BART Exemption Modeling of Sources in Georgia

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

TRC Environmental Corporation, on behalf of VISTAS has been retained to conduct Best Available Retrofit Technology (BART) exemption modeling for a number of facilities in the southeastern United States. This report documents the results of the modeling simulations conducted in accordance with the VISTAS BART Protocol Revision 3.2 dated August 31, 2006 (VISTAS, 2006) for emissions from seven BART-eligible facilities in Georgia.

The VISTAS BART protocol is based on the use of the CALMET and CALPUFF models (Scire et al., 2000a, 2000b). The modeling approach uses 12-km VISTAS regional CALMET meteorological datasets for facilities located more than 50-km from the closest Class I area for screening simulations of predicted impacts. The highest impact during the three year simulation period is compared to a 0.5 deciview threshold. According to the VISTAS protocol, sources with impacts less than this threshold are not subject to BART control. For sources failing the screen by a small margin, or those located within 50 km of the closest Class I area, TRC performed modeling using the refined 4-km subregional CALMET Domain 4 datasets. The impacts on the 98^{th} percentile day (i.e., 8^{th} highest within a year) predicted by the refined simulations were compared to the 0.5 deciview threshold. Facilities with a maximum 98^{th} percentile impact below 0.5 deciview were determined to be exempt from BART controls

The modeling uses the VISTAS version of the CALPUFF modeling system (CALMET Version 5.723 and CALPUFF Version 5.754) available from the TRC Atmospheric Studies Group web site (http://www.src.com).

2. SOURCE PARAMETERS

VISTAS BART exemption modeling was performed for seven facilities in Georgia. These sources are: (1) Brunswick Mill, (2) Tronox, (3) Augusta Plant, (4) PCA Valdosta Mill, (5) Interstate Paper, LLC, (6) DSM Chemicals North, and (7) Chemical Products Corp. Five of these facilities were modeled using the screening 12-km regional VISTAS CALMET domain with CALPUFF computational subdomains as shown in Figure 3-1. Two facilities (Brunswick Mill and Interstate Paper, LLC) were modeled using the 4-km subregional Domain 4 since their distance to the closest Class I Area (Wolf Island) is less than 50 km. PCA Valdosta Mill facility was first modeled using the 12-km domain as a screening run, and then using the 4-km domain as a refined run. Locations of the seven Georgia facilities are shown in Figures 3-1 through 3-3.

Source parameters and emissions rates as provided by the State of Georgia for each of the facilities used in the CALPUFF simulations are shown in Tables 2-1a through 2-7a. Tables 2-1b through 2-7b show the particle speciation used in the CALPUFF simulations. In the tables, the column heading PM_{10} includes all PM mass (condensable plus filterable) emitted as particulate matter less than 10 micrometers (µm) in diameter. The emissions labeled as $PM_{2.5}$ are a subset of the PM_{10} composed of particles less than 2.5 µm in diameter. All condensable emissions are assumed to be in the $PM_{2.5}$ size range. The PM_{10} and $PM_{2.5}$ categories include H_2SO_4 emissions, which in the model are treated as primary sulfate (SO_4). The emissions of H_2SO_4 are adjusted by the ratio of molecular weights (96/98) to obtain the emissions as SO_4 which is entered into the model.

The PM_{10} size distribution was represented in the modeling as six explicit size ranges. The particle sizes modeled were as 8.0 µm diameter size particles (PM800) reflecting the size bin 6-10 µm, 4.25 µm diameter particles (PM425) for the size bin 2.5-6 µm, 1.875 µm particles (PM187) for the size bin 1.25-2.5 µm, 1.125 µm particles (PM112) for the size bin 1.00-1.25 µm, 0.8125 µm particles (PM081) for the size bin 0.625-1.00 µm, and 0.5625 µm (PM056) for the size range 0.500-0.625 µm. PM056 was also used for all particles less than 0.5 µm diameter. Emissions of particulate matter in the 2.5-10 µm diameter size range define “coarse particulate matter”. Fine particles (soil) were defined using the particle size categories of PM187, PM112, PM081, and PM056 which is particulate matter with a size of 2.5 µm diameters or less. For sources with no speciation (emissions given as PM_{10} only) it was conservatively assumed that all the particulate emissions were condensable which have higher extinction efficiency than either soil or coarse particulate matter. Condensable emissions were assumed to be evenly distributed across the smallest two size categories modeled (i.e. 50 percent in PM081 and 50 percent in PM056).

For the Brunswick Mill facility, Tables 2-1a and 2-1b show source parameters, emissions and particle speciation data extracted from the “BART Exemption Protocol Brunswick.doc” document, Tables 1 and 2. For three of the four stacks, PM distribution was provided. For one of the stacks (MG04A), the PM distribution was not provided, so PM_{10} emissions were equally divided between the two size categories of OC for modeling purposes.

For the Tronox facility, Tables 2-2a and 2-2b show source parameters, emissions and particle speciation data obtained from the “Tronox Emission data.pdf” document. For one of the stacks (1024), PM_{10} emissions were equally divided between the two size categories of OC for modeling purposes. All PM emissions from the second stack (1356) compose of H_2SO_4 emissions.

For the Augusta Plant, Table 2-3a show source parameters and emissions obtained from the “Prayon BART Modeling Protocolrev.doc”, Table 2-1. The PM speciation was not provided. Therefore, All PM_{10} emissions were equally divided between the two size categories of OC (Table 2-3b).

For the PCA Valdosta Mill, Tables 2-4a and 2-4b show source parameters, emissions and particle speciation data obtained from the “PCA Table 3_1 Emission Rates.pdf” document. The PM distribution for all four stacks was extracted from the information provided in this document.

For the Interstate Paper, LLC, Table 2-5a show source parameters and emissions obtained from the “EPD BART Emissions.xls” file. The PM speciation was not provided. Therefore, All PM_{10} emissions were equally divided between the two size categories of OC (Table 2-5b).

For DSM Chemicals North, Table 2-6a show source parameters and emissions obtained from the “DSM Chemicals Emissions Stack Data revisedp2.xls” document. The PM speciation was not provided. Therefore, All PM_{10} emissions were equally divided between the two size categories of OC (Table 2-6b).

For Chemical Products Corp, Table 2-7a show source parameters and emissions obtained from the “CPCBART VISTAS modeling emissionsa.xls” file.

Table 2-1a. Brunswick Mill: Source Parameters and Emissions[1]

Stack ID #	Lambert Conformal Coordinates		Stack Height	Base Elevation	Diameter	Gas Exit Velocity	Stack Gas Exit Temp.	SO_2 Emissions	H_2SO_4 Emissions[2]	NO_x Emissions	PM_{10} Emissions[3]	$PM_{2.5}$ Emissions	NH_3 Emissions
	LCC East	LCC North											
	km	km	m	m	m	m/s	K	g/s	g/s	g/s	g/s	g/s	g/s
R401A	1470.759	-853.324	82.90	1.50	3.95	8.20	474.00	3.8800	0.2204	10.4000	2.6100	1.6000	-
R402A	1470.762	-853.334	82.90	1.50	3.95	8.20	474.00	3.8800	0.2204	10.4000	2.6100	1.6000	-
MG04A	1470.876	-853.572	19.80	1.50	3.66	14.33	339.00	-	-	-	0.1110	0.1110	-
R403A	1470.757	-853.315	80.50	1.50	1.04	18.60	350.00	0.1600	-	0.3500	2.1000	1.9000	-

Table 2-1b. Brunswick Mill: Particle Speciation[1]

