ENVIRON

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TECHNICAL MEMORANDUM No. 2: AREA AND NON-ROAD EMISSIONS

To: Tom Moore, Western Regional Air Partnership (WRAP)

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Subject: Non-Point (Area) and Non-Road Mobile Source emissions for the WestJumpAQMS 2008 Photochemical Modeling

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INTRODUCTION

ENVIRON International Corporation (ENVIRON), Alpine Geophysics, LLC (Alpine) and the University of North Carolina (UNC) at Chapel Hill Institute for Environment are performing the West-wide Jump Start Air Quality Modeling Study (WestJumpAQMS) managed by the Western Governors' Association (WGA) for the Western Regional Air Partnership (WRAP). WestJumpAQMS is setting up the CAMx photochemical grid model for the 2008 calendar year (plus spin up days for the end of December 2007) on a 36 km CONUS, 12 km WESTUS and several 4 km Inter-Mountain West domains. The WestJumpAQMS Team are currently compiling emissions to be used for the 2008 base case modeling, with the 2008 National Emissions Inventory (NEI) being a major data source, and are preparing 13 Technical Memorandums discussing the sources of the 2008 emissions by major source sector:

1. Point Sources including Electrical Generating Units (EGUs) and Non-EGUs;
2. Non-Point (Area) plus Non-Road Mobile Sources;
3. On-Road Mobile Sources that will be based on MOVES;
4. Oil and Gas Sources;
5. Fires Emissions including wildfire, prescribed burns and agricultural burning;
6. Fugitive Dust Sources;
7. Off-Shore Shipping Sources;
8. Ammonia Emissions;
9. Biogenic Emissions;
10. Eastern USA Emissions;

11. Mexico/Canada;
12. Sea Salt and Lightning Emissions; and
13. Emissions Modeling Parameters including spatial surrogates, temporal adjustment parameters and chemical (VOC and PM) speciation profiles.

This document is draft Technical Memo Number 2 that discusses the approach and data sources to be used for developing 2008 emissions for the Non-Point (Area) and Non-Road Mobile sources.

2008 NEI V2.0 OVERVIEW

The U.S. Environmental Protection Agency (EPA) develops and maintains the National Emissions Inventory (NEI). The NEI is a comprehensive and detailed estimate of air emissions of both Criteria and Hazardous air pollutants from all air emissions sources in the United States. The NEI is prepared every three years by the EPA based primarily upon emission estimates and emission model inputs provided by State, Local, and Tribal air agencies for sources in their jurisdictions, and supplemented by data developed by the EPA. The most current version of the NEI is Version 2 of the 2008 NEI (2008 NEIv2) that we obtained from EPA at the end of February 2012 and were publicly released on the NEI website on April 10, 2012[1].

A draft Technical Support Document (TSD) for the 2008 NEIv2 has been developed by EPA and is available at http://www.epa.gov/ttn/chief/net/2008neiv2/2008_neiv2_tsd_draft.pdf. This memo summarizes pertinent details for the non-point (area) and non-road mobile source sectors. Additional information on the compilation and calculation of these sectors is available in the 2008 NETv2.0 TSD referenced above.

Non-Point (Area) Source Emissions

The 2008 NEI Non-Point (or Area) source data category contains emission estimates for sources that individually are too small in magnitude or too numerous to inventory as individual point sources, which is why they are called non-point sources in the 2008 NEI. In many cases these sources can often be estimated more accurately as a single aggregate source for a County or Tribal area using a top down approach for sources that the regional consumption is known, but the spatial distribution is not (e.g., paint consumption or consumer products). Area source (non-point) emissions are emissions sources that are summed over a geographic region, rather than specifically located. Examples of area sources include small industrial, residential, consumer product, and agricultural emissions. For emissions modeling purposes, these types of emissions are defined by state and county (or tribal) identifiers, and SCC codes. Prior to the 2008 NEI this source category was termed the area source category. However, for the 2008 NEI several source categories that have been in the mobile source category in the past, such as

1 http://www.epa.gov/ttnchie1/net/2008inventory.html

Class I and II commercial marine vessels, Class III marine vessels on in-land waterways and in-transit locomotive emissions, are now in this category. This is why the 2008 NEI has changed the category name from area sources to non-point sources. For the 2008 NEIv.2, EPA developed emissions estimates for a large number of Source Classification Code (SCC) categories, based on emission factors, activity data, and historical estimates. This process is described in detail in the TSD Section 3.1.6. State/Local/Tribal (S/L/T) agencies were allowed to review and revise all or some of these estimates. Table 1 contains a list of the S/L/T Agencies that provided area/non-point emissions data and review. For the 15-state WRAP region, state air agencies in all states except Montana, Nevada, New Mexico, North Dakota, and South Dakota participated in the area/non-point emissions estimation process. For those states, in some cases data were just submitted for portions of some states such as Nevada (Clark County), New Mexico (City of Albuquerque) and Montana (Northern Cheyenne Tribe). In all cases, where S/L/T agency emissions estimates were not provided; EPA estimates for the source category were included in the 2008 NEIv2.

Figure 1 shows the states that agencies submitted area (non-point) emissions to the 2008 NEIv2. Agencies in 41 states submitted criteria air pollutant (CAP) emissions and agencies in 32 states also submitted HAPs. Only 7 states did not submit any non-point emissions, and at least some of these notified EPA that EPA's estimates were acceptable for the source types that EPA estimated**.**

Table 1. Agencies supplying non-point/area emissions data for the 2008 NEIv2.

Alabama Department of Environmental Management
Alaska Department of Environmental Conservation
Arizona Department of Environmental Quality
Arkansas Department of Environmental Quality
California Air Resources Board
Chattanooga Air Pollution Control Bureau (CHCAPCB)
City of Albuquerque
Clark County Department of Air Quality and Environmental Management
Colorado Department of Public Health and Environment
Connecticut Department Of Environmental Protection
DC Department of Health Air Quality Division
Delaware Department of Natural Resources and Environmental Control
Eastern Band of Cherokee Indians
Fond du Lac Band of the Minnesota Chippewa Tribe
Georgia Department of Natural Resources
Hawaii Department of Health Clean Air Branch
Idaho Department of Environmental Quality
Illinois Environmental Protection Agency
Indiana Department of Environmental Management
Kansas Department of Health and Environment
Kootenai Tribe of Idaho

Leech Lake Band of Ojibwe Reservation
Little River Band of Ottawa Indians, Michigan
Louisiana Department of Environmental Quality
Louisville Metro Air Pollution Control District
Maine Department of Environmental Protection
Makah Indian Tribe of the Makah Indian Reservation
Maricopa County Air Quality Department
Maryland Department of the Environment
Massachusetts Department of Environmental Protection
Metro Public Health of Nashville/Davidson County
Michigan Department of Environmental Quality
Minnesota Pollution Control Agency
Missouri Department of Natural Resources
New Hampshire Department of Environmental Services
New Jersey Department of Environment Protection
New York State Department of Environmental Conservation
Nez Perce Tribe
North Carolina Department of Environment and Natural Resources
Northern Cheyenne Tribe
Ohio Environmental Protection Agency
Oklahoma Department of Environmental Quality
Omaha Tribe of Nebraska
Oregon Department of Environmental Quality
Pennsylvania Department of Environmental Protection
Prairie Band of Potawatomi Indians
Pueblo of Pojoaque
Red Lake Band of Chippewa Indians, Minnesota
Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho
South Carolina Department of Health and Environmental Control
Tennessee Department of Environmental Conservation
Texas Commission on Environmental Quality
Utah Division of Air Quality
Vermont Department of Environmental Conservation
Virginia Department of Environmental Quality
Washington State Department of Ecology
Washoe County Health District
Washoe Tribe of California and Nevada
West Virginia Division of Air Quality
Wisconsin Department of Natural Resources
Wyoming Department of Environmental Quality

