Technical Support Document (TSD)

Preparation of Emissions Inventories for the Version 7.1

2014 Emissions Modeling Platform for the

National Air Toxics Assessment

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Contacts:
Madeleine Strum, Alison Eyth, Jeff Vukovich

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Air Quality Assessment Division
Emissions Inventory and Analysis Group
Research Triangle Park, North Carolina

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Acronyms

Acronym	Definition
AE5	CMAQ Aerosol Module, version 5, introduced in CMAQ v4.7
AE6	CMAQ Aerosol Module, version 6, introduced in CMAQ v5.0
AEO	Annual Energy Outlook
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
NBAFM	Naphthalene, Benzene, Acetaldehyde, Formaldehyde and Methanol
BEIS	Biogenic Emissions Inventory System
BELD	Biogenic Emissions Land use Database
Bgal	Billion gallons
BPS	Bulk Plant Storage
BTP	Bulk Terminal (Plant) to Pump
C1/C2	Category 1 and 2 commercial marine vessels
C3	Category 3 (commercial marine vessels)
CAEP	Committee on Aviation Environmental Protection
CAIR	Clean Air Interstate Rule
CAMD	EPA's Clean Air Markets Division
CAMx	Comprehensive Air Quality Model with Extensions
CAP	Criteria Air Pollutant
CARB	California Air Resources Board
CB05	Carbon Bond 2005 chemical mechanism
CBM	Coal-bed methane
CEC	North American Commission for Environmental Cooperation
CEMS	Continuous Emissions Monitoring System
CEPAM	California Emissions Projection Analysis Model
CISWI	Commercial and Industrial Solid Waste Incinerators
Cl	Chlorine
CMAQ	Community Multiscale Air Quality
CMV	Commercial Marine Vessel
CO	Carbon monoxide
CSAPR	Cross-State Air Pollution Rule
E0, E10, E85	0%, 10% and 85% Ethanol blend gasoline, respectively

Acronym	Definition
EBAFM	Ethanol, Benzene, Acetaldehyde, Formaldehyde and Methanol
ECA	Emissions Control Area
EEZ	Exclusive Economic Zone
EF	Emission Factor
EGU	Electric Generating Units
EIS	Emissions Inventory System
EISA	Energy Independence and Security Act of 2007
EPA	Environmental Protection Agency
EMFAC	Emission Factor (California's onroad mobile model)
FAA	Federal Aviation Administration
FAPRI	Food and Agriculture Policy and Research Institute
FASOM	Forest and Agricultural Section Optimization Model
FCCS	Fuel Characteristic Classification System
FF10	Flat File 2010
FIPS	Federal Information Processing Standards
FHWA	Federal Highway Administration
HAP	Hazardous Air Pollutant
HCl	Hydrochloric acid
HDGHG	Heavy-Duty Vehicle Greenhouse Gas
Hg	Mercury
HMS	Hazard Mapping System
HPMS	Highway Performance Monitoring System
HWC	Hazardous Waste Combustion
HWI	Hazardous Waste Incineration
ICAO	International Civil Aviation Organization
ICI	Industrial/Commercial/Institutional (boilers and process heaters)
ICR	Information Collection Request
IDA	Inventory Data Analyzer
I/M	Inspection and Maintenance
IMO	International Marine Organization
IPAMS	Independent Petroleum Association of Mountain States
IPM	Integrated Planning Model
ITN	Itinerant
LADCO	Lake Michigan Air Directors Consortium
LDGHG	Light-Duty Vehicle Greenhouse Gas
LPG	Liquefied Petroleum Gas
MACT	Maximum Achievable Control Technology
MARAMA	Mid-Atlantic Regional Air Management Association
MATS	Mercury and Air Toxics Standards
MCIP	Meteorology-Chemistry Interface Processor
Mgal	Million gallons
MMS	Minerals Management Service (now known as the Bureau of Energy Management, Regulation and Enforcement (BOEMRE)
MOVES	Motor Vehicle Emissions Simulator
MSA	Metropolitan Statistical Area
MSAT2	Mobile Source Air Toxics Rule
MTBE	Methyl tert-butyl ether
MWRPO	Mid-west Regional Planning Organization
NCD	National County Database

Acronym	Definition
NEEDS	National Electric Energy Database System
NEI	National Emission Inventory
NESCAUM	Northeast States for Coordinated Air Use Management
NESHAP	National Emission Standards for Hazardous Air Pollutants
NH_3	Ammonia
NIF	NEI Input Format
NLCD	National Land Cover Database
NLEV	National Low Emission Vehicle program
nm	nautical mile
NMIM	National Mobile Inventory Model
NOAA	National Oceanic and Atmospheric Administration
NODA	Notice of Data Availability
NONROAD	OTAQ's model for estimation of nonroad mobile emissions
NO_X	Nitrogen oxides
NSPS	New Source Performance Standards
NSR	New Source Review
OAQPS	EPA's Office of Air Quality Planning and Standards
OHH	Outdoor Hydronic Heater
OTAQ	EPA's Office of Transportation and Air Quality
ORIS	Office of Regulatory Information System
ORD	EPA's Office of Research and Development
ORL	One Record per Line
OTC	Ozone Transport Commission
PADD	Petroleum Administration for Defense Districts
PF	Projection Factor, can account for growth and/or controls
PFC	Portable Fuel Container
$PM_{2.5}$	Particulate matter less than or equal to 2.5 microns
PM_{10}	Particulate matter less than or equal to 10 microns
ppb, ppm	Parts per billion, parts per million
RBT	Refinery to Bulk Terminal
RFS2	Renewable Fuel Standard
RIA	Regulatory Impact Analysis
RICE	Reciprocating Internal Combustion Engine
RWC	Residential Wood Combustion
RPO	Regional Planning Organization
RVP	Reid Vapor Pressure
SCC	Source Classification Code
SEMAP	Southeastern Modeling, Analysis, and Planning
SESARM	Southeastern States Air Resource Managers
SESQ	Sesquiterpenes
SMARTFIRE	Satellite Mapping Automated Reanalysis Tool for Fire Incident Reconciliation
SMOKE	Sparse Matrix Operator Kernel Emissions
SO_2	Sulfur dioxide
SOA	Secondary Organic Aerosol
SI	Spark-ignition
SIP	State Implementation Plan
SPDPRO	Hourly Speed Profiles for weekday versus weekend
SPPD	Sector Policies and Programs Division
TAF	Terminal Area Forecast

Acronym	Definition
TCEQ	Texas Commission on Environmental Quality
TOG	Total Organic Gas
TSD	Technical support document
ULSD	Ultra Low Sulfur Diesel
USDA	United States Department of Agriculture
VOC	Volatile organic compounds
VMT	Vehicle miles traveled
VPOP	Vehicle Population
WRAP	Western Regional Air Partnership
WRF	Weather Research and Forecasting Model

1 Introduction

The U.S. Environmental Protection Agency (EPA) developed an air quality modeling platform for air toxics and criteria air pollutants that represents the year 2014 based on the 2014 National Emissions Inventory (NEI), version 2 (2014NEIv2). The air quality modeling platform consists of all the emissions inventories and ancillary data files used for emissions modeling, as well as the meteorological, initial condition, and boundary condition files needed to run the air quality model. This document focuses on the emissions modeling component of the 2014 modeling platform, which includes the emission inventories, the ancillary data files, and the approaches used to transform inventories for use in air quality modeling. Many emissions inventory components of this air quality modeling platform are based on the 2014NEIv2, although there are some differences between the platform inventories and the 2014NEIv2 emissions as a result of the emissions modeling process, and timing between the modeling and the public release of the NEI.

This 2014 modeling platform includes all criteria air pollutants and precursors (CAPs), two groups of hazardous air pollutants (HAPs) and diesel particulate matter. The first group of HAPs are those explicitly used by the chemical mechanism in the Community Multiscale Air Quality (CMAQ) model for ozone/particulate matter (PM): chlorine (Cl), hydrogen chloride (HCl), benzene, acetaldehyde, formaldehyde, methanol, naphthalene. The second group consists of 51 HAPs or HAP groups (such as polycyclic aromatic hydrocarbon groups) added to CMAQ for the purposes of air quality modeling for the 2014 National Air Toxics Assessment (NATA). The latter five HAPs in the first group are also abbreviated as NBAFM in subsequent sections of the document. A list of all HAPs and diesel species in this modeling platform is in Appendix A. This platform is called the “2014 NATA-Based Platform, version 7.1” (2014v7.1) because it is a HAP-CAP used primarily for NATA. Here, “version 7.1” denotes an evolution from the earlier versions of the 2014-based platform. Version 7.0 supported the initial modeling for NATA. A version subsequent to that supported a CAP application of the 2014 NEI. Both platforms were the starting point for a number of the ancillary (non-emissions) data files for version 7.1. The 2014v7.0 Technical Support Document (TSD) is available on the EPA’s Air Emissions Modeling website https://www.epa.gov/air-emissions-modeling/2014-version-70-technical-support-document-tsd.

For the rest of this document, the platform described is referred to as the “2014 v7.1 platform” or “2014v7.1.”

The 2014v7.1 platform was used to support the 2014 NATA, the focus of which is multipollutant modeling of HAPs and CAPs using CMAQ version 5.2 multipollutant (Appel, 2018). The CMAQ modeling domain includes the lower 48 states and parts of Canada and Mexico. The 2014 NATA also utilizes the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) (EPA, 2018), which is an air dispersion modeling system, for all NEI HAPs (about 130 more than covered by CMAQ) across all 50 states, Puerto Rico and the Virgin Islands. Emissions preparation for AERMOD is discussed elsewhere.

The CMAQ model requires hourly and gridded emissions of chemical species that correspond to CAPs and specific HAPs. The chemical mechanism used by CMAQ for this platform is called Carbon Bond version 6 -CMAQ (CB6-CMAQ) and includes important reactions for simulating ozone formation, nitrogen oxides (NOx) cycling, and formation of secondary aerosol species. It is basically the same as the CB6 used in the 2011v6.3 platform described in (Hildebrandt Ruiz and Yarwood, 2013) except that CB6-CMAQ removes naphthalene from the lumped species group “XYL” and treats it explicitly. In addition, many additional HAPs are included to support the NATA analysis.

The 2014v7.1 platform consists of one 'complete' emissions case: the 2014 base case, i.e., 2014fd_nata_cb6_14j, and two zero-out runs. The purpose of these 2014 cases is to provide year 2014 emissions inputs for multipollutant air quality modeling that includes the HAPs in the 2014 NEI. This platform accounts for atmospheric chemistry and transport within a state of the art photochemical grid model and approximates the contribution of biogenic and fire emissions to air quality concentrations.

In the case abbreviation 2014fd_nata_cb6_14j, 2014 is the year represented by the emissions; the "f" represents the base year platform iteration (the previous platform, which was a 2011-based platform, was "e") and the "d" stands for the fourth set of emissions modeled for a 2014-based modeling platform. Table 1-1 summarizes the emissions cases.

Table 1-1. List of cases in the 2014 Version 7.1 Emissions Modeling Platform

Case Name	Abbreviation	Description
2014 base case	2014fd_nata_cb6_14j	2014 case relevant for air quality model evaluation purposes. Uses 2014NEIv2 along with some other inventory data, with hourly 2014 continuous emissions monitoring system (CEMS) data for electrical generating units (EGUs), hourly onroad mobile emissions, and 2014 day-specific wild and prescribed fire data.

When CMAQ is run, has the ability to compute biogenic emissions during the run, and it has options to take multiple sets of point source fire emission files as input. These features were used in this study to quantify the impacts of biogenic and fire emissions by running CMAQ three times:

1) The base case run used all fire and anthropogenic emissions from the 2014fd_nata case and had the option to generate biogenic emissions turned on.
2) The biogenic zero out run used all fire and anthropogenic emissions from the 2014fd_nata case but had the option to generate biogenic emissions turned off.
3) The fire zero out run used all anthropogenic emissions from the 2014fd_nata case and had the option to generate biogenic emissions turned on, but it excluded the input files for wild, prescribed, and anthropogenic fires.

The emissions data in the 2014v7.1 platform are primarily based on the 2014NEIv2 for point sources, nonpoint sources, commercial marine vessels (CMV), onroad and nonroad mobile sources, and fires. Some platform categories are based on more disaggregated data than are made available in the 2014NEI. For example, in NATA, onroad mobile source emissions are representated as hourly emissions by vehicle type, fuel type process and road type. In contrast, the onroad emissions in the 2014NEIare developed using the same inputs, but those emissions are aggregated to vehicle type/fuel type totals and annual temporal resolution. In addition, emissions from Canada and Mexico are used for the platform but are not part of the NEI. Temporal, spatial and other changes in emissions between the 2014NEI and the emissions input into the platform are described in Section 2 of this TSD.

The primary emissions modeling tool used to create the air quality model-ready emissions was the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system (http://www.smoke-model.org/), version 4.5 (SMOKE 4.5) with some updates. Emissions files were created for a 12-km national grid, "12US2," that includes all of the contiguous states and parts of Canada and Mexico as shown in Figure 3-1. Electronic copies of the data used as input to SMOKE for the 2014 Platform are available from the EPA Air Emissions Modeling website, https://www.epa.gov/air-emissions-modeling/2014-version-7-air-emissions-modeling-platforms, under the 2014v7.1 section.

The gridded meteorological model used to provide input data for the emissions modeling was developed using the Weather Research and Forecasting Model (WRF, http://wrf-model.org) version 3.8, Advanced Research WRF core (Skamarock, et al., 2008). The WRF Model is a mesoscale numerical weather prediction system developed for both operational forecasting and atmospheric research applications. The WRF was run for 2014 over a domain covering the continental U.S. at a 12km resolution with 35 vertical layers. The data output from WRF were collapsed to 25 layers prior to running the emissions and air quality models. The run for this platform included high resolution sea surface temperature data from the Group for High Resolution Sea Surface Temperature (GHRSST) (see https://www.ghrsst.org/) and is given the EPA meteorological case label "14j." The full case name includes this abbreviation following the emissions portion of the case name to fully specify the name of the case as "2014fd_nata_cb6_14j."

This document contains five sections and several appendices. Section 2 describes the 2014 inventories input to SMOKE. Section 3 describes the emissions modeling and the ancillary files used with the emission inventories. Data summaries are provided in Section 4. Section 5 provides references. The Appendices provide additional details about specific technical methods or data.

2 2014 Emission Inventories and Approaches

This section describes the 2014 emissions data that make up the 2014 platform. The starting point for the 2014 stationary source emission inputs is the 2014NEIv2 or more detailed temporal/spatial resolution data used to build the NEI, with adjustments made to support modeling as described here. Documentation for the 2014NEIv2, including a TSD, is available at https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-documentation.

The NEI data for CAPs are largely compiled from data submitted by state, local and tribal (S/L/T) air agencies. HAP emissions data are also from the S/L/T agencies, but are often augmented by the EPA because they are voluntarily submitted. The EPA uses the Emissions Inventory System (EIS) to compile the NEI. The EIS includes hundreds of automated quality assurance (QA) checks to help improve data quality, and also supports tracking release point (e.g., stack) coordinates separately from facility coordinates. The EPA collaborated extensively with S/L/T agencies to ensure a high quality of data in the 2014NEI. A targeted review of the data was conducted between the 2014NEIv1 and 2014NEIv2 using initial risk projections to identify potential outliers as a part of the NATA review process.

Onroad and nonroad mobile source emissions in the 2014NEIv2 were developed using the Motor Vehicle Emission Simulator (MOVES). MOVES2014a was used with S/L inputs, where provided, in combination with EPA-generated default data. The 2014 NEI is the first use of MOVES for nonroad emissions. MOVES2014a replaces the National Mobile Inventory Model (NMIM) as the interface for using the NONROAD2008 model, ensuring that the gasoline fuels used for nonroad equipment are consistent with those used for onroad vehicles and using newer data to estimate the HAPs than had been used in NMIM.

The 2014 NEI includes five data categories: point sources, nonpoint (formerly called "stationary area") sources, nonroad mobile sources, onroad mobile sources, and events consisting of fires. The NEI uses 60 sectors to further describe the emissions, with an additional biogenic sector generated from a summation of the gridded, hourly 2014 biogenic data used in the emissions modeling platform. In addition to the NEI data, emissions from the Canadian and Mexican inventories and several other non-NEI data sources are included in the 2014 emissions modeling platform. Improved emission approaches and/or updated emission factors were used in the 2014 NEI for many sectors including nonroad, commercial marine vessels, residential wood combustion, oil and gas, agricultural ammonia (including both livestock and fertilizer sources), and fires (including wild, prescribed and agricultural burning).

Other than the use of emissions for areas outside the U.S., there are no significant differences in the emissions used in the 2014 v7.1 platform and the 2014NEIv2. As in other modeling platforms there are typically small differences resulting from the use of CEMS data for EGUs, exclusion of point emissions without geographic coordinates (i.e., temporary asphalt plants) and exclusion of some tribal-submitted sectors that are potentially double counted with county-level estimates. There are several non-emissions differences for this platform. S/L/Ts changed some point source release parameter locations and stack parameters in EIS after the modeling file was generated but prior to the 2014NEIv2 public release. There were also differences in the characterization of sources such as the treatment of the Category 3 commercial marine vessel emissions as point sources and all agricultural fires as day-specific. In addition, the modeling platform uses more temporally-resolved emissions than the NEI for many sectors.

For the purposes of preparing the air quality model-ready emissions, the 2014NEI was split into finer-grained sectors used for emissions modeling. The significance of an emissions modeling or "platform sector" is that the data are run through the SMOKE programs independently from the other sectors except for the final merge (Mrggrid). The final merge program combines the sector-specific gridded, speciated, hourly emissions together to create CMAQ-ready emission inputs.

Table 2-1 presents the sectors in the 2014 platform and how they generally relate to the 2014NEIv2 as a starting point. As discussed in greater detail in Table 2-2, the data in some of these sectors were modified from the 2014NEI emissions for the 2014 modeling platform. The platform sector abbreviations are provided in italics. These abbreviations are used in the SMOKE modeling scripts, inventory file names, and throughout the remainder of this document.

Table 2-1. Platform sectors for the 2014v7.1 emissions modeling platform

Platform Sector: ***abbreviation***	**NEI Data Category**	**Description and resolution of the data input to SMOKE**
EGU units: ***ptegu***	Point	2014NEIv2 point source EGUs. The 2014 emissions are replaced with hourly 2014 CEMS values for NO_X and SO_2 for any units that are matched to the NEI, and other pollutants for matched units are scaled from the 2014NEIv2 using CEMS heat input. Emissions for all sources not matched to CEMS data come from the 2014NEIv2. Annual resolution for sources not matched to CEMS data, hourly for CEMS sources.
Point source oil and gas: ***pt_oilgas***	Point	2014NEIv2 point sources that include oil and gas production and related processes based on facilities with the following NAICS: 2111, 21111, 211111, 211112 (Oil and Gas Extraction); 213111 (Drilling Oil and Gas Wells); 213112 (Support Activities for Oil and Gas Operations); 2212, 22121, 221210 (Natural Gas Distribution); 48611, 486110 (Pipeline Transportation of Crude Oil); 4862, 48621, 486210 (Pipeline Transportation of Natural Gas). Includes offshore oil and gas platforms in the Gulf of Mexico (FIPs=85). Annual resolution.
Remaining non-EGU point: ***ptnonipm***	Point	All 2014NEIv2 point source records not matched to the ptegu or pt_oilgas sectors. Includes all aircraft and airport ground support emissions and some rail yard emissions. Annual resolution.
Agricultural: ***ag***	Nonpoint	Nonpoint livestock and fertilizer application emissions. Livestock includes ammonia and other pollutants (except PM2.5). Fertilizer includes only ammonia. County and daily resolution for livestock; county and annual resolution for fertilizer.

Platform Sector: *abbreviation*	NEI Data Category	Description and resolution of the data input to SMOKE
Agricultural fires with point resolution: *ptagfire*	Nonpoint	2014NEIv2 agricultural fire sources that were developed by EPA as point sources with day-specific emissions or reported by S/L/T as county level emissions and were apportioned to point sources using spatial surrogates (geographic coordinates of point sources are based on the center of the grid cell). They are in the nonpoint NEI data category, but in the platform, they are treated as point sources.
Area fugitive dust: *afdust*	Nonpoint	PM_{10} and $PM_{2.5}$ fugitive dust sources from the 2014NEIv2 nonpoint inventory; including building construction, road construction, agricultural dust, and road dust. The NEI emissions are reduced during modeling according to a transport fraction and a meteorology-based (precipitation and snow/ice cover) zero-out. County and annual resolution.
Biogenic: *beis*	Nonpoint	Year 2014, hour-specific, grid cell-specific emissions generated from the BEIS3.61 model within SMOKE, including emissions in Canada and Mexico using BELD v4.1 land use data (slightly updated from the BELDv4.1 used in 2014v7.0)
Category 1, 2 CMV: *cmv_c1c2*	Nonpoint	Category 1 (C1) and category 2 (C2) commercial marine vessel (cmv) emissions sources from the 2014NEIv2 nonpoint inventory, except that it does not use emissions from the 2014 NEI in Federal Waters. County and annual resolution; see othpt sector for all non-U.S. C3 emissions.
Category 3 CMV: *cmv_c3*	Nonpoint	Category 3 (C3) cmv emissions converted to point sources based on the center of the grid cells
locomotives: *rail*	Nonpoint	Rail locomotives emissions from the 2014NEIv2. County and annual resolution.
Remaining nonpoint: *nonpt*	Nonpoint	2014NEIv2 nonpoint sources not included in other platform sectors, with adjustments to remove chromium from fugitive dust categories (paved and unpaved roads, construction and crops and livestock). County and annual resolution.
Nonpoint source oil and gas: *np_oilgas*	Nonpoint	2014NEIv2 nonpoint sources from oil and gas-related processes. County and annual resolution.
Residential Wood Combustion: *rwc*	Nonpoint	2014NEIv2 nonpoint sources from residential wood combustion (RWC) processes. County and annual resolution.
Nonroad: *nonroad*	Nonroad	2014NEIv2 nonroad equipment emissions developed with the MOVES2014a using NONROAD2008 version NR08a and new HAP emission factors than had been used in the 2011NEI. MOVES was used for all states except California, which submitted their own emissions. County and monthly resolution.
Onroad: *onroad*	Onroad	2014 onroad mobile source gasoline and diesel vehicles from moving and non-moving vehicles that drive on roads, along with vehicle refueling. Includes the following modes: exhaust, extended idle, auxiliary power units, evaporative, permeation, refueling, and brake and tire wear. For all states except California, developed using winter and summer MOVES emissions tables produced by MOVES2014a.
Onroad California: *onroad_ca_adj*	Onroad	2014 California-provided CAP and metal HAP onroad mobile source gasoline and diesel vehicles submitted to the NEI, gridded and temporalized using MOVES2014a. Volatile organic compound (VOC) HAP emissions derived from California-provided VOC emissions and MOVES-based speciation.

Platform Sector: *abbreviation*	NEI Data Category	Description and resolution of the data input to SMOKE
Point source fires- ***ptfire***	Events	Point source day-specific wildfires and prescribed fires for 2014 computed using SMARTFIRE2 for both flaming and smoldering processes (i.e., SCCs 281XXXX002). Smoldering is forced into layer 1 (by adjusting heat flux).
Non-US. fires: ***ptfire_othna***	N/A	Point source day-specific wildfires and prescribed fires for 2014 provided by Environment Canada with data for missing months and for Mexico filled in using fires from the Fire INventory (FINN) from National Center for Atmospheric Research (NCAR) fires (NCAR, 2016 and Wiedinmyer, C., 2011).
Other dust sources not from the 2014 NEI: ***othafdust***	N/A	Fugitive dust sources from Canada's 2013 inventory. A transport fraction adjustment is applied along with a meteorology-based (precipitation and snow/ice cover) zero-out. County and annual resolution.
Other point sources not from the 2014 NEI: ***othpt***	N/A	Point sources from Canada's 2013 inventory and Mexico's 2014 inventory, annual resolution. Also includes all non-U.S. non-Canada C3 CMV
Other non-NEI nonpoint and nonroad: ***othar***	N/A	Year 2013 Canada (province or sub-province resolution) emissions: monthly for agricultural ammonia, and nonroad sources; annual for rail, CMV and other nonpoint Canada sectors. Year 2014 Mexico (municipio resolution): annual nonpoint and nonroad mobile inventories.
Other non-NEI onroad sources: ***onroad_can***	N/A	Monthly year 2013 Canada (province resolution or sub-province resolution, depending on the province) onroad mobile inventory.
Other non-NEI onroad sources: ***onroad_mex***	N/A	Monthly year 2014 Mexico (municipio resolution) onroad mobile inventory.

Table 2-2 provides a brief by-sector overview of the most significant differences between the 2014v7.1 emissions platform and the 2014v7.0 platform methodologies including major NEI changes. The specific by-sector updates to the 2014v7.1 platform are described in greater detail later in this section under each by-sector subsection.

Table 2-2. Summary of methodological differences between 2014v7.1 platform and 2014v7.0 emissions by sector

Platform Sector	Summary of Significant Methodological Differences of 2014v7.1 Platform vs. v7.0 Platform
EGU units: ***ptegu***	-Updated version of the 2014 CEMS data (April 2018) was used. Also, additional matches of CEMS units to NEI units allowed increased use of 2014 CEMS data. - Municipal waste combustors and cogeneration units in this sector were temporalized using a uniform temporal profile as opposed to a regional average profile based on units with CEMS data.
Point source oil and gas: ***pt_oilgas***	-Added offshore platforms (FIPS85) to this sector; they were previously put in the othpt sector. Offshore oil and gas emissions in v2 completely replace the offshore oil and gas emissions from v1 which were carried forward from 2011. -Put the natural gas distribution NAICS back into this sector (in v7.0 it was put into ptnonipm but before that, it had been put into pt_oilgas -Because this sector is a "no-integrate" sector, HAPs are no longer produced via speciation for the offshore oil and gas sources, which have no HAPs in the 2014 NEI.
Agricultural: ***ag***	-Includes VOC and HAP VOC emissions from livestock which were estimated for the 2014NEIv2 using speciation profiles. In v7.0 and previous platforms, this sector contained only ammonia.
Agriculture Burning: ***ptagfire***	-All agricultural burning emissions were put into this sector. In v7.0, only the EPA-estimated day-specific point emissions were put into this sector; in v7.1 both EPA and the SLT reported emissions are put into this sector. SLT-reported emissions were converted to day specific emissions from county annual. -Speciation is "integrated" meaning that the speciation profiles are for the non-HAP portion of the VOC and are normalized, and HAPs in the inventory are used for speciation, conserving VOC mass (see Section 3.2.1)
Point source fires: ***ptfire***	-Contains both flaming and smoldering. In v7.0, these were separated into two different sectors: 1) Flaming combustion emissions and 2) Smoldering emissions during simultaneously with flaming and residual smoldering combustion phases. Flaming and smoldering proportions from the NEI were adjusted for the platform such that the resulting smoldering SCC in the platform is considered residual smoldering and is forced into layer 1. -Speciation is integrated (see Section 3.2.1) - New emissions for Georgia were submitted that correct the HAPs (use revised HAP EFs computed based on ratio of HAP to VOC)
Nonroad: ***Nonroad***	-Temporal profiles for several nonroad equipment types were updated -Removed oil field equipment emissions, SCCs ending in -10010, because these double count other oil/gas emissions. -Fixed water surrogate in the few counties where surrogate was missing.
Onroad sector: ***Onroad***	-Inventory changes due to updated EPA default inputs to MOVES for vehicle population and age distributions, along with changes to inputs submitted by SLT. -Revised hoteling emissions in some counties based on a comparison of hours from the model and maximum hours computed based on number of parking spaces at truck stops within county. -New county-specific temporal and speed profiles based on Coordinating Research Council (CRC) A-100 study; updated hoteling profiles using the updated temporal profiles information. -Updated spatial surrogates to use surrogates that are not specific to urban and rural road types.
Category 1, 2 CMV: ***cmv_c1c2***	-In v7.0 c1/c2 was in same sector as c3, but in v7.1 was separated into its own sector to allow c3 to be modeled as point sources with plume rise. - New spatial surrogates for both port and underway emissions.

