411	MOODY AFB	449	449	N/A	0	0	-449	-449	N/A
536111	Owens Brockway Glass Container Inc.	336	336	N/A	352	352	16	16	N/A
1801411	Southern Natural Gas Company, L.L.C - Thomaston Comp. Station	319	319	N/A	135	135	-183	-183	N/A
3678111	Imperial-Savannah, L.P.	314	314	N/A	522	522	208	208	N/A
3711211	Ga Power Co Plt McIntosh	313	338	340	447	0	-313	-338	-340
536311	Georgia-Pacific Consumer Operations LLC - Savannah River Mill	300	392	405	352	352	52	-40	-53
3694611	Mount Vernon Mills	288	258	197	438	438	149	180	241
3699211	Ga Power Company - Plant McDonough/Atkinson	277	429	486	223	223	-54	-206	-263
3713211	Ga Power Company - Plant Hammond	269	217	212	865	0	-269	-217	-212
9760811	Robins AFB Airport	264	264	N/A	0	0	-264	-264	N/A
3703111	Ga Power Company - Plant Yates	260	452	815	406	406	146	-46	-409
16658111	Southern Power - Wansley Combined Cycle	253	256	267	227	227	-26	-29	-40
2655111	Huber Engineered Woods, LLC	246	232	224	77	77	-169	-156	-148
2827411	Langboard Osb, Quitman	229	229	N/A	291	291	61	61	N/A
2775311	BASF Corporation, Edgar Plant	227	228	225	241	241	14	12	16
554411	Pinova, Inc.	219	220	202	36	36	-183	-184	-166
14419911	WAYCROSS	217	217	N/A	99	99	-118	-118	N/A
532511	Langboard, Inc.	214	214	N/A	268	268	54	54	N/A
15652211	Multitrade Rabun Gap, LLC	194	194	N/A	164	164	-30	-30	N/A
9751411	Thomas A. Smith Energy Facility	191	165	197	197	197	6	32	0
553411	Georgia-Pacific Wood Products LLC (Warm Springs)	186	286	N/A	191	191	4	-95	N/A
9736811	Ga Power Company - McIntosh Combined Cycle Facility	179	184	175	179	179	0	-6	4
538811	Georgia-Pacific Panel Products LLC - Thomson Particleboard Plant	177	199	N/A	202	202	25	3	N/A
12687111	Taylor County LFGTE Power Station	168	168	N/A	26	26	-142	-142	N/A
2533711	Resolute FP Augusta LLC	164	189	107	383	383	219	194	276
2613811	SP Fiber Technologies Southeast, LLC	155	N/A	N/A	40	40	-115	N/A	N/A
2612111	Southern Natural Gas Company, L.L.C. - Ellerslie Comp. Station	147	147	N/A	106	106	-41	-41	N/A

EIS Facility ID	Facility	NOx 2017 (tpy)	NOx 2018 (tpy)	NOx 2019 (tpy)	NOx 2028 Original (tpy)	NOx 2028 Remodel (tpy)	NOx 2028 Remodel minus 2017 (tpy)	NOx 2028 Remodel minus 2018 (tpy)	NOx 2028 Remodel minus 2019 (tpy)
14478611	HOWELLS	145	145	N/A	135	135	-10	-10	N/A
15604411	US Army Signal Center & Fort Gordon	138	138	N/A	62	62	-75	-75	N/A
2668511	KaMin - Wrens Main	134	134	N/A	133	133	-1	-1	N/A
9751911	Savannah/Hilton Head In	131	131	N/A	164	164	33	33	N/A
15602211	Sewell Creek Energy Facility	125	192	N/A	148	148	23	-44	N/A
15559111	Hawk Road Energy Facility	124	124	N/A	224	224	100	100	N/A
9765611	Municipal Electric Authority Of Ga-Wansley	119	100	N/A	117	117	-1	17	N/A
557011	Renessenz LLC	117	117	N/A	69	69	-48	-48	N/A
3721111	Ga Power Company - Plant McManus	113	103	104	72	72	-41	-31	-32
554511	Caraustar Industries Inc	112	112	N/A	215	215	103	103	N/A
1803911	Thiele Kaolin Company - Sandersville Plant	110	110	N/A	111	111	1	1	N/A
2615911	ADM Valdosta	106	108	N/A	223	223	117	115	N/A
534211	University of Georgia	103	107	105	104	104	1	-3	-1
2533511	Occidental Chemical Co	103	103	N/A	106	106	3	3	N/A
2654411	Ga Power Company - Robins	101	165	N/A	55	55	-47	-110	N/A
15562011	Southern Natural Gas Company, L.L.C - Wrens Comp. Station	101	101	N/A	76	76	-25	-25	N/A
14479011	TILFORD	101	101	N/A	99	99	-1	-1	N/A

7.7. Evaluating the Four Statutory Factors for Specific Emissions Sources

Section 169A(g)(1) of the CAA and the regional haze rule at 40 CFR 51.308(f)(2)(i) require a state to evaluate the following four "statutory" factors when establishing the RPG for any Class I area within a state: (1) cost of compliance, (2) time necessary for compliance, (3) energy and non-air quality environmental impacts of compliance, and (4) remaining useful life of any existing source subject to such requirements.

On August 20, 2019, EPA issued a memorandum entitled "Guidance on Regional Haze State Implementation Plan for the Second Implementation Period." This memorandum included guidance for characterizing the four statutory factors including which emission control measures to consider, selection of emission information for characterizing emissions-related factors, characterizing the cost of compliance (statutory factor 1), characterizing the time necessary for compliance (statutory factor 2), characterizing energy and non-air environmental impacts (statutory factor 3), charactering remaining useful life of the source (statutory factor 4), characterizing visibility benefits, and reliance on previous analysis and previously approved approaches. The memorandum also contains guidance on decisions on what control measures are necessary to make reasonable progress. This guidance was used in evaluating the four statutory factors for the facilities in Georgia selected for reasonable progress analysis as identified in Table 7-29. The results of these analyses are found in Section 7.8.

For the cost of compliance factor, Georgia EPD did not set a specific cost per ton threshold, but rather analyzed each facility to determine whether a given control measure is cost-effective based on the EPA's Control Cost Manual, the 2019 Regional Haze Guidance, and a historical range of cost/ton values. Specifically, Georgia EPD reviewed an Excel spreadsheet assembled by Arkansas DEQ that compared the cost of compliance for SO_2 and NOx in dollars per ton for various types of industrial emission units (e.g., EGU Boiler, Industrial Boiler, Kiln, Smelter, All Non-EGU). The spreadsheet was updated with the addition of VISTAS data (Appendix G-4) and presents the maximum and minimum cost/ton and various statistical percentile values (98th, 95th, 90th, 85th, 80th, 75th, 70th, and 65th). While Georgia EPD did not pick a specific cost/ton threshold, it should be noted that in all cases where Georgia EPD determined that a control cost was "not cost effective" or "cost effectiveness was not reasonable", the cost was above the 98th percentile values listed in the Arkansas DEQ spreadsheet.

7.8. Control Measures Representing Reasonable Progress for Individual Sources to be Included in the Long-Term Strategy

The following summarizes the process for determining reasonable progress for Georgia sources. Georgia EPD sent letters requesting a four-factor analysis to three Georgia facilities (Georgia Power Company - Plant Bowen, International Paper - Savannah, and Brunswick Cellulose) with contributions greater than 1.00% sulfate or nitrate to any Class I area in Georgia or in a neighboring state. Each facility provided a reasonable progress assessment (see Appendix G). Georgia EPD reviewed these assessments and made final reasonable progress determinations as discussed below.

7.8.1. International Paper – Savannah Mill

The emission sources at International Paper – Savannah Mill (IP Savannah) that were evaluated in the submitted Four Factor Analysis report are already subject to various stringent emission limits and emissions reductions have already been made at the facility to comply with the Boiler Maximum Achievable Control Technology (MACT) requirements and the 1-hour SO_2 NAAQS. Georgia EPD evaluated whether additional emissions controls for SO_2 are feasible for the No. 13 Power Boiler (PB13). The No. 15 Recovery Furnace (RF15), No. 15 Recovery Furnace Smelt Dissolving Tank (RF10), and No. 7 Lime Kiln (LK07) are small sources of SO_2 emissions. Together, they emit less than 30 tpy of SO_2 based on 2018-2020 emissions inventories. Compared to the roughly 4,000 tpy of SO_2 that the No. 13 Power Boiler (PB13) emits, this is less than 1% of the total SO_2 emissions at the facility. Thus, Georgia EPD did not evaluate RF15, RF10, and LK07 for additional emission controls due to their very low SO_2 emissions.

As a part of this analysis, site-specific emissions and control information, industry- and site-specific cost data, publicly available cost data, previous similar control evaluations, the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC) database, and U.S. EPA's Office of Air Quality Planning and Standards (OAQPS) Control Cost Manual were reviewed. In addition, the three other statutory factors were also considered: energy and non-air impacts, time necessary for compliance, and remaining useful life of the emission units.

The energy and non-air impacts analyses show that implementing additional control measures would increase energy usage, water usage, wastewater generation, and/or solid waste generation and could potentially cause a smaller compliance margin against non-air permit limits. All the emission units are presumed to have a remaining useful life exceeding 20 years and the time necessary to implement any of the control measures would be at least four years. Based on the results of the four-factor analysis, adding SO_2 control devices to the sources at the facility would not be reasonable for purposes of making further progress in reducing regional haze. However, the removal of coal as a fuel in PB13 was determined to be reasonable.

Table 7-34: Summary of Emissions Sources Evaluated

Emissions Unit Description	Size	Year Installed	Permitted Fuels	Control Technology	Major Regulatory Programs	Projected 2028 Actual SO_2 Emissions (tons)
No. 13 Power Boiler (PB13)[a]	1,280 MMBTU/hr	1982	Biomass, Natural Gas (Coal to be removed)	Electrostatic Precipitator, LVHC sent to a White Liquor Scrubber	40 CFR 61 Subpart D 40 CFR 63 DDDDD	4,082

a. The No. 13 Power Boiler (PB13) is permitted to combust high-volume, low -concentration (HVLC) pulp mill gases, low-volume, high-concentration (LVHC) pulp mill gasses, and stripper off-gases (SOG). A portion of the LVHC gases are controlled by the White Liquor Scrubber.

No. 13 Power Boiler (PB13)

Taking into account current air pollution controls, fuels fired, and RBLC Database information, the following technically feasible control technologies for industrial boilers were evaluated: low-sulfur fuels, wet scrubbers, and dry scrubbing systems. Fuel switching from biomass to 100% natural gas was not evaluated because the purpose of the analysis is not to change the functional design of the source or to evaluate alternative energy projects.[50] A wet scrubber with flue gas reheat, a circulating dry scrubber with pulse jet fabric filter system, and dry sorbent injection were reviewed for the No. 13 Power Boiler (PB13) using four-factor analysis. In addition, the removal of coal as a fuel was evaluated.

Added electricity, natural gas, and water would be needed to run a wet scrubber with flue gas reheat and this option generates wastewater for disposal. Treated wastewater from IP Savannah is discharged to the Savannah River. IP Savannah's 2019 National Pollutant Discharge Permit currently limits their wastewater discharge, and the facility has since committed to meet biologically based Ultimate Oxygen Demand limits which represent an approximately 85% reduction in their current permit limits. The facility is also limited on how much groundwater can be withdrawn and its water withdrawal permit limits will be lower starting in 2025, which will cause any projects requiring additional water use to be offset by water-savings projects. Thus, the wet scrubber, which would represent 10% of the facility's freshwater demand, is deemed unreasonable for reasonable progress. As a result, a cost analysis was not performed for this control option.

In 2014, the SO_2 emissions from combusting coal in PB13 were 2,662 tons/year. In 2015, IP Savannah started phasing out the combustion of coal in PB13. Removal of coal as a fuel in PB13 would permanently reduce the allowable SO_2 emission in the future. Table 7-35 contains a

[50] The August 20, 2019 regional haze implementation guidance indicates that states may determine it is unreasonable to consider fuel use changes because they would be too fundamental to the operation and design of a source. EPA BACT guidance states that it is not reasonable to change the design of a source, such as by requiring conversion of a coal boiler to a gas turbine. https://www.epa.gov/sites/production/files/2015-07/documents/igccbact.pdf

summary of the SO_2 economic impacts of implementing each SO_2 control technology for the No. 13 Power Boiler (PB13), based on operating date and the projected 2028 actual SO_2 emissions.

Table 7-35: No. 13 Power Boiler (PB13) Cost Summary[a]

Emission Unit	Control Technology Proposed (control effeciency)	Total Project Cost	Annual Cost ($/yr)	SO_2 tpy Reductions	Cost-Effectiveness ($/ton)
No. 13 Power Boiler (PB13) (1,280 MMBtu/hr)	Dry Scrubber[b] (90%)	$192,758,246[c]	$19,177,000	3,674	$5,220
No. 13 Power Boiler (PB13) (1,280 MMBtu/hr)	Dry Sorbent[b] Injection (50%)	$63,153,860[c]	$16,571,000	2,653	$6,245
No. 13 Power Boiler (PB13) (1,280 MMBtu/hr)	Removal of Coal as a Fuel	N/A	Cost Savings	2,662	Cost Savings

a. Interest rate of 4.75% used. Costs are all based on 2016 dollars scaled to 2021 dollars using Chemical Engineering Plant Cost Index (CEPCI)
b. Using 20-year equipment life
c. Including costs to expand onsite landfill

Both the dry scrubber and DSI systems would generate additional solid waste. Currently there is no additional disposal capacity in the existing mill-owned landfill, and strict waste management requirements of the privately-owned landfill where the majority of the facility's waste is disposed, causes this to be an unreliable disposal outlet. The amount of waste generated for the DSI option would require siting, permitting, and construction of a new landfill, which is expected to take years and have a considerable cost. These landfill costs are included in the dry scrubber and DSI cost analysis shown in Table 7-35.

Summary and Proposed Permit Conditions

In summary, current and future controls and regulations impacting the No. 13 Power Boiler (PB13) include:

- No. 13 Power Boiler (PB13) is subject to Boiler MACT emission limits and work practices that became effective in 2013 with a 2016 compliance date. The required tune ups serve to ensure good combustion practices (indirectly limiting emissions of all pollutants) and the boiler only starts up on clean fuel.
- EPA will continue the required process to evaluate acid gas control technology improvements for the industrial boiler source category with its upcoming periodic technology review for National Emission Standards for Hazardous Air Pollutants (NESHAP) Subpart DDDDD sources.
- No. 13 Power Boiler (PB13) is subject to New Source Performance Standards (NSPS) Subpart D which contains emission limits for SO_2.

- IP Savannah's SO_2 emissions demonstrate compliance with the 1-hour SO_2 NAAQS.

Georgia EPD agrees with the analysis conducted by IP Savannah and believes that the facility followed the EPA Air Pollution Control Cost Manual principles to the best of their ability. Georgia EPD's evaluation of IP Savannah's four-factor analysis, including the existing and future controls already scheduled for the No. 13 Power Boiler (PB13), indicates that requiring additional SO_2 emission control devices for the sources at IP Savannah would not be reasonable for purposes of making further progress in reducing regional haze. Georgia EPD finds that the costs associated with both the Dry scrubber and DSI systems found in Table 7-35 were not reasonable, and that the situation regarding wastewater and ground water allowances makes the wet scrubber not feasible. However, the removal of coal as a fuel in PB13 was determined to be reasonable. The permit conditions to be included in the Regional Haze SIP are related to the removal of coal as a fuel and the combustion of non-condensable gases in PB13. Permit conditions for the other fuels (natural gas and wood waste) are not included because those conditions are unchanged and are not necessary to make reasonable progress. The natural gas SO_2 emissions at PB13 for the most recent five years (2016-2020) range from 1.1-1.5 tons/year. The waste wood SO_2 emissions at PB13 for the most recent five years (2016-2020) range from 46.8-89.5 tons/year. This facility has consistently implemented its existing measures for natural gas and waste wood and has achieved, using those measures, a reasonably consistent emission rate. Compliance with the corresponding permit conditions would be immediate upon approval of this Regional Haze SIP. The corresponding permit conditions are as follows (note that anything underlined has been added and anything with strikethrough will be taken away):

3.2.X The Permittee shall not burn coal in the No 13 Power Boiler (PB13).
[40 CFR 51.308(f)(2)]

Note: The following permit condition (3.3.X) is already a federally enforceable condition included in IP Savannah's Title V operating permit. It was also included in Georgia's Regional Haze SIP that was submitted February 11, 2010, and approved on July 30, 2012. It has been included here for completeness.

3.3.X Effective January 1, 2016, the Permittee shall not discharge, or cause the discharge, into the atmosphere from the No. 13 Power Boiler (PB13) and from the combustion of low-volume high-concentration (LVHC) non-condensable gases, high-volume low-concentration (HVLC) non-condensable gases, and stripper off-gases (SOG) (excluding the combustion of any of these gases in the No. 7 Lime Kiln (LK07)) sulfur dioxide (SO2) emissions in excess of 6578 tons respectively during any twelve consecutive month period. The first compliance period shall be January through December 2016.
[40 CFR 51.308]

6.1.X For the purpose of reporting excess emissions, exceedances or excursions in the report required in Condition 6.1.4, the following excess emissions, exceedances, and excursions shall be reported:

[40 CFR 51.308(f)(2)]

a. Excess emissions: (means for the purpose of this Condition and Condition 6.1.4, any condition that is detected by monitoring or record keeping which is specifically defined, or stated to be, excess emissions by an applicable requirement)

   None required to be reported for this condition.

b. Exceedances: (means for the purpose of this Condition and Condition 6.1.4, any condition that is detected by monitoring or record keeping that provides data in terms of an emission limitation or standard and that indicates that emissions (or opacity) do not meet the applicable emission limitation or standard consistent with the averaging period specified for averaging the results of the monitoring)

   i. Any time of process operation during which coal is burned in the No. 13 Power Boiler (PB13).

c. Excursions: (means for the purpose of this Condition and Condition 6.1.4, any departure from an indicator range or value established for monitoring consistent with any averaging period)

   None required to be reported for this condition.

6.2.X The Permittee shall measure and record the total amount of each fuel burned in the No. 13 Power Boiler (PB13) each month.
[40 CFR 51.308(f)(2)]

6.2.X After completion of the Boiler MACT/Regional Haze PSD Project, the Permittee shall calculate and maintain the following records of the sulfur dioxide (SO2) emission rate for the No. 13 Power Boiler (PB13):

c. The twelve-month rolling total SO2 emissions, in tons per twelve consecutive months, to determine compliance with the SO2 emission standard in Condition No. 3.3.X. The first compliance period shall be January through December 2016.
[40 CFR 51.308]

7.8.2. Georgia Power – Plant Bowen

The emission sources at Georgia Power – Plant Bowen (Plant Bowen) evaluated in the submitted Four Factor Analysis report are already subject to various stringent emission limits, and emissions reductions have already been made at the facility. Currently, the coal-fired electric generating units (EGUs), Units 1-4, must burn <3% sulfur coal and are fully controlled for SO_2 with FGD scrubbers. All units are subject to the Georgia Multi-pollutant Rule (sss), which requires the scrubbers to be operated with an average 95% removal rate or greater, and scrubber operation is further optimized for compliance with all applicable regulations, including the Mercury and Air Toxics Standard (MATS), and Effluent Limitation Guidelines (ELG). Compared to emissions preceding installation of the scrubber, Plant Bowen has reduced annual SO_2 emissions from Units 1-4 by over 96%.

Plant Bowen evaluated whether additional emissions controls for SO_2 are feasible for Units 1-4. As a part of this analysis, site-specific emissions and control information, industry- and site-specific cost data, publicly available cost data, previous similar control evaluations, the U.S. EPA RBLC database, and U.S. EPA's OAQPS Control Cost Manual were reviewed. In addition, the three other statutory factors were also considered: energy and non-air impacts, time necessary for compliance, and remaining useful life of the emission units.

The energy and non-air impacts analyses show that implementing additional control measures would increase energy usage, water usage, wastewater generation, and/or solid waste generation and could potentially cause a smaller compliance margin against non-air permit limits. All of the emission units are presumed to have a remaining useful life exceeding 20 years and the time necessary to implement any of the control measures would not exceed the 2028 RPG timeframe. Based on the results of the four-factor analysis provided by Plant Bowen, adding SO_2 control devices to the sources at the facility would not be reasonable for reducing regional haze.

Units 1-4

The SO_2 emissions reduction measures identified for Units 1-4 are coal switching to Powder River Basin (PRB) coal, coal switching to Central Appalachian (CAPP) coal, and replacing the current FGD scrubbers with dry FGD scrubbers. The two coal switching options are both found to be highly unreasonable due to the high cost per ton SO_2 reduced for both coal types. The dry FGD scrubbers are an inferior control option that would provide no additional, and likely even decreased, SO_2 reductions over baseline facility operations. Table 7-36 below summarizes the SO_2 emissions control effectiveness and calculated cost effectiveness for each evaluated option.

Table 7-36: Units 1-4 Cost Summary[a]

Emission Unit	Control Technology Proposed (control efficiency)	Annual Cost ($/yr)	SO_2 tpy Reductions	Cost-Effectiveness ($/ton)
Units 1-4 Coal Fired EGU (118,872,778 MMBtu/hr all combined)	Coal Switching to PRB Coal (81%)	$48,059,482	7,482	$6,424
Units 1-4 Coal Fired EGU (118,872,778 MMBtu/hr all combined)	Coal Switching to CAPP Coal (56%)	$69,911,996	5,199	$13,447
Units 1-4 Coal Fired EGU (118,872,778 MMBtu/hr all combined)	Dry FGD Scrubbers[b]	N/A	N/A	N/A

a. Using firm specific interest rate of 6.04% and an equipment lifespan of 30 years. Year basis for dollars is 2019

b. Expected to likely decrease SO_2 reductions over baseline

With the specific costs listed above in Table 7-36, evaluating each unit on an individual basis was not necessary and would not have provided different results. Similarly, while no units at Plant Bowen currently have approved retirement dates, any assumed unit retirements would also not have changed the results. To be conservative, the evaluation did not include capital equipment costs associated with each control. Thus, both the costs (such as fuel, commodities, and labor) and emissions reductions generally vary proportionally with the number of affected units. In fact, evaluating fewer units or individual units in isolation could remove any cost efficiencies gained by implementing the control options at all four units, which would only lead to increased costs per SO_2 tons reduced. Therefore, for evaluating the control options in the Plant Bowen four factor analysis, each individual unit is proportionally the same and would return cost per SO_2 tons reduced values equal to or greater than the aggregated plant totals.

Coal Switching to PRB Coal

Due to significantly lower heat content and higher moisture content, burning PRB coal requires additional coal to be burned to achieve the same amount of energy as a bituminous coal. PRB coal has significantly lower heat content than Illinois Basin (IB) coal, and this decrease in heat content paired with an increase in coal moisture content is estimated to result in total capacity decrease, or derate, of Units 1-4. A capacity derate of around 27% or greater would be expected using current unit equipment to process PRB coal at the same rate as current IB coal operations. The 27% derate was calculated based on the heat content of the PRB coal (8,800 Btu/lb) in comparison to IB coal (12,002 Btu/lb). Therefore, any PRB coal percentage evaluated would provide 27% less heat input to the unit than the same percentage of IB coal, resulting in a proportional unit capacity derate and associated capacity replacement costs. This switch would reduce the amount of energy produced by Plant Bowen Units 1-4 through reductions in unit capacities. Although these units are not currently scheduled for retirement, investment restrictions are placed on Units 1 and 2 through July 31, 2022, by the PSC 2019 IRP final order, and Georgia Power's capacity needs. The time necessary for such a switch would require extensive engineering evaluations to be completed and would conceivably take until December 31, 2028, due to the uncertainty associated with the scope of work needed to install new systems. Switching to PRB coal also poses energy production concerns due to the lower heat content and higher moisture content of PRB coal.

Coal Switching to CAPP Coal

For CAPP coal, the significant increase in fuel costs would be anticipated to impact the economic dispatch operations of Units 1-4 to the point that they would potentially run only when needed to ensure the reliability of the Southern Company system. The cost of compliance for coal switching to CAPP is significant compared to IB coal and is therefore extremely cost ineffective that is not necessary to make reasonable progress. The energy impact of CAPP coal is primarily addressed through the large increase in delivered coal cost incurred in order to maintain equal annual heat input. Although these units are not currently scheduled for retirement, investment restrictions are placed on Units 1 and 2 through July 31, 2022, by the GPSC 2019 IRP final order, and Georgia Power's capacity needs. The timeline associated to switching to CAPP coal would be at least until December 31, 2024, due to coal contract timeframes. Due to the significant delivery cost incurred for the switching to CAPP coal, Plant Bowen has stated that this would impact Units 1-4 such that they would potentially only run when needed for reliability of the power system. This would in turn reduce the amount of energy produced by the units.