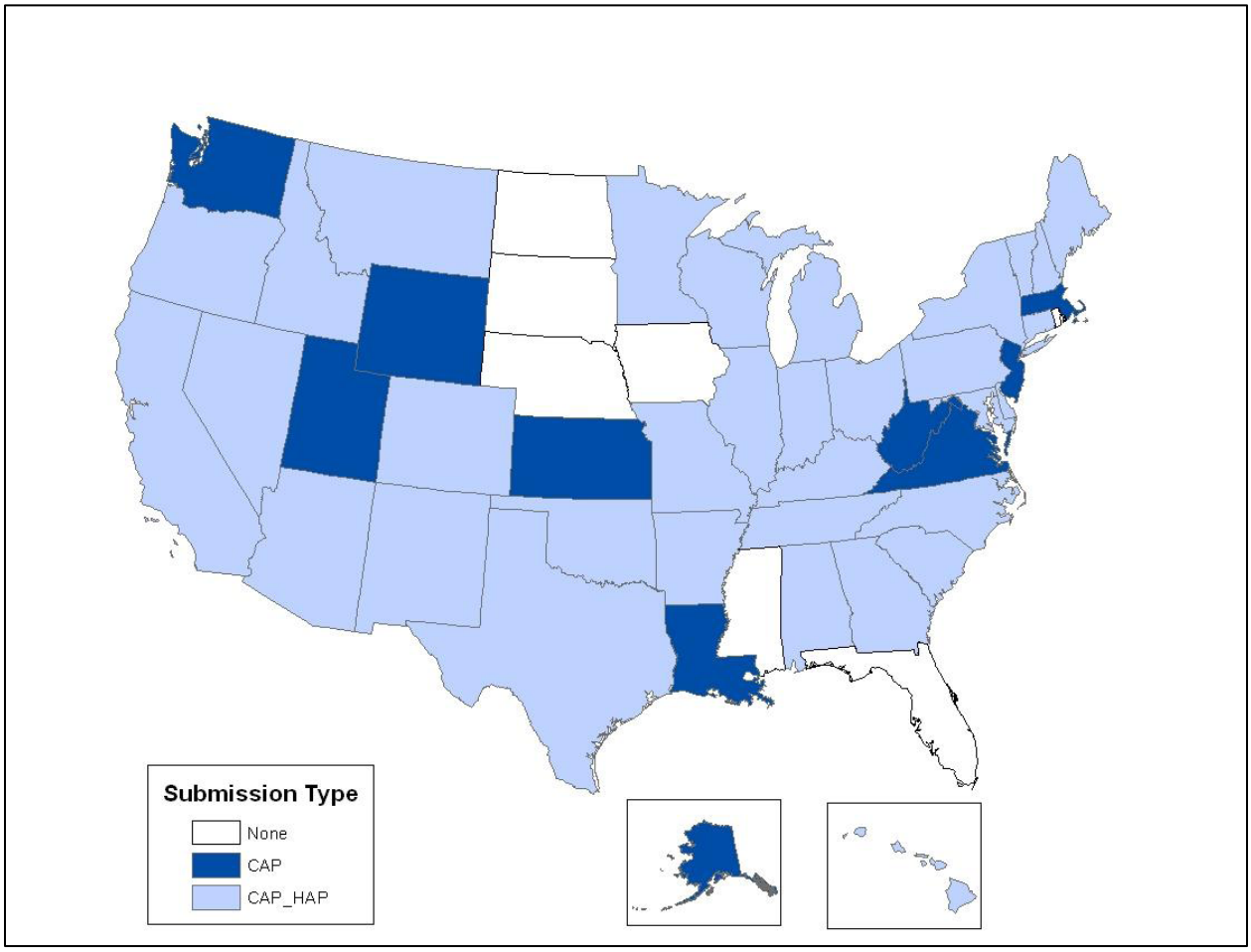

Figure 1. States with agencies who submitted area (non-point) source criteria (CAP) and hazardous (HAP) air pollutant emissions for the 2008 NEIv2.

Table 2 contains summaries of non-point source emissions by state. Note that Table 2 lists the non-point source emissions in the 2008 NEIv2.0 prior to the elimination of the area source oil and gas emissions, which are processed separately and discussed in a series of five Technical Memorandums Number 4. Texas (16.0%) has the highest non-point source NO_X emissions in the NEIv2 followed by Louisiana (7.2%), California (6.2%), New York (3.8%), Oklahoma (3.8%) and Illinois (3.7%). Texas also has by far the highest non-point source VOC emissions (28.4%) with California a distant second (4.6%). The highest non-point source ammonia emitting states tend to be those with the most livestock such as California (8.5%), Iowa (7.8%), Texas (7.6%), Minnesota (4.9%) and Nebraska (4.6%). The three states with the largest non-point source SO_2 emissions in 2008 are Pennsylvania (12.1%), New York (12.0%) and Tennessee (10.6%) with Missouri fourth (7.4%) and all other states less than 4%.

Table 3 contains summaries of non-point source emissions by SCC categories for the 2008 NEIv2. Note that unlike for Table 2, the area source oil and gas emissions have been removed from Table 3. Commercial Marine Vessels emit half (49.5%) of the non-point NO_X emissions. This category includes Class I and II vessels including those in the great lakes and among major waterways as well as Class III vessels operating on the in-land waterways. Note that emissions from Class III marine vessels in the open ocean are not included in the NEI and are estimated separately as discussed in the Off-Shore Shipping Technical Memorandum Number 7 and Class III vessels in and near Ports are in the NEIv2 point source category. The second largest NO_X emitting category in the non-point source category (without oil and gas emission) after Commercial Marine is Railroad Equipment (24.8 %) that includes in-transit locomotive emissions that has also been in the non-road source sector in past inventories; note that locomotive emissions in rail yards are in the NEIv2 point source category. Stationary Fuel Combustion for Residential (11.4%), Industrial (5.9%) and Commercial/Institutional (5.3%) are the next three highest non-point NO_X emitting categories, with all other categories emitting less than 2% of the non-point NO_X emissions.

The non-point source sector is a major contributor to the anthropogenic volatile organic compound (VOC) emissions with the Solvent category contributing ~60% of the non-point VOC emissions and having five of the seven highest contributing categories: Consumer/Commercial (20.9%), Surface Coatings (17.1%), Non-Industrial Commercial (10.0%), Graphic Arts (6.6%) and Degreasing (3.8%). The second largest VOC emitting category in the non-point source sector is Petroleum Storage and Transport (18.5%) that includes Stage I and II gasoline vapor emissions. And the fifth highest VOC emitting non-point source category is Stationary Source Residential Fuel Combustion (7.4%).

The two most important ammonia (NH_3) emitting source categories in the 2008 NEI are Livestock (63.8%) and Crops (31.3%) under Agricultural Production that together contribute 95% of the non-point NH_3 emissions.

The non-point source category includes four sub-categories that merit special attention: Ammonia, Fugitive Dust, Oil and Gas, and Fire emissions. These four area source categories were extracted from the NEIv2 non-point source files and processed as separate emissions categories. Handling of ammonia and fugitive dust emissions are addressed in separate Emission Technical Memorandums (Memorandums No. 8 and 6). Oil and gas emissions are addressed in a series of Technical Memorandums (Labeled No. 4).

The NEIv2 non-point source files contain fire event emissions for several categories. The WestJumpAQMS will use 2008 episodic emissions for wildfires (WF), prescribed fires (Rx) and agricultural burning (AB) from the Fire Inventory from NCAR (FINN[2]) for the initial photochemical modeling and then the 2008 fire emissions from the DEASCO3[3] study when they are available. Any WF, Rx and AG fire emissions will be removed from the 2008 NEIv2

2 http://bai.acd.ucar.edu/Data/fire/
3 http://www.wrapair2.org/pdf/JSFP_DEASCO3_TechnicalProposal_November19_2010.pdf

emissions prior to processing. Details on the procedures for the development of the WF, Rx and AG fire emission inventories are provided in Technical Memorandum No. 5.

Table 2. 2008 NEIv2 total non-point (area) source emissions by state, average daily emissions in tons per day (TPD)[1].

FIPS CODE	State	CO (TPD)	NO_X (TPD)	VOC (TPD)	NH_3 (TPD)	SO_2 (TPD)
1000	Alabama	186.67	108.44	196.99	171.13	6.39
4000	Arizona	158.74	108.08	262.75	103.38	10.09
5000	Arkansas	290.45	101.04	219.87	330.48	4.79
6000	California	1240.70	470.88	830.19	885.88	48.17
8000	Colorado	272.33	62.83	174.74	193.01	1.38
9000	Connecticut	142.52	45.29	92.45	9.51	36.41
10000	Delaware	20.23	19.74	26.19	36.49	7.71
11000	DC	14.74	4.75	15.87	0.49	2.25
12000	Florida	325.78	172.86	698.61	92.73	52.59
13000	Georgia	439.16	116.44	517.99	235.40	7.21
16000	Idaho	279.65	55.06	257.55	285.22	24.64
17000	Illinois	457.74	280.36	578.83	335.61	21.49
18000	Indiana	337.55	147.32	421.87	284.57	44.27
19000	Iowa	152.42	87.44	193.44	812.19	7.08
20000	Kansas	238.53	151.03	209.30	428.06	21.53
21000	Kentucky	220.02	108.67	171.53	143.61	5.93
22000	Louisiana	472.97	542.26	400.68	176.58	63.88
23000	Maine	153.26	42.37	74.31	19.03	26.68
24000	Maryland	207.13	90.22	171.86	98.02	23.57
25000	Massachusetts	187.91	92.91	233.65	11.62	60.92
26000	Michigan	662.04	215.28	519.81	181.17	59.08
27000	Minnesota	462.21	149.41	312.94	509.76	26.87
28000	Mississippi	281.50	85.31	165.08	160.99	5.65
29000	Missouri	309.41	180.85	335.45	345.22	124.88
30000	Montana	66.86	70.76	48.82	151.38	1.62
31000	Nebraska	99.39	204.16	122.15	484.04	2.68
32000	Nevada	50.30	31.06	108.92	15.66	13.27
33000	New Hampshire	126.49	18.30	59.45	4.19	17.65
34000	New Jersey	184.42	248.89	277.96	42.39	46.18
35000	New Mexico	99.15	76.07	98.63	126.97	0.96
36000	New York	515.33	289.45	719.06	115.13	203.43
37000	North Carolina	418.13	87.00	468.09	464.57	38.42
38000	North Dakota	74.12	47.37	60.20	216.04	2.27
39000	Ohio	661.86	255.93	475.20	241.27	44.55
40000	Oklahoma	318.62	285.34	681.49	268.59	13.05
41000	Oregon	316.99	71.92	167.31	120.04	7.46