Stack ID #	Particle speciation		Condensable					Filterable									
	condensable PM_{10}	filterable PM_{10}	organic condensable (OC)		inorganic condensable		H_2SO_4	COARSE		Soil				Elemental Carbon (EC)			
			0.625-1.0 µm	0.5-0.625 µm	0.625-1.0 µm	0.5-0.625 µm	M[4]=0.48 SD[4]=2.0 µm	6-10 µm	2.5-6 µm	1.25-2.5 µm	1.0-1.25 µm	0.625-1.0 µm	0.5-0.625 µm	1.25-2.5 µm	1.0-1.25 µm	0.625-1.0 µm	0.5-0.625 µm
	%	%	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s
R401A	12.0	88.0	0.0441	0.0441	-	-	0.2204	0.3882	0.6215	0.5138	0.1398	0.2581	0.3269	0.0197	0.0054	0.0099	0.0126
R402A	12.0	88.0	0.0441	0.0441	-	-	0.2204	0.3882	0.6215	0.5138	0.1398	0.2581	0.3269	0.0197	0.0054	0.0099	0.0126
MG04A	100.0	0.0	0.0555	0.0555	-	-	-	-	-	-	-	-	-	-	-	-	-
R403A	16.0	84.0	0.1680	0.1680	-	-	-	0.0769	0.1231	0.6251	0.1699	0.3139	0.3977	0.0240	0.0065	0.0121	0.0153

1 Emission and speciation data extracted and obtained from Tables 1 and 2 of the "BART Exemption Protocol Brunswick.doc" document.
2 H_2SO_4 emissions are entered in CALPUFF as SO_4 i.e., weighted by ratio of molecular weights (96/98).
3 PM_{10} emission rate includes filterable and condensable emissions. The condensable component includes H_2SO_4 emissions.
4 M and SD stand for Geometric Mass Mean Diameter and Geometric Standard Deviation. These are the parameters used to calculate the (SO_4) particle size distribution in CALPUFF.

Table 2-2a. Tronox: Source Parameters and Emissions[1]

Stack ID #	Lambert Conformal Coordinates		Stack Height	Base Elevation	Diameter	Gas Exit Velocity	Stack Gas Exit Temp.	SO_2 Emissions	H_2SO_4 Emissions[2]	NO_x Emissions	PM_{10} Emissions[3]	$PM_{2.5}$ Emissions	NH_3 Emissions
	LCC East	LCC North											
	km	km	m	m	m	m/s	K	g/s	g/s	g/s	g/s	g/s	g/s
1024	1499.340	-745.631	18.29	3.00	0.30	7.62	297.04	-	-	-	0.1200	0.1200	-
1356	1499.580	-745.337	45.72	3.00	1.68	9.45	350.37	18.9000	0.7100	0.8200	0.7100	0.7100	-

Table 2-2b. Tronox: Particle Speciation[1]

Stack ID #	Particle speciation		Condensable					Filterable									
	condensable PM_{10}	filterable PM_{10}	organic condensable (OC)		inorganic condensable		H_2SO_4	COARSE		Soil				Elemental Carbon (EC)			
			0.625-1.0 µm	0.5-0.625 µm	0.625-1.0 µm	0.5-0.625 µm	M[4]=0.48 SD[4]=2.0 µm	6-10 µm	2.5-6 µm	1.25-2.5 µm	1.0-1.25 µm	0.625-1.0 µm	0.5-0.625 µm	1.25-2.5 µm	1.0-1.25 µm	0.625-1.0 µm	0.5-0.625 µm
	%	%	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s
1024	100.0	0.0	0.0600	0.0600	-	-	-	-	-	-	-	-	-	-	-	-	-
1356	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[1] Emission data extracted from "Tronox Emission data.pdf" document. The PM speciation was not provided by the state. All PM_{10} - H_2SO_4 emissions were equally divided between the two size categories of OC. This is a conservative approach since organic condensables have an extinction efficiency of 4 m^2/g.

[2] H_2SO_4 emissions are entered in CALPUFF as SO_4 i.e., weighted by ratio of molecular weights (96/98).

[3] PM_{10} emission rate includes filterable and condensable emissions. The condensable component includes H_2SO_4 emissions.

[4] M and SD stand for Geometric Mass Mean Diameter and Geometric Standard Deviation. These are the parameters used to calculate the (SO_4) particle size distribution in CALPUFF.

Table 2-3a. Augusta Plant: Point Source Parameters and Emissions[1]

Stack ID #	Lambert Conformal Coordinates LCC East	Lambert Conformal Coordinates LCC North	Stack Height	Base Elevation	Diameter	Gas Exit Velocity	Stack Gas Exit Temp.	SO_2 Emissions	H_2SO_4 Emissions[2]	NO_x Emissions	PM_{10} Emissions[3]	$PM_{2.5}$ Emissions	NH_3 Emissions
	km	km	m	m	m	m/s	K	g/s	g/s	g/s	g/s	g/s	g/s
S201	1386.472	-617.364	2.44	61.87	0.81	4.57	353.15	-	-	-	1.2600	1.2600	-
S304	1386.472	-617.364	5.49	71.02	0.25	16.00	366.48	-	-	0.0315	0.0378	0.0378	-
S306	1386.472	-617.364	6.86	71.02	0.25	16.00	310.93	-	-	-	0.0365	0.0365	-
S305	1386.472	-617.364	6.63	71.02	0.36	18.90	405.37	-	-	0.0328	0.0643	0.0643	-
S307	1386.472	-617.364	6.86	71.02	0.25	16.00	298.15	-	-	-	0.0365	0.0365	-

Table 2-3b. Augusta Plant: Particle Speciation[1]

Stack ID #	Particle speciation		Condensable					Filterable									
	condensable PM_{10}	filterable PM_{10}	organic condensable (OC)		inorganic condensable		H_2SO_4	COARSE		Soil				Elemental Carbon (EC)			
			0.625-1.0 µm	0.5-0.625 µm	0.625-1.0 µm	0.5-0.625 µm	M[4]=0.48 SD[4]=2.0 µm	6-10 µm	2.5-6 µm	1.25-2.5 µm	1.0-1.25 µm	0.625-1.0 µm	0.5-0.625 µm	1.25-2.5 µm	1.0-1.25 µm	0.625-1.0 µm	0.5-0.625 µm
	%	%	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s
S201	100.0	0.0	0.6300	0.6300	-	-	-	-	-	-	-	-	-	-	-	-	-
S304	100.0	0.0	0.0189	0.0189	-	-	-	-	-	-	-	-	-	-	-	-	-
S306	100.0	0.0	0.0183	0.0183	-	-	-	-	-	-	-	-	-	-	-	-	-
S305	100.0	0.0	0.0321	0.0321	-	-	-	-	-	-	-	-	-	-	-	-	-
S307	100.0	0.0	0.0183	0.0183	-	-	-	-	-	-	-	-	-	-	-	-	-

[1] Emission data extracted from Table 2-1 the "Prayon BART Modeling Protocolrev.doc" document. The PM speciation was not provided by the state. All PM_{10} - H_2SO_4 emissions were equally divided between the two size categories of OC. This is a conservative approach since organic condensables have an extinction efficiency of 4 m^2/g.

[2] H_2SO_4 emissions are entered in CALPUFF as SO_4 i.e., weighted by ratio of molecular weights (96/98).

[3] PM_{10} emission rate includes filterable and condensable emissions. The condensable component includes H_2SO_4 emissions.

[4] M and SD stand for Geometric Mass Mean Diameter and Geometric Standard Deviation. These are the parameters used to calculate the (SO_4) particle size distribution in CALPUFF.