Platform Sector	Summary of Significant Methodological Differences of 2014v7.1 Platform vs. v7.0 Platform
Category 3 CMV: ***cmv_c3***	-In v7.0 c3 was in same sector as c1/c2, but in v7.1 was separated into its own sector to allow c3 to be modeled as point sources with plume rise. - Includes c3 in Federal waters (FIPS85) -estimated diesel PM for c3 in FIPS85
Other point sources not from the 2014 NEI: ***Othpt***	-Offshore (FIPS85) oil and gas platforms removed and had previously been included in pt_oilgas. -2013 Canada emissions replaced 2010 data.
Other dust sources not from the 2014 NEI: ***othafdust***	-2013 Canada emissions replaced 2010 data; Canada provided new spatial surrogates.
Other non-NEI nonpoint and nonroad: ***othar***	-2013 Canada emissions replaced 2010 data for nonpoint and 2010-projected-to-2014 for nonroad; Canada provided new spatial surrogates.
Other non-NEI sources: ***onroad_can***	-2013 Canada emissions replaced 2010 data for nonpoint and 2010-projected-to-2014; Canada provided new spatial surrogates.
Other non-NEI sources: ***onroad_mex***	-updated population spatial surrogate used based on 2015 population.

The emission inventories in SMOKE input formats for the 2014 base case are available from the EPA's Air Emissions Modeling website for the version 7.1 platform: https://www.epa.gov/air-emissions-modeling/2014-version-7-air-emissions-modeling-platforms, under the section entitled "2014v7.1 Platform." The 2014v7.1 "README" file indicates the particular zipped files associated with each platform sector. A number of reports (i.e., summaries) are available with the data files for the 2014v7.1 platform. The types of reports include state summaries of inventory pollutants and model species by modeling platform sector and county annual totals by modeling platform sector.

The remainder of Section 2 provides details about the data contained in each of the 2014 platform sectors. Different levels of detail are provided for different sectors depending on the availability of reference information for the data, the degree of changes or manipulation of the data needed to prepare it for input to SMOKE, and whether the 2014 platform emissions are significantly different from the 2014NEIv2.

2.1 2014 NEI point sources (ptegu, pt_oilgas and ptnonipm)

Point sources are sources of emissions for which specific geographic coordinates (e.g., latitude/longitude) are specified, as in the case of an individual facility. A facility may have multiple emission release points that may be characterized as units such as boilers, reactors, spray booths, kilns, etc. A unit may have multiple processes (e.g., a boiler that sometimes burns residual oil and sometimes burns natural gas). This section describes NEI point sources within the contiguous U.S. and the offshore oil platforms which are processed by SMOKE as point source inventories, as described in Section 2.5.1. A comprehensive description of how EGU emissions were characterized and estimated in the 2014 NEI is located in Section 3.4 in the 2014NEIv2 TSD.

The point source file used for the modeling platform is exported from EIS into the Flat File 2010 (FF10) format that is compatible with SMOKE (see https://www.cmascenter.org/smoke/documentation/4.0/html/ch08s02s08.html).

For the v7.1 platform, the export of point source emissions, including stack parameters and locations from EIS, was done on November 1, 2017. A few emissions changes were made to the 2014NEIv2 prior to its release on EPA's website in February 2018. Most emissions changes were incorporated into the FF10 used for the NATA modeling; those that were not were insignificant or were for pollutants not used in the platform:

- Change for primary PM2.5 and PM10 from 0.754 tons to 0.846 tons affecting facility 16691911 (SOL 95-18 Wastewater Management Facility) in Wyoming
- Changes to the following pollutants not used in the platform: condensable and filterable portion of particulate matter and the speciated components (EC, OC, SO4, NO3 and PMFINE) affecting facility 16691911 (SOL 95-18 Wastewater Management Facility) in Wyoming and facility 4195111 (Covanta Alexandria/Arlington Inc) in Virginia.

There were also facility inventory (e.g., geographic coordinates, FIPS and release parameters) changes made in the EIS after the modeling file was generated. These changes are reflected in the summaries of 2014NEIv2 on EPA's website. Facility ID and FIPs changes will cause differences in facility or county summaries between the modeling file and 2014NEIv2.

Table 2-3. Point inventory differences between the Modeling flat file and 2014NEIv2

Facility Identifier Changes	
Alabama	Facility 17057711 (Integrity Cabinets) has two HAPs split between this ID and 17133511 in the FF10, but all emissions are under 17057711 in the NEI. Same total emissions.
Minnesota	Geringhoff Manufacturing has ID 17066711 in the FF10, and 17903811 in the NEI.
Ohio	TRINITY HIGHWAY PRODUCTS LLC has two HAPs under ID 8102011 in the FF10; entire facility is ID 16535611 in the NEI; ID 8102011 is an alternate ID for this facility in EIS. WHEMCO - OHIO FOUNDRY INC has HAPs under alternate ID 8103111 in EMF; entire facility is facility_id 16806011 in the NEI; ID 8103111 is an alternate ID for this facility in the NEI. Facility 14756011 (Gerken Materials Inc) has FIPS 39069 in the FF10, 39043 in the NEI.
FIPS changes	
Louisiana	Facility 8024611 (Noranda Alumina LLC) has FIPS 22095 in the FF10, 22093 in the NEI.
Minnesota	Facility 6384211 (Viking Gas Transmission - Cushing) has FIPS 27097 in the FF10, 27153 in the NEI. Facility 9496511 (University of MN - Landscape Arboretum) has FIPS 27053 in the FF10, 27019 in the NEI. Facility 6455811 (Hardrives Inc - Plant 701) has FIPS 27053 in the FF10, 27145 in the NEI. Facility 6951111 (Brown-Wilbert Vault Co - Lakeville) has FIPS 27039 in the FF10, 27139 in the NEI. Facility 7038911 (Northern Improvement Co - Nonmetallic) has FIPS 27027 in the FF10, 27021 in the NEI. Facility 13596111 (Cannon Falls Energy Center) has FIPS 27037 in the FF10, 27049 in the NEI. Facility 17095711 (Two Harbors Birch Bark Processing & Pellet Plant) has FIPS 27137 in the FF10, 27075 in the NEI.
Ohio	Facility 14756011 (Gerken Materials Inc) has FIPS 39069 in the FF10, 39043 in the NEI.
Utah	Facility 6432511 (Northwest Pipeline GP- Moab Compressor Station) has FIPS 49037 in the FF10, 49019 in the NEI. Facility 8178511 (Chevron Products Co - Salt Lake Refinery) has FIPS 49035 in EMF, 49011 in the NEI.
Virginia	Facility 6683711 (CHURCH & DWIGHT CO INC) has FIPS 51570 in EMF, 51041 in the NEI.

Release Point Changes	S/L/T made facility inventory changes after the SMOKE FF10 was produced due to the submittal of the year 2016 emissions inventory. These differences were not quantified.

As in the 2014v7.0 platform we incorporated all changes to release parameters that would occur in SMOKE as a result of missing values or values outside SMOKE internally set ranges in the FF10 file prior to SMOKE run. This is done for two reasons: 1) to provide better transparency in the FF10 files with respect to the data used in the model, and 2) to ensure that emission inputs are consistent across CMAQ and AERMOD models since both use the FF10 as the starting point. Because SMOKE uses metric units (i.e., m and K) for defaults, these are converted to the English units (ft and F) as specified by the FF10 file format. Out-of-range criteria were changed from v7.0 to be consistent with the EIS quality assurance checks (as opposed to the default ranges in SMOKE). Other than velocities, for which the EIS range for flowrate and velocity were inconsistent, no parameters in the NEI had to be changed due to not falling within the EIS range. Out of range values existed because the flow range checks in EIS allow some velocities to be above or below the range and we ran the velocity check after computing the missing flowrates.

Table 2-4 through Table 2-6 show conditions for which changes are made to the NEI values in the modeling file. The "Records changed" column indicates how many records were changed and provide the keywords used in the FF10 that indicate that a release parameter was changed and the situation. Table 2-7 describes the comment incorporated into the SMOKE made for each change. Even though SMOKE does not use the fugitive release point parameters for CMAQ, they are included in the table for completeness.

Table 2-4. Release parameter changes to the SMOKE Modeling flat file for point sources-For point sources with stack releases (ERPtype NOT equal to "1")

Field	Existing value	New value	Conditions/notes	Records changed
stkhgt	missing	Use SMOKE defaults		None
stkdiam	missing	Use SMOKE defaults		None
stkvel	missing	calculate from stkflow and stkdiam if not missing; otherwise use SMOKE defaults	vel = 4*stkflow/(pi*stkdiam^2) If the flow and diam are missing such that you cannot compute, then use new value based pstk or global defaults.	1,473,185 No pstk values used *ERPVelCompute*
stktemp	missing	Use SMOKE defaults		None
stkhgt	Outside EIS range	use minimum value or maximum value in feet	Less than 1 ft (0.3048 m) or greater than 1300 ft (396 m)	None
stkdiam	Outside EIS range	use minimum value or maximum value in ft	Less than 0.001 ft (0.0003048 m) or greater than 300 ft (91.4 m)	None
stkvel	Outside EIS range	use minimum value or maximum value in ft/s	Less than 0.001ft/s (0.0003048 m/s) or greater than 1000 ft/s (304.8 m/s)	Below min: 18,817 Above max: 11,742 *ERPVelRange*

Field	Existing value	New value	Conditions/notes	Records changed
stktemp	Outside SMOKE tolerance	use minimum value or maximum value in F	Less than -30 F (-34.4 C or 248.15 K) or greater than 4000 F (2204.4 C or 2477.6 K)	None

Table 2-5. Release parameter changes to the SMOKE Modeling flat file for point sources-For Fugitive Release Points

Field	Existing value	New value	Conditions/notes	Records changed
fug_width_ydim	missing	32.808 ft		3,856,867; *ERPFugMissing*
fug_length_xdim	missing	32.808 ft		3,888,847; *ERPFugMissing*
fug_angle	missing	0		3,932,478; *ERPFugMissing*
fug_height	missing	10 ft	fug_width_ydim and fug_length_xdim are missing	3,556,330; *ERPFugMissing*
fug_height	missing	0	WHEN fug_width_ydim and fug_length_xdim are not missing and > 0	12,742 *ERPFugHeight0*

Table 2-6. Release parameter changes to the SMOKE Modeling flat file for point sources-For Coke Ovens, any release point that emits coke oven emissions (pollutant code 140)

Field	Existing value	New value	Conditions/notes	Records changed
Stkhgt	< 126 ft	126 ft	erptype NOT = "1"	2159; *ERPCokeoven126*
fug_height	< 126 ft	126 ft	erptype = "1"	2829; *ERPCokeoven126*
fug_length_xdim	< 50 ft	50 ft	erptype = "1"	2767; *ERPCokeovenFug50*
fug_width_ydim	< 50 ft	50 ft	erptype = "1"	2767; *ERPCokeovenFug50*

Table 2-7. Description of Comments added to SMOKE Modeling flat file used when defaulting or changing values from the NEI

Comment	Description
ERPHtRange	height in the inventory was out of range
ERPDiamRange	diameter in the inventory was out of range
ERPVelRange	velocity in the inventory or velocity calculated from the flowrate in the inventory was out of range
ERPTempRange	Temperature in the inventory was out of range
ERPFugMissing	fugitive height, length and width are missing or fugitive length and/or width are missing
ERPFugHeight0	fugitive height in the inventory was set to 0 because the width and length were not missing
ERPCokeoven126	fugitive or stack height of release point emitting coke oven emissions was less than 126 ft
ERPCokeovenFug50	fugitive length or width was less than 50 ft.

After implementing the release parameter changes shown in the above tables, the flat file was modified to remove sources without specific locations (i.e., their FIPS code ends in 777). Then the point source FF10 was divided into three NEI-based platform point source sectors: the EGU sector (ptegu), point source oil and gas extraction-related emissions (pt_oilgas), and the remaining non-EGU sector also called the non-IPM (ptnonipm) sector. The split was done at the unit level for ptegu and facility level for pt_oilgas such that a facility may have units and processes in both ptnonipm and ptegu, but cannot be in both pt_oilgas and any other point sector.

The EGU emissions are split out from the other sources to facilitate the use of distinct SMOKE temporal processing and future-year projection techniques. The oil and gas sector emissions (pt_oilgas) were processed separately for summary tracking purposes and distinct future-year projection techniques from the remaining non-EGU emissions (ptnonipm).

The inventory pollutants processed through SMOKE for all point source sectors were: carbon monoxide (CO), NO_X, VOC, sulfur dioxide (SO_2), ammonia (NH_3), particles less than 10 microns in diameter (PM_{10}), and particles less than 2.5 microns in diameter ($PM_{2.5}$), and all of the air toxics listed in Appendix A. The NBAFM species are explicit in the CB6-CMAQ chemical mechanism and are taken from the HAP emissions in the flat file as opposed to using emissions generated through VOC speciation, as is normally done for non-toxics modeling applications such as the 2011v6.3 platform. To prevent double counting of mass, NBAFM species are removed from VOC speciation profiles, thus resulting in speciation profiles that may sum to less than 1. This is called the "no-integrate" VOC speciation case and is discussed in detail in Section 3.2.1.1. The resulting VOC in the modeling system may be higher or lower than the VOC emissions in the NEI; they would only be the same if the HAP inventory and speciation profiles were exactly consistent. For HAPs other than those in NBAFM, there is no concern for double-counting since CMAQ handles these outside the CB6 mechanism.

The ptnonipm and pt_oilgas sector emissions were provided to SMOKE as annual emissions. For those ptegu sources with CEMS data that could be matched to the 2014NEIv2, hourly CEMS NO_X and SO_2 emissions were used rather than the annual total NEI emissions. For all other pollutants at matched units, the annual emissions were used as-is from the NEI, but were allocated to hourly values using heat input from the CEMS data. For the sources in the ptegu sector not matched to CEMS data, daily emissions were created using an approach described in Section 2.1.1. For non-CEMS units other than municipal waste combustors and cogeneration units, IPM region- and pollutant-specific diurnal profiles were applied to create hourly emissions.

2.1.1 EGU sector (ptegu)

The ptegu sector contains emissions from EGUs in the 2014NEIv2 point inventory that could be matched to units found in the National Electric Energy Data System (NEEDS) v5.16 database. The matching was prioritized according to the amount of the emissions produced by the source. It is customary to put these EGUs into separate sectors in the platform to support future year modeling even though future year modeling is not done as part of the 2014 NATA. In the SMOKE point flat file, emission records for sources that have been matched to the NEEDS database have a value filled into the IPM_YN column based on the matches stored within EIS.

Some units in the ptegu sector are matched to CEMS data via ORIS facility codes and boiler ID. For the matched units, SMOKE replaces the 2014 emissions of NO_X and SO_2 with the CEMS emissions, thereby ignoring the annual values specified in the NEI. For other pollutants at matched units, the hourly CEMS heat input data are used to allocate the NEI annual emissions to hourly values. All stack parameters, stack locations, and Source Classification Codes (SCC) for these sources come from the NEI (except those changed as discussed in Table 2-4). Because these attributes are obtained from the NEI, the chemical speciation of VOC and $PM_{2.5}$ for the sources is selected based on the SCC or in some cases, based on unit-specific data. If CEMS data exists for a unit, but the unit is not matched to the NEI, the CEMS data for that unit is not used in the modeling platform. However, if the source exists in the NEI and is not matched to a CEMS unit, the emissions from that source are still modeled using the annual emission value in the NEI temporally allocated to hourly values. The EIS stores many matches from EIS units to the ORIS facility codes and boiler IDs used to reference the CEMS data.

In the SMOKE point flat file, emission records for point sources matched to CEMS data have values filled into the ORIS_FACILITY_CODE and ORIS_BOILER_ID columns. The CEMS data in SMOKE-ready format is available at http://ampd.epa.gov/ampd/ near the bottom of the "Prepackaged Data" tab. Many smaller emitters in the CEMS program are not identified with ORIS facility or boiler IDs that can be matched to the NEI due to inconsistencies in the way a unit is defined between the NEI and CEMS datasets, or due to uncertainties in source identification such as inconsistent plant names in the two data systems. Also, the NEEDS database of units modeled by IPM includes many smaller emitting EGUs that do not have CEMS. Therefore, there will be more units in the NEEDS database than have CEMS data. The temporal allocation of EGU units matched to CEMS is based on the CEMS data, whereas regional profiles are used for most of the remaining units. More detail can be found in Section 3.3.2.

For sources not matched to CEMS data, except for municipal waste combustors (MWC) waste-to-energy and cogeneration units, daily emissions were computed from the NEI annual emissions using average CEMS data profiles specific to fuel type, pollutant[2], and IPM region. To allocate emissions to each hour of the day, diurnal profiles were created using average CEMS data for heat input specific to fuel type and IPM region. See Section 3.5.2 for more details on the temporal allocation approach for ptegu sources. MWC and cogeneration units were specified to use uniform temporal allocation such that the emissions are allocated to constant levels for every hour of the year. These sources do not use hourly CEMs, and instead use a PTDAY file with the same emissions for each day, combined with a uniform hourly temporal profile applied by SMOKE. The different temporal allocation for MWC and cogeneration units from other non-CEMS units is a change from 2014v7.0.

2.1.2 Point source oil and gas sector (pt_oilgas)

The pt_oilgas sector was separated from the ptnonipm sector by selecting sources with specific NAICS codes shown in Table 2-8. This list was modified from the NAICS used in the 2011 platforms in that the 2014v7.0 platform excludes NAICS related to natural gas distribution but v7.1 includes gas distribution. The use of NAICS to separate out the point oil and gas emissions forces all sources within a facility to be in this sector, as opposed to ptegu where sources within a facility can be split between ptnonipm and ptegu sectors.

Table 2-8. Point source oil and gas sector NAICS Codes

NAICS	NAICS description
2111,21111	Oil and Gas Extraction
211111	Crude Petroleum and Natural Gas Extraction
211112	Natural Gas Liquid Extraction
213111	Drilling Oil and Gas Wells
213112	Support Activities for Oil and Gas Operations

[2] The year to day profiles use NOx and SO_2 CEMS for NOx and SO_2, respectively. For all other pollutants, they use heat input CEMS data.

NAICS	NAICS description
2212, 22121, 221210	Natural Gas Distribution
4862,48621,486210	Pipeline Transportation of Natural Gas
48611, 486110	Pipeline Transportation of Crude Oil

The emissions and other source characteristics in the non-Federal waters part of the pt_oilgas sector are submitted by states, while the EPA developed a dataset of nonpoint oil and gas emissions for each county in the U.S. with oil and gas activity that was available for states to use. Nonpoint oil and gas emissions can be found in the np_oilgas sector. More information on the development of the 2014 oil and gas emissions can be found in Section 4.16 of the 2014NEIv2 TSD.

For the 2014NEIv7.1, point emissions from offshore oil platforms located in Federal Waters in the Gulf of Mexico were included in this sector. In 204v7.0 they were put into the othpt sector. The 2014NEIv2 is a complete replacement of the 2014NEIv1 which utilized 2011 emissions. A 2014 inventory was developed by the U.S. Department of the Interior, Bureau of Ocean and Energy Management, Regulation, and Enforcement (BOEM) and is documented at https://www.boem.gov/2014-Gulfwide-Emission-Inventory/. This inventory contains only CAPS, so during speciation (which is "no-integrate") the profiles used in this modeling drop NBAFM. In a future study, HAPs can be generated through speciation if they are absent from the NEI to prevent the loss of NBAFM mass.

2.1.3 Non-IPM sector (ptnonipm)

With minor exceptions, the ptnonipm sector contains the 2014NEIv2 point sources that are not in the ptegu or pt_oilgas sectors. For the most part, the ptnonipm sector reflects the non-EGU sources of the NEI point inventory; however, it is likely that some small low-emitting EGUs not matched to the NEEDS database or to CEMS data are present in the ptnonipm sector.

The ptnonipm sector contains a small amount of fugitive dust PM emissions from vehicular traffic on paved or unpaved roads at industrial facilities, coal handling at coal mines, and grain elevators. Sources with state/county FIPS code ending with "777" are in the 2014NEIv2 but are not included in any modeling sectors. These sources typically represent mobile (i.e., temporary) asphalt plants that are only reported for some states, and are generally in a fixed location for only a part of the year, and are thus difficult to allocate to specific places and days as is needed for modeling. Therefore, these sources are dropped from the point-based sectors in the modeling platform. Select CAP emissions totals by state of the dropped emissions are shown in Table 2-9.

Table 2-9. Summary of point sources with state/county FIPS ending with "777"

State	VOC (TPY)	NO_X (TPY)	$PM_{2.5}$ (TPY)	SO_2 (TPY)	Total HAP (TPY)
Alaska	60	983	66	197	0.001
Colorado	472	3,043	283	319	49.5
Florida	68	107	9	42	2.1
Kansas	76	137	68	75	0.015
Kentucky	82	85	57	15	4.9
Michigan	34	348	91	43	2.1
Minnesota	186	471	109	217	48.7
Nevada	7	4	2	1	0.1

State	VOC (TPY)	NO_X (TPY)	$PM_{2.5}$ (TPY)	SO_2 (TPY)	Total HAP (TPY)
Ohio	257	162	179	77	1.8
Texas	2	1	0.2	1	0.1

2.2 2014 nonpoint sources (afdust, ag, agfire, ptagfire, np_oilgas, rwc, nonpt)

Several modeling platform sectors were created from the 2014NEIv2 nonpoint inventory. This section describes the *stationary* nonpoint sources. Locomotives, C1 and C2 CMV, and C3 CMV are also included the 2014NEIv2 nonpoint data category, but are mobile sources that are described in Sections 2.4.1 and 2.4.2 as the cmv and rail sectors, respectively. The 2014NEIv2 TSD, available from https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-technical-support-document-tsd, includes documentation for the nonpoint sector of the 2014NEIv2.

The nonpoint tribal-submitted emissions are dropped during spatial processing with SMOKE due to the configuration of the spatial surrogates. Part of the reason for this is to prevent possible double-counting with county-level emissions and also because spatial surrogates for tribal data are not currently available. These omissions are not expected to have an impact on the results of the air quality modeling at the 12-km resolution used for this platform.

The following subsections describe how the sources in the 2014NEIv2 nonpoint inventory were separated into 2014 modeling platform sectors, along with any data that were updated replaced with non-NEI data.

2.2.1 Area fugitive dust sector (afdust)

The area-source fugitive dust (afdust) sector contains PM_{10} and $PM_{2.5}$ emission estimates for nonpoint SCCs identified by EPA as dust sources. Categories included in the afdust sector are paved roads, unpaved roads and airstrips, construction (residential, industrial, road and total), agriculture production, and mining and quarrying. It does not include fugitive dust from grain elevators, coal handling at coal mines, or vehicular traffic on paved or unpaved roads at industrial facilities because these are treated as point sources so they are properly located.

The afdust sector is separated from other nonpoint sectors to allow for the application of a "transport fraction," and meteorological/precipitation reductions. These adjustments are applied using a script that applies land use-based gridded transport fractions, followed by another script that zeroes out emissions for days on which at least 0.01 inches of precipitation occurs or there is snow cover on the ground. The land use data used to reduce the NEI emissions determines the amount of emissions that are subject to transport. This methodology is discussed in Pouliot, et al., 2010, and in "Fugitive Dust Modeling for the 2008 Emissions Modeling Platform" (Adelman, 2012). Both the transport fraction and meteorological adjustments are based on the gridded resolution of the platform (e.g., 12km grid cells); therefore, different emissions will result if the process were applied to different grid resolutions. A limitation of the transport fraction approach is the lack of monthly variability that would be expected with seasonal changes in vegetative cover. While wind speed and direction are not accounted for in the emissions processing, the hourly variability due to soil moisture, snow cover and precipitation is accounted for in the subsequent meteorological adjustment.

The sources in the afdust sector are for SCCs and pollutant codes (i.e., PM_{10} and $PM_{2.5}$) considered to be "fugitive" dust sources. These SCCs are provided in Table 2-10. Table 2-11 shows the SCCs that would have also been included in this sector if they had emissions in the 2014 NEI.

Table 2-10. SCCs in the afdust platform sector for NEI2014v2; nonzero emissions

SCC	SCC Description
2294000000	Mobile Sources; Paved Roads; All Paved Roads; Total: Fugitives
2294000002	Mobile Sources; Paved Roads; All Paved Roads; Total: Sanding/Salting - Fugitives
2296000000	Mobile Sources; Unpaved Roads; All Unpaved Roads; Total: Fugitives
2311000000	Industrial Processes; Construction: SIC 15 - 17;All Processes; Total
2311010000	Industrial Processes; Construction: SIC 15 - 17;Residential;Total
2311010070	Industrial Processes; Construction: SIC 15 - 17;Residential;Vehicle Traffic
2311020000	Industrial Processes; Construction: SIC 15 - 17;Industrial/Commercial/Institutional; Total
2311030000	Industrial Processes; Construction: SIC 15 - 17;Road Construction; Total
2325000000	Industrial Processes;Mining and Quarrying: SIC 14;All Processes;Total
2325060000	Industrial Processes;Mining and Quarrying: SIC 10;Lead Ore Mining and Milling;Total
2801000003	Miscellaneous Area Sources;Agriculture Production - Crops;Agriculture - Crops;Tilling
2801000005	Miscellaneous Area Sources;Agriculture Production - Crops;Agriculture - Crops;Harvesting
2801000007	Miscellaneous Area Sources;Agriculture Production - Crops;Agriculture - Crops;Loading
2801000008	Miscellaneous Area Sources;Agriculture Production - Crops;Agriculture - Crops;Transport
2805001000	Miscellaneous Area Sources; Agriculture Production - Livestock; Beef cattle - finishing operations on feedlots (drylots); Dust Kicked-up by Hooves (use 28-05-020, -001, -002, or -003 for Waste
2805001100	Miscellaneous Area Sources;Agriculture Production - Livestock;Beef cattle - finishing operations on feedlots (drylots);Confinement
2805001300	Miscellaneous Area Sources;Agriculture Production - Livestock;Beef cattle - finishing operations on feedlots (drylots);Land application of manure
2805002000	Miscellaneous Area Sources;Agriculture Production - Livestock;Beef cattle production composite;Not Elsewhere Classified
2805003100	Miscellaneous Area Sources;Agriculture Production - Livestock;Beef cattle - finishing operations on pasture/range;Confinement
2805007100	Miscellaneous Area Sources;Agriculture Production - Livestock;Poultry production - layers with dry manure management systems;Confinement
2805009100	Miscellaneous Area Sources;Agriculture Production - Livestock;Poultry production - broilers;Confinement
2805010100	Miscellaneous Area Sources;Agriculture Production - Livestock;Poultry production - turkeys;Confinement
2805018000	Miscellaneous Area Sources;Agriculture Production - Livestock;Dairy cattle composite;Not Elsewhere Classified
2805020002	Miscellaneous Area Sources;Agriculture Production - Livestock;Cattle and Calves Waste Emissions;Beef Cows
2805023100	Miscellaneous Area Sources;Agriculture Production - Livestock;Dairy cattle - drylot/pasture dairy;Confinement

SCC	SCC Description
2805030000	Miscellaneous Area Sources;Agriculture Production - Livestock;Poultry Waste Emissions;Not Elsewhere Classified (see also 28-05-007, -008, -009)
2805030007	Miscellaneous Area Sources;Agriculture Production - Livestock;Poultry Waste Emissions;Ducks
2805030008	Miscellaneous Area Sources;Agriculture Production - Livestock;Poultry Waste Emissions;Geese
2805035000	Miscellaneous Area Sources;Agriculture Production - Livestock;Horses and Ponies Waste Emissions;Not Elsewhere Classified
2805039100	Miscellaneous Area Sources;Agriculture Production - Livestock;Swine production - operations with lagoons (unspecified animal age);Confinement
2805040000	Miscellaneous Area Sources;Agriculture Production - Livestock;Sheep and Lambs Waste Emissions;Total
2805045000	Miscellaneous Area Sources;Agriculture Production - Livestock;Goats Waste Emissions;Not Elsewhere Classified
2805047100	Miscellaneous Area Sources;Agriculture Production - Livestock;Swine production - deep-pit house operations (unspecified animal age);Confinement
2805053100	Miscellaneous Area Sources;Agriculture Production - Livestock;Swine production - outdoor operations (unspecified animal age);Confinement

Table 2-11. SCCs in the afdust platform sector for NEI2014v2; zero emissions

SCC	SCC Description
2275085000	Mobile Sources; Aircraft; Unpaved Airstrips; Total
2801000000	Miscellaneous Area Sources; Agriculture Production - Crops; Agriculture - Crops; Total
2805001200	Miscellaneous Area Sources; Agriculture Production - Livestock; Beef cattle - finishing operations on feedlots (drylots); Manure handling and storage
2805007300	Miscellaneous Area Sources; Agriculture Production - Livestock; Poultry production - layers with dry manure management systems; Land application of manure
2805008100	Miscellaneous Area Sources; Agriculture Production - Livestock; Poultry production - layers with wet manure management systems; Confinement
2805008200	Miscellaneous Area Sources; Agriculture Production - Livestock; Poultry production - layers with wet manure management systems; Manure handling and storage
2805008300	Miscellaneous Area Sources; Agriculture Production - Livestock; Poultry production - layers with wet manure management systems; Land application of manure
2805009200	Miscellaneous Area Sources; Agriculture Production - Livestock; Poultry production - broilers; Manure handling and storage
2805009300	Miscellaneous Area Sources; Agriculture Production - Livestock; Poultry production - broilers; Land application of manure
2805010200	Miscellaneous Area Sources; Agriculture Production - Livestock; Poultry production - turkeys; Manure handling and storage
2805010300	Miscellaneous Area Sources; Agriculture Production - Livestock; Poultry production - turkeys; Land application of manure
2805019100	Miscellaneous Area Sources; Agriculture Production - Livestock; Dairy cattle - flush dairy; Confinement
2805019200	Miscellaneous Area Sources; Agriculture Production - Livestock; Dairy cattle - flush dairy; Manure handling and storage
2805019300	Miscellaneous Area Sources; Agriculture Production - Livestock; Dairy cattle - flush dairy; Land application of manure

SCC	SCC Description
2805021100	Miscellaneous Area Sources; Agriculture Production - Livestock; Dairy cattle - scrape dairy; Confinement
2805021200	Miscellaneous Area Sources; Agriculture Production - Livestock; Dairy cattle - scrape dairy; Manure handling and storage
2805021300	Miscellaneous Area Sources; Agriculture Production - Livestock; Dairy cattle - scrape dairy; Land application of manure
2805022100	Miscellaneous Area Sources; Agriculture Production - Livestock; Dairy cattle - deep pit dairy; Confinement
2805022200	Miscellaneous Area Sources; Agriculture Production - Livestock; Dairy cattle - deep pit dairy; Manure handling and storage
2805022300	Miscellaneous Area Sources; Agriculture Production - Livestock; Dairy cattle - deep pit dairy; Land application of manure
2805023200	Miscellaneous Area Sources; Agriculture Production - Livestock; Dairy cattle - drylot/pasture dairy; Manure handling and storage
2805023300	Miscellaneous Area Sources; Agriculture Production - Livestock; Dairy cattle - drylot/pasture dairy; Land application of manure
2805025000	Miscellaneous Area Sources; Agriculture Production - Livestock; Swine production composite; Not Elsewhere Classified (see also 28-05-039, -047, -053)
2805039200	Miscellaneous Area Sources; Agriculture Production - Livestock; Swine production - operations with lagoons (unspecified animal age); Manure handling and storage
2805039300	Miscellaneous Area Sources; Agriculture Production - Livestock; Swine production - operations with lagoons (unspecified animal age); Land application of manure
2805047300	Miscellaneous Area Sources; Agriculture Production - Livestock; Swine production - deep-pit house operations (unspecified animal age); Land application of manure

For the data compiled into the 2014NEIv2, meteorological adjustments are applied to paved and unpaved road SCCs but not transport adjustments. For the 2014NEIv1, the meteorological adjustments were inadvertently not applied. This created a large difference between the 2014NEIv1 and 2014NEIv2 dust emissions but did not impact the modeling platform. This is because the modeling platform applies meteorological adjustments and transport adjustments based on unadjusted NEI values (for both v1 and v2). For the 2014NEIv2, the meteorological adjustments that were applied (to paved and unpaved road SCCs) had to be backed out in order reapply them in SMOKE. Because it was determined that some counties in the v2 did not have the adjustment applied, their emissions were used as-is. Thus, the FF10 that is run through SMOKE consists of 100% unadjusted emissions, and after SMOKE all afdust sources have both transport and meteorological adjustments applied. The total impacts of the transport fraction and meteorological adjustments are shown in Table 2-12 after backing out the meteorological adjustment applied in the 2014NEIv2. The amount of the reduction ranges from about 94 percent in New Hampshire to about 23 percent in Nevada. The afdust emissions adjustments are similar to previous platforms. In the 2011v6.3 the reduction ranged from 29 percent in Nevada to 93 percent in New Hampshire.