42000	Pennsylvania	623.09	227.79	537.82	198.61	205.48
44000	Rhode Island	41.91	14.10	27.36	1.61	8.98
45000	South Carolina	208.86	56.29	253.29	83.20	7.07
46000	South Dakota	35.38	16.46	73.39	360.58	0.97
47000	Tennessee	271.56	148.07	286.39	95.62	179.88
48000	Texas	771.77	1206.50	4728.70	796.67	57.10
49000	Utah	134.42	48.94	200.82	113.62	5.45
50000	Vermont	138.23	12.45	30.32	21.97	10.24
51000	Virginia	331.45	149.56	378.19	118.32	46.50
53000	Washington	439.68	195.59	276.87	121.58	43.06
54000	West Virginia	150.01	86.00	71.03	35.23	15.66
55000	Wisconsin	614.38	122.81	360.80	324.89	20.91
56000	Wyoming	65.33	147.76	319.10	53.27	5.68
88000	Tribal Data	21.39	1.34	5.97	3.98	1.09
State non-point source emission totals include NEIv2 area source oil and gas emissions that are processed separately.						

Table 3. 2008 NEIv2 total non-point source emissions by SCC categories, average daily emissions in tons per day (TPD)[1].

	Description	CO TPD	NO_X TPD	VOC TPD	NH_3 TPD
2102	Stationary Source Fuel Combustion ;Industrial	412.40	506.28	22.42	10.31
2103	Stationary Source Fuel Combustion ;Commercial/Institutional	305.29	459.65	21.61	3.83
2104	Stationary Source Fuel Combustion ;Residential	6947.0	987.78	1005.5	167.89
2280	Mobile Sources ;Marine Vessels, Commercial	557.95	4280.5	127.25	1.89
2285	Mobile Sources ;Railroad Equipment	307.39	2145.5	109.82	0.93
2301	Industrial Processes ;Chemical Manufacturing: SIC 28	4.50	4.68	28.67	0.20
2302	Industrial Processes ;Food and Kindred Products: SIC 20	88.66	0.38	86.54	14.45
2303	Industrial Processes ;Primary Metal Production: SIC 33	0.00	0.00	0.00	0.02
2304	Industrial Processes ;Secondary Metal Production: SIC 33	0.31	0.16	0.24	0.00
2305	Industrial Processes ;Mineral Processes: SIC 32	6.79	35.76	2.89	0.00
2306	Industrial Processes ;Petroleum Refining: SIC 29	1.46	0.43	7.42	0.00
2307	Industrial Processes ;Wood Products: SIC 24	0.31	0.56	2.91	0.00
2308	Industrial Processes ;Rubber/Plastics: SIC 30	0.00	0.00	11.18	0.00
2309	Industrial Processes ;Fabricated Metals: SIC 34	0.00	0.00	7.05	0.01
2312	Industrial Processes ;Machinery: SIC 35	0.01	0.06	0.77	0.09
2325	Industrial Processes ;Mining and Quarrying: SIC 14	0.00	0.01	0.13	0.00
2399	Industrial Processes ;Industrial Processes: NEC	2.10	2.39	7.14	68.26
2399	Industrial Processes ;Industrial Refrigeration	0.00	0.00	0.00	3.38
2401	Solvent Utilization ;Surface Coating	0.03	0.05	2330.0	0.05
2415	Solvent Utilization ;Degreasing	0.00	0.00	513.75	0.00
2420	Solvent Utilization ;Dry Cleaning	0.00	0.00	131.01	0.00
2425	Solvent Utilization ;Graphic Arts	0.00	0.00	895.96	0.02
2430	Solvent Utilization ;Rubber/Plastics	0.00	0.00	17.40	0.00
2440	Solvent Utilization ;Miscellaneous Industrial	0.00	0.01	148.30	0.00
2460	Solvent Utilization ;Misc. Non-industrial: Consumer and Commer	0.00	0.00	2852.8	0.19
2461	Solvent Utilization ;Miscellaneous Non-industrial: Commercial	0.09	0.03	1363.2	0.00
2465	Solvent Utilization ;Miscellaneous Non-industrial: Consumer	0.00	0.00	220.50	0.00
2501	Storage and Transport ;Petroleum and Petroleum Product Storage	0.00	0.00	2516.5	0.00
2505	Storage and Transport ;Petroleum and Petroleum Product Trans.	0.00	0.00	323.23	0.00
2510	Storage and Transport ;Organic Chemical Storage	0.00	0.00	0.38	0.00
2515	Storage and Transport ;Organic Chemical Transport	0.00	0.00	4.04	0.00
2520	Storage and Transport ;Inorganic Chemical Storage	0.00	0.01	0.09	8.64
2601	Waste Disposal, Treatment, and Recovery ;On-site Incineration	41.11	12.70	13.33	0.00
2610	Waste Disposal, Treatment, and Recovery ;Open Burning	3631.0	136.44	291.96	1.39
2620	Waste Disposal, Treatment, and Recovery ;Landfills	0.90	0.57	33.74	12.01
2630	Waste Disposal, Treatment, and Recovery ;Wastewater Treatment	0.00	0.00	65.48	12.73
2635	Waste Disposal, Treatment, and Recovery ;Soil and Groundwater Remediation	0.00	0.00	0.03	0.00
2640	Waste Disposal, Treatment, and Recovery ;TSDFs	0.00	0.00	7.21	0.01
2650	Waste Disposal, Treatment, and Recovery ;Scrap and Waste	0.14	0.05	0.00	0.00

	Materials				
2660	Waste Disposal, Treatment, and Recovery ;Leaking Underground Storage Tanks	0.32	0.91	2.84	0.00
2680	Waste Disposal, Treatment, and Recovery ;Composting	0.00	0.00	38.45	138.91
2801	Miscellaneous Area Sources ;Agriculture Production - Crops	1602.8	67.79	147.00	3270.5
2805	Miscellaneous Area Sources ;Agriculture Production - Livestock	0.00	0.00	253.29	6663.7
2806	Miscellaneous Area Sources ;Domestic Animals Waste Emissions	0.00	0.00	0.00	30.74
2807	Miscellaneous Area Sources ;Wild Animals Waste Emissions	0.00	0.00	0.00	12.70
2810	Miscellaneous Area Sources ;Other Combustion	96.90	5.37	12.22	29.91
2830	Miscellaneous Area Sources ;Catastrophic/Accidental Releases	0.00	0.00	1.30	0.00
2840	Miscellaneous Area Sources ;Automotive Repair Shops	0.00	0.00	5.15	0.00
2850	Miscellaneous Area Sources ;Health Services	0.00	0.00	0.17	0.00

1. Does not include area source oil and gas emissions.

Non-Road Mobile Source Emissions

Non-road mobile source emissions result from the use of fuel in a diverse collection of vehicles and equipment that usually do not travel along paved or un-paved roadways, including vehicles and equipment in the following categories:

- Recreational vehicles, such as all-terrain vehicles, off-road motorcycles and snow mobiles;
- Logging equipment, such as chain saws;
- Agricultural equipment, such as tractors;
- Construction equipment, such as graders and back hoes;
- Industrial equipment, such as fork lifts, sweepers and cranes;
- Residential and commercial lawn and garden equipment, such as lawn mowers and leaf and snow blowers; and
- Recreational marine vessels, such as power boats and jet skis.

The NONROAD2008 emissions model predicts emissions for almost all non-road equipment including the categories listed above. The model includes more than 80 basic and 260 specific types of non-road equipment, and further stratifies equipment types by horsepower rating. Fuel types include gasoline, diesel, compressed natural gas (CNG), and liquefied petroleum gas (LPG). The EPA NONROAD model does not provide emission estimates for the airplane, locomotive and commercial marine non-road mobile source categories.

The NONROAD model estimates emissions for each specific type of non-road equipment by multiplying the following input data estimates:

- Equipment population for base year (or base year population grown to a future year), distributed by age, power, fuel type, and application;
- Average load factor expressed as average fraction of available power;
- Available power in horsepower;
- Activity in hours of use per year; and
- Emission factor with deterioration and/or new standards.

The NEI non-road data categories contain mobile sources which are estimated for version 2.0 of the 2008 NEI using the NONROAD[4] model, run within the National Mobile Inventory Model (NMIM[5]), for all states except California. California supplied non-road emissions calculated using the California state-specific model OFFROAD (http://www.arb.ca.gov/msei/offroad/offroad.htm).