Table 2-4a. PCA Valdosta Mill: Source Parameters and Emissions[1]

Stack ID #	Lambert Conformal Coordinates		Stack Height	Base Elevation	Diameter	Gas Exit Velocity	Stack Gas Exit Temp.	SO_2 Emissions	H_2SO_4 Emissions[2]	NO_x Emissions	PM_{10} Emissions[3]	$PM_{2.5}$ Emissions	NH_3 Emissions
	LCC East	LCC North											
	km	km	m	m	m	m/s	K	g/s	g/s	g/s	g/s	g/s	g/s
CSS	1310.712	-933.115	61.26	61.00	3.05	14.10	338.00	12.4500	-	11.3500	5.7700	5.7700	-
3RFS	1310.769	-933.133	55.17	61.00	2.13	20.71	395.00	14.2600	-	5.1100	2.1760	1.9400	-
3SDTS	1310.776	-933.163	33.53	61.00	1.22	9.31	328.00	0.0600	-	-	0.2200	0.2200	-
SLAKER	1310.877	-933.186	27.43	61.00	0.61	7.34	311.00	-	-	-	0.1540	0.1510	-

Table 2-4b. PCA Valdosta Mill: Particle Speciation[1]

Stack ID #	Particle speciation		Condensable					Filterable									
	condensable PM_{10}	filterable PM_{10}	organic condensable (OC)		inorganic condensable		H_2SO_4	COARSE		Soil				Elemental Carbon (EC)			
			0.625-1.0 µm	0.5-0.625 µm	0.625-1.0 µm	0.5-0.625 µm	M[4]=0.48 SD[4]=2.0 µm	6-10 µm	2.5-6 µm	1.25-2.5 µm	1.0-1.25 µm	0.625-1.0 µm	0.5-0.625 µm	1.25-2.5 µm	1.0-1.25 µm	0.625-1.0 µm	0.5-0.625 µm
	%	%	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s
CSS	16.1	83.9	0.4656	0.4656	-	-	-	-	-	1.8209	0.4950	0.9142	1.1582	0.1867	0.0508	0.0937	0.1188
3RFS	59.1	40.9	0.6432	0.6432	-	-	-	0.0907	0.1445	0.2675	0.0727	0.1343	0.1701	0.0042	0.0011	0.0021	0.0026
3SDTS	0.0	100.0	-	-	-	-	-	-	-	0.0913	0.0248	0.0458	0.0581	-	-	-	-
SLAKER	0.0	100.0	-	-	-	-	-	0.0012	0.0018	0.0626	0.0170	0.0314	0.0398	-	-	-	-

[1] Emission and speciation data extracted and obtained from "PCA Table 3_1 Emission Rates.pdf" document.
[2] H_2SO_4 emissions are entered in CALPUFF as SO_4 i.e., weighted by ratio of molecular weights (96/98).
[3] PM_{10} emission rate includes filterable and condensable emissions. The condensable component includes H_2SO_4 emissions.
[4] M and SD stand for Geometric Mass Mean Diameter and Geometric Standard Deviation. These are the parameters used to calculate the (SO_4) particle size distribution in CALPUFF.

Table 2-5a. Interstate Paper, LLC: Source Parameters and Emissions[1]

Stack ID #	Lambert Conformal Coordinates		Stack Height	Base Elevation	Diameter	Gas Exit Velocity	Stack Gas Exit Temp.	SO_2 Emissions	H_2SO_4 Emissions[2]	NO_x Emissions	PM_{10} Emissions[3]	$PM_{2.5}$ Emissions	NH_3 Emissions
	LCC East	LCC North											
	km	km	m	m	m	m/s	K	g/s	g/s	g/s	g/s	g/s	g/s
LK	1470.714	-788.897	15.24	3.60	1.52	4.96	342.09	0.1600	-	2.2000	0.7400	0.7200	-
RB	1470.714	-789.026	46.04	4.20	2.74	13.73	353.37	0.1200	-	8.8000	5.5000	5.4000	-

Table 2-5b. Interstate Paper, LLC: Particle Speciation[1]

Stack ID #	Particle speciation		Condensable					Filterable									
	condensable PM_{10}	filterable PM_{10}	organic condensable (OC)		inorganic condensable		H_2SO_4	COARSE		Soil				Elemental Carbon (EC)			
			0.625-1.0 µm	0.5-0.625 µm	0.625-1.0 µm	0.5-0.625 µm	M[4]=0.48 SD[4]=2.0 µm	6-10 µm	2.5-6 µm	1.25-2.5 µm	1.0-1.25 µm	0.625-1.0 µm	0.5-0.625 µm	1.25-2.5 µm	1.0-1.25 µm	0.625-1.0 µm	0.5-0.625 µm
	%	%	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s
LK	100.0	0.0	0.3700	0.3700	-	-	-	-	-	-	-	-	-	-	-	-	-
RB	100.0	0.0	2.7500	2.7500	-	-	-	-	-	-	-	-	-	-	-	-	-

1 Stack parameters and emission data obtained from "EPD BART Emissions.xls" file. The PM speciation was not provided by the state. All PM_{10} - H_2SO_4 emissions were equally divided between the two size categories of OC. This is a conservative approach since organic condensables have an extinction efficiency of 4 m^2/g.

2 H_2SO_4 emissions are entered in CALPUFF as SO_4 i.e., weighted by ratio of molecular weights (96/98).

3 PM_{10} emission rate includes filterable and condensable emissions. The condensable component includes H_2SO_4 emissions.

4 M and SD stand for Geometric Mass Mean Diameter and Geometric Standard Deviation. These are the parameters used to calculate the (SO_4) particle size distribution in CALPUFF.

Table 2-6a. DSM Chemicals North: Source Parameters and Emissions[1]

Stack ID #	Lambert Conformal Coordinates		Stack Height	Base Elevation	Diameter	Gas Exit Velocity	Stack Gas Exit Temp.	SO_2 Emissions	H_2SO_4 Emissions[2]	NO_x Emissions	PM_{10} Emissions[3]	$PM_{2.5}$ Emissions	NH_3 Emissions
	LCC East	LCC North											
	km	km	m	m	m	m/s	K	g/s	g/s	g/s	g/s	g/s	g/s
S014	1390.356	-611.414	67.06	40.31	3.58	15.15	422.04	27.8241	-	11.0933	2.4169	0.6272	-
S020	1390.356	-611.414	24.38	38.10	1.37	15.09	449.82	-	-	2.6581	-	-	-

Table 2-6b. DSM Chemicals North: Particle Speciation[1]

Stack ID #	Particle speciation		Condensable					Filterable									
	condensable PM_{10}	filterable PM_{10}	organic condensable (OC)		inorganic condensable		H_2SO_4	COARSE		Soil				Elemental Carbon (EC)			
			0.625-1.0 µm	0.5-0.625 µm	0.625 -1.0 µm	0.5-0.625 µm	M[4]=0.48 SD[4]=2.0 µm	6-10 µm	2.5-6 µm	1.25-2.5 µm	1.0-1.25 µm	0.625-1.0 µm	0.5-0.625 µm	1.25-2.5 µm	1.0-1.25 µm	0.625-1.0 µm	0.5-0.625 µm
	%	%	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s
S014	100.0	0.0	1.2084	1.2084	-	-	-	-	-	-	-	-	-	-	-	-	-
S020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1 Emission data extracted from the "DSM Chemicals Emissions Stack Data revisedp2.xls" document. The PM speciation was not provided by the state. All PM_{10} - H_2SO_4 emissions were equally divided between the two size categories of OC. This is a conservative approach since organic condensables have an extinction efficiency of 4 m^2/g.

2 H_2SO_4 emissions are entered in CALPUFF as SO_4 i.e., weighted by ratio of molecular weights (96/98).

3 PM_{10} emission rate includes filterable and condensable emissions. The condensable component includes H_2SO_4 emissions.

4 M and SD stand for Geometric Mass Mean Diameter and Geometric Standard Deviation. These are the parameters used to calculate the (SO_4) particle size distribution in CALPUFF.

3. GEOPHYSICAL AND METEOROLOGICAL DATA

3.1 Modeling Domain, Terrain, and Class I Areas

Gridded terrain elevations for the 12-km regional VISTAS modeling domain are derived from GTOPO30, a global digital elevation model (DEM) with a horizontal grid spacing of 30 arc seconds (approximately 1 kilometer). GTOPO30 is a global data set covering the full extent of latitude from 90 degrees south to 90 degrees north, and the full extent of longitude from 180 degrees west to 180 degrees east, developed by the United States Geological Survey (USGS). The horizontal grid spacing is 30-arc seconds, resulting in a DEM having dimensions of 21,600 rows and 43,200 columns. The horizontal coordinate system is decimal degrees of latitude and longitude referenced to WGS84. The vertical units represent elevation in meters above mean sea level. GTOPO30 has been divided into 33 smaller pieces, or tiles. Two of these tiles cover regional VISTAS domain: W100N40 and W100N90.

