Appendix G

Development of the 2005-2006 Base-Case Emission Inventory

INTRODUCTION

For the Continental Divide-Creston (CD-C) EIS, a base case simulation has been completed. CAMx was applied for the calendar years 2005 and 2006 using a nested-grid modeling domain with horizontal spatial resolution 36/12/4 km. The 2005 and 2006 base case model runs used actual emissions of NO_x, SO_2, PM_{10}, $PM_{2.5}$, VOC and CO from all sources for those years and included a comprehensive inventory of oil and gas (O&G) emissions sources within Southwest Wyoming developed by Carter Lake and BP as well as the WRAP Phase III O&G emissions for the Denver-Julesburg, Piceance, and Uinta Basins. The2005-6 base case emission inventory was reviewed by the Wyoming Department of Environmental Quality and approved for use in the 2005-6 base case modeling on February 11, 2010. In this Appendix, we describe the development of each source category of the 2005-6 emission inventory.

SMOKE POINT SOURCE EMISSIONS MODELING

Carter Lake has developed a detailed point source emissions inventory for 2005 and 2006 for the region covered by the 12 km grid. The data included annual emissions for all point sources and hourly continuous emissions monitoring (CEM) data for points in the EPA's Clean Air Markets (CAMD) database. Point source emissions were separated into electricity generating unit (EGU), non-EGU, trona, and O&G exploration and production categories to be processed separately to facilitate source apportionment. The O&G emissions were further subdivided into the Southwest Wyoming, Denver-Julesburg, Uinta, Piceance and other basins for processing. The details of O&G emissions processing are discussed in the next section.

The detailed 2005 and 2006 point inventory developed by Carter Lake was quality assured and adjustments were made as follows:

- The inventory did not include point emissions within Tribal lands, thus, ENVIRON projected the Tribal point emissions from the WRAP 2002 emissions inventory and incorporated these projected emissions into the 2005-2006 point inventory;
- ENVIRON moved O&G emissions from small compressor engines out of the point source inventory to the O&G inventory for the purpose of source apportionment;
- The State of Wyoming does not inventory $PM_{.2.5}$ emissions. Therefore, the Wyoming point source emissions inventory for 2005-2006 did not contain $PM_{2.5}$, although PM_{10} emissions were included. ENVIRON determined the ratio of $PM_{2.5}/PM_{10}$ by source category code (SCC) by state from the WRAP 2002 inventory and applied these ratios to point sources within Wyoming. Analysis of the WRAP inventory showed:
  - 56% of PM10 comes from mineral products (mining [especially coal mining], and transfer of materials). These sources contribute to minimal PM2.5.
  - 20% of PM10 comes from EGUs. 99% of PM10 emissions are PM2.5 for these sources.
  - 8% of PM10 comes from Chemical Manufacturing (sodium carbonate, fertilizer facilities). No PM2.5 is reported from these sources.
  - 7% of PM10 comes from the cooling tower at the Dave Johnston coal-fired plant. No PM2.5 is reported for this category.

Based on this analysis, ENVIRON determined that 30% of the PM_{10} emissions will be allocated to $PM_{2.5}$;

- Where CEM data were missing or flagged as suspect, ENVIRON checked the CAMD reports and determined appropriate corrections;
- CEM sources that were unmatched with the Carter Lake's point inventory were identified and were added to the point inventory;
- CEM sources that were matched with multiple records in the Carter Lake's point inventory were weighted allocated among those records based on their emissions.

Point source emissions from non-EGU sectors were not based on day- or hour-specific emissions (i.e., are not included in CAMD). Emissions from these sources were temporally allocated to month, day, and hour using annual emissions and SCC based allocation factors available in the WRAP SMOKE setup which incorporated any relevant data that has been developed by other RPOs.

To temporally allocate the EGU point source emissions for species in the emissions inventory other than NO_x and SO_2, specifically CO, VOC, NH_3, and PM, heat input data from the 2005 and 2006 CEM datasets were used to develop facility-level temporal distributions. The day-specific and facility-specific temporal profiles were used in conjunction with the supplied emissions data to calculate hourly EGU emissions by facility.

The Acid Rain data does not contain hourly emissions of VOC or CO, so this information was calculated by ENVIRON based on the hourly heat input reported in the Acid Rain database and the daily VOC and CO emissions data from the WRAP database. For each source, an average diurnal cycle of hourly heat input was calculated by averaging all heat inputs for a given hour across all days in that quarter. For each hour, the daily value of the VOC and CO emissions for that source was multiplied by the ratio of the measured heat input for that hour from the Acid Rain data base to the quarterly average heat input. An example calculation is shown below:

$$VOC(2\,pm, May\ 21)) = \overline{VOC_{WRAP}}(May\ 21)' \frac{Heat\ Input_{acidrain}(2\,pm, May\ 21)}{\overline{Heat\ Input_{acidrain}(Quarter\ 2)}}$$

Table G-1 lists EGU sources in Wyoming that report hourly CEM data to CAMD. These sources' hourly emissions data were used for SMOKE EGU emissions processing.

Table G-1 Wyoming EGU Sources in 2005&2006 CAMD CEM Database.

Facility	ORIS ID	NO_x (tpy)		SO_2 (tpy)	
		2005	2006	2005	2006
Dave Johnston	4158	14,721	16,457	19,751	22,351
Jim Bridger	8066	32,171	28,054	21,651	20,055
Laramie River	6204	19,951	19,781	13,098	11,539
Naughton	4162	14,736	14,168	23,229	20,664
Neil Simpson II	7504	634	824	498	633
Neil Simpson II (CT2)	55477	10	12	0	0
Wygen I	55479	561	587	538	647
Wyodak	6101	4,946	3,855	7,732	6,514

All non-O&G point sources were spatially allocated in the domain based on their geographic coordinates.

Stack parameters are often more important to the reliability of the air quality modeling results than the emissions rates themselves. Stack parameter data are frequently incorrect, especially in some of the current regional modeling inventories, and careful QA is required to assure that the point source emissions are properly located both horizontally and vertically within the modeling domain. To screen for simple, but potentially serious inventory errors, the modeling team modified procedures originally developed by EPA to quality assure, augment, and where necessary, revise, stack parameters to ensure the accuracy of the point source emissions, as well as standardize procedures to identify and correct stack data errors. SMOKE has a number of built-in QA procedures designed to catch missing or out-of-range stack parameters. These procedures were also invoked in the processing of the point source data.

Figures G-1 and G-2 show 2005 and 2006 point sources within the 12 km domain, excluding O&G sources within the 5-county area. For clarity, the Denver area, which has many point sources within a small area, is shown separately in Figure G-3. Sources are classified within SMOKE as EGU or non-EGU based on SCC code. SCCs considered to be EGUs begin with the digits 101 or 201. Because the SMOKE EGU/non-EGU convention causes small sources such as hospital emergency generators to be classified as EGUs along with power plants, we have divided EGUs into two categories in Figures G-1-G-3: EGUs that appear in the EPA Acid Rain Program Database and those that do not. Only large power plants appear in the Acid Rain Program Database. These EGUs are labeled and indicated in Figure G-1-G-3 by a square icon.

For Wyoming point sources, SCCs were available, but SIC codes were not; therefore, it was difficult to determine whether a given source should be classified as an O&G source. Special efforts were made to identify O&G sources inside the 5-County area of SW Wyoming. Outside the 5-County area, all Wyoming point sources that were not classified as either EGU or trona sources were included in the non-EGU category.

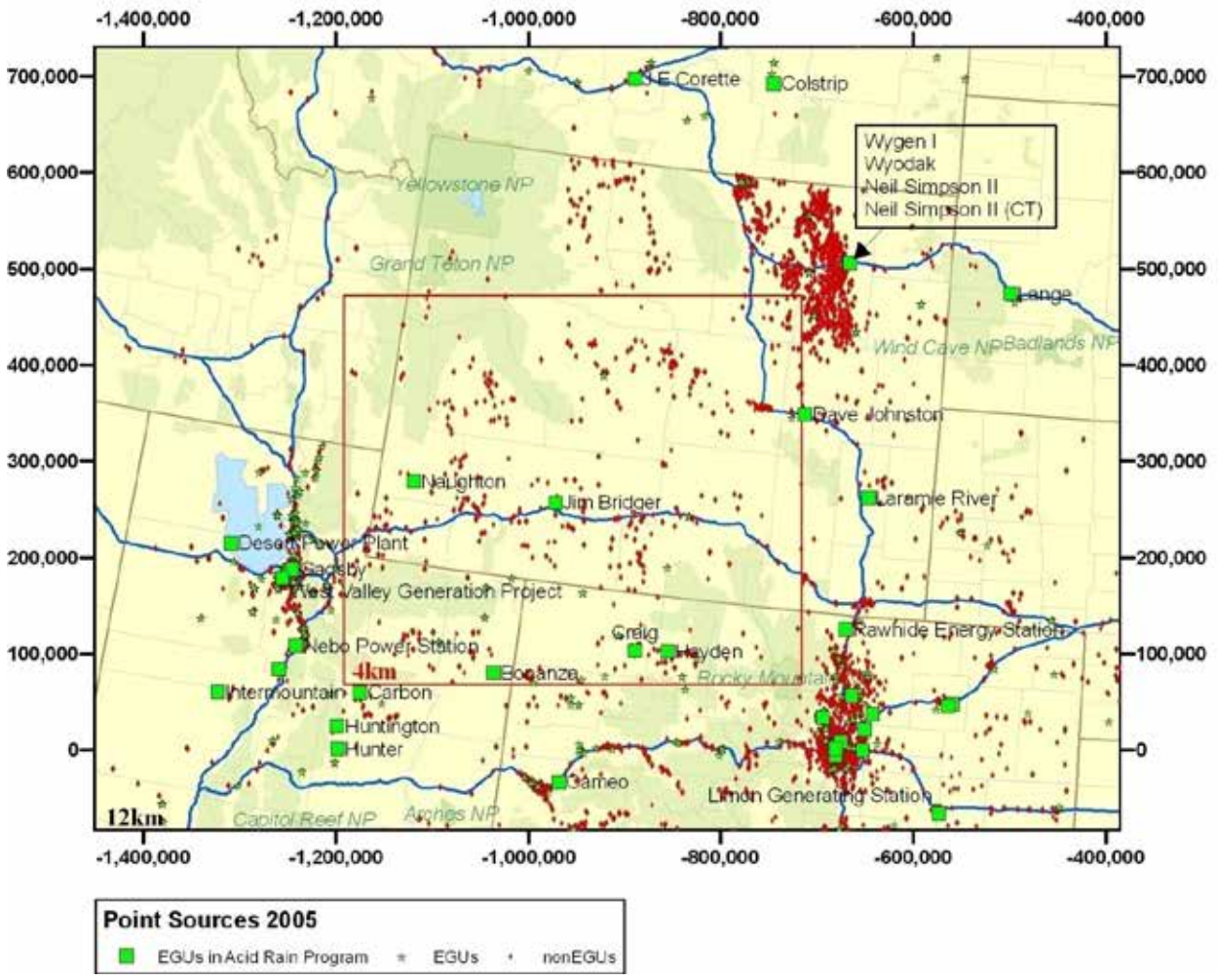


Figure G-1 2005 point sources within the 12 km domain, excluding O&G sources within the 5-county area.

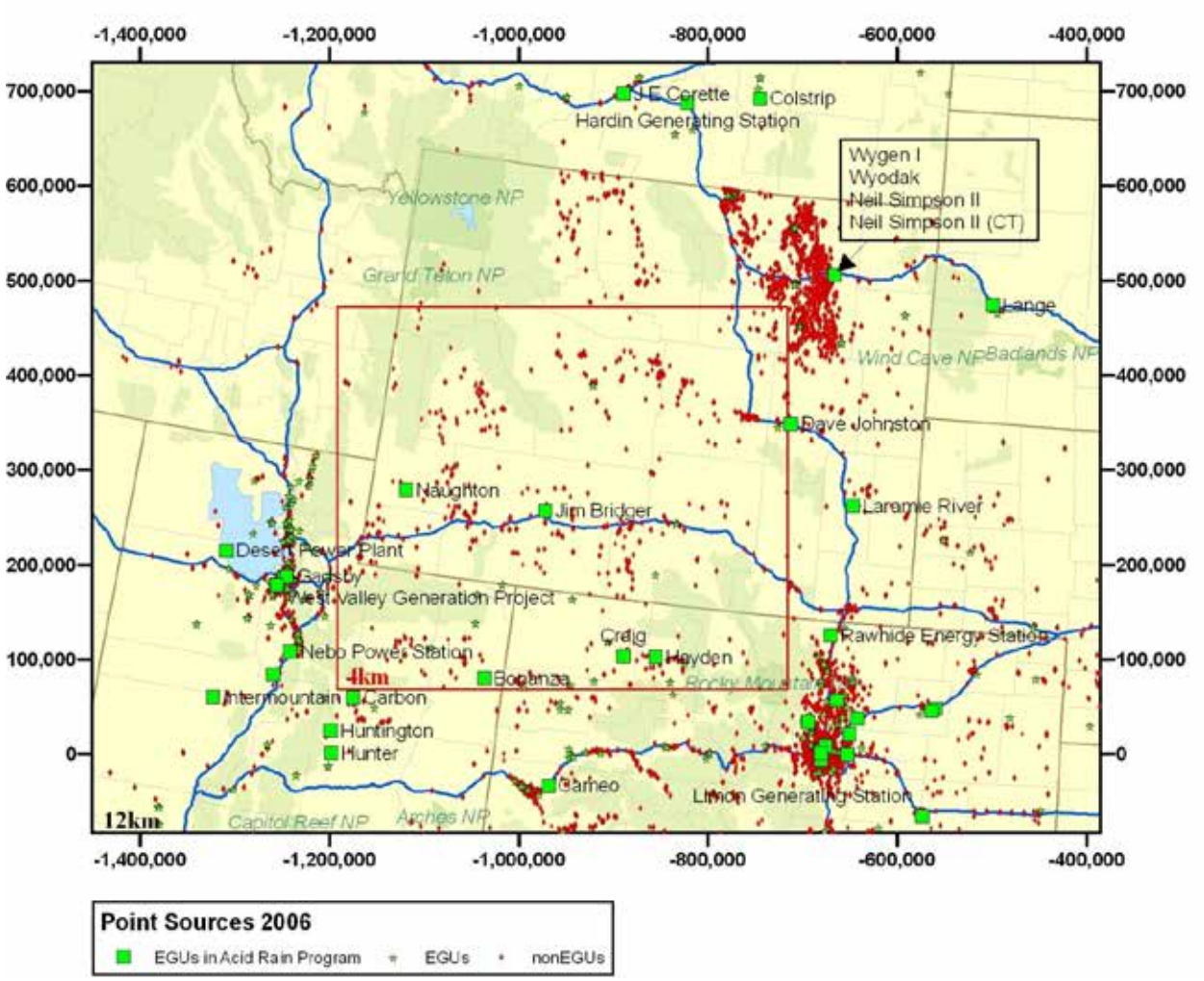


Figure G-2 2006 point sources within the 12 km domain excluding O&G sources within the 5-county area.

Figure G-3 2005 and 2006 ARD point sources in the Denver area within the 12 km domain.

Sources Modeled With CAMx Plume-In-Grid Model

Large stationary NOx sources within the 12 km domain were modeled with the CAMx Plume-in-Grid (PiG) model. For each simulated day, PiG sources were identified in the following way:

1. Identified sources (i.e. individual stacks) emitting more than 1 ton/day NOx emissions
2. Identified sources co-located with those sources found in (1);

   i.e. sources that are within 100 m distance AND have NOx emissions greater than or equal to 0.1 ton/day were identified

The sources identified in this manner for all 365 days of 2005 and 2006 were appended together to compile a list of distinct sources within the 12 km domain for each year. Sources on this list were selected for PiG treatment in emissions processing. Maps of sources selected for PiG treatment within the 12 km domain are shown in Figures G-1-G-3. Point sources were broken out by source category into EGU, oil and gas, trona, and non-EGU sources that do not fit under either oil and gas or trona source categories. This was done to configure the inventory for use in CAMx source apportionment analyses. PiGged sources are displayed in separate figures by source category and year in Figures G-4 through G-11. Tables G-2 through G-9 list the sources selected for PiG treatment along with their locations, source identification information, and NOx, SO_2, CO, NH_3, and PM emissions.

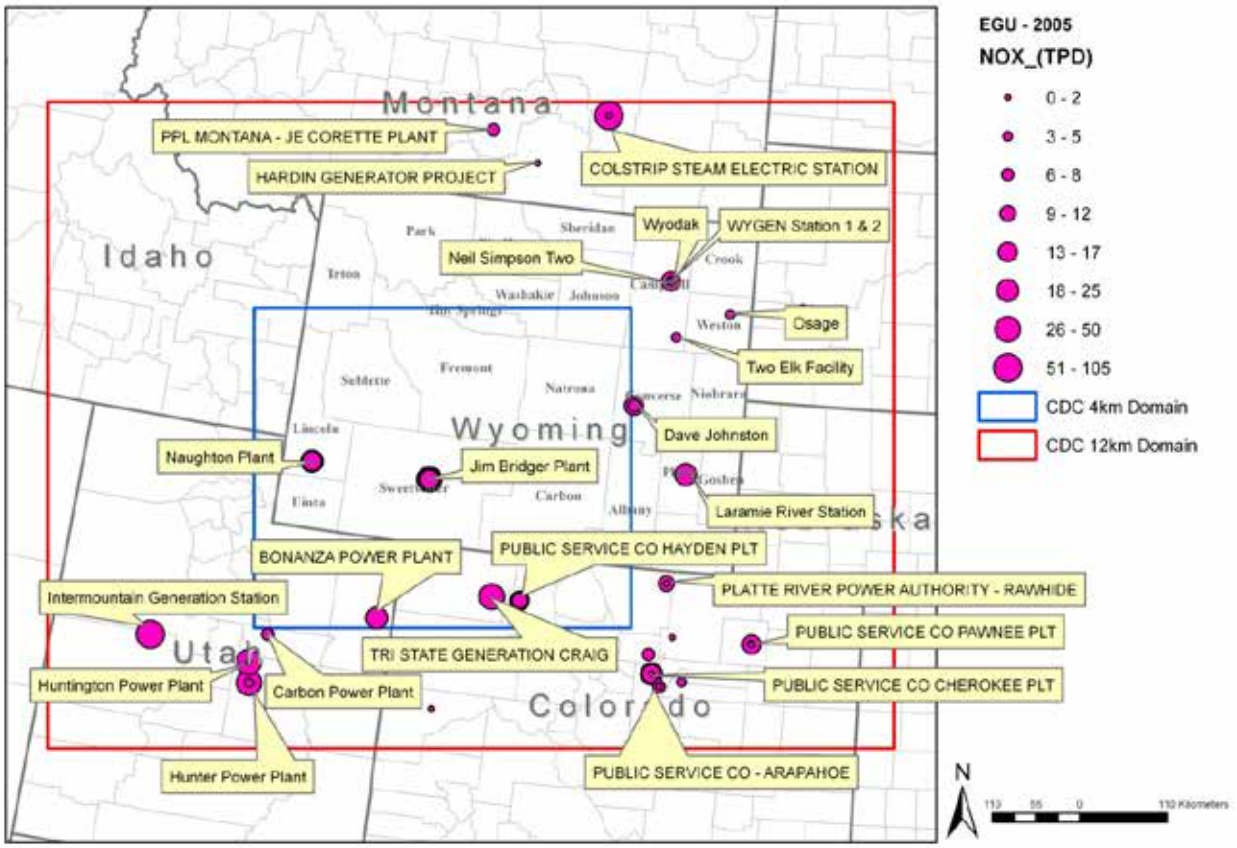


Figure G-4 2005 EGU sources treated with the CAMx Plume-in-Grid (PiG) Model within the 12 km domain.

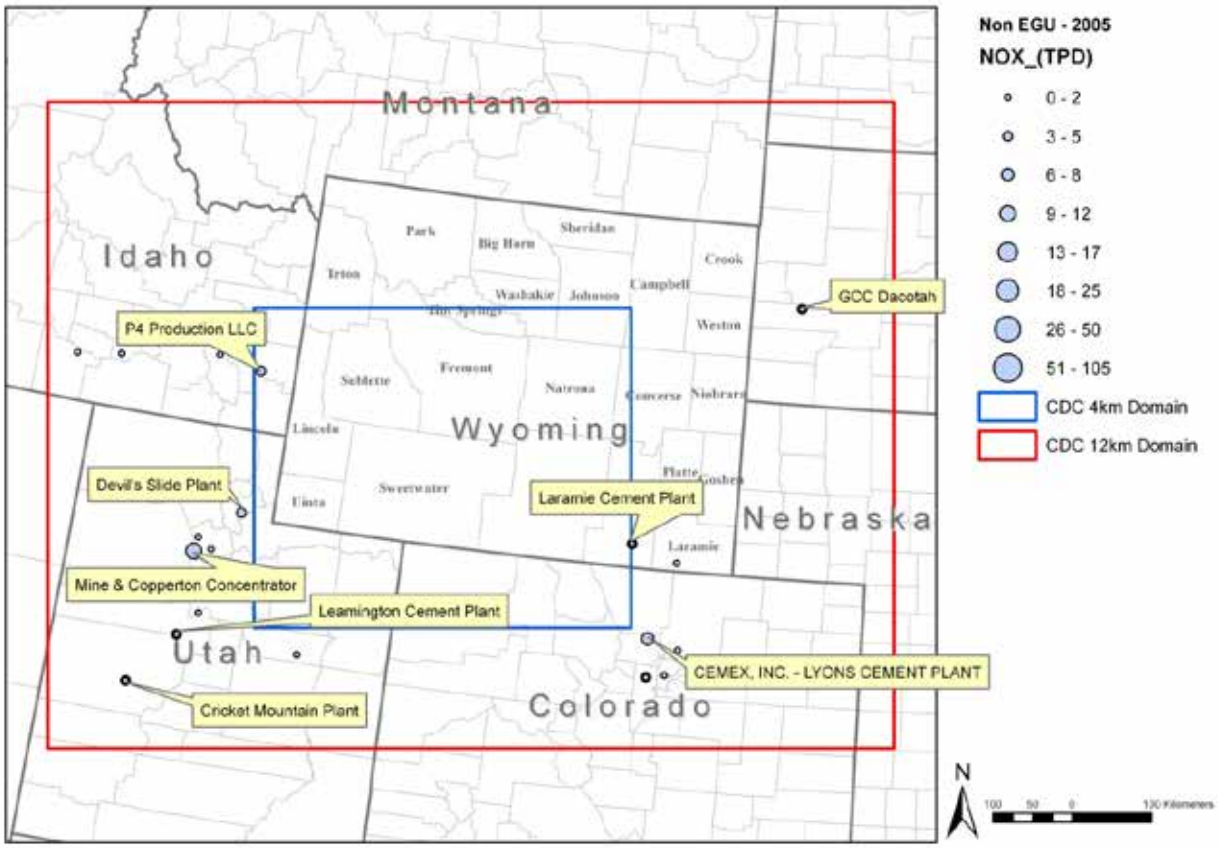


Figure G-5 2005 non-EGU sources treated with the CAMx Plume-in-Grid (PiG) Model within the 12 km domain.

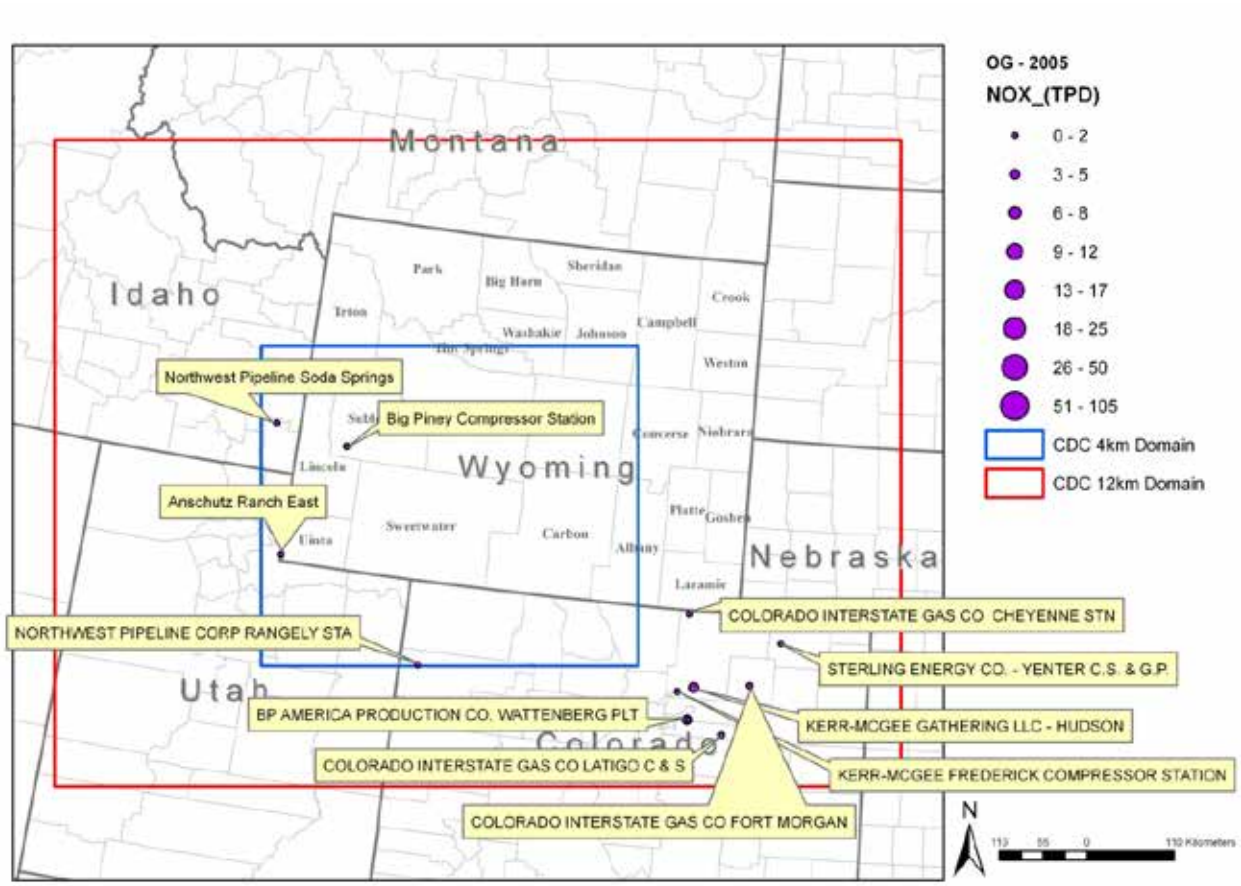


Figure G-6 2005 oil and gas sources treated with the CAMx Plume-in-Grid (PiG) Model within the 12 km domain.