EPA developed and maintains the National County Database (NCD) that contains the county-level parameters required as inputs to the NONROAD model. For the development of the 2008 NEIv2 inventory, EPA encouraged S/L/T agencies to review and revise inputs or emissions totals in their NONROAD model calculations. Of the WRAP states, Nevada provided revise NONROAD

4 http://www.epa.gov/otaq/nonrdmdl.htm
5 http://www.epa.gov/otaq/nmim.htm

input parameters. California, Idaho, and Utah, along with the Maricopa County AQD (Phoenix, AZ) provided updated emissions estimates. All other states were calculated using the NCD values compiled by EPA. Figure 2 summarizes which states provided their own CAP or HAP emissions to EPA, which states provided new NONROAD model inputs to EPA so they could recalculate the state's non-road mobile source emissions and which states accepted the EPA NONROAD model emissions estimates using the NCD.

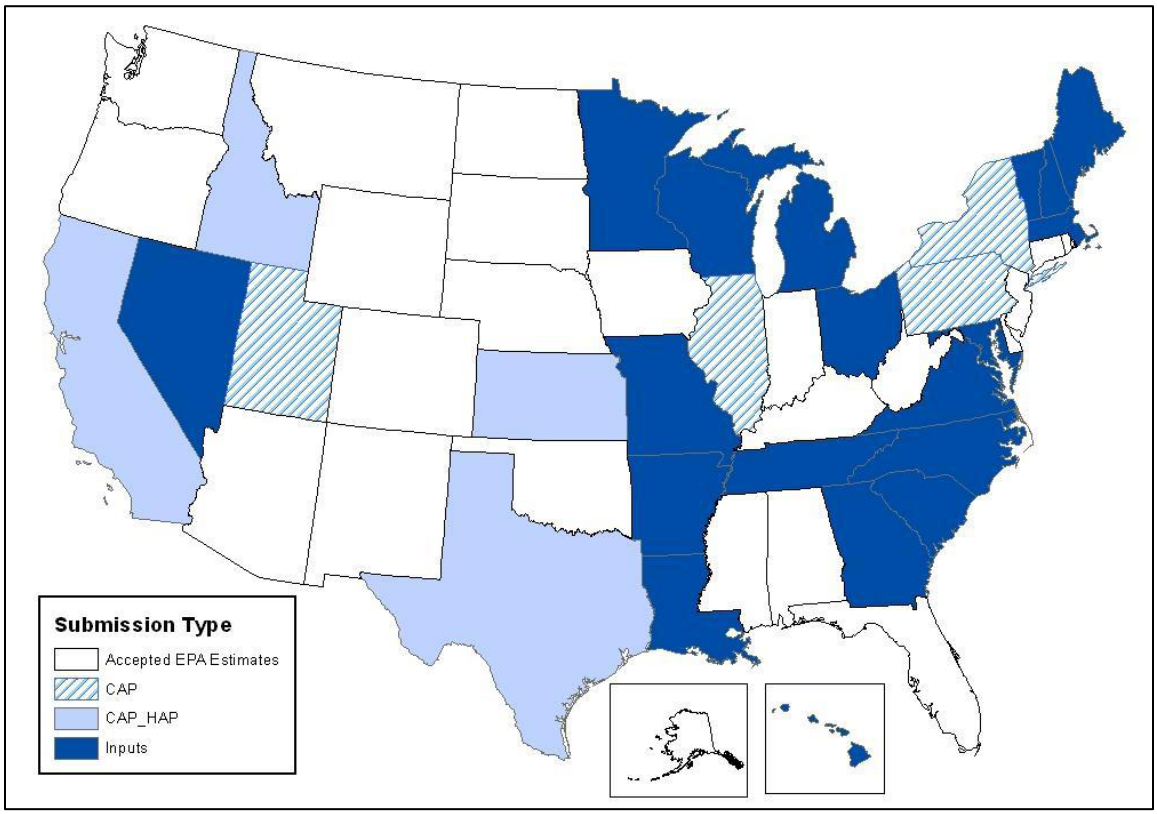

Figure 2. Non-Road Mobile Source Data Submissions for the 2008 NEIv2.

The non-road mobile source emissions have been compiled as both annual total emissions, and average day emissions by month. In order to take the best advantage of the monthly and seasonal variability of the non-road emissions sources, we will use the monthly options for SMOKE modeling inputs. Note that emissions data for aircraft, locomotives, and commercial marine vessels are <u>not</u> included in the NEI non-road mobile source data category starting with the 2008 NEI. These three mobile source categories are handled as special cases, with separate input processing streams. Aircraft engine emissions occurring during Landing and Takeoff (LTO) operations and the Ground Support Equipment (GSE) and Auxiliary Power Units (APU) associated with the aircraft are now included in the point source data category at individual airports in the 2008 NEI. The 2008 NEI does not include in-transit aircraft emissions besides the LTO phase. Railroad emissions are present in the point (emissions associated with rail yards),

non-point (in-transit locomotives) and non-road (railroad maintenance equipment) source categories in the 2008 NEIv2. Commercial Marine Vessel emissions are also split between the point (in and near Ports) and non-point (Class I and II vessels and Class III on inland waterways) source categories in the 2008 NEIv2.

Table 4 summarizes the non-road mobile source emissions in the 2008 NEIv2.0 by state. California is the largest contributor to non-road mobile NO_X, VOC and $PM_{2.5}$ emissions in the U.S. (~10%) with Texas and Florida being the next largest contributor (6-8%). However, Texas (9.1%) and Florida (7.1%) are the two largest contributors to non-road mobile SO_2 emissions. The California non-road SO_2 emissions (0.59 TPD) are over 10 times lower than Texas (7.42 TPD). This is because of the California fuel regulations that have much lower gasoline and diesel fuel sulfur content than the Federal rules.

Table 5 displays the non-road mobile source emissions for the 2008 NEI by SCC category. Non-road diesel engines have by far the highest NO_X contributions (74.3%) followed by LPG (9.8%), 4-stroke gasoline (8.8%) and pleasure craft (5.7%) categories with the rest of the categories having NO_X contributions of less than 1%. The non-road categories of 4-stroke and 2-stroke gasoline engines and pleasure craft each have a ~30% contribution to the total U.S. non-road VOC emissions. Non-road diesel dominates (91.8%) the non-road SO_2 emissions and most of the non-road $PM_{2.5}$ emissions come from non-road diesel (68.2%) and 2-stroke gasoline (20.9%) engines.

Table 4. 2008 NEIv2 total non-road emissions by state for an average June day (Tons per Day)

FIPS CODE	State	EXH CO	EXH NO_X	EXH NH_3	EXH SO_2	EVP VOC	EXH VOC	RFL VOC	EXH PM_{10}	EXH $PM_{2.5}$	EXH PMC
1	Alabama	860.44	73.14	0.09	1.30	22.81	100.27	5.02	7.53	7.14	0.38
4	Arizona	1084.20	96.79	0.11	1.90	20.07	86.76	6.98	9.86	9.40	0.46
5	Arkansas	590.76	77.40	0.08	1.46	12.09	74.38	2.76	7.94	7.60	0.35
6	California	5604.00	471.07	0.54	0.59	89.98	460.05	35.83	45.51	43.30	2.21
8	Colorado	679.98	81.04	0.08	1.56	8.80	55.95	4.33	7.87	7.53	0.34
9	Connecticut	507.64	42.94	0.05	0.66	8.89	49.33	3.26	3.78	3.59	0.19
10	Delaware	150.02	12.80	0.01	0.23	2.62	14.00	0.91	1.24	1.18	0.06
11	DC	40.68	7.14	0.01	0.15	0.62	2.89	0.21	0.61	0.59	0.02
12	Florida	3924.60	297.85	0.38	5.77	93.30	375.29	23.15	30.62	29.12	1.51
13	Georgia	1700.40	142.65	0.17	2.68	28.14	145.77	9.98	14.42	13.74	0.69
16	Idaho	237.80	36.02	0.04	0.70	3.78	30.92	1.17	3.67	3.51	0.16
17	Illinois	1488.80	200.34	0.20	3.68	27.15	116.77	8.59	16.60	15.91	0.69
18	Indiana	802.63	92.95	0.09	1.59	19.32	70.87	4.95	7.16	6.83	0.33
19	Iowa	508.90	142.98	0.12	2.66	7.58	58.03	2.33	12.67	12.22	0.45
20	Kansas	499.62	126.37	0.11	2.43	6.31	44.23	2.39	11.64	11.23	0.41
21	Kentucky	658.25	84.89	0.09	1.56	12.32	77.62	3.30	8.22	7.86	0.36
22	Louisiana	822.39	73.42	0.09	1.35	27.75	109.36	4.35	7.65	7.27	0.38
23	Maine	207.39	19.29	0.02	0.36	5.00	24.73	1.12	1.93	1.83	0.10
24	Maryland	817.80	68.31	0.08	1.28	15.55	77.35	5.92	6.92	6.57	0.35
25	Massachus.	775.29	72.65	0.08	1.21	13.78	67.91	4.56	6.25	5.95	0.29