Figure 2-1 illustrates the impact of each step of the adjustment, using the 2014v7.0 platform afdust sector7.1. The reductions due to the transport fraction adjustments alone are shown at the top of Figure 2-1. The reductions due to the precipitation adjustments are shown in the middle of Figure 2-1. The cumulative emission reductions after both transport fraction and meteorological adjustments are shown at the bottom of Figure 2-1. The top plot shows how the transport fraction has a larger reduction effect in the east, where forested areas are more effective at reducing PM transport than in many western areas. The middle plot shows how the meteorological impacts of precipitation, along with snow cover in the north, further reduce the dust emissions.

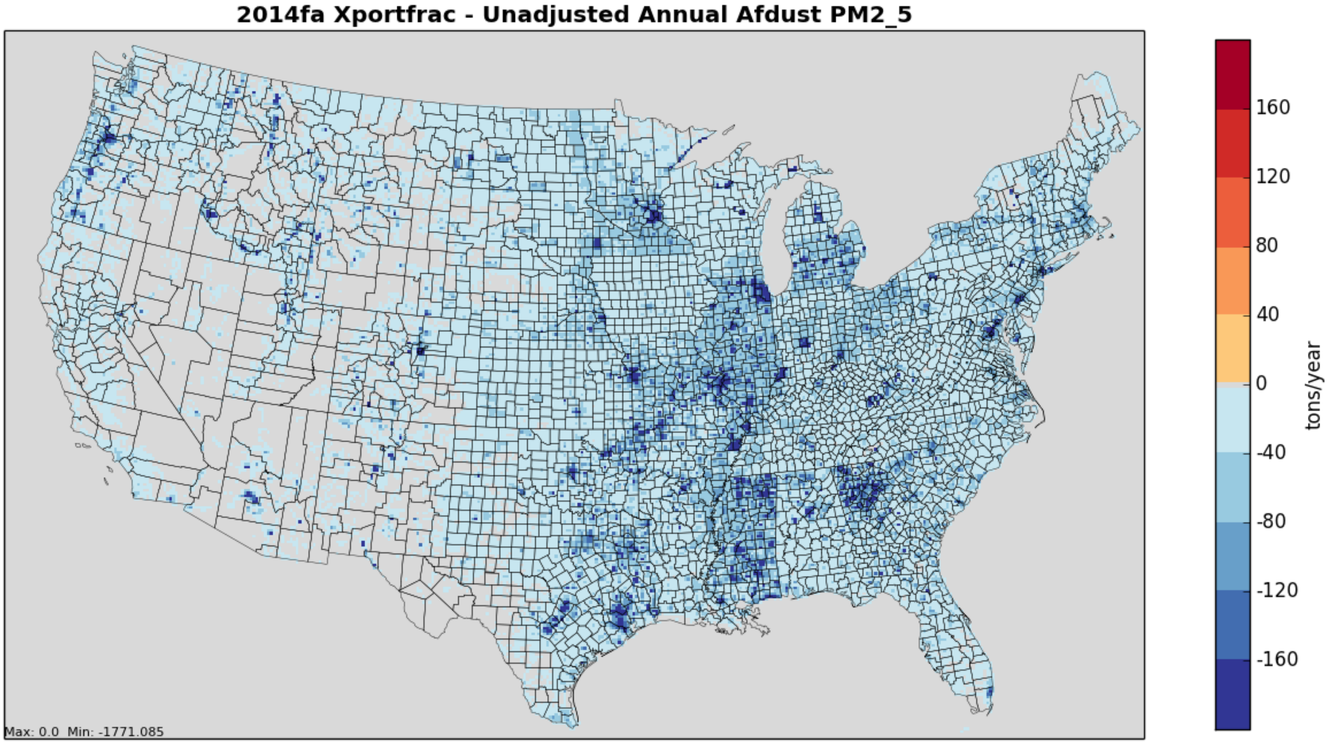
Table 2-12. Total impact of fugitive dust adjustments to unadjusted 2014 inventory

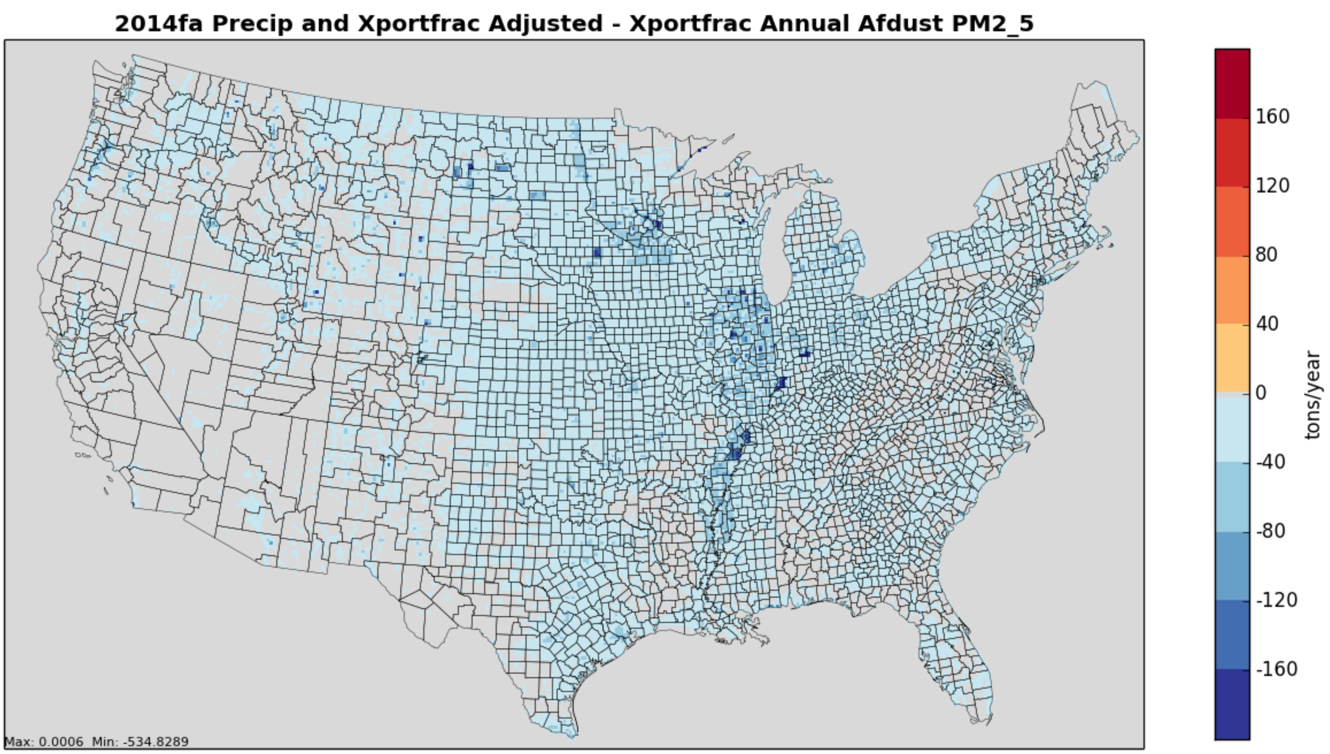
State	Unadjusted * PM_{10}	Unadjusted * $PM_{2.5}$	Change in PM_{10}	Change in $PM_{2.5}$	PM_{10} Reduction	$PM_{2.5}$ Reduction
Alabama	531,293	62,937	-438,671	-51,997	83%	83%
Arizona	263,125	32,553	-87,885	-10,853	33%	33%
Arkansas	319,496	49,010	-228,479	-34,266	71%	70%
California	312,634	41,077	-144,062	-18,498	46%	45%
Colorado	240,391	36,454	-139,202	-20,316	58%	55%
Connecticut	23,464	3,341	-20,583	-2,936	88%	88%
Delaware	14,316	2,456	-10,454	-1,800	73%	73%
District of Columbia	2,547	367	-1,932	-277	75%	75%
Florida	715,494	81,268	-445,103	-50,357	63%	62%
Georgia	552,231	65,601	-458,075	-54,088	83%	83%
Idaho	449,835	55,636	-299,519	-36,055	67%	65%
Illinois	994,307	143,485	-647,183	-93,160	65%	64%
Indiana	713,793	83,925	-531,386	-62,342	75%	74%
Iowa	384,852	59,826	-241,936	-37,560	63%	62%
Kansas	610,450	98,980	-295,548	-46,914	48%	47%
Kentucky	311,270	42,672	-244,594	-33,289	79%	78%
Louisiana	265,757	35,626	-191,357	-25,271	72%	71%
Maine	37,846	5,854	-34,175	-5,310	90%	91%
Maryland	103,136	16,220	-80,553	-12,624	77%	77%
Massachusetts	147,627	18,236	-127,438	-15,662	87%	86%
Michigan	388,603	48,408	-307,739	-38,155	79%	79%
Minnesota	403,260	61,397	-296,519	-44,688	73%	72%
Mississippi	432,583	53,230	-350,713	-42,515	81%	80%
Missouri	1,597,370	184,016	-1,170,745	-134,315	74%	73%
Montana	431,167	61,792	-275,027	-37,722	64%	61%
Nebraska	347,803	55,013	-176,311	-27,704	51%	50%
Nevada	159,216	22,770	-37,590	-5,235	23%	23%
New Hampshire	21,762	4,476	-20,281	-4,169	94%	94%
New Jersey	39,910	9,017	-31,436	-7,082	79%	79%
New Mexico	487,322	53,646	-169,159	-18,644	35%	35%
New York	266,587	44,926	-225,543	-38,051	85%	85%
North Carolina	201,723	29,163	-166,360	-24,065	82%	82%
North Dakota	472,269	82,353	-285,360	-49,598	60%	60%
Ohio	926,270	115,558	-714,546	-88,754	77%	77%
Oklahoma	448,827	67,546	-234,212	-34,417	52%	51%
Oregon	656,174	73,388	-510,850	-55,666	78%	76%

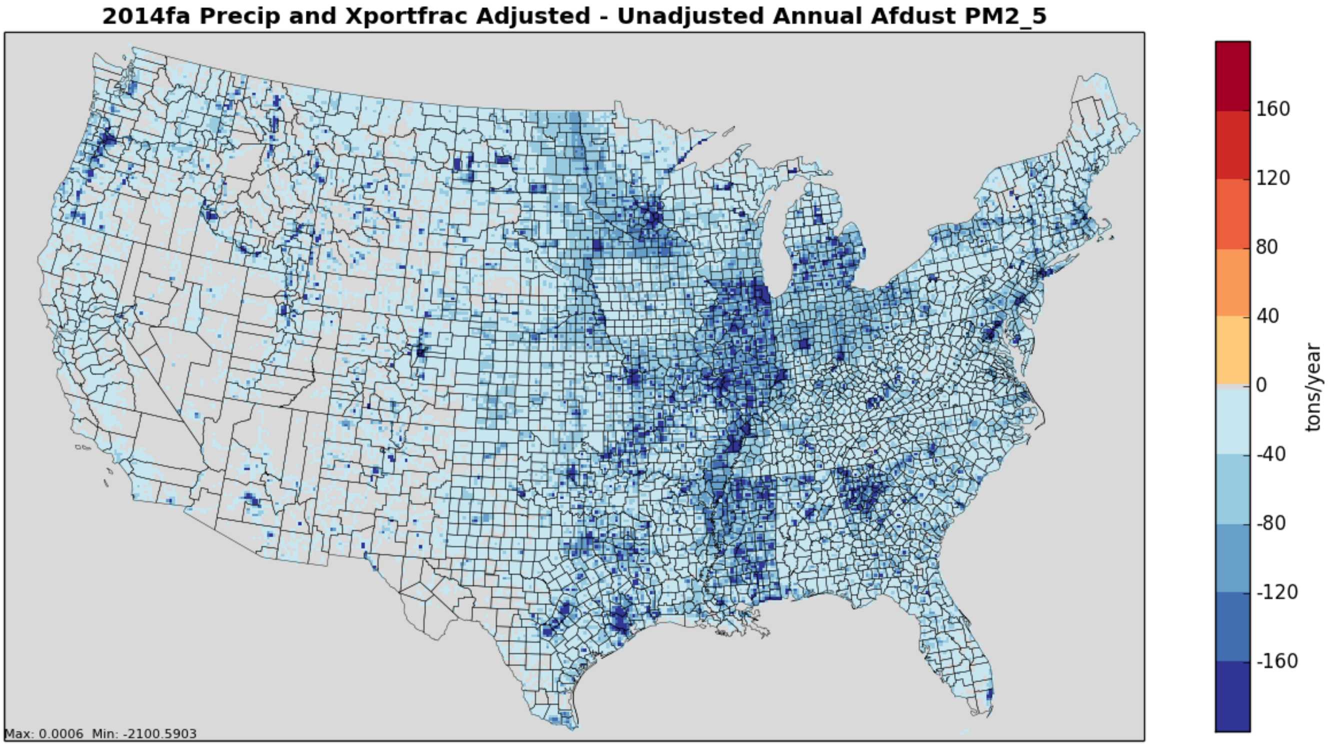
State	Unadjusted * PM_{10}	Unadjusted * $PM_{2.5}$	Change in PM_{10}	Change in $PM_{2.5}$	PM_{10} Reduction	$PM_{2.5}$ Reduction
Pennsylvania	239,408	37,266	-204,741	-31,915	85%	85%
Rhode Island	4,773	759	-3,723	-592	78%	78%
South Carolina	161,909	21,449	-126,440	-16,760	78%	78%
South Dakota	337,913	62,999	-192,859	-35,808	57%	56%
Tennessee	292,101	42,813	-236,307	-34,482	81%	80%
Texas	1,253,345	178,124	-639,339	-88,138	51%	49%
Utah	207,734	26,019	-111,731	-13,796	54%	53%
Vermont	22,131	3,212	-20,038	-2,898	91%	90%
Virginia	283,722	36,631	-239,744	-30,957	85%	85%
Washington	239,794	41,136	-140,928	-24,047	59%	58%
West Virginia	122,180	15,017	-112,762	-13,862	92%	92%
Wisconsin	687,613	89,370	-532,980	-68,885	78%	77%
Wyoming	239,512	29,074	-131,571	-15,750	55%	54%
Domain Total	**18,366,850**	**2,486,092**	**-12,333,687**	**-1,642,242**	**67%**	**66%**

***** Unadjusted" here does not mean raw 2014NEIv2, it means 2014NEIv2 with met adjustments backed out as appropriate (i.e. the inventory that was fed into SMOKE)

Figure 2-1. Impact of adjustments to fugitive dust emissions due to transport fraction, precipitation, and cumulative







2.2.2 Agricultural sector (ag)

The "ag" sector includes the NH_3 emissions from fertilizer from the 2014NEIv2 and emissions of all pollutants other than $PM_{2.5}$ from livestock in the nonpoint (county-level) data category. $PM_{2.5}$ from livestock are in the afdust sector. The addition of non-NH3 pollutants is a change from previous platforms. The additional pollutants were included because of new EPA methodologies to compute VOC and HAP VOC. Table 2-13 provides the SCCs for livestock. Of these, all have NH_3 and the ones marked in the 3rd column of the table include additional pollutants. Table 2-14 shows the fertilizer SCCs. While all fertilizer emissions are in the nonpoint data category and hence in the "ag" sector, there is a very small amount of NH_3 emissions from livestock in the ptnonipm inventory (as point sources) in California (883 tons; less than 0.5 percent of state total) and Wisconsin (356 tons; about 1 percent of state total).

Table 2-13. Livestock SCCs extracted from the NEI to create the ag sector

SCC	SCC Description*	NH3+ other pollutants
2805001100	Beef cattle - finishing operations on feedlots (drylots);Confinement	
2805001200	Beef cattle - finishing operations on feedlots (drylots);Manure handling and storage	
2805001300	Beef cattle - finishing operations on feedlots (drylots);Land application of manure	Yes
2805002000	Beef cattle production composite; Not Elsewhere Classified	Yes
2805003100	Beef cattle - finishing operations on pasture/range; Confinement	
2805007100	Poultry production - layers with dry manure management systems;Confinement	Yes
2805007300	Poultry production - layers with dry manure management systems;Land application of manure	
2805008100	Poultry production - layers with wet manure management systems;Confinement	yes
2805008200	Poultry production - layers with wet manure management systems;Manure handling and storage	
2805008300	Poultry production - layers with wet manure management systems;Land application of manure	
2805009100	Poultry production - broilers;Confinement	yes
2805009200	Poultry production - broilers;Manure handling and storage	

SCC	SCC Description*	NH3+ other pollutants
2805009300	Poultry production - broilers;Land application of manure	
2805010100	Poultry production - turkeys;Confinement	yes
2805010200	Poultry production - turkeys;Manure handling and storage	yes
2805010300	Poultry production - turkeys;Land application of manure	
2805018000	Dairy cattle composite;Not Elsewhere Classified	yes
2805019100	Dairy cattle - flush dairy;Confinement	yes
2805019200	Dairy cattle - flush dairy;Manure handling and storage	
2805019300	Dairy cattle - flush dairy;Land application of manure	
2805020002	Cattle and Calves Waste Emissions:Beef Cows	
2805021100	Dairy cattle - scrape dairy;Confinement	yes
2805021200	Dairy cattle - scrape dairy;Manure handling and storage	
2805021300	Dairy cattle - scrape dairy;Land application of manure	
2805022100	Dairy cattle - deep pit dairy;Confinement	yes
2805022200	Dairy cattle - deep pit dairy;Manure handling and storage	
2805022300	Dairy cattle - deep pit dairy;Land application of manure	
2805023100	Dairy cattle - drylot/pasture dairy;Confinement	
2805023200	Dairy cattle - drylot/pasture dairy;Manure handling and storage	
2805023300	Dairy cattle - drylot/pasture dairy;Land application of manure	
2805025000	Swine production composite;Not Elsewhere Classified (see also 28-05-039, -047, -053)	yes
2805030000	Poultry Waste Emissions;Not Elsewhere Classified (see also 28-05-007, -008, -009)	yes
2805030007	Poultry Waste Emissions;Ducks	
2805030008	Poultry Waste Emissions;Geese	
2805035000	Horses and Ponies Waste Emissions;Not Elsewhere Classified	yes
2805039100	Swine production - operations with lagoons (unspecified animal age);Confinement	yes
2805039200	Swine production - operations with lagoons (unspecified animal age);Manure handling and storage	
2805039300	Swine production - operations with lagoons (unspecified animal age);Land application of manure	
2805040000	Sheep and Lambs Waste Emissions;Total	yes
2805045000	Goats Waste Emissions;Not Elsewhere Classified	yes
2805047100	Swine production - deep-pit house operations (unspecified animal age);Confinement	yes
2805047300	Swine production - deep-pit house operations (unspecified animal age);Land application of manure	
2805053100	Swine production - outdoor operations (unspecified animal age);Confinement	

* All SCC Descriptions begin "Miscellaneous Area Sources;Agriculture Production – Livestock"

Table 2-14. Fertilizer SCCs extracted from the NEI for inclusion in the "ag" sector

SCC	SCC Description*
2801700001	Anhydrous Ammonia
2801700002	Aqueous Ammonia
2801700003	Nitrogen Solutions
2801700004	Urea
2801700005	Ammonium Nitrate
2801700006	Ammonium Sulfate
2801700007	Ammonium Thiosulfate
2801700010	N-P-K (multi-grade nutrient fertilizers)
2801700011	Calcium Ammonium Nitrate
2801700012	Potassium Nitrate
2801700013	Diammonium Phosphate
2801700014	Monoammonium Phosphate

SCC	SCC Description*
2801700015	Liquid Ammonium Polyphosphate
2801700099	Miscellaneous Fertilizers

* All descriptions include "Miscellaneous Area Sources; Agriculture Production – Crops; Fertilizer Application" as the beginning of the description.

Agricultural emissions in the platform are based on the 2014NEIv2, which is a mix of state-submitted data and EPA estimates. The EPA estimates in 2014NEIv2 were revised from 2014NEIv1, using refined methodologies and/or data for livestock and fertilizer. Livestock emissions utilized improved animal population data. VOC livestock emissions, new for this sector, were estimated by multiplying a national VOC/NH3 emissions ratio by the county NH3 emissions. HAP emissions used HAP-to-VOC factors from livestock profiles in the SPECIATE database (EPA, 2016). The 2014NEI approach for livestock utilizes daily emission factors by animal and county from a model developed by Carnegie Mellon University (CMU) (Pinder, 2004, McQuilling, 2015) and 2012 and 2014 U.S. Department of Agriculture (USDA) agricultural census data. Details on the approach are provided in Section 4.5 of the 2014NEIv1 TSD; updates for 2014NEIv2 (the new population estimates) are provided in Section 4.5 of the 2014NEIv2 TSD.

Annual fertilizer emissions were submitted by three states for all or part of the sector as shown in parentheses: California (57 percent), Illinois (100 percent) and Idaho (100 percent). Georgia had previously submitted data in v1 but used the EPA estimates for v2. The EPA estimates employed a methodology that uses the bidirectional (bi-di) version of CMAQ (v5.0.2) and the Fertilizer Emissions Scenario Tool for CMAQ FEST-C (v1.2). The FEST-C and CMAQ simulations were used to directly estimate emission rates based on 2014 inputs. This is a refinement from the earlier estimates that relied on emission factors calculated from a 2011 model simulation applied to 2014 FEST-C county level fertilizer application estimates. Additionally, revised FEST-C estimates of fertilizer application were reduced for pasture and hay due to estimates of fertilizer use and hay yield being higher than USDA estimates. This resulted in a reduction of NH_3 emissions, primarily in the Southeastern U.S. Section 4.5 of the 2014NEIv2 TSD presents the updated approach.

For livestock, meteorological-based temporal allocation (described in Section 3.5.5) is used for month-to-day and day-to-hour temporal allocation. Monthly profiles are based on the daily data underlying the EPA estimates. This was different from 2014v7.0 where the daily data underlying the NEI were used for generating daily emissions. Fertilizer uses different state-specific year-to-month profiles than livestock but uses the same meteorological-based month-to-hour profiles as livestock. These monthly profiles have not changed from previous platforms.

2.2.3 Agricultural fires (ptagfire)

In the 2014v7.1 platform, we used just one sector, ptagfire, for agricultural fires instead of using both point and nonpoint-based sectors as had been done in 2014v7.0. This was done to reduce the processing needed for the CMAQ run without fires. When ag. fires are put all into a point sector, all fires are processed as 3-D files, and hence there is no need to remerge the 2-D emissions for the no-fire zero-out run. We used agricultural fires from the 2014NEIv2, some were estimated by EPA, others were submitted by states. The EPA estimates were already provided as day-specific point sources. State data were converted to day-specific point sources using temporal profiles to allocate annual-to-day, and spatial surrogates to allocate the county emissions to grid cells. The centroid of the grid cell for which the county emissions were allocated was selected as the latitude/longitude of the fire. Heat flux and acres burned were provided by George Pouliot of EPA's Office of Research and Development. Based on field reconnaissance of J. McCarty (2013, personal communication), a "typical" agricultural field size was assumed for each burn location, which varied by region of the country between 40 and 80 acres. The assumed field sizes can be found at http://www.epa.gov/sites/production/files/2015-06/draft_2014_ag_grasspasture_emissions_nei_may62015.xlsx. The heat flux calculation for each agfire fire used depending on estimated field size burned and the fuel loading by SCC (tons/acre). The fuel load estimate is also provided in the above spreadsheet. These were used directly where there were no state-submitted data. For state-submitted data, calculated acres burned/$PM_{2.5}$ and heat flux/$PM_{2.5}$ ratios were calculated by state and applied them to state-submitted ag fire $PM_{2.5}$ emissions to get heat flux and acres burned. States that provided county emissions that were converted to point sources are: Arizona, California, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, New Jersey, South Carolina and Washington.

The agricultural fires sector is based on the 2014NEIv2 emissions for SCCs starting with '28015'. The first three levels of descriptions for these SCCs are: 1) Fires - Agricultural Field Burning; Miscellaneous Area Sources; 2) Agriculture Production - Crops - as nonpoint; and 3) Agricultural Field Burning - whole field set on fire. The SCC 2801500000 does not specify the crop type or burn method, while the more specific SCCs specify field or orchard crops and, in some cases, the specific crop being grown. New agricultural field burning SCCs were added to the 2014 NEI to account for grass/pasture burning (also known as rangeland burning) which is included the agriculture field burning sector of the NEI.