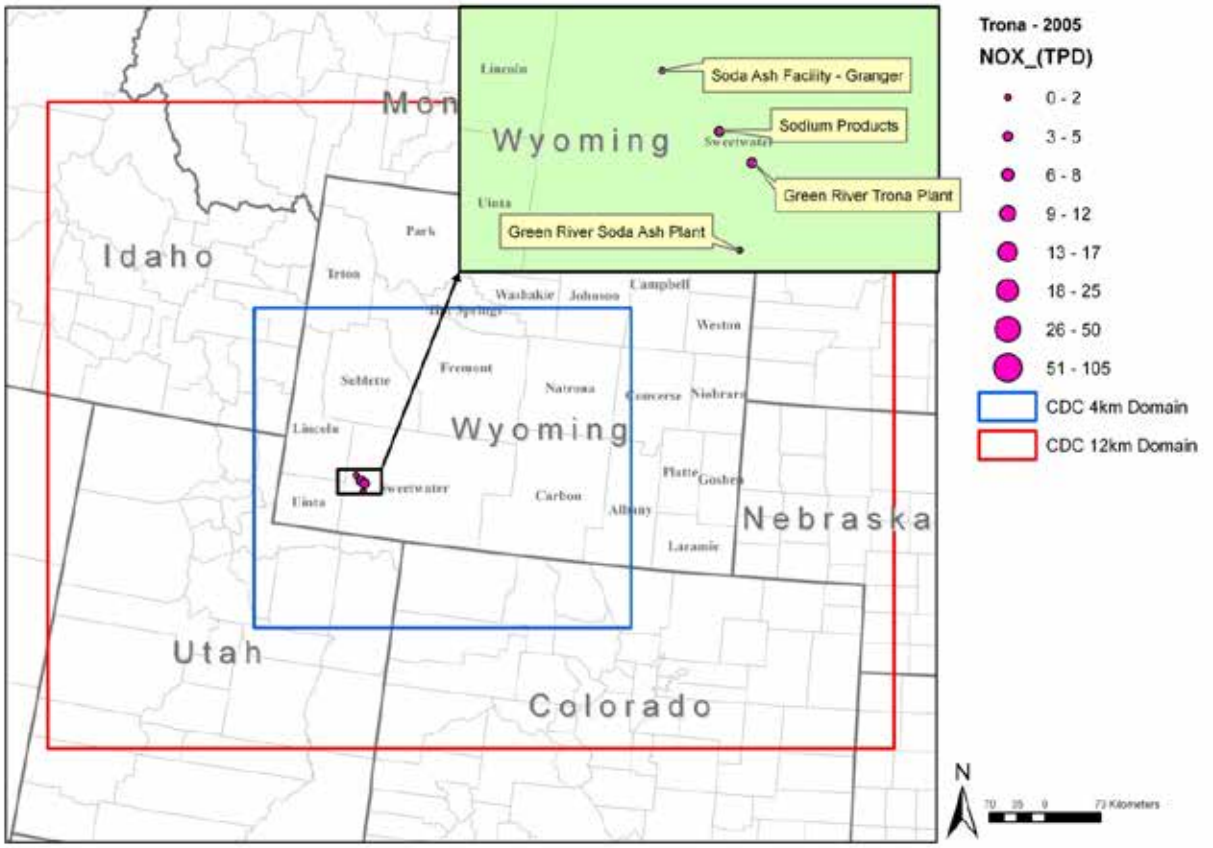


Figure G-7 2005 trona sources treated with the CAMx Plume-in-Grid (PiG) Model within the 12 km domain.

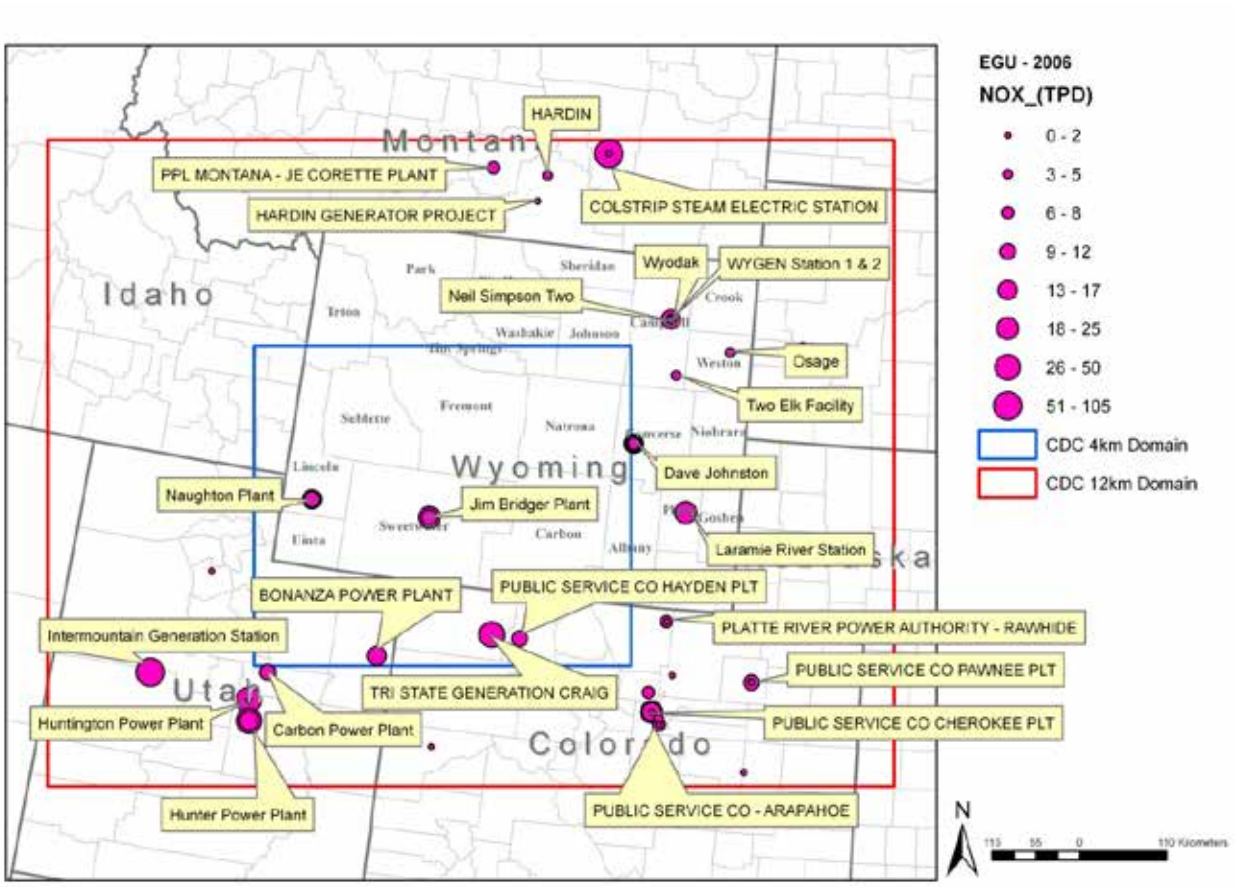


Figure G-8 2006 EGU sources treated with the CAMx Plume-in-Grid (PiG) Model within the 12 km domain.

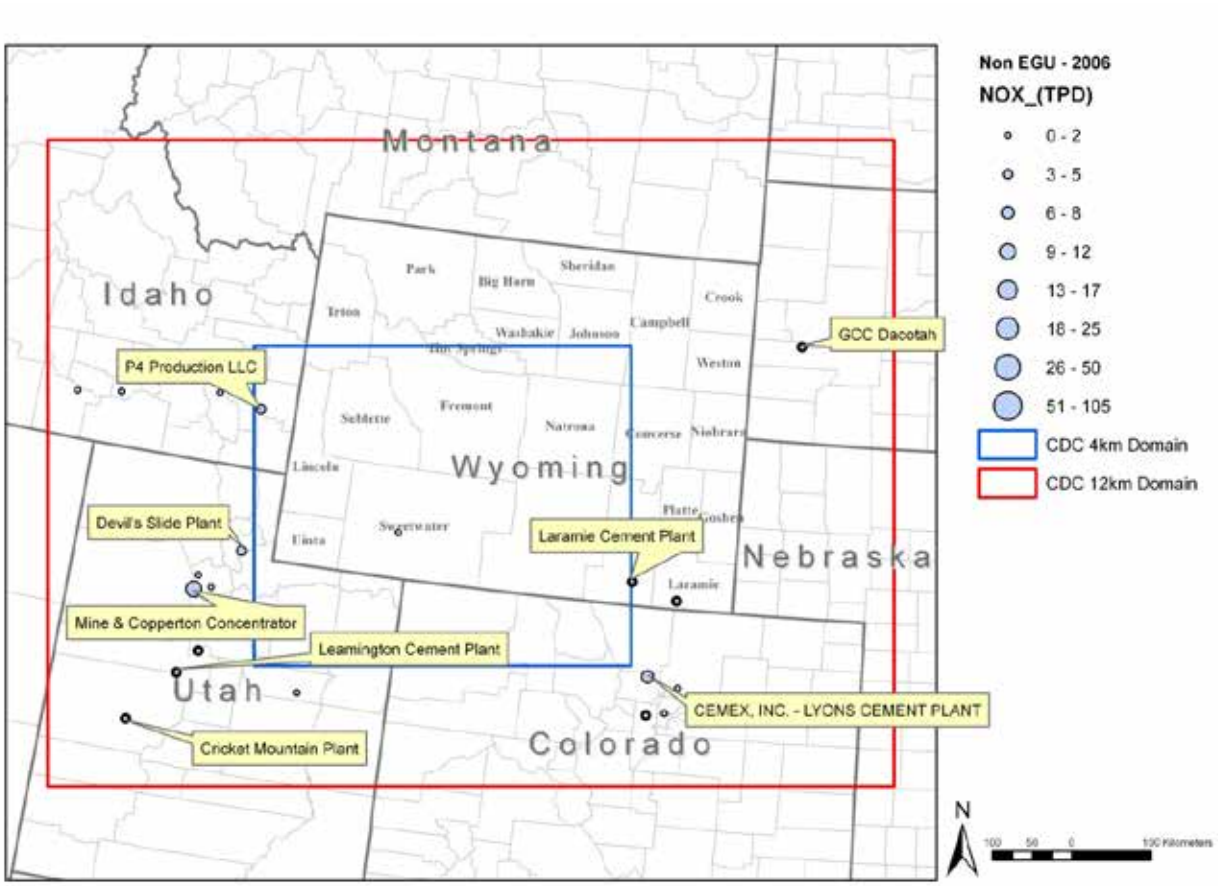


Figure G-9 2006 non-EGU sources treated with the CAMx Plume-in-Grid (PiG) Model within the 12 km domain.

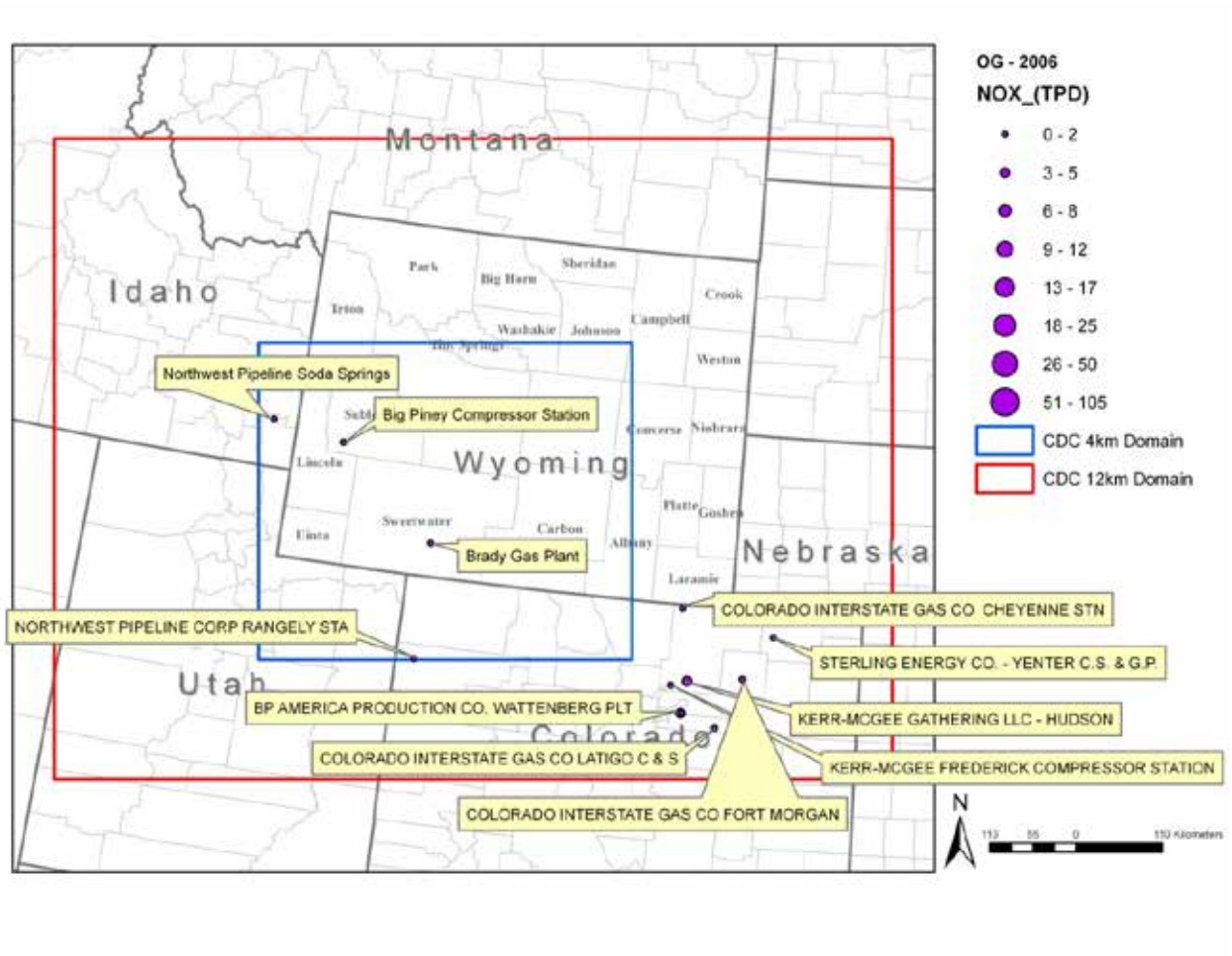


Figure G-10 2006 oil and gas sources treated with the CAMx Plume-in-Grid (PiG) Model within the 12 km domain.

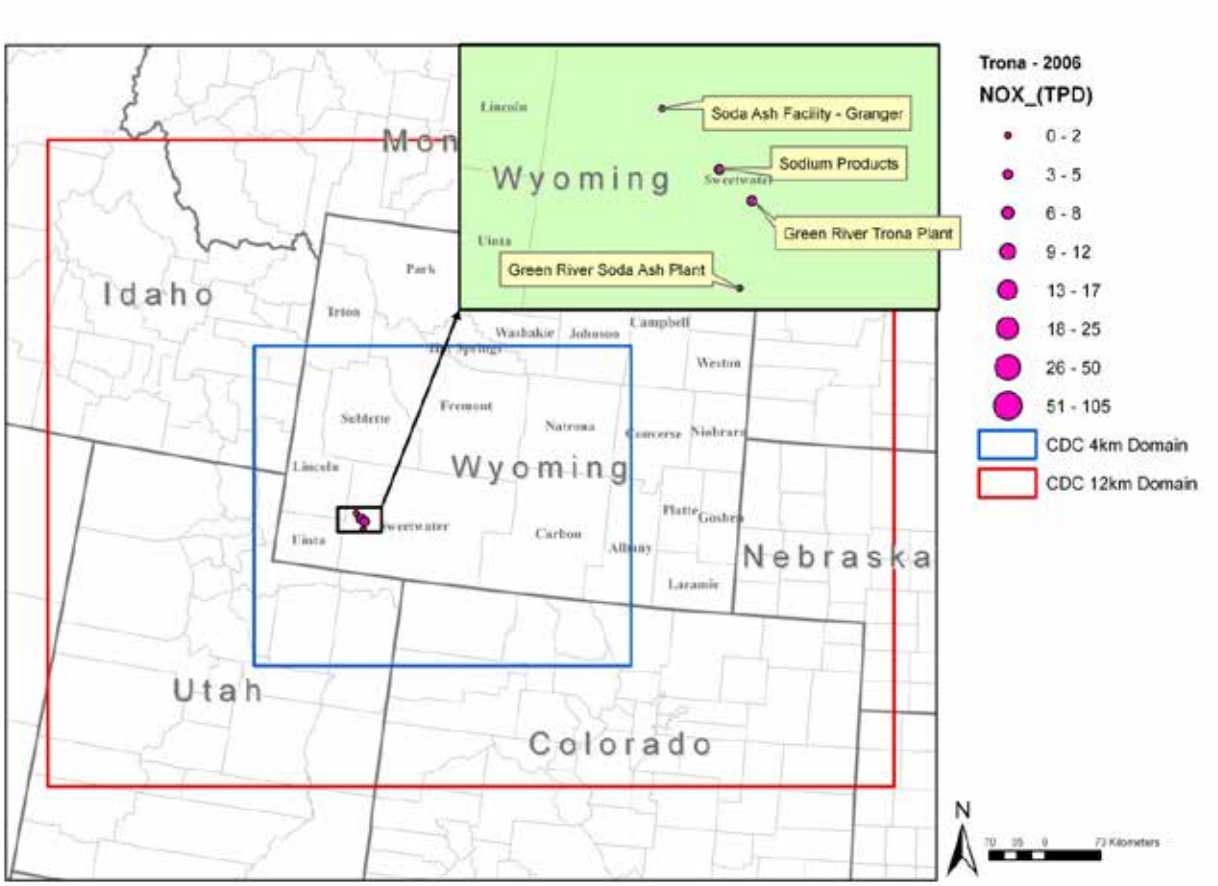


Figure G-11 2006 trona sources treated with the CAMx Plume-in-Grid (PiG) Model within the 12 km domain.

Table G-2 2005 EGU Sources within the 12/4 km grid modeled with the CAMx Plume-in-Grid. Sources are ranked by their NOx emissions.

		Source Parameters								Emissions (tons/year)						
Rank	NOx (TPD)	PT	X	Y	PlantID	StackID	ORISID	FIPS	PLANT	NOx	VOC	CO	SO2	PM10	PM25	NH3
1	104.6	203	-743950.	714784.	EGU0727	0226	6076	30087	COLSTRIP STEAM ELECTRIC STATION	36,393.6			13,279.7			
2	80.5	299	-1322699.	59547.	EGU1222	202	6481	49027	Intermountain Generation Station	25,062.7	0.0	0.0	3,593.9	0.0	0.0	81.5
3	48.3	142	-891863.	107264.	EGU0175	0222	6021	08081	TRI STATE GENERATION CRAIG	17,683.1			4,075.6			74.5
4	38.6	292	-1198213.	-1559.	EGU1220	212	6165	49015	Hunter Power Plant	12,156.4	0.0	0.0	5,033.8	0.0	0.0	0.0
5	32.1	294	-1198431.	24452.	EGU1221	212	8069	49015	Huntington Power Plant	10,167.2	0.0	0.0	17,362.8	0.0	0.0	0.0
6	31.2	655	-970515.	255230.	5603701002	2085	8066	56037	Jim Bridger Plant	9,743.3	77.3	662.3	6,383.0	477.7	477.7	31.3
7	25.4	653	-970515.	255230.	5603701002	2062	8066	56037	Jim Bridger Plant	8,894.3	76.6	657.0	6,700.8	165.0	165.0	31.3
8	23.8	515	-1036751.	80250.	EGU1224	202	7790	49047	BONANZA POWER PLANT	7,398.3	62.8	523.0	1,229.7	680.8	562.7	31.4
9	21.2	654	-970515.	255230.	5603701002	2076	8066	56037	Jim Bridger Plant	4,822.1	64.1	549.4	5,100.6	137.1	137.1	31.3
10	21.1	633	-646798.	261361.	5603100001	213	6204	56031	Laramie River Station	6,922.2	81.9	682.3	4,475.5	98.8	98.8	39.5
11	20.5	635	-646798.	261361.	5603100001	225	6204	56031	Laramie River Station	6,009.7	70.7	588.4	4,142.7	138.0	138.0	39.5
12	19.8	634	-646798.	261361.	5603100001	224	6204	56031	Laramie River Station	7,019.2	87.2	726.8	4,479.6	161.9	161.9	39.5
13	19.5	626	-1118665.	278236.	5602300004	2107	4162	56023	Naughton Plant	5,560.0	42.9	368.1	6,103.2	232.1	232.1	13.5
14	17.1	21	-689997.	9568.	EGU0163	0222	469	08001	PUBLIC SERVICE CO CHEROKEE PLT	6,415.5			5,310.4			16.8
15	15.8	622	-712198.	348399.	5600900001	2040	4158	56009	Dave Johnston	5,583.5	48.7	405.6	5,382.4	841.5	841.5	14.4
16	15	656	-970515.	255230.	5603701002	2086	8066	56037	Jim Bridger Plant	8,711.3	73.8	633.0	3,466.4	118.0	118.0	31.3
17	14	154	-563976.	46860.	EGU0179	0222	6248	08087	PUBLIC SERVICE CO PAWNEE PLT	3,646.4			11,247.8			31.0
18	14	574	-665551.	505468.	5600500046	2122	6101	56005	Wyodak Plant	4,946.3	58.2	485.3	7,732.1	1,642.9	1,642.9	0.5
19	13.9	625	-1118665.	278236.	5602300004	2106	4162	56023	Naughton Plant	4,988.1	29.2	250.0	9,464.3	201.5	201.5	13.5
20	13.8	621	-712154.	348344.	5600900001	2039	4158	56009	Dave Johnston	4,602.6	33.0	275.0	7,685.2	176.4	176.4	14.4
21	13.8	22	-689997.	9568.	EGU0163	0226	469	08001	PUBLIC SERVICE CO CHEROKEE PLT	4,093.2			1,749.7			14.9
22	13	171	-856301.	102086.	EGU0183	0222	525	08107	PUBLIC SERVICE CO HAYDEN PLT	4,090.0			1,297.4			11.3
23	12.4	624	-1118665.	278236.	5602300004	2095	4162	56023	Naughton Plant	4,188.2	22.9	196.1	7,661.8	32.9	32.9	13.5
24	11.7	119	-671031.	123737.	EGU0173	0226	6761	08069	PLATTE RIVER POWER AUTHORITY - RAWHID	3,726.3			875.4			18.0
24	11.7	119	-671031.	123737.	EGU0173	0226	6761	08069	RAWHIDE ENERGY STATION	0.6	0.0	0.2	0.0	0.0	0.0	0.0
25	11.6	172	-856301.	102086.	EGU0183	0226	525	08107	PUBLIC SERVICE CO HAYDEN PLT	3,979.5			1,592.8			15.8
26	6.7	216	-889488.	696596.	EGU0728	0226	2187	30111	PPL MONTANA - JE CORETTE PLANT	1,655.5			2,874.5			10.8
27	6.5	79	-680287.	-6529.	EGU0165	0222	465	08031	PUBLIC SERVICE CO - ARAPAHOE	2,307.9			2,410.8			9.8
28	6.5	620	-712125.	348311.	5600900001	2038	4158	56009	Dave Johnston	2,289.6	16.9	141.1	3,395.4	40.6	40.6	14.4
29	6.5	615	-712096.	348278.	5600900001	2025	4158	56009	Dave Johnston	2,245.4	17.2	143.6	3,287.7	256.6	256.6	14.4
30	6.2	40	-693836.	34254.	EGU0164	0226	477	08013	PUBLIC SERVICE CO - VALMONT	2,510.8			878.6			8.3
31	5.6	259	-1174662.	59571.	EGU1218	212	3644	49007	Carbon Power Plant	3,402.3	0.0	0.0	5,410.1	0.0	0.0	0.0
32	5	291	-1198213.	-1559.	EGU1220	202	6165	49015	Hunter Power Plant	6,082.1	0.0	0.0	1,243.0	0.0	0.0	0.0
33	2.7	25	-652300.	-778.	ORIS55645	STKDEF	55645	08001	BLUE SPRUCE ENERGY CENTER	50.9	0.3	13.1	4.0	0.3	0.3	1.0
33	4.6	603	-665477.	505749.	5600590001	3149	0	56005	WYGEN 2	1,578.0	225.0	3,381.0	2,254.0	270.0	270.0	0.0
34	3.2	664	-591164.	463283.	5604500005	398	0	56045	Osage	1,105.4	7.3	61.1	2,051.3	609.8	609.8	0.0
35	3.2	605	-658592.	434661.	5600590002	3639	0	56005	Two Elk Facility	1,166.8	175.6	1,750.2	1,711.4	233.5	0.0	0.0
36	2.7	228	-498985.	470013.	28.0801-02	1		46103	Black Hill Power & Light Company (Ben Fr	907.7	3.3	126.9	785.0	30.4		
37	2	133	-968076.	-34362.	EGU0174	0202	468	08077	PUBLIC SERVICE CO CAMEO PLT	724.5			2,108.0			3.1
38	1.9	578	-665602.	505182.	5600500063	385	7504	56005	Neil Simpson Two	628.4	3.9	194.9	498.4	78.4	78.4	12.1
39	1.6	602	-665586.	505259.	5600500146	3156	55479	56005	WYGEN Station 1	561.5	8.2	340.2	538.4	81.9	81.9	0.0
40	1.4	199	-834061.	655046.	003-0018	0		30003	HARDIN GENERATOR PROJECT					0.5	0.4	
41	1.3	205	-743950.	714784.	EGU0727	0801	6076	30087	COLSTRIP STEAM ELECTRIC STATION	459.6			2,226.4			
42	1	194	-663958.	55844.	EGU0186	0201	6112	08123	PUBLIC SERVICE CO FORT SAINT VRAIN PLT	386.2			9.8			121.3
42	1.2	573	-665857.	505353.	5600500002	380	0	56005	Neil Simpson One	419.0	6.2	18.9	949.8	342.0	342.0	0.0
42	1.3	81	-680930.	986.	EGU0166	0601	478	08031	Zuni	52.7			0.2			3.5
42	1.4	153	-564179.	47790.	EGU0178	0201	55127	08087	MANCHIEF POWER COMPANY LLC	27.2	9.1	354.0	0.3	29.0	29.0	27.7
43	0.6	23	-689997.	9568.	EGU0163	0601	469	08001	PUBLIC SERVICE CO CHEROKEE PLT	227.8			0.8			3.2
44	0.1	80	-680287.	-6529.	EGU0165	0601	465	08031	PUBLIC SERVICE CO - ARAPAHOE	28.6			0.8			2.3
44	0.2	24	-689997.	9568.	EGU0163	0604	469	08001	PUBLIC SERVICE CO CHEROKEE PLT	64.5			0.1			1.4
45	0.1	295	-1198431.	24452.	EGU1221	501	8069	49015	Huntington Power Plant	25.4	0.0	0.0	2.0	0.0	0.0	0.0
46	0.1	118	-671031.	123737.	EGU0173	0201	6761	08069	PLATTE RIVER POWER AUTHORITY - RAWHID	3.6			0.1			1.1
47	0.1	155	-563976.	46860.	EGU0179	0601	6248	08087	PUBLIC SERVICE CO PAWNEE PLT	21.7			0.3			0.8

Table G-3 2005 non-EGU Sources within the 12/4 km grid modeled with the CAMx Plume-in-Grid. Sources are ranked by their NOx emissions.