Evaluation of Coal Blending

While the option of blending IB with PRB is technically feasible, they would present technical challenges and additional costs for smaller emission reductions. Therefore, for the purposes of the Bowen 4FA, Georgia Power considers coal blending of either CAPP or PRB coals to inferior options to the full fuel switching options already evaluated, and therefore inappropriate for further review. Since coal blending would only increase costs and yield smaller emissions reductions, it would result in higher cost per SO_2 ton reduced.

The significant challenges of coal blending of PRB coal instead of full fuel switching would pose additional costs and burden. Due to the safety requirements of handling PRB coal, coal blending of PRB at any percentage would require the implementation of the same equipment for the coal handling systems to address fire and dust suppression as it would for full fuel switching to PRB coal. These changes and upgrades would have to be implemented on all four units. Coal blending also introduces significant new logistical challenges, due to the need for consistent and precise mixing of coal types. Maintaining consistent percentages of IB and PRB coal being fed to the boiler would be labor and time intensive, if not impossible. Due to the differences in the coal characteristics, variations in the ratio of IB coal to PRB coal would negatively impact not only the operation of the boiler but also the supporting systems, including environmental controls.

In addition, the derate of the unit capacity associated with fuel switching to PRB coal would still apply to the coal blending with PRB. The estimated capacity derate would remain proportional to the amount of PRB coal introduced. In the Bowen 4FA of the full switch to PRB coal, the 27% derate was calculated based on the heat content of the PRB coal (8,800 Btu/lb) in comparison to IB coal (12,002 Btu/lb). Therefore, any PRB coal percentage evaluated would provide 27% less heat input to the unit than the same percentage of IB coal, resulting in a proportional unit capacity derate and associated capacity replacement costs.

Summary and Proposed Permit Conditions

In summary, the additional SO_2 emission reduction measures identified were determined to result in unreasonable costs of compliance. Also, coal switching to PRB coal or CAPP coal would have significant energy impacts on the operations of Units 1-4 that could affect the remaining useful life of the units. The concept of efficiency improvements for the existing scrubbers as another potential control option has been discussed and is encouraged by EPA's most recent 2021 guidance memo. Plant Bowen Units 1-4 are equipped with Chiyoda Jet Bubbling Reactor (JBR) wet FGD scrubbers, in which the flue gas from the boiler flows down a large set of sparger tubes submerged into a limestone slurry in the scrubber vessel. The flue gas is forced through the slurry bath where SO_2 from the flue gas reacts with the limestone to form gypsum, effectively removing SO_2 from the flue gas stream before it exits the stack. The scrubbers are also critical to mercury control and MATS compliance, since the scrubber can capture mercury in the scrubber liquid or reagent, depending on how it is operated. For Bowen Units 1-4, scrubber operating parameters are optimized based on Georgia Power's operational experience to maintain SO_2 removal compliance, mercury removal compliance, and wastewater treatment requirements for both mercury and selenium, while balancing the increased equipment wear and scrubber vessel scaling experienced at higher submergence levels and pH levels. The 2019 average SO_2 removal rate was 96.3% for Units 1-4 and reflects the level of oxidation needed to comply with all applicable regulatory requirements.

While Georgia Power does not have current plans to retire Plant Bowen Units 1-4, the 2019 IRP final order places significant cost restrictions on Units 1-2 through July 2022, and the remaining useful life of Units 1-4 will be further evaluated during the 2022 IRP process. Therefore, none of the identified control technologies or emission reduction measures are necessary or appropriate for Plant Bowen for the purpose of setting or achieving the 2028 RPGs.

Considering this conclusion and that Units 1-4 are fully controlled with wet FGD scrubber systems that are operated and maintained to optimize performance for not only SO_2 emissions removal but also for other environmental compliance requirements, such as MATS mercury emissions limits and ELG selenium wastewater treatment, it was concluded that the MATS alternative SO_2 limit of 0.20 lb/MMBtu for Units 1-4 be included in the Georgia Regional Haze SIP for the second implementation period. Furthermore, EPD examined the compliance margin for the SO_2 emission rate to evaluate if the emissions are appropriate and reasonable. The wet FGD systems for Plant Bowen Units 1-4 must be optimized not only for SO_2 removal but also to maintain compliance with MATS mercury emissions control and wastewater treatment requirements for both mercury and selenium. Average annual SO_2 emissions rates (lb/MMBtu) over the last 3 years ranges from 0.11 to 0.17 and equates to percent removal of SO_2 of 96%-97.3%. EPD agrees that this is an appropriate compliance margin and does not intend to lower the SO_2 limit beyond the MATS limit. The compliance schedule for Plant Bowen should be the effective date of EPA approval of the Georgia Regional Haze SIP. This approach avoids the potential for inconsistent requirements during the review of the SIP. Because no additional controls need to be installed, the MATS alternative SO_2 limit can be immediately applicable following completion of the EPA approval process.

The Plant Bowen Title V permit currently allows for Units 1-4 to comply with either the MATS HCl limit or the alternative SO_2 limit. This recommendation would remove the HCl limit option from the Title V permit, creating a federally enforceable SO_2 limit for Units 1-4 beyond the allowance trading program requirements of CSAPR and the Acid Rain Program. Incorporation of the MATS SO_2 limit into the 2021 Georgia Regional Haze SIP would demonstrate that Units 1-4 are already fully controlled for SO_2 with optimized wet FGD scrubber systems and that through compliance with an already applicable federal air quality rule, Plant Bowen is meeting any measures that are necessary to make reasonable progress toward natural visibility levels at surrounding federal Class I areas. See Appendix G-1d for the complete Plant Bowen permit (included for reference only, not to be adopted into the SIP).

Georgia EPD agrees with the analysis conducted by Georgia Power and has determined that the facility followed the EPA Air Pollution Control Cost Manual principles to the best of their ability. Georgia EPD's reasonable progress determination for Plant Bowen requires the facility to limit their Steam Generating Units (Emission IDs SG01, SG02, SG03, and SG04) to the MATS SO_2 emission limit of 0.20 lb/MMBtu based on a 30-day operating rolling average. Georgia Power Plant Bowen will no longer have the option to use the HCl emission limit as an alternative. This commitment will be incorporated into the Regional Haze SIP with the following permit conditions (note that anything underlined has been added and anything with strikethrough will be removed):

<u>3.4.19. The Permittee shall not discharge or cause the discharge into the atmosphere from any steam generating unit (Emission IDs SG01, SG02, SG03, and SG04), any gases which contain sulfur dioxide in excess of 0.20 lb/MMBtu heat input based on a 30-operating day rolling average for each steam generating unit. The emission limits apply at all times except during periods of startup and shutdown as defined in 40 CFR 63.10042 when work practice standards are applicable as required by Permit Condition 6.2.23.
[40 CFR 51.308(f)(2); 40 CFR 63.9991(a)(1) subsumed]</u>

5.2.1. The Permittee shall install, calibrate, maintain, and operate a system to continuously monitor and record the indicated pollutants on the following equipment. Each system shall meet the applicable performance specification(s) of the Division's monitoring requirements.
[391-3-1-.02(6)(b)1 and 40 CFR 70.6(a)(3)(i)]

f. A continuous emissions monitoring system (CEMS), for the measurement of sulfur dioxide concentration (ppm) and diluent concentrations (either Oxygen or Carbon Dioxide, percent), is required to be installed on each steam generating unit (Emission Unit ID SG01, SG02, SG03, and SG04). Sulfur dioxide emissions are monitored at the outlet of the SO_2 control devices (Control Device IDs FGD1, FGD2, FGD3, and FGD4). The output of the CEMS shall be expressed in terms of pounds per million British thermal units (lb/MMBtu).

5.2.26. The CEMS required by Condition 5.2.1.f. shall be operated and data recorded during all periods of operation of the affected Steam Generating Units (Emission Unit IDs SG01, SG02, SG03, and SG04) including periods of startup, shutdown, malfunction or emergency conditions, except for periods of monitoring system malfunctions or out-of-control periods and associated repairs and required monitoring system quality assurance or quality control activities, including, as applicable, calibration checks and required zero and span adjustments.
[40 CFR 51.308(f)(2); 40 CFR 10020(b) subsumed]

6.1.7. For the purpose of reporting excess emissions, exceedances or excursions in the report required in Condition 6.1.4, the following excess emissions, exceedances, and excursions shall be reported:
[391-3-1-.02(6)(b)1 and 40 CFR 70.6(a)(3)(i)]

a. Excess emissions: (means for the purpose of this Condition and Condition 6.1.4, any condition that is detected by monitoring or record keeping which is specifically defined, or stated to be, excess emissions by an applicable requirement)

iii. ~~If the alternative SO2 limit is used for hydrogen chloride compliance under 40 CFR 63 Subpart UUUUU, any~~ Any 30 operating day period in which the SO_2 emissions rate from a steam generating unit (Emission Unit IDs SG01, SG02, SG03, and SG04) exceeds the applicable emissions limit in Condition ~~3.3.8(d)~~ 3.4.19.

6.2.23. The Permittee must comply with applicable work practice standards required by 40 CFR 63.10021 and Table 3 to 40 CFR 63 Subpart UUUUU for the steam generating units (Emission Unit IDs SG01, SG02, SG03, and SG04) during periods of startup and shutdown as defined in 40 CFR 63.10042.
[40 CFR 63.10021 and Table 3 to 40 CFR 63 Subpart UUUUU; 40 CFR 51.308(f)(2)]

6.2.24 The Permittee must maintain the following records for any steam generating unit (Emission Unit IDs SG01, SG02, SG03, and SG04):
[40 CFR 63.10032; 40 CFR 51.308(f)(2)]

a. A copy of each notification and report that the Permittee submitted to comply with 40 CFR 63 Subpart UUUUU, including all documentation supporting any Initial Notification, Notification of Compliance Status, or semiannual compliance report.
b. Records of performance stack tests, fuel analyses, or other compliance demonstrations and performance evaluations.
c. For each CEMS, the Permittee must keep the following records:
    i. Each period during which a CMS is malfunctioning or inoperative (including out-of-control periods).
    ii. All required measurements needed to demonstrate compliance with the relevant standard
    iii. Previous versions of the performance evaluation plan.

iv. Any requests for alternatives to relative accuracy test for CEMS as required in 63.8(f)(6)(i).

v. Records of the date and time that each deviation started and stopped, and whether the deviation occurred during a period of startup, shutdown, or malfunction or during another period.

d. Monthly records of fuel use by each steam generating unit, including the types of fuel and amount(s) used.

e. The occurrence and duration of each malfunction of an operation (i.e. process equipment) or the air pollution control and monitoring equipment and the actions taken during periods of malfunction to minimize emissions, including corrective actions to restore malfunctioning process and air pollution control and monitoring equipment to its normal or usual manner of operation.

f. The occurrence and duration of each startup and/or shutdown and the type(s) and amount(s) of fuel used during each startup or shutdown.

6.2.25 The Permittee shall prepare and submit MATS compliance reports on the schedule specified by and containing the applicable information required by 40 CFR 63.10031 for each steam generating unit (Emission Unit IDs SG01, SG02, SG03, and SG04). The MATS compliance reports shall include any failed stack test required by Conditions 4.2.1 (a) ~~and (b)~~ per the applicable methods in Condition 4.1.3. All reports shall be submitted electronically no later than 60 days following the end of the reporting period.
[40 CFR 63.10031; 40 CFR 51.308(f)(2)]

7.8.3. Brunswick Cellulose

The emission sources at Brunswick Cellulose evaluated in the submitted Four Factor Analysis report are already subject to various stringent emission limits and emissions reductions have already been made at the facility. Brunswick Cellulose evaluated whether additional emissions controls for SO_2 are feasible for the No. 4 Power Boiler (U700), No. 5 Recovery Furnace (R401), and No. 6 Recovery Furnace (R407). The No. 5 Lime Kiln (L537), No. 6 Power Boiler (U706), No. 7 Power Boiler (U707), No. 5 Smelt Dissolving Tank (R403), No. 6 Smelt Dissolving Tank (R408), and Backup NCG Incinerator (R480) are also SO_2 emissions sources. However, the 3-year average (2017-2019) actual SO_2 emissions from each of these sources are 2 tpy or less. Therefore, these sources were not evaluated because any reductions from these sources would be minimal.

As a part of this analysis, site-specific emissions and control information, industry- and site-specific cost data, publicly available cost data, previous similar control evaluations, the U.S. EPA RBLC database, and U.S. EPA's OAQPS Control Cost Manual were reviewed. In addition, the three other statutory factors were also considered: energy and non-air impacts, time necessary for compliance, and remaining useful life of the emission units.

The energy and non-air impacts analyses show that implementing additional control measures would increase energy usage, water usage, wastewater generation, and/or solid waste generation and could potentially cause a smaller compliance margin against non-air permit limits. All of the emission units are presumed to have a remaining useful life exceeding 30 years and the time necessary to implement any of the control measures would not exceed the 2028 RPG timeframe.

Table 7-37: Summary of Emissions Sources Evaluated

Emissions Unit Description	Permitted Fuels	Control Technology	Major Regulatory Programs
No. 4 Power Boiler (U700)	Carbonaceous Fuel (consisting of wood materials such as bark, chips, and sawdust), No. 6 Fuel Oil, Natural Gas, Wastewater Treatment System Residuals, Tire-Derived Fuel (TDF)	Electrostatic Precipitator	40 CFR 63 Subpart DDDDD
No. 5 Recovery Furnace (R401)	Organic Material Present in Black Liquor and Reduce the Inorganic Compounds, Natural Gas, No. 6 Fuel Oil, Rectified Methanol	Electrostatic Precipitator	40 CFR 63 Subpart MM
No. 6 Recovery Furnace (R407)	Organic Material Present in Black Liquor and Reduce the Inorganic Compounds, Natural Gas, No. 2 Fuel Oil, Rectified Methanol	Electrostatic Precipitator	40 CFR 63 Subpart MM

No. 4 Power Boiler (U700)

Considering current air pollution controls, fuels fired, and RBLC Database information, the following technically feasible control technologies for industrial boilers were evaluated: good operating practices, low-sulfur fuels, wet scrubber, and dry sorbent injection (DSI).

The four-factor analysis reviewed substitution of No. 6 Fuel Oil with Natural Gas, wet scrubber with caustic addition, and trona dry sorbent injection. Table 7-38 contains a summary of the SO_2 economic impacts of implementing each SO_2 control technology for the No. 4 Power Boiler, based on operating data and the projected 2028 actual SO_2 emissions.

Table 7-38: No. 4 Power Boiler (800 MMBtu/hr) Cost Summary[a]

Control Technology Proposed (Control Efficiency)	Capital Cost	Annual Cost ($/yr)	SO_2 tpy Reductions	Cost-Effectiveness ($/ton)
Replacement of No. 6 Fuel Oil with Natural Gas	N/A	Cost Savings[b]	48.98	Cost Savings[b]
Wet Scrubber[c] (98%)	$9,518,762[d]	$1,452,133[d]	141	$10,330[d]
Trona Dry Sorbent Injection[c] (90%)	$8,776,851[e]	$3,395,367[e]	129.1	$26,301[e]
Replacement of TDF with Natural Gas	N/A	Cost Savings[b]	66.97	Cost Savings[b]

a. Using a 3.25% interest rate
b. Takes into account cost savings attributed to the lower cost of natural gas vs. the fuel being replaced
c. Using a 30-year equipment lifespan
d. Year basis for dollars is 2020
e. Year basis for dollars is 2019. 2016 costs associated were scaled to 2019 dollars using CEPCI.

Based on current natural gas costs for Brunswick Cellulose, cost savings associated with the reduction in fuel oil purchases, and the average heat input to the No. 4 Power Boiler from No. 6

fuel oil over the past three years, the cost effectiveness of replacing No. 6 fuel oil with natural gas is negative. Brunswick Cellulose would save money by switching from fuel oil to natural gas, even at the higher natural gas prices. However, the supply of natural gas may be inadequate during gas curtailments, which could lead to production curtailments and other operational impacts at the facility. The flexibility to burn No. 6 fuel oil in the No. 4 Power Boiler as needed by the facility during gas curtailments ensures the stability of the steam supply and the stability of all other operations at the facility that are dependent on steam supply.

When the facility analyzed the replacement of TDF in the No. 4 Power Boiler (U700), they found that based on natural gas costs for the mill compared to the average 2018-2019 cost of TDF, the facility would save money by replacing TDF with natural gas. The cost of natural gas that was used for this analysis may not be indicative of future costs or of the cost of natural gas at certain times of the year. The site can, and has been, subject to natural gas curtailments during colder months that result in higher natural gas costs. However, even if all additional natural gas were purchased at the higher curtailment price, the facility would still save money by replacing TDF firing with natural gas firing in the No. 4 Power Boiler based on the data used in this analysis. The discontinuing of the firing of TDF at the facility as an auxiliary fuel would not require modifications to any equipment at the site, eliminating any considerations related to the time necessary to comply.

The cost effectiveness for the wet scrubber and DSI options are not reasonable. Added electricity, natural gas, and water would be needed to run a wet scrubber. The wet scrubber option would generate wastewater for disposal and added electricity is required to power scrubber fans. Dry sorbent injection results in additional waste being generated as well.

No. 5 and No. 6 Recovery Furnaces (R401 and R407)

Taking into account current air pollution controls, fuels fired, and RBLC Database information, the following technically feasible control technologies for recovery furnaces in the pulp and paper industry were evaluated: good operating practices, low-sulfur fuels, and wet scrubbers. These three control measures were identified as available for reducing SO_2 emissions from recovery furnaces. Good operating practices are already used by the recovery furnaces and do not present opportunities for SO_2 reductions.

The four-factor analysis reviewed the use of low-sulfur fuels and a wet scrubber system as technically feasible control technology. Table 7-39 contains a summary of the SO_2 economic impacts of implementing a wet scrubber for the No. 5 and No. 6 Recovery Furnaces, based on operating data and the projected 2028 actual SO_2 emissions.

Table 7-40 is a summary of associated costs with switching to lower sulfur fuels for the No. 4 Power Boiler and No. 5 Recovery Furnace and the cost estimates are from a supplemental email sent by the facility[51]. Although the No.5 Lime Kiln is not being evaluated, it shares the single No. 6 fuel oil tank supply with both emission units (No. 4 Power Boiler and the No. 5 Recovery Furnace); therefore, either the fuel oil for all three emission units would need to be substituted with a lower sulfur fuel oil blend, or a new fuel oil tank would need to be constructed to supply the No. 4 Power Boiler and No. 5 Recovery Furnace separately from the No. 5 Lime Kiln. These scenarios were evaluated for their cost effectiveness. Also, an emission reduction of 35% was used in Table 7-40 which is attributed to the No. 5 Recovery furnace's SO_2 emissions and represents the most conservative SO_2 removal efficiency taken from a technical bulletin distributed by the National Council of the Paper Industry for Air and Stream Improvement (NCASI)[52]. The bulletin evaluated SO_2 emissions reductions gathered from different pulp mill's CEMs data for recovery furnaces and found SO_2 reductions ranging from mainly from 70% – 95%, with the only value below this range being at 35%. This lowest efficiency value (35%) was used to calculate the most conservative cost scenario (lowest $/ton value) and is shown in Table 7-40. Any higher SO_2 removal efficiency would result in higher $/ton values, which according to the bulletin is a more likely scenario. The emissions reductions that the NCASI bulletin evaluated are attributed to the capturing of oil generated SO_2 emissions by sodium fumes generated and released from the char bed and the burning liquor during normal operating conditions of a recovery furnace.

Table 7-39: Nos. 5 and 6 Recovery Furnaces Cost Summary[a]

Emission Unit	Control Technology Proposed (Control Efficiency)	Capital Cost	Annual Cost ($/yr)[a]	SO_2 tpy Reductions	Cost-Effectiveness ($/ton)
No. 5 Recovery Furnace	Wet Scrubber (98%)	$21,716,392	$2,874,749	119	$24,242
No. 6 Recovery Furnace	Wet Scrubber (98%)	$27,697,618	$3,664,067	13	$275,621

a. Using an equipment lifespan of 30 years, an interest rate of 3.25%, and 2001 dollars scaled to 2019 dollars using CEPCI

Table 7-40: Cost Summary to Switch to Lower Sulfur Fuels[ab]

Emission Unit	Fuel Switch Proposed	Annual Cost ($/yr)	SO_2 tpy Reductions	Cost-Effectiveness ($/ton)
No. 4 Power Boiler, No. 5 Recovery Furnace, and No. 5 Lime Kiln	Replacement of No. 6 Fuel Oil with 1.5% S Fuel Oil	$142,602	7	$19,326
No. 4 Power Boiler, No. 5 Recovery Furnace, and No. 5 Lime Kiln	Replacement of No. 6 Fuel Oil with 1% S Fuel Oil	$208,605	41	$5,028
No. 4 Power Boiler, No. 5 Recovery Furnace, and No. 5 Lime Kiln	Replacement of No. 6 Fuel Oil with No. 2 Fuel Oil (0.0015% S)	$959,019	112	$8,527
No. 4 Power Boiler and No. 5 Recovery Furnace[c]	Replacement of No. 6 Fuel Oil with 1.5% S Fuel Oil	$165,069	7	$22,371
No. 4 Power Boiler and No. 5 Recovery Furnace[c]	Replacement of No. 6 Fuel Oil with 1% S Fuel Oil	$211,503	41	$5,098
No. 4 Power Boiler and No. 5 Recovery Furnace[c]	Replacement of No. 6 Fuel Oil with No. 2 Fuel Oil (0.0015% S)	$739,424	113	$6,571

a. Using an interest rate of 4.75% and an equipment lifespan of 30 years. Dollars are in year 2019

b. Using a conservative SO_2 emission reduction of 35% for the No.5 Recovery Furnace, Source: Appendix G-3d NCASI Technical Bulletin 578

c. Includes costs associated with construction of a new 500,00-gallon fuel oil tank

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Added electricity, natural gas, and water would be needed to run a wet scrubber and this option generates wastewater for disposal. Added electricity is required to power scrubber fans. Based on the unreasonably high control costs and other factors, none of the control technologies evaluated for the No. 5 and No. 6 Recovery Furnaces were deemed reasonable. No permit conditions will be included in the Regional Haze SIP for the No. 5 and No. 6 Recovery Furnaces because those conditions are unchanged and are not necessary to make reasonable progress. The SO_2 emissions at the No. 6 Recovery Furnaces for the most recent five years (2016-2020) are 21.7 tons/year (2016), 22.0 tons/year (2017), 21.7 tons/year (2018), 8.2 tons/year (2019), and 7.8 tons/year (2020). The SO_2 emissions at the No. 5 Recovery Furnaces for the most recent five years (2016-2020) are 93.1 tons/year (2016), 97.2 tons/year (2017), 90.4 tons/year (2018), 109.6 tons/year (2019), and 213.5 tons/year (2020). This facility has consistently implemented its existing control measures for the No. 5 and No. 6 Recovery Furnaces and has achieved, using those measures, a reasonably consistent emission rate. Based on this, we expect future SO_2 emissions at the No. 6 Recovery Furnaces to remain in the range of 7.8-22.0 tons/year and the future SO_2 emissions at the No. 5 Recovery Furnaces to remain in the range of 90.4-213.5 tons/year. See Appendix G-3e for the current permit conditions for the No. 5 and No. 6 Recovery Furnaces (include for reference only, not to be adopted into the SIP).

Summary and Proposed Permit Conditions

In summary, all of the fuel replacement SO_2 emission reduction measures identified in Table 7-40 were determined to result in unreasonable costs of compliance. The options of replacing the firing of No. 6 fuel oil and TDF with natural gas in the No. 4 Power Boiler found in Table 7-38 were deemed to be reasonable and cost effective. Note that the No. 4 Power Boiler is subject to Boiler MACT emission limits and work practices that became effective in 2013 with a 2016 compliance date. The required tune ups serve to ensure good combustion practices (indirectly limiting emissions of all pollutants) and the boiler only starts up on clean fuel. EPA will continue the required process to evaluate acid gas control technology improvements for the industrial boiler source category with its upcoming periodic technology review for NESHAP Subpart DDDDD sources.

Based on results of the four-factor analysis, add-on SO_2 controls in Table 7-38 and Table 7-39 are not feasible or cost-effective and would not be necessary for the purposes of making reasonable progress.