Gridded terrain elevations for the 4-km modeling VISTAS Domain 4 are derived from 3 arc-second DEMs produced by the USGS. Data are provided in files covering 1-degree by 1-degree blocks of latitude and longitude. The 1-degree DEMs are produced by the Defense Mapping Agency using cartographic and photographic sources. USGS 1:250,000 scale topographic maps are the primary source of 1-degree DEMs. One-degree DEM data consists of an array of 1201 by 1201 elevations referenced on the geographic (latitude/ longitude) coordinate system of the World Geodetic System 1972 Datum. Elevations are in meters relative to mean sea level, and the spacing of the elevations along each profile is 3 arc-seconds, which corresponds to a spacing of approximately 90 meters.

The VISTAS CALMET 12-km regional domain was used in CALPUFF modeling and BART visibility analysis for the following facilities: Tronox, Augusta Plant, PCA Valdosta Mill, DSM Chemicals North, and Chemical Products Corp. The CALPUFF computational subdomain was chosen to cover all Class I areas that fall into the 300 km circle around the GA sources, as well as a 50 km buffer zone from these Class I areas and Georgia facilities. The subdomain extends at least 50 km from the Class I areas and all of the facilities in order to provide an adequate buffer zone at the boundaries, and to allow the effects of flow curvature and possible small-scale recirculation to be evaluated.

Figure 3-1 shows contours of the terrain averaged to 12 km grid cells on the VISTAS 12-km regional domain. Blue rectangle depicts the area of the CALPUFF computational subdomain covering 720 km by 948 km or 60x79 grid cells. This subdomain was used for modeling Tronox, Augusta Plant, PCA Valdosta Mill, DSM Chemicals North facilities. Class I areas included in this computational subdomain and analysis are: Cape Romain, Chassahowitzka, Cohutta, Great Smoky Mountains, Joyce Kilmer-Slickrock, Linville Gorge, Okefenokee, Shining Rock, St. Marks, and Wolf Island. For the Chemical Products Corp, Sipsey is an additional Class I area that is located within the 300 km from the facility. For this facility, computational domain was

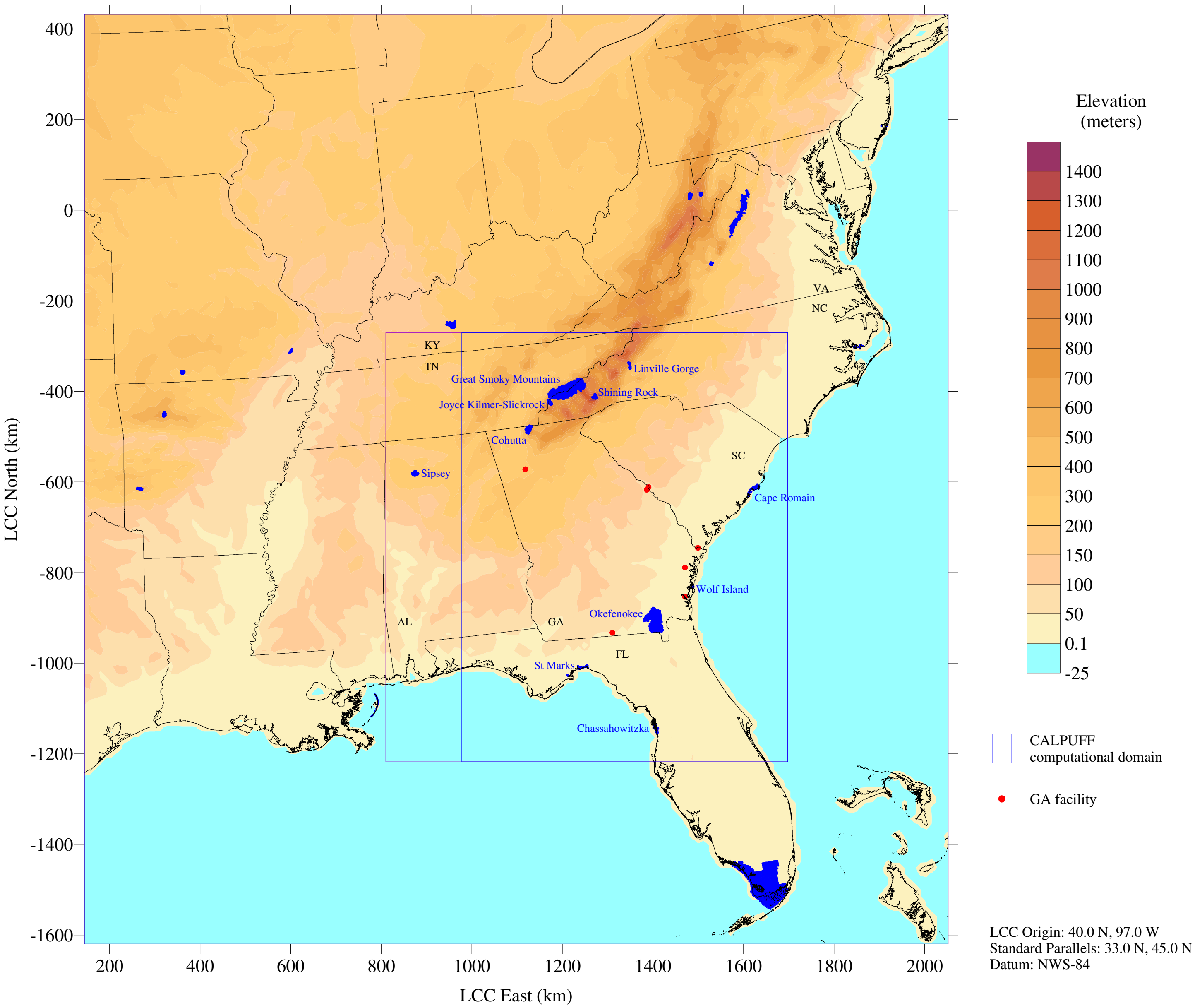

Figure 3-1. Terrain elevations for the CALMET 12-km Regional Domain. The CALPUFF computational subdomains, the Class I areas and the locations of Georgia facilities are also shown.

extended to the west as shown by the purple line in Figure 3-1. This computational domain covers 888 km by 948 km or 74x79 grid cells. A Lambert Conformal Projection is used with an origin of 40.0N, 97.0W and standard parallels at 33N and 45N. The datum used is NWS-84.

The subregional VISTAS 4-km CALMET Domain 4 was used in CALPUFF modeling and BART visibility analysis for Brunswick Mill, Interstate Paper, LLC and PCA Valdosta Mill sources. VISTAS Domain 4 was designed for the refined modeling of the Georgia, South Carolina and Alabama sources. It covers entire states of Georgia, South Carolina and Alabama, all Class I areas that are within 300 km from any of the sources in GA, SC and AL, as well as a 50 km buffer zone from these Class I areas and GA, SC and AL facilities. Domain 4 covers an area of 992 km by 1028 km. The CALMET simulations use a resolution of 4 km in the horizontal resulting in 248x257 grid cells. Figure 3-2 shows terrain contours for Domain 4 averaged to 4 km grid cells, seven Georgia sources modeled, and Class I areas within the Domain 4. The CALPUFF computational domain is the same as the CALMET Domain 4.

3.2 Land Use

The USGS Land Use data within the CALMET regional and subregional domains have been used to produce a gridded field of dominant land use categories. The land use data were obtained in Composite Theme Grid format (CTG) from the USGS, with a resolution of 200 m. For the portions of the domains where CTG data were missing, North America USGS land use/land cover data have been used. The North America land cover data base is one portion of a global land cover characteristics data base that was developed on a continent-by-continent basis with 1-km nominal spatial resolution.

Land use data were processed to produce a 12 km and a 4 km resolution gridded field of fractional land use categories for the regional domain and the subregional Domain 4, respectively. The 37 USGS land use categories were then mapped into 14 CALMET land use categories. Surface properties such as albedo, Bowen ratio, roughness length, and leaf area index were computed proportionally to the fractional land use. The USGS land use categories and their associated geophysical parameters are described in Scire et al. (2000a). Figure 3-3 shows the dominant land use categories for each 4-km CALMET grid cell in modeling Domain 4.