26	Michigan	1348.40	129.73	0.14	2.19	38.52	137.32	7.33	10.97	10.42	0.54
27	Minnesota	752.31	135.33	0.13	2.42	17.61	95.47	4.06	12.21	11.72	0.50
28	Mississippi	502.26	57.22	0.06	1.05	15.40	68.60	2.63	5.85	5.58	0.28
29	Missouri	862.60	123.95	0.12	2.31	17.06	92.84	4.60	11.79	11.29	0.49
30	Montana	169.93	42.04	0.04	0.83	2.27	20.26	0.64	4.19	4.03	0.15
31	Nebraska	313.68	107.65	0.09	2.09	4.24	34.17	1.49	10.02	9.68	0.34
32	Nevada	448.47	50.47	0.06	0.95	6.54	40.42	3.02	5.17	4.94	0.23
33	N.Hampshire	210.09	19.26	0.02	0.33	4.58	22.96	1.11	1.77	1.69	0.09
34	New Jersey	1317.30	99.06	0.12	1.62	23.85	121.13	8.28	9.28	8.80	0.47
35	New Mexico	264.58	24.80	0.03	0.48	4.92	24.40	1.56	2.52	2.40	0.12
36	New York	2094.10	192.83	0.21	3.39	45.21	183.56	11.56	17.19	16.40	0.79
37	N.Carolina	1847.10	149.61	0.17	2.78	35.75	160.39	11.11	14.74	14.04	0.70
38	North Dakota	152.30	85.32	0.07	1.69	2.30	18.23	0.55	7.97	7.71	0.25
39	Ohio	1610.10	143.22	0.15	2.42	32.77	129.24	10.29	12.08	11.48	0.60
40	Oklahoma	699.35	86.23	0.09	1.62	13.81	68.75	3.95	8.39	8.04	0.35
41	Oregon	551.58	61.68	0.07	1.13	9.07	60.22	3.19	5.99	5.71	0.28
42	Pennsylvania	1692.60	148.93	0.16	2.49	31.92	151.49	10.74	14.02	13.34	0.68
44	Rhode Island	137.71	11.00	0.01	0.17	2.33	13.00	0.78	0.92	0.87	0.05
45	S. Carolina	928.13	72.00	0.08	1.34	16.52	85.96	4.97	7.11	6.77	0.35
46	South Dakota	137.32	61.33	0.05	1.20	2.22	16.86	0.54	5.73	5.55	0.19
47	Tennessee	1065.30	108.13	0.12	1.96	21.27	112.48	5.96	10.45	9.96	0.49
48	Texas	3731.50	387.00	0.42	7.42	73.41	303.88	21.41	36.91	35.31	1.60
49	Utah	362.71	38.26	0.04	0.73	5.92	43.20	1.79	3.90	3.72	0.18
50	Vermont	91.36	9.72	0.01	0.17	2.18	9.45	0.48	0.90	0.86	0.04
51	Virginia	1286.50	106.34	0.12	2.00	15.96	109.40	7.35	10.71	10.20	0.51
53	Washington	903.47	99.81	0.11	1.84	13.66	92.11	5.09	9.44	9.01	0.43
54	West Virginia	271.53	19.94	0.02	0.35	7.12	35.70	1.60	2.47	2.33	0.13
55	Wisconsin	772.55	87.85	0.09	1.42	19.38	93.04	4.08	7.26	6.91	0.35
56	Wyoming	86.63	12.06	0.01	0.23	1.52	11.12	0.37	1.23	1.18	0.05

Table 5. 2008 NEI v2 total non-road mobile source emissions by SCC categories for an average June day (tons per day).

	Category	CO	NO_X	VOC	NH_3	SO_2	PM_{10}	$PM_{2.5}$
2260	Off-highway Vehicle Gasoline, 2-Stroke	3173.93	18.16	1549.4	0.19	0.26	101.9	93.74
2265	Off-highway Vehicle Gasoline, 4-Stroke	34616.43	433.2	1876.2	1.47	2.74	18.07	16.63
2267	LPG	2694.11	485.4	134.56	0	0.85	4.16	4.16
2268	CNG	226.18	42.19	0.66	0	0.09	0.49	0.49
2270	Off-highway Vehicle Diesel	1876.13	3674.2	375.47	3.12	76.77	314.8	305.4
2282	Pleasure Craft	4862.52	281.52	1748.9	0.52	2.75	28.78	26.58
2285	Railroad Equipment	17.35	8.57	1.92	0.01	0.15	1.05	1.01

Emissions Processing

The non-point (area) and the non-road mobile source emissions were processed by the Sparse Matrix Operator Kernel Emissions (SMOKE[6]) emissions modeling system. Emissions are inputs as annual or average day totals by state, county, and SCC code. SMOKE applies temporal and spatial allocation profiles to distribute the county-level emissions to gridded, hourly emission estimates. Note that prior to processing the 2008 NEIv2.0 non-point emissions, the oil and gas, residential wood combustion and ammonia emissions were removed from the NEIv2 and either processed separately (residential wood combustion and ammonia) or updated and then processed (oil and gas).

Spatial Allocation

Spatial allocation profiles have been updated using the 2010 census data files and other data. Details of the development and application of the spatial allocation profiles will be included in Technical Memorandum No. 13.

Temporal Allocation

Revised temporal allocation factors have been provided by EPA for use with the 2008NEIv2 datasets. Details of the development and application of the temporal allocation profiles will be included in Technical Memorandum No. 13.

Chemical Speciation

Speciation profiles for the CB6 chemical mechanism are based on SPECIATE 4.3 database. Speciation profiles are assigned by SCC category. The speciation profile assignments have been updated in conjunction with the release of the 2008 NEIv2, and these updated files will be used. Details of the development of the chemical speciation profiles will be included in Technical Memorandum No. 13.

Quality Assurance

Quality assurance (QA) will be performed following the emissions quality assurance protocol developed for the WRAP Regional Modeling Center (Adelman, 2004[7]). These procedures include systematic procedures for:

- Modeling QA – accuracy assurance and problem identification.
- System QA – software and data tracking.
- Documentation – tracking QA issues, recording the QA process and report writing.

An emissions QA checklist is developed that delineates each step of the QA process and allows a systematic approach to the QA process to assure critical steps are not overlooked. The completed QA checklists and templates include:

- Model configuration settings.

6 http://www.smoke-model.org/index.cfm
7 http://www.epa.gov/ttnchie1/conference/ei13/qaqc/adelman_pres.pdf

- Inventory file log.
- Ancillary input file log.
- Model execution log.

A series of QA products are produced that are compared to other studies and the expected outcomes:

- Spatial plots of emissions by source category.
- Annual time series plots of emissions for subregions.
- Diurnal time series plots.
- Daily vertical profile plots.

Comparison of 2008 NEIv2 to WRAP 2002 Base02b

Tables 6 through 11 compare the 2008 NEIv2 and WRAP 2002 Base02b VOC, NO_X, SO_2, CO, NH_3 and $PM_{2.5}$ area (non-point) source and non-road mobile source emissions for WRAP states. Note that there are differences in how the area/non-road source and non-road source categories were defined in the 2008 NEI versus previous inventories, like in the 2002 WRAP inventory. In particular, Class I and II and some inland waterway Class III commercial marine vessels and in-transit locomotive emissions that were part of the non-road source sector in the 2002 WRAP inventory are now part of the non-point source category in the 2008 NEI.

There are significant reductions (-42%) in non-point/area source VOC across the WRAP states between the WRAP 2002 and NEIv2 2008 emissions inventories (Table 6). The area source VOC reductions range from -84% for New Mexico to -12% for California, with one state (Nevada) even showing increases in area source VOC emissions between WRAP 2002 and NEIv2 2008. The increase in area source VOC emissions in Nevada is likely related to the increased population, whereas the less reductions in area source VOC emissions in California is likely related to the fact that California has been ahead of the rest of the nation in area source VOC control prior to 2002. Non-road VOC emissions are estimate to be reduced by -19% across the WRAP states between the WRAP 2002 and NEIv2 2008 emission inventories. Most states are exhibiting non-road VOC reductions of -20% to -60%, although Nevada has essential no change (+1%) and California has an 11% increase in non-road VOC emissions.

There are wide differences across the WRAP states in the changes in non-point/area source NO_X emissions between the WRAP 2002 and NEIv2 2008 emission inventories (Table 7). Four states exhibit decreases in area source NO_X emissions (CO, ID NM and SD), whereas three states (AK, AZ and WA) have increases of over 200%. The large increase in non-point/area source NO_X emissions between the 2002 WRAP and 2008 NEI are likely due to the re-classification of some of the commercial marine vessel and in-transit locomotive emissions from the non-road to the non-point source categories in the 2008 NEI. Across the WRAP states there is an average increase in non-point/area source NO_X emissions of +32%. All of the WRAP states have decreases in non-road NO_X emissions with decreases ranging from -43% to -81% and an average decrease of -57%. Again, the re-classification of some of the marine vessel and locomotive

sources from non-road to non-point source categories in the 2008 NEI contribute to these non-road NO_X emissions reductions between the 2002 WRAP and 2008 NEI inventories.