		Source Parameters								Emissions (tons/year)						
Rank	NOx (TPD)	PT	X	Y	PlantID	StackID	ORISID	FIPS	PLANT	NOx	VOC	CO	SO2	PM10	PM25	NH3
1	10.1	11167	-1267843.	164918.	10571	927593		49035	Mine & Copperton Concentrator	3,749.5	343.4	1,564.0	45.4	306.7	306.7	
2	5.7	1334	-694677.	53910.	0003	007		08013	CEMEX, INC. - LYONS CEMENT PLANT	2,162.0	3.0	136.0	18.0	134.0		
3	4.4	5410	-1183016.	392330.	02900001	010		16029	P4 Production LLC	1,625.5		110.2	8,551.8	48.2	37.9	
4	3.7	9191	-1289629.	59699.	10303	1616	0	49023	Leamington Cement Plant	1,340.7	52.7	8,626.3	0.3	44.6	44.6	4.4
5	3.5	9516	-1207603.	213047.	10007	16758	0	49029	Devil's Slide Plant	1,293.7	46.8	768.8	228.5	14.7	4.6	4.1
6	3.5	9599	-1207603.	213047.	10007	948011	0	49029	Devil's Slide Plant	1,293.7	46.8	768.8	228.5	14.7	4.6	4.1
7	3.5	9624	-1207603.	213047.	10007	952430	0	49029	Devil's Slide Plant	1,293.7	46.8	768.8	228.5	14.7	4.6	4.1
8	3	5949	-499781.	470177.	28.1121-02	9		46103	GCC Dacotah	1,871.0	50.8	1,668.0	198.6	3.8		
9	2.8	3390	-697446.	5119.	0820	006	10003	08059	TRIGEN - COLORADO ENERGY CORPORATIOI	1,005.1	5.2	43.0	1,947.5	17.4		
10	2.5	9327	-1354245.	1417.	10313	17059	0	49027	Cricket Mountain Plant	908.8	17.6	440.8	3.1	24.5	19.6	21.7
11	2.4	15696	-714543.	173840.	600100002	1863	0	56001	Laramie Cement Plant	920.2	30.6	660.3	85.5	20.1	0.0	28.6
12	1.7	5565	-1414379.	416258.	08300001	010		16083	TASCO, Twin Falls	606.1	2.4	173.0	717.0	44.8	22.3	
13	1.6	11197	-1262021.	182635.	10572	1312	0	49035	Power Plt/ Lab/ Tailings Impoundment	573.8	2.3	28.9	711.7	8.3	4.4	0.1
14	1.6	11198	-1262021.	182635.	10572	1313	0	49035	Power Plt/ Lab/ Tailings Impoundment	573.8	2.3	28.9	711.7	8.3	4.4	0.1
15	1.5	3388	-697446.	5119.	0820	004	10003	08059	TRIGEN - COLORADO ENERGY CORPORATIOI	541.3	2.5	20.9	657.7	7.8		
16	1.4	11201	-1262021.	182635.	10572	1316	0	49035	Power Plt/ Lab/ Tailings Impoundment	526.9	3.7	30.0	902.3	15.4	6.7	0.2
17	1.4	11202	-1262021.	182635.	10572	1317	0	49035	Power Plt/ Lab/ Tailings Impoundment	526.9	3.7	30.0	902.3	15.4	6.7	0.2
18	1.4	15690	-714543.	173840.	600100002	1856	0	56001	Laramie Cement Plant	531.1	12.1	177.7	53.8	8.6	0.0	0.9
19	1.4	5566	-1414379.	416258.	08300001	020		16083	TASCO, Twin Falls	508.4	2.3	19.0	827.0	85.6	42.9	
20	1.4	11195	-1262021.	182635.	10572	1310	0	49035	Power Plt/ Lab/ Tailings Impoundment	492.9	2.2	28.3	682.2	2.9	1.5	0.1
21	1.3	11196	-1262021.	182635.	10572	1311	0	49035	Power Plt/ Lab/ Tailings Impoundment	492.9	2.2	28.3	682.2	2.9	1.5	0.1
22	1.3	21022	-658369.	149577.	602100002	668	0	56021	Cheyenne Nitrogenous Fertilizer Facility	481.7	56.1	59.6	0.0	0.0	0.0	0.0
23	1.3	5537	-1358824.	414676.	06700001	020		16067	TASCO, Paul	473.0	1.7	169.0	189.0	119.5	59.4	
24	1.3	5536	-1358824.	414676.	06700001	010		16067	TASCO, Paul	471.4	2.0	19.3	139.8	95.6	47.8	
25	1.3	11199	-1262021.	182635.	10572	1314	0	49035	Power Plt/ Lab/ Tailings Impoundment	471.0	2.3	29.3	712.8	2.9	1.6	0.1
26	1.3	11200	-1262021.	182635.	10572	1315	0	49035	Power Plt/ Lab/ Tailings Impoundment	471.0	2.3	29.3	712.8	2.9	1.6	0.1
27	1.3	5973	-499542.	470162.	28.1121-02	41		46103	GCC Dacotah	467.8	12.7	417.1	79.5	8.0		
28	1.1	21023	-658369.	149577.	602100002	669	0	56021	Cheyenne Nitrogenous Fertilizer Facility	410.8	48.2	59.5	0.0	0.0	0.0	0.0
29	1.1	5943	-499781.	470177.	28.1121-02	3		46103	GCC Dacotah	706.8	14.6	91.3	26.3	135.8		
30	1.2	5126	-1234508.	412961.	00500004	090		16005	Ash Grove Cement	496.2	14.8	529.0	2.2	25.3	6.5	4.4
31	1.1	6817	-1137841.	33914.	10096	3236	50951	49007	Sunnyside Cogeneration Facility	387.3	12.2	116.1	931.7	38.7	38.7	0.2
32	1.1	33	-674199.	7746.	0003	025		08001	SUNCOR ENERGY - DENVER REFINERY	389.9		409.8	422.2	315.7		
33	1.1	4841	-656837.	39181.	0250	001		08123	THERMO COGEN PARTNERSHIP FT LUPTON	350.0	36.9	371.1	5.5	54.5		
34	1	9326	-1354245.	1417.	10313	73	0	49027	Cricket Mountain Plant	372.6	11.6	289.7	10.6	19.4	15.5	14.3
35	1.2	9269	-1262203.	86989.	12524	965416	56102	49023	Pacificorp Currant Creek Power Plant	88.8	0.9	21.5	0.3	3.8	3.8	6.6
36	1	12441	-1245947.	167466.	12096	954511	0	49035	I-15 CORRIDOR RECONSTRUCTION	370.3	17.1	159.5	40.4	22.8	22.8	0.0
37	1	9324	-1354245.	1417.	10313	71	0	49027	Cricket Mountain Plant	366.1	7.1	177.0	1.3	66.7	53.4	8.7
38	0.6	5944	-499781.	470177.	28.1121-02	4		46103	GCC Dacotah	388.0	15.8	199.2	431.0	45.2		
39	0.6	9325	-1354245.	1417.	10313	72	0	49027	Cricket Mountain Plant	206.1	7.0	173.9	1.7	23.2	18.5	8.6
40	0.5	3387	-697446.	5119.	0820	003	10003	08059	TRIGEN - COLORADO ENERGY CORPORATIOI	185.3	0.8	84.2	247.6	2.2		
41	0.9	5125	-1234508.	412961.	00500004	080		16005	Ash Grove Cement	396.6	10.2	515.0	11.2	34.3	7.3	1.5
42	0.4	5951	-499781.	470177.	28.1121-02	11		46103	GCC Dacotah	140.3	3.8	125.1	23.9	6.8		
43	0.4	12437	-1245947.	167466.	12096	954507	0	49035	I-15 CORRIDOR RECONSTRUCTION	140.0	12.6	55.9	11.8	11.5	11.5	0.0
44	0.4	12450	-1245947.	167466.	12096	954520	0	49035	I-15 CORRIDOR RECONSTRUCTION	138.3	11.2	29.8	9.1	9.8	9.8	0.0
45	0.4	12479	-1245947.	167466.	12096	954552	0	49035	I-15 CORRIDOR RECONSTRUCTION	134.8	10.9	29.1	8.9	9.6	9.6	0.0
46	0.3	21028	-658369.	149577.	602100002	675	0	56021	Cheyenne Nitrogenous Fertilizer Facility	119.9	0.0	0.0	0.0	0.0	0.0	0.0
47	0.3	5539	-1358824.	414676.	06700001	040		16067	TASCO, Paul	115.1	6.1	544.0	43.8	72.2	36.1	
48	0.3	5538	-1358824.	414676.	06700001	030		16067	TASCO, Paul	102.8	4.6	401.7	33.1	90.8	44.6	
49	0.3	12435	-1245947.	167466.	12096	954505	0	49035	I-15 CORRIDOR RECONSTRUCTION	99.1	4.6	42.7	10.8	6.1	6.1	0.0
50	0.2	5567	-1414379.	416258.	08300001	030		16083	TASCO, Twin Falls	74.0	5.7	260.0	25.0	30.0	15.0	
51	0.2	12433	-1245947.	167466.	12096	954503	0	49035	I-15 CORRIDOR RECONSTRUCTION	68.4	9.0	20.7	6.6	6.2	6.2	0.0
52	0.1	21040	-658369.	149577.	602100002	687	0	56021	Cheyenne Nitrogenous Fertilizer Facility	52.8	2.6	1.9	3.0	0.9	0.0	0.0
53	0.1	21039	-658369.	149577.	602100002	686	0	56021	Cheyenne Nitrogenous Fertilizer Facility	48.2	3.1	2.6	3.0	1.1	0.0	0.0
54	0.1	21038	-658369.	149577.	602100002	685	0	56021	Cheyenne Nitrogenous Fertilizer Facility	45.7	1.9	0.5	0.2	0.7	0.0	0.0
55	0.2	9270	-1262203.	86989.	12524	965417	56102	49023	Pacificorp Currant Creek Power Plant	13.1	0.7	27.2	0.2	5.1	5.1	5.0
56	0.1	9195	-1289629.	59699.	10303	17008	0	49023	Leamington Cement Plant	38.1	2.8	38.1	0.1	3.6	3.6	0.0
57	0.1	21021	-658369.	149577.	602100002	667	0	56021	Cheyenne Nitrogenous Fertilizer Facility	35.4	3.8	58.3	0.4	1.3	0.0	0.0

Table G-4 2005 oil and gas sources within the 12/4 km grid modeled with the CAMx Plume-in-Grid. Sources are ranked by their NOx emissions.

		Source Parameters								Emissions (tons/year)						
Rank	NOx (TPD)	PT	X	Y	PlantID	StackID	ORISID	FIPS	PLANT	NOx	VOC	CO	SO2	PM10	PM25	NH3
1	3.4	411	-645321	40225	123-0048	1		8123	KERR-MCGEE GATHERING LLC - HUDSON	1,247.1	64.6	209.4	0.2	17.1	17.1	
2	2.9	2	-653901	-533	001-0036	1		8001	COLORADO INTERSTATE GAS CO WATKINS STA	1,062.5	102.1	281.3	0.5	8.4	8.4	
3	2.2	631	-1269939.	421949.	5-ID-01-01	1		5001	Pocatello Compressor Station	785.1	21.9	115.2	1.3	1.7	0.0	0.0
4	2	1	-652351	-366	001-0025	1		8001	BP AMERICA PRODUCTION CO. WATTENBERG PLT	739.2	58.6	149.4	0.1	2.1	2.1	
5	1.8	60	-610746	-19277	005-0055	1		8005	COLORADO INTERSTATE GAS CO LATIGO C & S	640.7	17.2	177.0	0.1	1.6	1.6	
6	1.8	413	-651163	133421	123-0051	1		8123	COLORADO INTERSTATE GAS CO CHEYENNE STN	668.1	295.2	339.3	3.7	10.6	10.6	
7	1.5	18	-1172147.	374572.	00700008	040		16007	Northwest Pipeline Soda Springs	560.4	20.4	122.3	0.1	0.0	0.0	0.0
8	1.3	145	-1083213	345109	603500004	2887	0	56035	Big Piney Compressor Station	481.8	19.0	34.6	0.0	0.0	0.0	0.0
9	1.2	275	-575438	42400	087-0003	1		8087	COLORADO INTERSTATE GAS CO FORT MORGAN	441.8	82.5	323.8	132.0	1.2	1.2	
10	1.1	294	-993845	68874	103-0021	1		8103	NORTHWEST PIPELINE CORP RANGELY STA	383.4	14.5	46.7	0.1	4.6	4.6	
11	1.1	446	-666557	35211	123-0184	1		8123	KERR-MCGEE FREDERICK COMPRESSOR STATION	392.6	98.3	202.6	0.2	11.2	11.2	
12	1.1	436	-1166696	208277	604100006	1632	0	56041	Anschutz Ranch East	400.2	17.9	62.5	0.0	0.0	0.0	0.0
13	1.1	437	-1166668	208290	604100006	1641	0	56041	Anschutz Ranch East	390.4	18.3	126.2	0.0	0.0	0.0	0.0
14	1	171	-535652	95785	075-0029	1		8075	STERLING ENERGY CO. - YENTER C.S. & G.P.	376.5	27.6	89.3	0.1	1.2	1.2	
15	0.5	15	-1172147.	374572.	00700008	010		16007	Northwest Pipeline Soda Springs	190.9	4.8	13.0	0.0	0.0	0.0	0.0
16	0.5	16	-1172147.	374572.	00700008	020		16007	Northwest Pipeline Soda Springs	192.8	4.8	15.0	0.0	0.0	0.0	0.0
17	0.5	17	-1172147.	374572.	00700008	030		16007	Northwest Pipeline Soda Springs	182.8	4.6	14.2	0.0	0.0	0.0	0.0
18	0.2	14	-1172147.	374572.	00700008	40		16007	Northwest Pipeline Soda Springs	73.2	6.9	41.2	0.0	0.0	0.0	0.0

Table G-5 2005 trona sources within the 12/4 km grid modeled with the CAMx Plume-in-Grid. Sources are ranked by their NOx emissions.

		Source Parameters								Emissions (tons/year)						
Rank	NOx (TPD)	PT	X	Y	PlantID	StackID	ORISID	FIPS	PLANT	NOx	VOC	CO	SO2	PM10	PM25	NH3
1	5.7	304	-1056349	253483	5603700048	974	0	56037	Sodium Products	2,088.8	0.1	2.2	2,541.4	0.3	0.0	0.0
2	5.7	303	-1056349	253483	5603700048	973	0	56037	Sodium Products	2,087.1	0.1	2.1	2,463.4	0.4	0.0	0.0
3	4.5	126	-1052567	249905	5603700002	1201	0	56037	Green River Trona Plant	1,648.9	11.0	94.5	3,202.7	0.6	0.0	0.0
4	3	105	-1052567	249905	5603700002	1180	0	56037	Green River Trona Plant	1,096.6	6.9	59.4	2,013.7	0.3	0.0	0.0
5	1.5	139	-1053989	239839	5603700005	2434	0	56037	Green River Soda Ash Plant	547.1	2.1	52.6	42.1	0.0	0.0	0.0
6	1.5	140	-1053991	239827	5603700005	2435	0	56037	Green River Soda Ash Plant	535.4	2.1	52.2	25.0	0.0	0.0	0.0
7	0.2	111	-1052567	249905	5603700002	1186	0	56037	Green River Trona Plant	82.2	105.3	1,261.8	0.0	0.4	0.0	0.0
8	0.2	112	-1052567	249905	5603700002	1187	0	56037	Green River Trona Plant	81.0	103.8	2,439.8	0.0	0.2	0.0	0.0
9	0.2	324	-1056349	253483	5603700048	995	0	56037	Sodium Products	58.5	0.5	1.6	0.0	0.1	0.0	0.0

Table G-6 2006 EGU Sources within the 12/4 km grid modeled with the CAMx Plume-in-Grid. Sources are ranked by their NOx emissions.

		Source Parameters								Emissions (tons/year)						
Rank	NOx (TPD)	PT	X	Y	PlantID	StackID	ORISID	FIPS	PLANT	NOx	VOC	CO	SO2	PM10	PM25	NH3
1	86	201	-743950.	714784.	EGU0727	0226	6076	30087	COLSTRIP STEAM ELECTRIC STATION	32,472.5			12,232.7			
2	79.7	297	-1322699.	59547.	EGU1222	202	6481	49027	Intermountain Generation Station	28,896.9	0.0	0.0	4,238.3	0.0	0.0	81.5
3	49.7	140	-891863.	107264.	EGU0175	0222	6021	08081	TRI STATE GENERATION CRAIG	17,058.2			3,585.8			74.5
4	31.6	292	-1198431.	24452.	EGU1221	212	8069	49015	Huntington Power Plant	11,130.4	0.0	0.0	17,395.4	0.0	0.0	0.0
5	31	290	-1198213.	-1559.	EGU1220	212	6165	49015	Hunter Power Plant	12,882.8	0.0	0.0	5,832.9	0.0	0.0	0.0
6	24.7	653	-970515.	255230.	603701002	2085	8066	56037	Jim Bridger Plant	8,073.1	79.3	685.0	5,950.3	647.8	647.8	
7	21.4	651	-970515.	255230.	603701002	2062	8066	56037	Jim Bridger Plant	7,480.0	78.5	679.5	5,062.0	223.8	223.8	
8	20.8	633	-646798.	261361.	603100001	225	6204	56031	Laramie River Station	6,900.2	71.0	591.6	4,481.6	198.7	198.7	35.6
9	19.8	632	-646798.	261361.	603100001	224	6204	56031	Laramie River Station	7,084.2	87.7	730.8	3,867.4	233.2	233.2	44.0
10	18.7	631	-646798.	261361.	603100001	213	6204	56031	Laramie River Station	5,796.8	82.4	686.1	3,190.1	142.3	142.3	41.3
11	17.5	21	-689997.	9568.	EGU0163	0222	469	08001	PUBLIC SERVICE CO CHEROKEE PLT	5,900.0			4,806.2			16.8
12	17.4	654	-970515.	255230.	603701002	2086	8066	56037	Jim Bridger Plant	7,969.3	75.7	654.7	3,308.1	160.0	160.0	
13	17	513	-1036751.	80250.	EGU1224	202	7790	49047	BONANZA POWER PLANT	7,348.1	62.8	523.0	864.2	680.8	562.7	31.4
14	15.1	289	-1198213.	-1559.	EGU1220	202	6165	49015	Hunter Power Plant	5,946.1	0.0	0.0	1,505.4	0.0	0.0	0.0
15	15	620	-712198.	348399.	600900001	2040	4158	56009	Dave Johnston	6,277.6	50.8	423.4	5,457.1	949.8	949.8	
16	13.2	624	-1118665.	278236.	602300004	2107	4162	56023	Naughton Plant	6,604.0	41.2	353.6	6,098.9	340.4	340.4	
17	13.1	572	-665551.	505468.	600500046	2122	6101	56005	Wyodak Plant	3,854.6	51.0	425.7	6,513.9	1,403.2	1,403.2	0.5
18	12.8	22	-689997.	9568.	EGU0163	0226	469	08001	PUBLIC SERVICE CO CHEROKEE PLT	4,033.1			2,308.9			14.9
19	11.7	652	-970515.	255230.	603701002	2076	8066	56037	Jim Bridger Plant	4,531.4	65.7	568.2	5,734.4	185.9	185.9	
20	11	619	-712154.	348344.	600900001	2039	4158	56009	Dave Johnston	5,346.6	34.5	287.1	9,060.8	199.1	199.1	
21	11	152	-563976.	46860.	EGU0179	0222	6248	08087	PUBLIC SERVICE CO PAWNEE PLT	4,575.5			13,072.2			31.0
22	10.4	169	-856301.	102086.	EGU0183	0222	525	08107	PUBLIC SERVICE CO HAYDEN PLT	3,531.5			1,056.5			11.3
23	10.1	623	-1118665.	278236.	602300004	2106	4162	56023	Naughton Plant	4,101.8	28.1	240.2	7,726.6	295.5	295.5	
24	10	257	-1174662.	59571.	EGU1218	212	3644	49007	Carbon Power Plant	3,703.1	0.0	0.0	6,778.6	0.0	0.0	0.0
25	9.4	622	-1118665.	278236.	602300004	2095	4162	56023	Naughton Plant	3,462.3	22.0	188.4	6,838.3	48.3	48.3	
26	9.2	170	-856301.	102086.	EGU0183	0226	525	08107	PUBLIC SERVICE CO HAYDEN PLT	4,154.2			1,599.1			15.8
27	7.7	39	-693836.	34254.	EGU0164	0226	477	08013	PUBLIC SERVICE CO - VALMONT	2,300.9			748.0			8.3
28	6.8	613	-712096.	348278.	600900001	2025	4158	56009	Dave Johnston	2,428.1	18.0	149.9	3,895.1	289.6	289.6	
29	6.4	618	-712125.	348311.	600900001	2038	4158	56009	Dave Johnston	2,404.8	17.6	147.3	3,937.8	45.8	45.8	
30	5.9	214	-889488.	696596.	EGU0728	0226	2187	30111	PPL MONTANA - JE CORETTE PLANT	1,918.3			3,473.3			10.8
31	5.5	117	-671031.	123737.	EGU0173	0226	6761	08069	PLATTE RIVER POWER AUTHORITY - RAWHID	1,988.7			942.6			18.0
32	5.1	77	-680287.	-6529.	EGU0165	0222	465	08031	PUBLIC SERVICE CO - ARAPAHOE	2,827.6			2,493.5			9.8
33	4.5	601	-665477.	505749.	600590001	3149	0	56005	WYGEN 2	1,578.0	225.0	3,381.0	2,254.0	270.0	270.0	0.0
34	3.1	603	-658592.	434661.	600590002	3639	0	56005	Two Elk Facility	1,166.8	175.6	1,750.2	1,711.4	233.5	0.0	0.0
35	2.9	662	-591164.	463283.	604500005	398	0	56045	Osage	1,023.7	7.6	63.1	2,870.5	629.4	629.4	
33	2.8	79	-680930.	986.	EGU0166	0601	478	08031	Zuni	68.1			1.8			3.5
36	2.7	197	-821441.	687100.	ORIS55749	STKDEF	55749	30003	HARDIN	3,293.0	67.5	562.7	315.5	36,392.0	9,493.6	33.8
37	2.6	226	-498985.	470013.	28.0801-02	1		46103	Black Hill Power & Light Company (Ben Fr	907.7	3.3	126.9	785.0	30.4		
38	2.1	576	-665602.	505182.	600500063	385	7504	56005	Neil Simpson Two	815.2	4.6	215.3	633.0	86.1	86.1	12.1
39	1.7	600	-665586.	505259.	600500146	3156	55479	56005	WYGEN Station 1	587.0	8.2	176.9	625.6	82.0	82.0	0.0
41	1.6	151	-564179.	47790.	EGU0178	0201	55127	08087	MANCHIEF POWER COMPANY LLC	34.9	9.1	354.0	0.4	29.0	29.0	27.7
40	1.4	196	-834061.	655046.	003-0018	0		30003	HARDIN GENERATOR PROJECT					0.5	0.4	
42	1.4	120	-573494.	-66662.	0036	002	55504	08073	TRI-STATE GENERATION & TRANS - LIMON	4.4		4.1	0.6	1.0		
42	1.3	468	-1245283.	187343.	EGU1223	601	3648	49035	Gadsby Power Plant	43.7	0.0	0.0	0.3	0.0	0.0	0.0
41	1.1	131	-968076.	-34362.	EGU0174	0202	468	08077	PUBLIC SERVICE CO CAMEO PLT	650.7			1,899.1			3.1
41	1.1	192	-663958.	55844.	EGU0186	0201	6112	08123	PUBLIC SERVICE CO FORT SAINT VRAIN PLT	391.6			9.7			121.3
42	0.7	203	-743950.	714784.	EGU0727	0801	6076	30087	COLSTRIP STEAM ELECTRIC STATION	359.0			2,062.3			
45	0.7	469	-1245283.	187343.	EGU1223	604	3648	49035	Gadsby Power Plant	42.6	0.0	0.0	0.3	0.0	0.0	0.0
43	0.6	23	-689997.	9568.	EGU0163	0601	469	08001	PUBLIC SERVICE CO CHEROKEE PLT	206.7			0.7			3.2
39	0.2	116	-671031.	123737.	EGU0173	0201	6761	08069	PLATTE RIVER POWER AUTHORITY - RAWHID	7.4			0.1			1.1
44	0.2	24	-689997.	9568.	EGU0163	0604	469	08001	PUBLIC SERVICE CO CHEROKEE PLT	63.5			0.2			1.4
41	0.1	153	-563976.	46860.	EGU0179	0601	6248	08087	PUBLIC SERVICE CO PAWNEE PLT	27.2			0.3			0.8
43	0.1	78	-680287.	-6529.	EGU0165	0601	465	08031	PUBLIC SERVICE CO - ARAPAHOE	35.5			0.8			2.3
46	0.1	293	-1198431.	24452.	EGU1221	501	8069	49015	Huntington Power Plant	25.4	0.0	0.0	2.0	0.0	0.0	0.0

Table G-7 2006 non-EGU Sources within the 12/4 km grid modeled with the CAMx Plume-in-Grid. Sources are ranked by their NOx emissions.