Georgia EPD agrees with the analysis conducted by Brunswick Cellulose and believes that the facility followed the EPA Air Pollution Control Cost Manual principles to the best of their ability. The discontinuing of No. 6 fuel oil usage and replacement with the firing of natural gas in No. 4 Power Boiler (except for times of curtailment) is expected to reduce SO_2 emissions by approximately 49 tpy with a negative cost-effectiveness, meaning that Brunswick Cellulose would save money by switching from No. 6 fuel oil to natural gas, even at the higher natural gas price associated with a curtailment. The discontinuing of tire derived fuel usage and replacement with the firing of natural gas in No. 4 Power Boiler is expected to reduce SO_2 emissions by approximately 67 tpy with a negative cost-effectiveness, meaning that Brunswick Cellulose would save money by switching from tire derived fuel to natural gas, even at the higher natural gas price associated with a curtailment. Thus, Georgia EPD's reasonable progress determination for Brunswick Cellulose requires the facility to eliminate the firing of tire derived fuel in the No. 4 Power Boiler, and to limit the firing of No. 6 fuel oil in the same boiler to times of natural gas curtailment with additional fuel oil firing allowances during adverse bark/wood fuel conditions (e.g., excess moisture in the fuel) to give the facility operational flexibility. Specifically, the No. 4 Power Boiler will be limited to 15 tons per year of SO_2 emissions from firing fuel oil outside of periods of natural gas curtailment. As a result, the No. 4 Power Boiler will run mainly on natural gas. These changes will be incorporated into the Regional Haze SIP by the following permit conditions (note that anything underlined has been added and anything with strikethrough will be removed):

3.2.X No later than 24 months after the issuance of this permit, the Permittee shall not burn tire derived fuel in the No. 4 Power Boiler (U700).
[40 CFR 51.308(f)(2)]

3.2.X The Permittee shall not burn No. 6 fuel oil in the No. 4 Power Boiler (U700) outside of the following operating conditions:
[40 CFR 51.308(f)(2)]

a. Periods of natural gas curtailment; or

b. Periods of adverse fuel conditions affecting wood and/or bark (e.g., excess moisture in the fuel).

3.2.X For periods during which No. 6 fuel oil is burned in the No. 4 Power Boiler (U700) in accordance with Condition 3.2.X.b, the Permittee shall not discharge, or cause the discharge, into the atmosphere, from the No. 4 Power Boiler, any gases which contain sulfur dioxide (SO_2) emissions in excess of 15 tons during any consecutive 12-month period.
[40 CFR 51.308(f)(2)]

6.1.X For the purpose of reporting excess emissions, exceedances or excursions in the report required in Condition 6.1.4, the following excess emissions, exceedances, and excursions shall be reported:
[40 CFR 51.308(f)(2)]

a. Excess emissions: (means for the purpose of this Condition and Condition 6.1.4, any condition that is detected by monitoring or record keeping which is specifically defined, or stated to be, excess emissions by an applicable requirement)

None required to be reported for this condition.

b. Exceedances: (means for the purpose of this Condition and Condition 6.1.4, any condition that is detected by monitoring or record keeping that provides data in terms of an emission limitation or standard and that indicates that emissions (or opacity) do not meet the applicable emission limitation or standard consistent with the averaging period specified for averaging the results of the monitoring)

i. Any time of process operation during which tire derived fuel is burned in the No. 4 Power Boiler (U700).

ii. Any time of process operation during which No. 6 fuel oil is burned in the No. 4 Power Boiler (U700) outside of the conditions specified in Condition 3.2.X.a or b.

iii. Any 12-consecutive month period during which SO_2 emissions, while firing No. 6 fuel oil the No. 4 Power Boiler (U700) in accordance with Condition 3.2.X.b, exceed 15 tons.

c. Excursions: (means for the purpose of this Condition and Condition 6.1.4, any departure from an indicator range or value established for monitoring consistent with any averaging period)

None required to be reported for this condition.

6.2.X The Permittee shall record the total amount of each fuel burned in the No. 4 Power Boiler (U700) each operating day. The monthly fuel summaries may be updated at the end of each month to reflect accounting reconciliation. If No. 6 fuel oil is burned in accordance with Condition 3.2.X, the records shall include:
[40 CFR 51.308(f)(2)]

a. The dates and duration of periods of natural gas curtailment;

b. The dates, duration, and reason for periods of adverse fuel conditions that require No. 6 fuel oil to be burned.

6.2.X The Permittee shall use emission factors and the records required by Condition 6.2.X to calculate monthly SO_2 emissions from the No. 4 Power Boiler (U700) while firing No. 6 fuel oil in accordance with Condition 3.2.x.b to demonstrate compliance with Condition 3.2.X on a monthly basis. All calculations used to determine the total must be kept as part of the record. The monthly emissions shall be used to calculate the 12-consecutive month period total of SO_2 emissions. Each month's 12-consecutive month total shall be the sum of the current month's emissions plus the previous 11 months' emissions.
[40 CFR 51.308(f)(2)]

7.9. Consideration of Five Additional Factors

Section 51.308(f)(2(iv) of the Regional Haze Rule requires that states must consider five additional factors when developing a long-term strategy. These five additional factors are:

A. Emission reductions due to ongoing air pollution control programs, including measures to address reasonably attributable visibility impairment;
B. Measures to mitigate the impacts of construction activities;
C. Source retirement and replacement schedules;
D. Basic smoke management practices for prescribed fire used for agricultural and wildland vegetation management purposes and smoke management programs; and
E. The anticipated net effect on visibility due to projected changes in point, area, and mobile source emissions over the period addressed by the long-term strategy.

Factors B and D are addressed below in Section 7.9.2 and Section 7.9.1, respectively.

Factors A and C are addressed in other sections of this document. For Factor A, the emission reductions from ongoing air pollution control programs, including, where applicable, measures to address reasonably attributable visibility impairment, are included in the baseline and 2028 emission inventories discussed in Section 4. For Factor C, specific source retirements and replacements are explained in Section 7.2.2.1.

For Factor E, the anticipated net effect on visibility due to projected changes in point, area, and mobile source emissions over the period addressed by the long-term strategy is reflected in the reasonable progress goals discussion located in Section 8.

7.9.1. Smoke Management

As discussed in Section 2.4.2 and demonstrated in Figure 2-1, elemental carbon (sources include agriculture, prescribed wildland fires, and wildfires) is a relatively minor contributor to visibility impairment at the Class I areas in Georgia. On July 11, 2008, GA EPD entered into a memorandum of understanding with the Georgia Forestry Commission and Georgia Department of Natural Resources Wildlife Resources Division adopting a smoke management plan that addresses the issues laid out in US EPA's 1998 draft guidance for smoke management plans. This plan is sufficient to satisfy the directive in section 308(d)(3)(v)(E). A copy of the current smoke management plan can be obtained from Georgia EPD, or it can be viewed on the Georgia EPD web page.[53]

[53] URL: https://epd.georgia.gov/document/document/view-georgias-smoke-management-plan/download

7.9.2. Dust and Fine Soil from Construction Activities

As discussed in Section 2.4.2 and demonstrated in Figure 2-1, fine soils were a relatively minor contributor to visibility impairment at the Class I areas in Georgia during the baseline period of 2000-2004. Figure 2-2 and Figure 2-3 show that no VISTAS Class I areas experienced significant visibility impairment from soils during this timeframe. Figure 2-7 shows that fine soils continue to be only a minor contributor to visibility at the Class I areas in Georgia during the most current period of monitoring data (2014-2018). Figure 2-8 and Figure 2-9 show that no VISTAS Class I areas experienced significant visibility impairment from soils during the 2014-2018 timeframe.

Georgia's Rules for Air Quality Control include requirements for precautions to prevent fugitive dust from becoming airborne and also limit the opacity of fugitive emissions to less than 20 percent. The requirements of rule 391-3-1-.02(n) include preventive measures for construction activities and are deemed adequate to satisfy the directive in Section 308(d)(3)(v)(B) of the Regional Haze rule. The current version of Georgia's air rules is available on the Georgia Secretary of State website.[54]

7.10. Consideration of NOx and Nitrate in Source Selection

As stated in EPA's August 2019 regional haze guidance, "When selecting sources for analysis of control measures, a state may focus on the PM species that dominate visibility impairment at the Class I areas affected by emissions from the state and then select only sources with emissions of those dominant pollutants and their precursors." Both SO_2 and NOx emissions sources were analyzed during the AoI and PSAT modeling work for consideration in the source selection step. Identical screening thresholds were used for SO_2/sulfate and NO_X/nitrate. No facilities exceeded the screening thresholds for NO_X/nitrate. As a result, Georgia EPD did not perform any reasonable progress analyses on any NO_X emission sources as part of the long-term strategy.

Georgia EPD evaluated the appropriate and available data to develop the projected reasonable progress goals (RPGs) for 2028, taking into consideration all relevant emissions. Georgia EPD concluded that ammonium sulfate is the dominant pollutant impacting visibility at Georgia Class I areas, followed by organic carbon and ammonium nitrate. States are required to establish RPGs for each mandatory Class I Federal area located within the state. The LTS and RPGs must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least impaired days over the same period. Figure 7-44 shows the visibility impairment by species at the Cohutta Wilderness Area for 2000-2019. Figure 7-45 shows the visibility impairment by species at the Okefenokee

[54] URL: https://rules.sos.ga.gov/gac/391-3-1

National Wilderness Area for 2000-2019. Although sulfate has decreased dramatically over this 20-year period, it is still the dominant species in 2019.

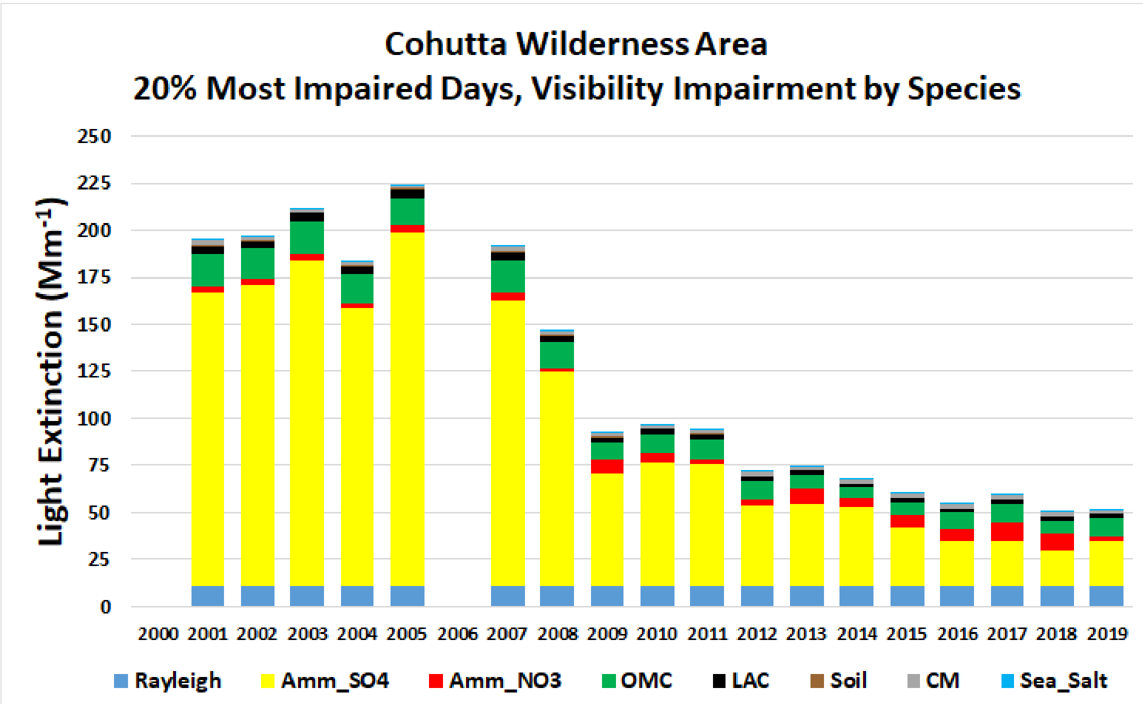

Figure 7-44: Speciated Light Extinction at Cohutta Wilderness Area for 2000-2019 on the 20% Most Impaired Days.

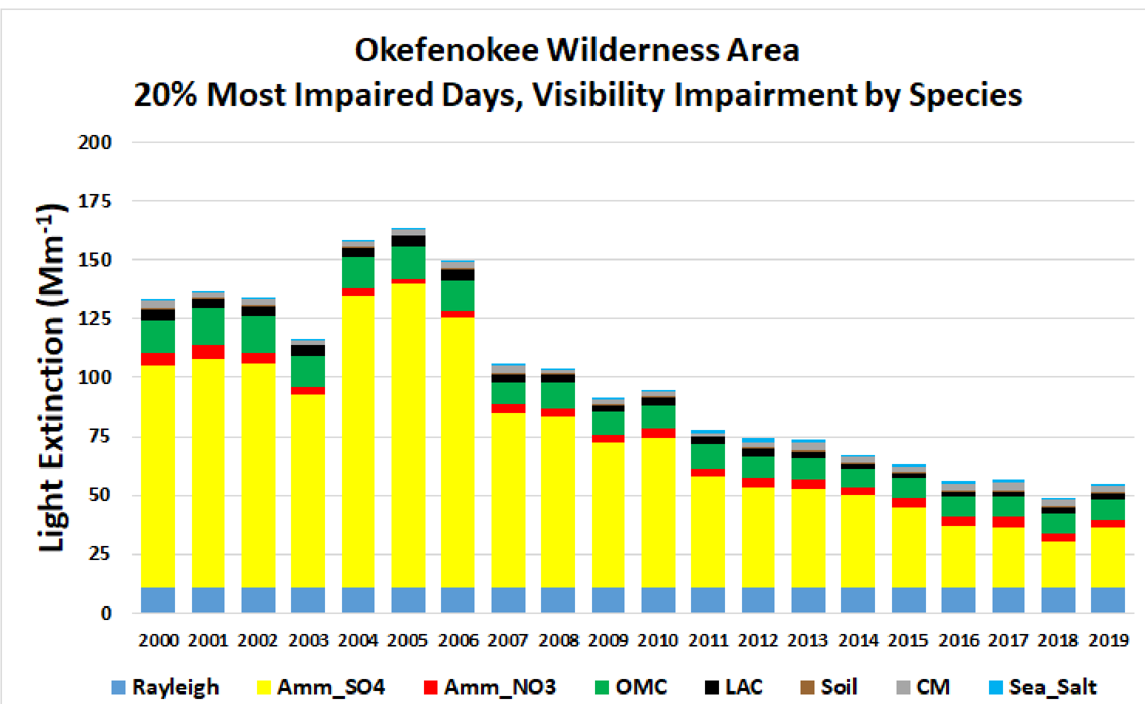

Figure 7-45: Speciated Light Extinction at Okefenokee National Wilderness Area for 2000-2019 on the 20% Most Impaired Days.

Figure 7-46 compares the relative particle contributions to light extinction for the five-year average of 2009 – 2013 and 2015 – 2019 measured by IMPROVE monitors for the 20% most impaired days. The Okefenokee National Wilderness Area IMPROVE data is used as a surrogate for the Wolf Island National Wilderness Area. Comparison of these five-year periods show that while sulfate and total visibility impairment have declined significantly in Cohutta Wilderness Area (COHU1) and Okefenokee National Wilderness Area (OKEF1), ammonium nitrate has slightly increased. However, during the 2015 – 2019 period, ammonium sulfate continues to be the dominant visibility impairing species at the Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area.

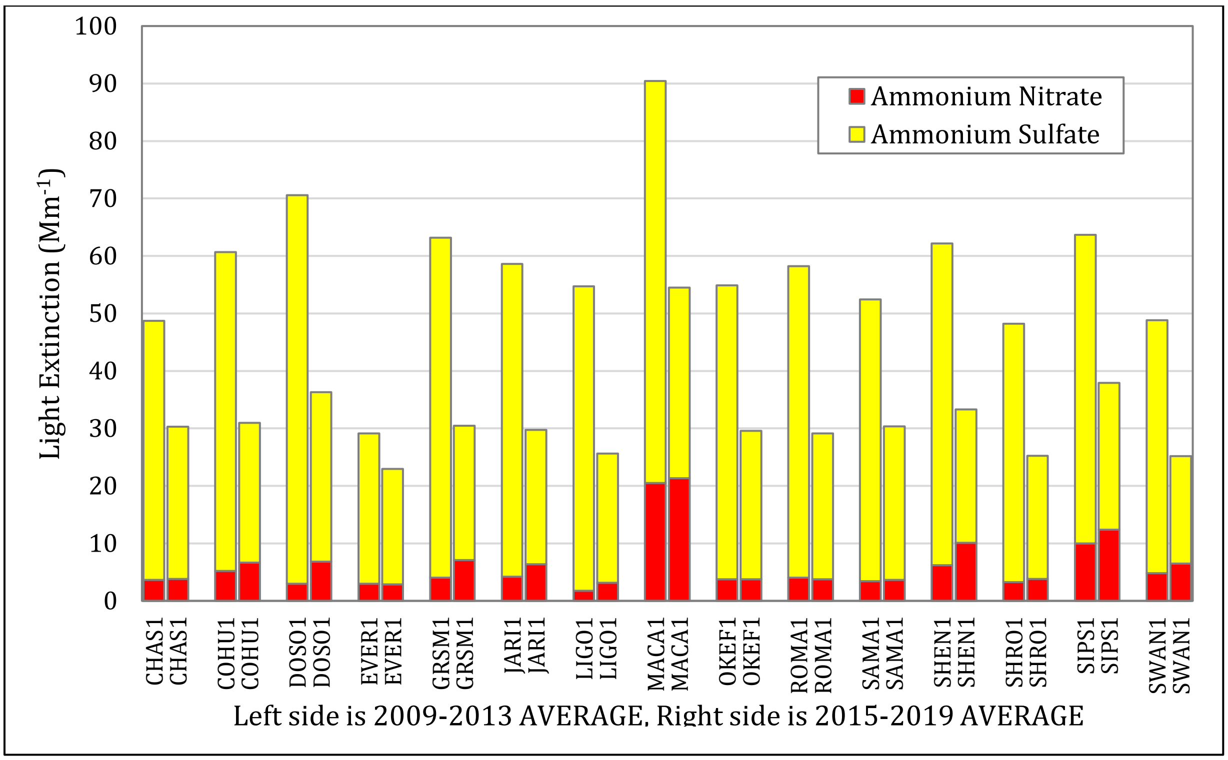

Figure 7-46: Comparison of Ammonium Sulfate and Ammonium Nitrate Five-Year Average (2009 – 2013 vs. 2015 – 2019) Contributions to Visibility Impairment for 20% Most Impaired Days at VISTAS Class I areas.

The large decreases in sulfate and slight increase in nitrate can be explained by inorganic chemistry and thermodynamics. SO_2 is oxidized to SO_3 which is then oxidized to SO_4 (sulfate). Due to its low vapor pressure, all SO_4 will be found in particulate form: H_2SO_4 (sulfuric acid mist), $(NH_4)HSO_4$ (ammonium bisulfate which is half neutralized), or $(NH_4)_2SO_4$ (ammonium sulfate which is fully neutralized). The amount of free NH_3 in the atmosphere does not impact the amount of sulfate formed, but it will determine which form of sulfate is present (H_2SO_4 vs. $(NH_4)HSO_4$ vs. $(NH_4)_2SO_4$). NOx is oxidized to HNO_3 (nitric acid). Nitric acid is a gas. Under the right conditions (temperatures and available NH_3), HNO_3 is converted to NH_4NO_3 (which is a particle). This conversion is reversible ($NH_4NO3 \leftrightarrow HNO_3 + NH_3$) under the appropriate conditions. NH_3/NH_4 preferentially combines with sulfate. When there is an abundance of sulfate, there is little available NH_3 to form NH_4NO_3. As SO_2 emissions decrease, sulfate concentrations decrease linearly. As sulfate decreases, more NH_3 is available to convert HNO_3 to NH_4NO_3. As a result, nitrate increases.

IMPROVE assumes all sulfate is $(NH_4)_2SO_4$ and all nitrate is $(NH_4)NO_3$. The extinction coefficients (amount of light extinction per mass of visibility impairing pollutant) used by IMPROVE are slightly higher for ammonium nitrate compared to ammonium sulfate. Also, the molecular weight of $(NH_4)_2SO_4$ is 132 and $(NH_4)NO_3$ is 80. If one sulfate molecule is removed (by reducing SO_2), one $(NH_4)_2SO_4$ molecule is removed, resulting in two NH_3 molecules being freed to form two $(NH_4)NO_3$ molecules. Two $(NH_4)NO_3$ molecules weigh 21.2% more than one $(NH_4)_2SO_4$ molecule (calculated as (80*2)/132=1.212).

The control of ammonium nitrate is dependent on the limiting gaseous pollutant (HNO_3 or NH_3). If NH_3 is the limiting pollutant, reductions of NH_3 will have large benefits and reductions of NOx will have limited benefits until the levels of HNO_3 drop to a level where HNO_3 becomes the limiting pollutant. If HNO_3 is the limiting pollutant, reductions of NOx will have large benefits and reductions of NH_3 will have limited benefits until the levels of NH_3 drop to a level where NH_3 becomes the limiting pollutant. In the southeastern US, nitrate formation is typically limited by available NH_3. Therefore, NOx reductions will have minimal impacts on nitrate concentrations.

Figure 7-47 shows the Georgia annual NOx emissions (secondary y-axis) and ammonium nitrate concentrations (primary y-axis) at Cohutta Wilderness Area and Okefenokee National Wilderness Area for 2000-2019. This graph clearly demonstrates that reductions in NOx emissions do not necessarily lead to reductions in nitrate.

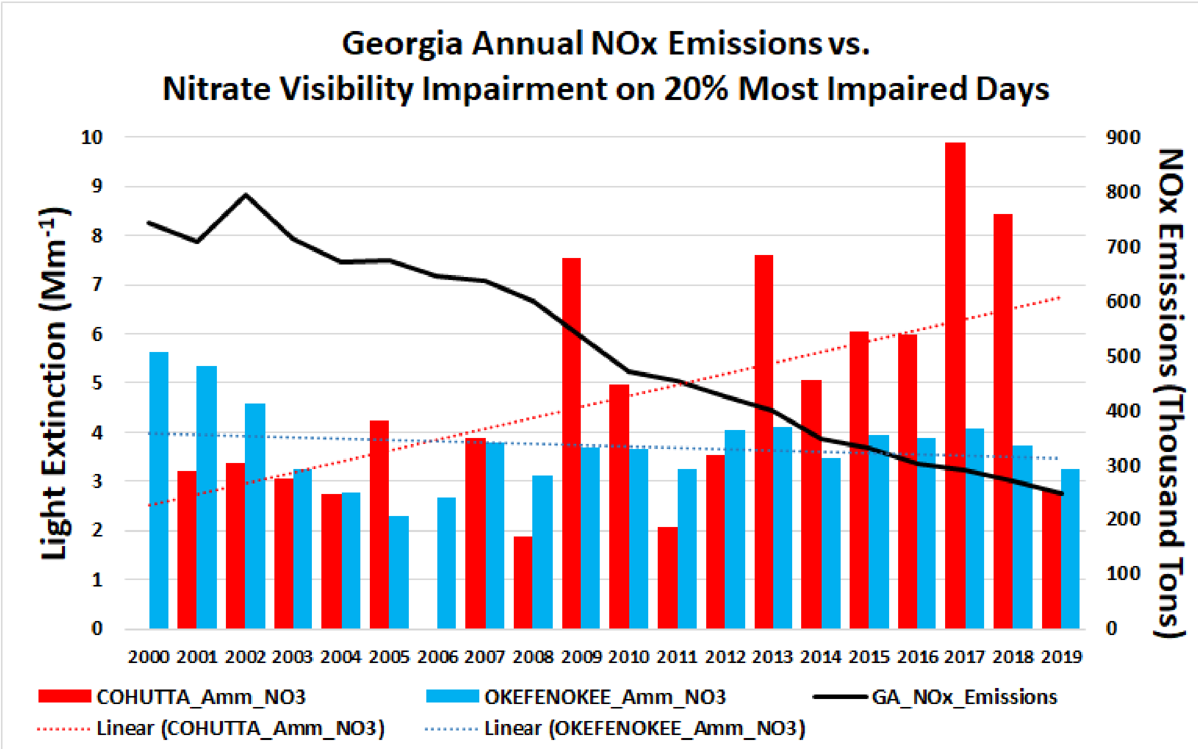

Figure 7-47: Comparison of Annual NOx Emissions in Georgia to Ammonium Nitrate Light Extinction at Cohutta Wilderness Area and Okefenokee National Wilderness Area for 2000-2019.

For a 2011 modeling base year, EPA's modeling guidance requires the species-specific RRFs be applied to the 2009 – 2013 IMPROVE measurements when projecting RPGs for 2028. EPA's modeling guidance does not allow the use of more recent IMPROVE measurements (e.g., 2015-2019) in combination with a 2011 modeling base year. The modeling contained in this SIP followed the detailed procedures contained in EPA's modeling guidance for determining speciated light extinction values in 2028.

Figure 7-48, Figure 7-49, and Figure 7-50 contain the nitrate PSAT results on the 20% most impaired days for Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area. Figure 7-48 shows that combined contribution from Georgia EGU and non-EGU NOx point sources contribute (0.016 + 0.028)/2.667 = **1.6%** of the total nitrate at Cohutta Wilderness Area. Figure 7-49 shows that combined contribution from Georgia EGU and non-EGU NOx point sources contribute (0.043 + 0.105)/3.752 = **3.9%** of the total nitrate at Okefenokee National Wilderness Area. Figure 7-50 shows that combined contribution from Georgia EGU and non-EGU NOx point sources contribute (0.035 + 0.100)/3.662 = **3.7%** of the total nitrate at Wolf Island National Wilderness Area. The majority of the nitrate at these Class I areas is coming from outside Georgia and from non-point emission sources (e.g., mobile sources).