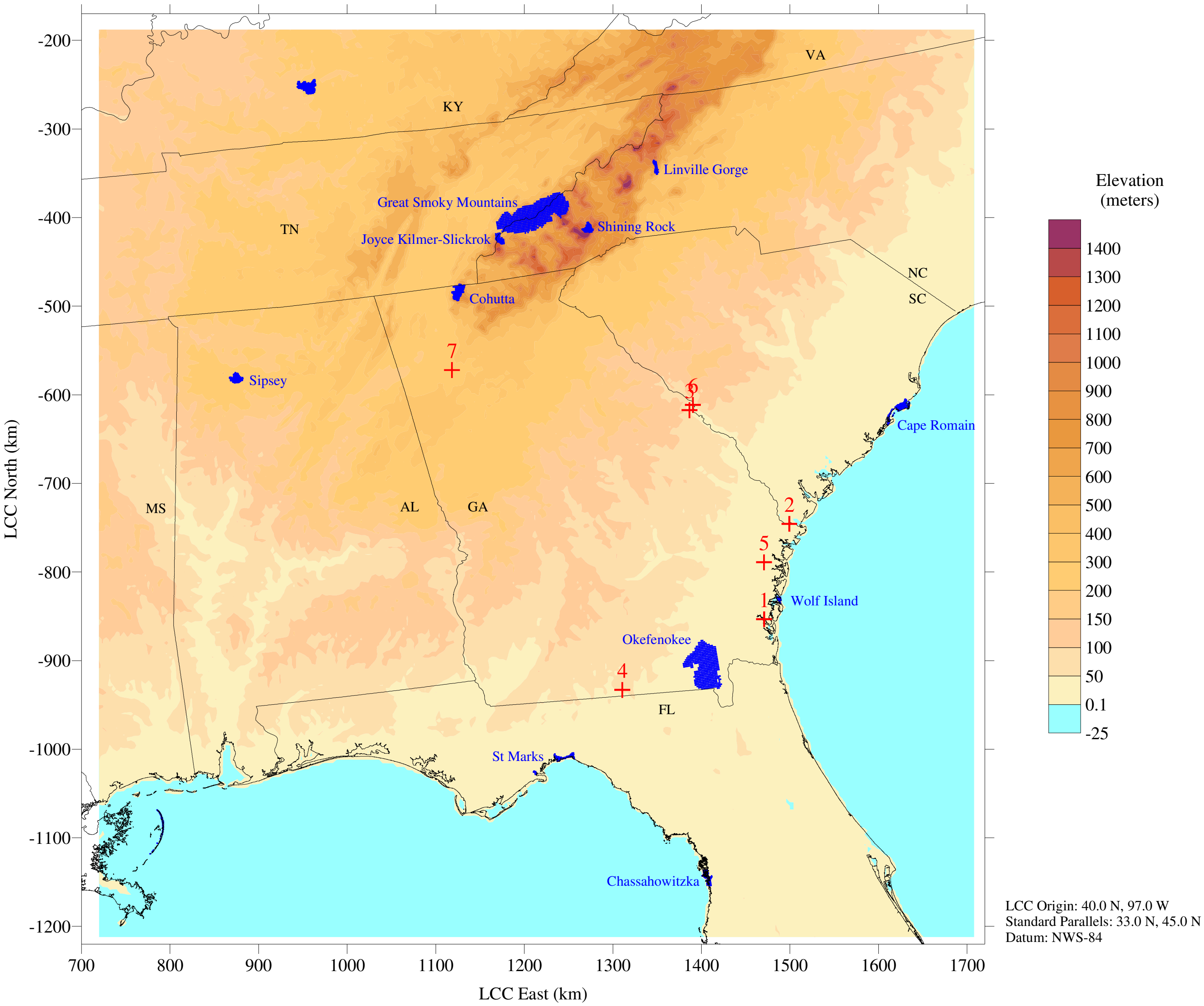

Figure 3-2. Terrain elevations for the CALMET/CALPUFF Domain 4. The Class I areas and the sites of Georgia facilities are also shown.

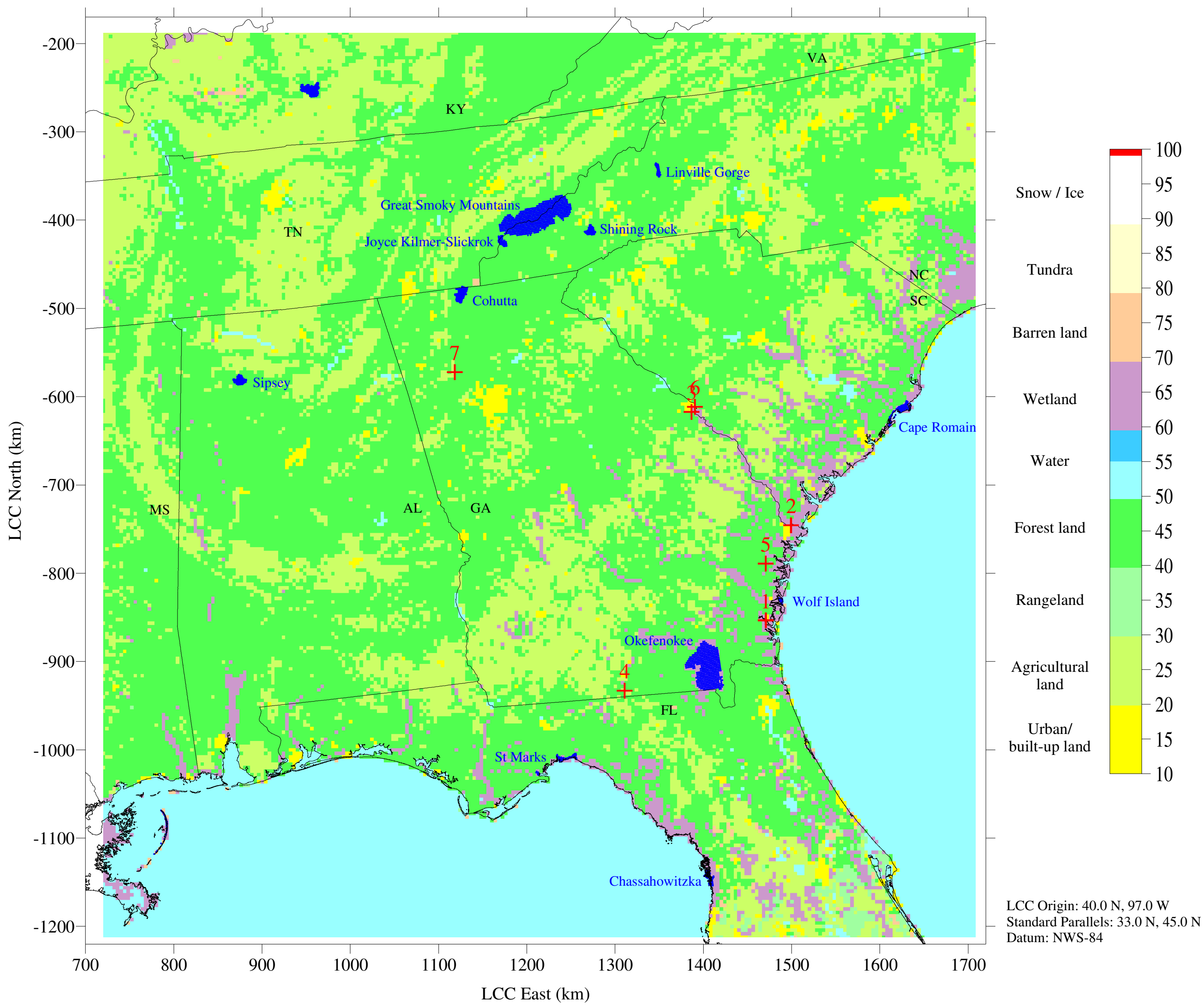

Figure 3-3. Land Use for the CALMET/ CALPUFF Domain 4. The Class I areas and the sites for the Georgia facilities are also shown.

3.3 Meteorological Data Base

The meteorological data used include the three dimensional gridded model output from the Fifth Generation Penn State/NCAR MM5 (Grell 1995) provided by VISTAS. VISTAS has assembled three years of MM5 meteorological data for the regional CALPUFF modeling. These MM5 datasets have been developed by EPA for 2001, VISTAS for 2002 and Midwest Regional Planning Organization (RPO) for 2003. The MM5 gridded data set consists of hourly values of wind speed, wind direction, temperature and pressure on a grid covering the VISTAS regional 12-km CALMET domain and VISTAS subregional 4-km CALMET Domain 4. The MM5 data was run at a horizontal spatial resolution of 12 km for 2001 and 2002 and 36-km for 2003.