		Source Parameters								Emissions (tons/year)						
Rank	NOx (TPD)	PT	X	Y	PlantID	StackID	ORISID	FIPS	PLANT	NOx	VOC	CO	SO2	PM10	PM25	NH3
1	10.1	11167	-1267843.	164918.	10571	927593		49035	Mine & Copperton Concentrator	3,749.5	343.4	1,564.0	45.4	306.7	306.7	
2	5.7	1334	-694677.	53910.	0003	007		08013	CEMEX, INC. - LYONS CEMENT PLANT	2,162.0	3.0	136.0	18.0	134.0		
3	4.4	5410	-1183016.	392330.	02900001	010		16029	P4 Production LLC	1,625.5		110.2	8,551.8	48.2	37.9	
4	3.7	9191	-1289629.	59699.	10303	1616	0	49023	Leamington Cement Plant	1,340.7	52.7	8,626.3	0.3	44.6	44.6	4.4
5	3.5	9516	-1207603.	213047.	10007	16758	0	49029	Devil's Slide Plant	1,293.7	46.8	768.8	228.5	14.7	4.6	4.1
6	3.5	9599	-1207603.	213047.	10007	948011	0	49029	Devil's Slide Plant	1,293.7	46.8	768.8	228.5	14.7	4.6	4.1
7	3.5	9624	-1207603.	213047.	10007	952430	0	49029	Devil's Slide Plant	1,293.7	46.8	768.8	228.5	14.7	4.6	4.1
8	3.4	15696	-714543.	173840.	500100002	1863	0	56001	Laramie Cement Plant	1,276.7	56.5	666.2	56.4	48.5	0.0	30.1
9	3	5949	-499781.	470177.	28.1121-02	9		46103	GCC Dacotah	1,871.0	50.8	1,668.0	198.6	3.8		
10	2.8	3390	-697446.	5119.	0820	006	10003	08059	TRIGEN - COLORADO ENERGY CORPORATIOI	1,005.1	5.2	43.0	1,947.5	17.4		
11	2.8	9269	-1262203.	86989.	12524	965416	56102	49023	Pacificorp Currant Creek Power Plant	218.2	0.9	21.5	2.1	3.8	3.8	6.6
12	2.5	9327	-1354245.	1417.	10313	17059	0	49027	Cricket Mountain Plant	908.8	17.6	440.8	3.1	24.5	19.6	21.7
13	2.1	20996	-658369.	149577.	502100002	668	0	56021	Cheyenne Nitrogenous Fertilizer Facility	753.9	41.3	72.5	0.0	0.0	0.0	0.0
14	2	15690	-714543.	173840.	500100002	1856	0	56001	Laramie Cement Plant	736.9	22.2	179.3	35.5	20.8	0.0	0.9
15	1.8	20997	-658369.	149577.	502100002	669	0	56021	Cheyenne Nitrogenous Fertilizer Facility	643.0	35.4	72.4	0.0	0.0	0.0	0.0
16	1.7	5565	-1414379.	416258.	08300001	010		16083	TASCO, Twin Falls	606.1	2.4	173.0	717.0	44.8	22.3	
17	1.6	11197	-1262021.	182635.	10572	1312	0	49035	Power Plt/ Lab/ Tailings Impoundment	573.8	2.3	28.9	711.7	8.3	4.4	0.1
18	1.6	11198	-1262021.	182635.	10572	1313	0	49035	Power Plt/ Lab/ Tailings Impoundment	573.8	2.3	28.9	711.7	8.3	4.4	0.1
19	1.5	3388	-697446.	5119.	0820	004	10003	08059	TRIGEN - COLORADO ENERGY CORPORATIOI	541.3	2.5	20.9	657.7	7.8		
20	1.4	11201	-1262021.	182635.	10572	1316	0	49035	Power Plt/ Lab/ Tailings Impoundment	526.9	3.7	30.0	902.3	15.4	6.7	0.2
21	1.4	11202	-1262021.	182635.	10572	1317	0	49035	Power Plt/ Lab/ Tailings Impoundment	526.9	3.7	30.0	902.3	15.4	6.7	0.2
22	1.4	5566	-1414379.	416258.	08300001	020		16083	TASCO, Twin Falls	508.4	2.3	19.0	827.0	85.6	42.9	
23	1.4	11195	-1262021.	182635.	10572	1310	0	49035	Power Plt/ Lab/ Tailings Impoundment	492.9	2.2	28.3	682.2	2.9	1.5	0.1
24	1.3	11196	-1262021.	182635.	10572	1311	0	49035	Power Plt/ Lab/ Tailings Impoundment	492.9	2.2	28.3	682.2	2.9	1.5	0.1
25	1.3	5537	-1358824.	414676.	06700001	020		16067	TASCO, Paul	473.0	1.7	169.0	189.0	119.5	59.4	
26	1.3	5536	-1358824.	414676.	06700001	010		16067	TASCO, Paul	471.4	2.0	19.3	139.8	95.6	47.8	
27	1.3	11199	-1262021.	182635.	10572	1314	0	49035	Power Plt/ Lab/ Tailings Impoundment	471.0	2.3	29.3	712.8	2.9	1.6	0.1
28	1.3	11200	-1262021.	182635.	10572	1315	0	49035	Power Plt/ Lab/ Tailings Impoundment	471.0	2.3	29.3	712.8	2.9	1.6	0.1
29	1.3	5973	-499542.	470162.	28.1121-02	41		46103	GCC Dacotah	467.8	12.7	417.1	79.5	8.0		
30	1.1	5943	-499781.	470177.	28.1121-02	3		46103	GCC Dacotah	706.8	14.6	91.3	26.3	135.8		
31	1.1	6817	-1137841.	33914.	10096	3236	50951	49007	Sunnyside Cogeneration Facility	387.3	12.2	116.1	931.7	38.7	38.7	0.2
32	1.3	9270	-1262203.	86989.	12524	965417	56102	49023	Pacificorp Currant Creek Power Plant	83.7	0.7	27.2	1.9	5.1	5.1	5.0
33	1.1	33	-674199.	7746.	0003	025		08001	SUNCOR ENERGY - DENVER REFINERY	389.9		409.8	422.2	315.7		
34	1	9326	-1354245.	1417.	10313	73	0	49027	Cricket Mountain Plant	372.6	11.6	289.7	10.6	19.4	15.5	14.3
35	1.2	5126	-1234508.	412961.	00500004	090		16005	Ash Grove Cement	496.2	14.8	529.0	2.2	25.3	6.5	4.4
36	1	12441	-1245947.	167466.	12096	954511	0	49035	I-15 CORRIDOR RECONSTRUCTION	370.3	17.1	159.5	40.4	22.8	22.8	0.0
37	1.1	4841	-656837.	39181.	0250	001		08123	THERMO COGEN PARTNERSHIP FT LUPTON	350.0	36.9	371.1	5.5	54.5		
38	1	22795	-1009636.	236437.	503700003	2021	0	56037	Rock Springs - Rotary Coking	394.3	2.3	10.5	705.6	56.5	0.0	
39	1	9324	-1354245.	1417.	10313	71	0	49027	Cricket Mountain Plant	366.1	7.1	177.0	1.3	66.7	53.4	8.7
40	0.6	5944	-499781.	470177.	28.1121-02	4		46103	GCC Dacotah	388.0	15.8	199.2	431.0	45.2		
41	0.6	9325	-1354245.	1417.	10313	72	0	49027	Cricket Mountain Plant	206.1	7.0	173.9	1.7	23.2	18.5	8.6
42	0.5	21002	-658369.	149577.	502100002	675	0	56021	Cheyenne Nitrogenous Fertilizer Facility	187.7	0.0	0.0	0.0	0.0	0.0	0.0
43	0.5	3387	-697446.	5119.	0820	003	10003	08059	TRIGEN - COLORADO ENERGY CORPORATIOI	185.3	0.8	84.2	247.6	2.2		
44	0.4	5951	-499781.	470177.	28.1121-02	11		46103	GCC Dacotah	140.3	3.8	125.1	23.9	6.8		
45	0.9	5125	-1234508.	412961.	00500004	080		16005	Ash Grove Cement	396.6	10.2	515.0	11.2	34.3	7.3	1.5
46	0.4	12437	-1245947.	167466.	12096	954507	0	49035	I-15 CORRIDOR RECONSTRUCTION	140.0	12.6	55.9	11.8	11.5	11.5	0.0
47	0.4	12450	-1245947.	167466.	12096	954520	0	49035	I-15 CORRIDOR RECONSTRUCTION	138.3	11.2	29.8	9.1	9.8	9.8	0.0
48	0.4	12479	-1245947.	167466.	12096	954552	0	49035	I-15 CORRIDOR RECONSTRUCTION	134.8	10.9	29.1	8.9	9.6	9.6	0.0
49	0.3	5539	-1358824.	414676.	06700001	040		16067	TASCO, Paul	115.1	6.1	544.0	43.8	72.2	36.1	
50	0.3	5538	-1358824.	414676.	06700001	030		16067	TASCO, Paul	102.8	4.6	401.7	33.1	90.8	44.6	
51	0.3	12435	-1245947.	167466.	12096	954505	0	49035	I-15 CORRIDOR RECONSTRUCTION	99.1	4.6	42.7	10.8	6.1	6.1	0.0
52	0.2	5567	-1414379.	416258.	08300001	030		16083	TASCO, Twin Falls	74.0	5.7	260.0	25.0	30.0	15.0	
53	0.2	12433	-1245947.	167466.	12096	954503	0	49035	I-15 CORRIDOR RECONSTRUCTION	68.4	9.0	20.7	6.6	6.2	6.2	0.0
54	0.2	20995	-658369.	149577.	502100002	667	0	56021	Cheyenne Nitrogenous Fertilizer Facility	55.4	2.8	70.9	0.5	1.6	0.0	0.0
55	0.1	9195	-1289629.	59699.	10303	17008	0	49023	Leamington Cement Plant	38.1	2.8	38.1	0.1	3.6	3.6	0.0

Table G-8 2006 oil and gas sources within the 12/4 km grid modeled with the CAMx Plume-in-Grid. Sources are ranked by their NOx emissions.

		Source Parameters								Emissions (tons/year)						
Rank	NOx (TPD)	PT	X	Y	PlantID	StackID	ORISID	FIPS	PLANT	NOx	VOC	CO	SO2	PM10	PM25	NH3
1	3.4	411	-645321	40225	123-0048	1		8123	KERR-MCGEE GATHERING LLC - HUDSON	64.6	1,247.1	209.4	0.2	17.1	17.1	
2	2.9	2	-653901	-533	001-0036	1		8001	COLORADO INTERSTATE GAS CO WATKINS STA	102.1	1,062.5	281.3	0.5	8.4	8.4	
3	2.2	631	-1269939	421949	R10T5-ID-01-01	1		5001	Pocatello Compressor Station	21.9	785.1	115.2	1.3	1.7	0.0	0.0
4	2	1	-652351	-366	001-0025	1		8001	BP AMERICA PRODUCTION CO. WATTENBERG PLT	58.6	739.2	149.4	0.1	2.1	2.1	
5	2	222	-1083213	345109	5603500004	2887	0	56035	Big Piney Compressor Station	18.6	720.4	41.6		0.0		
6	1.8	60	-610746	-19277	005-0055	1		8005	COLORADO INTERSTATE GAS CO LATIGO C & S	17.2	640.7	177.0	0.1	1.6	1.6	
7	1.8	413	-651163	133421	123-0051	1		8123	COLORADO INTERSTATE GAS CO CHEYENNE STN	295.2	668.1	339.3	3.7	10.6	10.6	
8	1.5	18	-1172147	374572	00700008	40		16007	Northwest Pipeline Soda Springs	6.9	73.2	41.2	0.0	0.0	0.0	0.0
9	1.2	275	-575438	42400	087-0003	1		8087	COLORADO INTERSTATE GAS CO FORT MORGAN	82.5	441.8	323.8	132.0	1.2	1.2	
10	1.1	294	-993845	68874	103-0021	1		8103	NORTHWEST PIPELINE CORP RANGELY STA	14.5	383.4	46.7	0.1	4.6	4.6	
11	1.1	446	-666557	35211	123-0184	1		8123	KERR-MCGEE FREDERICK COMPRESSOR STATION	98.3	392.6	202.6	0.2	11.2	11.2	
12	1.1	394	-972459	216166	5603700008	163	0	56037	Brady Gas Plant	4.6	404.1	4.4	0.0	0.0		
13	1	171	-535652	95785	075-0029	1		8075	STERLING ENERGY CO. - YENTER C.S. & G.P.	27.6	376.5	89.3	0.1	1.2	1.2	
14	0.5	15	-1172147	374572	00700008	10		16007	Northwest Pipeline Soda Springs	1.6	24.9	4.4	0.0	0.0	0.0	0.0
15	0.5	16	-1172147	374572	00700008	20		16007	Northwest Pipeline Soda Springs	1.6	25.2	5.0	0.0	0.0	0.0	0.0
16	0.5	17	-1172147	374572	00700008	30		16007	Northwest Pipeline Soda Springs	1.5	23.9	4.8	0.0	0.0	0.0	0.0
17	0.2	14	-1172147	374572	00700008	40		16007	Northwest Pipeline Soda Springs	6.9	73.2	41.2	0.0	0.0	0.0	0.0
18	0.2	393	-972457	216175	5603700008	159	0	56037	Brady Gas Plant	3.9	87.9	12.0	0.0	0.0		

Table G-9 2006 trona sources within the 12/4 km grid modeled with the CAMx Plume-in-Grid. Sources are ranked by their NOx emissions.

		Source Parameters								Emissions (tons/year)						
Rank	NOx (TPD)	PT	X	Y	PlantID	StackID	ORISID	FIPS	PLANT	NOx	VOC	CO	SO2	PM10	PM25	NH3
1	5.4	305	-1056349	253483	603700048	974	0	56037	Sodium Products	1,985.5	0.1	126.8	2,475.9	0.4	0.0	
2	5.4	304	-1056349	253483	603700048	973	0	56037	Sodium Products	1,983.9	0.1	121.1	2,399.9	0.4	0.0	
3	4.4	126	-1052567	249905	603700002	1201	0	56037	Green River Trona Plant	1,617.8	11.0	95.1	3,349.3	0.1	0.0	
4	2.9	105	-1052567	249905	603700002	1180	0	56037	Green River Trona Plant	1,075.9	6.9	59.8	2,105.9	0.5	0.0	
5	2	252	-1062920	260498	603700010	1004	0	56037	Soda Ash Facility - Granger	713.1	3.4	965.1	156.7	3.0	0.0	
6	1.4	139	-1053989	239839	603700005	2434	0	56037	Green River Soda Ash Plant	508.6	2.1	49.2	39.6	0.0	0.0	0.0
7	1.4	140	-1053991	239827	603700005	2435	0	56037	Green River Soda Ash Plant	497.7	2.1	48.8	23.5	0.0	0.0	0.0
8	0.2	111	-1052567	249905	603700002	1186	0	56037	Green River Trona Plant	80.7	105.6	1,270.3	0.0	0.3	0.0	
9	0.2	112	-1052567	249905	603700002	1187	0	56037	Green River Trona Plant	79.5	104.1	2,456.2	0.0	0.2	0.0	
10	0.2	325	-1056349	253483	603700048	995	0	56037	Sodium Products	55.6	0.0	92.2	0.0	2.3	0.0	

SMOKE AREA AND NON-ROAD MOBILE SOURCE EMISSIONS MODELING

This category comprises stationary sources that are not identified as individual points and so are treated as being spread over a spatial extent (usually a county). Examples of stationary area sources include (but are not limited to) residential emissions, fugitive dust, and road dust. Although oil and gas exploration and production sources are often included as part of an area source inventory, they are treated as a separate source category in this study. The 2005 and 2006 base year emissions were projected from the 2002 WRAP Plan D inventory. The 2008 baseline emissions were interpolated from the 2002 WRAP Plan D and 2018 WRAP PRP18b inventories. The emissions team considered updating 2006 Colorado emissions with the Colorado Department of Public Health and Environment (CDPHE) Air Pollution Control Division (APCD) emissions inventory used in the Denver 8-hour ozone SIP Modeling. However, the purpose of the database was mainly to serve ozone modeling in summer period, thus winter-time sources and particulate matter emissions were not well characterized. Thus, the CDPHE/APCD data were not used in this study.

All area (except oil and gas production) source emissions were temporally allocated to a specific month, day, and hour using their annual emissions and allocation factors based on their source category code (SCC). These factors were based on the cross-reference and profile data supplied with the WRAP SMOKE setup. Area sources were spatially allocated in the domain using SCC-based spatial allocation factor files. If an area source SCC did not have an existing cross-reference profile assigned to it, the county-level emissions were allocated by population density in that county.

A crustal PM transport factor has been applied to fugitive dust emission sources that have been identified in U.S. EPA modeling to have only a portion of their mass transported from the source of the emission generation. The EPA's studies (Pace, 2003; 2005) indicate that 60 to 90 percent of PM emissions from fugitive dust sources do not reach an elevated level necessary for transport and are deposited near the source. For this reason, the county-specific fugitive dust emissions transport factors have been applied to these sources to adjust PM emissions prior to the SMOKE modeling. This procedure is consistent with the WRAP fugitive dust inventory.

Off-road mobile sources include, for example, railroad locomotives, aircraft, commercial marine vessels, farm equipment, recreational boating, and lawn and garden equipment. The 2005 and 2006 base year emissions were projected from the WRAP 2002. The off-road mobile source emissions were temporally and spatially allocated in the same manner as the area source emissions.

The marine shipping emissions were held constant from WRAP 2002 inventory, which was estimated using the Waterway Network Ship Traffic, Energy and Environment Model (STEEM) to characterize ship traffic, estimate energy use and assess the environmental impacts of shipping (Corbett et al., 2006).

SMOKE ON-ROAD MOBILE SOURCE EMISSIONS MODELING

This category comprises vehicular sources that operate on roadways such as light-duty gasoline vehicles and heavy-duty diesel vehicles. The MOBILE6 module of SMOKE was used to develop the on-road mobile source emissions. The MOBILE6 parameters, vehicle fleet descriptions, and vehicle miles of travel (VMT) estimates were combined with gridded, episode-specific temperature data to obtain the gridded, temporally allocated emission estimates for weekday, Saturday, and Sunday for the 2005 and 2006 base years. For the 2008 baseline year, 2005 and 2006 meteorology were used to develop two years of on-road mobile inputs for the 2008 emissions year.

The MOBILE6 emissions factors were based on episode-specific monthly average temperatures for each hour predicted by the MM5 meteorological model. Further, the MOBILE6 emissions factor model accounts for the following:

- Hourly and daily minimum/maximum temperatures;
- Vehicle speeds;
- Locale-specific inspection/maintenance (I/M) control programs, if any;
- Adjustments for running losses;
- Splitting of evaporative and exhaust emissions into separate source categories;
- VMT, fleet turnover, and changes in fuel composition and Reid vapor pressure (RVP).

The MOBILE6 input file identifies the various options (e.g. type of inspection and maintenance program in effect, type of oxygenated fuel program in effect, alternative vehicle mix profiles, RVP of in-use fuel, operating mode) that direct the calculation of the MOBILE6 emissions factors for each county. Within Colorado, the MOBILE6 inputs for Colorado were obtained from the mobile source inventory of the Denver 2006 8-hour ozone SIP modeling. The data set was based on the CDPHE estimates of VMT for 2006, divided by county, vehicle type and roadway type. Also provided by CDPHE were average speeds estimated by county and roadway, and fleet information parameters (such as I/M and fuel programs) required as input into MOBILE6. To model the states outside of Colorado, the VISTAS/WRAP 2002 and 2009 inventories were used as a basis for VMT and activity data estimates. The 2005, 2006, and 2008 county VMT totals were interpolated from the 2002 and 2009 VMT estimates, and the MOBILE6 inputs were adjusted to reflect 2005, 2006 and 2008 conditions.

BIOGENIC SOURCE EMISSIONS MODELING

Biogenic emissions were modeled using the Model of Emissions of Gases and Aerosols from Nature (MEGAN) version 2.03 with modifications made by ENVIRON (Guenther et al, 2006; Guenther and Wiedinmyer, 2007; Mansell et al, 2007). MEGAN was used to prepare gridded hourly biogenic emissions inventories suitable for input to CAMx. MEGAN is the latest biogenic emissions model developed by researchers from the National Center for Atmospheric Research (NCAR) and incorporates the full range of ozone and PM precursor species. MEGAN accounts for the spatial variability of biogenic emissions through the use of high resolution estimates of vegetation type and quantity. MEGAN requires as input weather data, Leaf Area Index (LAI), plant functional type (PFT) cover and compound-specific emission factors that are based on plant species composition. All of these variables are provided in a geo-referenced gridded database in several formats (e.g., netcdf, ESRI GRID). The inputs to MEGAN model are:

- Landcover: The land cover available in MEGAN database has global coverage at 30 sec (~ 1km) spatial resolution (Guenther et al, 2006).
- Surface Temperature Data: Gridded, hourly temperature fields were extracted from MM5 predictions for each day for each grid cell.
- Photosynthetically active radiation (PAR): The PAR data represents the intensity of solar radiation in the spectral range that is used by plants for the photosynthesis process. The PAR data were downloaded from the University of Maryland (UMD; 2006) and a FORTRAN program was used to reformat the data. Some of the PAR data were missing. As part of the QA process, the PAR data were inspected, and the missing data were replaced by interpolating the missing data between hours with available data.

Day-specific hourly biogenic emissions were generated for all grid domains for the 2005 and 2006 base years. The 2005 and 2006 biogenic emissions will be used for the 2008 baseline modeling for the 2005 and 2006 meteorological years, respectively.

SMOKE WILDFIRES AND PRESCRIBED BURNS EMISSIONS MODELING

Wildfire and prescribed burn emissions were handled separately from the standard area source input files. For the 2005 and 2006 calendar years, ENVIRON has received estimates of fire emissions from the National Center for Atmospheric Research (NCAR). These emission estimates are derived from analysis of fire locations determined by satellite-borne detectors. The MODerate-resolution Imaging Spectroradiometer (MODIS) instruments fly aboard two polar-orbiting satellites, Terra, and Aqua. These two satellites orbit the Earth, traveling from pole to pole while the earth rotates beneath them; a given area of the Earth will have an overpass from Terra and Aqua approximately twice a day. MODIS instruments detect fires as thermal anomalies (i.e. hot spots seen against a cooler background) at a spatial resolution of about 1 kilometer. Fire emissions derived from the MODIS data include NO_x, CO, VOC and PM species, along with other compounds (e.g., Hg). The NCAR fire emissions inventory development is described by Wiedinmyer and co-workers (2006).

The NCAR satellite-derived fire emissions data for 2005 and 2006 contain daily emissions location, acreage burned, and fuel loading at a resolution of 1 km^2, representing the size of each satellite pixel. SMOKE does not have the capability to handle this type of inventory; therefore, the fire inventory was processed using the Emissions Processing System version 3 (EPS3). Similar to SMOKE, the EPS model can perform the intensive data manipulations required to incorporate spatial, temporal, and chemical resolution into an emissions inventory used for photochemical modeling. Two new EPS modules, PREFIR and PSTFIR, were recently developed specifically to handle point source fire emissions. These new modules allow EPS to treat fire emissions from many data sources including satellite-derived fire emissions and fire inventories from RPO databases. ENVIRON recently conducted fire emissions modeling for the Texas Commission on Environmental Quality (TCEQ) (Tai et al., 2008). The EPS configuration from the TCEQ modeling was used for fire processing in this study.

Each fire record was treated as a point source and emissions were distributed vertically into multiple model layers to better represent each fire plume. A plume profile was calculated for each point in order to distribute the emissions vertically using the methodology outlined in the WRAP 2002 Phase II report (WRAP, 2005). In the WRAP algorithm, fires are assigned to one of

five fire size classes. Three plume parameters – the top and bottom of the plume and the fraction of emissions in layer 1 – are computed from tables of buoyancy efficiencies and maximum top and bottom plume heights, which are functions of the fire size class and/or hour of the day.

The diurnal profiles, parameters, and equations needed to compute the plume attributes were obtained from the WRAP report and were incorporated into the PSTFIR routine in EPS3. The only variable not directly available from the NCAR dataset and required by EPS3 was the fire size.

In the WRAP report, fire sizes were classed in terms of virtual acres, which are estimated using the equation below:

$$Acreage_{virtual} = Acreage_{actual} * \sqrt{FuelLoading / Normalizer}$$

WRAP normalized wildfires to 13.8 tons per acre (tpa) and prescribed fires to 5.0 tpa. The five fire classes are shown in Table G-10. Because it is not possible to determine from the NCAR satellite data whether a particular fire is a wildfire or a prescribed burn, all points were conservatively treated as wildfires. Any point within 5 km of another point was assumed to be part of the same fire event. The virtual area for each fire event was set to the sum of the virtual areas from the cluster of points defining the fire event.

Table G-10 Fire Classes used by WRAP.

Fire Class	MinVirtual Area [acres]	Max Virtual Area [acres]
1	>= 0	<10
2	10	100
3	100	1000
4	1000	5000
5	5000	

The chemical speciation profile used in this task (shown in Table G-11) was derived from a recent study on tropical biomass burning (Karl et al., 2007). The study integrated laboratory experiments and field measurements conducted as part of the TROFFEE (Tropical Fire and Forest Emissions Experiment) campaign. The combination of laboratory and field measurements makes it possible to report many compounds previously not quantified in the field and therefore not included in previous studies

Table G-11 Chemical Speciation Profile used to Convert TOG to CB05 Species for Fire Emissions.