The ptagfire fire emissions estimated by the EPA are at point source and day-specific resolution. EPA data were developed using a multiple satellite detection database and crop level land use information. For the NEI, these are summed to the county and national level, but because they are computed at this finer temporal resolution, we chose to use the data at this level for the platform. States covered by the EPA estimates are: AL, AR, CO, KS, KY, LA, MD, MA, MI, MN, MS, MO, MT, NE, NV, NM, NY, NC, ND, OH, OK, OR, PA, SD, TN, TX, UT, VA, WV, WI, and WY.

The major change between the v1 and v2 emission values are the HAP VOCs, which were estimated for the state data using state-specific augmentation factors as opposed to mixing state/EPA data which resulted in HAP VOC exceeding total VOC in the 2014NEIv1. Another change resulting from this emissions change and the SMOKE update to allow the use of HAP integration for speciation for PTDAY inventories was speciation. All sources with VOC in this sector use the integrate case for speciation, whereby the NBAFM species are subtracted from the VOC and the remainder NONHAPVOC is speciated with profiles that remove NBAFM species and are renormalized to account for that removal.

2.2.4 Nonpoint source oil and gas sector (np_oilgas)

The nonpoint oil and gas (np_oilgas) sector contains onshore and offshore oil and gas emissions. The EPA estimated emissions for all counties with 2014 oil and gas activity data with the Oil and Gas Tool, which was updated for the 2014NEIv2 as described in the 2014NEIv2 TSD. In addition, S/L/T agencies submitted nonpoint oil and gas data for the 2014NEIv2. Several states submitted all or a significant portion of their oil and gas VOC and NOX emissions: California (85% VOC, 98% NOX), Colorado (100% VOC&NOX), Illinois (100% VOC&NOX), Michigan (100% VOC&NOX), New York(100% VOC, 99% NOX), Ohio (100% VOC&NOX), Oklahoma (100% VOC&NOX), Pennsylvania (52% VOC, 79% NOX), Texas (100% VOC&NOX), Utah (85% VOC, 97% NOX), West Virginia (100% VOC&NOX) and Wyoming (77% VOC, 95% NOX). Where S/L/T submitted nonpoint CAPS but no HAPs, the EPA augmented the HAPs using HAP augmentation factors (county and SCC level) which were updated based on the updated Oil and Gas Tool. The types of sources covered include drill rigs, workover rigs, artificial lift, hydraulic fracturing engines, pneumatic pumps and other devices, storage tanks, flares, truck loading, compressor engines, and dehydrators.

A complete list of SCCs for the np_oilgas modeling platform sector is provided in Appendix B; this includes additional SCCs added between the 2014NEIv1 and 2014NEIv2 to support state submissions for v2. See the pt_oilgas sector (section 2.1.2) for more information on point source oil and gas sources. Updates were made to the speciation for v2 consistent with the updated Oil and Gas Tool estimates for the 2014NEIv2. In addition to the updated emissions, the spatial allocation of sources and temporal profiles were also updated. Sections 3.2, 3.3, and 3.4 provide additional details.

2.2.5 Residential wood combustion sector (rwc)

The residential wood combustion (rwc) sector includes residential wood burning devices such as fireplaces, fireplaces with inserts (inserts), free standing woodstoves, pellet stoves, outdoor hydronic heaters (also known as outdoor wood boilers), indoor furnaces, and outdoor burning in firepits and chimneas. Free standing woodstoves and inserts are further differentiated into three categories: 1) conventional (not EPA certified); 2) EPA certified, catalytic; and 3) EPA certified, noncatalytic. Generally, the conventional units were constructed prior to 1988. Units constructed after 1988 had to meet EPA emission standards and they are either catalytic or non-catalytic. The SCCs in the rwc sector are listed in Table 2-15. As with the other nonpoint categories, a mix of S/L and EPA estimates were used. The 2014NEIv2 EPA estimates included adjustments to appliance fractions to account for that not all appliances burn 100% wood (they also can burn natural gas and propane) and some changes to emission factors. National totals for the 2014NEIv2 are slightly lower except for mercury, which increased due to a change in the emission factor. For more information on the development of the residential wood combustion emissions, see Section 4.14 of the 2014NEIv2 TSD.

Table 2-15. SCCs in the residential wood combustion sector (rwc)*

SCC	SCC Description
2104008100	SSFC;Residential;Wood;Fireplace: general
2104008210	SSFC;Residential;Wood;Woodstove: fireplace inserts; non-EPA certified
2104008220	SSFC;Residential;Wood;Woodstove: fireplace inserts; EPA certified; non-catalytic
2104008230	SSFC;Residential;Wood;Woodstove: fireplace inserts; EPA certified; catalytic
2104008310	SSFC;Residential;Wood;Woodstove: freestanding, non-EPA certified
2104008320	SSFC;Residential;Wood;Woodstove: freestanding, EPA certified, non-catalytic
2104008330	SSFC;Residential;Wood;Woodstove: freestanding, EPA certified, catalytic
2104008400	SSFC;Residential;Wood;Woodstove: pellet-fired, general (freestanding or FP insert)
2104008510	SSFC;Residential;Wood;Furnace: Indoor, cordwood-fired, non-EPA certified
2104008610	SSFC;Residential;Wood;Hydronic heater: outdoor
2104008700	SSFC;Residential;Wood;Outdoor wood burning device, NEC (fire-pits, chimeas, etc)
2104009000	SSFC;Residential;Firelog;Total: All Combustor Types

* SSFC=Stationary Source Fuel Combustion

The spatial and temporal allocation for the rwc sector are the same as in the 2014v7.0 platform. The temporal allocation of annual rwc emissions to day of year uses a meteorological-based approach for most SCCs as discussed in Section 3.5.4. All SCCs in this sector are spatially allocated using low intensity residential land (code 300).

2.2.6 Other nonpoint sources sector (nonpt)

Stationary nonpoint sources that were not subdivided into the afdust, ag, np_oilgas, or rwc sectors were assigned to the “nonpt” sector. Locomotives and CMV mobile sources from the 2014NEIv2 nonpoint inventory are not included in this sector and are described in Section 2.4.1. There are too many SCCs in the nonpt sector to list all of them individually, but the types of sources in the nonpt sector include:

- stationary source fuel combustion, including industrial, commercial, and residential and orchard heaters;
- commercial sources such as commercial cooking;
- industrial processes such as chemical manufacturing, metal production, mineral processes, petroleum refining, wood products, fabricated metals, and refrigeration;
- solvent utilization for surface coatings such as architectural coatings, auto refinishing, traffic marking, textile production, furniture finishing, and coating of paper, plastic, metal, appliances, and motor vehicles;
- solvent utilization for degreasing of furniture, metals, auto repair, electronics, and manufacturing;
- solvent utilization for dry cleaning, graphic arts, plastics, industrial processes, personal care products, household products, adhesives and sealants;
- solvent utilization for asphalt application and roofing, and pesticide application;
- storage and transport of petroleum for uses such as portable gas cans, bulk terminals, gasoline service stations, aviation, and marine vessels;
- storage and transport of chemicals;
- waste disposal, treatment, and recovery via incineration, open burning, landfills, and composting;
- miscellaneous area sources such as cremation, hospitals, lamp breakage, and automotive repair shops.

2.3 2014 onroad mobile sources (onroad)

Onroad mobile source emissions result from motorized vehicles that are normally operated on public roadways. These include passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks, and buses. The sources are further divided between diesel, gasoline, E-85, and compressed natural gas (CNG) vehicles. The sector characterizes emissions from parked vehicle processes (e.g., starts, hot soak, and extended idle) as well as from on-network processes (i.e., from vehicles as they move along the roads). Except for California, all onroad emissions are generated using the SMOKE-MOVES emissions modeling framework that leverages MOVES generated emission factors (http://www.epa.gov/otaq/models/moves/index.htm), county and SCC-specific activity data, and hourly meteorological data. The onroad SCCs in the modeling platform are more resolved than those in the NEI, because the NEI SCCs distinguish vehicles and fuels, but in the platform, they also distinguish between off-network, extended idle, and the various MOVES road-types. For more details on the approach and for a summary of the inputs submitted by states, see the section 6.5 of the 2014NEIv2 TSD.

One difference between the preparation of 2014 onroad emissions inventories as compared to those for previous years is that the 2014 inventories (i.e., both NEI and platform) contain pollutants called DIESEL-PM10 and DIESEL-PM25 that represent the diesel PM for diesel-fueled vehicles. The pollutants DIESEL-PM10 and DIESEL-PM25 were set equal to the PM_{10} and $PM_{2.5}$ emissions for all diesel vehicles. Note that the PM emissions from diesel vehicles are included as part of PM_{10} and PM_{25} in this and in previous inventories.

For the 2014NEIv2 (and 2014v7.1 platform), updated inputs to MOVES and SMOKE-MOVES were used based on new data available for vehicle population, speeds and temporal profiles. Additional details on the development of onroad emissions in the 2014NEIv2 are available in Section 6 of the 2014NEIv2 TSD.

2.3.1 Onroad (onroad)

For the continental U.S., the EPA uses a modeling framework that accounts for the temperature sensitivity of the on-road emissions. Specifically, the EPA used MOVES inputs for representative counties, vehicle miles traveled (VMT), vehicle population (VPOP), and hoteling data for all counties, along with tools that integrated the MOVES model with SMOKE. In this way, it was possible to take advantage of the gridded hourly temperature information available from meteorology modeling used for air quality modeling. The "SMOKE-MOVES" integration tool was developed by the EPA in 2010 and is used for regional air quality modeling of onroad mobile sources.

SMOKE-MOVES requires that emission rate "lookup" tables be generated by MOVES, which differentiates emissions by process (i.e., running, start, vapor venting, etc.), vehicle type, road type, temperature, speed, hour of day, etc. To generate the MOVES emission rates that could be applied across the U.S., the EPA used an automated process to run MOVES to produce emission factors for a series of temperatures and speeds for a set of "representative counties," to which every other county is mapped. Representative counties are used because it is impractical to generate a full suite of emission factors for the more than 3,000 counties in the U.S. The representative counties for which emission factors are generated are selected according to their state, elevation, fuels, age distribution, ramp fraction, and inspection and maintenance programs. Each county is then mapped to a representative county based on its similarity to the representative county with respect to those attributes. For age distributions and vehicle fuel types, rather than choose the value based on the representative county, a weighted average was computed. For the 2014v7.1 platform, there are 303 representative counties, twelve more than the number of representative counties in the 2014v7.0 platform. A detailed discussion of the representative counties is in the 2014NEIv2 TSD, Section 6.8.2.

Once representative counties have been identified, emission factors are generated by running MOVES for each representative county and for two "fuel months" – January to represent winter months, and July to represent summer months – because different types of fuels are used in each season. SMOKE selects the appropriate MOVES emissions rates for each county, hourly temperature, SCC, and speed bin and multiplies the emission rate by appropriate activity data: VMT (vehicle miles travelled), VPOP (vehicle population), or HOTELING (hours of extended idle) to produce emissions. These calculations are done for every county and grid cell in the continental U.S. for each hour of the year.

The SMOKE-MOVES process for creating the model-ready emissions consists of the following steps:

1) Determine which counties will be used to represent other counties in the MOVES runs.
2) Determine which months will be used to represent other month's fuel characteristics.
3) Create inputs needed only by MOVES. MOVES requires county-specific information on vehicle populations, age distributions, speed distribution, temporal profiles, and inspection-maintenance programs for each of the representative counties.
4) Create inputs needed both by MOVES and by SMOKE, including temperatures and activity data.
5) Run MOVES to create emission factor tables for the temperatures and speeds that exist in each county during the modeled period.
6) Run SMOKE to apply the emission factors to activity data (VMT, VPOP, and HOTELING) to calculate emissions based on the gridded hourly temperatures in the meteorological data.

7) Aggregate the results to the county-SCC level for summaries and QA.

The onroad emissions are processed in four processing streams that are merged together into the onroad sector emissions after each of the four streams have been processed:

- rate-per-distance (RPD) uses VMT as the activity data plus speed and speed profile information to compute on-network emissions from exhaust, evaporative, permeation, refueling, and brake and tire wear processes;
- rate-per-vehicle (RPV) uses VPOP activity data to compute off-network emissions from exhaust, evaporative, permeation, and refueling processes;
- rate-per-profile (RPP) uses VPOP activity data to compute off-network emissions from evaporative fuel vapor venting, including hot soak (immediately after a trip) and diurnal (vehicle parked for a long period) emissions; and
- rate-per-hour (RPH) uses hoteling hours activity data to compute off-network emissions for idling of long-haul trucks from extended idling and auxiliary power unit process.

The onroad emissions inputs for the platform are the same as for the emissions in the onroad data category of the 2014NEIv2, described in more detail in Section 6 of the 2014NEIv2 TSD. These inputs are:

- MOVES County databases (CDBs) including Low Emission Vehicle (LEV) table
- Representative counties
- Fuel months
- Meteorology
- Activity data (VMT, VPOP, speed, HOTELING)

The key differences between the 2014v7.1 platform onroad emission inventories and the 2014NEIv2 inventories are:

- The 2014 platform uses a different post-processor to create emission factors for SMOKE because the pollutants needed for speciation and running CMAQ are different than what is needed for the NEI. For example, the NEI needs a much larger set of HAPs and the modeling platform requires emissions for the components of $PM_{2.5}$.
- The NEI includes emissions for Alaska, Hawaii, Puerto Rico, and the Virgin Islands, whereas the modeling platform does not.
- The treatment of California emissions differs between the two inventories (see below for more details). Due to this treatment, the California HAP VOC emissions are different in the platform than what was submitted to the NEI (See Table 2-13, below).
- The list of emission modes and SCCs differ between the two inventories. Both SMOKE-MOVES runs were generated at the same level of detail, but the NEI emissions were aggregated into 2 all-inclusive modes: refueling and all other modes. In addition, the NEI SCCs were aggregated over roads to all parking and all road emissions. The list of modes (or aggregate processes) and the corresponding MOVES processes mapped to them are listed in Table 2-16.

Table 2-16. Onroad emission aggregate processes

Aggregate process	Description	MOVES process IDs
40	All brake and tire wear	9;10
53	All extended idle exhaust	17;90
62	All refueling	18;19
72	All exhaust and evaporative except refueling and hoteling	1;2;11;12;13;15;16
91	Auxiliary Power Units	91

An additional step was taken for the refueling emissions. Colorado submitted point emissions for refueling for some counties[3]. For these counties, the EPA zeroed out the onroad estimates of refueling (i.e., SCCs =220xxxxx62) so that the states' point emissions would take precedence. The onroad refueling emissions were zeroed out using the adjustment factor file (CFPRO) and Movesmrg.
For more detailed information on the methods used to develop the 2014 onroad mobile source emissions and the input data sets, see the 2014NEIv2 TSD.

California is the only state agency for which submitted onroad emissions were used in the 201 NEIv2 and 2014v7.1 platform. California uses their own emission model, EMFAC, which uses emission inventory codes (EICs) to characterize the emission processes instead of SCCs. The EPA and California worked together to develop a code mapping to better match EMFAC's EICs to EPA MOVES' detailed set of SCCs that distinguish between off-network and on-network and brake and tire wear emissions. This detail is needed for modeling but not for the NEI. This code mapping is provided in "2014v1_EICtoEPA_SCCmapping.xlsx." which is found in the supporting data for the 2014 NEI v2 TSD (ftp://newftp.epa.gov/air/nei/2014/doc/2014v2_supportingdata/onroad/). California provided their CAP and HAP emissions by county using EPA SCCs after applying the mapping. There was one change made after the mapping: the vehicle/fuel type combination gas intercity buses (first 6 digits of the SCC = 220141), that is not generated using MOVES, was changed to gasoline single unit short-haul trucks (220152) for consistency with the modeling inventory.

California also submitted onroad refueling VOC emissions. For the NEI, the mapped California emissions were summed to the level of fuel type and MOVES source type. For the modeling platform, the emissions were used to adjust the MOVES-based California onroad emissions (including refueling) as described below. MOVES provides chemical-mechanism specific emissions that, for onroad, use the MOVES-based HAPs, and ethanol, and the speciation of the remainder of the VOC based on model-year information. For California, we adjusted the MOVES-based emissions using California VOC, NO_X, PM and metal HAPs. This preserved the MOVES speciation but it did not allow for use of the California-submitted VOC HAPs that are in the 2014NEIv2. Differences between the platform emissions and those in 2014NEIv2 are shown in Table 2-17.

The California onroad mobile source emissions were created through a hybrid approach of combining state-supplied annual emissions with EPA-developed SMOKE-MOVES runs. Through this approach, the platform was able to reflect the unique rules in California, while leveraging the more detailed SCCs and the highly resolved spatial patterns, temporal patterns, and speciation from SMOKE-MOVES. The basic steps involved in temporally allocating onroad emissions from California based on SMOKE-MOVES results were:

[3] There were 52 counties in Colorado that had point emissions for refueling. Outside Colorado, it was determined that refueling emissions in the 2014 NEIv1 point did not significantly duplicate the refueling emissions in onroad.

1) Run CA using EPA inputs through SMOKE-MOVES to produce hourly 2014 emissions hereafter known as "EPA estimates." These EPA estimates for CA are run in a separate sector called "onroad_ca."
2) Calculate ratios between state-supplied emissions and EPA estimates[4]. These were calculated for each county/SCC/pollutant combination. Unlike in previous platforms, the California data separated off and on-network emissions and extended idling. However, the on-network did not provide specific road types, and California's emissions did not include information for vehicles fueled by E-85, so these differentiations were obtained using MOVES.
3) Create an adjustment factor file (CFPRO) that includes EPA-to-state estimate ratios.
4) Rerun CA through SMOKE-MOVES using EPA inputs and the new adjustment factor file.

Through this process, adjusted model-ready files were created that sum to annual totals from California, but have the temporal and spatial patterns reflecting the highly resolved meteorology and SMOKE-MOVES. After adjusting the emissions, this sector is called "onroad_ca_adj." Note that in emission summaries, the emissions from the "onroad" and "onroad_ca_adj" sectors are summed and designated as the emissions for the onroad sector.

Table 2-17. Differences in California VOC HAP emissions between 2014v7.1 platform and the 2014NEIv2

Pollutant	NEI	Platform
1,3-Butadiene	348	373
2,2,4-Trimethylpentane	2,691	2,789
Acetaldehyde	1,346	1,162
Acrolein	55	101
Benzene	3,075	2,429
Ethylbenzene	1,380	2,012
Formaldehyde	2,809	1,664
Hexane	1,389	2,820
Methanol	3,334	141
Methyl tert-butyl ether	111	0
Naphthalene	182	210
Styrene	137	71
Toluene	8,034	12,559
Xylenes	6,635	7,409

[4] These ratios were created for all matching pollutants. These ratios were duplicated for all appropriate modeling species. For example, the EPA used the NO_X ratio for NO, NO_2, HONO and used the $PM_{2.5}$ ratio for PEC, PNO_3, POC, PSO_4, etc. (For more details on NO_X and PM speciation, see Sections 3.2.2, and 3.2.3. For VOC model-species, if there was an exact match (e.g., BENZENE), the EPA used that HAP pollutant ratio. For other VOC-based model-species that didn't exist in the NEI inventory, the EPA used VOC ratios.)

2.4 2014 nonroad mobile sources (cmv, rail, nonroad)

The nonroad mobile source emission modeling sectors consist of nonroad equipment emissions (nonroad), locomotive (rail) and CMV emissions.

2.4.1 Category 1, Category 2, Category 3 Commercial Marine Vessels (cmv_c1c2, cmv_c3)

The cmv_c1c2 and cmv_c3 sectors contain commercial marine vessel (CMV) emissions. The cmv_c1c2 sector contains Category 1 and 2 (C1 and C2) CMV emissions that traverse state and Federal waters and that are in the 2014 NEIv2. The cmv_c3 sector contains Category 3 emissions that traverse state and Federal waters (in the NEI) plus C3 in waters not covered by the NEI. This sectorization is different from the v7.0 platform, where all the NEI-based CMV were in a single sector (cmv) and the C3 outside the NEI were in the othpt sector. We split C1 and c2 from C3 in the v7.1 platform to allow the c3 to be modeled as point sources with plume rise.

All NEI emissions from these sectors that are in state waters are annual and at county-SCC resolution; however, in the NEI they are provided at the sub-county level (port or underway shape ids) and by SCC and emission type (e.g., hoteling, maneuvering). NEI emission estimates are a mix of state-submitted values and EPA-developed emissions in areas where states did not submit. The emissions developed by EPA use a “bottom up” procedure based on activity details from the U.S. Coast Guard and Army Corps of Engineers databases. For the 2014NEIv2, emissions developed by the Lake Michigan Air Directors Consortium (LADCO) were used for several states in the region: Illinois, Indiana, Iowa, Minnesota, Michigan, Missouri, Ohio and Wisconsin. In addition, Delaware submitted data for v2. See section 4.19 of the 2014NEIv2 TSD for a description of the methodology and updates to commercial marine vessels in the 2014NEIv2.

The NEI includes CMV outside of state waters, but that are in Federal waters (FIPS = 85). These areas include parts of the Gulf of Mexico and East and West Coasts. The U.S. Federal waters around Puerto Rico and Alaska are outside the CONUS modeling domain and are not used in the platform. The Federal Waters emissions are also categorized as port or underway shapes.

For all CMV in these sectors, DIESEL-PM10 and DIESEL-PM2.5 were set equal to the PM_{10} and $PM_{2.5}$ for each source for both diesel and residual oil fuels. These pollutants are included in both the NEI and the FF10 input to SMOKE.

Table 2-18 provides the SCCs extracted from the NEI for the cmv_c1c2 sector. For the purpose of the NEI, it is assumed that C1 and C2 vessels typically used distillate fuels.

Table 2-18. 2014NEI SCCs extracted for the cmv_c1c2 sector

SCC	Sector	Description: Mobile Sources prefix for all
2280002100	cmv	Marine Vessels; Commercial; Diesel; Port
2280002200	cmv	Marine Vessels; Commercial; Diesel; Underway

The sources in the cmv_c1c2 sector are gridded from the county estimates. For the 2014v7.1, changes to the spatial surrogates were made. Ports for c1/c2 changed to Ports NEI2014 activity (surrogate 820); for 2014v7.0, port areas were used.

Table 2-19 provides the SCCs extracted from the NEI for the cmv_c3 sector. For the purpose of the NEI, it is assumed that C3 vessels typically use residual blends; however, in California, the larger C3 vessels are required to use cleaner diesel fuel in state waters and were thus mapped to c1 and c2 vessels. In the future, these SCCs will change to properly categorize C3 vessels that use diesel fuel appropriately.

Table 2-19. 2014NEI SCCs extracted for the cmv_c3 sector

SCC	Sector	Description: Mobile Sources prefix for all
2280003100	cmv	Marine Vessels, Commercial; Residual; Port emissions
2280003200	cmv	Marine Vessels, Commercial; Residual; Underway emissions

The cmv_c3 sector sources are treated as point sources. This allows plume rise to be computed so that emissions can be allocated to air quality model layers higher than layer 1. A set of fixed stack parameters were assigned to every CMV point source: 65.62 ft (20 m) height, 2.625 ft (0.8 m) diameter, 82.02 ft/s (25 m/s) velocity and 539.5 F (282 C). In the 2014v7.0 platform, C3 were not separated from C1 and c2 and were gridded using spatial surrogates and allocated to layer 1.

Another difference from the 2014v7.0 platform is that for v7.1, the FIPS=85 (Federal Waters) C3 emissions are from the NEI; in the v7.0 platform we utilized the 2011-based non-NEI emissions outside the Exclusive Economic Zone (EEZ) from the "ECA-IMO-based" C3 CMV inventory.

For the 2014v7.1 the "ECA-IMO-based" C3 CMV inventory is used for waters not covered by the NEI (with FIPS assigned to 98001) and is used for allocating the county-level NEI emissions to geographic locations. These data are described below.

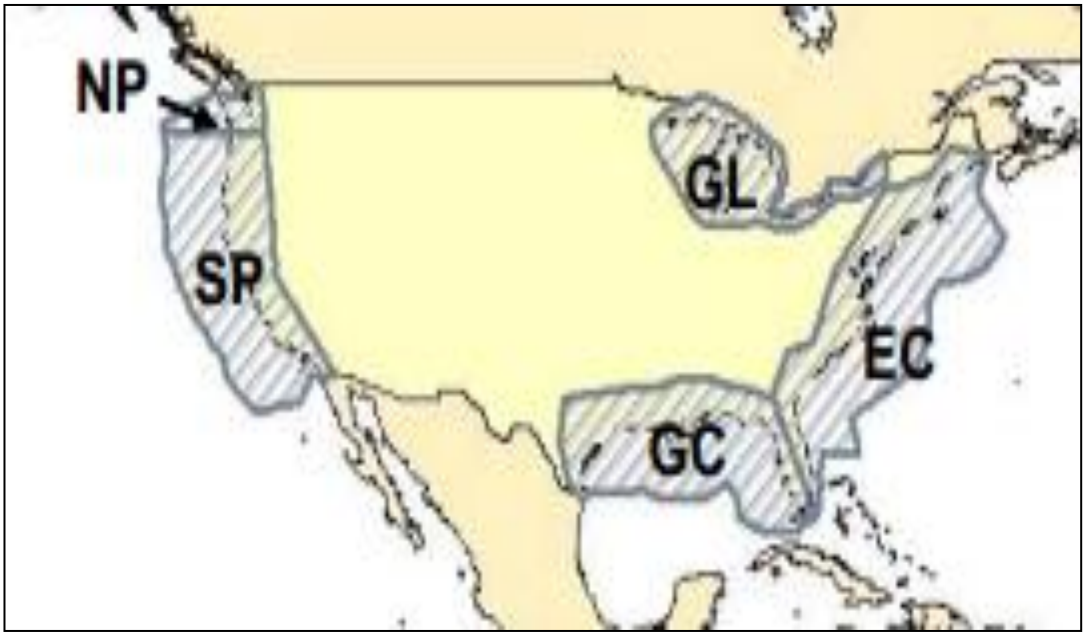
The EPA-"ECA-IMO-based" emissions were developed based on a 4-km resolution ASCII raster format dataset that preserves shipping lanes. This dataset has been used since the ECA-IMO project began in 2005, although it was then known as the Sulfur Emissions Control Area (SECA). The ECA-IMO emissions consist of large marine diesel engines (at or above 30 liters/cylinder) that, until recently, were allowed to meet relatively modest emission requirements and, as a result, these ships would often burn residual fuel in that region. The emissions in this sector are comprised of primarily foreign-flagged ocean-going vessels, referred to as C3 CMV ships. The cmv inventory sector includes these ships in several intra-port modes (i.e., cruising, hoteling, reduced speed zone, maneuvering, and idling) and an underway mode, and includes near-port auxiliary engine emissions.

An overview of the C3 ECA Proposal to the International Maritime Organization project (EPA-420-F-10-041, August 2010) and future-year goals for reduction of NO_X, SO_2, and PM C3 emissions can be found at: http://www.epa.gov/oms/regs/nonroad/marine/ci/420r09019.pdf. The resulting ECA-IMO coordinated strategy, including emission standards under the Clean Air Act for new marine diesel engines with per-cylinder displacement at or above 30 liters, and the establishment of ECA is available from http://www.epa.gov/oms/oceanvessels.htm. The base-year ECA inventory is 2002 and consists of these CAPs: PM_{10}, $PM_{2.5}$, CO, CO_2, NH_3, NO_X, SO_X (assumed to be SO_2), and hydrocarbons (assumed to be VOC). The EPA developed regional growth (activity-based) factors that were applied to create the 2011 inventory from the 2002 data. These growth factors are provided in Table 2-20. The geographic regions listed in the table are shown in Figure 2-2. The East Coast and Gulf Coast regions were divided along a line roughly through Key Largo (longitude 80° 26' West). Technically, the Exclusive Economic Zone (EEZ) FIPS are not really "FIPS" state-county codes, but are treated as such in the inventory and emissions processing.