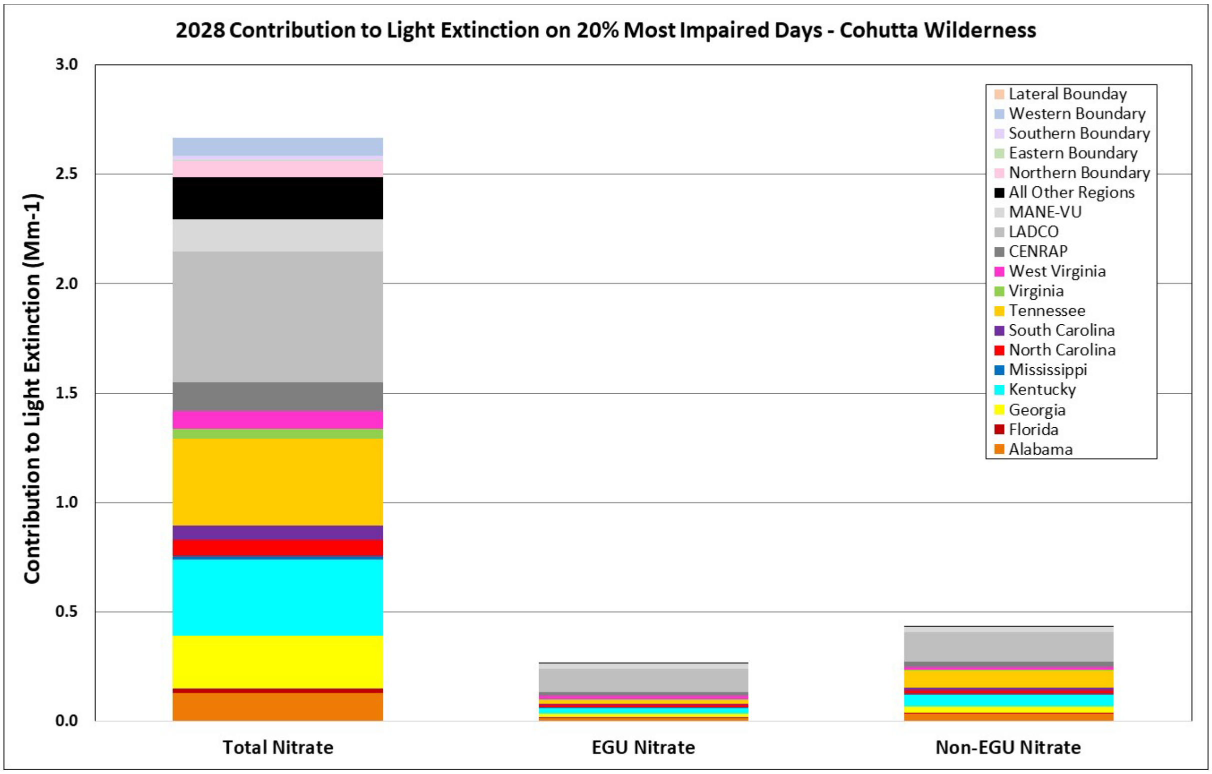

Figure 7-48: 2028 Contribution to Nitrate Light Extinction on the 20% Most Impaired Days at Cohuttta Wilderness Area.

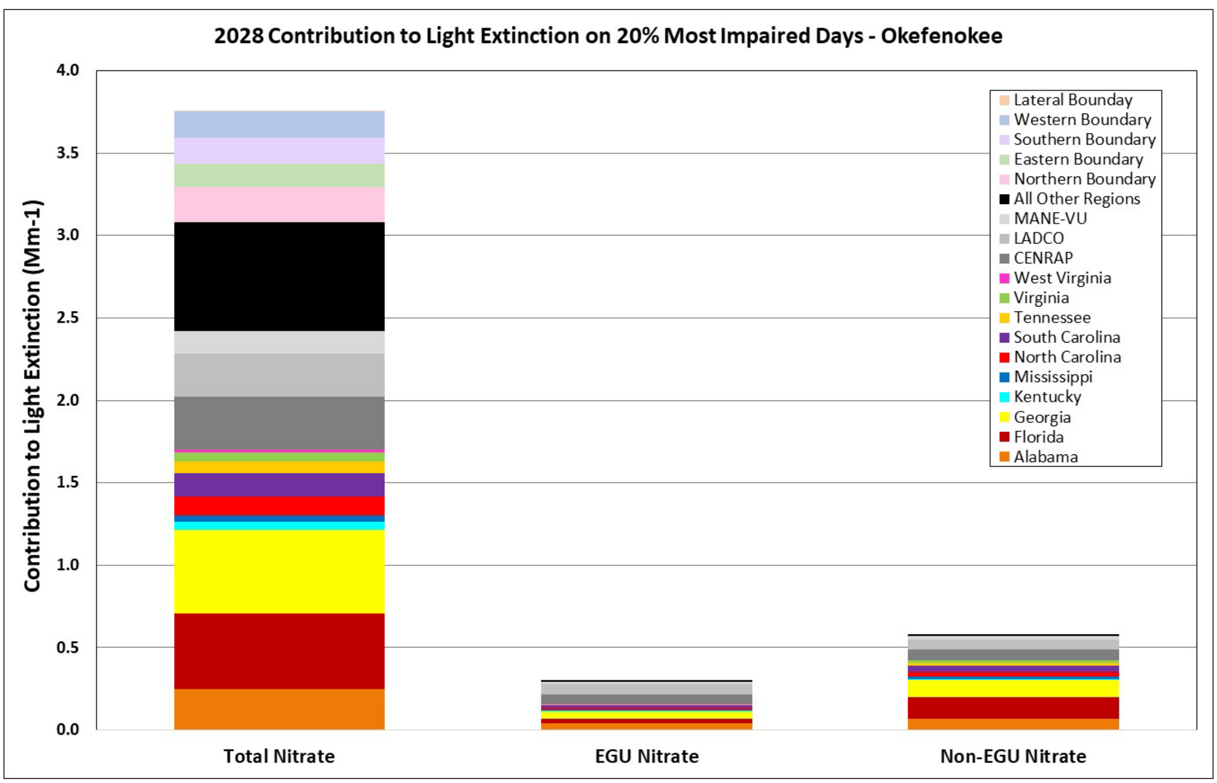

Figure 7-49: 2028 Contribution to Nitrate Light Extinction on the 20% Most Impaired Days at Okefenokee National Wilderness Area.

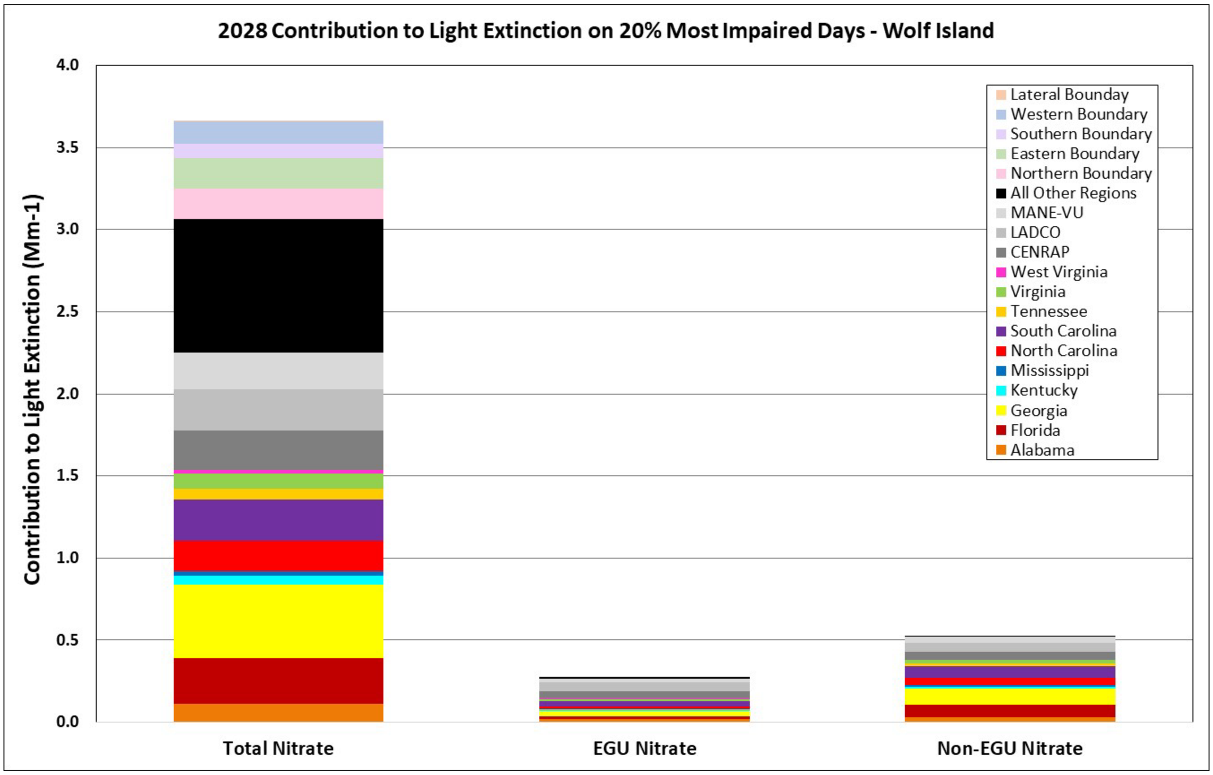

Figure 7-50: 2028 Contribution to Nitrate Light Extinction on the 20% Most Impaired Days at Wolf Island National Wilderness Area.

Figure 7-20, Figure 7-21, and Figure 7-22 contain the sulfate and nitrate PSAT results on the 20% most impaired days for Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area. Figure 7-20 shows that combined contribution from Georgia EGU and non-EGU NOx point sources contributes (0.016 + 0.028)/21.560 = **0.20%** of the total sulfate + nitrate at Cohutta Wilderness Area. Figure 7-21 shows that combined contribution from Georgia EGU and non-EGU NOx point sources contributes (0.043 + 0.105)/28.976 = **0.51%** of the total sulfate + nitrate at Okefenokee National Wilderness Area. Figure 7-22 shows that combined contribution from Georgia EGU and non-EGU NOx point sources contributes (0.035 + 0.100)/28.117 = **0.48%** of the total sulfate + nitrate at Wolf Island National Wilderness Area. The PSAT source apportionment modeling demonstrates that NOx emissions from all point sources (EGU + non-EGU) in Georgia contributes less than 1% of the total sulfate + nitrate light extinction at all Class I areas. Therefore, NOx emissions from individual EGU and non-EGU point sources in Georgia will contribute even smaller percentages to the total sulfate + nitrate light extinction. Detailed calculations for the combined contribution from Georgia EGU and non-EGU NOx point sources to the total sulfate + nitrate are contained in Appendix E-7a.

Georgia EPD analyzed visibility impairment per ton of SO_2 and per ton of NOx emissions for all Georgia facilities selected for reasonable progress analysis (see Table 7-29), as well as all facilities outside of Georgia selected by Georgia EPD for reasonable progress analysis (see Table 7-30 and

Table 7-31). The sulfate visibility impairment per ton of SO_2 emissions was compared against the nitrate visibility impairment per ton of NOx emissions as a ratio as follows:

$$Ratio\ (facility, Class\ I\ area) = \frac{\left[\frac{Sulfate\ Visibility\ Impairment\ in\ Mm^{-1}}{2028\ SO_2\ Emissions\ in\ tpy}\right]}{\left[\frac{Nitrate\ Visibility\ Impairment\ in\ Mm^{-1}}{2028\ NOx\ Emissions\ in\ tpy}\right]}$$

The sulfate/ton to nitrate/ton ratios by facility at the Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area are shown in Table 7-41 (the cells with "#DIV/0!" indicate a nitrate PSAT visibility impact of zero associated with NOx emissions). Sulfate visibility impacts per ton are universally higher than nitrate visibility impacts per ton, and range between 3.7 to 70.9. The average sulfate/ton to nitrate/ton ratio is 30.7 at the Cohutta Wilderness Area. This means that the reduction of one ton of SO_2 will have the equivalent benefit of reducing 30.7 tons of NOx. The average sulfate/ton to nitrate/ton ratio is 19.0 at the Okefenokee National Wilderness Area and 19.2 at the Wolf Island National Wilderness Area. This means that the reduction of one ton of SO_2 will have the equivalent benefit of reducing 19.0-19.2 tons of NOx. These results clearly indicate that SO_2 emission reductions have a significantly higher benefit on improving visibility at these Class I areas compared to controlling NOx emissions. This supports Georgia EPD's decision to focus on SO_2 emission reductions for this second planning period. Detailed calculations for the sulfate/ton to nitrate/ton ratios by facility are contained in Appendix E-7a.

Table 7-41: Facility-Level Comparison of Sulfate versus Nitrate Visibility Impairment for Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area

State	Facility ID	Facility Name	COHU Ratio	OKEF Ratio	WOLF Ratio
GA	13015-2813011	Ga Power Company - Plant Bowen	**35.8**	**28.0**	**27.4**
GA	13051-3679811	International Paper - Savannah	**#DIV/0!**	**6.9**	**6.6**
GA	13127-3721011	Brunswick Cellulose Inc	**#DIV/0!**	**37.0**	**70.9**
FL	12031-640211	JEA	**#DIV/0!**	**8.6**	**10.1**
FL	12047-769711	WHITE SPRINGS AGRICULTURAL CHEMICALS,INC	**#DIV/0!**	**13.4**	**6.3**
FL	12089-753711	ROCK TENN CP, LLC	**#DIV/0!**	**7.8**	**15.0**
FL	12107-2474411	SEMINOLE ELECTRIC COOPERATIVE, INC.	**NO PSAT**	**NO PSAT**	**NO PSAT**
FL	12123-752411	BUCKEYE FLORIDA, LIMITED PARTNERSHIP	**#DIV/0!**	**18.3**	**19.3**
KY	21145-6037011	Tennessee Valley Authority (TVA) - Shawnee Fossil Plant	**34.1**	**8.3**	**11.2**
SC	45015-4120411	SANTEE COOPER CROSS GENERATING STATION	**64.2**	**20.1**	**11.7**
SC	45015-4834911	ALUMAX OF SOUTH CAROLINA	**#DIV/0!**	**3.7**	**4.7**
TN	47163-3982311	EASTMAN CHEMICAL COMPANY	**14.8**	**27.6**	**20.7**
IN	18051-7363111	Gibson	**43.0**	**9.0**	**12.3**
IN	18147-8017211	INDIANA MICHIGAN POWER DBA AEP ROCKPORT	**29.5**	**17.8**	**16.9**
OH	39025-8294311	Duke Energy Ohio, Wm. H. Zimmer Station (1413090154)	**20.0**	**38.3**	**22.8**
OH	39053-8148511	General James M. Gavin Power Plant (0627010056)	**13.3**	**37.7**	**27.8**
PA	42005-3866111	GENON NE MGMT CO/KEYSTONE STA	**21.4**	**21.3**	**23.3**
		AVERAGE	**30.7**	**19.0**	**19.2**

In summary, NOx/nitrate were evaluated in the source section approach. However, no NOx/nitrate sources were selected for a reasonable progress analysis because no facilities exceeded the NOx/nitrate screening thresholds. PSAT source apportionment modeling clearly demonstrates that contributions from Georgia's point source NOx emissions is insignificant and additional NOx controls would not be reasonable. Specifically, the PSAT source apportionment modeling demonstrates that NOx emissions from all point sources (EGU + non-EGU) in Georgia contributes less than 1% of the total sulfate + nitrate light extinction at all Class I areas. Therefore, NOx emissions from individual EGU and non-EGU point sources in Georgia will contribute even smaller percentages to the total sulfate + nitrate light extinction. In addition, the PSAT results indicate that, on average, the reduction of one ton of SO_2 will have the equivalent benefit of reducing 30.7 tons of NOx at Cohutta Wilderness Area, 19.0 tons of NOx at the Okefenokee National Wilderness Area, and 19.2 tons of NOx at the Wolf Island National Wilderness Area. Although sulfates have decreased and nitrates have slightly increased, sulfates are still the dominant visibility impairing species at the Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area. If sulfates continue to decrease and nitrates continue to increase in the future, it may be appropriate to consider NOx emission sources for reasonable progress analyses in Georgia's Regional Haze SIP for future planning periods.

7.11. Environmental Justice

Environmental justice (EJ) is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. This goal will be achieved when everyone enjoys the same degree of protection from environmental and health hazards, and equal access to the decision-making process to have a healthy environment in which to live, learn, and work.[55] The purpose of the Regional Haze Rule is to improve visibility in the Federal Class I Areas. Georgia EPD has not identified any EJ communities living in any Federal Class I Areas whose visibility would be disproportionately impacted by Georgia EPD's selection of reasonable progress controls.

[55] URL: https://www.epa.gov/environmentaljustice

8. Reasonable Progress Goals

The rule at 40 CFR 51.308(f)(3) requires states to establish RPGs in units of dv for each Class I area within the state that reflect the visibility conditions that are projected to be achieved by the end of the applicable implementation period (2028), as a result of those enforceable emissions limitations, compliance schedules, and other measures required that can be fully implemented by the end of the applicable implementation period (2028), as well as the implementation of other requirements of the CAA. The long-term strategy and the RPGs must provide for an improvement in visibility for the most impaired days since the baseline period and ensure no degradation in visibility for the clearest days since the baseline period.

If a state in which a mandatory federal Class I area is located establishes an RPG for the most impaired days that provides for a slower rate of improvement in visibility than the URP, the state must demonstrate, based on the analysis required by 40 CFR 51.308(f)(2)(i), that there are no additional emission reduction measures for anthropogenic sources in the state that may reasonably be anticipated to contribute to visibility impairment in the Class I area that would be reasonable to include in the long-term strategy. (See 40 CFR 51.308(f)(3)(ii)(A) for additional requirements.)

Further, if a state contains sources that are reasonably anticipated to contribute to visibility impairment in a mandatory federal Class I area in another state for which that state has established an RPG that provides for slower rate of improvement in visibility than the URP, the state must demonstrate that there are no additional emission reduction measures for anthropogenic sources or groups of sources in the state that may reasonably be anticipated to contribute to visibility impairment in the Class I area that would be reasonable to include in its own long-term strategy. (See 40 CFR 51.308(f)(3)(ii)(B).)

It is notable that the RPGs established in this SIP are not directly enforceable, but the RPGs can be used to evaluate whether the SIP is adequately providing reasonable progress towards achieving natural visibility. (See 40 CFR 51.308(f)(3)(iii).)

8.1. RPGs for Class I Areas within Georgia

Therefore, in accordance with the requirements of 40 CFR 51.308(f)(3), this regional haze SIP establishes RPGs for the Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area. To calculate the rate of progress represented by each goal, Georgia compared baseline visibility conditions (2000 to 2004) to natural visibility conditions in 2064 at Cohutta Wilderness Area and Okefenokee National Wilderness Area and determined the uniform rate of visibility improvement (in dv) that would need to be maintained during each implementation period in order to attain natural visibility conditions by 2064.

Through the VISTAS modeling, Georgia estimated the expected visibility improvements by 2028 in Cohutta Wilderness Area and Okefenokee National Wilderness Area resulting from existing federal and state regulations expected to be implemented and facility closures expected to occur by 2028 in Georgia and neighboring states. The VISTAS baseline modeling demonstrated that the 2028 base case control scenario provides for an improvement in visibility below than the URP for the Cohutta Wilderness Area and Okefenokee National Wilderness Area for the 20% most impaired days and ensures no degradation in visibility for the 20% clearest days over the 2000 to 2004 baseline period. These controls and facility closures, to the extent known and quantifiable, were modeled as part of the long-term strategy. The results of this modeling are shown in Section 7.2.5.

As detailed in Section 7.6, seventeen (17) facilities were identified for reasonable progress analysis based on PSAT modeling. Three (3) facilities are located in Georgia, five (5) facilities are located in Florida, one (1) facility is located in Kentucky, two (2) facilities are located in South Carolina, one (1) facility is located in Tennessee, two (2) facilities are located in Indiana, two (2) facilities are located in Ohio, and one (1) facility is located in Pennsylvania.

Table 8-1 provides the RPGs for Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area. The table lists the 2028 reasonable progress goals, the uniform rates of progress for 2028, and natural visibility conditions. The numbers in brackets contain the projected improvement from the baseline, the amount of improvement form the baseline needed to meet the 2028 uniform rate of progress, and the additional improvement needed to achieve natural conditions, respectively. Since there is not an IMPROVE monitor located at Wolf Island National Wilderness Area, the Okefenokee National Wilderness Area uniform rate of progress and reasonable progress goals are being used as a surrogate for Wolf Island National Wilderness Area. Table 8-2 provides the expected visibility in 2028 on 20% clearest days as compared to the 2000-2004 baseline 20% clearest day values. This table shows that projected visibility on the 20% clearest days will not degrade but rather will improve significantly by 2028. The number in the brackets indicates the projected improvement from baseline conditions.

Table 8-1: Georgia RPGs – 20% Most Impaired Days

Class I Area	2000-2004 Baseline Visibility (dv)[(1)]	2028 Reasonable Progress Goals (dv) [2004 – 2028 decrease, (dv)]	2028 Uniform Rate of Progress (dv) [2004 – 2028 decrease to meet uniform progress, (dv)]	Natural Visibility (dv) [2028 – 2064 decrease needed from 2028 goal]
Cohutta Wilderness Area	29.12	14.90 [14.22]	21.42 [7.7]	9.88 [5.02]
Okefenokee National Wilderness Area	25.34	16.90 [8.44]	18.98 [6.36]	9.45 [7.45]
Wolf Island National Wilderness Area	25.34	16.90 [8.44]	18.98 [6.36]	9.45 [7.45]

(1) The 2000-2004 baseline visibility data reflect values included in Table 1 in the EPA memorandum with subject: Technical addendum including updated visibility data through 2018 for the memo titled, "Recommendation for the use of Patched and Substituted Data and Clarification of Data Completeness for Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program."[56]

Table 8-2: Georgia Class I Area 20% Clearest Day Comparisons

Class I Area	2000-2004 Baseline Visibility (dv)[(1)]	2028 Reasonable Progress Goal (dv) [2004 – 2028 improvement goal]
Cohutta Wilderness Area	13.73	9.15 [4.58]
Okefenokee National Wilderness Area	15.23	11.58 [3.65]
Wolf Island National Wilderness Area	15.23	11.58 [3.65]

(1) The 2000-2004 baseline visibility data reflect values included in Table 1 in the EPA memorandum with subject: Technical addendum including updated visibility data through 2018 for the memo titled, "Recommendation for the use of Patched and Substituted Data and Clarification of Data Completeness for Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program."[57]

Georgia has determined that the RPGs will be at least as stringent as the expected glide path prediction for Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area. In addition, there are no sources in Georgia that are reasonably anticipated to contribute to visibility impairment in a Class I area in another state for which an RPG has been established that is slower than the URP.

8.2. Reductions Not Included in the 2028 RPG Analysis

Additional reductions in visibility impairing pollutants have occurred since VISTAS conducted the modeling analyses for the 2028 RPGs. These reductions, described below, will help to

[56] URL: https://www.epa.gov/sites/production/files/2020-06/documents/memo_data_for_regional_haze_technical_addendum.pdf
[57] URL: https://www.epa.gov/sites/production/files/2020-06/documents/memo_data_for_regional_haze_technical_addendum.pdf

ensure that the Georgia Class I areas will meet these projected RPGs and that additional visibility improvement is likely.

8.2.1. Out of State Reasonable Progress Evaluation Reductions

Table 7-44 and Table 7-45 provide the listing of facilities that were estimated to impact Georgia's Class I areas that are located outside of Georgia within VISTAS and outside of VISTAS, respectively. As required by the Regional Haze Rule, Georgia notified these states of the findings of significant contribution and asked those states for information regarding the results of the reasonable progress evaluations performed at those facilities. Section 10.1 provide a description of each response. These reductions were not included in the VISTAS 2028 RPG modeling and thus will help ensure that the RPGs provided in Table 8-1 are met for 20% most impaired days and that no visibility degradation on the 20% clearest days occurs.

8.2.1.1. CSAPR Update Rule Reductions

As stated in Section 7.2.1.1, the amended CSAPR Update Rule was published in the Federal Register on April 30, 2021. The final rule includes state-by-state adjusted ozone season emission budgets for 2021 through 2024. Emission reductions are required at power plants in the 12 states based on optimization of existing, already-installed selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) controls beginning in the 2021 ozone season, and installation or upgrade of state-of-the-art NOx combustion controls beginning in the 2022 ozone season. EPA estimates the Revised CSAPR Update will reduce summertime NOx emissions from power plants in the 12 linked upwind states by 17,000 tons in 2021 compared to projections without the rule.