Criteria Pollutant	CB05 Species	Split Factor	Divisor [mol/g]	# Carbons
TOG	ALD2	0.1519	43.5932	2
TOG	ALDX	0.0622	37.1144	2
TOG	FORM	0.0619	29.2445	1
TOG	ISOP	0.024	68.117	5
TOG	MEOH	0.1766	32.0419	1
TOG	OLE	0.0383	36.9936	2
TOG	PAR	0.2334	22.0391	1
TOG	TOL	0.0285	92.2464	7
TOG	UNR	0.2091	22.8743	1
TOG	XYL	0.014	106.165	8

The NCAR fire emissions were reformatted into the EPS3 input format for point source fires and CAMx-ready hourly fire emissions were generated for each simulation day.

Fire emission totals for 2005 and 2006 for the 12 km domain for $PM_{2.5}$ and NOx are shown in Figures G-12 and G-13. The Figures are derived directly from the raw NCAR fire emissions dataset. There were more emissions from fires in 2006 than in 2005, and this is reflected in the fire emissions totals for the two years in Tables G-12 through G-15 below. The 2005 and 2006 fire emissions will be used for the 2008 baseline modeling for the 2005 and 2006 meteorological years, respectively.

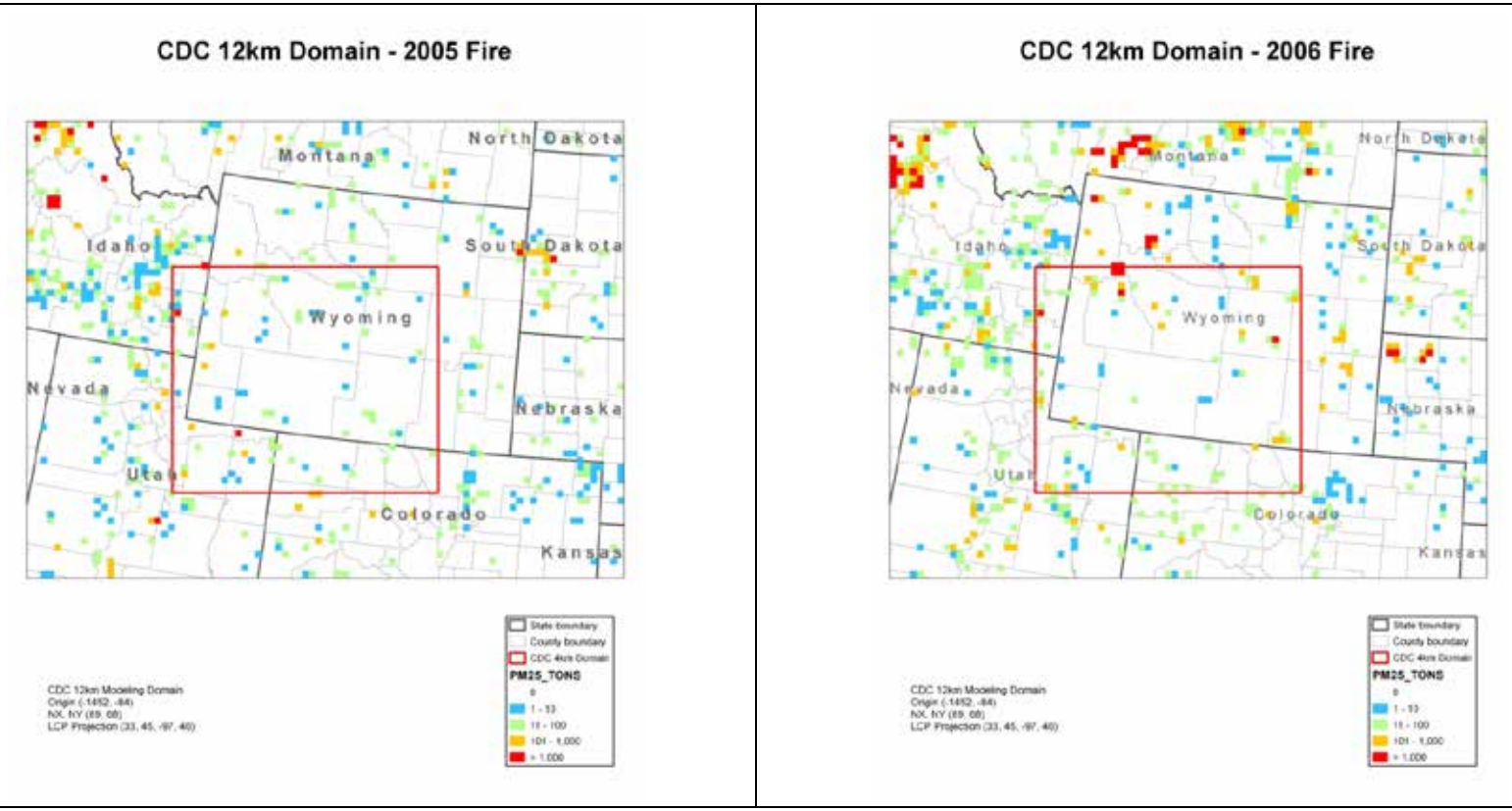
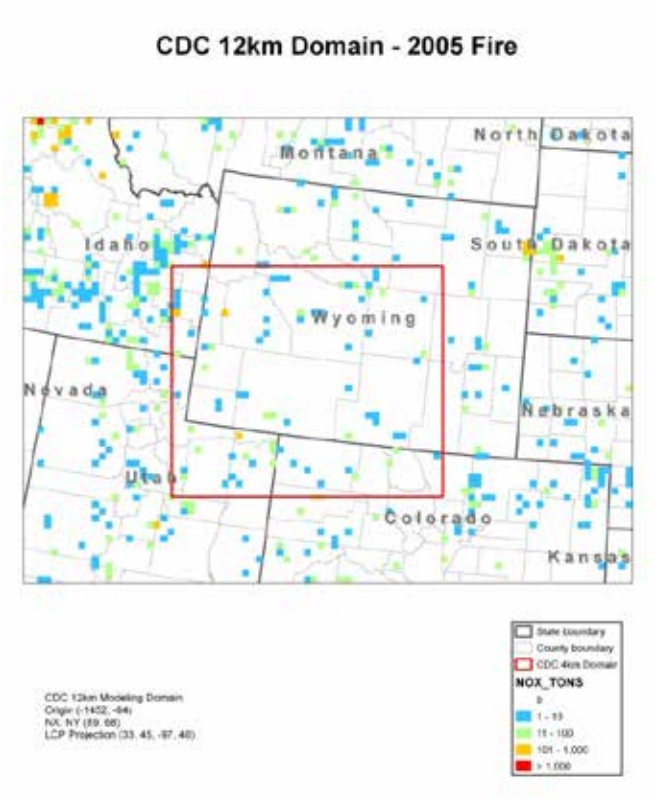


Figure G-12 Comparison of 2005 and 2006 $PM_{2.5}$ fire emissions within the 12/4 km domain.



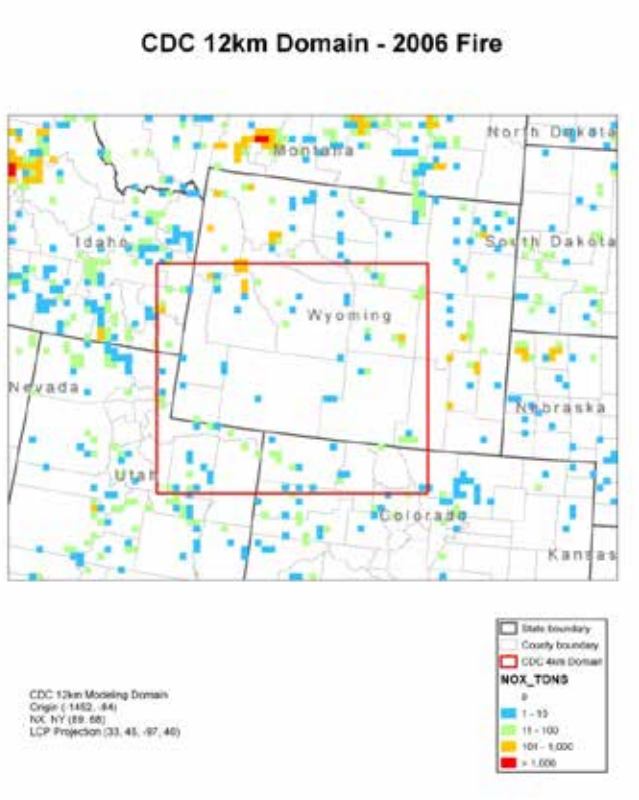


Figure G-13 Comparison of 2005 and 2006 NOx fire emissions within the 12/4 km domain.

SMOKE OIL AND GAS EMISSIONS MODELING

Oil and gas sources are a critical part of the CD-C regional emissions inventory. In this section, we discuss the three O&G emissions inventories that were used across different regions in the modeling domain. These are the Carter Lake/BP 2005-6 inventory for southwest Wyoming, the Carter Lake 2008 inventory for southwest Wyoming and the WRAP Phase II and Phase III oil and gas inventories.

Carter Lake/BP 2005-6 Emission Inventory for Southwest Wyoming

Carter Lake and BP have compiled a detailed and comprehensive emissions inventory of O&G sources in Southwest Wyoming for the years 2005 and 2006. Based on field data and well data from the WYOGCC, this inventory includes emissions from drill rigs, well venting, flashing, fugitives, construction and production truck traffic, and well site production equipment such as dehydrators, heaters, and pumps. Carter Lake/BP provided the following description of the drill rig and truck traffic emission inventory methods to CD-C stakeholders on June 27, 2008:

Monthly drill rig emissions (NO_x, CO, VOC, SO_2, and PM_{10}) were developed for all drill rigs that operated during 2005 and 2006 in Carbon, Lincoln, Sublette, Sweetwater and Uinta Counties. Monthly drill rig emissions were computed from hourly emissions and well drilling durations. Emissions were allocated to the corresponding latitude and longitude coordinates of each drill rig that operated for at least one hour during the month.

Well spud date and well depth data were obtained from the WOGCC for all wells drilled in Carbon, Lincoln, Sublette, Sweetwater and Uinta Counties beginning in November 2004 though December 2006.

BP drill rig summary data for BP rigs in the CDC field during 2005 and 2006 were used for drill rig emissions and drilling durations for all BP drill rigs within the CDC field. BP data for well completion/well fracing emissions were added to each drilling event. The well completion events were assumed to last 24 hours. Monthly emissions were developed for each drill rig that operated during the month. Average drilling rates (ft/hour) and emissions (lbs/hour) were determined from the BP CDC drill rig summary data.

For other operators within the CDC project area, Carbon County, Sweetwater County, Lincoln County, Uinta County, and all of Sublette County with the exception of Jonah Field and the Pinedale Anticline Project Area, the basis for calculating the rig emissions is BP's CDC drill rig summary data. Well depth data and well spud date data from the WOGCC combined with BP average drilling rate information were used to estimate a drilling duration for each well. Average hourly emissions were applied to each hour over the drilling duration. 24 hours of well completion emissions were added to each drilling event. Monthly emissions were developed for each drill rig that operated during the month.

For Jonah Field, well depth data and well spud data from the WOGCC combined with BP average drilling rate information for wells in the Jonah Field were used to estimate a drilling duration for each well. WDEQ provided individual well drilling emissions for 2005 and 2006 were applied to each well for all hours over each drilling event. Data for well completion emissions obtained from the WDEQ 2007 Ozone Study - Upper Green River Basin emissions

inventory were added to each drilling event. The well completion events were assumed to last 96 hours. Monthly emissions were developed for each drill rig that operated during the month.

For the Pinedale Anticline Field, WDEQ provided individual well drilling emissions for 2005 and 2006 were used in combination with WOGCC well spud date data and an assumed 45 day well drilling duration to develop hourly well drilling emission events. Data for well completion emissions obtained from the WDEQ 2007 Ozone Study - Upper Green River Basin emission inventory were added to each drilling event. The well completion events were assumed to last 96 hours. Monthly emissions were developed for each drill rig that operated during the month.

WDEQ requested revisions to the original Carter Lake/BP well VOC emissions inventory that increased the field-wide VOC emissions for both fields by approximately 3%. The additional VOC emissions are due to adjustments to working/breathing losses from well site tanks and dehydration. Carter Lake/BP has revised the VOC emissions and has submitted the updated emissions inventories to WDEQ for review.

Truck traffic emissions (NO_x, CO, VOC, SO_2, and PM_{10}) associated with 2005 and 2006 well production activities were developed for each production well in Carbon, Lincoln, Sublette, Sweetwater, and Uinta Counties. Per well annual production truck traffic emissions were computed using the 2005 Pinedale Anticline emissions inventory obtained from the Pinedale Revised Draft Supplemental EIS.

Monthly truck traffic emissions (NO_x, CO, VOC, SO_2, and PM_{10}) were developed for all wells that were constructed during 2005 and 2006 in Carbon, Lincoln, Sublette, Sweetwater and Uinta Counties. The methodology used for computing drill rig emissions was applied to estimate construction traffic emissions. Monthly construction traffic emissions were computed from hourly emissions that were based on well pad construction, well drilling duration, and well completion assumptions. Emissions were allocated to the latitude and longitude coordinates of the drill rigs.

Well spud date data obtained from the WOGCC, for all wells drilled in Carbon, Lincoln, Sublette, Sweetwater and Uinta Counties beginning in November 2004 though December 2006, and used for computing drill rig emissions were used as a basis for calculating construction traffic emissions.

Per well, construction traffic emissions data were obtained from the Pinedale Anticline SDEIS and Jonah EIS emissions inventories. Hourly emissions were calculated and assigned to drill rig locations.

There are three phases of well construction traffic emissions; 1) Well pad and access road construction, 2) drilling traffic, and 3) rig move and completion traffic.

1. For wells in the Pinedale Anticline, well pad and access road construction was estimated to occur for 16 days. Well pad and access road construction for wells in the Jonah Field was estimated to occur for 4 days. Well pad and access road construction hourly emissions for wells in the Pinedale Anticline were assigned to corresponding drill rig locations for the 16 days prior to the well spud date. For Jonah Field wells, well pad and access road construction hourly emissions were applied for the 4 days prior to the well

spud date. The Jonah Field emissions assumption was used for all other wells in Sublette County, and for all wells in Carbon, Lincoln, Sweetwater and Uinta Counties.

2. For all counties, hourly emissions for drilling haul trucks were applied for all hours when drilling occurs.
3. For all counties, rig move and completion traffic emissions were added for 10 days after drilling was completed.

Spatial surrogates were not required to process the Carter Lake/BP southwest Wyoming emissions, as the wells were modeled as point sources and the latitude and longitudes of the wells were compiled as part of the inventory development. Emissions from drill rigs, completion, and traffic as well as production emissions were all modeled as point sources sited at the well location. Maps of production well and drill rig locations are shown in 2005 and 2006 are shown in Figures G-14-G-17.

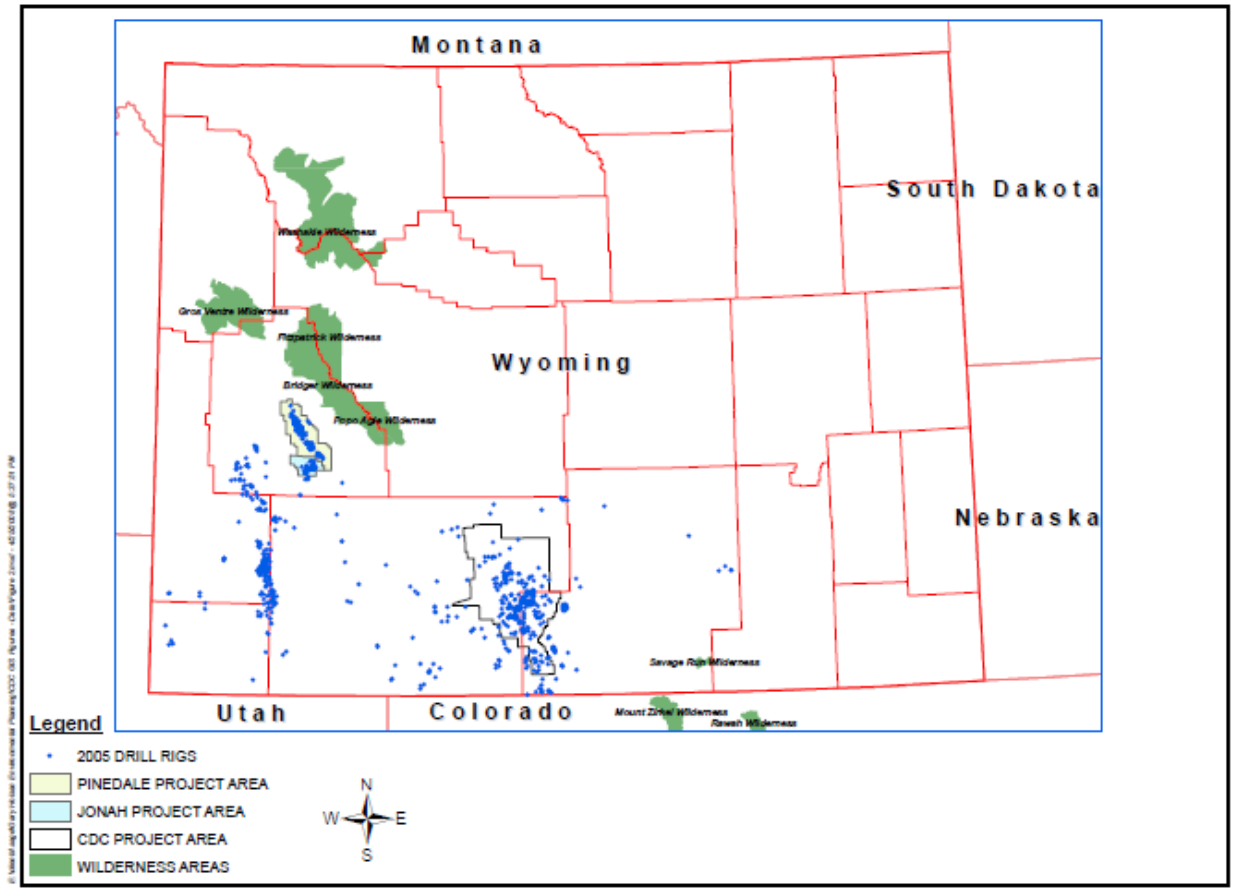


Figure G-14 2005 drill rig locations in Southwest Wyoming.

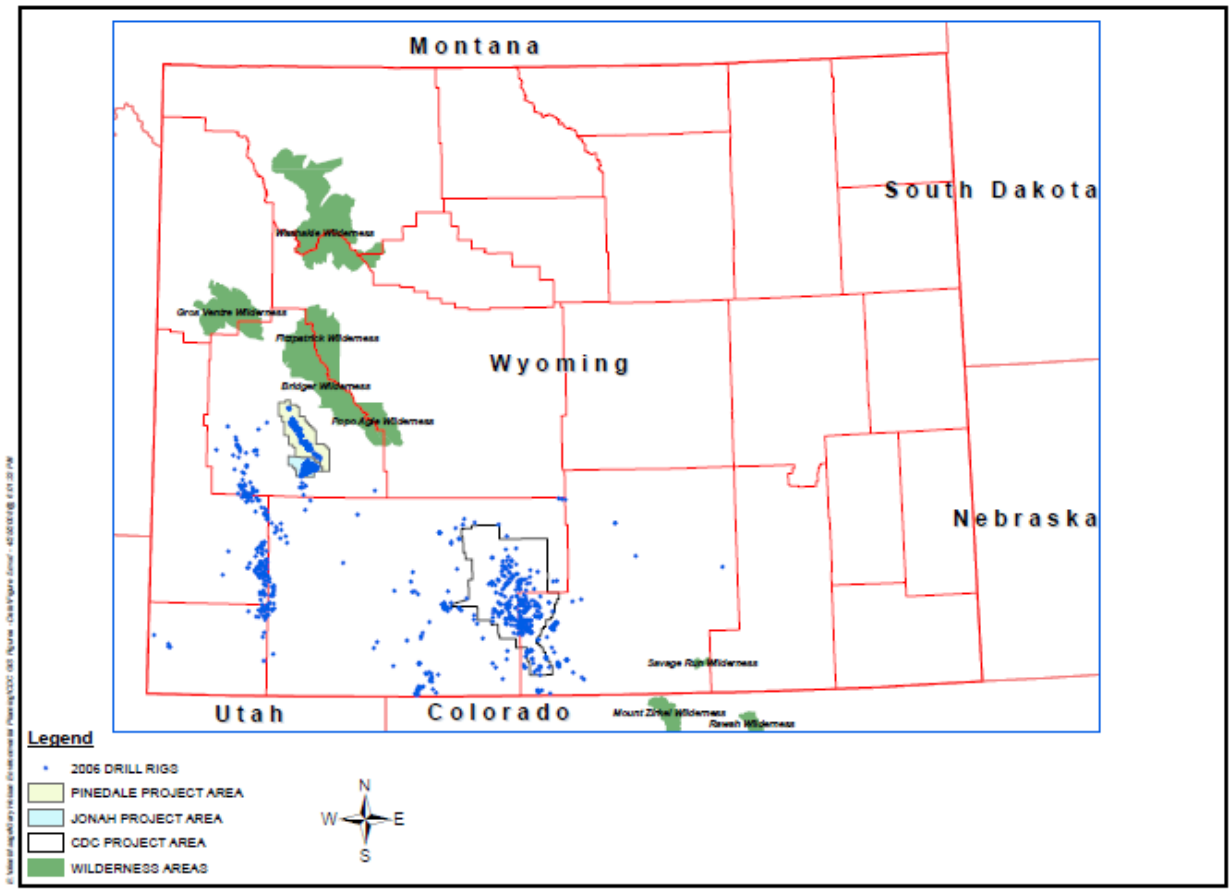


Figure G-15 2006 drill rig locations in Southwest Wyoming.

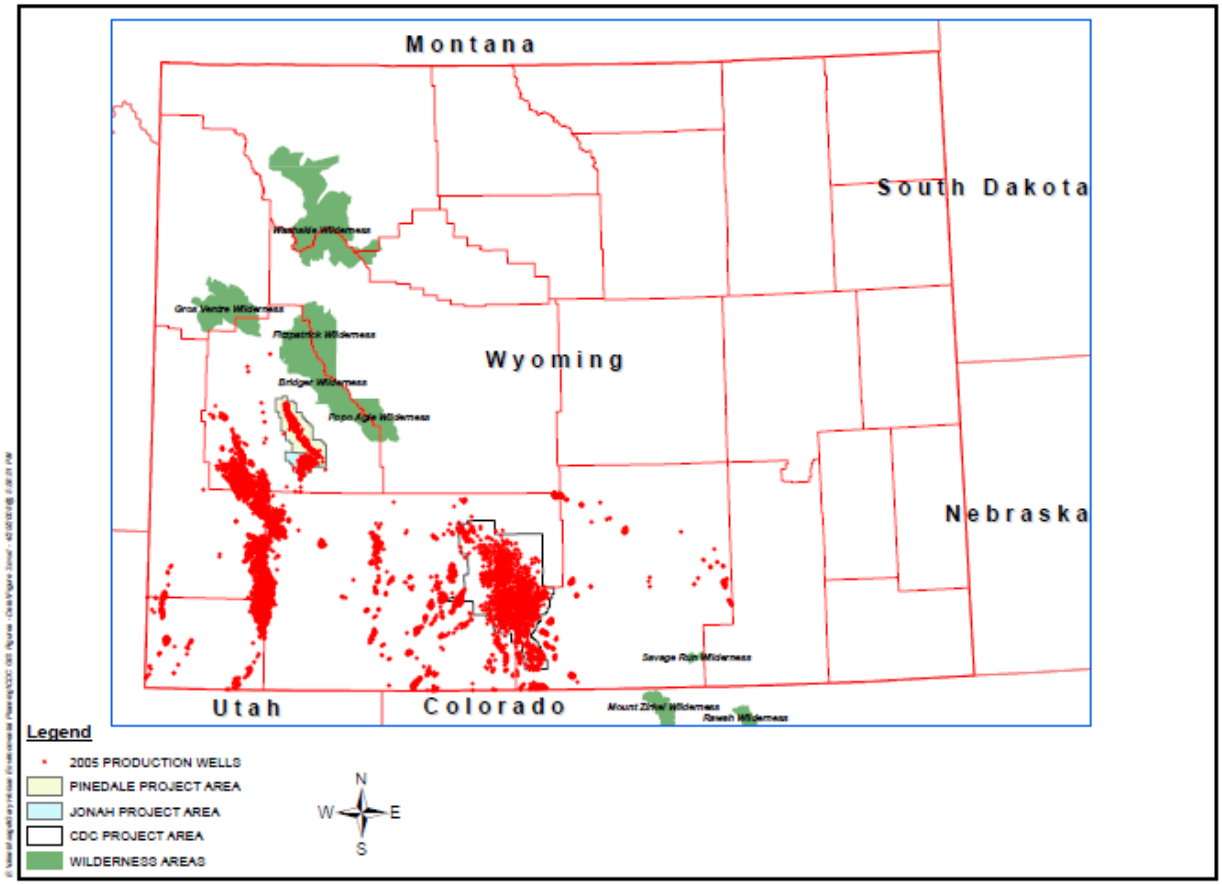


Figure G-16 Map of 2005 production well locations within Southwest Wyoming.