Table 2-20. Growth factors to project the 2002 ECA-IMO inventory to 2011

Region	EEZ FIPS	NO_X	PM_{10}	$PM_{2.5}$	VOC	CO	SO_2
East Coast (EC)	85004	1.301	0.500	0.496	1.501	1.501	0.536
Gulf Coast (GC)	85003	1.114	0.428	0.423	1.288	1.288	0.461
North Pacific (NP)	85001	1.183	0.467	0.458	1.353	1.353	0.524
South Pacific (SP)	85002	1.367	0.525	0.521	1.565	1.562	0.611
Great Lakes (GL)	n/a	1.072	0.394	0.390	1.177	1.176	0.415
Outside ECA	98001	1.341	1.457	1.457	1.457	1.457	1.457

Figure 2-2. Illustration of regional modeling domains in ECA-IMO study



The emissions were converted to SMOKE point source inventory format as described in http://www3.epa.gov/ttn/chief/conference/ei17/session6/mason.pdf, allowing for the emissions to be allocated to modeling layers above the surface layer. As described in the paper, the ASCII raster dataset was converted to latitude-longitude, mapped to state/county FIPS codes that extended up to 200 nautical miles (nm) from the coast, assigned stack parameters, and monthly ASCII raster dataset emissions were used to create monthly temporal profiles. All non-US, non-EEZ emissions (i.e., in waters considered outside of the 200 nm EEZ and, hence, out of the U.S. and Canadian ECA-IMO controllable domain) were simply assigned a dummy state/county FIPS code=98001, and were projected to year 2011 using the "Outside ECA" factors in Table 2-20.

No data from this inventory were used for State waters which extend approximately 3 to 10 miles offshore or FIPs beginning with 85, since these were taking from the 2014NEIv2. However, the "ECA-IMO-based" inventory was used to convert the NEI emissions to point sources. Also, the SMOKE-ready data have been cropped from the original ECA-IMO entire northwestern quarter of the globe to cover only the large continental U.S. 36-km "36US1" air quality model domain, the largest Continental U.S. domain used by the EPA in recent years[5].

The original ECA-IMO inventory did not delineate between ports and underway emissions (or other C3 modes such as hoteling, maneuvering, reduced-speed zone, and idling). However, a U.S. ports spatial

[5] The extent of the "36US1" domain is similar to the full geographic region shown in Figure 3-1. Note that this domain is not specifically used in this 2011 platform, although spatial surrogates that can be used with it are provided.

surrogate dataset was used to assign the ECA-IMO emissions to ports and underway SCCs 2280003100 and 2280003200, respectively. This had no effect on temporal allocation or speciation because all C3 CMV emissions, unclassified/total, port and underway, share the same temporal and speciation profiles. See Section 3.2.1.3 for more details on C3 speciation in the cmv sector and Section 3.5.8 for details on temporal allocation.

A hierarchical process was used for generating the geographic coordinates of the points. The ECA inventory was used as a first choice, port polygons as a next choice (for port SCCs), and then gridding surrogates where there is not county overlap between the C3 emissions and the ECA or port polygons.

2.4.2 Railroad sources: (rail)

The rail sector includes all locomotives in the NEI nonpoint data category, SCCs are shown in Table 2-21. This sector excludes railway maintenance locomotives and point source yard locomotives. Railway maintenance emissions are included in the nonroad sector. The point source yard locomotives are included in the ptnonipm sector.

The nonpoint rail data are a mix of S/L and EPA data. EPA estimates cover only SCCs 2285002006 and 2285002007. Revised and/or new data were provided by some states for the 2014NEIv2. The EPA data were completely replaced from the v1 estimates, which had been carried forward from the 2011 NEI. The updated EPA data were developed by the Eastern Regional Technical Advisory Committee's (ERTAC) rail group. The group coordinated with the Federal Rail Administration to collect link-based activity data and apply the equipment-specific emission factors appropriate. For more information on locomotive sources in the NEI, see Section 4.20 of the 2014NEIv2 TSD.

Table 2-21. 2014NEIv2 SCCs extracted for rail sector

SCC	Sector	Description: Mobile Sources prefix for all
2285002006	rail	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations
2285002007	rail	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations
2285002008	rail	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)
2285002009	rail	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines
2285002010	rail	Railroad Equipment;Diesel;Yard Locomotives

2.4.3 Nonroad mobile equipment sources: (nonroad)

The nonroad equipment emissions in the platform and the NEI result primarily from running the MOVES2014a model, which incorporates the NONROAD2008 model. MOVES2014a replaces NMIM, which was used for 2011 and earlier NEIs. MOVES2014a provides a complete set of HAPs and incorporates updated nonroad emission factors for HAPs. MOVES2014a was used for all states other than California, which uses their own model. As with other mobile diesel sources, the EPA added DIESEL-PM10 and DIESEL-PM25 for all diesel fuel SCCs and they were set equal to the PM_{10} and $PM_{2.5}$ emissions from these diesel SCCs. Additional details on the development of the 2014NEI nonroad emissions are available in Section 5 of the 2014NEIv2 TSD.

Three states provided 2014NEIv2 updates to their nonroad inputs: Delaware Department of Natural Resources and Environmental Control, Georgia Department of Natural Resources and North Carolina

Department of Air Quality (NCDAQ) which resulted in revised platform emissions for these states in the 2014v7.1 platform. The remainder of this section describes differences between the FF10 file used for the platform versus the 2014NEI related to temporal allocation and speciation.

The magnitude of the annual nonroad emissions in the platform are equivalent to the emissions in the nonroad data category of the 2014NEIv2. However, the platform has monthly emission totals, which are provided by MOVES2014a, and contain additional pollutants used in the emissions modeling. The emissions in the modeling platform include NONHAPTOG and ETHANOL, and these are not included in the NEI. NONHAPTOG is the difference between total organic gases (TOG) and explicit species that are estimated separately such as benzene, toluene, styrene, ethanol, and numerous other compounds and are integrated into the chemical speciation process. MOVES2014a provides estimates of NONHAPTOG along with the speciation profile code for the NONHAPTOG emission source. This is accomplished by using NHTOG#### as the pollutant code in the FF10 inventory file, where #### is a speciation profile code. Since speciation profiles are applied by SCC and pollutant, no changes to SMOKE were needed to use the FF10 with this profile information. This approach is not used for California, because their model provides VOC. Therefore, the profiles used in the 2011v6.3 profile were used for all California VOC sources.

The CARB-supplied nonroad annual inventory emissions values were temporalized to monthly values using monthly temporal profiles applied in SMOKE by SCC. Some VOC emissions were added to California to account for situations when VOC HAP emissions were included in the inventory, but VOC emissions were either less than the sum of the VOC HAP emissions, or were missing entirely. These additional VOC emissions were computed by summing benzene, acetaldehyde, formaldehyde, and naphthalene for the specific sources.

2.5 "Other Emissions": non-U.S. sources

The emissions from Canada and Mexico are included as part of four emissions modeling sectors: othpt, othar, othafdust, onroad_can, and onroad_mex. The "oth" refers to the fact that these emissions are usually "other" than those in the NEI, and the remaining characters provide the SMOKE source types: "pt" for point, "ar" for "area and nonroad mobile," "afdust" for area fugitive dust (Canada only). Because Canada and Mexico onroad mobile emissions are modeled differently from each other, they are separated into two sectors: onroad_can and onroad_mex.

2.5.1 Point sources from Canada and Mexico (othpt)

The othpt sector contains a variety of point sources that are located in Canada or Mexico. This sector longer contains any emissions from the ECA-IMO-based C3 CMV inventory as it had for the 2014v7.0 platform.

For Canadian point sources, 2013 emissions provided by Environment Canada were used and replace the 2010 projected-to-2014 inventories used in 2014v7.0 platform. The 2013 Canadian point inventories were used as-is (i.e., no projections) for 2014. They cover upstream oil and gas, dust (the portion with transport fraction applied), electric power generation, airports and point sources from Canada's National Pollutant Release Inventory (NPRI). The NPRI was initially provided as CB6 speciated emissions (excluding ACET and CH4). Later Environment Canada provided VOC which was added to the inventory as VOC_INV and was speciated for ACET, CH4 and CB6-CMAQ species not covered in the CB6-speciated inventory (XYLMN, NAPH and SOAALK). Upstream oil and gas and oil sands SCCs were provided as VOC emissions using more detailed SCCs. Temporal profiles were also provided.

Other than the CB6 species of NBAFM present in the speciated NPRI data, there are no explicit HAP emissions in this inventory.

Point sources in Mexico were projected from 2008 to create a year 2014 inventory (ERG, 2017). They include some nonroad emissions: diesel cmv and diesel construction equipment. The Mexico point source emissions in the 2014 inventory were converted to English units and into the FF10 format that could be read by SMOKE, missing stack parameters were gapfilled using SCC-based defaults, and latitude and longitude coordinates were verified and adjusted if they were not consistent with the reported municipality. Only CAPs are covered in the Mexico point source inventory.

2.5.2 Area and nonroad mobile sources from Canada and Mexico (othar, othafdust)

Environment Canada provided annual and monthly year-2013 emissions which were used for the 2014v7.1 platform; the 2014v7.0 used 2010 Canada inventories which EPA projected to 2014. The 2013 data were used as is (i.e., no projections). Agricultural ammonia and nonroad are monthly; rail, CMV and other nonpoint Canada sectors are annual.

The following Canadian area inventories are sub-province: agricultural ammonia (for all provinces) and nonroad (Quebec, Ontario, and BC only). The ag inventory goes all the way down to census division. For nonroad, Quebec/Ontario/BC resolution is by "region", not by census division, with only a couple of regions in each province.

The Canadian inventory includes fugitive dust emissions that do not incorporate either a transportable fraction or meteorological-based adjustments. To properly account for this, a separate sector called othafdust was created and modeled using the same adjustments as are done for U.S. sources (see Section 2.2.1 for more details.

For Mexico, emissions projected to the year 2014 based on Mexico's 2008 inventory were used for area, point and nonroad sources (ERG, 2017). The resulting inventory was written using English units to the nonpoint FF10 format that could be read by SMOKE. Note that unlike the U.S. inventories, there are no explicit HAPs in the nonpoint or nonroad inventories for Canada and Mexico and, therefore, all HAPs are created from speciation.

2.5.3 Onroad mobile sources from Canada and Mexico (onroad_can, onroad_mex)

For Mexico, a version of the MOVES model for Mexico was run that provided the same VOC HAPs and speciated VOCs as for the U.S. MOVES model (ERG, 2017). This includes NBAFM plus several other VOC HAPs such as toluene, xylene, ethylbenzene and others. Except for VOC HAPs that are part of the speciation, no other HAPs are included in the Mexico onroad inventory (but not particulate HAPs nor diesel particulate matter).

For Canada, month-specific year-2013 emissions provided by Environment Canada were used, which replaced the 2014v7.0 2010-to-2014 projected emissions. This inventory is sub-province in Ontario (4 regions) and BC (2 regions), and province elsewhere. Note that unlike the U.S. and Mexico inventories, there are no explicit HAPs in the onroad inventories for Canada and, therefore, NBAFM HAPs are created from speciation.

2.5.4 Fires from Canada and Mexico (*ptfire_othna*)

Annual 2014 wildland emissions for Mexico and Canada in the 2014v7.1 platform were developed from a combination of FINN (Fire Inventory from NCAR) daily fire emissions and fire data provided by Environment Canada when available. Environment Canada emissions were used for Canada wildland fire emissions for June through November and FINN fire emissions were used to fill in the annual gaps from January through May and December. Only CAP emissions are provided in the Canada and Mexico fire inventories.

For FINN fires, listed vegetation type codes of 1 and 9 are defined as agricultural burning, all other fire detections and assumed to be wildfires. All wildland fires that are not defined as agricultural are assumed to be wild fires rather than prescribed. FINN fire detects less than 50 square meters (0.012 acres) are removed from the inventory. The locations of FINN fires are geocoded from latitude and longitude to FIPS code.

Quality assurance of the FINN fire data used in the 2014v.7.0 platform (NATAv1) revealed that the FINN data was missing vegetation type codes of 1 (grasslands) and 9 (croplands) for the year 2014. After informing the FINN authors of this error, a new, corrected version of the FINN fires for year 2014 was generated by NCAR. This corrected version of year 2014 FINN data also included changes to other wildfires besides grassland and cropland fires. This new, corrected version of FINN fire data was used in the 2014v7.1 platform modeling (NATAv2).

2.6 Fires (ptfire)

In the 2014v7.1 platform, wildfires and prescribed burning emissions are contained in the ptfire sector which contain emissions from flaming and smoldering combustion phases. Fire emissions are specified at geographic coordinates (point locations) and have daily emissions values. These emissions are consistent with the fires stored in the events data category of the 2014NEIv2. For the 2014NEIv2 Washington state submitted emissions which were used instead of the EPA data, and Georgia corrected its HAP VOC estimates using HAP-to-VOC ratios so that they would no longer exceed VOC the Georgia submitted VOC.

For the 2014v7.1 platform, adjustments were made to the allocation of emissions between flaming/smoldering SCCs. In the 2014 NEI, the smoldering emissions included both 1) the smoldering emissions that occur simultaneously with the flaming combustion phase emissions and 2) the residual smoldering emissions that occur after the flaming phase is over. In 2014v7.0 platform, the 2014 NEI fire emissions were used as is with this flaming and smoldering apportionment. For 2014v7.1 platform, the flaming and smoldering emissions were reapportioned such that the flaming combustion SCC now contains the flaming and the simultaneous smoldering emissions and the “smoldering” combustion SCC contains the residual smoldering emissions only. This was done to break out residual smoldering from the NEI smoldering and allow the better vertical allocation of only the residual portion of the smoldering to layer 1 in CMAQ. To force the residual smoldering to layer 1, the heat flux (HFLUX) for the smoldering was capped at 1000 Btu/hour. This reallocation of flaming and smoldering emissions was not done for AK/HI/PR since they are outside of the CMAQ modeling domain.

The ptfire sector excludes agricultural burning and other open burning sources that are included in the nonpt sector. The NEI SCCs for the ptfire sector are shown in Table 2-22. In the v7.0 platform, separate sectors were used for smoldering versus flaming in order to force smoldering into layer 1, and vertically distribute flaming based on plume rise. However, this was changed for v7.1 because it was recognized that some of the smoldering emissions should also undergo plume rise, and hence not all be put into layer 1. Parameters associated with the emissions such as acres burned and fuel load allow estimation of plume rise. For more information on the development of the 2014NEI fire inventory, see Section 7 of the 2014NEIv2 TSD.

Table 2-22. 2014 Platform SCCs representing emissions in the ptfire modeling sector

SCC	SCC Description*
2810001001	Other Combustion-as Event; Forest Wildfires; Smoldering
2810001002	Other Combustion-as Event; Forest Wildfires; Flaming
2811015001	Other Combustion-as Event; Prescribed Forest Burning; Smoldering
2811015002	Other Combustion-as Event; Prescribed Forest Burning; Flaming

* The first tier level of the SCC Description is "Miscellaneous Area Sources."

Preparation of the 2014 wildland fire EI begins with raw input fire activity data and ends with daily estimates of emissions from each included fire location. Following on the use of local data sets for the 2011 NEI, input data sets from 22 states and one Indian Nation were used to calculate fire activity. State, local, and tribal agencies that provided input data were also asked to complete the NEI Wildland Fire Inventory Database Questionnaire, which consisted of a self-assessment of data completeness. Based on input from SLT data providers, submitted data sets were supplemented with up to seven data sets from national sources. The data sets were cleaned to eliminate errors and to achieve standardized formatting. Cleaned data sets were reconciled into a single, comprehensive fire location data set using the SmartFire2 (SF2) data processing system (airfire.org/smartfire). The SF2 reconciles multiple data sets to retain the best available information for each aspect of each fire event. The reconciled fire locations, along with fuel moisture and fuel loading data, were used in the BlueSky Framework (Larkin et al., 2009) to estimate smoke emissions. BlueSky Framework is a modeling framework that "links a variety of independent models of fire information, fuel loading, fire consumption, fire emissions, and smoke dispersion." (airfire.org/bluesky. For the 2014 NEI, wildland fire emissions estimates were estimated separately for flaming and smoldering combustion phases of fire to facilitate the better understanding of emission characteristics and to allow for the phases to be distinguished from one another during modeling.

SMARTFIRE2 estimates were used directly for all states except Georgia and Washington. These states submitted their own emissions.

Large fires of more than 20,000 acres in a single day were split using GeoMAC (https://www.geomac.gov/) fire shapes, where available, or using a circle centered on the detect lat/lon based on 12US2 grid cell overlap. The resulting split fires have emissions and area apportioned from the original fire into the grid cells based on fraction of area overlap between the fire shape and the cell. The idea is to prevent all of the emissions from a very large fire from going into a single grid cell, when in reality the fire emissions were more dispersed than a single point. The "subfires" were given new names that were the same as the original, but with "_a", "_b", "_c", and "_d" appended as needed. The FIPS state and county codes and fire IDs for the ten fires apportioned to multiple grid cells are shown in Table 2-23.

Table 2-23. Large fires apportioned to multiple grid cells

County FIPS[a]	Fire ID
02122	nei140018117
02122	nei140018197
06017	nei140125469

County FIPS[a]	Fire ID
12011	nei140014500
16063	nei140105145
27007	nei140082399
41025	nei140105167
41025	nei140105172
49001	nei140097811
53047	nei140105851
[a]We split fires in Alaska even though it was outside our modeling domain.	

For speciation, the "integrate" case was used for the first time, since SMOKE was updated to allow integration of daily inventories. This required making two inventory changes: 1) Smoldering SCCs with zero emissions had to be removed, because for daily integration, VOC=0 and HAPs=0 triggers an error. These zero emission records are a normal product of the smoldering/flaming re-binning process. 2) Two very tiny fires in Nebraska had zero VOC but nonzero HAPs. We set VOC equal to the sum of NBAFM (2.8E-7 tons for each fire).

2.7 Biogenic sources (beis)

Biogenic emissions were computed when CMAQ was run based on the same 14j version of the 2014 meteorology data used for the air quality modeling, and were developed using the Biogenic Emission Inventory System version 3.61 (BEIS3.61) within SMOKE. The BEIS3.61 creates gridded, hourly, model-species emissions from vegetation and soils. It estimates CO, VOC (most notably isoprene, terpene, and sesquiterpene), and NO emissions for the contiguous U.S. and for portions of Mexico and Canada.

For the NEIv2 landuse changes were made for the states of Florida, Texas and Washington to correct an error with the land use fractions which did not sum to 1; but the version remained named BELD4.1.

The BEIS3.61 was used in conjunction with the modified Version 4.1 of the Biogenic Emissions Landuse Database (BELD4) and incorporates a canopy two-layer canopy model to estimate leaf-level temperatures (Pouliot and Bash, 2015). In the BEIS 3.61 two-layer canopy model, the layer structure varies with light intensity and solar zenith angle. Both layers include estimates of sunlit and shaded leaf area based on solar zenith angle and light intensity, direct and diffuse solar radiation, and leaf temperature (Bash et al., 2015). The new algorithm requires additional meteorological variables over previous versions of BEIS. The variables output from the Meteorology-Chemistry Interface Processor (MCIP) that are used to convert WRF outputs to CMAQ inputs are shown in Table 2-24.

Table 2-24. Meteorological variables required by BEIS 3.61

Variable	Description
LAI	leaf-area index
PRSFC	surface pressure
Q2	mixing ratio at 2 m
RC	convective precipitation per met TSTEP
RGRND	solar rad reaching sfc

Variable	Description
RN	nonconvective precipitation per met TSTEP
RSTOMI	inverse of bulk stomatal resistance
SLYTP	soil texture type by USDA category
SOIM1	volumetric soil moisture in top cm
SOIT1	soil temperature in top cm
TEMPG	skin temperature at ground
USTAR	cell averaged friction velocity
RADYNI	inverse of aerodynamic resistance
TEMP2	temperature at 2 m

The BELD version 4.1 is based on an updated version of the USDA-USFS Forest Inventory and Analysis (FIA) vegetation speciation based data from 2001 to 2014 from the FIA version 5.1. Canopy coverage is based on the Landsat satellite National Land Cover Database (NLCD) product from 2011. The FIA includes approximately 250,000 representative plots of species fraction data that are within approximately 75 km of one another in areas identified as forest by the NLCD canopy coverage. The 2011 NLCD provides land cover information with a native data grid spacing of 30 meters. For land areas outside the conterminous United States, 500 meter grid spacing land cover data from the Moderate Resolution Imaging Spectroradiometer (MODIS) is used. BELDv4.1 also incorporates the following:

- 30 meter NASA's Shuttle Radar Topography Mission (SRTM) elevation data (http://www2.jpl.nasa.gov/srtm/) to more accurately define the elevation ranges of the vegetation species than in previous versions; and
- 2011 30 meter USDA Cropland Data Layer (CDL) data (http://www.nass.usda.gov/research/Cropland/Release/).

To provide a sense of the scope and spatial distribution of the emissions, plots of annual BEIS outputs for NO, isoprene, acetaldehyde, and formaldehyde associated with the 2014v7.0 platform are shown in Figure 2-3, Figure 2-4, Figure 2-5, and Figure 2-6, respectively. The land use changes made in 2014v7.1 would not impact these v7.0-based figures.