The average change in non-point/area source SO_2 emissions between WRAP 2002 and NEIv2 2008 across the WRAP states is -34% (Table 8). Although the variations across the states is quite large with area source SO_2 emission reductions between 2002 and 2008 being as high as –95% to -97% (NM and SD) and increases of over 100% for three states (CA, WA and ID). The re-classification of marine vessels and locomotives are contributing to these seemingly increases in the SO_2 emissions for these three states. Non-road SO_2 emissions are estimated to be reduced between WRAP 2002 and NEIv2 2008 across all the WRAP states with reductions ranging from -60% to -99% across the different states and an average reduction of -92%. The use of lower sulfur gasoline and diesel fuel in 2008 compared to 2002 and the elimination of marine vessel and locomotive emissions from the no-road source category in the 2008 NEI are the major reasons for the reduction in non-road SO_2 emissions between 2002 and 2008.

There are increases and decreases in area source CO emissions across the WRAP states between the WRAP 2002 and NEIv2 2008 emission inventories with an average change of -15% (Table 9). Although there are reductions in non-road CO emissions between the WRAP 2002 and NEIv2 2008 emission inventories across all of the WRAP states except California, because of the size of the 2008 California non-road emissions increase (+78%), there is little change in the average non-road CO emissions across the WRAP states (-3%). Why there is an increase in non-road CO emissions in California between the 2002 and 2008 inventories is unclear, but we suspect it is due to a methodology change.

The comparison of the WRAP 2002 and NEIv2 2008 area source NH_3 emissions is an apple-orange comparison since the NEIv2 2008 non-point sources includes livestock emissions, whereas in WRAP 2002 they were processed separately so are not included in the area source category (Table 10). Non-road source sector is not a large source of NH_3 emissions with the 2008 NEIv2 inventory being about half of what was in the WRAP 2002 inventory.

There are wide differences in the changes between WRAP 2002 and NEIv2 2008 non-point/area source $PM_{2.5}$ emissions across the WRAP states ranging from a -52% reduction to +403% increase with an average change of +9% (Table 11). $PM_{2.5}$ emissions from non-road sources are estimated to be reduced going from the WRAP 2002 to NEIv2 2008 emissions inventories with an average reduction of -45%.

Table 6. Comparisons of 2008 NEIv2 and WRAP 2002 Base02b area and non-road source volatile organic compound (VOC) emissions (tons per year).

VOC Emissions [tpy]	Non-Point/Area Sources				Non-Road Sources			
State	**2008 NEIv2**	**2002 Base02b**	**Difference**	**% Difference**	**2008 NEIv2**	**2002 Base02b**	**Difference**	**% Difference**
Alaska	10259	13019	-2760	-21%	7151	17769	-10618	-60%
Arizona	95907	110809	-14902	-13%	41543	57035	-15492	-27%
California	303038	343788	-40750	-12%	213876	193451	20425	11%
Colorado	63809	125515	-61705	-49%	25247	38438	-13191	-34%
Washington	101061	198283	-97222	-49%	40464	61692	-21228	-34%
Oregon	61068	252048	-190980	-76%	26458	39646	-13188	-33%
Idaho	94009	126416	-32407	-26%	13095	23887	-10792	-45%
Montana	17821	63285	-45464	-72%	8461	14267	-5806	-41%
Wyoming	116475	144209	-27733	-19%	4750	13751	-9002	-65%
North Dakota	21974	69795	-47821	-69%	7692	13521	-5829	-43%
Nevada	39756	29977	9779	33%	18246	18147	98	1%
New Mexico	36000	219577	-183577	-84%	11275	14017	-2742	-20%
South Dakota	26787	42661	-15874	-37%	7164	12779	-5615	-44%
Utah	73299	85320	-12021	-14%	18582	26944	-8361	-31%
Tribal Data	2179							
Total	**1063442**	**1824702**	**-763437**	**-42%**	**444004**	**545344**	**-101341**	**-19%**

Table 7. Comparisons of 2008 NEIv2 and WRAP 2002 Base02b area and non-road source oxides of nitrogen (NO_X) emissions (tons per year).

NOx Emissions [tpy]	Area Sources				Non-Road Sources			
State	**2008 NEIv2**	**2002 Base02b**	**Difference**	**% Difference**	**2008 NEIv2**	**2002 Base02b**	**Difference**	**% Difference**
Alaska	26092	8488	17604	207%	3220	9369	-6149	-66%
Arizona	39449	10305	29144	283%	35332	66483	-31152	-47%
California	171875	114471	57403	50%	171981	328321	-156341	-48%
Colorado	22937	35608	-12671	-36%	29589	62581	-32992	-53%
Washington	71394	18355	53039	289%	36433	84867	-48434	-57%
Oregon	26250	14926	11324	76%	22513	56002	-33489	-60%
Idaho	20097	30464	-10366	-34%	13148	28438	-15290	-54%
Montana	25826	13340	12486	94%	15346	52134	-36788	-71%
Wyoming	53932	36060	17872	50%	4401	76675	-72274	-94%
North Dakota	17288	15459	1829	12%	31144	55659	-24515	-44%
Nevada	11336	5787	5549	96%	18424	32606	-14182	-43%
New Mexico	27767	85590	-57823	-68%	9053	48699	-39646	-81%
South Dakota	6009	6345	-337	-5%	22387	39187	-16800	-43%
Utah	17863	11335	6527	58%	13963	47197	-33234	-70%
Tribal Data	488							
TOTAL	**538604**	**406533**	**132070**	**32%**	**426936**	**988220**	**-561284**	**-57%**

Table 8. Comparisons of 2008 NEIv2 and WRAP 2002 Base02b area and non-road source sulfur dioxide (SO_2) emissions (tons per year).

SO2 Emissions [tpy]	Area Sources				Non-Road Sources			
State	**2008 NEIv2**	**2002 Base02b**	**Difference**	**% Difference**	**2008 NEIv2**	**2002 Base02b**	**Difference**	**% Difference**
Alaska	7500	5531	1969	36%	395	987	-592	-60%
Arizona	3684	2679	1005	38%	695	4226	-3531	-84%
California	17584	8314	9269	111%	215	7540	-7325	-97%
Colorado	503	6559	-6056	-92%	570	2472	-1902	-77%
Washington	15718	7388	8330	113%	671	13936	-13264	-95%
Oregon	2723	9952	-7229	-73%	412	6877	-6465	-94%
Idaho	8992	3046	5946	195%	254	3457	-3203	-93%
Montana	591	3324	-2733	-82%	304	4374	-4070	-93%
Wyoming	2072	17948	-15876	-88%	85	5871	-5785	-99%
North Dakota	829	5748	-4919	-86%	615	6852	-6237	-91%
Nevada	4845	12954	-8109	-63%	346	1403	-1058	-75%
New Mexico	349	6560	-6211	-95%	175	3773	-3597	-95%
South Dakota	354	10167	-9812	-97%	438	5756	-5318	-92%
Utah	1988	3581	-1593	-44%	265	4514	-4249	-94%
Tribal Data	397							
TOTAL	**68130**	**103752**	**-35623**	**-34%**	**5442**	**72038**	**-66597**	**-92%**

Table 9. Comparisons of 2008 NEIv2 and WRAP 2002 Base02b area and non-road source carbon monoxide (CO) emissions (tons per year).

CO Emissions [tpy]	Area Sources				Non-Road Sources			
State	**2008 NEIv2**	**2002 Base02b**	**Difference**	**% Difference**	**2008 NEIv2**	**2002 Base02b**	**Difference**	**% Difference**
Alaska	18110	27258	-9148	-34%	36213	80977	-44764	-55%
Arizona	57940	50157	7783	16%	395806	545609	-149803	-27%
California	452892	374920	77972	21%	2045898	1147102	898796	78%
Colorado	99587	88417	11169	13%	248580	392997	-144417	-37%
Washington	160483	222555	-62072	-28%	329792	527169	-197377	-37%
Oregon	115701	355865	-240163	-67%	201338	332542	-131204	-39%
Idaho	102072	47164	54908	116%	86804	158064	-71259	-45%
Montana	24405	78490	-54085	-69%	62032	100324	-38292	-38%
Wyoming	23846	29341	-5495	-19%	31622	73265	-41643	-57%
North Dakota	27052	21970	5082	23%	55593	96069	-40476	-42%
Nevada	18358	13737	4621	34%	163713	170925	-7212	-4%
New Mexico	36189	37938	-1748	-5%	96583	124713	-28131	-23%
South Dakota	12913	24249	-11336	-47%	50125	92711	-42585	-46%
Utah	49063	42919	6144	14%	132396	205433	-73037	-36%
Tribal Data	7806							
TOTAL	**1206417**	**1414980**	**-208563**	**-15%**	**3936496**	**4047900**	**-111404**	**-3%**

Table 10. Comparisons of 2008 NEIv2 and WRAP 2002 Base02b area and non-road source ammonia (NH_3) emissions (tons per year).