9. Monitoring Strategy

The SIP is to be accompanied by a strategy for monitoring regional haze visibility impairment. Specifically, the Rule states at 40 CFR 51.308(f)(6):

> (6) The State must submit with the implementation plan a monitoring strategy for measuring, characterizing, and reporting of regional haze visibility impairment that is representative of all mandatory Class I Federal areas within the State. Compliance with this requirement may be met through participation in the Interagency Monitoring of Protected Visual Environments network. The implementation plan must also provide for the following:
>
> > (i) The establishment of any additional monitoring sites or equipment needed to assess whether reasonable progress goals to address regional haze for all mandatory Class I Federal areas within the State are being achieved.
> >
> > (ii) Procedures by which monitoring data and other information are used in determining the contribution of emissions from within the State to regional haze visibility impairment at mandatory Class I Federal areas both within and outside the State.
> >
> > (iii) For a State with no mandatory Class I Federal areas, procedures by which monitoring data and other information are used in determining the contribution of emissions from within the State to regional haze visibility impairment at mandatory Class I Federal areas in other States.
> >
> > (iv) The implementation plan must provide for the reporting of all visibility monitoring data to the Administrator at least annually for each mandatory Class I Federal area in the State. To the extent possible, the State should report visibility monitoring data electronically.
> >
> > (v) A statewide inventory of emissions of pollutants that are reasonably anticipated to cause or contribute to visibility impairment in any mandatory Class I Federal area. The inventory must include emissions for the most recent year for which data are available, and estimates of future projected emissions. The State must also include a commitment to update the inventory periodically.
> >
> > (vi) Other elements, including reporting, recordkeeping, and other measures, necessary to assess and report on visibility.

Such monitoring is intended to provide the data needed to satisfy four objectives:

- Track the expected visibility improvements resulting from emissions reductions identified in this SIP.
- Better understand the atmospheric processes of importance to haze.
- Identify chemical species in ambient particulate matter and relate them to emissions from sources.
- Evaluate regional air quality models for haze and construct RRFs for using those models.

The primary monitoring network for regional haze, both nationwide and in Georgia, is the IMPROVE network. Given that IMPROVE monitoring data from 2000-2004 serves as the baseline for the regional haze program, the future regional haze monitoring strategy must necessarily be based on, or directly comparable to, IMPROVE. The IMPROVE measurements provide the only long-term record available for tracking visibility improvement or degradation, and, therefore, Georgia intends to rely on the IMPROVE network for complying with the regional haze monitoring requirement in the rule.

As shown in Table 9-1, there are currently two IMPROVE site in the state, in Cohutta Wilderness Area and Okefenokee National Wilderness Area. Wolf Island National Wilderness Area relies on data from the Okefenokee National Wilderness Area IMPROVE monitoring site (OKEF1) because it does not have an IMPROVE monitor. Figure 9-1 shows the IMPROVE monitoring network for the VISTAS Region.

Table 9-1: Georgia Class I Areas and Representative IMPROVE Monitors

Class I Area	IMPROVE Site Designation
Cohutta Wilderness Area	COHU1
Okefenokee National Wilderness Area	OKEF1

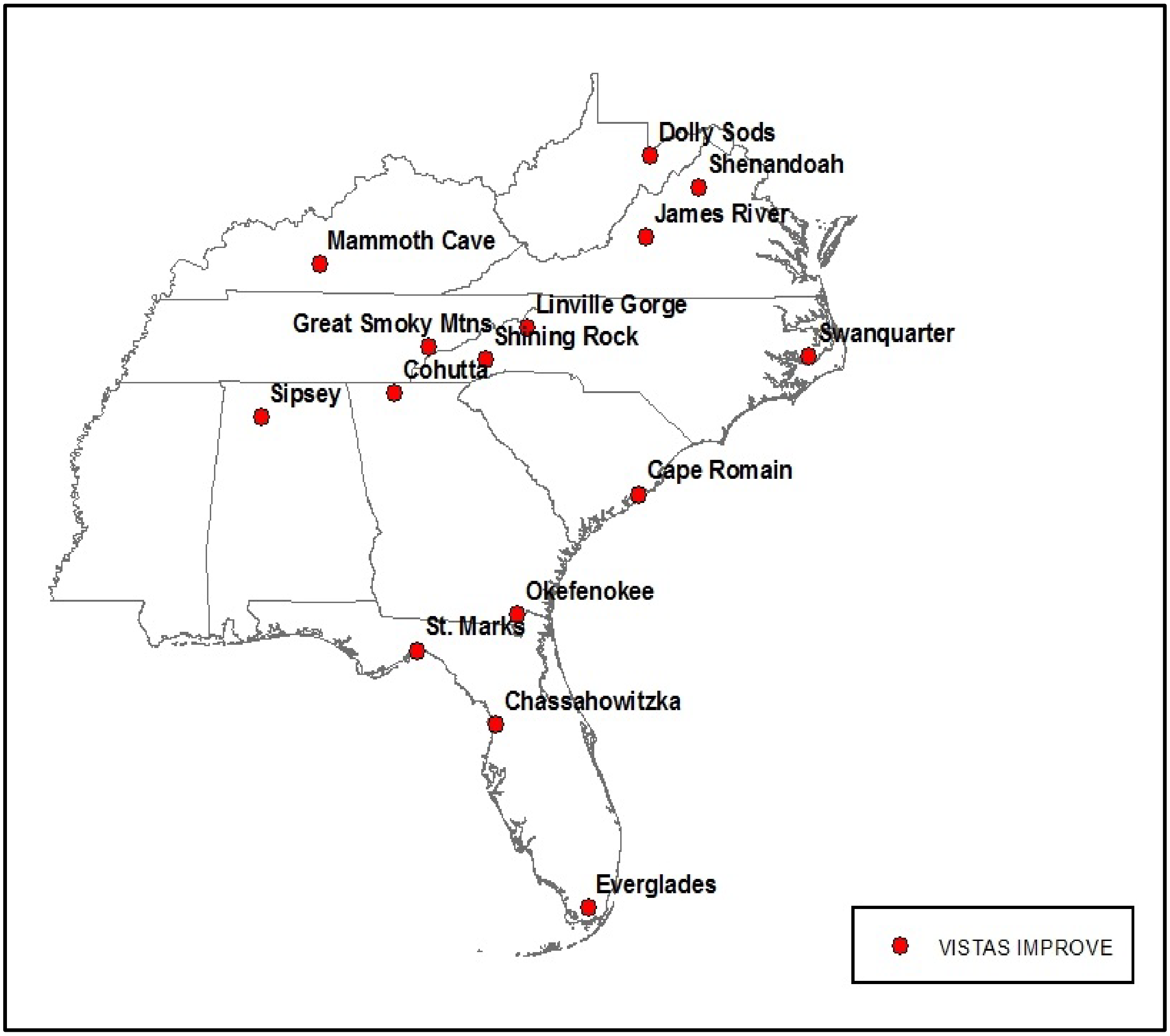

Figure 9-1: VISTAS States IMPROVE Monitoring Network

The IMPROVE measurements are central to Georgia's regional haze monitoring strategy because the IMPROVE monitor in Georgia represent unique air sheds, and it is difficult to visualize how the objectives listed above could be met without the monitoring provided by IMPROVE. Any reduction in the scope of the IMPROVE network in Georgia and neighboring Class I areas would jeopardize the state's ability to demonstrate reasonable progress toward visibility improvement in its Class I areas and plan for appropriate future programs. In particular, Georgia's regional haze strategy relies on emission reductions that will result from federal and state programs in Georgia and in neighboring states, which occur on different time scales and will most likely not be spatially uniform. Monitoring at Class I areas is important to document the different air quality responses to the emissions reductions that occur in those unique air sheds during the second implementation period to document reasonable progress.

Because the current IMPROVE monitor in Georgia represents a unique airshed and a significant component of the contributions are regional, any reduction of the IMPROVE network by shutting down these monitoring sites impedes tracking progress or planning improvements at the affected Class I areas. If any of these IMPROVE monitors are shut down, Georgia, in consultation with the EPA and FLMs, will develop an alternative approach for meeting the tracking goal, perhaps by seeking contingency funding to carry out limited monitoring or by relying on data from nearby urban monitoring sites to demonstrate trends in speciated $PM_{2.5}$ mass.

Data produced by the IMPROVE monitoring network will be used for preparing the five-year progress reports and the 10-year comprehensive SIP revisions, each of which relies on analysis of the preceding five years of data. Consequently, the monitoring data from the IMPROVE sites needs to be readily available and up to date. Presumably, the IMPROVE network will continue to process information from its own measurements at about the same pace and with the same attention to quality as it has shown to date. A website has been maintained by Colorado State University, FLMs, and RPOs to provide ready access to the IMPROVE data and data analysis tools. These databases provide a valuable resource for states and the funding and necessary upkeep of the repository is crucial.

The remainder of this section addresses the requirements of 40 CFR 51.308(f)(6). Georgia relies on the IMPROVE monitoring network to fulfill the requirements in paragraphs 40 CFR 51.308(f)(6)(i) through (iv) and paragraph (vi).

- 51.803(f)(6)(i): Georgia believes the existing IMPROVE monitors for the state's Class I areas are adequate and does not believe any additional monitoring sites or equipment are needed to assess whether RPGs for all mandatory Class I Federal areas within the state are being achieved.

- 51.308(f)(6)(ii): Data produced by the IMPROVE monitoring network will be used for preparing the five-year progress reports and the 10-year comprehensive SIP revisions, each of which rely on analysis of the preceding five years of IMPROVE monitor data.

- 51.308(f)(6)(iii): This provision for states with no mandatory Class I Federal areas does not apply to Georgia.

- 51.308(f)(6)(iv): Georgia believes the existing IMPROVE monitors for the State's Class I areas are sufficient for the purposes of this SIP revision. IMPROVE is a cooperative measurement effort managed by a Steering Committee that consists of representatives from various organizations (EPA, NPS, USFS, FWS, BLM, NOAA, four organizations representing state air quality organizations (NACAA, WESTAR, NESCAUM, and MARAMA), and three Associate Members: AZ DEQ, Env. Canada, and the South Korea Ministry of Environment). Georgia believes that participation of the state organizations in the IMPROVE Steering Committee adequately represents the needs of the state. The IMPROVE program establishes current visibility and aerosol conditions in mandatory Class I areas; identifies chemical species and emission sources responsible for existing man-made visibility impairment; documents long-term trends in visibility; and provides regional haze monitoring at mandatory federal Class I areas. (http://vista.cira.colostate.edu/Improve/improve-program/) The National Park Service (NPS) manages and oversees the IMPROVE monitoring network. The IMPROVE monitoring network samples particulate matter from which the chemical composition of the sampled particles is determined. The measured chemical composition is then used to calculate visibility. Samples are collected and data are reviewed, validated, and verified by NPS/NPS contractors before submission to EPA's Air Quality System (AQS), https://www.epa.gov/aqs). The network also posts raw (http://views.cira.colostate.edu/fed/) and summary data (http://vista.cira.colostate.edu/Improve/rhr-summary-data/) to assist states and local air agencies and multijurisdictional organizations. Details about the IMPROVE monitoring network and procedures are available at http://vista.cira.colostate.edu/Improve/.

- 51.308(f)(6)(v): The requirements of 40 CFR 51.308(f)(6)(v) are addressed in Section 4, Section 7.2.3, and Section 13.1 of the SIP. Georgia will continue to participate in SESARM/VISTAS efforts for projecting future emissions and continue to comply with the requirements of the AERR to periodically update emissions inventories.

- 51.308(f)(6)(vi): There are no elements, including reporting, recordkeeping, or other measures, necessary to address and report on visibility for Georgia's Class I areas or Class I areas outside the state that are affected by sources in Georgia.

10. Consultation Process

The VISTAS states have jointly developed the technical analyses that define the amount of visibility improvement that can be achieved by 2028 as compared to the uniform rate of progress for each Class I area. VISTAS initially used an AoI analysis to identify the areas and source sectors most likely contributing to poor visibility in Class I areas. This AoI analysis involved running the HYSPLIT Model to determine the origin of the air parcels affecting visibility within each Class I area. This information was then spatially combined with emissions data to determine the pollutants, sectors, and individual sources that are most likely contributing to the visibility impairment at each Class I area. This information indicated that the pollutants and sector with the largest impact on visibility impairment in 2028 were SO_2 and NO_X from point sources. Next, VISTAS states used the results of the AoI analysis to identify sources to "tag" for PSAT modeling. PSAT modeling uses "reactive tracers" to apportion particulate matter among different sources, source categories, and regions. PSAT was implemented with the CAMx photochemical model to determine visibility impairment due to individual sources. PSAT results showed that in 2028 the majority of visibility impairment at VISTAS Class I areas will continue to be from point source SO_2 and NO_X emissions. Using the PSAT data, VISTAS states identified, for the reasonable progress analyses, sources shown to have a sulfate or nitrate impact on one or more Class I areas greater than or equal to 1.00% of the total sulfate plus nitrate point source visibility impairment on the 20% most impaired days for each Class I area. The states collectively accept the conclusions of these analyses for use in evaluating reasonable progress.

10.1. Interstate Consultation

This section addresses paragraph 40 CFR 51.308(f)(2) of the Regional Haze Rule that requires each state to addresses in its Long-Term Strategy (LTS) visibility impairment for each mandatory Class I Federal area located outside the State that may be affected by emissions from the State. The LTS must include the enforceable emissions limitations, compliance schedules, and other measures that are necessary to make reasonable progress, as determined pursuant to paragraphs 40 CFR 51.308(f)(2)(i) through (iv). Section 10.1.1 documents Georgia's consultation with other states with emission sources that impact Class I Areas in Georgia, and Section 10.1.2 addresses Georgia impacts on Class I areas outside of the state. Georgia EPD agrees with the decisions made by other state agencies concerning the emission sources listed in Section 10.1.1., except for the decision made by the Indiana Department of Environmental Management to not require 4-factor analyses from its EGUs, including Gibson and Indiana Michigan Power.

10.1.1. Emission Sources in Other States with Impacts on Class I Areas in Georgia

In evaluating controls needed to assess reasonable progress, VISTAS state with a Class I area initiated a consultation process with other VISTAS states with one or more facilities identified as having greater than or equal to 1.00% of the total sulfate plus nitrate point source visibility impairment on the 20% most impaired days. The letter requested that the VISTAS state provide a response indicating its plans for conducting a reasonable progress analysis for each facility.

In addition, VISTAS sent a letter to each non-VISTAS state with one or more facilities identified as having greater than or equal to 1.00% of the total sulfate plus nitrate point source visibility impairment on the 20% most impaired days in one or more VISTAS Class I areas. The letter requested that the non-VISTAS state verify if the 2028 SO_2 and NO_X emissions modeled for each facility identified in the letter were correct. If the emissions have decreased since the modeling was initiated, the non-VISTAS state was asked to provide updated emissions so that the facility contribution could be adjusted using the PSAT results to determine if additional analysis of controls would be necessary. If a non-VISTAS state did not decrease the 2028 emissions modeled, the non-VISTAS state was asked to provide a response indicating its plans for conducting a reasonable progress analysis for each facility.

There are several sources for which PSAT modeling indicated a contribution to visibility impairment of ≥1.00% for sulfate in one or more of Georgia's Class I areas. GA EPD sent letters to each state requesting reasonable progress assessments for the facilities. For sources outside of the VISTAS states, a similar letter was sent by VISTAS to obtain the analyses.

Table 10-1 provides a summary of the VISTAS and non-VISTAS states to which a letter was sent and identifies the total number of facilities impacting each Class I area in Georgia. Table 10-2 identifies each facility and its PSAT contribution to each Class I area in Georgia. Appendix F-1 provides the consultation letters from GA EPD to each VISTAS state and the responses to the letters. Appendix F-2 provides the consultation letters from VISTAS to each non-VISTAS state and the responses to the letters.

Table 10-1: Number of Out-of-State Facilities with ≥ 1.00% Sulfate Contribution to Georgia Class I Areas in 2028

Class I Area	Region	States
Cohutta Wilderness Area	VISTAS	KY, TN
	Non-VISTAS	IN, PA, OH
	Total States	5
	Total Facilities	7
Okefenokee National Wilderness Area	VISTAS	FL, SC, KY
	Non-VISTAS	PA, OH
	Total States	5
	Total Facilities	7
Wolf Island National Wilderness Area	VISTAS	FL, SC
	Non-VISTAS	PA, OH
	Total States	4
	Total Facilities	6

Table 10-2: Out-of-State Facilities with ≥1.00% Sulfate Contributions in 2028 in Georgia Class I Areas

Facility	State	Georgia Class I Area Impacted	Percent Impairment Impact	Letter Sent by and Date	Response Received
WHITE SPRINGS AGRICULTURAL CHEMICALS,INC	FL	Okefenokee	2.77%	GA, November 24, 2020	See FL RH SIP
BUCKEYE FLORIDA, LIMITED PARTNERSHIP	FL	Okefenokee	2.16%	GA, November 24, 2020	See FL RH SIP
ROCK TENN CP, LLC	FL	Okefenokee	1.31%	GA, November 24, 2020	See FL RH SIP
		Wolf Island	2.35%		
JEA	FL	Wolf Island	1.29%	GA, November 24, 2020	See FL RH SIP
SANTEE COOPER CROSS GENERATING STATION	SC	Okefenokee	1.18%	GA, November 24, 2020	See SC RH SIP
		Wolf Island	1.30%		
ALUMAX OF SOUTH CAROLINA	SC	Wolf Island	1.25%	GA, November 24, 2020	See SC RH SIP
Tennessee Valley Authority (TVA) - Shawnee Fossil Plant	KY	Cohutta	1.44%	GA, November 24, 2020	See KY RH SIP
		Okefenokee	1.03%		
EASTMAN CHEMICAL COMPANY	TN	Cohutta	1.25%	GA, November 24, 2020	See TN RH SIP
General James M. Gavin Power Plant (0627010056)	OH	Cohutta	2.44%	VISTAS, June 22, 2020	October 29, 2020
		Okefenokee	1.51%		
		Wolf Island	1.73%		
Duke Energy Ohio, Wm. H. Zimmer Station (1413090154)	OH	Cohutta	1.31%	VISTAS, June 22, 2020	October 29, 2020
Gibson	IN	Cohutta	1.03%	VISTAS, June 22, 2020	December 22, 2021
INDIANA MICHIGAN POWER DBA AEP ROCKPORT	IN	Cohutta	1.37%	VISTAS, June 22, 2020	December 22, 2021
GENON NE MGMT CO/KEYSTONE STA	PA	Cohutta	1.04%	VISTAS, June 22, 2020	July 8, 2020
		Okefenokee	1.02%		
		Wolf Island	1.15%		

The following identifies where to find the response or summarizes the response received for each facility.

WHITE SPRINGS AGRICULTURAL CHEMICALS, INC – FL

- The White Springs, Florida source is listed as "Nutrien White Springs Ag Chem (12047-769711)" on page 254 of the October 8, 2021, Florida Regional Haze Plan narrative as effectively controlled for sulfuric acid plants C, D, E, and F, which is further discussed on page 256. The provisions to be adopted into the Florida SIP are in the file named: "Final SIP 2021-01 Regional Haze.pdf" on pages 13-14.

BUCKEYE FLORIDA, LIMITED PARTNERSHIP – FL

- The Buckeye Florida, LLC source is listed as "Foley Cellulose, LLC Foley Mill (12123-752411)" and discussed on page 280-282 of the October 8, 2021, Florida Regional Haze Plan narrative.

ROCK TENN CP, LLC – FL

- The Rock Tenn CP, LLC source is listed as "WestRock Fernandina Beach Mill (12089-753711)" and discussed on pages 269-280 of the October 8, 2021, Florida Regional Haze Plan narrative.

JEA – FL

- JEA Northside in Florida is discussed as Units 1 and 2 together and, separately, Unit 3. Units 1 and 2 are determined to be effectively controlled with SO_2 limits more stringent than the alternative Mercury and Air Toxics Standard (MATS) 0.2 pounds (lb) SO_2/million British Thermal Units (MMBtu) limit (see p.254 Florida haze plan narrative, Appendix G-3c-1, and p.12 of the "Final SIP 2021-01" file). JEA Northside Unit 3's FFA is discussed in section 7.8.1 on pages 264-269 with the conclusions in Section 7.8.1.1.5 on page 264 of the Florida narrative, Appendix G-3c-2, and on page 13 of the "Final SIP 2021-01" file.[58]

SANTEE COOPER CROSS GENERATING STATION – SC

- Santee Cooper Cross Generating Station in South Carolina is discussed in the May 3, 2022, South Carolina Regional Haze Plan narrative on pages 181-184 in Section 7.8.4[59] and Appendix G.

ALUMAX OF SOUTH CAROLINA – SC

- Alumax of South Carolina (now Century Aluminum of South Carolina) is discussed in the May 3, 2022, South Carolina Regional Haze Plan narrative in section 7.8.1[60] on pages 162-168 and Appendix G. The units affected are listed in Table 7-21 as Potlines 02, 03, 04, 05, and Bake Oven 01.

Tennessee Valley Authority (TVA) - Shawnee Fossil Plant – KY

- The State of Kentucky requested that this facility perform a reasonable progress analysis. Kentucky provided the facility's reasonable progress analysis, dated February 19, 2021, which is included in Appendix F-1. TVA proposes to accept a facility-wide emission limitation of no more than 8,719 tons of SO_2 per 12-month rolling total starting on December 31, 2034. This represents a 7,028 ton per year reduction in SO_2 emissions when compared to projected 2028 emissions. At the time of writing this SIP, Georgia EPD is not aware that an emission limitation has been finalized. Kentucky has yet to propose its Regional Haze SIP revision for the second planning period.

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[58] See Florida's conclusions for JEA Unit 3 on page 269 of the SIP narrative that: "…the Department has determined that switching to lower sulfur No. 6 fuel oil is necessary for reasonable progress…. Thus, the Department will require JEA to either begin firing only fuel oil with sulfur content less than or equal to 1% in 2026, or shut down the unit by the end of 2028."

[59] See South Carolina's conclusions for Units 1-4 that: "Units 1-4 are well controlled, and additional controls are not needed for the purpose of remedying any existing anthropogenic visibility impairment at Cape Romain….the Department is proposing that existing SO_2 control measures for Cross based on the MATS rule be adopted into the regulatory portion of the SIP as required by Section 169A(b)(2) of the CAA."

[60] See South Carolina's conclusions that: "…the units at Century are well controlled for SO_2, and additional controls are not needed for the purpose of remedying any existing anthropogenic visibility impairment at Cape Romain.… the Department is proposing that existing measures in Department-issued permits be adopted into the SIP as required by Section 169A(b)(2) of the CAA."

EASTMAN CHEMICAL COMPANY – TN

- Eastman Chemical Company (Eastman) in Tennessee is discussed in the February 23, 2022, Regional Haze SIP narrative in section 7.8.1 on pages 205-206 and Appendix G-2 of the Tennessee Regional Haze SIP (Appendix G-2f contains Tennessee's analysis and conclusions).[61]

General James M. Gavin Power Plant (0627010056) – OH

- Ohio EPA's Regional Haze SIP for the Second Implementation Period, dated July 2021, contains a four-factor analysis for the General James M. Gavin Power Plant. Ohio EPA concluded that no technically feasible control measures were identified for SO_2 control at Gavin Power Plant beyond existing wet FGD systems.

Duke Energy Ohio, Wm. H. Zimmer Station (1413090154) – OH

- Ohio EPA's Regional Haze SIP for the Second Implementation Period, dated July 2021, contains an enforceable commitment, in the form of a Director's Final Findings and Orders, requiring the permanent shutdown of the coal-fired boilers at the Zimmer Power Station by no later than January 1, 2028.

Gibson – IN

- The Indiana Department of Environmental Management (IDEM) is not requiring 4-factor analyses from its EGUs, including Gibson and Indiana Michigan Power. In their letter, IDEM states that "IDEM is intently evaluating other emission sectors for this second implementation period to determine their visibility impacts on Class I areas. IDEM will conduct a review of all its emission sources, with focus on the EGU sector, for its January 31, 2025, progress report; pursuant to 40 CFR 51.308(g). IDEM will evaluate EGUs for the third implementation period of the RH rule, as necessary, to be submitted in 2028." Additionally, IDEM cites the EPA's 2019 Guidance that states a "key flexibility of the regional haze program is that a state is not required to evaluate all sources of emissions in each implementation period." IDEM submitted their final Regional Haze SIP to EPA on December 30, 2021.

INDIANA MICHIGAN POWER DBA AEP ROCKPORT – IN

- The Indiana Department of Environmental Management (IDEM) is not requiring 4-factor analyses from its EGU's. See above information for Gibson.

GENON NE MGMT CO/KEYSTONE STA – PA

- The State of Pennsylvania requested that this facility perform a reasonable progress analysis. Pennsylvania provided the facility's reasonable progress analysis, dated January 11, 2021. The facility stated that emissions of SO_2 and NOx from Units 1 and 2 at the Station are already well controlled by wet FGD and SCR and that substantial SO_2 and NOx emission reductions have already been achieved with the existing emission controls. The facility concluded that, for Keystone Generating Station's Units 1 and 2, no

[61] See conclusions in Appendix G-2f of the Tennessee Regional Haze SIP: "TDEC-APC…concluded that reasonable progress for Eastman Chemical Company the permanent shutdown of B-83 Boilers 18, 19, and 20 and the installation of permanent dry sorbent injection (without upgrading the existing ESPs) on Boilers 23 and 24."

additional controls are needed in order for PA DEP to meet their reasonable progress goal for the Second Decadal Review.