Figure 2-3. Annual NO emissions output from BEIS 3.61 for 2014

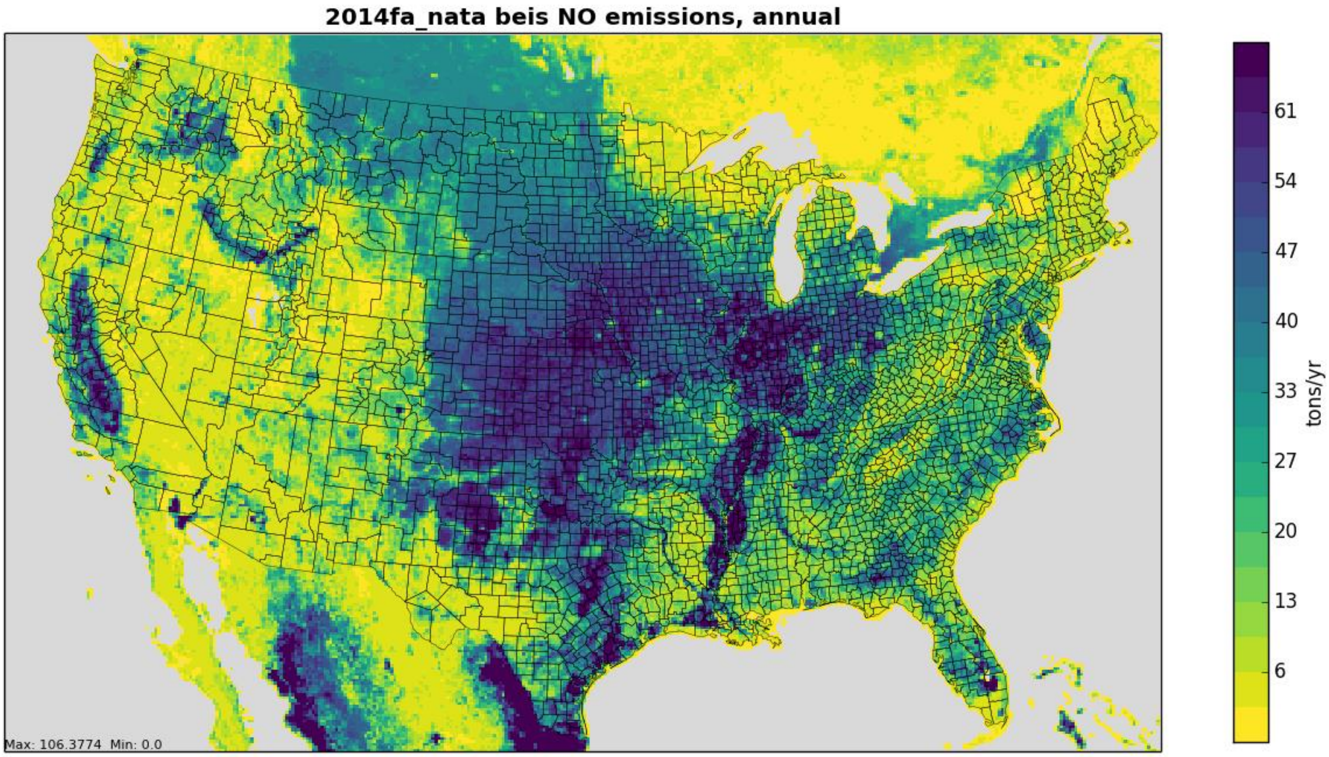


Figure 2-4. Annual isoprene emissions output from BEIS 3.61 for 2014

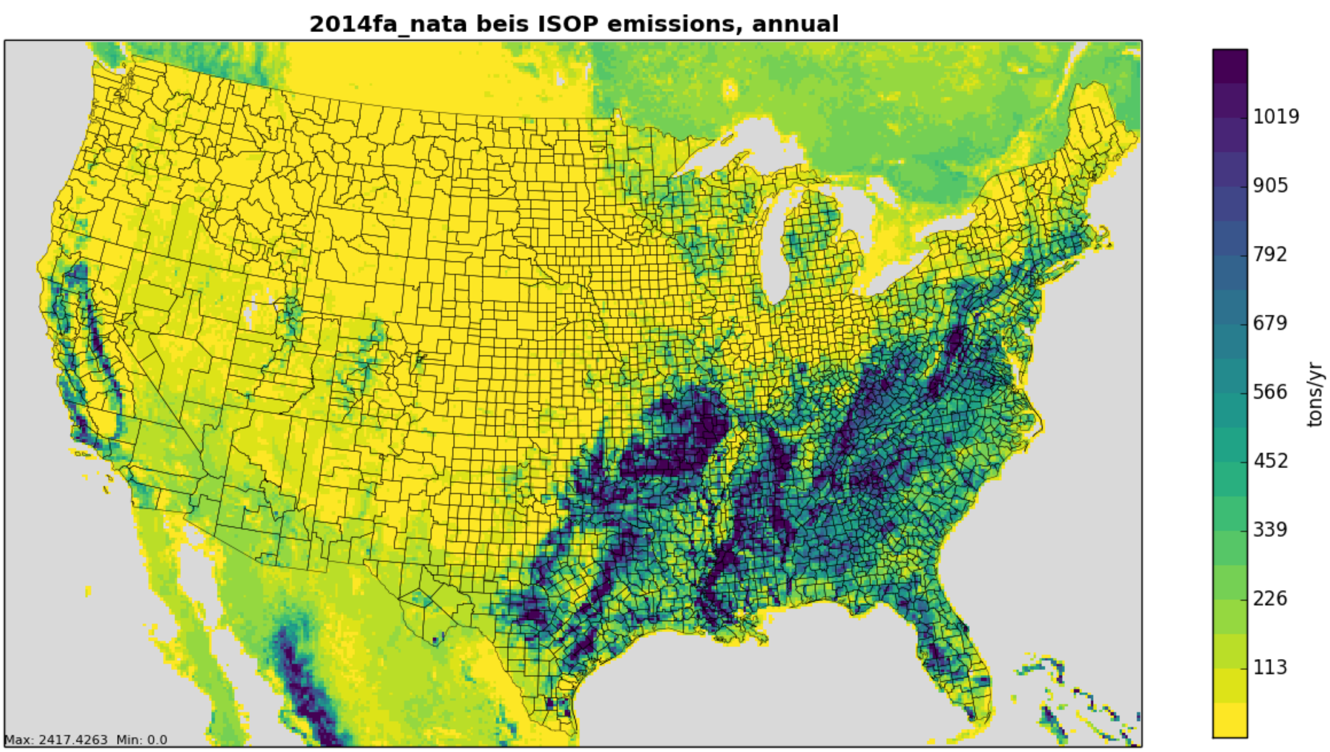


Figure 2-5. Annual acetaldehyde emissions output from BEIS 3.61 for 2014

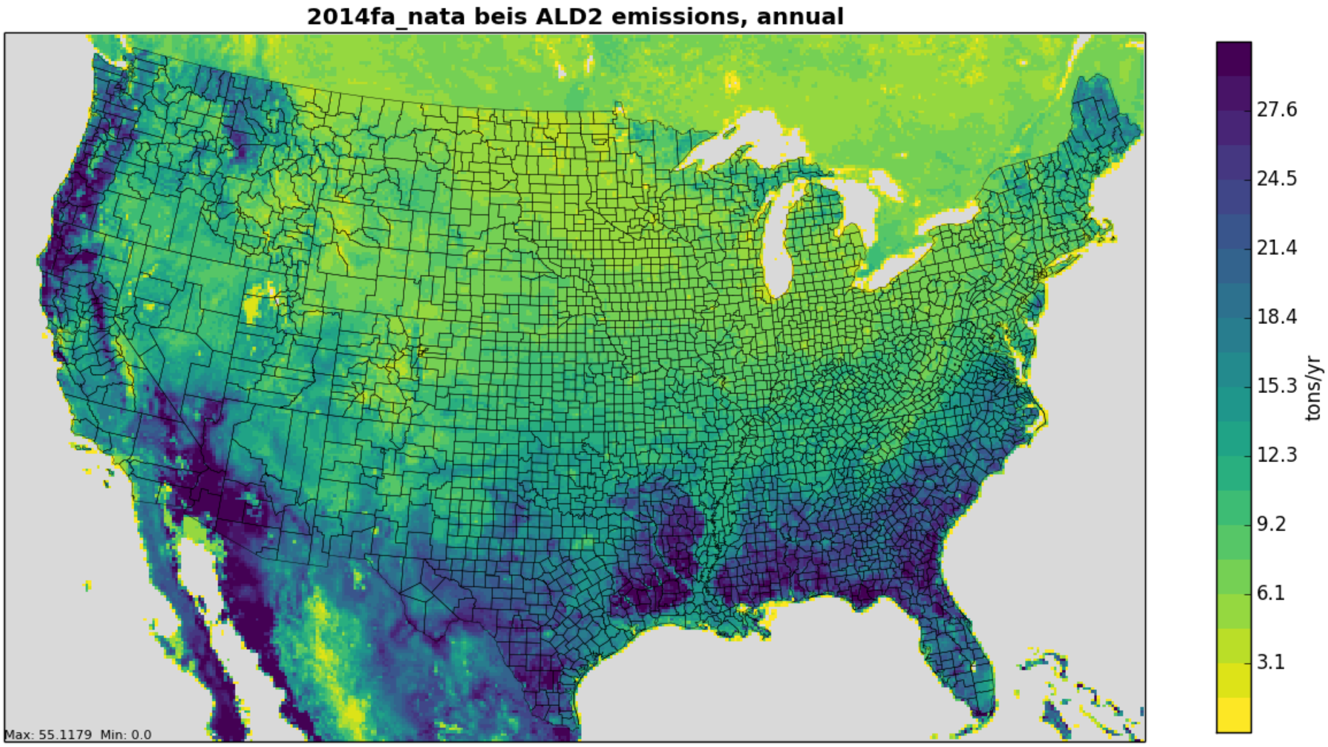
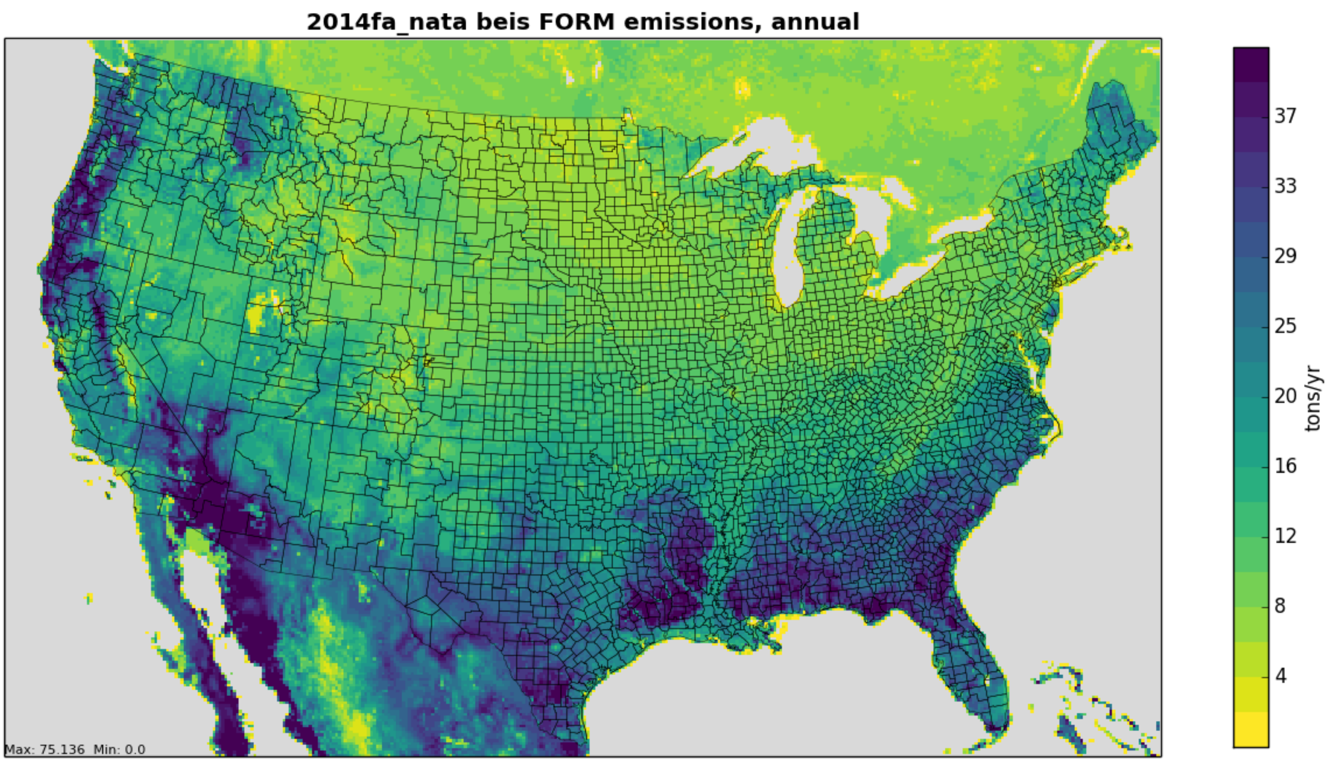


Figure 2-6. Annual formaldehyde emissions output from BEIS 3.61 for 2014



2.8 SMOKE-ready non-anthropogenic inventories for chlorine and mercury

The ocean chlorine gas emission estimates are based on the build-up of molecular chlorine (Cl_2) concentrations in oceanic air masses (Bullock and Brehme, 2002). Data at 36 km and 12 km resolution were available and were not modified other than the model-species name "CHLORINE" was changed to "CL2" to support CMAQ modeling.

For mercury, we are using the same volcanic mercury emissions as were used in the last several modeling platforms. The emissions were originally developed for a 2002 multipollutant modeling platform (ftp://ftp.epa.gov/EmisInventory/2002v3CAPHAP/documentation/volumeiii_hap_main_07may2008.pdf) with coordination and data from Christian Seigneur and Jerry Lin for 2001 (Seigneur et. al, 2004 and Seigneur et. al, 2001).

Because of mercury bidirectional flux within the latest version of CMAQ, the only natural mercury emissions we need to include in the merge are from volcanoes.

3 Emissions Modeling Summary

The CMAQ model requires hourly emissions of specific gas and particle species for the horizontal and vertical grid cells contained within the modeled region (i.e., modeling domain). To provide emissions in the form and format required by the model, it is necessary to "pre-process" the "raw" emissions (i.e., emissions input to SMOKE) for the sectors described above in Section 2. In brief, the process of emissions modeling transforms the emissions inventories from their original temporal resolution, pollutant resolution, and spatial resolution into the hourly, speciated, gridded resolution required by the air quality model. Emissions modeling includes temporal allocation, spatial allocation, and pollutant speciation. In some cases, emissions modeling also includes the vertical allocation of point sources, but many air quality models also perform this task because it greatly reduces the size of the input emissions files if the vertical layers of the sources are not included.

As seen in Section 2, the temporal resolutions of the emissions inventories input to SMOKE vary across sectors and may be hourly, daily, monthly, or annual total emissions. The spatial resolution, may be individual point sources, county/province/municipio totals, or gridded emissions and varies by sector. This section provides some basic information about the tools and data files used for emissions modeling as part of the modeling platform. In Section 2, the emissions inventories and how they differ from the the previous platform are described. In Section 3, the descriptions of data are limited to the ancillary data SMOKE uses to perform the emissions modeling steps. Note that all SMOKE inputs for the 2014 platform are available from the Air Emissions Modeling website (https://www.epa.gov/air-emissions-modeling).

SMOKE version 4.5 was used to process the raw emissions inventories into emissions inputs for each modeling sector into a format compatible with CMAQ. For sectors that have plume rise, the in-line plume rise capability allows for the use of emissions files that are much smaller than full three-dimensional gridded emissions files. For QA of the emissions modeling steps, emissions totals by specie for the entire model domain are output as reports that are then compared to reports generated by SMOKE on the input inventories to ensure that mass is not lost or gained during the emissions modeling process.

3.1 Emissions modeling Overview

When preparing emissions for the air quality model, emissions for each sector are processed separately through SMOKE, and then the final merge program (Mrggrid) is run to combine the model-ready, sector-specific 2-D gridded emissions across sectors. The SMOKE settings in the run scripts and the data in the SMOKE ancillary files control the approaches used by the individual SMOKE programs for each sector. Table 3-1 summarizes the major processing steps of each platform sector. The "Spatial" column shows the spatial approach used: "point" indicates that SMOKE maps the source from a point location (i.e., latitude and longitude) to a grid cell; "surrogates" indicates that some or all of the sources use spatial surrogates to allocate county emissions to grid cells; and "area-to-point" indicates that some of the sources use the SMOKE area-to-point feature to grid the emissions (further described in Section 3.4.2). The "Speciation" column indicates that all sectors use the SMOKE speciation step, though biogenics speciation is done within the Tmpbeis3 program and not as a separate SMOKE step. The "Inventory resolution" column shows the inventory temporal resolution from which SMOKE needs to calculate hourly emissions. Note that for some sectors (e.g., onroad, beis), there is no input inventory; instead, activity data and emission factors are used in combination with meteorological data to compute hourly emissions.

Finally, the "plume rise" column indicates the sectors for which the "in-line" approach is used. These sectors are the only ones with emissions in aloft layers based on plume rise. The term "in-line" means that the plume rise calculations are done inside of the air quality model instead of being computed by SMOKE. The air quality model computes the plume rise using stack parameters and the hourly emissions in the SMOKE output files for each emissions sector. The height of the plume rise determines the model layer into which the emissions are placed. The othpt sector has only "in-line" emissions, meaning that all of the emissions are treated as elevated sources and there are no emissions for those sectors in the two-dimensional, layer-1 files created by SMOKE. Other inline-only sectors are: cmv_c3, ptegu, ptfire, ptfire_othna, ptagfire. Day-specific point fire emissions are treated differently in CMAQ. After plume rise is applied, there are emissions in every layer from the ground up to the top of the plume.

Table 3-1. Key emissions modeling steps by sector.

Platform sector	Spatial	Speciation	Inventory resolution	Plume rise
afdust	Surrogates	Yes	annual	
ag	Surrogates	Yes	monthly	
beis	Pre-gridded land use	in BEIS3.61	computed hourly	
cmv_c1c2	Surrogates	Yes	annual	
cmv_c3	Point	Yes	annual	in-line
nonpt	Surrogates & area-to-point	Yes	annual	
nonroad	Surrogates & area-to-point	Yes	monthly	
np_oilgas	Surrogates	Yes	annual	
onroad	Surrogates	Yes	monthly activity, computed hourly	
onroad_ca_adj	Surrogates	Yes	monthly activity, computed hourly	
othafdust	Surrogates	Yes	annual	
othar	Surrogates	Yes	annual & monthly	
onroad_can	Surrogates	Yes	monthly	
onroad_mex	Surrogates	Yes	monthly	
othpt	Point	Yes	annual & monthly	in-line
ptagfire	Point	Yes	daily	in-line
pt_oilgas	Point	Yes	annual	in-line
ptegu	Point	Yes	daily & hourly	in-line
ptfire	Point	Yes	daily	in-line
ptfire_othna	Point	Yes	daily	in-line
ptnonipm	Point	Yes	annual	in-line
rail	Surrogates	Yes	annual	
rwc	Surrogates	Yes	annual	

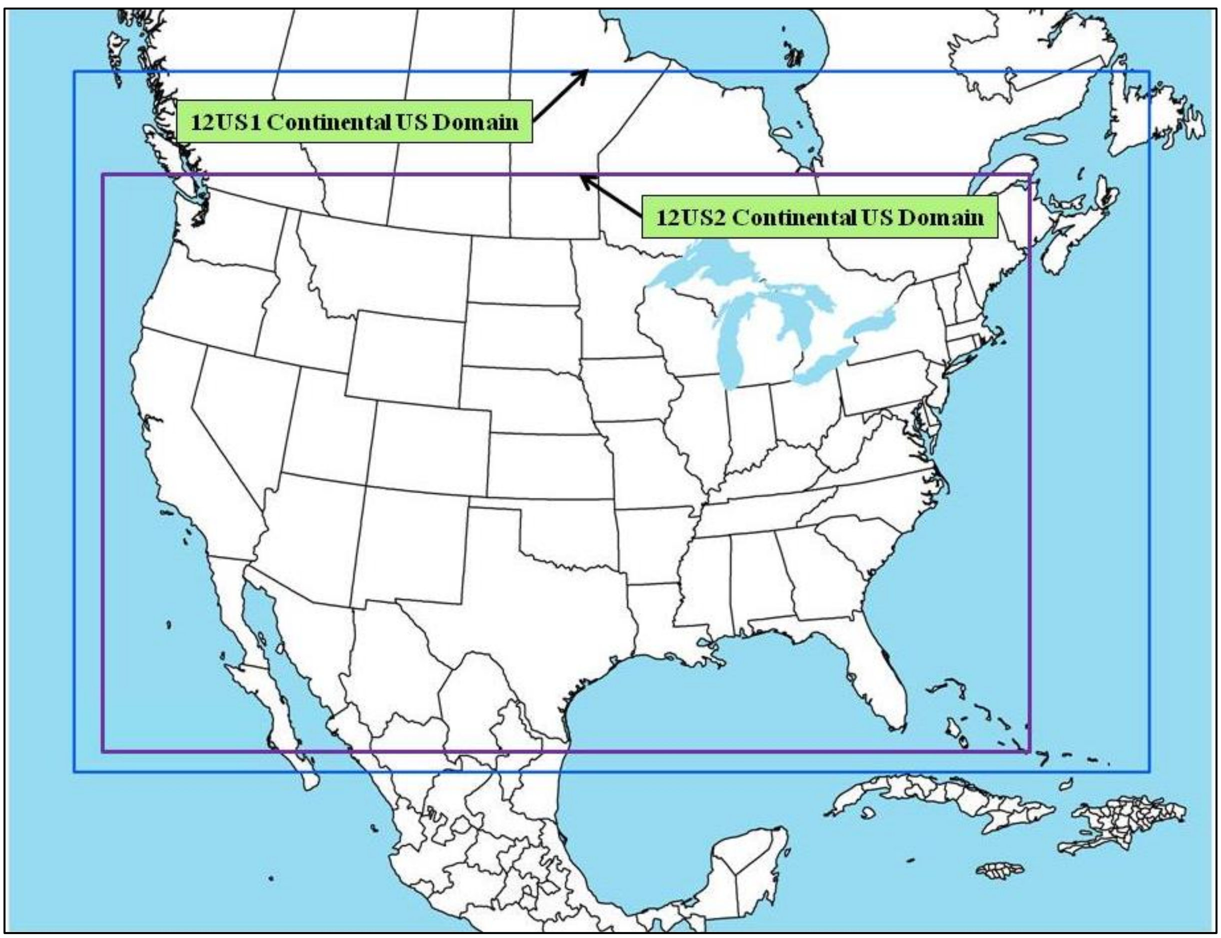
SMOKE has the option of grouping sources so that they are treated as a single stack when computing plume rise. For this platform, no grouping was performed because grouping combined with "in-line" processing will not give identical results as "offline" processing (i.e., when SMOKE creates 3-

dimensional files). This occurs when stacks with different stack parameters or latitudes/longitudes are grouped, thereby changing the parameters of one or more sources. The most straightforward way to get the same results between in-line and offline is to avoid the use of grouping.

Each sector was processed through SMOKE one time, but three cases were run through CMAQ: 1) a 2014 base case with all sources including biogenic emissions computed within CMAQ, 2) a 2014 fire zero out case where CMAQ computed biogenic emissions but excluded all fire input files (ptagfire, ptfire, and ptfire_othna) and 3) a 2014 biogenic zero out case that included fires but for which CMAQ did not compute biogenic emissions.

SMOKE was run for the smaller 12-km CONtinental United States "CONUS" modeling domain (12US2) shown in Figure 3-1 and boundary conditions for some model species including formaldehyde and acetaldehyde were obtained from a 2014 run of GEOS-Chem (others such as benzene relied on ambient measurements or were set to 0). Section 3.6 provides the details on the spatial surrogates and area-to-point data used to accomplish spatial allocation with SMOKE.

Figure 3-1. Air quality modeling domains



Both grids use a Lambert-Conformal projection, with Alpha = 33º, Beta = 45º and Gamma = -97º, with a center of X = -97º and Y = 40º. Table 3-2 describes the grids for the two domains.

Table 3-2. Descriptions of the platform grids

Common Name	Grid Cell Size	Description (see Figure 3-1)	Grid name	Parameters listed in SMOKE grid description (GRIDDESC) file: projection name, xorig, yorig, xcell, ycell, ncols, nrows, nthik
Continental 12km grid	12 km	Entire conterminous US plus some of Mexico/Canada	12US1_459X299	'LAM_40N97W', -2556000, -1728000, 12.D3, 12.D3, 459, 299, 1
US 12 km or "smaller" CONUS-12	12 km	Smaller 12km CONUS plus some of Mexico/Canada	12US2	'LAM_40N97W', -2412000 , -1620000, 12.D3, 12.D3, 396, 246, 1

3.2 Chemical Speciation

The emissions modeling step for chemical speciation creates the "model species" needed by the air quality model for a specific chemical mechanism and aerosol treatment. These model species are either individual chemical compounds (i.e., "explicit species") or groups of species (i.e., "lumped species"). Key CAP inventory pollutants that are speciated are VOC, $PM_{2.5}$ and NO_X; mercury and HAP metals are also speciated. In general, SMOKE converts VOC to TOG and the speciates it into the mechanism-specific model species. Special steps (described in 3.2.1) are taken to use inventory HAP VOC emissions in the speciation process. SMOKE speciates $PM_{2.5}$ into PM model species used by the air quality model's aerosol module.

The chemical mechanism used for the 2014 platform is the CB6 mechanism (Yarwood, 2010). We used a particular version of CB6 that we refer to here as "CB6-CMAQ" that breaks out naphthalene (NAPH) from XYL and PAR as an explicit model species, resulting in model species NAPH and XYLMN instead of XYL, and revising PAR to remove the naphthalene portion (very small amount). CB6-CMAQ also uses SOAALK (Pye and Pouliot, 2012), a species produced from TOG speciation that is not used in CAMX. This platform generates the $PM_{2.5}$ model species associated with the CMAQ Aerosol Module version 6 (AE6). Table 3-3 through Table 3-5 list the model species produced by SMOKE in the 2014 platform. Per Table 3-4, many HAPs added as tracer species (not participating in the CB6 chemistry) are used. These species are not generated through speciation but rather mapped or aggregated from inventory species directly to model species. Eight species were added to CMAQ (these are shown with an asterisk) since the version that was used in the 2011 NATA. The HAP metals, also from the inventory, are speciated within SMOKE into coarse and fine components.

The TOG and $PM_{2.5}$ speciation factors that are the basis of the chemical speciation approach were developed from the SPECIATE database (https://www.epa.gov/air-emissions-modeling/speciate-version-45-through-40), which is the EPA's repository of TOG and PM speciation profiles of air pollution sources. The SPECIATE database development and maintenance is a collaboration involving the EPA's Office of Research and Development (ORD), Office of Transportation and Air Quality (OTAQ), and the Office of Air Quality Planning and Standards (OAQPS), in cooperation with Environment Canada (EPA, 2016). The SPECIATE database contains speciation profiles for TOG, speciated into individual chemical compounds, VOC-to-TOG conversion factors associated with the TOG profiles, and speciation profiles for $PM_{2.5}$. In addition to the new/revised profiles we used in v7.0 based on SPECIATE4.5, we added a few profiles that will be included in the next release (v5.0). Appendix C provides a summary of the new/revised TOG profiles that we used from SPECIATE version 4.5 for v7.0 and v7.1[6].

[6] Excluding onroad mobile since speciation is done, other than for brake and tire, within MOVES. Two new-to-SPECIATE4.5 brake and tirewear profiles were used in this platform: 95462 (Composite - Brake Wear) and 95460 (Composite - Tire Dust).

The TOG and $PM_{2.5}$ speciation profiles are applied to inventory sources in SMOKE through speciation profile cross reference assignments contained in the ancillary files called “GSREF”. This cross reference is not a part of the SPECIATE database, but rather is a part of the modeling platform. Profiles can be applied to sources based on the any source attributes; most commonly the SCC or the SCC and FIPS are used.

Some key features of the 2014v7.1 platform include the following (the subsections below contain more details on the specific changes):

- VOC speciation profile cross reference assignments for point and nonpoint oil and gas sources were updated to (1) make corrections to the 2011v6.3 cross references, (2) use new and revised profiles that were added to SPECIATE4.5 and (3) account for the portion of VOC estimated to come from flares, based on data from the Oil and Gas estimation tool used to estimate emissions for the NEI. The new/revised profiles included oil and gas operations in specific regions of the country and a national profile for natural gas flares;
- the Western Regional Air Partnership (WRAP) speciation profiles are the SPECIATE4.5 revised versions (profiles with “_R” in Table 3-8) used for the np_oilgas sector were revised;
- the VOC speciation process for nonroad mobile has been updated - profiles are now assigned within MOVES2014a which outputs the emissions with those assignments; also the nonroad profiles themselves were updated;
- VOC and PM speciation for onroad mobile sources occurs within MOVES2014a except for brake and tirewear PM speciation which occurs in SMOKE;
- speciation for onroad mobile sources in Mexico is done within MOVES and is more consistent with that used in the United States; and
- As with previous platforms, some Canadian point source inventories are provided from Environment Canada as pre-speciated emissions; however for the 2013 inventories, not all CB6-CMAQ species were provided; missing species were supplemented by speciating VOC which was provided separately.

Speciation profiles and cross-references for the 2014 platform are available in the SMOKE input files for the 2014 platform. Emissions of VOC and $PM_{2.5}$ emissions by county, sector and profile for all sectors other than onroad mobile are available with the sector summaries for the case. Totals of each model species and key inventory pollutants by state and sector can be found in the state-sector totals workbook for this case.

Table 3-3. Emission model species produced for CB6-CMAQ

Inventory Pollutant	Model Species	Model species description
Cl_2	CL2	Atomic gas-phase chlorine
HCl	HCL	Hydrogen Chloride (hydrochloric acid) gas
CO	CO	Carbon monoxide
NO_X	NO	Nitrogen oxide
	NO2	Nitrogen dioxide
	HONO	Nitrous acid
SO_2	SO2	Sulfur dioxide
	SULF	Sulfuric acid vapor
NH_3	NH3	Ammonia
VOC	ACET	Acetone
	ALD2	Acetaldehyde
	ALDX	Propionaldehyde and higher aldehydes
	BENZ	Benzene
	CH4	Methane[1]
	ETH	Ethene
	ETHA	Ethane
	ETHY	Ethyne
	ETOH	Ethanol
	FORM	Formaldehyde
	KET	Ketone Groups
	IOLE	Internal olefin carbon bond (R-C=C-R)
	ISOP	Isoprene
	MEOH	Methanol
	NAPH	Naphthalene
	OLE	Terminal olefin carbon bond (R-C=C)
	PAR	Paraffin carbon bond
	PRPA	Propane
	TOL	Toluene and other monoalkyl aromatics
	XYLMN	Xylene and other polyalkyl aromatics, minus naphthalene
	SOAALK	Lumped SOA tracer
Naphthalene[2]	NAPH	Naphthalene from inventory
Benzene[2]	BENZ	Benzene from the inventory
Acetaldehyde[2]	ALD2	Acetaldehyde from inventory
Formaldehyde[2]	FORM	Formaldehyde from inventory
Methanol[2]	MEOH	Methanol from inventory
VOC species from the biogenics model that do not map to model species above	SESQ	Sesquiterpenes
	TERP	Terpenes
PM_{10}	PMC	Coarse PM > 2.5 microns and ≤ 10 microns
$PM_{2.5}$	PAL	Aluminum
	PCA	Calcium
	PCL	Chloride
	PEC	Particulate elemental carbon and ≤ 2.5 microns
	PFE	Iron

Inventory Pollutant	**Model Species**	**Model species description**
	PK	Potassium
	PH2O	Water
	PMG	Magnesium
	PMN	Manganese
	PMOTHR	$PM_{2.5}$ not in other AE6 species
	PNA	Sodium
	PNCOM	Non-carbon organic matter
	PNO3	Particulate nitrate
	PNH4	Ammonium
	POC	Particulate organic carbon (carbon only) ≤ 2.5 microns
	PSI	Silicon
	PSO4	Particulate Sulfate ≤ 2.5 microns
	PTI	Titanium
Sea-salt species (non – anthropogenic) [3]	PCL	Particulate chloride
	PNA	Particulate sodium

[1]Technically, CH_4 is not a VOC but part of TOG. Although emissions of CH_4 are derived, the AQ models do not use these emissions because the anthropogenic emissions are dwarfed by the CH_4 already in the atmosphere.
[2]Naphthalene, benzene, acetaldehyde, formaldehyde and methanol (NBAFM) is produced via VOC speciation for Canada and Mexico, for other than onroad mobile sources in Mexico, or, in very small quantities due to mixtures in the speciation profiles as is discussed in 3.2.1.1 from profiles listed in Appendix E.
[3]These emissions are created outside of SMOKE.

Table 3-4. Additional HAP Gaseous model species produced for CMAQ multipollutant specifically for NATA (not used within CB6)

Inventory Pollutant	Model Species
Acetaldehyde	ALD2_PRIMARY
Formaldehyde	FORM_PRIMARY
Acetonitrile[1]	ACETONITRILE
Acrolein	ACROLEIN
Acrylic acid [1]	ACRYLICACID
Acrylonitrile	ACRYLONITRILE
1,3-Butadiene	BUTADIENE13
Carbon tetrachloride	CARBONTET
Carbonyl Sulfide[1]	CARBSULFIDE
Chloroform	CHCL3
Chloroprene[1]	CHLOROPRENE
1,4-Dichlorobenzene(p)	DICHLOROBENZENE
1,3-Dichloropropene	DICHLOROPROPENE
Ethylbenzene[1]	ETHYLBENZ
Ethylene dibromide (Dibromoethane)	BR2_C2_12
Ethylene dichloride (1,2-Dichloroethane)	CL2_C2_12
Ethylene oxide	ETOX
Hexamethylene-1,6-diisocyanate	HEXAMETH_DIIS
Hexane[1]	HEXANE
Hydrazine	HYDRAZINE
Maleic Anyhydride	MAL_ANYHYDRIDE
Methyl Chloride[1]	METHCLORIDE
Methylene chloride (Dichloromethane)	CL2_ME
Specific PAHs assigned with URE =0	PAH_000E0
Specific PAHs assigned with URE =9.6E-06 (previously 1.76E-5)	PAH_176E5
Specific PAHs assigned with URE =4.8E-05 (previously 8.8E-5)	PAH_880E5
Specific PAHs assigned with URE =9.6E-05 (previously 1.76E-4)	PAH_176E4
Specific PAHs assigned with URE =9.6E-04 (previously 1.76E-3)	PAH_176E3
Specific PAHs assigned with URE =9.6E-03 (previously 1.76E-2)	PAH_176E2
Specific PAHs assigned with URE =0.01 (previously 1.01E-2)	PAH_101E2
Specific PAHs assigned with URE =1.14E-1	PAH_114E1
Specific PAHs assigned with URE =9.9E-04 (previously 1.92E-3)	PAH_192E3
Propylene dichloride (1,2-Dichloropropane)	PROPDICHLORIDE
Quinoline	QUINOLINE
Styrene[1]	STYRENE
1,1,2,2-Tetrachloroethane	CL4_ETHANE1122
Tetrachloroethylene (Perchloroethylene)	CL4_ETHE
Toluene	TOLU
2,4-Toluene diisocyanate	TOL_DIIS
Trichloroethylene	CL3_ETHE
Triethylamine	TRIETHYLAMINE
m-xylene, o-xylene, p-xylene, xylenes (mixed isomers) [2]	XYLENES
Vinyl chloride	CL_ETHE

[1]New to CMAQ5.2 – version of CMAQ used for 2011 NATA did not include these HAPs.
[2]In 2011 NATA, these were separated into 3 model species: MXYL, OXYL and PXYL; in 2014 they are combined into XYLENES.