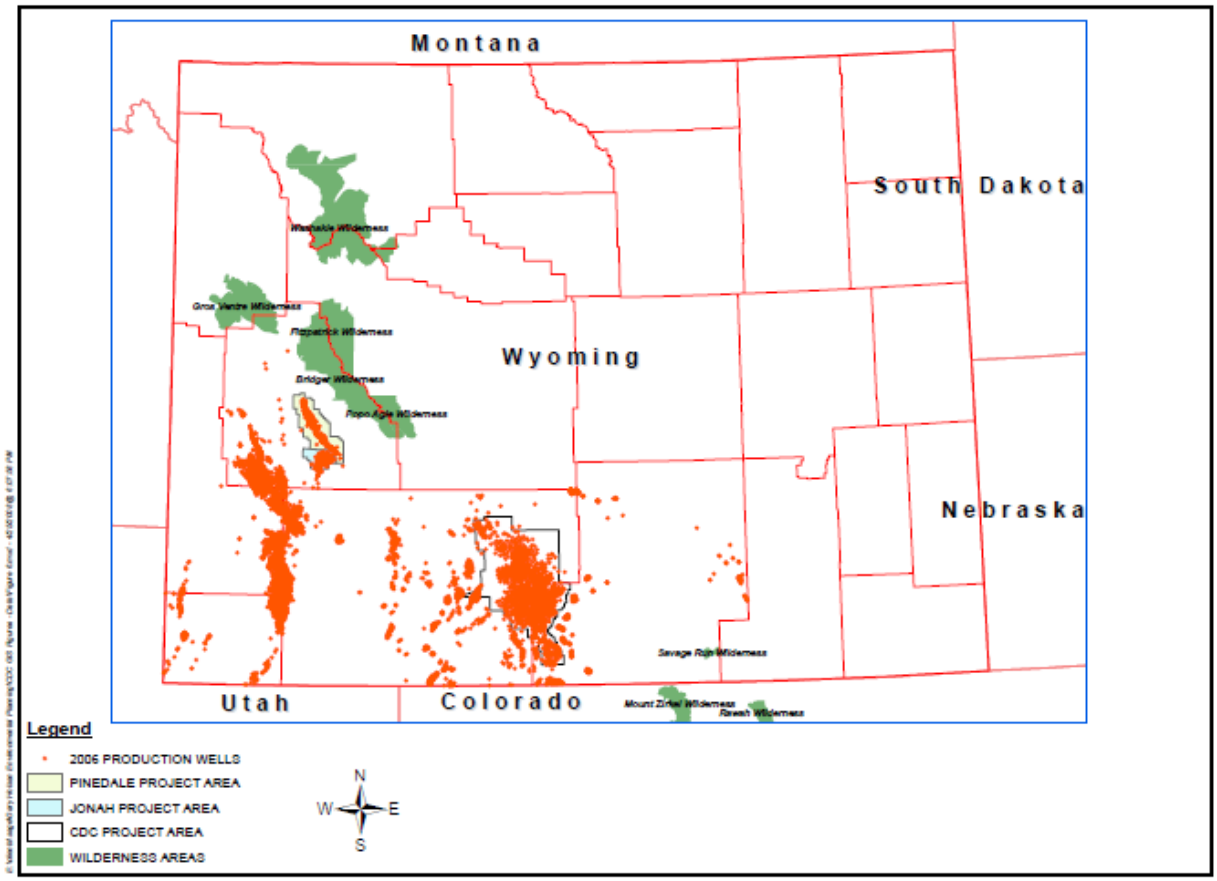


Figure G-17 Map of 2006 production well locations within Southwest Wyoming.

WRAP Phase II Emissions Inventory

Beginning in 2005, the Western States Regional Air Partnership initiated a series of projects to develop a regionally consistent emissions inventory of oil and gas exploration and production activities for all of the western U.S. states. The first of these projects, the Phase I inventory, completed in 2005, represented the first regional oil and gas emissions inventory for the western U.S (Russell and Pollack, 2005). This was followed by the Phase II inventory (Bar-Ilan et al., 2007), which focused on improving emissions estimates of drilling rigs and compressors from those in the Phase I work. Both the Phase I and Phase II inventories were focused on estimating oil and gas NO_x and SO_x emissions for regional haze modeling purposes. Final reports of the Phase I and Phase II inventories are available on the WRAP web page at http://www.wrapair.org/forums/ssjf/documents/eictts/oilgas.html.

The WRAP Phase II O&G emissions inventory, which is being used in the Regional Haze SIP modeling, is available for all basins in the western U.S. Because the emphasis of the WRAP Phase II O&G emissions inventory development was on visibility impairment precursors the inventory was focused on SO_x, NO_x and PM emissions. The WRAP Phase II O&G emissions inventory is known to be deficient in VOC emissions as O&G VOC emissions are not significant contributors to visibility impairment, but are critically important contributors to ozone formation. The understated VOCs in the WRAP Phase II inventory could potentially cause CAMx to underestimate ozone concentrations. The WRAP Phase II emissions are, however the best source of O&G emissions information away from the Carter Lake/BP Southwest Wyoming and WRAP Phase III inventory regions, and the WRAP Phase III inventory will not be completed in time for the CD-C modeling for regions outside the Piceance, Uinta and Denver-Julesburg Basins. ENVIRON suspects that using the WRAP Phase II inventory in areas of Wyoming that are predominately downwind of the Wind River Range will not significantly affect ozone upwind in Southwest Wyoming. For the 2008 baseline modeling, oil and gas emissions data were available as part of the Wyoming 2008 point source emission inventory, and the use of the WRAP Phase II inventory was not required within Wyoming.

WRAP Phase III Emissions Inventory

The WRAP Phase III work, which is currently in progress, will expand on the work done under WRAP Phase II, and will address the limitations of its VOC inventory. A comprehensive 2006 inventory of emissions from oil and gas sources is under development for the following basins (Figure G-18):

- Denver-Julesburg Basin
- Uinta Basin
- San Juan Basin (North and South)
- Piceance Basin
- Southwest Wyoming Basin (Green River Basin)
- Powder River Basin
- Paradox Basin
- Williston Basin
- Wind River Basin
- North-Central Montana Basin (Great Plains Basin)

This list includes all of the major basins of significant oil and gas activity in New Mexico, Utah, Colorado, Wyoming, Montana and North Dakota. Note that the Big Horn Basin was originally slated for inventory development, but was removed from the list because of lack of producer response to the WRAP Phase III survey and the fact that the Basin has relatively little production compared to surrounding basins.

Figure G-18 Basins to be covered by the WRAP Phase III O&G Emissions Inventory.

The Phase III inventory is being assembled by combining data on permitted sources from states' permit databases, and data on unpermitted sources obtained from industry surveys. These surveys request information on typical equipment types, counts, configurations, annual activity levels, controls, and emissions factors. The IHS database is used to determine oil and gas production statistics, which are used to combine these two groups of source categories to generate a complete basin-wide emissions inventory. The IHS database (also known as the P.I. Dwight database) is a high-quality commercially available database of oil and gas statistics for all of the United States and is maintained by IHS Corporation.

To date, the 2006 WRAP Phase III emissions inventories for the Denver-Julesburg, Uinta, and Piceance Basins are complete, and this data was incorporated into the CD-C O&G emissions inventory. The 2006 Phase III data were used for the year 2005.

Processing of Oil and Gas Emissions within SMOKE

The SMOKE emissions model has been used to model the NOx, VOC, CO and PM emissions for Oil and Gas sources. O&G productions emissions were modeled as either point or area sources depending on how they are provided in the base emission inventories. All Wyoming oil and gas sources were modeled as point sources; this includes compressor engines, production sites, drill rigs, and gas plant and compressor station sources. In Colorado (i.e. Piceance & DJ Basins) - small compressor engines, compressor station and gas plants were included in the point source inventory (and therefore modeled as point sources) because of Colorado's requirement that sources with NOx emissions greater than 2 tons/year report emissions to the state. In Utah (Uinta Basin), compressor station and gas plants were included in the point inventory. The rest were included in the area inventory and were modeled as area sources.

Basin- and process-specific VOC speciation profiles derived from gas composition analyses from each basin were, rather than the SMOKE default VOC speciation that is cross-referenced by SCC category. No spatial surrogate is required to process the Carter Lake/BP southwest Wyoming emissions, as the wells are modeled as point sources and the latitude and longitudes of the wells were compiled as part of the inventory development. For Colorado and Utah, the WRAP Phase III emissions for the Uinta, Denver-Julesburg, and Piceance Basins were used. These emissions are calculated on a basin-wide basis, and were treated as area sources. The locations of wells within these three basins were used to develop a surrogate for the spatial allocation of emissions. For all other basins, the WRAP Phase II O&G emissions inventory was used.

Tables G-12 through G-15 show the SW Wyoming emission inventory in terms of the relevant species used in the Carbon Bond 05 (CB05; Yarwood et al., 2005) chemical mechanism for methane (CH4), ethane (ETHA), and VOC (CB05 VOC). Ethane is treated as explicit species in the CB05 mechanism, whereas methane is assumed to have a constant background of 1.7 ppm in the CB05 chemical mechanism as implemented in CAMx and CMAQ. Tables G-12 and G-14 show the input NOx, $PM_{2.5}$, SO_2, and VOC for 2005 and 2006 respectively for each source category of the southwest Wyoming oil and gas emission inventory. Tables G-13 and G-15 show the 2005 and 2006 SMOKE output species once the speciation into CB05 species has been performed. Inspection of Tables G-12 through G-15 shows that the output VOC mass emissions after speciation are close but do not exactly match the input VOC mass emissions. The output VOC mass emissions after speciation are not expected to match the input VOC mass emissions; an explanation for this is provided below.

Table G-12 2005 SMOKE Inputs.

County	Source Category	Emissions (Tons/Year)				
		CO	NOx	PM2.5	SO2	VOC
Carbon County	Compression	574	1,111	1	0	218
	Production	160	423	31	6	20,982
	Spud	63	447	42	7	24
Lincoln County	Compression	880	2,047	13	135	208
	Production	3,433	657	32	2,169	22,087
	Spud	47	361	35	5	16
Sublette County	Compression	812	1,564	0	0	784
	Production	421	758	67	8	27,079
	Spud	2,035	4,163	137	369	261
Sweetwater County	Compression	2,126	2,712	0	0	672
	Production	364	889	63	185	46,726
	Spud	112	787	77	11	31
Uinta County	Compression	705	1,414	0	0	205
	Production	1,076	314	15	4,736	6,532
	Spud	17	51	5	2	2
Grand Total		12,826	17,699	517	7,632	125,826

Table G-13 2005 SMOKE Outputs.

County	Source Category	Emissions (Tons/Year)						
		CO	NOx	PM2.5	SO2	CB05 VOC	CH4	ETHA
Carbon County	Compression	574	1,110	1	0	216	1,609	300
	Production	158	413	31	6	22,969	75,787	12,559
	Spud	62	446	38	7	28	3	1
Lincoln County	Compression	880	2,047	12	135	182	1,269	213
	Production	3,403	640	31	2,168	24,095	108,675	14,787
	Spud	48	361	32	5	18	2	0
Sublette County	Compression	812	1,561	0	0	836	6,439	1,256
	Production	410	761	64	7	29,596	122,723	16,054
	Spud	2,036	4,165	124	369	304	35	9
Sweetwater County	Compression	2,124	2,707	0	0	712	5,477	1,061
	Production	355	879	62	184	52,999	196,162	29,193
	Spud	111	786	70	11	36	4	1
Uinta County	Compression	705	1,414	0	0	193	1,396	250
	Production	1,069	311	13	4,735	7,182	30,640	4,282
	Spud	8	61	5	1	3	0	0
Grand Total		12,754	17,662	483	7,629	139,369	550,222	79,965

Table G-14 2006 SMOKE Inputs.

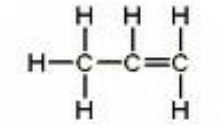
County	Source Category	Emissions (Tons/Year)				
		CO	NOx	PM2.5	SO2	VOC
Carbon County	Compression	1,128	2,092	1	0	559
	Production	192	485	35	7	23,562
	Spud	73	612	56	9	34
Lincoln County	Compression	682	2,010	46	129	148
	Production	701	691	43	2,080	23,185
	Spud	44	331	32	5	14
Sublette County	Compression	1,094	2,300	0	2	725
	Production	484	912	79	11	26,413
	Spud	1,946	4,036	133	250	253
Sweetwater County	Compression	2,620	4,361	0	0	819
	Production	396	1,084	67	122	49,240
	Spud	106	820	81	12	32
Uinta County	Compression	519	702	0	0	175
	Production	1,152	417	14	2,470	6,529
	Spud	11	82	8	1	4
Grand Total		11,149	20,935	595	5,099	131,692

Table G-15 2006 SMOKE Outputs.

County	Source Category	Emissions (Tons/Year)						
		CO	NOx	PM2.5	SO2	CB05 VOC	CH4	ETHA
Carbon County	Compression	1,129	2,094	1	0	574	4,345	827
	Production	184	473	35	7	26,028	84,877	13,680
	Spud	73	614	51	9	40	5	1
Lincoln County	Compression	683	2,010	41	130	148	1,110	207
	Production	677	673	39	2,080	25,348	113,693	15,450
	Spud	44	332	29	5	17	2	0
Sublette County	Compression	1,092	2,299	0	2	773	5,952	1,161
	Production	469	908	76	10	28,890	127,490	16,514
	Spud	1,945	4,035	121	250	294	34	9
Sweetwater County	Compression	2,620	4,356	0	0	871	6,682	1,300
	Production	388	1,073	64	121	56,251	210,547	31,474
	Spud	107	820	73	12	37	4	1
Uinta County	Compression	519	701	0	0	180	1,365	260
	Production	1,144	413	13	2,469	7,186	30,902	4,304
	Spud	11	81	7	1	4	0	0
Grand Total		11,084	20,882	550	5,096	146,642	587,007	85,189

O&G VOC emission estimates for southwest Wyoming for each region and source category were provided by the Carter Lake/BP emission inventory. These emission estimates for total VOC were converted to the more detailed chemical speciation used by the CB05 chemical mechanism in CAMx. For each VOC emissions source, a speciation profile code based on the emissions source category determines the "split factors" for that particular profile. The split factors are multiplicative factors for converting grams of criteria pollutant (e.g. VOC) emissions into moles of CB05 species. For example, in Appendix C, Table C.3, the JON06 profile gives the split factors required to take VOC emissions from well venting in the Jonah field and speciate the emissions into moles of CB05 species that can then be used by the chemical mechanism in CAMx. Note that the speciation of VOC to CB05 species conserves moles of material. An example of how split factors are derived from data specifying the composition of a hydrocarbon mixture (e.g. a gas composition analysis) is given below.

A given organic compound is assigned to CB05 model species based on its carbon bond structure. This is in contrast to a lumped species approach (e.g., SAPRC99) whereby VOC species with similar characteristics and reactivities are assigned to the same lumped species. In the Carbon Bond approach, a VOC species is decomposed based on its reactive carbon bonds. One advantage of the Carbon Bond approach is that it conserves Carbon atoms, however, information on other atoms that may be attached to the Carbon (e.g., hydrogen and oxygen) is lost. For example, propene contains 3 carbon atoms with one carbon-carbon double bond (olefin bond) and one carbon-carbon single bond (paraffinic bond) and six hydrogen atoms:



1 mole of propene is therefore assigned to 1 mole of PAR (paraffin) and 1 mole of OLE (olefin).

Consider a hypothetical mixture of several non-methane organic compounds (NMOCs; Table G-16). The first column shows the gases that comprise the mixture, and the second column shows the mole fraction for each gas. The third column shows the CB05 mapping for each compound; this mapping is done according to the carbon structure as in the propene example above. The CB05 mappings are weighted by mole fraction (shown in the second column) and then summed to obtain the total CB05 model species per mole of the NMOC mixture emitted (i.e. 0.2 ETHA + 1 PAR + 0.05 ETH + 0.1 OLE + 0.1 FORM + 0.15 TOL + 0.05 XYL).

Table G-16 Example calculation to assign a hypothetical non-methane organic compound (NMOC) mixture to CB05 model species.

NMOC Mixture	Mole Fraction	CB05 Mapping (mol/mol specie)	CB05 Mixture (mol/mol NMOC)
Ethane	0.2	1 ETHA	0.2 ETHA
Butane	0.15	4 PAR	0.6 PAR
Ethene	0.05	1 ETH	0.05 ETH
Propene	0.10	1 PAR + 1 OLE	0.1 PAR + 0.1 OLE
Formaldehyde	0.10	1 FORM	0.1 FORM
Acetaldehyde	0.15	1 ALD2	0.15 ALD2
Toluene	0.10	1 TOL	0.1 TOL
Ethylbenzene	0.05	1 PAR + 1 TOL	0.05 PAR + 0.05 TOL
Diethylbenzene	0.05	2 PAR + 1 XYL	0.1 PAR + 0.05 XYL
Acetone	0.05	3 PAR	0.15 PAR
Total	1.0		0.2 ETHA + 1 PAR + 0.05 ETH + 0.1 OLE + 0.1 FORM + 0.15 TOL + 0.05 XYL

In order to create the SMOKE output CB05 emissions summary tables shown in Table G-12 through G-15, the CB05 VOC species in moles must be converted back to units of weight (i.e. tons). This is done for reporting purposes only and has nothing to do with the CB05 chemical mechanism that is conserving moles of VOC. The default molecular weight for reporting the mass of CB05 species derived from hydrocarbons is the carbon number multiplied by the molecular weight of methane (16 gm/mole), which assumes that there are four hydrogen atoms associated with each carbon atom. Note that the while the number of carbon atoms in the original VOC emissions estimate is preserved throughout the speciation process, the number of atoms of other species (hydrogen, oxygen, etc.) is not, so that the VOC emissions input to SMOKE will not match the VOC emissions tallied after speciation has occurred. Also note that alternative molecular weights than that for methane could also be used for converting the CB05 species from moles to mass units for reporting purposes. For example, in the propene example given above, if we started with 42 gm of propene it would first be converted into one mole of propene (molecular weight of 42 gm/mole) and then speciated into one mole of PAR and one mole of OLE. To convert back to mass for reporting purposes we assume the molecular weight of methane (16 gm/mole) for each carbon and get the following CB05 VOC mass back for 42 gm of propene:

- 16 x (1 mole PAR) + 2 x 16 x (1 mole of OLE) = 48 gm

So in this case, the CB05 VOC mass for propene coming out of the speciation when reported as mass is 14% higher than the mass of propene going into the speciation. This is solely a reporting convention; as far as the CB05 speciation is concerned carbon, is preserved as three moles of carbon going in the speciation (propene) and three moles of carbon coming out of the speciation (one PAR and one OLE). For hydrocarbon species, the CB05 VOC mass will be the same or higher than the mass of hydrocarbons going into the speciation because the maximum number of hydrogen atoms that can be associated with a carbon atom is 4 (i.e., methane, CH4).

O&G Categories

O&G production categories by basin were processed separately into three source categories to facilitate source apportionment. The three source categories include:

1. Drill Rigs;
2. Compressor Engines (including compressor station);
3. Production sources including:
    a. Heaters
    b. Gas processing plants
    c. Flashing
    d. Venting
    e. Fugitives
    f. Dehydrators
    g. Pneumatic pumps
    h. Traffic Construction & Production (only available for SW Wyoming basin)
    i. Workover Rigs (used to restore or increase well production)

In SW Wyoming, all O&G emissions were modeled as point source. In Colorado (i.e. Piceance & Denver-Julesburg Basins) - small compressor engines, compressor station and gas plants were included in the point inventory (and hence modeled as point sources) because of Colorado's requirement that sources with NOx emissions greater than 2 tons/year report emissions to the state. In Utah (Uinta Basin), compressor station and gas plants were included in the point inventory. The rest of the oil and gas sources were modeled as area sources

O&G Spatial Surrogates

The WRAP Phase III O&G inventory for the Denver-Julesburg, Piceance, and Uinta Basins was assembled for both point (permitted) and area (unpermitted) source categories. All the permitted sources were modeled as point sources and unpermitted sources were modeled as area sources. WRAP Phase III emissions for the Denver-Julesburg, Piceance, and Uinta Basins were calculated on a basin-wide basis by SCCs (listed in Table G-17), and were treated as area sources. The next step in the emission inventory development process was to distribute the emissions among the model grid cells within each basin using a spatial surrogate that serves as a proxy for the location of the actual emitting processes. Area sources are often estimated at the county level, and are then allocated to the grid cells within each county based on such spatial surrogates as population or economic activity. Through this process, the spatial resolution of the emissions is matched to the CAMx grid(s).

The updated spatial allocation surrogates were developed using the 2006 IHS database for the WRAP Phase III basins. The oil and gas production surrogates were based on production data at known well locations, while the drilling surrogate was based solely on the number and location of wells drilled. For each individual well, the oil, gas and water production values were divided by the total oil, gas and water production values corresponding to the county in which the well was located. This division resulted in determination of the fraction of a county's total production taking place at each well. In the case of the drilling surrogate, the number of drilling

events, rather than the production values, was used. For each grid cell (intersecting a county) and county combination, well production fraction were summed for wells inside the given grid cell to obtain the surrogate value. A detailed description of the spatial surrogate development is given in Appendix B.

SW Wyoming emissions were prepared by Carter Lake/BP. In addition to WRAP Phase III source categories, the SW Wyoming inventory included traffic production and traffic construction source category emissions. These emissions were assigned to SCC - 2230070000 (Mobile Sources, Highway Vehicles - Diesel, All HDDV including Buses (use subdivisions -071 thru -075 if possible), Total: All Road Types). Spatial surrogates were not required to process the Carter Lake/BP southwest Wyoming emissions, as the wells were modeled as point sources and the latitude and longitudes of the wells were compiled as part of the inventory development. For all other basins, the WRAP Phase II O&G emissions inventory was used along with the WRAP Phase II spatial surrogates, developed using 2002 well and spud data obtained from the Wyoming Oil and Gas Conservation Commission (WOGCC).

Table G-17 WRAP Phase III O&G SCC List.

SCC	SCC Description
2310000110	Industrial Processes, Oil and Gas Production, All Processes, Drill Rigs
2310000120	Industrial Processes, Oil and Gas Production, All Processes, Workover Rigs
2310010100	Industrial Processes, Oil and Gas Production, Crude Petroleum, Truck Loading
2310010200	Industrial Processes, Oil and Gas Production, Crude Petroleum, Tanks - Flashing & Standing/Working/Breathing
2310010300	Industrial Processes, Oil and Gas Production, Crude Petroleum, Pneumatic devices
2310010400	Industrial Processes, Oil and Gas Production, Crude Petroleum, Fugitives
2310020100	Industrial Processes, Oil and Gas Production, Natural Gas, Dehydrators
2310020200	Industrial Processes, Oil and Gas Production, Natural Gas, Venting - Initial Completions
2310020300	Industrial Processes, Oil and Gas Production, Natural Gas, Venting – Recompletions
2310020400	Industrial Processes, Oil and Gas Production, Natural Gas, Venting - Blowdowns
2310020500	Industrial Processes, Oil and Gas Production, Natural Gas, Venting - Compressor Startup
2310020600	Industrial Processes, Oil and Gas Production, Natural Gas, Venting - Compressor Shutdown
2310020700	Industrial Processes, Oil and Gas Production, Natural Gas, Fugitives
2310020800	Industrial Processes, Oil and Gas Production, Natural Gas, Pneumatic Devices
2310020900	Industrial Processes, Oil and Gas Production, Natural Gas, Pneumatic Pumps
2310020110	Industrial Processes, Oil and Gas Production, Natural Gas, Amine Units
2310023100	Industrial Processes, Oil and Gas Production, CBM, Dehydrators
2310023200	Industrial Processes, Oil and Gas Production, CBM, Venting - Initial Completions
2310023300	Industrial Processes, Oil and Gas Production, CBM, Venting - Recompletions
2310023400	Industrial Processes, Oil and Gas Production, CBM, Venting - Blowdowns
2310023500	Industrial Processes, Oil and Gas Production, CBM, Venting - Compressor Startup
2310023600	Industrial Processes, Oil and Gas Production, CBM, Venting - Compressor Shutdown
2310023700	Industrial Processes, Oil and Gas Production, CBM, Fugitives
2310023800	Industrial Processes, Oil and Gas Production, CBM, Pneumatic Devices
2310023900	Industrial Processes, Oil and Gas Production, CBM, Pneumatic Pumps
2310023110	Industrial Processes, Oil and Gas Production, CBM, Amine Units
2310030100	Industrial Processes, Oil and Gas Production, Natural Gas Liquids, Gas Plant Truck Loading

SCC	SCC Description
2310030200	Industrial Processes, Oil and Gas Production, Natural Gas Liquids, Truck Loading
2310030300	Industrial Processes, Oil and Gas Production, Natural Gas Liquids, Tanks - Flashing & Standing/Working/Breathing
2310030400	Industrial Processes, Oil and Gas Production, Natural Gas Liquids, Water Tank Losses
2310024100	Industrial Processes, Oil and Gas Production, Natural Gas, Heaters
2310024200	Industrial Processes, Oil and Gas Production, Natural Gas, Initial Completion Flaring
2310024300	Industrial Processes, Oil and Gas Production, Natural Gas, Condensate Tank Flaring
2310024400	Industrial Processes, Oil and Gas Production, Natural Gas, Dehydrator Flaring
2310025100	Industrial Processes, Oil and Gas Production, Natural Gas, Compressor Engines
2310025200	Industrial Processes, Oil and Gas Production, Natural Gas, Miscellaneous Engines
2310025300	Industrial Processes, Oil and Gas Production, Natural Gas, Artificial Lift

O&G VOC Speciation

Basin-specific VOC composition profiles were used to the fullest extent possible, rather than the SMOKE default VOC speciation that is cross-referenced by SCC category. Specifically, for WRAP Phase III, those source categories that relied on estimates of volume of gas vented or leaked (i.e. blowdowns, completions, and fugitive emissions), gas composition analyses were compiled from data collected through surveys of producers. These composition analyses were averaged to derive a single basin-wide produced gas composition analysis for CBM, conventional gas and oil wells.

The Carter Lake/BP southwest Wyoming O&G inventory includes detailed VOC gas composition analyses for the 5-County area. Speciation profiles were developed for the main VOC-emitting processes from oil and gas production activities for each county in the region. Where additional spatial resolution was needed, counties were further subdivided; the Jonah and Pinedale fields were separated out from the rest of Sublette County, and Sweetwater County was divided into East Sweetwater and West Sweetwater. Separate speciation profiles were developed for the following processes: flashing, well venting, pneumatic pumps, and fugitive emissions, which were further broken down into emissions from sales gas, produced gas and condensate. Profile codes and descriptions are shown in Table C.3 of Appendix C. Since gas analyses for the Southwest Wyoming basin were available for both 2005 and 2006, two-year average profiles were used. The Speciation Tool (ENVIRON, 2007) was used to convert these gas composition analyses to CB05 speciation profiles ready for use in SMOKE.

The SMOKE emission model includes default speciation profiles indexed by SCC codes. These profiles are based on EPA default data as well as on various updates and improvements incorporated to account for such things as variations in fuels, solvent composition, and chemical mechanisms used in air quality models. For the CD-C southwest Wyoming O&G processing, instead of using generic EPA default profiles, region-specific VOC speciation profiles derived from the gas composition analysis for each basin were used.

Speciation profiles used for modeling of VOC emissions from O&G sources in SW Wyoming are shown in Table C.4, and the cross reference between speciation profiles and SCCs that shows which profile was used for a given source category is shown in Table C.5. Table C.6 provides a

key to the abbreviations for the CB05 species. For comparison, EPA default speciation profiles and cross references are shown in Tables C.7-C.9.