For the regional 12-km domain, CALMET runs have been made in the no-observational mode. For the subregional 4-km Domain 4, available surface, upper air and precipitation stations were also included in the CALMET simulations along with the gridded MM5 data. Figure 3-4 shows a plot of the MM5 grid along with the surface, precipitation, buoys and upper air stations used in the CALMET simulations for Domain 4.

3.4 Air Quality Monitoring Data

CALPUFF uses hourly ozone concentration measurements in the chemical transformation rates (SO_2 to SO_4, NO_x to HNO_3/NO_3). The ambient ozone measurements are used in determining SO_2 loss rates due to chemical transformation to sulfate and in determining NO_x loss rates to nitrate. Ambient ozone monitoring data from the U.S. EPA AIRS and CASTNET networks were used to develop the hourly ozone monitoring data file (OZONE.DAT). Figure 3-5 provides a plot of available ozone monitoring stations that were used for the CALPUFF modeling.

For the base case simulations, a constant ammonia concentration of 0.5 parts per billion (ppb) was assumed as recommended by the Interagency Workgroup on Air Quality Modeling (IWAQM, 1998) for forested Class I areas. In this application of the model, the Ammonia Limiting Method (ALM) was not used.

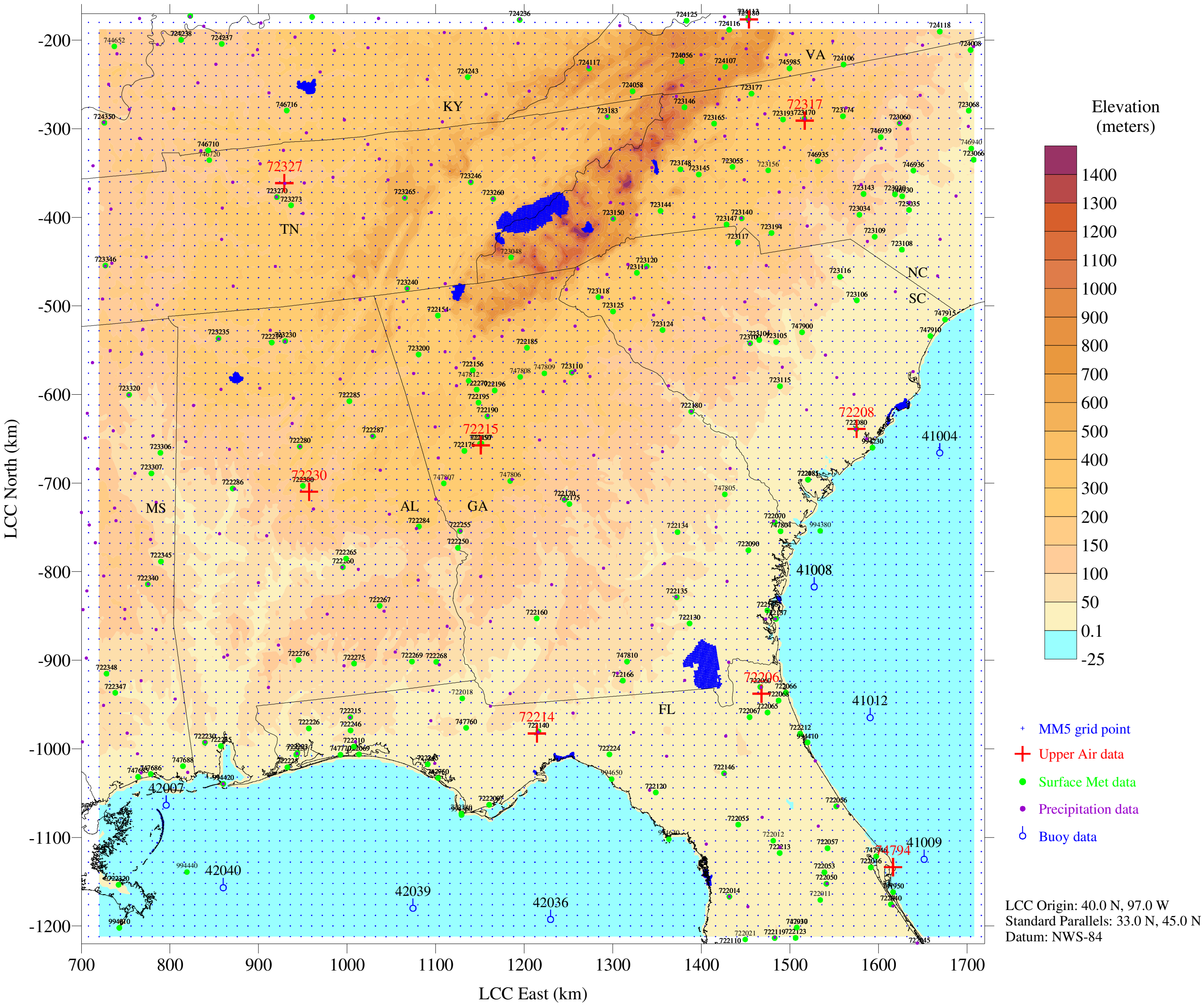

Figure 3-4. Plot of MM5 grid and surface, precipitation, buoy, and upper air stations for the CALMET/CALPUFF Subregional Domain 4.