Table 3-5. Additional HAP Particulate* model species produced for CMAQ multipollutant specifically for NATA

Inventory Pollutant	Model Species
Arsenic	ARSENIC_C, ARSENIC_F
Beryllium	BERYLLIUM_C, BERYLLIUM_F
Cadmium	CADMIUM_C, CADMIUM_F
Chromium VI, Chromic Acid (VI), Chromium Trioxide	CHROMHEX_C, CHROMHEX_F
Chromium III	CHROMTRI_C, CHROMTRI_F
Lead	LEAD_C, LEAD_F
Manganese	MANGANESE_C, MANGANESE_F
Mercury[1]	HGIIGAS, HGNRVA, PHGI
Nickel, Nickel Oxide, Nickel Refinery Dust	NICKEL_C, NICKEL_F
Diesel-PM10, Diesel-PM25	DIESEL_PMC , DIESEL_PMFINE, DIESEL_PMEC, DIESEL_PMOC, DIESEL_PMNO3, DIESEL_PMSO4

[1]Mercury is multi-phase

3.2.1 VOC speciation

The concept of VOC speciation is to use emission source-related speciation profiles to convert VOC to TOG, to speciate TOG into individual chemical compounds, and to use a chemical mechanism mapping file to aggregate the chemical compounds to the chemical mechanism model species. The chemical mechanism mapping file is typically developed by the developer of the chemical mechanism.

SMOKE uses profiles that convert inventory species and TOG directly to the model species. The SMOKE-ready profiles are generated from the Speciation Tool which uses the “raw” (TOG to chemical compounds) SPECIATE profiles and the chemical mechanism mapping file.

For the 2014v7.0 platform, the CB6 chemical mapping file was updated to add assignments for compounds in SPECIATE4.5 that had not been assigned (see Appendix D), and molecular weights were added to some compounds for which they were missing. In addition, he speciation cross reference was revised to use updated profiles from the SPECIATE4.5 database for oil and gas, livestock waste and nonroad mobile sources. For v7.1, the livestock waste profiles were modified to include methane and ethane by gapfilling these species. Appendix C provides a list of new profiles used for the v7.0 and v7.1 platforms. Similar to previous platforms, HAP VOC inventory species were used in the VOC speciation process for some sectors as described below.

3.2.1.1 The use of HAP NBAFM (naphthalene, benzene, acetaldehyde, formaldehyde and methanol) in VOC speciation

The VOC speciation process uses HAP emissions from the 2014NEI. Instead of speciating VOC to generate all of the species listed in Table 3-3, emissions of five specific HAPs: naphthalene, benzene, acetaldehyde, formaldehyde and methanol (collectively known as “NBAFM”) from the NEI were “integrated” with the NEI VOC. The integration combines these HAPs with the VOC in a way that does not double count emissions and uses the HAP inventory directly in the speciation process. The basic process is to subtract the specified HAPs emissions mass from the VOC emissions mass, and to then use a special "integrated" speciation profile to speciate the remainder of VOC to the model species. The "integrated" profile is one that excludes the specific HAPs and is applied to the non-HAP portion of the VOC (which is the difference between the VOC emissions mass and HAPs emissions). The EPA believes that the HAP emissions in the NEI are often more representative of emissions than HAP emissions generated via VOC speciation, although this varies by sector.

The NBAFM HAPs were chosen for integration because they are the only explicit VOC HAPs in the CMAQ version 5.2 multipollutant. Explicit means that they are not lumped chemical groups like PAR, IOLE and several other CB6 model species. These "explicit VOC HAPs" are model species that participate in the modeled chemistry using the CB6 chemical mechanism. The use of inventory HAP emissions along with VOC is called "HAP-CAP integration."

The integration of HAP VOC with VOC is a feature available in SMOKE for all inventory formats, including PTDAY (the format used for the ptfire and ptagfire sectors). The ability to use integration with the PTDAY format was made available in the version of SMOKE used for the v7.1 platform; but it was not available for the v7.0 platform. SMOKE allows the user to specify the particular HAPs to integrate via the INVTABLE. This is done by setting the "VOC or TOG component" field to "V" for all HAP pollutants chosen for integration. SMOKE allows the user to also choose the particular sources to integrate via the NHAPEXCLUDE file (which actually provides the sources to be *excluded* from integration[7]).

The speciation approach shown in Figure 3-2. For the "integrated" sources, SMOKE subtracts the "integrated" HAPs from the VOC (at the source level) to compute emissions for the new pollutant "NONHAPVOC." The user provides NONHAPVOC-to-NONHAPTOG factors and NONHAPTOG speciation profiles[8]. SMOKE computes NONHAPTOG and then applies the speciation profiles to allocate the NONHAPTOG to the other air quality model VOC species not including the integrated HAPs. After determining if a sector is to be integrated, if all sources have the appropriate HAP emissions, then the sector is considered fully integrated and does not need a NHAPEXCLUDE file. If, on the other hand, certain sources do not have the necessary HAPs, then an NHAPEXCLUDE file must be provided based on the evaluation of each source's pollutant mix. The EPA considered CAP-HAP integration for all sectors determined whether sectors would have full, no or partial integration (see Table 3-6). For sectors with partial integration, all sources are integrated other than those that have either the sum of NBAFM > VOC or the sum of NBAFM = 0.

For an air toxics platform such as the 2014v7.1 case, the "no-integrate" sources are treated differently from a criteria pollutant-focused (CAP) platform such as the 2011v6.3. In 2014v7.1, the "no-integrate" approach removes the specified HAPs from the profile and still use the emissions of these HAPs from the NEI. It is very similar to the "integrate" case except that it does not renormalize the revised profile. In 2011v6.3 or any CAP platform, no-integrate means that no inventory HAPs are used. The explicit HAP model species are instead created by speciating the "no-integrate" source VOC emissions. In general, we can generate HAP that are explicit in the chemical mechanism from either speciation or the inventory. We chose to use the HAPs in the inventory for NATA since these are the data that are used to represent HAP emissions in the U.S. Also, HAP emissions in the NEI may be developed using more site-specific

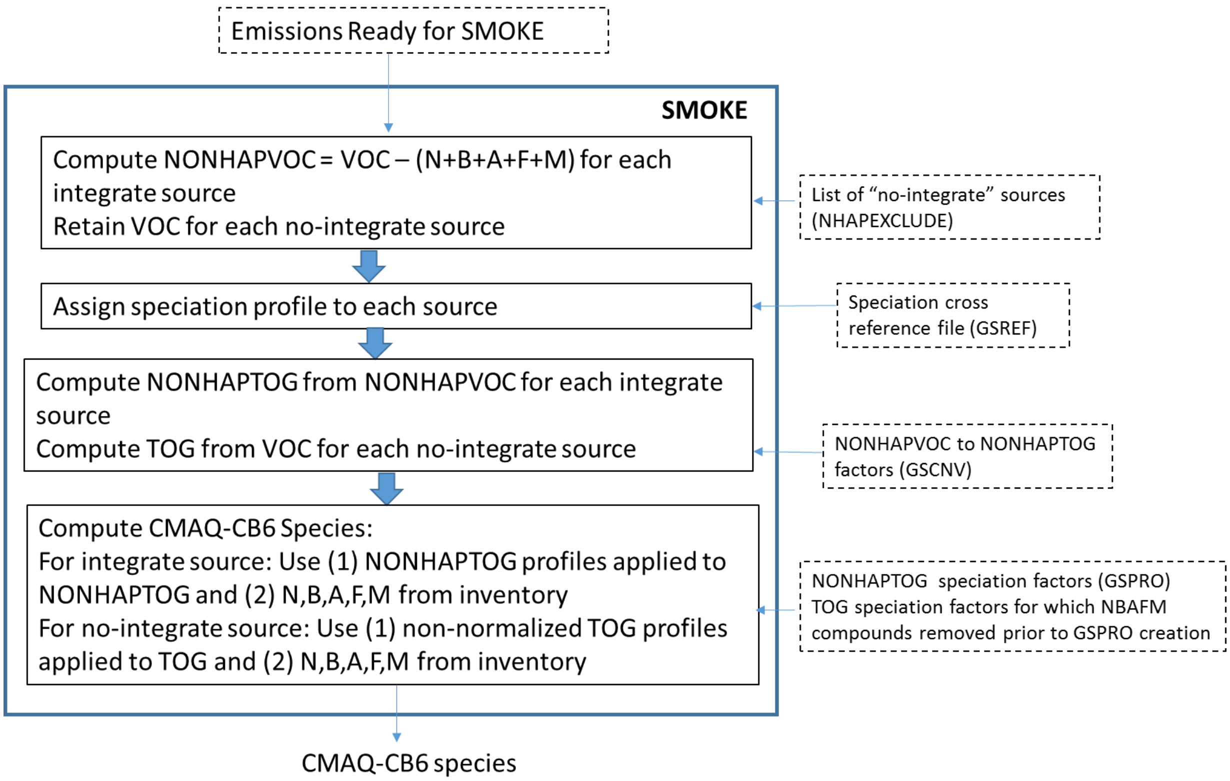
[7] Since SMOKE version 3.7, the options to specify sources for integration are expanded so that a user can specify the particular sources to include or exclude from integration, and there are settings to include or exclude all sources within a sector. In addition, the error checking is significantly stricter for integrated sources. If a source is supposed to be integrated, but it is missing BAFM or VOC, SMOKE will now raise an error.

[8] These ratios and profiles are typically generated from the Speciation Tool when it is run with integration of a specified list of pollutants, for example NBAFM.

data (e.g., source testing, material balance) that would not be reflected by applying a speciation profile to VOC emissions. In addition, we have applied numerous HAP augmentation measures in the NEI. Since Canada and Mexico inventories do not contain HAPs, we use the approach of generating the HAPs via speciation, except for Mexico onroad mobile sources where emissions for integrate HAPs were available.

It should be noted that even though NBAFM were removed from the SPECIATE profiles used to create the GSPRO for both the NONHAPTOG and no-integrate TOG profiles, there still may be small fractions for "BENZENE", "FORM", "ALD2", "METHANOL" present. This is because these model species may have come from species in SPECIATE that are mixtures. The quantity of these model species is expected to be very small compared to the BAFM in the NEI. These profiles are listed in Appendix E. There are no NONHAPTOG profiles that produce "NAPHTHALENE."

Figure 3-2. Process of integrating NBAFM with VOC for use in VOC Speciation for U.S. Sources



Integration for the mobile sources estimated from MOVES (onroad and nonroad sectors, other than for California) is done differently, and is discussed in more detail in 3.2.1.3. Briefly there are three major differences: 1) for these sources integration is done using more pollutants than just NBAFM, 2) all sources from the MOVES model are integrated and 3) integration is done fully or partially within MOVES. For onroad mobile, speciation is done fully within MOVES2014a such that the MOVES model outputs emission factors for individual VOC model species along with the HAPs. This requires MOVES to be run for a specific chemical mechanism. We ran it for a version of CB6 that excludes NAPH and SOAALK so post-SMOKE we converted the emissions to CB6-CMAQ as follows:

- XYLMN = XYL[1]-0.966*NAPHTHALENE[1]
- PAR = PAR[1]-0.00001*NAPHTHALENE[1]
- SOAALK = 0.108*PAR[1]

For nonroad mobile sources, speciation is partially done within MOVES such that it does not need to be run for a specific chemical mechanism. For nonroad, MOVES outputs emissions of HAPs and NONHAPTOG split by speciation profile. The integrated species were subtracted out by MOVES, and the appropriate speciation profiles are then applied in SMOKE to get the VOC model species. HAP integration for nonroad uses the same additional HAPs and ethanol as for onroad.

Table 3-6. Integration approach for NBAFM for each platform sector

Platform Sector	Approach for Integrating NEI emissions of Naphthalene (N), Benzene (B), Acetaldehyde (A), Formaldehyde (F), and Methanol (M)
afdust	N/A – sector contains no VOC
ag	Partial integration (NBAFM)[1] Use NBAFM in inventory for no-integrate sources
beis	N/A – sector contains no inventory pollutant "VOC"; but rather specific VOC species
cmv_c1c2	Full integration (NBAFM)
cmv_c3	Full integration (NBAFM)
nonpt	Partial integration (NBAFM)[2] Use NBAFM in inventory for no-integrate sources
nonroad	Full integration (NBAFM in California, internal to MOVES elsewhere)[1]
np_oilgas	Partial integration (NBAFM)[3] Use NBAFM in inventory for no-integrate sources
onroad	Full integration (internal to MOVES)[4]
othafdust	N/A – sector contains no VOC
othar	No integration, no NBAFM in inventory, create NBAFM from speciation
onroad_can	No integration, no NBAFM in inventory, create NBAFM from speciation
onroad_mex	Full integration (internal to MOVES-Mexico)[4]
othpt	No integration, no NBAFM in inventory, create NBAFM from speciation
ptagfire	Full integration (NBAFM)
pt_oilgas	No integration, use NBAFM from inventory and not speciation
ptegu	No integration, use NBAFM from inventory and not speciation
ptfire	Full integration (NBAFM)
ptfire_othna	No integration, no NBAFM in inventory, create NBAFM from speciation
ptnonipm	No integration, use NBAFM from inventory and not speciation
rail	Partial integration (NBAFM)[5]; no-integrate sources have no NBAFM so it is missing
rwc	Partial integration (NBAFM) Use NBAFM in inventory for no-integrate sources

[1]Ag VOC without NBAFM is 0; negligible (0.003 tons) NBAFM without VOC
[2] 731,000 tons VOCs without NBAFM across a variety of SCCs including solvent utilization, waste disposal; 590 tons NBAFM without VOC
[3] 345,000 tons VOCs without NBAFM
[4]For the integration that is internal to MOVES or MOVES-Mexico, an extended list of HAPs are integrated, not just BAFM. See 3.2.1.3

Platform Sector	Approach for Integrating NEI emissions of Naphthalene (N), Benzene (B), Acetaldehyde (A), Formaldehyde (F), and Methanol (M)
[5] 272 tons VOC from SCCs 2285002008,2285002009,2285002010, with no NBAFM, primarily in California, Maryland and Washington [5] 4 tons VOC from pellet stoves with NBAFM > VOC (66 tons NBAFM)	

More details on the integration of specific sectors and additional details of the speciation are provided in Section 3.2.1.3.

3.2.1.2 County specific profile combinations

SMOKE can compute speciation profiles from mixtures of other profiles in user-specified proportions via two different methods. The first method, GSPRO_COMBO was used in previous platforms since the 2005, and the second method (GSPRO with fraction) was used for the first time in the 2014v7.0. The GSPRO_COMBO method uses profile combinations specified in the GSPRO_COMBO ancillary file by pollutant (which can include emissions mode, e.g., EXH__VOC), state and county (i.e., state/county FIPS code) and time period (i.e., month). Different GSPRO_COMBO files can be used by sector, allowing for different combinations to be used for different sectors but within a sector, different profiles cannot be applied based on SCC. The GSREF file indicates that a specific source uses a combination file with the profile code "COMBO." SMOKE computes the resultant profile using the fraction of each specific profile assigned by county, month and pollutant.

In previous platforms, the GSPRO_COMBO feature was used to speciate nonroad mobile and gasoline-related stationary sources that use fuels with varying ethanol content. In these cases, the speciation profiles require different combinations of gasoline profiles, e.g. E0 and E10 profiles. Since the ethanol content varied spatially (e.g., by state or county), temporally (e.g., by month), and by modeling year (future years have more ethanol), the GSPRO_COMBO feature allowed combinations to be specified at various levels for different years. The GSPRO_COMBO is no longer needed for nonroad sources outside of California because nonroad emissions within MOVES have the speciation profiles built into the results, so there is no need to assign them via the GSREF or GSPRO_COMBO feature. For the 2014v7.1 platform, GSPRO_COMBO is still used for nonroad sources in California and for certain gasoline-related stationary sources nationwide. The fractions combining the E0 and E10 profiles are based on year 2010 regional fuels and do not vary by month. GSPRO_COMBO is not needed for inventory years after 2014, because the vast majority of fuel is E10.

In Canada and Mexico, only E0 speciation profiles are used, but the GSPRO_COMBO feature is still used for inventories where VOC emissions are not explicitly defined by mode (e.g. exhaust versus evaporative). Here, the GSPRO_COMBO specifies a mix of exhaust and evaporative speciation profiles. This is no longer necessary for Canadian mobile sources, whose inventories now include the mode in the pollutant, or for Mexico onroad sources, where VOC speciation is calculated by the MOVES model. For the 2014v7.1 platform, the GSPRO_COMBO is still used for Mexican nonroad sources which do not have modes in the inventory.

A new method to combine multiple profiles became available in SMOKE4.5. It allows multiple profiles to be combined by pollutant, state and county (i.e., state/county FIPS code) and SCC. This was used specifically for the oil and gas sectors (pt_oilgas and np_oilgas) because SCCs include both controlled and uncontrolled oil and gas operations which use different profiles.

3.2.1.3 Additional sector specific considerations for integrating HAP emissions from inventories into speciation

The decision to integrate HAPs into the speciation was made on a sector by sector basis. For some sectors, there is no integration and VOC is speciated directly; for some sectors, there is full integration meaning all sources are integrated; and for other sectors, there is partial integration, meaning some sources are not integrated and other sources are integrated. The integrated HAPs are either NBAFM or, in the case of MOVES (onroad, nonroad and MOVES-Mexico), a larger set of HAPs plus ethanol are integrated. Table 3-6 above summarizes the integration method for each platform sector.

For the rail sector, the EPA integrated NBAFM for most sources. Some SCCs had zero BAFM and, therefore, they were not integrated. These were SCCs provided by states for which EPA did not do HAP augmentation (2285002008, 2285002009 and 2285002010) because EPA does not create emissions for these SCCs. The VOC for these sources sum to 272 tons, and most of the mass is in California (189 tons) and Washington state (62 tons).

Speciation for the onroad sector is unique. First, SMOKE-MOVES (see Section 2.3.1) is used to create emissions for these sectors and both the MEPROC and INVTABLE files are involved in controlling which pollutants are processed. Second, the speciation occurs within MOVES itself, not within SMOKE. The advantage of using MOVES to speciate VOC is that during the internal calculation of MOVES, the model has complete information on the characteristics of the fleet and fuels (e.g., model year, ethanol content, process, etc.), thereby allowing it to more accurately make use of specific speciation profiles. This means that MOVES produces emission factor tables that include inventory pollutants (e.g., TOG) and model-ready species (e.g., PAR, OLE, etc)[9]. SMOKE essentially calculates the model-ready species by using the appropriate emission factor without further speciation[10]. Third, MOVES' internal speciation uses full integration of an extended list of HAPs beyond NBAFM (called "M-profiles"). The M-profiles integration is very similar to NBAFM integration explained above except that the integration calculation (see Figure 3-2) is performed on emissions factors instead of on emissions, and a much larger set of pollutants are integrated besides NBAFM. The list of integrated pollutants is described in Table 3-7. An additional run of the Speciation Tool was necessary to create the M-profiles that were then loaded into the MOVES default database. Fourth, for California, the EPA applied adjustment factors to SMOKE-MOVES to produce California adjusted model-ready files (see Section 2.3.1 for details). By applying the ratios through SMOKE-MOVES, the CARB inventories are essentially speciated to match EPA estimated speciation. This resulted in changes to the VOC HAPs from what CARB submitted to the EPA. Finally, MOVES speciation used the CAMx version of CB6 which does not split out naphthalene.

Table 3-7. MOVES integrated species in M-profiles

MOVES ID	Pollutant Name
5	Methane (CH_4)
20	Benzene
21	Ethanol
22	MTBE
24	1,3-Butadiene
25	Formaldehyde

[9] Because the EF table has the speciation "baked" into the factors, all counties that are in the county group (i.e., are mapped to that representative county) will have the same speciation.
[10] For more details on the use of model-ready EF, see the SMOKE 3.7 documentation: https://www.cmascenter.org/smoke/documentation/3.7/html/.

MOVES ID	Pollutant Name
26	Acetaldehyde
27	Acrolein
40	2,2,4-Trimethylpentane
41	Ethyl Benzene
42	Hexane
43	Propionaldehyde
44	Styrene
45	Toluene
46	Xylene
185	Naphthalene gas

For the nonroad sector, all sources are integrated using the same list of integrated pollutants as shown in Table 3-7. Outside of California, the integration calculations are performed within MOVES. For California, integration calculations are handled by SMOKE. The CARB-based nonroad inventory includes VOC HAP estimates for all sources, so every source in California was integrated as well. Some sources in the original CARB inventory had lower VOC emissions compared to sum of all VOC HAPs. For those sources, VOC was augmented to be equal to the VOC HAP sum, ensuring that every source in California could be integrated. The CARB-based nonroad data includes exhaust and evaporative mode-specific data for VOC, but does not contain refueling.

MOVES-MEXICO for onroad used the same speciation approach as for the U.S. in that the larger list of species shown in Table 3-7 was used. However, MOVES-MEXICO used CB6-CAMx, not CB6-CMAQ, so post-SMOKE we converted the emissions to CB6-CMAQ as follows:

- XYLMN = XYL[1]-0.966*NAPHTHALENE[1]
- PAR = PAR[1]-0.00001*NAPHTHALENE[1]
- SOAALK = 0.108*PAR[1]

For most sources in the rwc sector, the VOC emissions were greater than or equal to NBAFM, and NBAFM was not zero, so those sources were integrated, although a few specific sources that did not meet these criteria could not be integrated. In all cases, these sources have SCC= 2104008400 (pellet stoves), and NBAFM > VOC, but not by a significant amount. This results from the sum of NBAFM emission factors exceeding the VOC emission factor. In total, the no-integrate rwc sector sources sum to 4.4 tons VOC and 66 tons of NBAFM. Because for the NATA case the NBAFM are used from the inventory, these no-integrate NBAFM emissions were used in the speciation.

For the nonpt sector, sources for which VOC emissions were greater than or equal to BAFM and BAFM was not zero were integrated. There is a substantial amount of mass in the nonpt sector that is not integrated: 731,000 tons which is about 20% of the VOC in that sector. It is likely that there would be sources in nonpt that are not integrated because the emission source is not expected to have NBAFM. In fact, 390,000 tons of the no-integrate VOC have no NBAFM in the speciation profiles used for these no-integrate sources. Of the portion of no-integrate VOC with NBAFM there is 3900 tons NBAFM in the profiles (that are dropped from the profiles per the procedure in Figure 3-2) for these no-integrate sources.

For the biog sector, the speciation profiles used by BEIS are not included in SPECIATE. The 2011 platform uses BEIS3.61, which includes a new species (SESQ) that was mapped to the model species

SESQT. The profile code associated with BEIS3.61 for use with CB05 is "B10C5," while the profile for use with CB6 is "B10C6." The main difference between the profiles is the explicit treatment of acetone emissions in B10C6.

3.2.1.4 Oil and gas related speciation profiles

Most of the new VOC profiles from SPECIATE4.5 listed in Appendix C are for the oil and gas sector. A new national flare profile, FLR99, Natural Gas Flare Profile with DRE >98% was developed from a Flare Test study and used in the v7.0 platform. For the oil and gas sources in the np_oilgas and pt_oilgas sectors, several counties were assigned to newly available basin or area-specific profiles in SPECIATE4.5 that account for measured or modeled from measured compositions specific a particular region of the country. In the 2011 platform, the only county-specific profiles were for the WRAP, but in 2014, several new profiles were added for other parts of the country. In addition, some of the WRAP profiles were revised to correct for errors such as mole fractions being used for mass fractions and VOCtoTOG factors or replaced with newer data. All WRAP profile codes were renamed to include an "_R" to distinguish between the previous set of profiles (even those that did not change). For the Uintah basin and Denver-Julesburg Basin, Colorado, more updated profiles were used instead of the WRAP Phase III profiles. Table 3-8 lists the region-specific profiles assigned to particular counties or groups of counties. Although this platform increases the use of regional profiles, many counties still rely on the national profiles.

In addition to region-specific assignments, multiple profiles were assigned to particular county/SCC combinations using the SMOKE feature discussed in 3.2.1.2. The profile fractions were computed from VOC emissions provided in an intermediate file generated by the 2014 Nonpoint Oil and Gas Emission Estimation Tool and were updated for the version of the Tool used for the 2014NEIv2. The intermediate file provides flare, non-flare (process), and reboiler (for dehydrators) emissions for six source categories that have flare emissions: Associated Gas, Condensate Tanks, Crude Oil Tanks, Dehydrators, Liquids Unloading and Well Completions by county FIPS and SCC code for the U.S. to account for portions of VOC for a particular VOC that were from controlled emissions or reboiler.

Table 3-8. Basin/Region-specific profiles for oil and gas

Profile Code	Description	Region (if not in the profile name)
DJVNT_R	Denver-Julesburg Basin Produced Gas Composition from Non-CBM Gas Wells	
PNC01_R	Piceance Basin Produced Gas Composition from Non-CBM Gas Wells	
PNC02_R	Piceance Basin Produced Gas Composition from Oil Wells	
PNC03_R	Piceance Basin Flash Gas Composition for Condensate Tank	
PNCDH	Piceance Basin, Glycol Dehydrator	
PRBCB_R	Powder River Basin Produced Gas Composition from CBM Wells	
PRBCO_R	Powder River Basin Produced Gas Composition from Non-CBM Wells	
PRM01_R	Permian Basin Produced Gas Composition for Non-CBM Wells	
SSJCB_R	South San Juan Basin Produced Gas Composition from CBM Wells	
SSJCO_R	South San Juan Basin Produced Gas Composition from Non-CBM Gas Wells	
SWFLA_R	SW Wyoming Basin Flash Gas Composition for Condensate Tanks	

Profile Code	Description	Region (if not in the profile name)
SWVNT_R	SW Wyoming Basin Produced Gas Composition from Non-CBM Wells	
UNT01_R	Uinta Basin Produced Gas Composition from CBM Wells	
WRBCO_R	Wind River Basin Produced Gagres Composition from Non-CBM Gas Wells	
95087a	Oil and Gas - Composite - Oil Field - Oil Tank Battery Vent Gas	East Texas
95109a	Oil and Gas - Composite - Oil Field - Condensate Tank Battery Vent Gas	East Texas
95417	Uinta Basin, Untreated Natural Gas	
95418	Uinta Basin, Condensate Tank Natural Gas	
95419	Uinta Basin, Oil Tank Natural Gas	
95420	Uinta Basin, Glycol Dehydrator	
95398	Composite Profile - Oil and Natural Gas Production - Condensate Tanks	Denver-Julesburg Basin
95399	Composite Profile - Oil Field - Wells	State of California
95400	Composite Profile - Oil Field - Tanks	State of California
95403	Composite Profile - Gas Wells	San Joaquin Basin

3.2.1.5 Mobile source related VOC speciation profiles

The VOC speciation approach for mobile source and mobile source-related source categories is customized to account for the impact of fuels and engine type and technologies. The impact of fuels also affects the parts of the nonpt and ptnonipm sectors that are related to mobile sources such as portable fuel containers and gasoline distribution.

The VOC speciation profiles for the nonroad sector other than for California are listed in Table 3-9. They include new profiles (i.e., those that begin with "953") for 2-stroke and 4-stroke gasoline engines running on E0 and E10 and compression ignition engines with different technologies developed from recent EPA test programs, which also supported the updated toxics emission factor in MOVES2014a (Reichle, 2015 and EPA, 2015b). California nonroad source profiles are presented in Table 3-10.

Table 3-9. TOG MOVES-SMOKE Speciation for nonroad emissions in MOVES2014a used for the 2014v7.1 Platform

Profile	Profile Description	Engine Type	Engine Technology	Engine Size	Horse-power category	Fuel	Fuel Sub-type	Emission Process
95327	SI 2-stroke E0	SI 2-stroke	all	All	all	Gasoline	E0	exhaust
95328	SI 2-stroke E10	SI 2-stroke	all	All	all	Gasoline	E10	exhaust
95329	SI 4-stroke E0	SI 4-stroke	all	All	all	Gasoline	E0	exhaust
95330	SI 4-stroke E10	SI 4-stroke	all	All	all	Gasoline	E10	exhaust
95331	CI Pre-Tier 1	CI	Pre-Tier 1	All	all	Diesel	all	exhaust
95332	CI Tier 1	CI	Tier 1	all	all	Diesel	all	exhaust
95333	CI Tier 2	CI	Tier 2 and 3	all	all	Diesel	all	exhaust
95333	CI Tier 2	CI	Tier 4	<56 kW (75 hp)	S	Diesel	all	exhaust

Profile	Profile Description	Engine Type	Engine Technology	Engine Size	Horse-power category	Fuel	Fuel Sub-type	Emission Process
8775	ACES Phase 1 Diesel Onroad	CI Tier 4	Tier 4	>=56 kW (75 hp)	L	Diesel	all	exhaust
8753	E0 Evap	SI	all	all	all	Gasoline	E0	evaporative
8754	E10 Evap	SI	all	all	all	Gasoline	E10	evaporative
8766	E0 evap permeation	SI	all	all	all	Gasoline	E0	permeation
8769	E10 evap permeation	SI	all	all	all	Gasoline	E10	permeation
8869	E0 Headspace	SI	all	all	all	Gasoline	E0	headspace
8870	E10 Headspace	SI	all	all	all	Gasoline	E10	headspace
1001	CNG Exhaust	All	all	all	all	CNG	all	exhaust
8860	LPG exhaust	All	all	all	all	LPG	all	exhaust

Speciation profiles for VOC in the nonroad sector account for the ethanol content of fuels across years. A description of the actual fuel formulations for 2014 can be found in the 2014NEIv2 TSD. For previous platforms, the EPA used "COMBO" profiles to model combinations of profiles for E0 and E10 fuel use, but beginning with 2014v7.0 platform, the appropriate allocation of E0 and E10 fuels is done by MOVES.