10.1.2. Georgia Emission Source Impacts on Class I Areas in Other States

Georgia consulted with each VISTAS state during the development of its LTS. Georgia EPD received letters from other states requesting a reasonable progress analysis for certain facilities in Georgia. On December 18, 2020, FL DEP requested a reasonable process analysis for Georgia Power Company – Plant Bowen. On January 22, 2021, NC DAQ requested a reasonable process analysis for Georgia Power Company – Plant Bowen. On October 23, 2020, TN DEC requested a reasonable process analysis for Georgia Power Company – Plant Bowen. On November 5, 2020, SC DHEC requested a reasonable process analysis for Georgia Power Company – Plant Bowen and International Paper – Savannah.

As discussed in Section 10.2 of this SIP, VISTAS held a webinar on April 21, 2020, to present to the RPOs and their member states the VISTAS modeling analysis and results to make them aware of the impacts on Class I areas in their states. This information was also made available upon request from states outside of VISTAS and provided on the SESARM website. As discussed in Section 7.6.4, Georgia selected Georgia Power Company – Plant Bowen and International Paper – Savannah for reasonable progress analysis.

10.2. Outreach

The VISTAS states participated in national conferences and consultation meetings with other states, RPOs, FLMs, and EPA throughout the SIP development process to share information. VISTAS held calls and webinars with FLMs, EPA, RPOs and their member states, and other stakeholders (industry and non-governmental organizations) to explain the overall analytical approach, methodologies, tools, and assumptions used during the SIP development process and considered their comments along the way. The chronology of these meetings and conferences is presented in Table 10-3.

Table 10-3: Summary of VISTAS Consultation Meetings and Calls

Date	Meetings and Calls	Participants
December 5-7, 2017	Denver, CO, National Regional Haze Meeting – VISTAS States gave several presentations	FLMs; EPA OAQPS[1], Region 3, Region 4; RPOs; various VISTAS agency attendees
January 31, 2018	Teleconference and VISTAS Presentation	FLMs, EPA Region 4
August 1, 2018	Teleconference and VISTAS Presentation	FLMs, EPA OAQPS, Region 3, Region 4
September 5, 2018	Teleconference and VISTAS Presentation	RPOs, CC[2]/TAWG[3]
June 3, 2019	Teleconference and VISTAS Presentation	FLMs; EPA OAQPS, Region 3, Region 4; CC/TAWG
October 28-30, 2019	St Louis, MO, National Regional Haze Meeting – VISTAS States gave presentations	FLMs; EPA OAQPS, Region 3, Region 4; RPOs; various VISTAS agency attendees
April 2, 2020	Teleconference and VISTAS Presentation	FLMs; EPA OAQPS, Region 3, Region 4; CC/TAWG
April 21, 2020	Webinar and VISTAS Presentation	RPOs, CC/TAWG
May 11, 2020	Webinar and VISTAS Presentation	FLMs; EPA OAQPS, Region 3, Region 4; CC/TAWG
May 20, 2020	Webinar and VISTAS Presentation	Stakeholders; FLMs; EPA OAQPS, Region 3, Region 4; RPOs; and member states, STAD, CC/TAWG
August 4, 2020	Webinar and VISTAS Presentation	FLMs; EPA OAQPS, Region 3, Region 4; RPOs and Member States; CC/TAWG
October 26, 2020	Fall 2020 EPA Region 4 and State Air Director's Call - Webinar and VISTAS Presentation	EPA Region 3, EPA Region 4

[1]Office of Air Quality Planning and Standards (OAQPS)
[2]VISTAS Coordinating Committee (CC)
[3]VISTAS Technical Advisory Work Group (TAWG)

Beginning in January 2018, VISTAS held the first of several formal consultation calls with EPA and the FLMs to review the methodologies used to evaluate source lists for four-factor analyses. The development of AoIs for each Class I area with the HYSPLIT model was presented to identify source regions for which additional controls might be considered and that are likely to have the greatest impact on each Class I area. Additionally, information was shared on how states identified specific facilities within the AoIs to be tagged by the CAMx photochemical model to further identify impacts associated with those facilities on each Class I area. Based on the results of these two analyses, each state agreed to evaluate reasonable control measures for sources that met or exceeded individual state thresholds for four-factor analyses. Each state would consider sources within their state and would identify sources in neighboring states for consideration. States acknowledged that the review process would differ among states since some Class I areas are projected to see visibility improvements near the uniform rate of progress while most Class I areas are projected to have greater improvements than the uniform rate of progress.

Subsequent calls were held with EPA, FLMs and stakeholders to share revised analyses of sources in their state and neighboring states for each Class I area, as well as their criteria for listing sources and their plans for further interstate consultation. Documentation of these calls can be found in Appendix F-3.

Additionally, GA EPD attended a National Regional Haze Conference in St. Louis, Missouri in October 2019 to discuss national and regional modeling to date and to plan next steps for submitting 2028 regional haze SIPs. Georgia was part of a southeastern state breakout session with FLMs and EPA discussing the modeling and future expectations from all parties. Also, GA EPD regularly participated in CENRAP calls.

10.3. Federal Land Manager Consultation

As required by 40 CFR §51.308(i), the regional haze SIP must include procedures for continuing consultation between the States and Federal Land Managers (FLMs) pertaining to visibility protection. The FLMs responsible for Class I areas in Georgia are:

- Fish and Wildlife Service (FWS), under U.S. Department of Interior
- National Park Service (NPS), under U.S. Department of Interior
- Forest Service (FS), under U.S. Department of Agriculture

The requirements for ongoing State and FLMs consultation and how Georgia will comply with the requirements are described in the following paragraphs.

40 CFR 51.308(i)(2) requires the State to provide the FLMs with an opportunity for consultation, in person and at least 60 days prior to holding a public hearing on a SIP revision. The consultation must include the opportunity for the FLMs to discuss their:

- Assessment of visibility impairment in the Class I area; and
- Recommendations on the development of the reasonable progress goal and on the development and implementation of strategies to address visibility impairment.

Records of Georgia EPD’s consultations with the FLMs on this Regional Haze SIP are included in Appendix H.

40 CFR 51.308(i)(3) requires the State to incorporate into any SIP or SIP revision a description of how it addressed comments provided by the FLMs. The comments on the SIP and the description of how they were addressed will be included in Appendix H.

40 CFR 51.308(i)(4) requires the plan (or plan revision) to include procedures for continuing consultation between the State and Federal Land Managers on the implementation of the visibility protection program, including development and review of implementation plan revisions and 5-year progress reports, and on the implementation of other programs having the potential to contribute to impairment of visibility in mandatory Class I Federal areas. GA EPD will offer the Federal Land Managers an opportunity for consultation on a yearly basis, including the opportunity to discuss the implementation process and the most recent IMPROVE monitoring data and VIEWS data. Records of annual consultations and progress report consultations will be maintained in Georgia EPD's Regional Haze files.

11. Comprehensive Periodic Implementation Plan Revisions

40 CFR Section 51.308(f) requires Georgia to revise its regional haze SIP and submit a plan revision to the EPA by July 31, 2021, July 31, 2028, and every ten years thereafter. This plan is submitted in order to meet the July 31, 2021, requirement. In accordance with the requirements listed in Section 51.308(f) of the Regional Haze Rule, Georgia commits to revising and submitting this regional haze SIP by July 31, 2028, and every ten years thereafter.

In addition, Section 51.308(g) requires periodic reports evaluating progress towards the RPGs established for each mandatory Class I area. The periodic reports are due by January 31, 2025, July 31, 2033, and every ten years thereafter. Georgia commits to meeting all of the requirements for 40 CFR 51.308(g), including revising and submitting a regional haze progress report by January 31, 2025, July 31, 2033, and every ten years thereafter.

The progress report will evaluate the progress made towards the RPG for each of the mandatory federal Class I areas located within Georgia and in each mandatory federal Class I area located outside Georgia that may be affected by emissions from Georgia sources. All requirements listed in Section 51.308(g) shall be addressed in the periodic report.

The requirements listed in 51.308(g) include the following:

(1) A description of the status of implementation of all measures included in the implementation plan for achieving reasonable progress goals for mandatory Class I Federal areas both within and outside the state.

(2) A summary of the emissions reductions achieved throughout the state through implementation of the measures described in paragraph 51.308(g)(1).

(3) For each mandatory Class I Federal area within the state, the state must assess the following visibility conditions and changes, with values for most impaired, least impaired and/or clearest days as applicable expressed in terms of 5-year averages of these annual values. The period for calculating current visibility conditions is the most recent 5-year period preceding the required date of the progress report for which data are available as of a date 6 months preceding the required date of the progress report.

   (i) The current visibility conditions for the most impaired and clearest days;

   (ii) The difference between current visibility conditions for the most impaired and clearest days and baseline visibility conditions;

(iii) The change in visibility impairment for the most impaired and clearest days over the period since the period addressed in the most recent plan required under paragraph 51.308(f).

(4) An analysis tracking the change over the period since the period addressed in the most recent plan required under paragraph 51.308(f) in emissions of pollutants contributing to visibility impairment from all sources and activities within the state. Emissions changes should be identified by type of source or activity. With respect to all sources and activities, the analysis must extend at least through the most recent year for which the state has submitted emission inventory information to the Administrator in compliance with the triennial reporting requirements of subpart A of 40 CFR 51 as of a date six months preceding the required date of the progress report. With respect to sources that report directly to a centralized emissions data system operated by the Administrator, the analysis must extend through the most recent year for which the Administrator has provided a state-level summary of such reported data or an internet-based tool by which the state may obtain such a summary as of a date six months preceding the required date of the progress report. The state is not required to backcast previously reported emissions to be consistent with more recent emissions estimation procedures, and may draw attention to actual or possible inconsistencies created by changes in estimation procedures.

(5) An assessment of any significant changes in anthropogenic emissions within or outside the state that have occurred since the period addressed in the most recent plan required under 40 CFR 51.308(f) including whether or not these changes in anthropogenic emissions were anticipated in that most recent plan and whether they have limited or impeded progress in reducing pollutant emissions and improving visibility.

(6) An assessment of whether the current implementation plan elements and strategies are sufficient to enable the state, or other states with mandatory Class I Federal areas affected by emissions from the state, to meet all established reasonable progress goals for the period covered by the most recent plan required under 40 CFR 51.308(f).

(7) For progress reports for the first implementation period only, a review of the state's visibility monitoring strategy and any modifications to the strategy as necessary.

(8) For a state with a long-term strategy that includes a smoke management program for prescribed fires on wildland that conducts a periodic program assessment, a summary of the most recent periodic assessment of the smoke management program including conclusions if any that were reached in the assessment as to whether the program is meeting its goals regarding improving ecosystem health and reducing the damaging effects of catastrophic wildfires.

More specifically, the five-year Progress Report (due by January 31, 2025, July 31, 2033, and every 10 years thereafter.) will examine the effect of emission reductions as well as seek to evaluate the effectiveness of emission management measures implemented. Therefore, this Progress Report will provide for a comparison of emission inventories, ultimately expressing the change in visibility for the most impaired and least impaired days over the past five years.

Moreover, due to the uncertainty of some measures, this Progress Report will also provide the opportunity to evaluate the overall effectiveness of proposed measures to reduce visibility impairment to include the effect of state and federal measures.

In keeping with the EPA’s requirements and recommendations related to consultation, each five-year review will also enlist the support of appropriate state, local, and tribal air pollution control agencies as well as the corresponding FLMs.

12. Determination of the Adequacy of the Existing Plan

At the same time Georgia is required to submit any progress reports to EPA, depending on the findings of the five-year progress report, Georgia commits to taking one of the actions listed in 40 CFR Section 51.308(h). The findings of the five-year progress report will determine which action is appropriate and necessary.

List of Possible Actions - 40 CFR Section 51.308(h)

(1) If Georgia determines that the existing SIP requires no further substantive revision in order to achieve established goals, it will provide to the EPA a declaration that further revision of the SIP is not needed.

(2) If Georgia determines that the existing SIP may be inadequate to ensure reasonable progress due to emissions from other states that participated in the regional planning process, it will provide notification to the EPA and collaborate with the states that participated in regional planning to address the SIP's deficiencies.

(3) If Georgia determines that the current SIP may be inadequate to ensure reasonable progress due to emissions from another country, it will provide notification of such, along with available information making such a demonstration, to the EPA.

(4) If Georgia determines that the existing SIP is inadequate to ensure reasonable progress due to emissions within the state, it will revise its SIP to address the plan's deficiencies within one year after submitting such notification to the EPA.

13. Progress Report

13.1. Background

On February 11, 2010 (with a January 25, 2010, narrative cover date), as supplemented on November 19, 2010, Georgia submitted for approval its SIP for regional haze to the EPA Region 4.[62] Georgia's regional haze plan documents Georgia's long-term plan for improving visibility in three of the state's federal Class I areas as well as assisting with improvement of visibility in Class I areas located outside of the state. The SIP includes specific RPGs for visibility improvement at milestones that start in 2018. The ultimate goal is to reach background visibility levels in the Class I areas. Georgia's Class I areas regulated for visibility are the Cohutta Wilderness Area, Okefenokee National Wilderness Area, and Wolf Island National Wilderness Area.

Subparagraph 40 CFR 51.308(g) of the regional haze rule requires that states report on the success of the long-term strategy at specific intervals. On January 8, 2014 (with a December 12, 2013, narrative cover date), Georgia submitted the first regional haze progress report to EPA, which demonstrated that Georgia was on track to meet the RPGs set in the regional haze SIP.[63]

This progress report, in accordance with EPA's requirements, contains the following elements:

- Status of implementation of the control measures included in the original SIP;
- Summary of the emissions reductions achieved through the above-referenced control measures;
- Assessment of visibility conditions and changes for each Class I area located within the state;
- Analysis tracking the change over the past five years in emissions of pollutants contributing to visibility impairment from all sources and activities within Georgia; and
- Assessment of any significant changes in anthropogenic emissions within the past five years that have limited or impeded progress in reducing pollutant emissions and improving visibility.

Although future planning periods will focus on the most anthropogenically impaired ("most impaired") visibility days, the work completed in the first planning period and the development of the 2018 RPGs focused on the worst visibility days. In order to properly compare current

[62] EPA fully approved Georgia's regional haze plan on May 4, 2018 (83 FR 19637).
[63] EPA fully approved Georgia's first regional haze progress report on October 4, 2017 (82 FR 46136).

conditions to the 2018 RPGs, this progress report includes visibility data for the 20% worst visibility days, in addition to visibility data for the 20% most impaired days as required by the regional haze rule.

13.1.1. Georgia's Long-term Strategy for Visibility Improvement

In Section 7.4 of Georgia's Regional Haze Plan, atmospheric ammonium sulfate was identified as the largest contributor to visibility impairment in Class I areas throughout the southeastern United States during the baseline period. Emissions sensitivity modeling performed for VISTAS determined that the most effective ways to reduce ammonium sulfate were to reduce SO_2 emissions from EGUs and, with an important but smaller impact, to reduce SO_2 emissions from non-utility industrial point sources. SO_2 reductions from point sources were therefore identified as the focus of Georgia's long-term strategy for visibility improvement.

The bar charts in Figure 13-1 and Figure 13-2[64] show the speciated average light extinction for Georgia's Class I areas and demonstrate that sulfates have continued to be a significant contributor to light extinction since submittal of the last progress report, although the relative contribution from sulfates is decreasing over time.

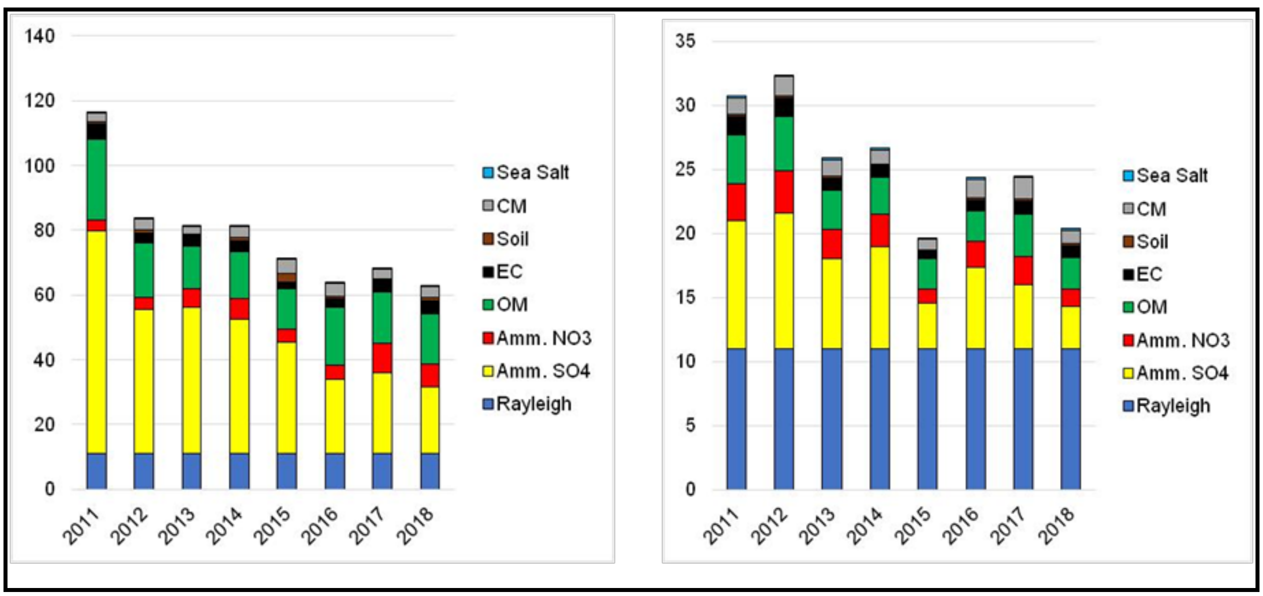

Figure 13-1: Average Light Extinction for the 20% Worst Visibility Days (left) and the 20% Clearest Visibility Days (right) at Cohutta Wilderness Area

[64] Since there is not an IMPROVE monitor located at Wolf Island National Wilderness Area, the IMPROVE monitor at Okefenokee National Wilderness Area serves as a surrogate monitor for that area.

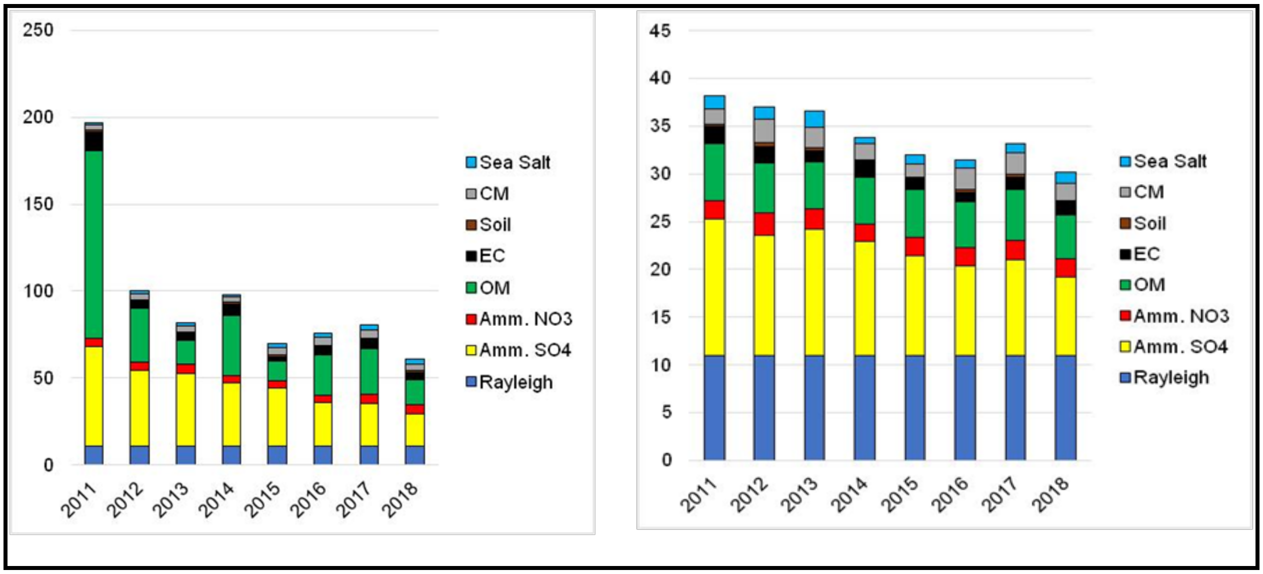

Figure 13-2: Average Light Extinction for the 20% Worst Visibility Days (left) and the 20% Clearest Visibility Days (right) at Okefenokee National Wilderness Area

13.1.2. 2018 Reasonable Progress Goals for Georgia's Class I Areas

Table 13-1 and Table 13-2 show the 2018 RPGs for Georgia's Class I areas on the 20% worst and 20% best visibility days, respectively. As seen in these tables, all three Georgia Class I areas have met the 2018 RPGs.

Table 13-1: 2018 RPGs for Visibility Impairment in Georgia's Class I Areas, 20% Worst Days

Class I Area	Baseline Average dv (2000-2004)	2018 Average dv (2014-2018)	2018 Goal (dv)	Natural Background (dv)
Cohutta	30.25	19.24	22.78	11.00
Okefenokee	27.38	19.87	23.77	11.44
Wolf Island	27.38	19.87	23.77	11.44

Table 13-2: RPGs for Visibility Impairment in Georgia's Class I Areas, 20% Clearest Days

Class I Area	Baseline Average dv (2000-2004)	2018 Average dv (2014-2018)	2018 Goal (dv)	Natural Background (dv)
Cohutta	13.73	8.10	<13.73	4.42
Okefenokee	15.23	11.57	<15.23	5.43
Wolf Island	15.23	11.57	<15.23	5.43

13.2. Requirements for the Periodic Progress Report

The requirements for periodic reports are outlined in 40 CFR 51.308(g). Each state must submit a report to EPA every five years evaluating the progress towards the reasonable progress goal for each Class I area located within the state and in each Class I area located outside the state which may be affected by emissions from within the state.

EPA's revised regional haze rule no longer requires the progress report to be a formal SIP submittal. At a minimum, the progress report must cover the first year not covered by the previously submitted progress report through the most recent year of data available prior to submission. Georgia's previous progress report included data through the year 2013. Therefore, this progress report covers years since 2013. For the purposes of this periodic review (included as part of this regional haze plan revision), the most recent data available are used to highlight the progress made. This review includes NEI data through 2017, visibility data through 2018, and stationary source data through 2019. Section 51.308(f)(5) of the Regional Haze Rule requires that this regional haze plan revision address the progress report requirements of paragraphs 51.308(g)(1) through (5):

(1) A description of the status of implementation of all measures included in the SIP for achieving reasonable progress goals for Class I areas both within and outside the State.

(2) A summary of the emission reductions achieved throughout the State through implementation of the measures described in (1) above.

(3) For each Class I area within the State, the State must assess the following visibility conditions and changes, with values for most impaired and least impaired days expressed in terms of five-year averages of these annual values:

    (i) The current visibility conditions for the most impaired and least impaired days;

    (ii) The difference between current visibility conditions for the most impaired and least impaired days and baseline visibility conditions;

    (iii) The change in visibility impairment for the most impaired and least impaired days over the past five years;

(4) An analysis tracking the change over the past five years in emissions of pollutants contributing to visibility impairment from all sources and activities within the state. Emissions changes should be identified by type of source or activity. The analysis must be based on the most recently updated emissions inventory, with estimates projected forward as necessary and appropriate, to account for emissions changes during the applicable five-year period.

(5) An assessment of any significant changes in anthropogenic emissions within or outside the State that have occurred over the past five years that have limited or impeded progress in reducing pollutant emissions and improving visibility.

13.3. Status of Implementation of Control Measures

This section provides the status of implementation of the emission reduction measures that were included in the original regional haze SIP starting in the year 2014 to 2019, as required by 40 CFR 51.308(g)(1). These measures include Federal programs, State requirements for EGUs, and State requirements for non-EGU point sources. As required by 40 CFR 51.308(g)(2), Georgia has estimated the SO_2 emissions reductions achieved through 2019 from measures implemented by the state. Where quantitative assessments of emission reductions are not available, a qualitative assessment is given.

This section also describes other strategies that were not included in the regional haze SIP. At the time of the best and final inventory development process, these measures were not fully documented or had not yet been published in final form, and therefore the benefits of these measures were not included in the 2018 inventory. Emission reductions from these measures have helped each Class I area meet the RPG set in the regional haze SIP for 2018.