NH3 Emissions [tpy]	Area Sources				Non-Road Sources			
State	**2008 NEIv2**	**2002 Base02b**	**Difference**	**% Difference**	**2008 NEIv2**	**2002 Base02b**	**Difference**	**% Difference**
Alaska	359	472	-113	-24%	4	12	-8	-67%
Arizona	37734	5922	31812	537%	42	48	-6	-13%
California	323361	7510	315851	4206%	198	546	-348	-64%
Colorado	70452	77	70375	91610%	31	43	-12	-29%
Washington	44377	4471	39906	893%	39	58	-19	-33%
Oregon	43815	316	43499	13785%	24	39	-15	-38%
Idaho	104109	1684	102425	6083%	13	17	-4	-24%
Montana	55254	460	54794	11920%	14	29	-15	-53%
Wyoming	19445	389	19056	4899%	5	41	-37	-89%
North Dakota	78858	368	78490	21332%	25	33	-8	-24%
Nevada	5717	1120	4597	411%	21	22	-1	-3%
New Mexico	46344	636	45709	7192%	10	26	-15	-60%
South Dakota	131615	381	131235	34469%	18	25	-7	-27%
Utah	41471	1320	40151	3042%	15	32	-17	-53%
Tribal Data	1453							
TOTAL	**1004363**	**25123**	**979240**	**3898%**	**458**	**971**	**-512**	**-53%**

Table 11. Comparisons of 2008 NEIv2 and WRAP 2002 Base02b area and non-road source fine particulate ($PM_{2.5}$) emissions (tons per year).

PM2.5 Emissions [tpy]	Area Sources				Non-Road Sources			
State	**2008 NEIv2**	**2002 Base02b**	**Difference**	**% Difference**	**2008 NEIv2**	**2002 Base02b**	**Difference**	**% Difference**
Alaska	13133	5474	7659	140%	411	1494	-1084	-73%
Arizona	52509	35758	16751	47%	3433	5600	-2168	-39%
California	170857	150474	20382	14%	15806	20222	-4416	-22%
Colorado	61105	47108	13997	30%	2748	5021	-2272	-45%
Washington	50436	105636	-55200	-52%	3288	7611	-4323	-57%
Oregon	43953	86164	-42210	-49%	2084	4963	-2879	-58%
Idaho	69923	14018	55905	399%	1282	2940	-1657	-56%
Montana	49176	134426	-85250	-63%	1473	3418	-1945	-57%
Wyoming	55232	11287	43945	389%	430	3089	-2659	-86%
North Dakota	74577	67094	7483	11%	2816	5096	-2281	-45%
Nevada	28337	18634	9703	52%	1803	2199	-396	-18%
New Mexico	89487	30421	59067	194%	877	2413	-1536	-64%
South Dakota	45705	54238	-8532	-16%	2024	4527	-2502	-55%
Utah	33062	6577	26485	403%	1356	3880	-2523	-65%
Tribal Data	1507							
TOTAL	**838998**	**767307**	**71692**	**9%**	**39832**	**72473**	**-32642**	**-45%**

SMOKE Emissions Modeling Results for Area and Non-Road Sources

Figures 3 and 4 display the spatial distribution of the, respectively, 2008 non-point and non-road sources NO and PAR emissions across the 36 km continental U.S. (CONUS) domain. NO dominates the NO_X emissions and PAR is the VOC species with the highest emissions so are representative of the spatial distributions of the NO_X and VOC non-point and non-road mobile source emissions. The non-point source NO and VOC emissions are highest in the urban areas (Figure 3). The non-road NO emissions are dominated by diesel equipment such as construction and agricultural equipment so are not only high in the urban areas, but they are also high in agricultural areas due to farm equipment (e.g., see California central valley). The non-road PAR emissions are dominated by gasoline equipment that includes lawn and garden equipment and snow mobiles so are not only high in urban areas but also in Michigan and Minnesota where snow mobiles are used more extensively.

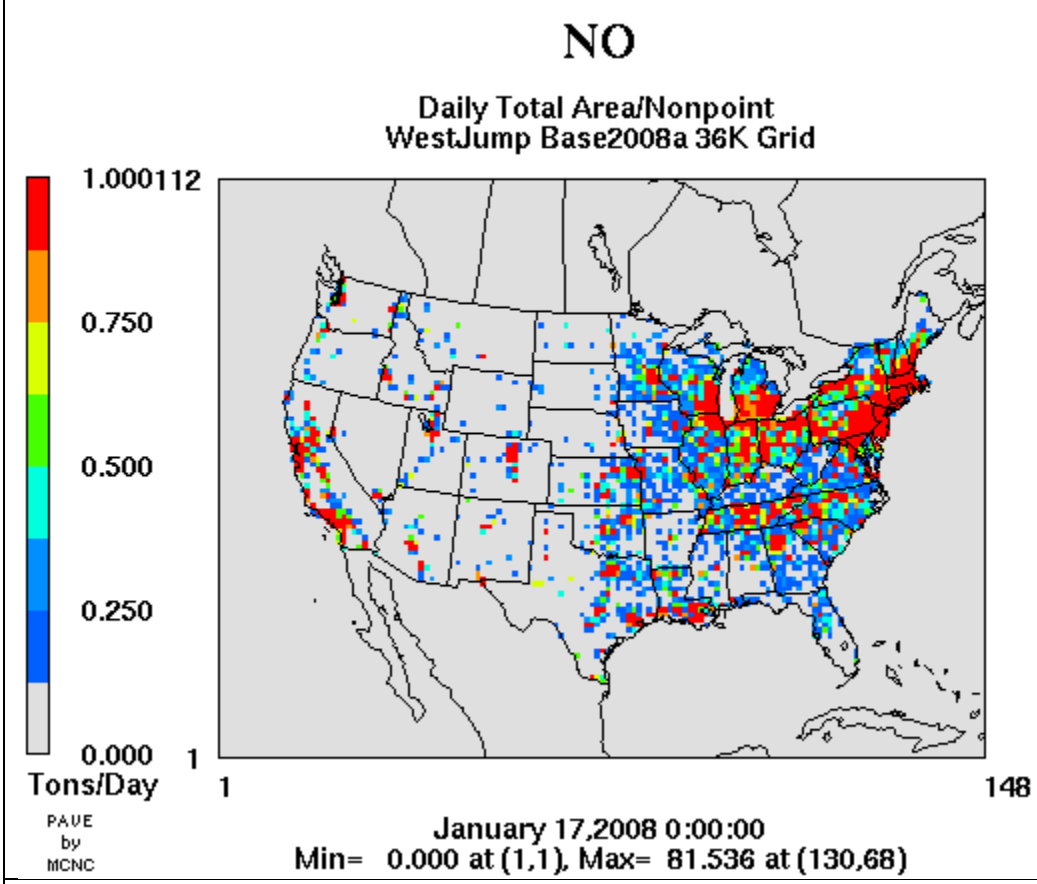

Figure 3a. Example spatial distribution of the 2008 NEIv2.0 non-point/area source (non-point) NO emissions across the 36 km CONUS domain.