O&G Temporal Allocation

The Carter Lake/BP inventory provided drill rig, construction traffic and heater emissions in southwest Wyoming as monthly emissions. In the emission inventory used for the Hiawatha modeling, the monthly heater emissions were allocated across all hours in the month during which the activity took place according to the default SMOKE temporal profile for oil and gas sources. This profile assumes that the source operates constantly throughout a given time period. Monthly construction traffic emissions were allocated in time using the SMOKE default profile for Heavy Duty Diesel Vehicles (HDDV), which has both weekly and diurnal variation. However, the drill rig emissions were incorrectly allocated evenly across the entire year in which a particular drilling event occurred, rather than only during the months when drilling actually took place. The 2005-6 drill rig emission inventory has been reprocessed so that the monthly emissions are allocated by month to hourly emissions using the default SMOKE temporal profile for oil and gas sources, as was done for the heater emissions.

Production traffic emissions were temporally allocated using the SMOKE default profile for Heavy Duty Diesel Vehicles. No temporal variation was applied to the rest of the O&G sources, i.e. emissions from well production sources were assumed to be equally distributed across every hour within the calendar year according to the default SMOKE temporal profile for oil and gas sources.

Other Source Categories

Other emission categories such as agricultural source ammonia and the wind-blown dust were processed outside of SMOKE and were obtained from the original data sources, described below.

Ammonia emissions from sources including livestock, fertilizer usage, domestic sources, and wild animals within WRAP states were generated from a GIS-based ammonia emissions model (Mansell, 2005) using day-specific meteorology for temporal distribution processing.

The windblown fugitive dust PM emission inventory was developed using the estimation methodology developed for WRAP by a team of contractors led by ENVIRON (ENVIRON, 2004). The methodology is based on the results of wind tunnel studies and a detailed characterization of vacant lands. The model generates estimates of PM_{10} dust emissions. The fine fraction of dust is obtained by using a nominal $PM_{2.5}$ of 0.10, as used in the implementation of the model for the WRAP. Windblown dust emissions are estimated hourly on a gridded modeling domain using hourly averaged wind speeds and other meteorological parameters. Estimates were developed for every hour of the 2005 and 2006 base year and these emissions will also be used the 2008 baseline modeling.

Merging Products of Emissions Processing into Model-Ready Files

Emissions for different major source groups (e.g., mobile, off-road mobile, area, point and biogenic) were processed separately and merged together prior to CAMx modeling. Table G-18 lists all of the pre-merged emissions files needed for the 36 km domain, and Table G-19 lists the pre-merged files required for the 12 km domain for 2006.

Table G-18 Pre-merged emissions files for the 36 km domain.

Major Category	Sub Category	File Name
Area	Generic Area excluding dust&fire	1. argts_l.{date}.1.RPO36km.{CASE}.cmaq.cb05p25.ncf
	Road dust	2. rdgts_s.{date}.1.RPO36km.{CASE}.cmaq.cb05p25.ncf
	Fugitive dust	3. fdgts_s.{date}.1.RPO36km.{CASE}.cmaq.cb05p25.ncf
	Wind-blown dust	4. wb_dust_ii_cmaq_{case}_{date}_agadj_tf_b.ncf
	Non-WRAP monthly ammonia	5. nh3mgts_l.{date}.1.RPO36km.{CASE}.cmaq.cb05p25.ncf
	Non-WRAP annual ammonia	6. nh3ygts_l.{date}.1.RPO36km.{CASE}.cmaq.cb05p25.ncf
	WRAP ammonia (fertilizer, domestics, wild animals, livestocks)	7. nh3frt.{CASE}.36k.{date}.CMAQ.ncf" 8. nh3domest.{CASE}.36k.{date}.CMAQ.ncf" 9. nh3wild.{CASE}.36k.{date}.CMAQ.ncf" 10. nh3lvstck.{CASE}.36k.{date}.CMAQ.ncf
Off-road	Annual nonroad	11. nrygts_l.{date}.1.RPO36km.{CASE}.cmaq.cb05p25.ncf
	Monthly nonroad	12. nrmgts_l.{date}.1.RPO36km.{CASE}.cmaq.cb05p25.ncf
Onroad Mobile	US onroad mobile	13. mbvgts_l.{date}.1.RPO36km.{CASE}.ncf
	Non-US onroad mobile	14. nusmgts_l.{date}.1.RPO36km.{CASE}.ncf
Point	EGUs	15. egugts3d_l.{date}.1.RPO36km.15L.{CASE}.cmaq.cb05p25
	Non-EGUs	16. negugts3d_l.{date}.1.RPO36km.15L.{CASE}.cmaq.cb05p25
	Trona	17. trngts3d_l.{date}.1.RPO36km.15L.{CASE}.cmaq.cb05p25
Off-shore	Offshore area facilities	18. ofsargts_l.{date}.1.RPO_US36. plan02d.cmaq.cb4p25.ncf
	Offshore point facilities	19. ofsgts3d_l.${date}.1.RPO_US36.15L.Base02a.cmaq.cb4p25
	Atlantic shipping emissions	20. ofsshgts_l.{date}.1.vista36.baseg_2002.shipping_NoPacific.ncf
	Pacific shipping emissions	21. offshore_marine_RPO36_{date}_pacific_Plan02a.ncf
O&G	Area - Uinta, DJ and Piceance	22. woggts_l.{date}.1.RPO36km.ubaqs2005.cmaq.cb05p25.ncf
	Point - Uinta, DJ and Piceance	23. poggts3d_l.{date}.1.RPO36km.15L.ubaqs2005.cmaq.cb05p25.ncf
	Point - SWWY	24. poggts3d_l.{date}.1.RPO36km.15L.SW_Wyoming_2005.cmaq.cb05p25.ncf
	Point – SWWY (monthly inputs)	25. poggts3d_l.{date}.1.RPO36km.15L.SW_Wyoming_Monthly_2005.cmaq.cb05p25.ncf
	WRAP Phase	26. woggts_l.{date}.1.RPO36km.phaseII_2005.cmaq.cb05p25.ncf

Major Category	Sub Category	File Name
	II area	
	WRAP Phase II point	27. poggts3d_I.{date}.1.RPO36km.15L.phaseII_2005.cmaq.cb05p25.ncf
Fire	Low-level fire	28. emiss.area.ncarfires.soa.rpo36km.{date}
	Elevated fire	29. ptsrce.ncarfires.soa.rpo36km.{date}.bin
Biogenic	Biogenic	30. emiss_MEGAN_CB05X_36km_{date}

Table G-19 Pre-merged emissions files for the 2006 12-km domain

Major Category	Sub Category	File Name
Area	Generic Area excluding dust&fire	1 argts_l.{date}.1.cdc12k.bpcdc06.cmaq.cb05p25.ncf
	Road dust	2 rdgts_s.{date}.1.cdc12k.bpcdc06.cmaq.cb05p25.ncf
	Fugitive dust	3. fdgts_s.{date}.1.cdc12k.bpcdc06.cmaq.cb05p25.ncf
	Wind-blown dust	4. wb_dust_ii_cmaq_cdc12k_{date}_agadj_tf_b.ncf
	Non-WRAP monthly ammonia	5. nh3mgts_l.{date}.1.cdc12k.bpcdc06.cmaq.cb05p25.ncf
	WRAP ammonia (fertilizer, domestics, wild animals, livestocks)	6. nh3all.bp12k.{date}.CMAQ.ncf
Off-road	Annual nonroad	7. nrygts_l.{date}.1.cdc12k.bpcdc06.cmaq.cb05p25.ncf
	Monthly nonroad	8. nrmgts_l.{date}.1.cdc12k.bpcdc06.cmaq.cb05p25.ncf
Onroad Mobile	US onroad mobile	9. mbvgts_l.{date}.1.cdc12k.bpcdc06.ncf
Point	EGUs	10. elevegu_l.{date}.1.cdc12k.bpcdc06_camx.txt
	Non-EGUs	11. elevnegu_l.{date}.1.cdc12k.bpcdc06_camx.txt
	Trona	12. elevtrn_l.{date}.1.cdc12k.bpcdc06_camx.txt
O&G	Area - Uinta, DJ and Piceance	13. ar_compgts_l.{date}.1.CDC12km.cdc_eis2006.cmaq.cb05p25.ncf 14. ar_prodgts_l.{date}.1.CDC12km.cdc_eis2006.cmaq.cb05p25.ncf 15. spudgts_l.{date}.1.CDC12km.cdc_eis2006.cmaq.cb05p25.ncf
	Point - Uinta, DJ and Piceance	16. elevpt_comp_l.{date}.1.CDC12km.cdc_eis2006.txt 17. elevpt_prod_l.{date}.1.CDC12km.cdc_eis2006.txt
	Point - SWWY	18. elevpt_comp_l.{date}.1.CDC12km.SW_Wyoming2006.txt 19. elevpt_prod_l.{date}.1.CDC12km.SW_Wyoming2006.txt 20. elevpt_spud_l.{date}.1.CDC12km.SW_Wyoming2006.txt
	Point – SWWY (monthly inputs)	21. elevpt_prod_l.{date}.1.CDC12km.SW_Wyoming_revised_2006.txt
	WRAP Phase II area	22. ar_compgts_l.{date}.1.CDC12km.phaseII2006.cmaq.cb05p25.ncf 23. ar_prodgts_l.{date}.1.CDC12km.phaseII2006.cmaq.cb05p25.ncf 24. spudgts_l.{date}.1.CDC12km.phaseII2006.cmaq.cb05p25.ncf
	WRAP Phase II point	25. elevpt_comp_l.{date}.1.CDC12km.phaseII2006.txt 26. elevpt_prod_l.{date}.1.CDC12km.phaseII2006.txt
Fire	Low-level fire	27. emiss.area.ncarfires.soa.cdc_12km.$Y2$M2$D2
	Elevated fire	28. ptsrce.ncarfires.soa.cdc_12km.$Y2$M2$D2.bin
Biogenic	Biogenic	29. emiss_MEGAN_CDC12km_CB05X_{date}.camx

EMISSIONS SUMMARY

Annual O&G emissions by county in southwest Wyoming region and O&G emissions by state in the 12 km domain for both calendar years are summarized in Tables G-20 and G-21, respectively. The spatial distribution of the annual O&G emissions by category within the 12 km domain is shown in Figure G-19. Note that PM emissions from compressors are minimal in southwest Wyoming due to the usage of natural gas fuel. In addition, there are no PM emissions from O&G sources in Northeastern Wyoming due to the lack of a PM inventory in the WRAP Phase II O&G database.

Annual emissions of non-O&G categories by state within the 12 km domain for both calendar years are summarized in Tables G-22 and G-23, respectively. Spatial distributions of the annual 2005 and 2006 emissions of the surface emissions (area, onroad, non-road and biogenics) at the 12 km resolution are shown in Figures G-20 and G-21, respectively.

For both base years, CO emissions in Wyoming are dominated by mobile sources, with on-road mobile sources contributing about half of the anthropogenic CO emissions and non-road mobile contributing most of the rest.

Several source categories contribute significantly to NOx emissions in Wyoming with EGU point sources being the largest contributor, followed by non-road mobile. NOx emissions from non-EGU point sources are comparable to those from O&G sources.

TOG emissions from anthropogenic sources in Wyoming are dominated by O&G sources, specifically, from production sources. Non-EGU point sources are the second largest contributor, followed by area sources.

PM emissions in Wyoming are primarily from wind-blown dust (part of the area source category) emissions. Non-EGU emissions also contribute to PM emissions due largely from mineral production processes such as coal mining. O&G sources do not significantly contribute to PM emissions in Wyoming.

Table G-20 2005 and 2006 Southwest Wyoming O&G emissions by county.

	2005			2006		
County	Compressor	Drilling	Production	Compressor	Drilling	Production
NOx						
Carbon Co	1,111	448	1,010	2092	554	1214
Lincoln Co	2,047	343	1,016	2010	314	1029
Sublette Co	1,564	4,169	2,433	2300	3155	2975
Sweetwater Co	2,712	806	1,682	4361	819	1940
Uinta Co	1,414	62	373	702	75	486
Grand Total	8,848	5,829	6,513	11465	4917	7644
VOC						
Carbon Co	218	23	20,613	559	30	23356
Lincoln Co	208	14	21,702	148	13	21997
Sublette Co	784	257	27,230	725	184	26500
Sweetwater Co	672	30	45,754	819	29	48156
Uinta Co	205	3	6,228	175	3	6225
Grand Total	2,087	326	121,528	2427	259	126234
CO						
Carbon Co	574	48	451	1128	50	558
Lincoln Co	880	37	3,614	682	34	874
Sublette Co	812	2,025	2,064	1094	1412	2356
Sweetwater Co	2,126	95	765	2620	86	827
Uinta Co	705	7	1,104	519	8	1189
Grand Total	5,097	2,213	7,999	6044	1590	5804
PM10						
Carbon Co	1	44	86	1	53	103
Lincoln Co	13	35	65	46	32	74
Sublette Co	0	138	185	0	102	232
Sweetwater Co	0	81	137	0	84	147
Uinta Co	0	6	20	0	8	21
Grand Total	14	304	494	46	279	577

Table G-21 2005 and 2006 O&G Emissions by state within the 12 km domain.

	2005			2006		
State	Compressor	Drilling	Production	Compressor	Drilling	Production
NOx						
Colorado	17,155	10,525	5,416	17,155	10,525	5,416
Idaho	1,394	0	0	1,394	0	0
Montana	1,092	304	759	1,092	304	759
Nevada	0	0	0	0	0	0
North Dakota	501	1,424	136	501	1,424	136
South Dakota	305	182	58	305	182	58
Utah	5,916	4,819	3,806	5,916	4,819	3,806
Wyoming	11,308	9,914	15,694	13,925	9,003	16,825
Tribes	838	0	1	838	0	1
Grand Total	38,509	27,168	25,869	41,126	26,257	27,000
VOC						
Colorado	3,893	600	104,004	3,893	600	104,004
Idaho	47	0	0	47	0	0
Montana	104	3	1,473	104	3	1,473
Nevada	0	0	0	0	0	0
North Dakota	3	0	3,374	3	0	3,374
South Dakota	0	0	369	0	0	369
Utah	1,891	417	71,534	1,891	417	71,534
Wyoming	2,799	503	165,372	3,139	436	170,078
Tribes	37	0	77	37	0	77
Grand Total	8,776	1,523	346,204	9,116	1,456	350,910
CO						
Colorado	11,172	4,819	4,768	11,172	4,819	4,768
Idaho	243	0	0	243	0	0
Montana	587	2	171	587	2	171
Nevada	0	0	0	0	0	0
North Dakota	86	0	70	86	0	70
South Dakota	0	1	12	0	1	12
Utah	3,635	1,815	3,686	3,635	1,815	3,686
Wyoming	6,408	3,528	9,658	7,354	2,905	7,464
Tribes	125	0	0	125	0	0
Grand Total	22,256	10,164	18,365	23,203	9,541	16,170
PM						
Colorado	238	1,178	222	238	1,178	222
Idaho	0	0	0	0	0	0
Montana	0	0	0	0	0	0
Nevada	0	0	0	0	0	0
North Dakota	0	0	0	0	0	0
South Dakota	0	0	0	0	0	0
Utah	63	354	207	63	354	207
Wyoming	14	304	498	47	279	581
Tribes	2	0	0	2	0	0
Grand Total	317	1,835	927	350	1,810	1,010

Table G-22 2005 Non-O&G Emissions by state within the 12 km domain.

	Source Category							
State	**Area**	**On-Road**	**Non-Road**	**EGU**	**NEGU**	**Trona**	**Biogenic**	**Fire**
CO								
Colorado	46,962	701,674	322,522	4,833	7,258		46,958	21,012
Idaho	14,057	130,655	69,006	0	14,622		27,081	316,859
Kansas	166	5,647	1,125	0	0		1,863	516
Montana	9,604	66,418	26,599	800	908		28,770	23,776
Nebraska	1,609	46,711	19,555	39	85		18,170	3,318
Nevada	58	5,695	491	0	0		1,048	0
North Dakota	579	2,673	2,612	0	0		2,963	449
South Dakota	5,605	40,381	16,838	139	3,573		22,407	37,015
Utah	36,481	445,281	190,599	4,336	21,790		32,538	59,242
Wyoming	28,281	194,920	77,532	13,241	42,421	14,029	55,886	51,284
NOx								
Colorado	9,787	80,652	42,969	77,845	11,692		3,390	753
Idaho	10,828	16,072	12,729	0	5,852		2,073	9,513
Kansas	50	706	408	0	0		183	26
Montana	1,387	8,314	9,266	46,421	1,367		2,109	781
Nebraska	550	5,956	28,812	28	87		1,735	157
Nevada	4	755	1,031	0	0		52	
North Dakota	89	360	1,388	0	0		397	28
South Dakota	624	5,412	5,121	977	4,021		1,928	1,086
Utah	5,899	50,922	40,360	118,724	25,888		2,058	1,857
Wyoming	15,516	24,649	69,321	92,711	43,878	10,209	3,207	1,708
TOG								
Colorado	84,810	65,098	28,730	2,655	25,184		240,257	979
Idaho	75,325	11,275	14,487	0	423		113,543	15,473
Kansas	455	528	124				9,826	17
Montana	16,107	5,799	3,261	91	718		134,355	1,097
Nebraska	5,741	4,240	4,619	0	2,950		43,856	128
Nevada	133	421	150				4,489	
North Dakota	1,864	249	579	0	0		6,932	17
South Dakota	6,380	3,696	2,841	7	304		71,833	1,863
Utah	58,848	39,771	26,734	585	13,830		158,436	2,812
Wyoming	39,496	16,642	16,290	1,710	50,966	16,546	259,276	2,379
PM								
Colorado	121,465	2,087	3,625	1,404	15,622		0	2,773
Idaho	79,187	427	1,503	0	1,859		0	44,426
Kansas	15,927	16	47				0	54
Montana	255,810	222	616	216	814		0	3,171
Nebraska	84,172	137	1,389	7	1,604		0	349
Nevada	9,238	20	38				0	
North Dakota	14,654	10	140	0	0		0	55
South Dakota	154,780	147	448	37	420		0	5,371
Utah	178,883	1,355	3,379	3,005	11,679		0	8,111
Wyoming	129,112	659	3,084	6,390	33,478	3,731	0	6,912

Table G-23 2006 Non-O&G Emissions by state within the 12 km domain.

State	Source Category							
	Area	On-Road	Non-Road	EGU	NEGU	Trona	Biogenic	Fire
CO								
Colorado	47,171	773,316	326,993	4,791	7,257		49,164	19,757
Idaho	14,201	114,720	70,573	0	14,622		29,984	397,803
Kansas	165	5,094	1,124	0	0		2,035	
Montana	9,670	57,974	27,177	1,362	908		31,756	412,343
Nebraska	1,594	41,936	19,495	39	85		19,983	76,911
Nevada	59	4,955	511	0	0		1,134	3,778
North Dakota	577	2,340	2,635	0	0		3,472	893
South Dakota	5,625	35,494	17,261	139	3,573		24,224	19,703
Utah	36,572	396,907	193,786	4,335	21,790		34,407	63,472
Wyoming	28,432	173,081	79,247	13,187	37,292	15,058	59,252	227,945
NOx								
Colorado	10,013	88,859	41,720	75,536	11,694		3,718	646
Idaho	11,063	14,409	12,490	0	5,852		2,361	12,107
Kansas	51	647	395	0	0		205	
Montana	1,411	7,445	8,975	45,930	1,367		2,408	13,216
Nebraska	554	5,449	27,602	28	87		1,972	2,526
Nevada	4	676	992	0	0		57	142
North Dakota	90	324	1,362	0	0		489	46
South Dakota	638	4,856	4,988	977	4,021		2,180	837
Utah	6,034	45,527	39,005	124,433	26,088		2,256	2,146
Wyoming	15,767	22,138	66,878	88,487	41,449	9,785	3,513	7,138
TOG								
Colorado	86,797	69,589	27,698	2,652	25,184		244,317	929
Idaho	77,749	10,210	14,739	0	423		127,746	18,866
Kansas	462	500	120	0	0		10,946	0
Montana	16,378	5,236	3,287	172	718		150,232	19,764
Nebraska	5,790	3,985	4,490	0	2,950		48,660	3,785
Nevada	139	384	156	0	0		4,895	110
North Dakota	1,872	224	583	0	0		8,207	43
South Dakota	6,480	3,325	2,909	7	304		76,863	921
Utah	60,990	35,709	26,619	584	13,826		166,270	2,716
Wyoming	40,263	15,138	16,490	1,717	49,319	16,494	272,709	11,115
PM								
Colorado	133,108	2,253	3,534	1,403	15,612			2,615
Idaho	85,168	404	1,451	0	1,859			54,248
Kansas	16,503	15	45	0	0			
Montana	249,621	210	600	36,592	814			57,346
Nebraska	80,502	129	1,335	7	1,604			11,015
Nevada	15,732	19	38	0	0			318
North Dakota	12,799	10	134	0	0			125
South Dakota	132,319	139	435	37	420			2,759
Utah	276,336	1,286	3,265	3,005	11,678			7,872
Wyoming	170,506	624	3,046	7,050	29,342	3,224		32,177

Table G-24 2005 CDC 4 km Domain Emission Summary (tpy).

STATE	Oil and Gas Sources			Non-Oil and Gas Sources							
	Compressor	Drilling	Production	Area	Onroad	Offroad	EGU	NEGU	Trona	Biogenic	Fire
CO											
Colorado	774	118	160	2,426	21,481	7,582	1,276	56	0	10,053	2,224
Idaho	242.8	0	0	472	3,058	4,597	0	9,527	0	6,777	16,701
Utah	2,343	1,220	3,166	1,915	22,990	11,504	525	748	0	2,504	17,793
Wyoming (5 counties)	5,095	2,265	5,395	5,474	40,804	17,676	3,405	2,892	14,022	8,667	6,157
Wyoming (rest)	119	780	933	8,094	46,126	17,199	2	3,762	0	9,532	2,434
NOx											
Colorado	1,305	322	144	143	2,120	1,299	25,825	85	0	566	66
Idaho	1392.8	0	0	308	373	667	0	1,836	0	352	575
Utah	4,392	3,232	3,101	201	2,387	1,858	7,405	1,329	0	140	515
Wyoming (5 counties)	8,838	5,820	3,004	2,731	5,099	12,909	47,180	3,903	10,208	443	210
Wyoming (rest)	538	1,667	3,510	3,873	5,738	8,244	10	3,282	0	490	85
TOG											
Colorado	1,110	19	72,003	1,536	1,770	1,709	127	256	0	53,008	116
Idaho	505.6	0	0	3,476	262	1,638	0	11	0	32,183	704
Utah	16,692	374	136,540	1,817	1,789	3,378	76	2,127	0	13,009	945
Wyoming (5 counties)	21,409	446	747,700	10,367	3,317	5,035	479	3,628	16,515	38,617	273
Wyoming (rest)	1,101	106	158,910	7,098	4,000	972	2	8,804	0	42,181	102
PM											
Colorado	10	49	16	10,423	56	141	373	3,919	0	0	320
Idaho	0	0	0	9,059	10	108	0	561	0	0	1,950
Utah	42	239	156	6,571	64	209	681	216	0	0	2,602
Wyoming (5 counties)	14	297	222	27,760	136	639	1,419	9,269	3,723	0	751
Wyoming (rest)	0	0	4	18,494	153	377	1	476	0	0	282
SO2											
Colorado	0	14	10	76	56	42	6,970	4	0	0	20
Idaho	1.3	0	0	15	11	55	0	9,892	0	0	125
Utah	4	244	15	140	65	110	1,230	5	0	0	159
Wyoming (5 counties)	135	393	7,100	1,943	142	676	45,177	4,607	10,359	0	48
Wyoming (rest)	51	41	936	3,937	159	437	1	3,135	0	0	18

Table G-25 2006 CDC 4 km Domain Emission Summary (tpy).