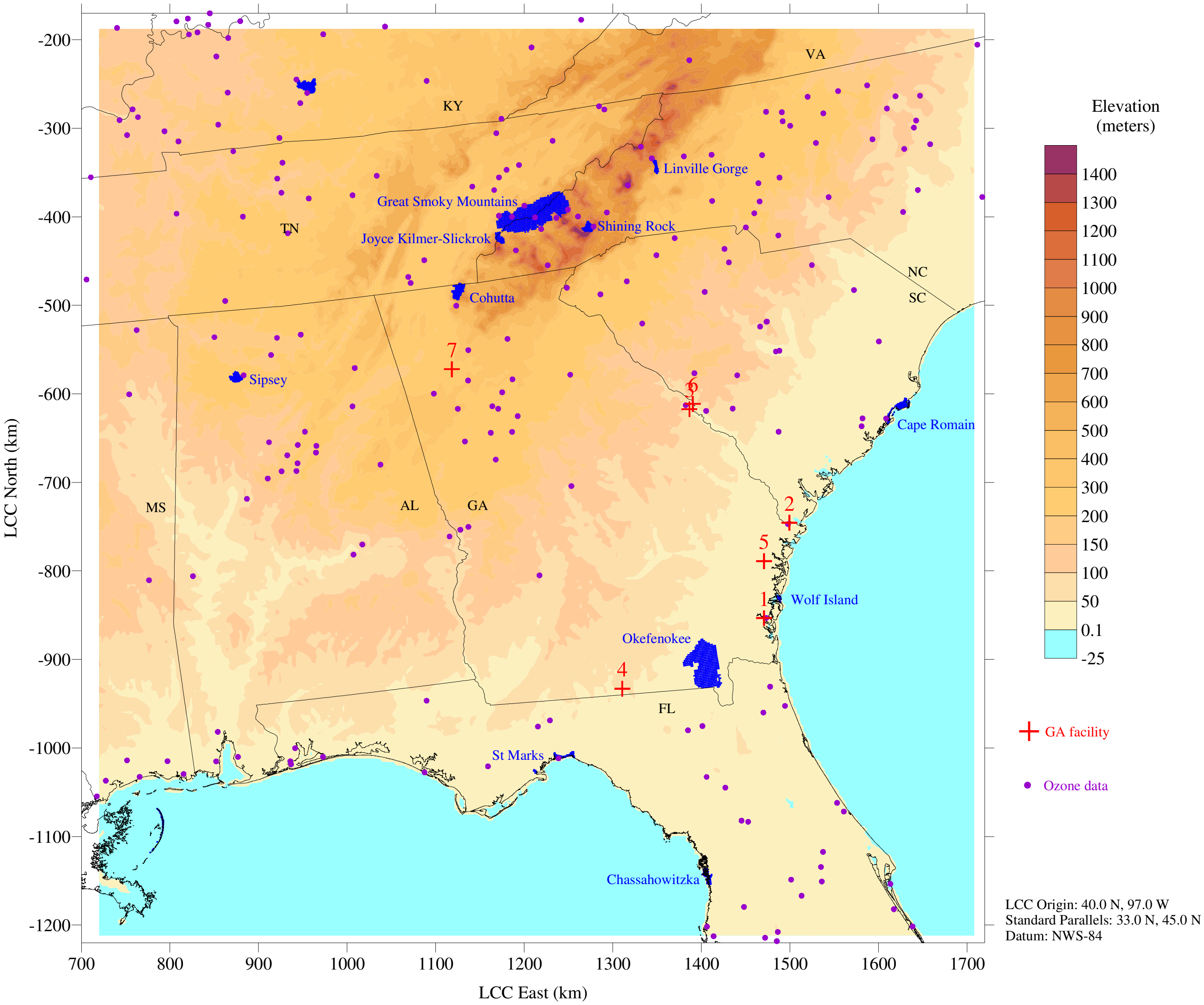

Figure 3-5. Plot of ozone stations used for the CALPUFF simulations. The Class I areas and the sites of the Georgia facilities are also shown.

4. RESULTS

The results of the CALMET and CALPUFF modeling for seven BART-eligible facilities in Georgia are presented in this section. The simulations were conducted over the three year period of 2001-2003. Modeling was conducted using the VISTAS 12-km or 4-km gridded CALMET meteorological data files. The POSTUTIL program was used to scale and sum the various CALPUFF concentration files to obtain total concentrations. Emission rates of SO_2, SO_4, and NO_X were input directly to the CALPUFF model while the six particulate species defining specific size categories were modeled as a unit emission rate (1 g/s) and then scaled source by source using the POSTUTIL program. CALPOST Method 6 was used to compute the extinction change in deciviews (dv) consistent with the procedures outlined in the VISTAS modeling protocol using the IMPROVE method (CSU, 1996) as recommended by FLAG (2000).

Table 4-8 provides the monthly f(RH) values based on the centroid of the Class I area as required for the application of Method 6. The last column in Tables 4-1 through 4-7 provides the annual average background b_{ext} values for each Class I area included in the analysis. For each Class I area, the Rayleigh scattering coefficient of 10 Mm^{-1} was subtracted from the annual average background b_{ext} and resulting values were entered in CALPOST as BKSOIL.

Tables 4-1 through 4-7 summarize the maximum predicted extinction changes for 2001, 2002, and 2003 for the Class I areas situated within a 300 km radius of each of the seven facilities. The highest values of the extinction change along with number of exceedances of the 0.5 dv threshold value are presented in the tables. For screening simulations using the 12-km CALMET meteorological grid, the highest predicted change in extinction is compared to the 0.5 dv threshold. According to the VISTAS protocol, screening simulation results below 0.5 dv for all three years indicates that facility is not subject to BART controls. For facilities failing the screen, or those located relatively close to one or more Class I areas (usually within 50 km) the state has recommended immediately using the more refined 4-km CALMET meteorological grid. In the refined simulations, the 98th percentile value of prediction change in extinction (i.e., the 8th highest day) is compared to the 0.5 dv threshold. If the highest 98th percentile value during the three year simulation period is below the 0.5 dv threshold, the source is considered not subject to BART controls.

Tables 4-1a and 4-1b show results for Brunswick Mill. This facility was modeled on the VISTAS 4-km CALMET Domain 4 refined grid. Table 4-1a show that in the Cape Romain, Chassahowitzka and St. Marks Class I areas, maximum predicted extinction change is below the 0.5 dv threshold value for all three years. Maximum predicted extinction change exceeds 0.5 dv in Okefenokee in 2003 and in Wolf Island in 2001 and 2003. However, the 98th percentile value, or the 8th highest predicted extinction change for these Class I areas do not exceed the 0.5 dv threshold value as shown in Tables 4-1a and 4-1b.

Tables 4-2, 4-3 and 4-6 show that for facilities Tronox, Augusta and DSM Chemicals North, modeled with 12-km CALMET domain, the maximum predicted extinction change for each of the Class I area are all below the 0.5 dv threshold value.

PCA Valdosta Mill was first modeled with 12-km domain. Visibility analyses showed that predicted maximum extinction changes in Chassahowitzka, Okefenokee, Wolf Island were below 0.5 dv for all three years Table 4-4a. In St. Marks, 0.5 dv was predicted to exceed 0.5 dv only once in 2003. As a refinement to this analysis, PCA Valdosta Mill sources were remodeled using the finer grid of 4 km (Table 4-4b). The maximum predicted extinction change in St. Marks in 2003 dropped from 0.551 dv to 0.510 dv. Table 4-4c shows eight highest values of extinction change for all three years for St. Marks.

Tables 4-5a and 4-5b show results for Interstate Paper, LCC. This is another facility, like Brunswick Mill that was modeled on the 4-km CALMET Domain 4 due to its proximity to the Wolf Island Class I area (less than 50 km). Table 4-5a show that in Cape Romain, Okefenokee and St. Marks Class I areas, maximum predicted extinction change is below the 0.5 dv threshold value for all three years. Maximum predicted extinction change exceeds 0.5 dv in Wolf Island with more than eight exceedances of the threshold value (Table 4-5b).

Table 4-1a. Summary of Visibility Results for Brunswick Mill – Refined Run (4-km grid)

Class I Area	2001	2002	2003	Annual average background b_{ext}
	Maximum delta-deciview, (# days>0.5 dv, # days >1 dv)			(Mm^{-1})
Cape Romain	0.046 (0 0)	0.064 (0 0)	0.092 (0 0)	21.22
Chassahowitzka	0.040 (0 0)	0.081 (0 0)	0.076 (0 0)	21.46
Okefenokee	0.387 (0 0)	0.257 (0 0)	**0.503 (1 0)**	21.41
St Marks	0.061 (0 0)	0.095 (0 0)	0.055 (0 0)	21.54
Wolf Island	**0.644 (1 0)**	0.431 (0 0)	**0.674 (7 0)**	21.33

Table 4-1b. Visibility Results – 8 Highest Values for Brunswick Mill – Refined Run (4-km grid)

	2001		2002		2003		
	Change in Deciview (dv)	Day	Change in Deciview (dv)	Day	Change in Deciview (dv)	Day	Rank
Okefenokee	0.387	Dec 11	0.257	Jan 26	0.503	Dec 28	1
	0.320	Nov 19	0.249	Dec 8	0.400	Jan 31	2
	0.304	Feb 13	0.247	Feb 3	0.333	Dec 22	3
	0.266	Dec 12	0.245	Feb 19	0.303	Dec 13	4
	0.264	Nov 3	0.244	Mar 7	0.289	Feb 20	5
	0.249	Mar 28	0.234	Dec 17	0.288	Nov 8	6
	0.249	Mar 11	0.232	Jan 27	0.285	Jan 16	7
	0.244	Nov 22	0.226	Feb 15	0.282	Dec 27	8
Wolf Island	0.644	Aug 29	0.431	Jun 1	0.674	Oct 24	1
	0.408	Aug 19	0.421	Jul 4	0.616	Jul 16	2
	0.405	Sep 19	0.42	Jul 24	0.577	Aug 5	3
	0.376	Feb 15	0.402	Aug 23	0.537	Feb 14	4
	0.348	Feb 6	0.402	Jan 17	0.535	Aug 19	5
	0.334	Aug 12	0.371	Aug 21	0.520	May 16	6
	0.318	Mar 2	0.340	Jan 5	0.506	Jul 12	7
	0.309	Nov 26	0.338	Oct 20	0.447	Jan 20	8

Table 4-2. Summary of Visibility Results for Tronox – Screening Run (12-km grid)

Class I Area	2001	2002	2003	Annual average background b_{ext}
	Maximum delta-deciview, (# days>0.5 dv, # days >1 dv)			(Mm^{-1})
Cape Romain	0.165 (0 0)	0.196 (0 0)	0.134 (0 0)	21.22
Okefenokee	0.113 (0 0)	0.140 (0 0)	0.213 (0 0)	21.41
Wolf Island	0.315 (0 0)	0.304 (0 0)	0.246 (0 0)	21.33