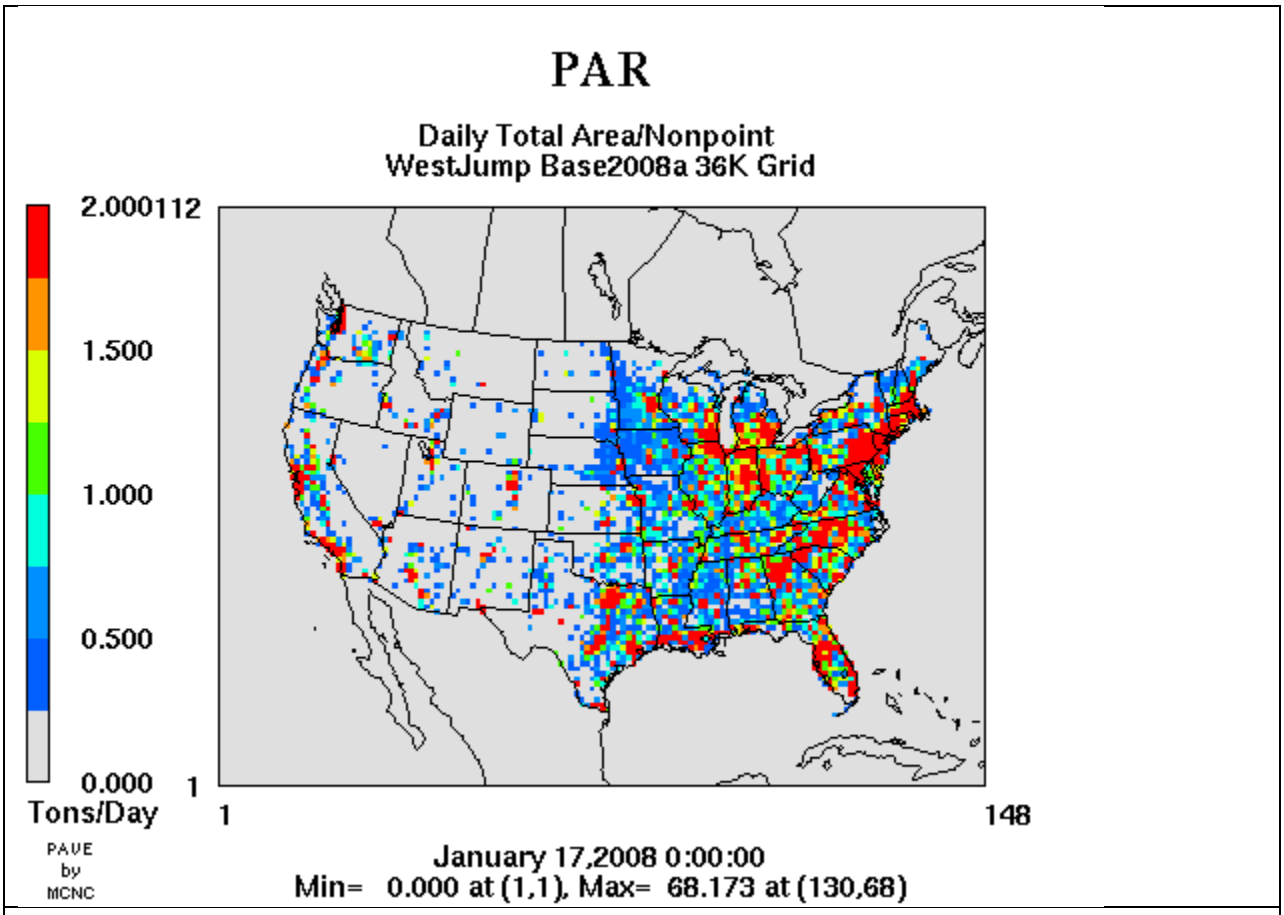

Figure 3b. Example spatial distribution of the 2008 NEIv2.0 non-point/area source (non-point) PAR emissions across the 36 km CONUS domain.

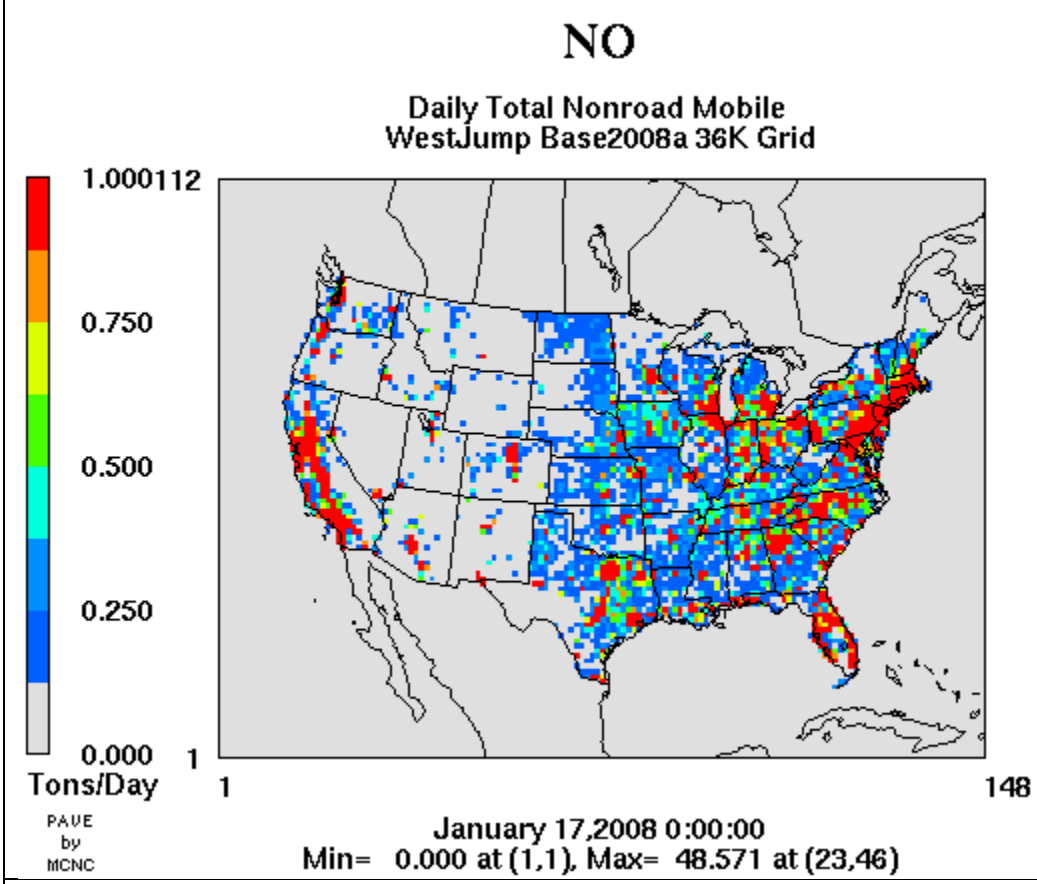

Figure 4a. Example spatial distributions of the 2008 NEIv2.0 non-road mobile source NO emissions across the 36 km CONUS domain.

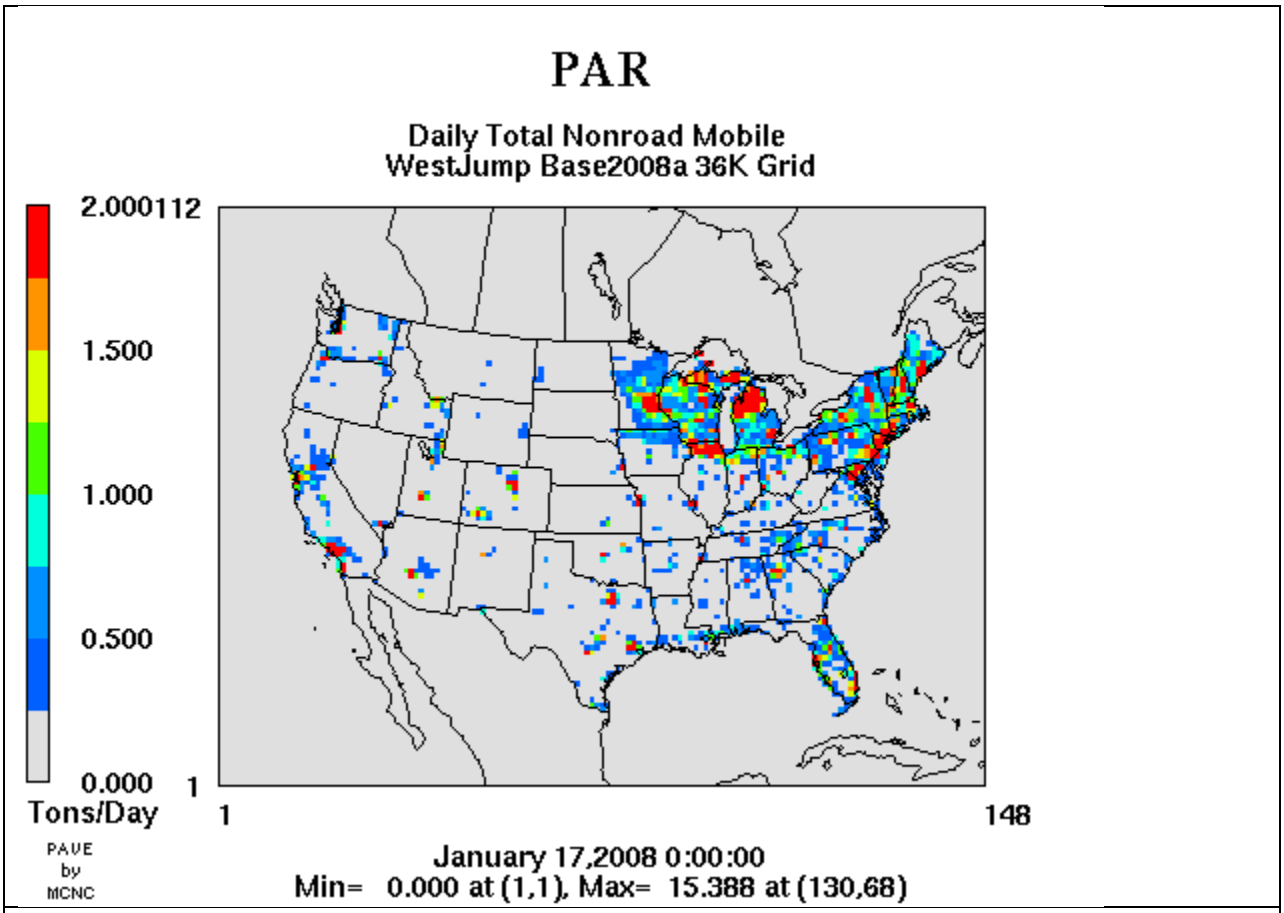

Figure 4b. Example spatial distribution of the 2008 NEIv2.0 non-road mobile source VOC emissions across the 36 km CONUS domain