13.3.1. Emissions Reduction Measures Included in the Regional Haze SIP

Georgia's regional haze SIP included the following types of measures for achieving reasonable progress goals:

- Federal programs and
- State reasonable progress and BART control measures

These emissions reduction strategies were included as inputs to the VISTAS modeling. The current status of the implementation of these measures is summarized in the following paragraphs and an estimate of the SO_2 emissions reductions achieved is presented.

13.3.1.1. Federal and Other State Programs

The emissions reductions associated with the Federal and other state programs that are described in the following paragraphs were included in the VISTAS future year emissions estimates for the first planning period. Descriptions contain qualitative assessments of emissions reductions associated with each program, and where possible, quantitative assessments. In cases where delays or modification have altered emissions reduction estimates such that the original estimates of emissions are no longer accurate, information is also provided on the effects of these alterations.

13.3.1.1.1. Clean Air Interstate Rule

On May 12, 2005, EPA promulgated CAIR, which required reductions in emissions of NO_X and SO_2 from large EGUs fired by fossil fuels. Due to court rulings, CAIR was remanded to EPA to revise elements that were deemed unacceptable and was ultimately replaced by CSAPR. This was later updated through the CSAPR Update rule.

However, at the time that the states were developing their regional haze plans, challenges to CSAPR had left CAIR in place until residual issues were decided by the D.C. Circuit and EPA had resolved implementation issues. Therefore, states included CAIR in the regional haze SIP. The 2018 projected emissions used in the regional haze analysis reflect a modified IPM solution based on the state's best estimate of that year.

Although different than the CAIR solution projected in the regional haze analysis, CSAPR and the CSAPR Update have continued reductions from large EGUs.

13.3.1.1.2. NO_X SIP Call

Phase I of the NO_X SIP Call was included on page iii in the 2010 regional haze SIP. This applies to certain EGUs and large non-EGUs, including large industrial boilers and turbines, and cement kilns. Those states affected by the NO_X SIP call in the VISTAS region have developed rules for the control of NO_X emissions that have been approved by the EPA. The NO_X SIP Call has resulted in a significant reduction in NO_X emissions from large stationary combustion sources. For the first regional haze SIP, the emissions for NO_X SIP Call-affected sources were capped at 2007 levels and carried forward to the 2009 and 2018 inventories.

13.3.1.1.3. Consent Agreements and Voluntary Agreement

In April of 2011, the USEPA announced a settlement with the Tennessee Valley Authority (TVA) to resolve alleged Clean Air Act violations at 11 of its coal-fired plants in Alabama, Kentucky, and Tennessee. The settlement requires TVA to invest $3 billion to $5 billion on new and upgraded state-of-the-art pollution controls. Once fully implemented, the pollution controls and other required actions will address 92 percent of TVA's coal-fired power plant capacity, reducing emissions of NO_X by 69 percent and SO_2 by 67 percent from TVA's 2008 emissions levels.

Under a settlement agreement, Tampa Electric Company (TECO) converted units at the TECO Gannon Station Power Plant (now TECO Bayside Power Station) from coal to natural gas and installed permanent emissions-control equipment to meet stringent pollution limits.

Under a settlement agreement, Virginia Electric and Power Company (VEPCO) agreed to spend $1.2 billion by 2013 to eliminate 237,000 tons of SO_2 and NO_X emissions each year from eight coal-fired electricity generating plants in Virginia and West Virginia.

In October 2007, American Electric Power (AEP) agreed to spend $4.6 billion dollars to eliminate 72,000 tons of NOx emissions each year by 2016 and 174,000 tons of SO_2 emissions each year by 2018 from sixteen coal-fired power plants located in Indiana, Kentucky, Ohio, Virginia, and West Virginia.

Under a 2002 voluntary agreement, Gulf Power upgraded its operation to significantly cut NO_X emissions at its Crist generating plant.

The consent agreements related to Tampa Electric Company, Virginia Electric and Power Company, Gulf Power, and American Electric Power were discussed on page v of the 2010 regional haze SIP.

13.3.1.1.4. One-hour Ozone SIPs (Atlanta/Birmingham/Northern Kentucky)

The regional haze SIP also included emissions reductions from one-hour ozone SIPs submitted to EPA to demonstrate attainment of the one-hour ozone NAAQS. These SIPs require NO_X reductions from specific coal-fired power plants and address transportation plans in these cities. These reductions further improve regional visibility.

13.3.1.1.5. NO_X RACT in 8-hour Nonattainment Area SIPs

The NCDAQ's SIP for the Charlotte / Rock Hill / Gastonia nonattainment area includes RACT for NO_X for two facilities located in the nonattainment area: Philip Morris USA and Norandal USA. These controls were also modeled for 2018. Additional RACT controls may be realized as other companies subject to RACT complete the determination, but RACT-level controls were assumed for just these two sources. These controls further improve regional visibility.

13.3.1.1.6. 2007 Heavy-Duty Highway Rule (40 CFR Part 86, Subpart P)

In this regulation, EPA set a PM emissions standard for new heavy-duty engines of 0.01 g/bhp-hr, which took full effect for diesel engines in the 2007 model year. This rule also included standards for NO_X and non-methane hydrocarbons (NMHC) of 0.20 g/bhp-hr and 0.14 g/bhp-hr, respectively. These diesel engine NO_X and NMHC standards were successfully phased in together between 2007 and 2010. The rule also required that sulfur in diesel fuel be reduced to facilitate the use of modern pollution-control technology on these trucks and buses. EPA required a 97% reduction in the sulfur content of highway diesel fuel, from levels of 500 ppm (low sulfur diesel) to 15 ppm (ultra-low sulfur diesel). These requirements were successfully implemented on the timeline in the regulation. This program applies to all areas of the country, including Georgia, thus, more directly affecting Georgia Class I areas.

13.3.1.1.7. Tier 2 Vehicle and Gasoline Sulfur Program (40 CFR Part 80 Subpart H; Part 85; Part 86)

EPA's Tier 2 fleet averaging program for on-road vehicles, modeled after the California Low Emission Vehicle (LEV) II standards, became effective in the 2005 model year. The Tier 2 program allows manufacturers to produce vehicles with emissions ranging from relatively dirty to very clean, but the mix of vehicles a manufacturer sells each year must have average NO_X emissions below a specified value. Mobile emissions continue to be reduced by this program as motorists replace older, more polluting vehicles with cleaner vehicles. The Tier 2 program applies nationwide, including Georgia, and, thus, has a more direct impact on Georgia Class I areas.

13.3.1.1.8. Large Spark Ignition and Recreational Vehicle Rule

EPA has adopted new standards for emissions of NO_X, hydrocarbons (HC), and CO from several groups of previously unregulated non-road engines. Included in these are large industrial spark-ignition engines and recreational vehicles. Non-road spark-ignition engines are those powered by gasoline, liquid propane gas, or compressed natural gas rated over 19 kW (25 horsepower). These engines are used in commercial and industrial applications, including forklifts, electric generators, airport baggage transport vehicles, and a variety of farm and construction applications. Non-road recreational vehicles include snowmobiles, off-highway motorcycles, and all-terrain-vehicles. These rules were initially effective in 2004 and were fully phased-in by 2012. These rules apply nationwide, including Georgia.

13.3.1.1.9. Non-Road Mobile Diesel Emissions Program (40 CFR Part 89)

EPA adopted standards for emissions of NO_X, HC, and CO from several groups of non-road engines, including industrial spark-ignition engines and recreational non-road vehicles. Industrial spark-ignition engines power commercial and industrial applications and include forklifts, electric generators, airport baggage transport vehicles, and a variety of farm and construction applications. Non-road recreational vehicles include snowmobiles, off-highway motorcycles, and all-terrain vehicles. These rules were initially effective in 2004 and were fully phased-in by 2012. Non-road mobile emissions continue to benefit from this program as motorists replace older, more polluting non-road vehicles with cleaner vehicles.

The non-road diesel rule set standards that reduced emissions by more than 90% from non-road diesel equipment and, beginning in 2007, the rule reduced fuel sulfur levels by 99% from previous levels. The reduction in fuel sulfur levels applied to most non-road diesel fuel in 2010 and applied to fuel used in locomotives and marine vessels in 2012. This is a nationwide program and impacts Georgia sources.

13.3.1.1.10. Maximum Achievable Control Technology Programs (40 CFR Part 63)

VISTAS applied controls to future year emissions estimates from various MACT regulations for VOC, SO_2, NO_X, and PM for source categories where controls were installed on or after 2002.

Table 13-3 describes the MACTs used as control strategies for the non-EGU point source emissions in the regional haze SIP. The table notes the pollutants for which controls were applied as well as the promulgation dates and the compliance dates for existing sources.

Table 13-3: MACT Source Categories

MACT Source Category	40CFR63 Subpart	Original Promulgation Date	Compliance Date (Existing Sources)	Pollutants Affected
Hazardous Waste Combustion (Phase I)	63(EEE), 261 and 270	9/30/99	9/30/03	PM
Portland Cement Manufacturing	LLL	6/14/99	6/10/02	PM
Secondary Aluminum Production	RRR	3/23/00	3/24/03	PM
Lime Manufacturing	AAAAA	1/5/04	1/5/07	PM, SO_2
Taconite Iron Ore Processing	RRRRR	10/30/03	10/30/06	PM, SO_2
Industrial Boilers, Institutional/ Commercial Boilers and Process Heaters	DDDDD	9/13/04	9/13/07	PM, SO_2
Reciprocating Internal Combustion Engines	ZZZZ	6/15/04	6/15/07	NO_X, VOC
Stationary Combustion Turbines	YYYY	3/5/04	3/5/04 (oil-fired) 3/9/22 (gas-fired)	CO, VOC

The Industrial/Commercial/Institutional (ICI) boiler MACT standard (40 CFR 63 Subpart DDDDD) was vacated by the U.S. Court of Appeals and remanded the regulation to EPA on June 8, 2007. VISTAS chose, however, to leave the emissions reductions associated with this regulation in place as the CAA required use of alternative control methodologies under Section 112(j) for uncontrolled source categories. The applied MACT control efficiencies were 4% for SO_2 and 40% for PM_{10} and $PM_{2.5}$ to account for the co-benefit from installation of acid gas scrubbers and other control equipment to reduce HAPs.

EPA finalized the revised ICI Boiler MACT on March 21, 2011. EPA subsequently reconsidered certain aspects of the rule and proposed changes on December 2, 2011. The rules were re-promulgated on January 31, 2013. The final compliance date for ICI boilers at major sources was 2016, with the option to request an additional year. EPA's estimate of nationwide SO_2 emissions reductions from this rule is over 500,000 tons/year, as compared to an estimate of 113,000 tons/year in the analysis for the 2004 rule (78 FR 7138 and 69 FR 55218). On November 5, 2015, EPA finalized additional revisions to the Boiler MACT and projected that these updates would not significantly change the emissions reductions expected from the rule. It is, therefore, reasonable to conclude that the 2012 rule has brought about more SO_2 reductions in Georgia than were modeled in Georgia's Regional Haze Plan.

13.3.1.2. State EGU Control Measures

Emissions from EGUs have been regulated through state measures in North Carolina and Georgia, which were included in the regional haze SIP modeling. Reductions associated with these measures were used to estimate the 2018 visibility improvements at the VISTAS Class I areas.

13.3.1.2.1. North Carolina Clean Smokestacks Act

In June of 2002, the North Carolina General Assembly enacted the Clean Smokestacks Act (CSA), which required significant actual emissions reductions from coal-fired power plants in North Carolina. The CSA was discussed on page v of the 2010 regional haze SIP. These reductions were included as part of the VISTAS 2018 Best and Final modeling effort. Under the CSA, power plants were required to reduce their NO_X emissions by 77% in 2009 and their SO_2 emission by 73% in 2013. Actions taken to date by facilities subject to these requirements comply with the provisions of the CSA, and compliance plans and schedules will allow these entities to achieve the emissions limitations set out by the Act. This program has been highly successful. In 2009, regulated entities emitted less than the 2013 system annual cap of 250,000 tons of SO_2 and less than the 2009 system annual cap of 56,000 tons of NO_X. In 2002, the sources subject to CSA emitted 459,643 tons of SO_2 and 142,770 tons of NO_X. In 2011, these sources emitted only 73,454 tons of SO_2 and 39,284 tons of NO_X, well below the Act's system caps.

This legislation established annual caps on both SO_2 and NO_X emissions for the two primary utility companies in North Carolina, Duke Energy and Progress Energy. Duke Energy and Progress Energy have produced emissions reductions beyond what was required which further improved regional visibility.

13.3.1.2.2. Georgia Multi-Pollutant Control for Electric Utility Steam Generating Units

Georgia rule 391-3-1.02(2)(sss), enacted in 2007, requires FGD and SCR controls on large coal-fired EGUs in Georgia. Reductions from this regulation were included as part of the VISTAS 2018 Best and Final modeling effort. These controls reduced SO_2 emissions from the affected emissions units by at least 95% and reduced NO_X emissions by approximately 85%. Control implementation dates vary by EGU, starting with December 31, 2008 and ending with December 31, 2015.

13.3.1.3. Georgia Reasonable Progress and BART Control Measures

Georgia completed BART determinations and source-specific reasonable progress for all applicable sources in the first-round regional haze SIP. Georgia had 24 BART-eligible sources. Twenty-two (22) of the twenty-four (24) sources were able to demonstrate that they did not cause or contribute to visibility impairment in any Class I area within 300 km of the source. The exemptions were demonstrated through CALPUFF modeling, conducted using the VISTAS modeling protocol, or by accepting emissions limits for visibility causing pollutants. Two BART-eligible sources, Georgia Power - Plant Bowen (Units 1-4) and Interstate Paper (F1 Power Boiler, F3 Recovery Boiler, and F4 Lime Kiln), completed a BART analysis and another BART-eligible source, Georgia Pacific - Cedar Springs (Power Boilers 1 and 2 and Recovery Boiler 3) took permit limits to avoid BART (77 FR 11471-11472). No additional controls were required for Georgia Power - Plant Bowen, but additional restrictions were implemented for Interstate Paper and Georgia Pacific - Cedar Springs through permit modifications.

Initially, 29 emission units were identified for analysis of additional controls for meeting the reasonable progress requirements because each unit's contribution to total sulfate visibility impairment was at least 0.5% of the total sulfate visibility impairment at one or more Class I areas. Of the 29 units, seven units were removed based on facilities' updated emission estimates, six units took enforceable permit limits that rendered them no longer subject to a four-factor analysis, and one was also a BART source that completed a BART demonstration (equivalent to a reasonable progress determination). The remaining 15 units completed a reasonable progress four-factor analysis determination. Of those 15, no additional controls were required for 13 emission units, but additional controls for 2 emission units were required.

Table 13-4 lists the current status for emission units that took voluntary emission limits, required reasonable progress controls, or required BART controls. All facilities that were required to implement emission reductions have met their compliance dates.

Table 13-4: Current Status of Reasonable Progress Sources and BART Sources from the First Implementation Period

Facility	Emissions Unit	Emission Controls Included in SIP	Estimated Tons Reduced	Required Control Date	Status of Controls
GA Pacific – Brunswick Cellulose	F1 Pwr. Boiler 4	Required by reasonable progress determination. Permit limit of 568 tpy of SO_2	1074	January 1, 2012	Permit condition in place; 2012 SO_2 emissions = 142 tons
Georgia Pacific – Cedar Springs	Power Boiler U500	BART avoidance limit. Permit limit of 135 pounds SO_2 per hour (same as BART exemption modeling limit)	1385	Upon Completion of BART exemption project	BART project was completed on July 31, 2011. The facility performed an initial compliance test and passed.
	Power Boiler U501	BART avoidance limit. Permit limit of 135 pounds SO_2 per hour (same as BART exemption modeling limit)	1385		
International Paper – Savannah	Power Boiler 13, including combustion of process organic emissions	Required by reasonable progress determination. Permit limit of 6578 tpy of SO_2	2000	January 1, 2016	Permit condition in place to meet the scheduled control date (Permit No. 2631-051-0007-V-02-0)
Packaging Corp. of America	CE Power Boiler	Reasonable progress avoidance limit. Permit limit of 600 tpy of SO_2	53	January 1, 2012	Permit condition in place; 2012 SO_2 emissions = 1.3 tons
Rayonier Perf. Fibers	PB02 Pwr. Boiler 2	Reasonable progress avoidance limit. Permit limit of 318 tons SO_2 per 12 consecutive months, compliance date of June 4, 2008	306	January 1, 2018	Permit condition in place to limit No. 6 & No. 2 oil to 7.4235 and 1.30305 MMgal/yr respectively (Permit No. 2631-305-0001-V-03-0)
	PB03 Pwr. Boiler 3	Reasonable progress avoidance limit. Permit limit of 149 tons SO_2 per 12 consecutive months, compliance date of June 4, 2008	1448	January 1, 2018	Permit condition in place (Permit No. 2631-305-0001-V-03-0)

Facility	Emissions Unit	Emission Controls Included in SIP	Estimated Tons Reduced	Required Control Date	Status of Controls
	RF01 No. 5 Rec. Furn.	Reasonable progress avoidance limit. Permit limit of 194 tons SO_2 per 12 consecutive months, compliance date tied to facility modification	139	January 1, 2018	Permit condition in place to meet the limit once the construction and conversion project is completed (Permit No. 2631-305-0001-V-03-0)
	RF04 No. 6 Rec. Furn.	Reasonable progress avoidance limit. Permit limit of 307 tons SO_2 per 12 consecutive months, compliance date tied to facility modification	27	January 1, 2018	Permit condition in place to meet the limit once the construction and conversion project is completed (Permit No. 2631-305-0001-V-03-0)
Southern States Phosphate and Fertilizer	SA02 Acid Plant 2	Reasonable progress avoidance limit. Permit limit of 580 tpy of SO_2	228	January 1, 2014	Permit condition in place to meet the scheduled control date (Permit No. 2819-051-0077-V-02-1)
Interstate Paper	Power Boiler	Required by BART determination. Burn natural gas except during curtailment	178	January 1, 2012	Permit condition in place; in 2012 burned oil during Q2 curtailment, burned nat. gas for balance of year
TOTAL of all reductions			8,223		

13.3.2. Emission Reduction Measures Not Included in the Regional Haze SIP

A number of regulations and requirements have been promulgated that were not included in Georgia's original SIP submittal. These measures provided additional emission reductions to allow VISTAS Class I areas to meet their 2018 reasonable progress goals.

- The International Maritime Organization has strengthened the standards for sulfur in marine fuel (discussed in Section 7.2.1.4.4).
- New source performance standards (NSPS) for stationary compression ignition internal combustion engines and stationary spark ignition internal combustion engines, contained in 40 CFR Part 60 Subpart IIII and Subpart JJJJ, respectively, have generated a significant decrease in NO_X emissions from these sources.
- EPA's Mercury and Air Toxics Standards (discussed in Section 7.2.1.2) and the 2010 SO_2 NAAQS (discussed in Section 7.2.1.3) have further reduced emissions from EGUs.
- A 2007 agreement called for the Dupont James River plant, located in Virginia, to install dual absorption pollution control equipment by September 1, 2009, resulting in emission reductions of approximately 1,000 tons of SO_2 annually.
- A 2004 agreement called for Stone Container, located in West Point, Virginia, to control SO_2 emissions from the #8 Power Boiler with a wet scrubber. This device was installed and operational in October of 2007, resulting in emission reduction of approximately 3,000 tons of SO_2 annually.
- The Maryland Healthy Air Act (HAA) regulations became effective on July 16, 2007, and required reductions in NO_X, SO_2, and mercury emissions from large coal burning power plants in Maryland. Emission reductions from the HAA come in two phases. The first phase required reductions in the 2009/2010 timeframe, and compared to a 2002 emission baseline, reduced NO_X emission by almost 70 percent and SO_2 emission by 80 percent. The second phase of emissions controls occurs in the 2012/2013 time frame. At full implementation, the HAA will reduce NO_X emissions by approximately 75 percent from 2002 levels and SO_2 emissions by approximately 85 percent from 2002 levels. Maryland is not a VISTAS participant. However, Maryland borders two VISTAS states, and Maryland facilities have calculated sulfate visibility impairment contributions to several VISTAS Class I areas. Reductions associated with this program were included as part of the VISTAS 2018 Round 1 Best and Final modeling effort.

13.4. Visibility Conditions

40 CFR 51.308(g)(3) requires the state to assess the visibility conditions for the most impaired and least impaired days expressed in terms of five-year averages. The visibility conditions that must be reviewed include: (1) the current visibility conditions; (2) the difference between current visibility conditions compared to the baseline; and (3) the change in visibility impairment for the

most and least impaired days over the past five years. Since there is not an IMPROVE monitor located at Wolf Island National Wilderness Area, the IMPROVE monitor at Okefenokee National Wilderness Area serves as a surrogate monitor for that area.

Table 13-5 and Table 13-6 show the current visibility conditions and the difference between the current visibility and the baseline condition expressed in terms of five-year averages of observed visibility impairment for the 20% worst days and the 20% clearest days, respectively. The baseline conditions are for 2000 through 2004 and the current conditions are for 2014 through 2018. Because the RPGs in the first planning period were calculated for the 20% worst days, the table includes a comparison of the baseline average and current average for the 20% worst days.

The data shows that all Class I areas saw an improvement in visibility on the 20% worst days and on the 20% clearest days. The current observed 5-year average values for all three areas on the 20% worst days are below the 2018 goal. On the 20% clearest days, the current observed 5-year average values for all three areas are below the 2018 goal of no degradation.

Table 13-5: Current Observed Visibility Impairment, Change from Baseline, and Comparison to 2018 RPGs, 20% Worst Days

Class I Area	Baseline Average dv (2000-2004)	Current Average, dv (2014-2018)	Change, current – baseline, (dv)	2018 Goal (dv)	Difference, current – goal, (dv)
Cohutta	30.25	19.24	-11.01	22.78	-3.54
Okefenokee	27.38	19.87	-7.51	23.77	-3.90
Wolf Island	27.38	19.87	-7.51	23.77	-3.90

Table 13-6: Current Observed Visibility Impairment, Change from Baseline, and Comparison to 2018 RPGs, 20% Clearest Days

Class I Area	Baseline Average dv (2000-2004)	Current Average, dv (2014-2018)	Change, current – baseline, (dv)	2018 Goal (dv)	Difference, current – goal, (dv)
Cohutta	13.73	8.10	-5.63	<13.73	-5.63
Okefenokee	15.23	11.57	-3.66	<15.23	-3.66
Wolf Island	15.23	11.57	-3.66	<15.23	-3.66

The previous progress report covered visibility through 2013. Table 13-7, Table 13-8, and Table 13-9 display the change in visibility impairment for the 20% worst days, 20% most impaired days, and 20% clearest days since 2013 through 2018. The data shows that all three Class I areas saw an improvement in visibility on the 20% worst, 20% most impaired, and 20% clearest days.

Table 13-7: Observed Visibility Impairment for Five-Year Periods Through 2018, 20% Worst Days

Class I Area	2010-2014	2011-2015	2012-2016	2013-2017	2014-2018
Cohutta	22.25	21.38	20.15	19.74	19.24
Okefenokee	23.15	22.28	20.73	20.45	19.87
Wolf Island	23.15	22.28	20.73	20.45	19.87

Table 13-8: Observed Visibility Impairment for Five-Year Periods Through 2018, 20% Most Impaired Days

Class I Area	2010-2014	2011-2015	2012-2016	2013-2017	2014-2018
Cohutta	20.53 dv	19.61 dv	18.54 dv	18.13 dv	17.37 dv
Okefenokee	20.13 dv	19.36 dv	18.74 dv	18.19 dv	17.39 dv
Wolf Island	20.13 dv	19.36 dv	18.74 dv	18.19 dv	17.39 dv

Table 13-9: Observed Visibility Impairment for Five-Year Periods Through 2018, 20% Clearest Days

Class I Area	2010-2014	2011-2015	2012-2016	2013-2017	2014-2018
Cohutta	10.85	9.60	9.14	8.57	8.10
Okefenokee	13.11	12.55	12.16	11.96	11.57
Wolf Island	13.11	12.55	12.16	11.96	11.57

Figure 13-3, Figure 13-4, Figure 13-5 and Figure 13-6 display the data listed in Table 13-5, as well as the URP towards natural background for the 20% worst days. The URP and 2018 RPGs in the first implementation period were based on the 20% worst days; therefore, the figures below continue to look at the 20% worst days. SIPs and progress reports in the second and subsequent planning period will look at the 20% most anthropogenically-impaired days.

Figure 13-3 shows the observed five-year average impairment values for the 20% worst days in Cohutta Wilderness Area, as well as the associated glide slope and the predicted impairment from the regional haze SIP. The 2018 RPG is included in the graph. The observed five-year average impairment for 2018 is below both the glide path and the predicted impairment.