Table 4-3. Summary of Visibility Results for Augusta Plant – Screening Run (12-km grid)

Class I Area	2001	2002	2003	Annual average background b_{ext}
	Maximum delta-deciview, (# days>0.5 dv, # days >1 dv)			(Mm^{-1})
Cape Romain	0.009 (0 0)	0.012 (0 0)	0.009 (0 0)	21.22
Cohutta	0.002 (0 0)	0.003 (0 0)	0.004 (0 0)	21.39
Great Smokey Mt.	0.002 (0 0)	0.002 (0 0)	0.002 (0 0)	21.39
Joyce Kilmer	0.002 (0 0)	0.002 (0 0)	0.002 (0 0)	21.40
Linville Gorge	0.008 (0 0)	0.003 (0 0)	0.005 (0 0)	21.36
Okefenokee	0.005 (0 0)	0.006 (0 0)	0.007 (0 0)	21.41
Shining Rock	0.004 (0 0)	0.003 (0 0)	0.003 (0 0)	21.40
Wolf Island	0.014 (0 0)	0.005 (0 0)	0.005 (0 0)	21.33

Table 4-4a. Summary of Visibility Results for PCA Valdosta Mill - Screening Run (12-km grid)

Class I Area	2001	2002	2003	Annual average background b_{ext}
	Maximum delta-deciview, (# days>0.5 dv, # days >1 dv)			(Mm^{-1})
Chassahowitzka	0.108 (0 0)	0.197 (0 0)	0.095 (0 0)	21.46
Okefenokee	0.349 (0 0)	0.268 (0 0)	0.345 (0 0)	21.41
St Marks	0.307 (0 0)	0.356 (0 0)	**0.551 (1 0)**	21.54
Wolf Island	0.181 (0 0)	0.136 (0 0)	0.096 (0 0)	21.33

Table 4-4b. Summary of Visibility Results for PCA Valdosta Mill - Refined Run (4-km grid)

Class I Area	2001	2002	2003	Annual average background b_{ext}
	Maximum delta-deciview, (# days>0.5 dv, # days >1 dv)			(Mm^{-1})
Chassahowitzka	0.113 (0 0)	0.138 (0 0)	0.104 (0 0)	21.46
Okefenokee	0.300 (0 0)	0.359 (0 0)	0.330 (0 0)	21.41
St Marks	0.321 (0 0)	0.424 (0 0)	**0.510 (1 0)**	21.54
Wolf Island	0.169 (0 0)	0.188 (0 0)	0.160 (0 0)	21.33

Table 4-4c. Visibility Results – 8 Highest Values for PCA Valdosta Mill - Refined Run (4-km grid)

	2001		2002		2003		
	Change in Deciview (dv)	**Day**	**Change in Deciview (dv)**	**Day**	**Change in Deciview (dv)**	**Day**	**Rank**
St. Marks	0.321	Nov 10	0.424	Oct 26	0.510	Jan 25	1
	0.304	Dec 11	0.352	Oct 12	0.227	May 24	2
	0.262	Sep 5	0.336	Nov 24	0.216	Feb 9	3
	0.202	Oct 30	0.291	Jan 27	0.215	Jan 26	4
	0.202	Oct 20	0.284	Sep 18	0.189	Dec 26	5
	0.188	Sep 10	0.271	Dec 7	0.178	Nov 25	6
	0.184	Feb 4	0.206	Nov 20	0.172	Oct 20	7
	0.174	Sep 6	0.190	Dec 12	0.171	Nov 21	8

Table 4-5a. Summary of Visibility Results for Interstate Paper, LLC – Refined Run (4-km grid)

Class I Area	2001	2002	2003	Annual average background b_{ext}
	Maximum delta-deciview, (# days>0.5 dv, # days >1 dv)			(Mm^{-1})
Cape Romain	0.069 (0 0)	0.106 (0 0)	0.048 (0 0)	21.22
Okefenokee	0.236 (0 0)	0.187 (0 0)	0.337 (0 0)	21.41
St Marks	0.034 (0 0)	0.041 (0 0)	0.045 (0 0)	21.54
Wolf Island	**0.718 (1 0)**	**0.502 (1 0)**	0.416 (0 0)	21.33

Table 4-5b. Visibility Results – 8 Highest Values for Interstate Paper, LLC – Refined Run (4-km grid)

	2001		2002		2003		
	Change in Deciview (dv)	Day	Change in Deciview (dv)	Day	Change in Deciview (dv)	Day	Rank
Wolf Island	0.718	Jan 15	0.502	Dec 27	0.416	Dec 8	1
	0.371	Sep 17	0.420	Nov 26	0.335	Oct 15	2
	0.345	Jan 10	0.357	Nov 1	0.268	Sep 7	3
	0.312	Feb 6	0.337	Jan 16	0.265	Nov 30	4
	0.310	Dec 21	0.311	Nov 19	0.257	Sep 8	5
	0.282	Jan 21	0.286	Dec 26	0.255	Jan 7	6
	0.231	Dec 30	0.273	Oct 26	0.250	Jan 5	7
	0.216	Jan 2	0.241	Jan 28	0.189	Feb 9	8

Table 4-6. Summary of Visibility Results for DSM Chemicals North – Screening Run (12-km grid)

Class I Area	2001	2002	2003	Annual average background b_{ext}
	Maximum delta-deciview, (# days>0.5 dv, # days >1 dv)			(Mm^{-1})
Cape Romain	0.107 (0 0)	0.096 (0 0)	0.094 (0 0)	21.22
Cohutta	0.064 (0 0)	0.053 (0 0)	0.112 (0 0)	21.39
Great Smokey Mt.	0.045 (0 0)	0.053 (0 0)	0.072 (0 0)	21.39
Joyce Kilmer	0.050 (0 0)	0.051 (0 0)	0.072 (0 0)	21.40
Linville Gorge	0.093 (0 0)	0.048 (0 0)	0.063 (0 0)	21.36
Okefenokee	0.088 (0 0)	0.131 (0 0)	0.063 (0 0)	21.41
Shining Rock	0.049 (0 0)	0.042 (0 0)	0.069 (0 0)	21.40
Wolf Island	0.102 (0 0)	0.085 (0 0)	0.114 (0 0)	21.33

Table 4-7. Monthly f(RH) Values Based on the Centroid of the Area, for Visibility Method 6 Applications

Class I area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cape Romain	3.3	3.0	2.9	2.8	3.2	3.7	3.6	4.1	4.0	3.7	3.4	3.2
Chassahowitzka	3.8	3.5	3.4	3.2	3.3	3.9	3.9	4.2	4.1	3.9	3.7	3.9
Cohutta	3.3	3.1	3.0	2.8	3.4	3.8	4.0	4.2	4.2	3.8	3.4	3.5
Great Smoky Mountains	3.3	3.0	2.9	2.7	3.2	3.9	3.8	4.0	4.2	3.8	3.3	3.4
Joyce Kilmer-Slickrock	3.3	3.1	2.9	2.7	3.3	3.8	4.0	4.2	4.2	3.8	3.3	3.5
Linville Gorge	3.3	3.0	3.0	2.7	3.3	3.9	4.1	4.5	4.4	3.7	3.2	3.4
Okefenokee	3.5	3.2	3.1	3.0	3.6	3.7	3.7	4.1	4.0	3.8	3.5	3.6
Shining Rock	3.3	3.0	2.9	2.7	3.4	3.9	4.1	4.5	4.4	3.8	3.3	3.4
Sipsey	3.4	3.1	2.9	2.8	3.3	3.7	3.9	3.9	3.9	3.6	3.3	3.4
St. Marks	3.7	3.4	3.4	3.4	3.5	4.0	4.1	4.4	4.2	3.8	3.7	3.8
Wolf Island	3.4	3.1	3.1	3.0	3.3	3.7	3.7	4.1	4.0	3.7	3.5	3.5

Source: Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule (2003), Appendix A, Table A-3

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