STATE	Oil and Gas Sources			Non-Oil and Gas Sources							
	Compressor	Drilling	Production	Area	Onroad	Offroad	EGU	NEGU	Trona	Biogenic	Fire
CO											
Colorado	774	118	160	2,434	22,689	10,407	1,276	56	0	10,462	2,073
Idaho	242.8	0	0	477	2,722	4,759	0	9,527	0	6,916	13,597
Utah	2,343	1,220	3,166	1,917	20,458	11,864	525	748	0	2,597	6,011
Wyoming (5 counties)	6,042	2,179	2,863	5,506	36,418	18,150	3,490	2,893	15,052	9,391	15,119
Wyoming (rest)	119	780	933	8,132	41,300	17,441	2	3,472	0	10,071	48,047
NOx											
Colorado	1,305	322	144	145	2,219	1,562	24,819	85	0	607	70
Idaho	1392.8	0	0	315	336	666	0	1,836	0	373	491
Utah	4,392	3,232	3,101	204	2,138	1,812	7,354	1,329	0	150	197
Wyoming (5 counties)	11,461	5,882	3,539	2,777	4,577	12,463	42,493	4,030	9,781	492	443
Wyoming (rest)	538	1,667	3,510	3,925	5,156	7,954	10	3,510	0	530	1,446
TOG											
Colorado	1,110	19	72,003	1,560	1,784	2,255	127	256	0	54,105	94
Idaho	505.6	0	0	3,600	238	1,654	0	11	0	31,941	545
Utah	16,692	374	136,540	1,882	1,622	3,491	76	2,127	0	13,133	274
Wyoming (5 counties)	25,756	449	792,633	10,660	3,022	5,113	484	3,514	16,459	42,058	800
Wyoming (rest)	1,101	106	158,881	7,169	3,646	937	2	8,621	0	44,609	2,510
PM											
Colorado	10	49	16	8,295	57	139	372	3,918	0		261
Idaho	0	0	0	8,785	10	106	0	561	0		1,513
Utah	42	239	156	5,244	60	207	691	216	0		756
Wyoming (5 counties)	47	310	249	25,915	129	632	1,961	10,381	3,223	0	2,203
Wyoming (rest)	0	0	4	16,971	145	368	1	538	0	0	6,936
SO2											
Colorado	0	14	1	77	70	48	6,245	4	0		16
Idaho	1.3	0	0	15	9	42	0	9,892	0		97
Utah	0	244	15	140	50	88	864	5	0		48
Wyoming (5 counties)	131	277	4,688	1,992	112	530	40,932	4,343	10,558	0	134
Wyoming (rest)	51	41	936	3,991	124	344	1	3,562	0	0	422

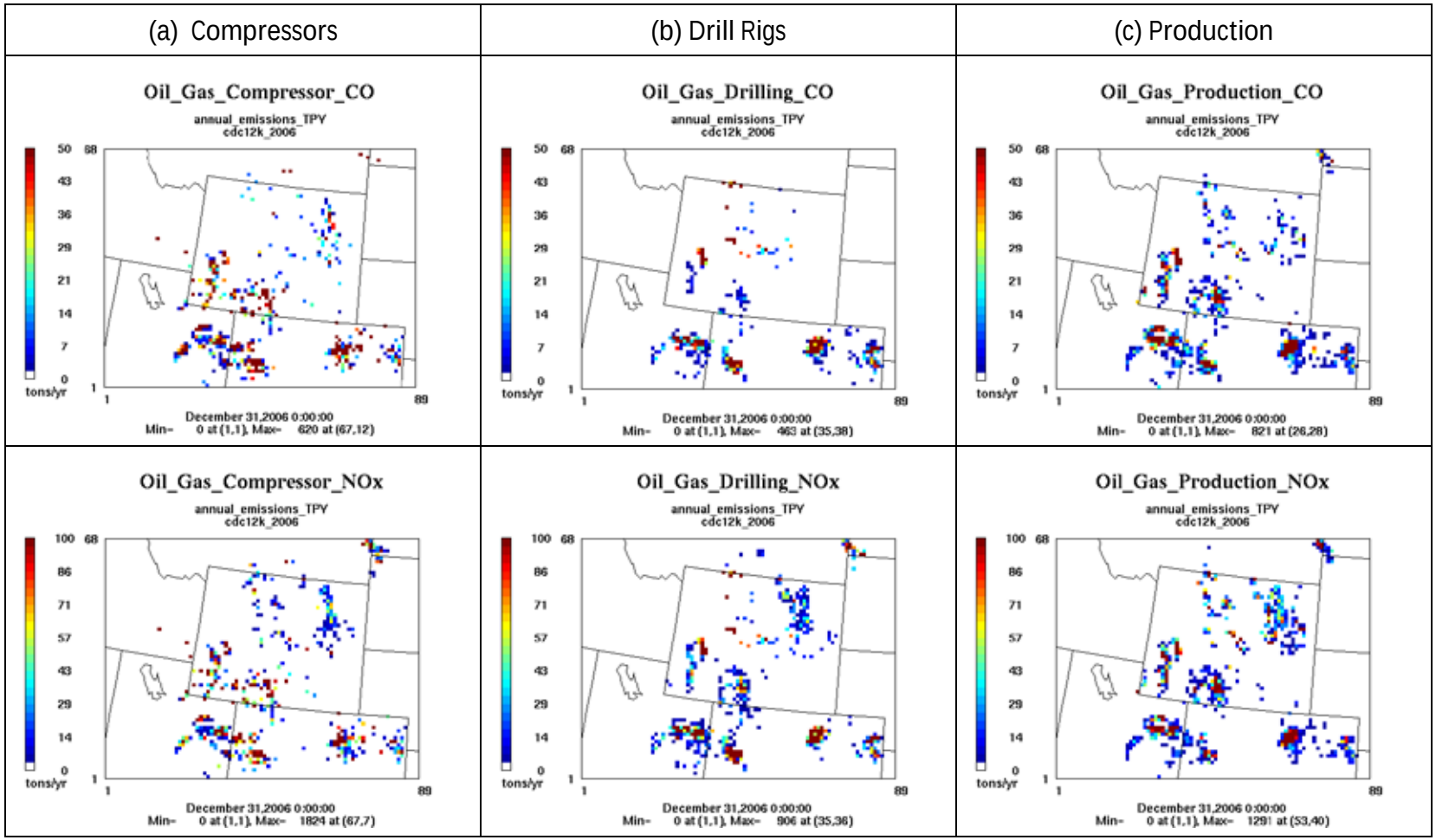


Figure G-19. Spatial distribution of CO, NOx, TOG, and PM emissions (TPY) in 2006 from (a) compressors, (b) drill rigs, and (c) productions within the 12 km domain.

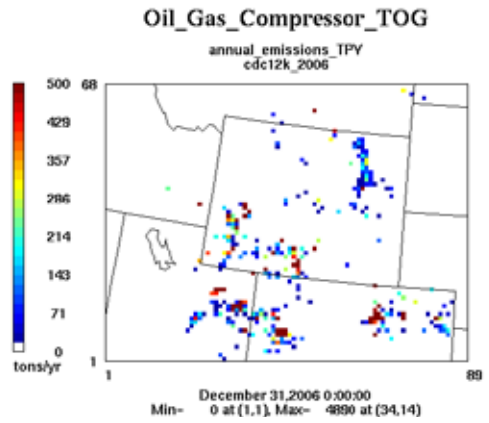
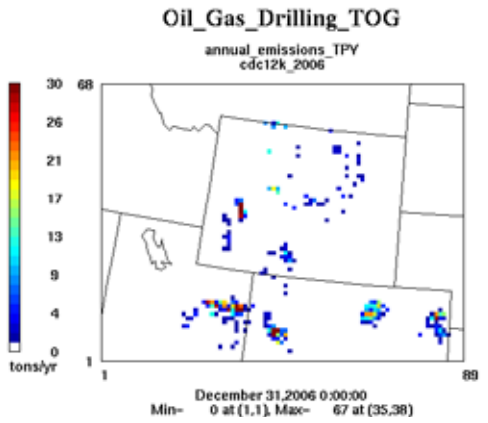
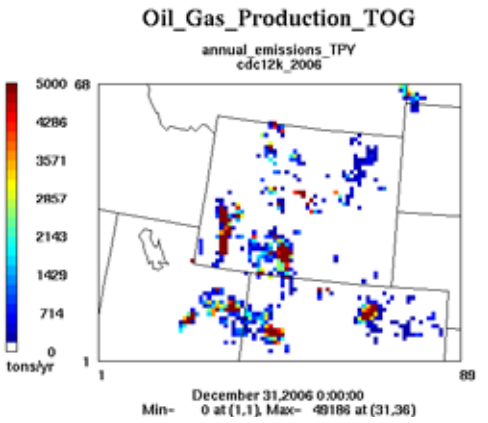
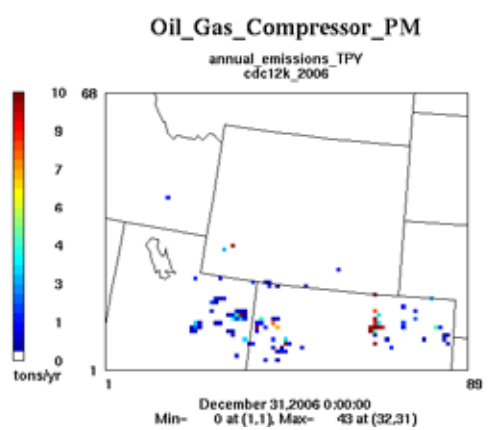
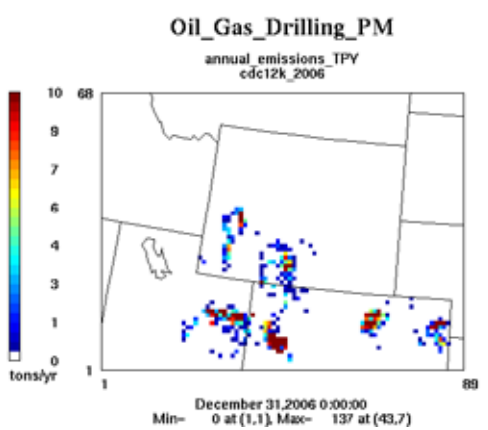
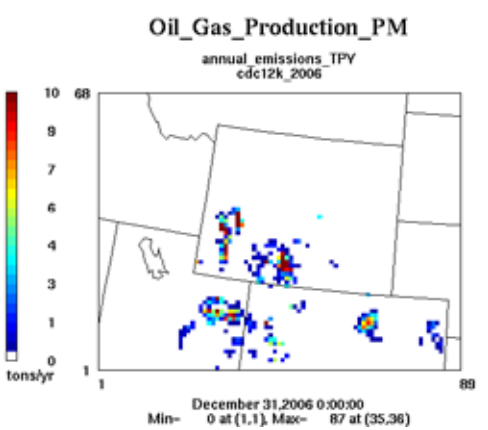
(a) Compressors	(b) Drill Rigs	(c) Production
		
		

Figure G-20. (cont.) Spatial distribution of CO, NOx, TOG, and PM emissions (TPY) in 2006 from (a) compressors, (b) drill rigs, and (c) productions within the 12 km domain.

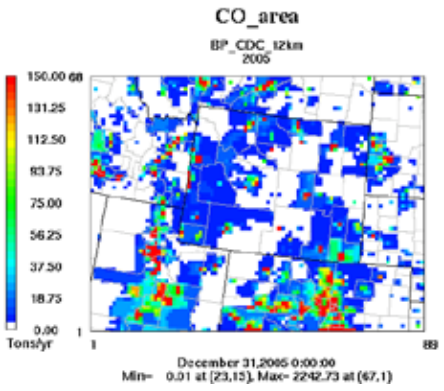
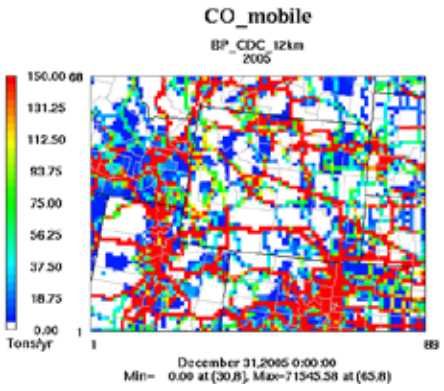
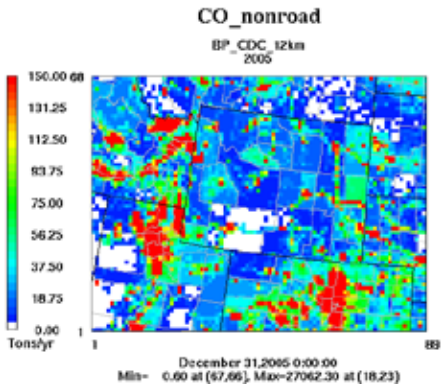
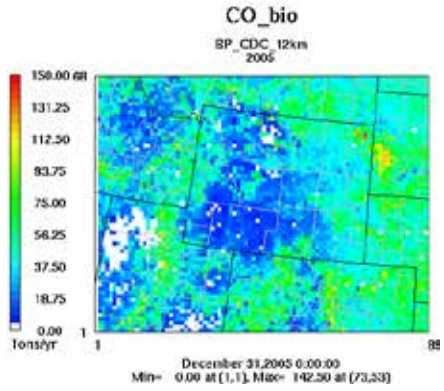
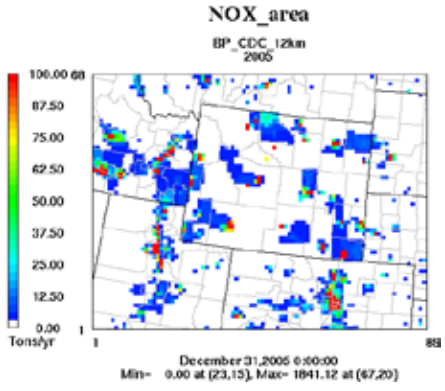
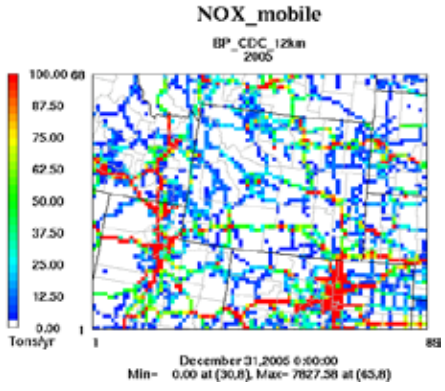
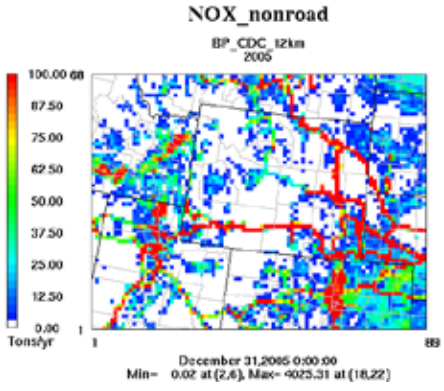
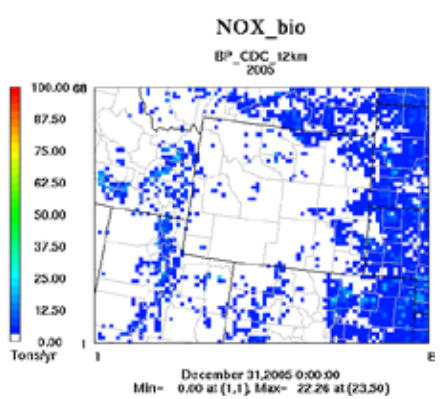
(a) Area	(b) On-road	(c) Off-road	(d) Biogenic
			
			

Figure G-21. Spatial distribution of CO, NOx, TOG, and PM emissions (TPY) in 2005 from (a) Area, (b) On-road Mobile, (c) Off-road Mobile and (d) Biogenic within the 12 km domain.

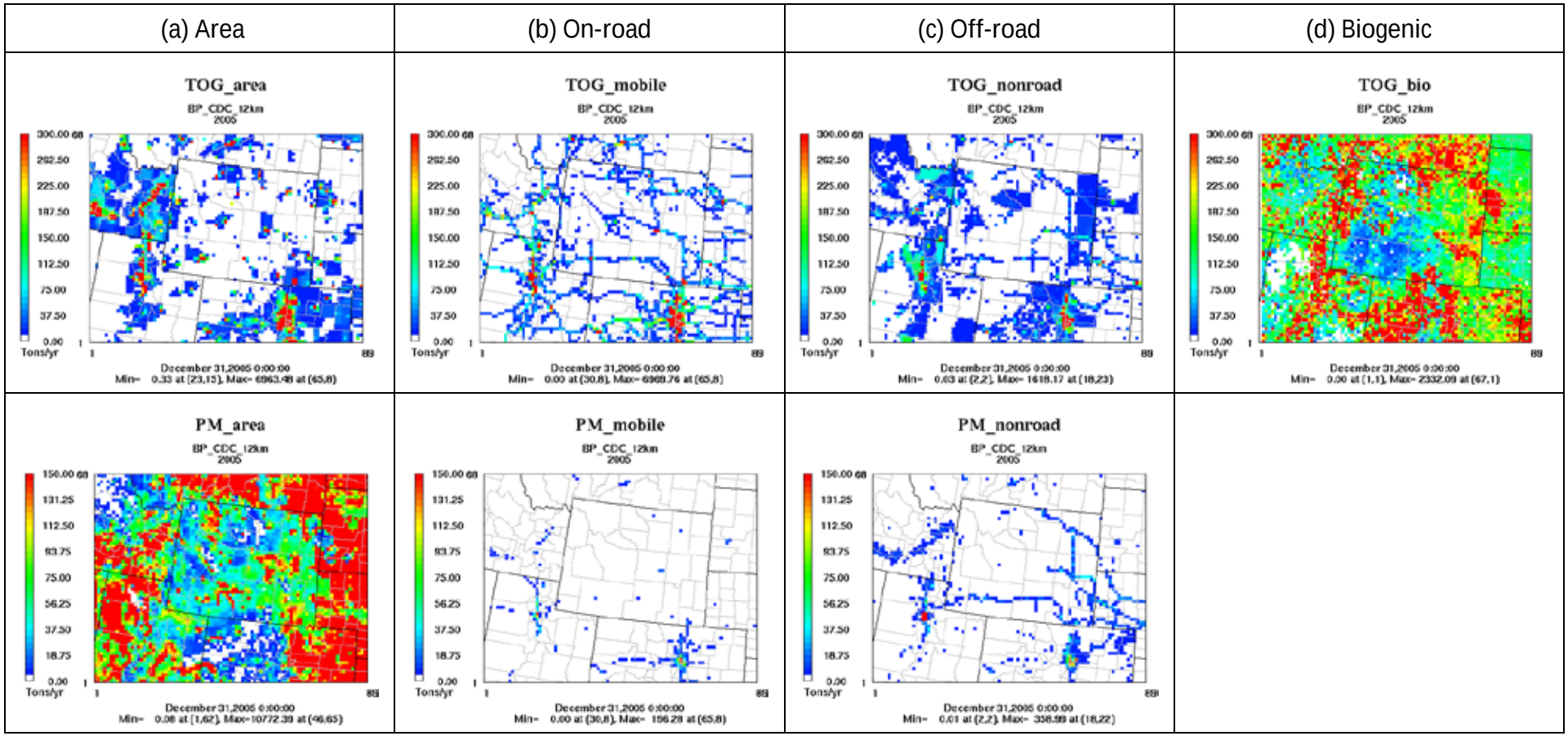


Figure G-22. (cont.) Spatial distribution of CO, NOx, TOG, and PM emissions (TPY) in 2005 from (a) Area, (b) On-road Mobile, (c) Off-road Mobile and (d) Biogenic within the 12 km domain.

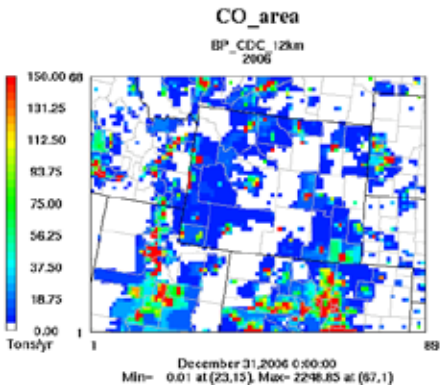
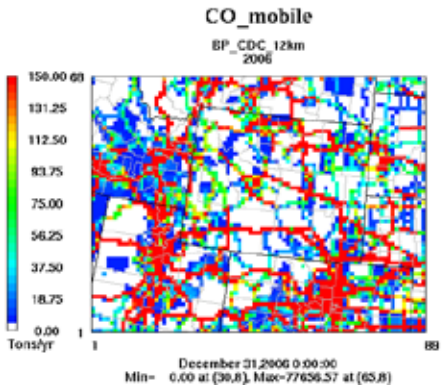
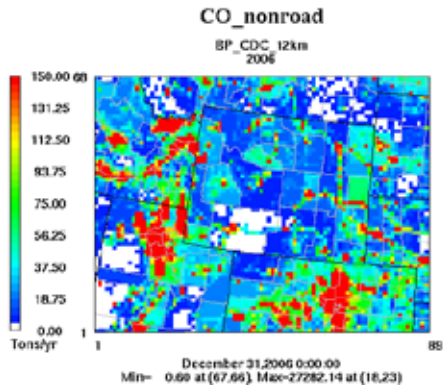
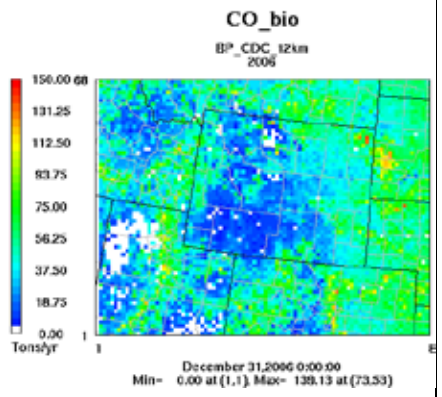
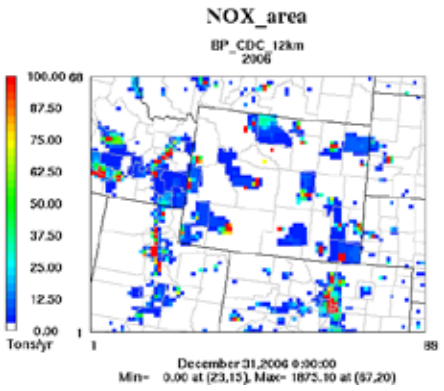
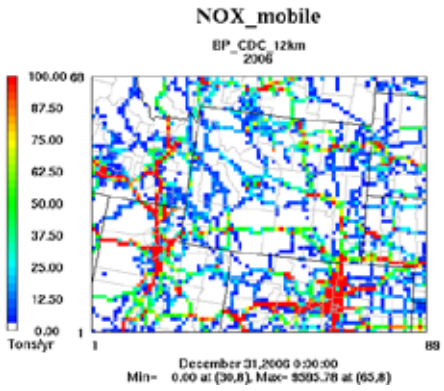
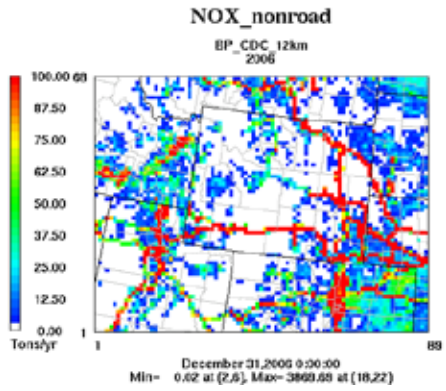
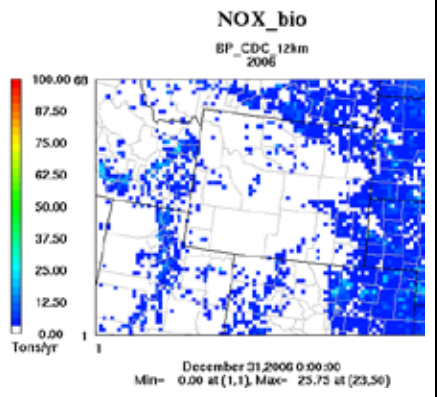
(a) Area	(b) On-road	(c) Off-road	(d) Biogenic
			
			

Figure G-23. (cont.) Spatial distribution of CO, NOx, TOG, and PM emissions (TPY) in 2006 from (a) Area, (b) On-road Mobile, (c) Off-road Mobile and (d) Biogenic within the 12 km domain.

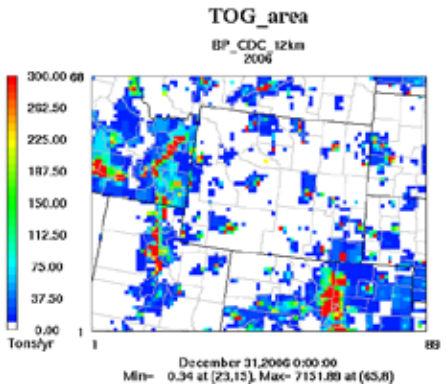
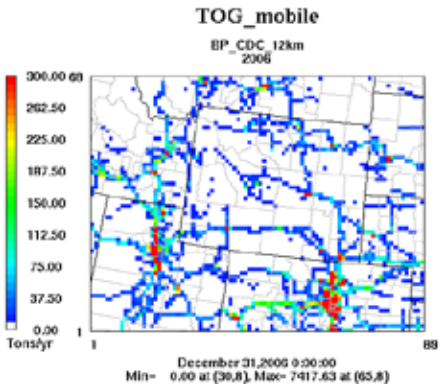
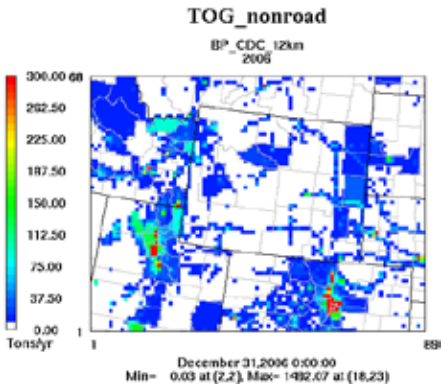
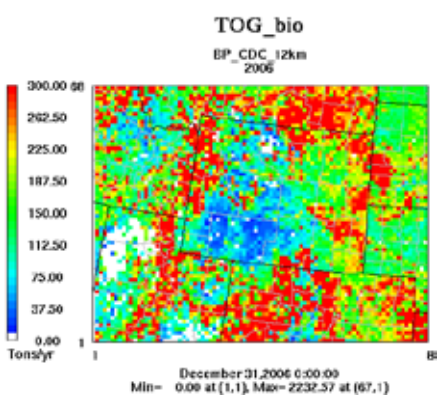
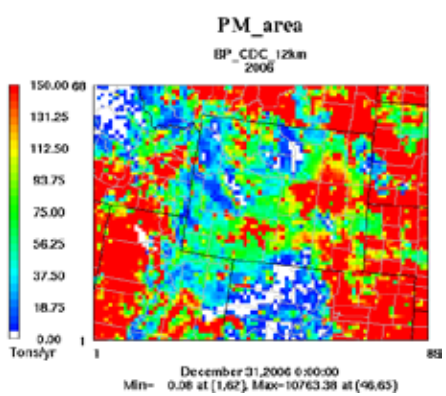
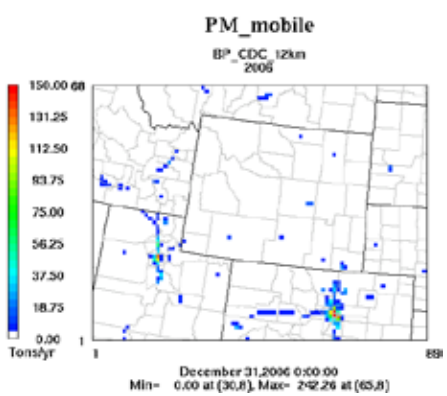
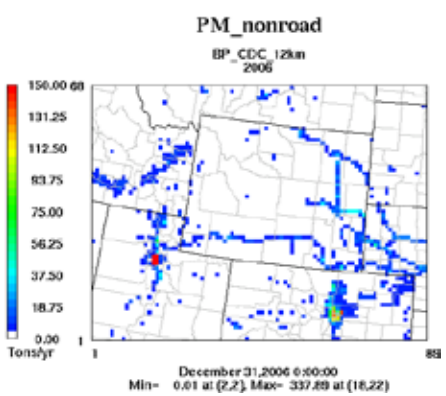
(a) Area	(b) On-road	(c) Off-road	(d) Biogenic
			
			

Figure G-24. Spatial distribution of CO, NOx, TOG, and PM emissions (TPY) in 2006 from (a) Area, (b) On-road Mobile, (c) Off-road Mobile and (d) Biogenic within the 12 km domain.

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