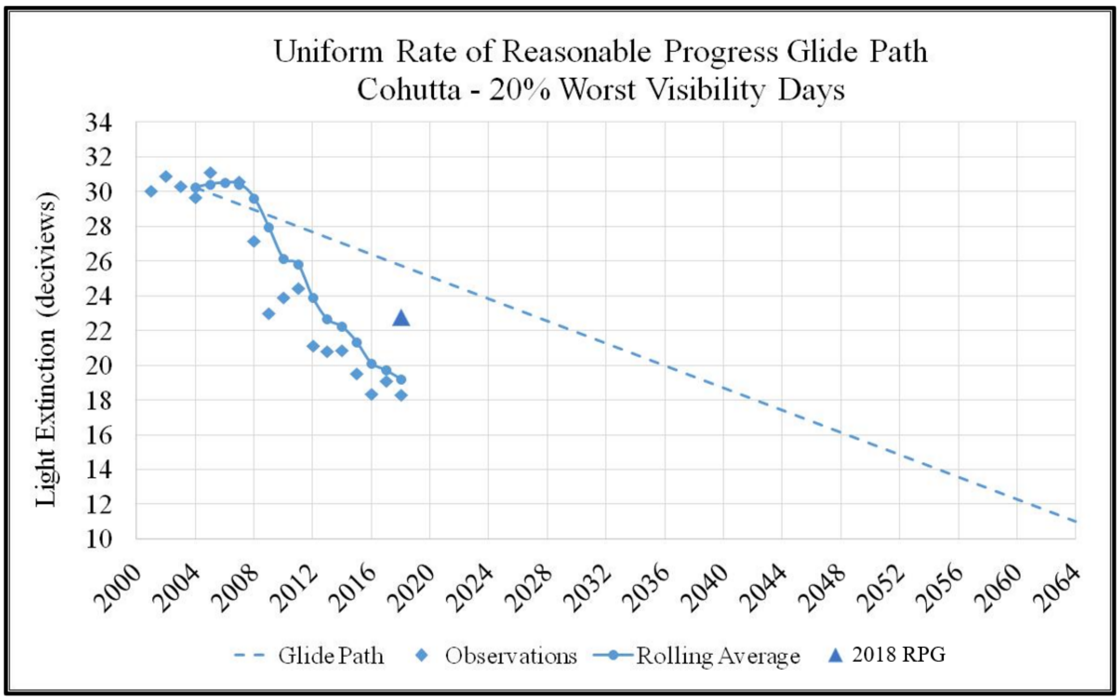

Figure 13-3: Cohutta Wilderness Area Visibility Impairment on the 20% Worst Visibility Days, Glide Path, and 2018 RPG

Figure 13-4 shows the observed five-year average impairment values for the 20% clearest days in Cohutta Wilderness Area, as well as the predicted impairment from the regional haze SIP. The observed five-year average impairment for the 20% clearest days of 2018 is below both the baseline and the predicted impairment.

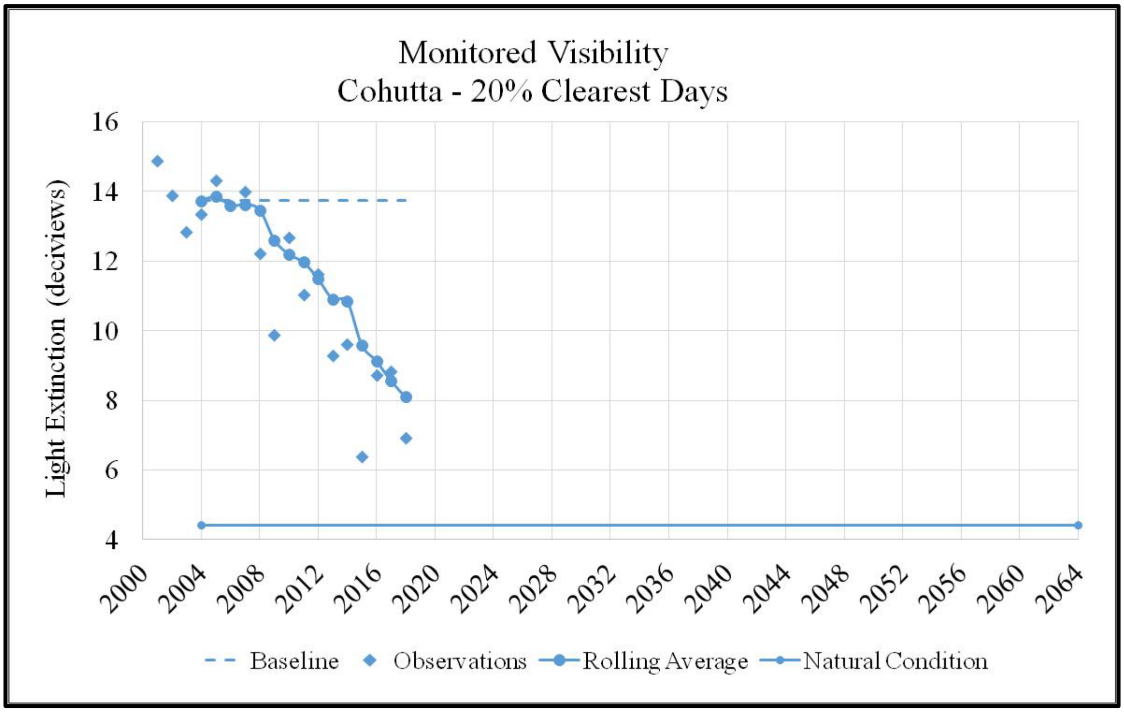

Figure 13-4: Cohutta Wilderness Area Visibility Impairment on the 20% Clearest Days and Natural Conditions

Figure 13-5 shows the observed five-year average impairment values for the 20% worst days in Okefenokee National Wilderness Area, as well as the associated glide slope and the predicted impairment from the regional haze SIP. The 2018 RPG is included in the graph. The observed five-year average impairment for 2018 is below both the glide path and the predicted impairment.

Figure 13-6 shows the observed five-year average impairment values for the 20% clearest days in Okefenokee National Wilderness Area, as well as the predicted impairment from the regional haze SIP. The observed five-year average impairment for the 20% clearest days of 2018 is below both the baseline and the predicted impairment.

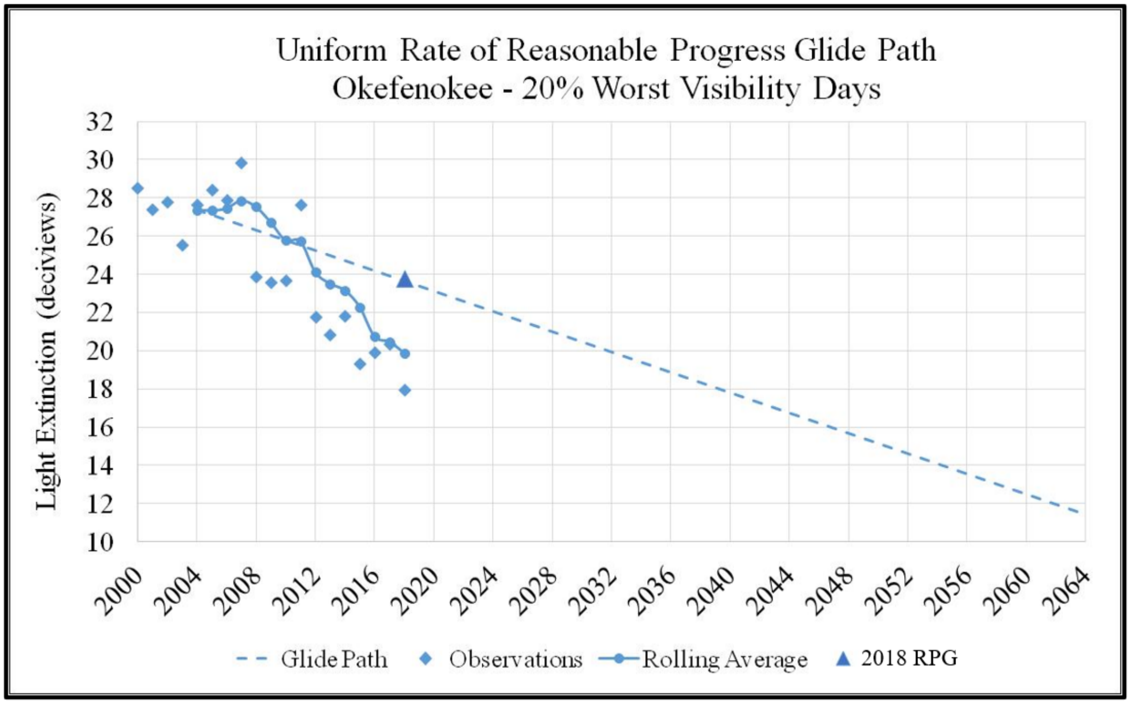

Figure 13-5: Okefenokee National Wilderness Area Visibility Impairment on the 20% Worst Visibility Days, Glide Path, and 2018 RPG

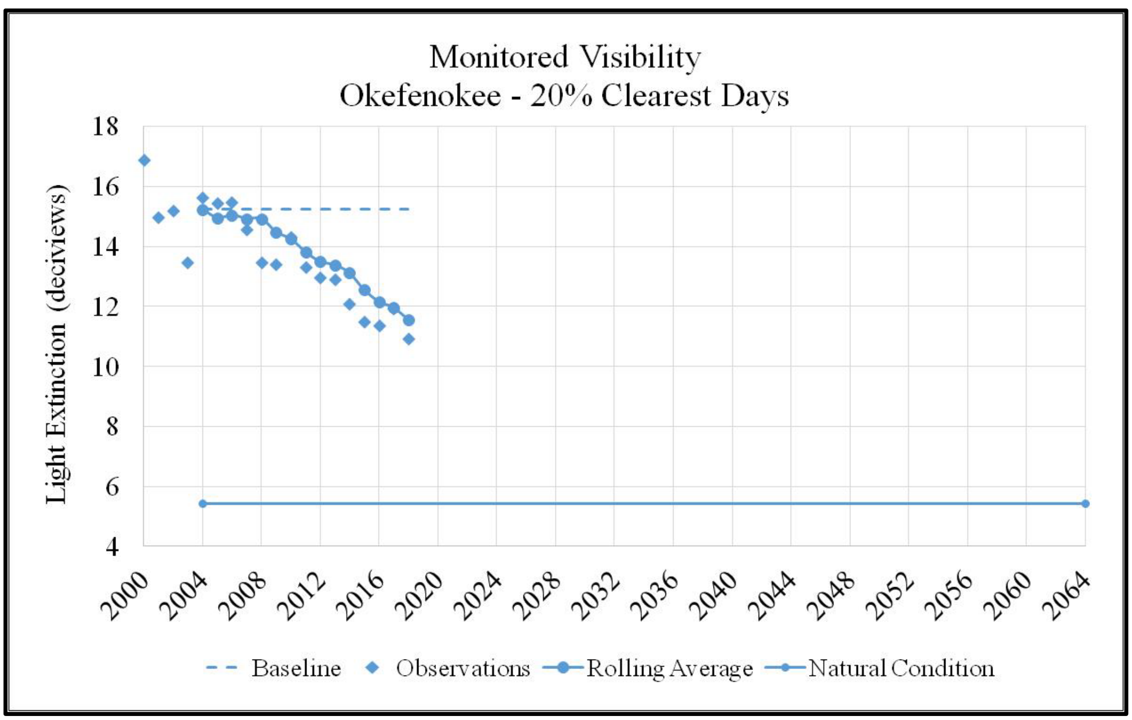

Figure 13-6: Okefenokee National Wilderness Area Visibility Impairment on the 20% Clearest Days and Natural Conditions

13.5. Emissions Analysis

This section includes an analysis tracking the change since 2013 in emissions of pollutants contributing to visibility impairment from all sources and activities within the state, as required by 40 CFR 51.308(g)(4). Because SO_2 was the significant pollutant contributing to visibility impairment during the first implementation period, the emissions analysis will focus mostly on SO_2 emissions. This section also includes an assessment of changes in anthropogenic emissions since 2013, as required by 40 CFR 51.308(g)(5).

13.5.1. Change in $PM_{2.5}$, NO_X, SO_2, Emissions from All Source Categories

There are six emissions inventory source categories: stationary point, area (non-point), non-road mobile, onroad mobile, fires, and biogenic sources.

- Stationary point sources are those sources that emit greater than a specified tonnage per year, with data provided at the facility level. Electricity generating utilities and industrial sources are the major categories for stationary point sources.
- Stationary area sources are those sources whose individual emissions are relatively small, but due to the large number of these sources, the collective emissions from the source category could be significant. These types of emissions are estimated on a countywide level.
- Non-road mobile sources are equipment that can move, but do not use the roadways (i.e., lawn mowers, construction equipment, marine vessels, railroad locomotives, aircraft). The emissions from these sources, like stationary area sources, are estimated on a countywide level.
- Onroad mobile sources are automobiles, trucks, and motorcycles that use the roadway system. The emissions from these sources are estimated by vehicle type and road type and are summed to the countywide level.
- Fire emissions include prescribed fire and wildfire emissions and can be summed to a countywide level or reported as a point source.
- Biogenic sources are natural sources like trees, crops, grasses and natural decay of plants. The biogenic emissions are not included in this review since they were held constant as part of the original regional haze SIP modeling and are not controllable emissions.

For the purpose of evaluating recent emissions changes and progress, Georgia used the 2014 NEI, the 2017 NEI, and the state Annual Operating Report point source data collected each year.

When available, data after 2017 is also used. For comparison purposes, the tables below include the 2018 emissions projected by VISTAS in the first regional haze SIP.

Table 13-10 shows how $PM_{2.5}$ emissions for each source category have changed. The table also includes the VISTAS 2018 emissions projections developed in the first planning period for comparison. Compared to the VISTAS 2018 emissions projections, $PM_{2.5}$ emissions were higher in the 2017 NEI for the onroad category. However, the overall $PM_{2.5}$ emissions across all categories in the 2017 NEI are approximately 35% lower than what VISTAS projected for 2018.

Table 13-10: $PM_{2.5}$ Emissions (tons) for the 2014 NEI, 2017 NEI, and 2018 VISTAS Inventories

PM2.5 Sector	NEI 2014 (tpy)	NEI 2017 (tpy)	VISTAS 2018G4 (tpy)
Point	16,391	14,293	36,297
Area	86,559	70,480	123,704
Onroad	5,163	4,532	2,380
Non Road	3,326	2,665	5,730
Fires	56,283	51,362	57,116
Total	**167,721**	**143,331**	**225,227**

For NO_X emissions (Table 13-11), there have been significant decreases in the point and non road categories. The 2017 NEI emissions for onroad and fires categories are higher than the 2018 projected emissions. However, the overall NO_X emissions from all categories for 2017 are approximately 16% lower than the 2018 projections.

Table 13-11: NOx Emissions (tons) for the 2014 NEI, 2017 NEI, and 2018 VISTAS Inventories

NO_X Sector	NEI 2014 (tpy)	NEI 2017 (tpy)	VISTAS 2018G4 (tpy)
Point	84,934	64,326	125,680
Area	41,067	36,052	41,332
Onroad	177,000	150,049	102,179
Non Road	29,785	25,227	64,579
Fires	15,668	14,418	14,243
Total	**348,454**	**290,072**	**348,013**

For SO_2 emissions (Table 13-12), point sources show the most significant decrease since 2014, and actual emissions from point sources are already 75% lower than the projected 2018 emissions. This is largely due to a significant reduction in oil use and shift to natural gas as well as installation of control measures from EPA rules such as MATS and the Data Requirements Rule. Overall, SO_2 emissions across all categories for 2017 are 75% below the 2018 projections.

Table 13-12: SO_2 Emissions (tons) for the 2014 NEI, 2017 NEI, and 2018 VISTAS Inventories

SO_2 Sector	NEI 2014 (tpy)	NEI 2017 (tpy)	VISTAS 2018G4 (tpy)
Point	91,824	32,018	127,858
Area	4,719	902	59,729
Onroad	1,239	1,253	1,457
Non Road	76	60	1,709
Fires	4,296	3,953	2,914
Total	**102,155**	**38,188**	**193,667**

Actual emissions reductions from the EGU sector have continued to decrease significantly due to installation of scrubbers and other controls on some of the larger power generation sources in Georgia. Repowering or shifting to natural gas, as well as some reduced utilization of coal EGUs and increased utilization of natural gas EGUs and renewable energy has also significantly reduced emissions of SO_2. Table 13-13 shows the CAMD emissions from 2014 to 2021.

Table 13-13: Georgia EGU SO_2 Emissions for CAMD (2014-2021)

SO_2 Emissions	2014	2015	2016	2017	2018	2019	2020	2021
CAMD	64,505.74	31,817.89	18,387.21	13,855.25	13,929.78	12,406.23	6,797.64	8,384.91

Figure 13-7 below depicts the trends for units that report annual emissions to CAMD and are located in Georgia. Since 2014, heat input has remained fairly steady with a decrease of about 7% over this period. The SO_2 emissions from these units decreased from 64,506 tons annually in 2014 to 12,406 tons annually in 2019, a decrease of 81%. The average SO_2 emission rate from these units decreased from 0.164 lbs/MMBtu in 2014 to 0.034 lbs/MMBtu in 2019, a decrease of 79%. The reductions in emissions are not attributable to reduced demand for power. Instead, the significant emission reductions are attributable to the overall emissions rate decrease that is due to the installation of controls and the use of cleaner burning fuels. Over the same period, NO_X emissions decreased from 36,567 tpy to 21,285 tpy, a drop of 42%.

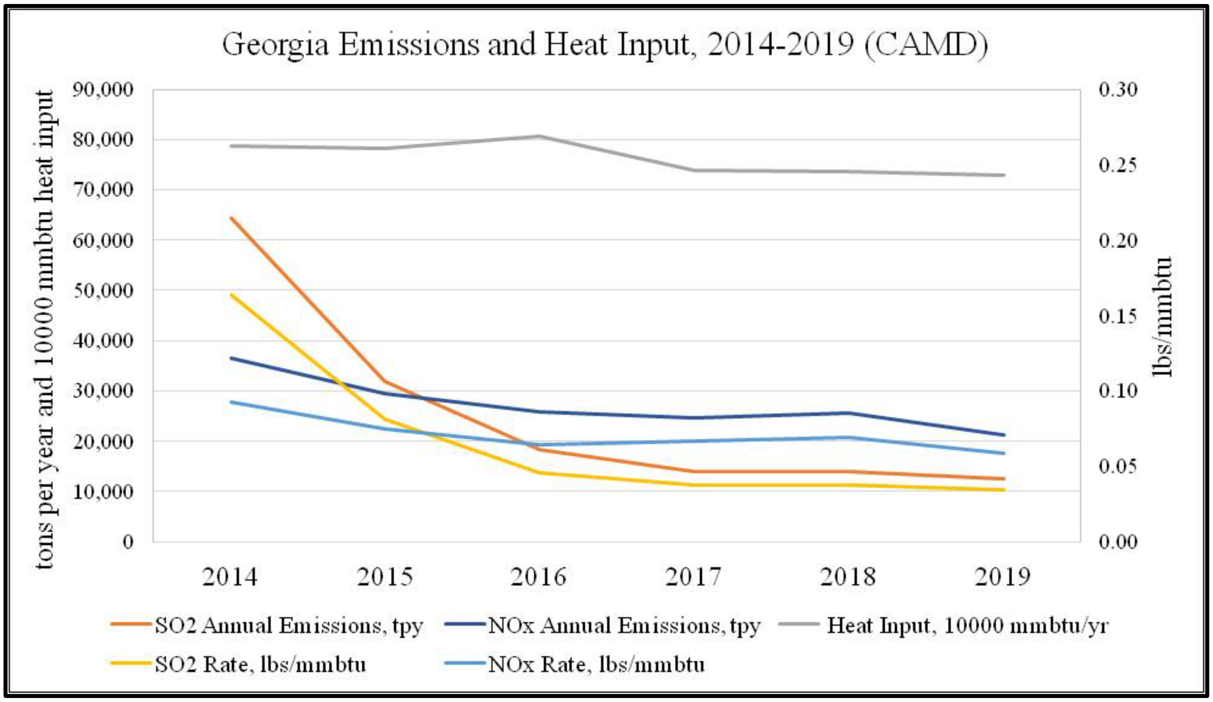

Figure 13-7: Georgia CAMD Emissions and Heat Input Data (Source: EPA CAMD Database)

Figure 13-8 shows the trends for units reporting to CAMD across all VISTAS states. Between 2014 and 2019, heat input to these units decreased approximately 11%. However, emissions from these units and the emission rates decreased significantly more than this. SO_2 emissions decreased from 831,079 to 169,013 tons annually, a decrease of 80%. The average SO_2 emission rate from these units decreased from 0.225 lb/MMBtu in 2014 to 0.051 lb/MMBtu in 2019, a decrease of 77%. Additional controls installed on certain units to meet the stringent requirements of MATS has further reduced the emission rates of those units. Over the same period, NO_X emissions decreased from 442,412 tpy to 228,673 tpy, a drop of 48%.

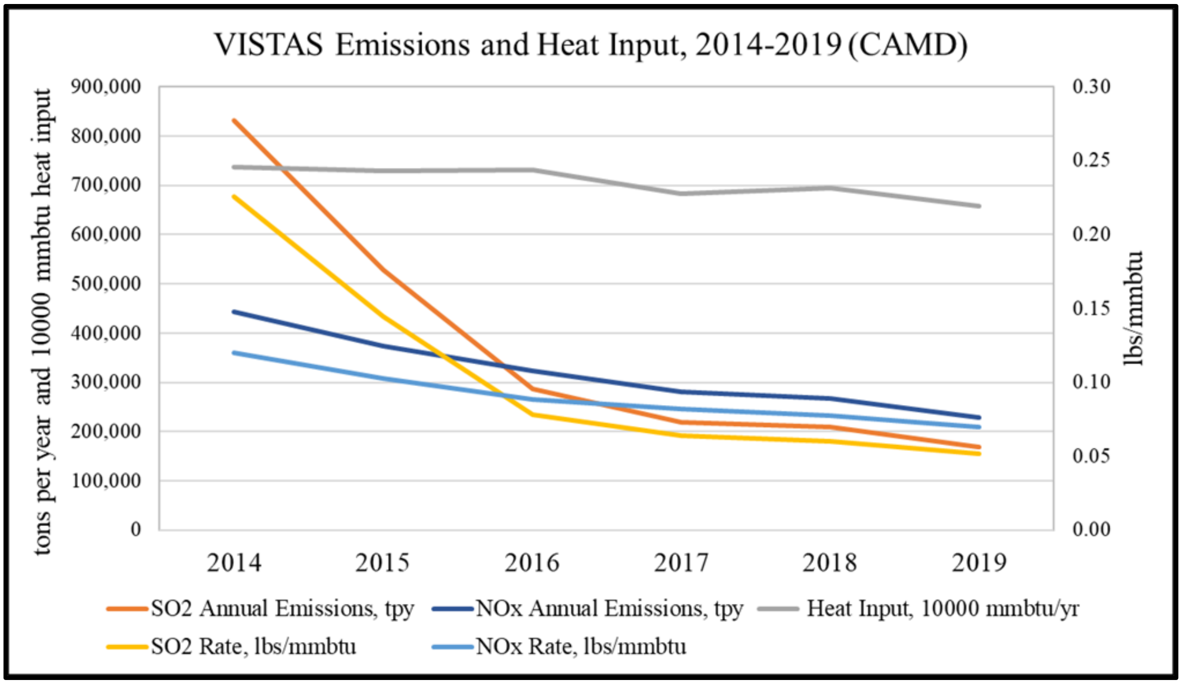

Figure 13-8: VISTAS CAMD Emissions and Heat Input Data (Source: EPA CAMD Database)

The figures above reflect the fact that the reductions in SO_2 and NO_X are generally a result of permanent changes at EGUs through the use of control technology and fuel switching, not reductions in heat input. Thus, visibility improvements from reduced sulfate and nitrate contribution should continue into the future even if demand for power and heat input to these units may have moderate increases. In addition, market forces on coal EGUs have shifted these units from baseload operations to load following operations with increased usage of natural gas and renewable energy sources for electricity production.

13.5.2. Assessments of Changes in Anthropogenic Emissions

Pursuant to 40 CFR 51.308(g)(5), there does not appear to be any significant change in anthropogenic emissions within Georgia or outside the State that have occurred since the period addressed in the most recent plan that would limit or impede progress in reducing pollutant emissions or improving visibility. These changes in anthropogenic emission were anticipated in that most recent plan. In particular, SO_2 emissions from point sources have significantly decreased since 2014. There have also been decreases in emissions of NO_X and $PM_{2.5}$ since 2014. As stated in Section 2.6, the IMPROVE monitoring data for 2014-2018 for the 20% most impaired days shows that sulfate continues to be the predominant visibility impairing pollutant.

13.6. Conclusion

This progress report documents that all control measures outlined in Georgia's regional haze SIP have been implemented and that Georgia has met all RPGs projected for 2018. Reductions in

SO_2 emissions have been significant and greater than VISTAS projected. In spite of significant reduction in SO_2, sulfates continue to play a significant role in visibility impairment, especially for the most anthropogenically impaired days. As SO_2 emissions continue to drop, nitrates may begin to have a larger relative impact on regional haze in future planning periods. The next regional haze progress report is due by January 31, 2025, and will cover progress in the second implementation period.