Combination profiles reflecting a combination of E10 and E0 fuel use are still used for sources upstream of mobile sources such as portable fuel containers (PFCs) and other fuel distribution operations associated with the transfer of fuel from bulk terminals to pumps (BTP) which are in the nonpt sector. They are also used for California nonroad sources. For these sources, ethanol may be mixed into the fuels, in which case speciation would change across years. The speciation changes from fuels in the ptnonipm sector include BTP distribution operations inventoried as point sources. Refinery-to-bulk terminal (RBT) fuel distribution and bulk plant storage (BPS) speciation does not change across the modeling cases because this is considered upstream from the introduction of ethanol into the fuel. The mapping of fuel distribution SCCs to PFC, BTP, BPS, and RBT emissions categories can be found in Appendix F.

Table 3-10 summarizes the different profiles utilized for the fuel-related sources in each of the sectors for 2014. The term "COMBO" indicates that a combination of the profiles listed was used to speciate that subcategory using the GSPRO_COMBO file.

Table 3-10. Select mobile-related VOC profiles 2014

Sector	Sub-category	2014	
Nonroad- California & non US	gasoline exhaust	COMBO	
		8750a	Pre-Tier 2 E0 exhaust
		8751a	Pre-Tier 2 E10 exhaust
Nonroad-California	gasoline evaporative	COMBO	
		8753	E0 evap
		8754	E10 evap
Nonroad-California	gasoline refueling	COMBO	
		8869	E0 Headspace
		8870	E10 Headspace
Nonroad-California	diesel exhaust	8774	Pre-2007 MY HDD exhaust
Nonroad-California	diesel evap-orative and diesel refueling	4547	Diesel Headspace

Sector	Sub-category	2014
nonpt/ ptnonipm	PFC and BTP	COMBO 8869 E0 Headspace 8870 E10 Headspace
nonpt/ ptnonipm	Bulk plant storage (BPS) and refine-to-bulk terminal (RBT) sources	8869 E0 Headspace

The speciation of onroad VOC occurs completely within MOVES. MOVES takes into account fuel type and properties, emission standards as they affect different vehicle types and model years, and specific emission processes. Table 3-11 describes all of the M-profiles available to MOVES depending on the model year range, MOVES process (processID), fuel sub-type (fuelSubTypeID), and regulatory class (regClassID). Table 3-12 through Table 3-14 describe the meaning of these MOVES codes. For a specific representative county and future year, there will be a different mix of these profiles. For example, for HD diesel exhaust, the emissions will use a combination of profiles 8774M and 8775M depending on the proportion of HD vehicles that are pre-2007 model years (MY) in that particular county. As that county is projected farther into the future, the proportion of pre-2007 MY vehicles will decrease. A second example, for gasoline exhaust (not including E-85), the emissions will use a combination of profiles 8756M, 8757M, 8758M, 8750aM, and 8751aM. Each representative county has a different mix of these key properties and, therefore, has a unique combination of the specific M-profiles. More detailed information on how MOVES speciates VOC and the profiles used is provided in the technical document, "Speciation of Total Organic Gas and Particulate Matter Emissions from On-road Vehicles in MOVES2014" (EPA, 2015c).

Table 3-11. Onroad M-profiles

Profile	Profile Description	Model Years	ProcessID	FuelSubTypeID	RegClassID
1001M	CNG Exhaust	1940-2050	1,2,15,16	30	48
4547M	Diesel Headspace	1940-2050	11	20,21,22	0
4547M	Diesel Headspace	1940-2050	12,13,18,19	20,21,22	10,20,30,40,41, 42,46,47,48
8753M	E0 Evap	1940-2050	12,13,19	10	10,20,30,40,41,42, 46,47,48
8754M	E10 Evap	1940-2050	12,13,19	12,13,14	10,20,30,40,41, 42,46,47,48
8756M	Tier 2 E0 Exhaust	2001-2050	1,2,15,16	10	20,30
8757M	Tier 2 E10 Exhaust	2001-2050	1,2,15,16	12,13,14	20,30
8758M	Tier 2 E15 Exhaust	1940-2050	1,2,15,16	15,18	10,20,30,40,41, 42,46,47,48
8766M	E0 evap permeation	1940-2050	11	10	0
8769M	E10 evap permeation	1940-2050	11	12,13,14	0
8770M	E15 evap permeation	1940-2050	11	15,18	0
8774M	Pre-2007 MY HDD exhaust	1940-2006	1,2,15,16,17,90	20, 21, 22	40,41,42,46,47, 48
8774M	Pre-2007 MY HDD exhaust	1940-2050	91[11]	20, 21, 22	46,47

[11] 91 is the processed for APUs which are diesel engines not covered by the 2007 Heavey-Duty Rule, so the older technology applieds to all years.

Profile	Profile Description	Model Years	ProcessID	FuelSubTypeID	RegClassID
8774M	Pre-2007 MY HDD exhaust	1940-2006	1,2,15,16	20, 21, 22	20,30
8775M	2007+ MY HDD exhaust	2007-2050	1,2,15,16	20, 21, 22	20,30
8775M	2007+ MY HDD exhaust	2007-2050	1,2,15,16,17,90	20, 21, 22	40,41,42,46,47,48
8855M	Tier 2 E85 Exhaust	1940-2050	1,2,15,16	50, 51, 52	10,20,30,40,41, 42,46,47,48
8869M	E0 Headspace	1940-2050	18	10	10,20,30,40,41, 42,46,47,48
8870M	E10 Headspace	1940-2050	18	12,13,14	10,20,30,40,41, 42,46,47,48
8871M	E15 Headspace	1940-2050	18	15,18	10,20,30,40,41, 42,46,47,48
8872M	E15 Evap	1940-2050	12,13,19	15,18	10,20,30,40,41, 42,46,47,48
8934M	E85 Evap	1940-2050	11	50,51,52	0
8934M	E85 Evap	1940-2050	12,13,18,19	50,51,52	10,20,30,40,41, 42,46,47,48
8750aM	Pre-Tier 2 E0 exhaust	1940-2000	1,2,15,16	10	20,30
8750aM	Pre-Tier 2 E0 exhaust	1940-2050	1,2,15,16	10	10,40,41,42,46,47,48
8751aM	Pre-Tier 2 E10 exhaust	1940-2000	1,2,15,16	11,12,13,14	20,30
8751aM	Pre-Tier 2 E10 exhaust	1940-2050	1,2,15,16	11,12,13,14,15, 18[12]	10,40,41,42,46,47,48

Table 3-12. MOVES process IDs

Process ID	Process Name
1	Running Exhaust
2	Start Exhaust
9	Brakewear
10	Tirewear
11	Evap Permeation
12	Evap Fuel Vapor Venting
13	Evap Fuel Leaks
15	Crankcase Running Exhaust
16	Crankcase Start Exhaust
17	Crankcase Extended Idle Exhaust
18	Refueling Displacement Vapor Loss
19	Refueling Spillage Loss
20	Evap Tank Permeation
21	Evap Hose Permeation
22	Evap RecMar Neck Hose Permeation
23	Evap RecMar Supply/Ret Hose Permeation
24	Evap RecMar Vent Hose Permeation
30	Diurnal Fuel Vapor Venting

[12] The profile assingments for pre-2001 gasoline vehicles fueled on E15/E20 fuels (subtypes 15 and 18) were corrected for MOVES2014a. This model year range, process, fuelsubtype regclass combinate is already assigned to profile 8758.

Process ID	Process Name
31	HotSoak Fuel Vapor Venting
32	RunningLoss Fuel Vapor Venting
40	Nonroad
90	Extended Idle Exhaust
91	Auxiliary Power Exhaust

Table 3-13. MOVES Fuel subtype IDs

Fuel Subtype ID	Fuel Subtype Descriptions
10	Conventional Gasoline
11	Reformulated Gasoline (RFG)
12	Gasohol (E10)
13	Gasohol (E8)
14	Gasohol (E5)
15	Gasohol (E15)
18	Ethanol (E20)
20	Conventional Diesel Fuel
21	Biodiesel (BD20)
22	Fischer-Tropsch Diesel (FTD100)
30	Compressed Natural Gas (CNG)
50	Ethanol
51	Ethanol (E85)
52	Ethanol (E70)

Table 3-14. MOVES regclass IDs

Reg. Class ID	Regulatory Class Description
0	Doesn't Matter
10	Motorcycles
20	Light Duty Vehicles
30	Light Duty Trucks
40	Class 2b Trucks with 2 Axles and 4 Tires (8,500 lbs < GVWR <= 10,000 lbs)
41	Class 2b Trucks with 2 Axles and at least 6 Tires or Class 3 Trucks (8,500 lbs < GVWR <= 14,000 lbs)
42	Class 4 and 5 Trucks (14,000 lbs < GVWR <= 19,500 lbs)
46	Class 6 and 7 Trucks (19,500 lbs < GVWR <= 33,000 lbs)
47	Class 8a and 8b Trucks (GVWR > 33,000 lbs)
48	Urban Bus (see CFR Sec 86.091_2)

For portable fuel containers (PFCs) and fuel distribution operations associated with the bulk-plant-to-pump (BTP) distribution, ethanol may be mixed into the fuels; therefore, county- and month-specific COMBO speciation was used (via the GSPRO_COMBO file). Refinery to bulk terminal (RBT) fuel distribution and bulk plant storage (BPS) speciation are considered upstream from the introduction of ethanol into the fuel; therefore, a single profile is sufficient for these sources. No refined information on potential VOC speciation differences between cellulosic diesel and cellulosic ethanol sources was available; therefore, cellulosic diesel and cellulosic ethanol sources used the same SCC (30125010: Industrial Chemical Manufacturing, Ethanol by Fermentation production) for VOC speciation as was used for corn ethanol plants.

3.2.2 PM speciation

In addition to VOC profiles, the SPECIATE database also contains profiles for speciating $PM_{2.5}$. We speciated $PM_{2.5}$ into the AE6 species associated with CMAQ 5.0.1 and later versions. Most of the 2014 platform PM profiles come from the 911XX series (Reff et. al, 2009), which include updated AE6 speciation[13]. For the v7.1 platform, we replaced profile 91112 (Natural Gas Combustion – Composite) with 95475 (Composite -Refinery Fuel Gas and Natural Gas Combustion). This updated profile is an AE6-ready profile based on the median of 3 SPECIATE4.5 profiles from which AE6 versions were made (to be added to SPECIATE5.0): boilers (95125a), process heaters (95126a) and internal combustion combined cycle/cogen plant exhaust (95127a). As with profile 91112, these profiles are based on tests using natural gas and refinery fuel gas (England et al., 2007). Profile 91112 which is also based on refinery gas and natural gas is thought to overestimate EC.

Profile 95475 (Composite -Refinery Fuel Gas and Natural Gas Combustion) is shown along with the underlying profiles composited in Figure 3-3. Figure 3-4 shows a comparison of the new profile which the one that we had been using in the v7.0 and earlier platforms.

[13] The exceptions are 5674 (Marine Vessel – Marine Engine – Heavy Fuel Oil) used for cmv and 92018 (Draft Cigarette Smoke – Simplified) used in nonpt.

Figure 3-3. Profiles composited for the new PM gas combustion related sources

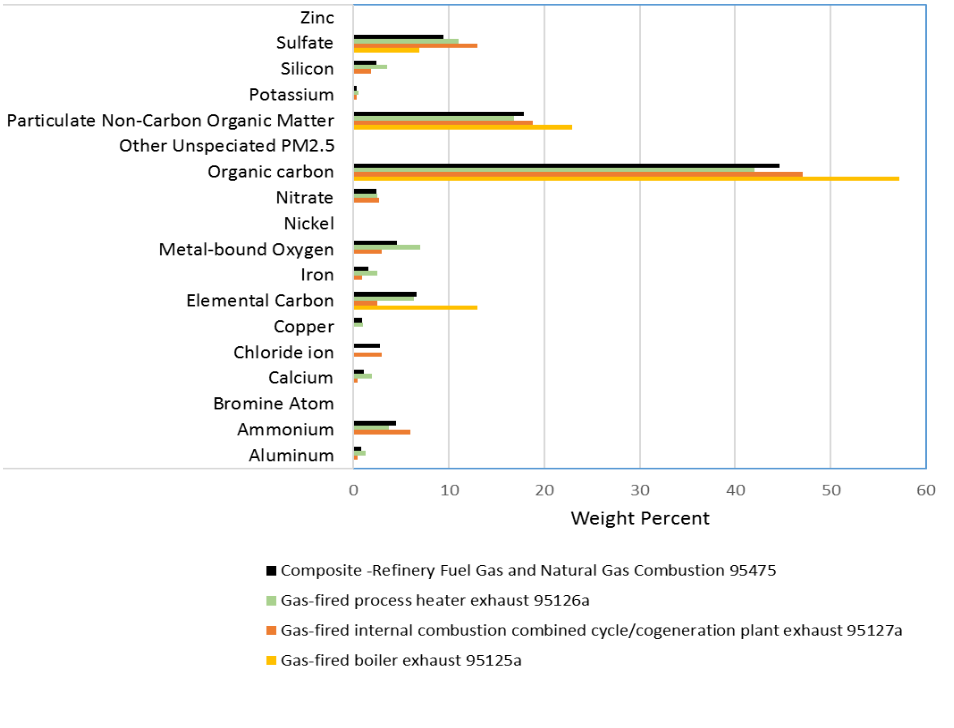
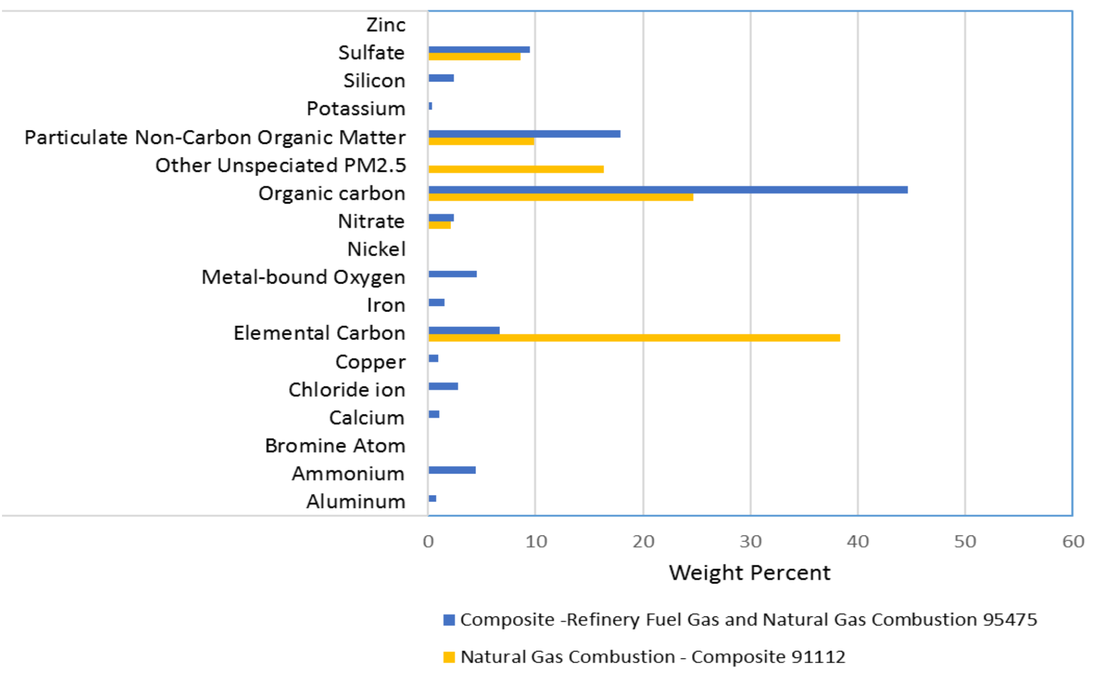


Figure 3-4. Comparison of PM profiles used for Natural gas combustion related sources



3.2.2.1 Mobile source related PM2.5 speciation profiles

For the onroad sector, for all processes except brake and tire wear, PM speciation occurs within MOVES itself, not within SMOKE (similar to the VOC speciation described above). The advantage of using MOVES to speciate PM is that during the internal calculation of MOVES, the model has complete information on the characteristics of the fleet and fuels (e.g., model year, sulfur content, process, etc.) to accurately match to specific profiles. This means that MOVES produces EF tables that include total PM (e.g., PM_{10} and $PM_{2.5}$) and speciated PM (e.g., PEC, PFE, etc). SMOKE essentially calculates the PM components by using the appropriate EF without further speciation[14]. The specific profiles used within MOVES include two compressed natural gas (CNG) profiles, 45219 and 45220, which were added to SPECIATE4.5. A list of profiles is provided in the technical document, "Speciation of Total Organic Gas and Particulate Matter Emissions from On-road Vehicles in MOVES2014" (EPA, 2015c).

For onroad brake and tire wear, the PM is speciated in the *moves2smk* postprocessor that prepares the emission factors for processing in SMOKE. The formulas for this are based on the standard speciation factors from brake and tire wear profiles, which were updated from the v6.3 platform based on data from a Health Effects Institute report (Schauer, 2006). Table 3-15 shows the differences in the v7.1 and v6.3 profiles.

Table 3-15. SPECIATE4.5 brake and tire profiles compared to those used in the 2011v6.3 Platform

Inventory Pollutant	Model Species	V6.3 platform brakewear profile: 91134	SPECIATE4.5 brakewear profile: 95462 from Schauer (2006)	V6.3 platform tirewear profile: 91150	SPECIATE4.5 tirewear profile: 95460 from Schauer (2006)
PM2_5	PAL	0.00124	0.000793208	6.05E-04	3.32401E-05
PM2_5	PCA	0.01	0.001692177	0.00112	
PM2_5	PCL	0.001475		0.0078	
PM2_5	PEC	0.0261	0.012797085	0.22	0.003585907
PM2_5	PFE	0.115	0.213901692	0.0046	0.00024779
PM2_5	PH2O	0.0080232		0.007506	
PM2_5	PK	1.90E-04	0.000687447	3.80E-04	4.33129E-05
PM2_5	PMG	0.1105	0.002961309	3.75E-04	0.000018131
PM2_5	PMN	0.001065	0.001373836	1.00E-04	1.41E-06
PM2_5	PMOTHR	0.4498	0.691704999	0.0625	0.100663209
PM2_5	PNA	1.60E-04	0.002749787	6.10E-04	7.35312E-05
PM2_5	PNCOM	0.0428	0.020115749	0.1886	0.255808124
PM2_5	PNH4	3.00E-05		1.90E-04	
PM2_5	PNO3	0.0016		0.0015	
PM2_5	POC	0.107	0.050289372	0.4715	0.639520309
PM2_5	PSI	0.088		0.00115	
PM2_5	PSO4	0.0334		0.0311	
PM2_5	PTI	0.0036	0.000933341	3.60E-04	5.04E-06

The formulas used based on brake wear profile 95462 and tire wear profile 95460 are as follows:

```
POC = 0.6395 * PM25TIRE + 0.0503 * PM25BRAKE
PEC = 0.0036 * PM25TIRE + 0.0128 * PM25BRAKE
```

[14] Unlike previous platforms, the PM components (e.g., POC) are now consistently defined between MOVES2014 and CMAQ. For more details on the use of model-ready EF, see the SMOKE 3.7 documentation: https://www.cmascenter.org/smoke/documentation/3.7/html/.

```
PNO3 = 0.000 * PM25TIRE + 0.000 * PM25BRAKE
PSO4 = 0.0 * PM25TIRE + 0.0 * PM25BRAKE
PNH4 = 0.000 * PM25TIRE + 0.0000 * PM25BRAKE
PNCOM = 0.2558 * PM25TIRE + 0.0201 * PM25BRAKE
```

Manganese, a CMAQ HAP (provided as coarse and fine manganese components, MANGANESE_C and MANGANESE_F) comes from both MOVES exhaust and from the *moves2smk* processor's brake and tire speciation. For non-California U.S. sources, exhaust manganese is set equal to PMN and break and tire manganese (PMN) is computed from $PM_{2.5}$ speciation. These are then further speciated into coarse and fine manganese using the factors presented in Section 3.4. For California, the CARB-submitted manganese is used.

For California onroad emissions, adjustment factors were applied to SMOKE-MOVES to produce California adjusted model-ready files (see Section 2.3.1 for details). California did not supply speciated PM, therefore, the adjustment factors applied to PM2.5 were also applied to the speciated PM components. By applying the ratios through SMOKE-MOVES, the CARB inventories are essentially speciated to match EPA estimated speciation.

For nonroad PM2.5, speciation is done in SMOKE similarly to nonpoint and point categories based on the GSREF SCC-to-speciation profile cross reference file. There are only 3 unique PM2.5 profiles assigned to the hundreds of nonroad SCCs.

Table 3-16. Nonroad PM2.5 profiles

SPECIATE4.5 Profile Code	SPECIATE4.5 Profile Name	Assigned to Nonroad sources based on Fuel Type
91106	HDDV Exhaust - Composite	Diesel
91113	Nonroad Gasoline Exhaust - Composite	Gasoline
91156	Residential Natural Gas Combustion - Composite	LPG, CNG

3.2.3 NO_X speciation

NOx emission factors and therefore NOx inventories are developed on a NO_2 weight basis. For air quality modeling, NO_X is speciated into NO, NO_2, and/or HONO. For the non-mobile sources, the EPA used a single profile "NHONO" to split NO_X into NO and NO_2.

The importance of HONO chemistry, identification of its presence in ambient air and the measurements of HONO from mobile sources have prompted the inclusion of HONO in NOx speciation for mobile sources. Based on tunnel studies, a HONO to NOx ratio of 0.008 was chosen (Sarwar, 2008). For the mobile sources, except for onroad (including nonroad, cmv, rail, othon sectors), and for specific SCCs in othar and ptnonipm, the profile "HONO" is used. Table 3-17 gives the split factor for these two profiles. The onroad sector does not use the "HONO" profile to speciate NO_X. MOVES2014 produces speciated NO, NO_2, and HONO by source, including emission factors for these species in the emission factor tables used by SMOKE-MOVES. Within MOVES, the HONO fraction is a constant 0.008 of NO_X. The NO fraction varies by heavy duty versus light duty, fuel type, and model year.
The NO_2 fraction = 1 – NO – HONO. For more details on the NO_X fractions within MOVES, see https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100F1A5.pdf .

Table 3-17. NO_X speciation profiles

Profile	pollutant	species	split factor
HONO	NOX	NO2	0.092
HONO	NOX	NO	0.9
HONO	NOX	HONO	0.008
NHONO	NOX	NO2	0.1
NHONO	NOX	NO	0.9

3.3 Creation of Sulfuric Acid Vapor (SULF)

Since at least the 2002 Platform, sulfuric acid vapor (SULF) has been estimated through the SMOKE speciation process for coal combustion and residual and distillate oil fuel combustion sources. Profiles that compute SULF from SO_2 are assigned to coal and oil combustion SCCs in the GSREF ancillary file. The profiles were derived from information from AP-42 (EPA, 1998), which identifies the fractions of sulfur emitted as sulfate and SO_2 and relates the sulfate as a function of SO2.

Sulfate is computed from SO_2 assuming that gaseous sulfate, which is comprised of many components, is primarily H_2SO_4. The equation for calculating H_2SO_4 is given below.

$$Emissions\ of\ SULF\ (as\ \mathrm{H2SO4}) = SO2\ emissions \times \frac{fraction\ of\ S\ emitted\ as\ sulfate}{fraction\ of\ S\ emitted\ as\ SO2} \times \frac{MW\ H2SO4}{MW\ SO2}$$

In the above, *MW* is the molecular weight of the compound. The molecular weights of H_2SO_4 and SO_2 are 98 g/mol and 64 g/mol, respectively.

This method does not reduce SO_2 emissions; it solely adds gaseous sulfate emissions as a function of SO2 emissions. The derivation of the profiles is provided in Table 3-18; a summary of the profiles is provided in Table 3-19.

Table 3-18. Sulfate split factor computation

fuel	SCCs	Profile Code	Fraction as SO2	Fraction as sulfate	Split factor (mass fraction)
Bituminous	1-0X-002-YY, where X is 1, 2 or 3 and YY is 01 thru 19 and 21-ZZ-002-000 where ZZ is 02,03 or 04	95014	0.95	0.014	.014/.95 * 98/64 = 0.0226
Subbituminous	1-0X-002-YY, where X is 1, 2 or 3 and YY is 21 thru 38	87514	.875	0.014	.014/.875 * 98/64 = 0.0245
Lignite	1-0X-003-YY, where X is 1, 2 or 3 and YY is 01 thru 18 and 21-ZZ-002-000 where ZZ is 02,03 or 04	75014	0.75	0.014	.014/.75 * 98/64 = 0.0286
Residual oil	1-0X-004-YY, where X is 1, 2 or 3 and YY is 01 thru 06 and 21-ZZ-005-000 where ZZ is 02,03 or 04	99010	0.99	0.01	.01/.99 * 98/64 = 0.0155
Distillate oil	1-0X-005-YY, where X is 1, 2 or 3 and YY is 01 thru 06	99010	0.99	0.01	Same as residual oil

fuel	SCCs	Profile Code	Fraction as SO2	Fraction as sulfate	Split factor (mass fraction)
	and 21-ZZ-004-000 where ZZ is 02,03 or 04				

Table 3-19. SO_2 speciation profiles

Profile	pollutant	species	split factor
95014	SO2	SULF	0.0226
95014	SO2	SO2	1
87514	SO2	SULF	0.0245
87514	SO2	SO2	1
75014	SO2	SULF	0.0286
75014	SO2	SO2	1
99010	SO2	SULF	0.0155
99010	SO2	SO2	1

3.4 Speciation of Metals and Mercury

Mercury and other metals from the inventory were speciated for use in modeling. Other than the facility specific data for one facility provided by Minnesota, the profiles are the same as were used in previous modeling platforms and are documented in Appendix D of the Technical Support Document for the 2011 National-scale Air Toxics Assessment (https://www.epa.gov/sites/production/files/2015-12/documents/2011-nata-tsd.pdf). Mercury in the inventory was reported as pollutant code 7439976 and needs to be speciated into the three forms for CMAQ: elemental, divalent gaseous, and divalent particulate. Metals (other than mercury) were speciated into coarse and fine particulate, which were needed by CMAQ. Table 3-20 contains summaries of the profiles. Most were applied across an entire sector or multiple sectors (i.e., the nonroad profiles were applied to the nonroad-related sector and the stationary profile was applied to the stationary-related sectors). A Minnesota facility and process-specific profile were added to the v7.1 platform based on data provided by the state during the 2014v1 emissions review.

Table 3-20. Speciation of Metals

Source Type	Profile	pollutant	Fine	coarse
Onroad	OARS	Arsenic	.95	.05
Onroad	ONBE	Beryllium	.39	.61
Onroad	ONMN	Manganese	.64	.36
Onroad	ONNI	Nickel	.83	.17
Onroad	CRON	Chromhex	.86	.14
Onroad	ONCD	Cadmium	.38	.62
Onroad	ONPB	Lead	.76	.24
Nonroad	NOARS	Arsenic	.83	.17
Nonroad	NONBE	Beryllium	.39	.61
Nonroad	NONCD	Cadmium	.38	.62
Nonroad	NONMN	Manganese	.67	.33

Source Type	Profile	pollutant	Fine	coarse
Nonroad	NONNI	Nickel	.49	.51
Nonroad	NONPB	Lead	.88	12
Nonroad	CRNR	Chromhex	.8	.2
Stationary	STANI	Nickel	.59	.41
Stationary	STACD	Cadmium	.76	.24
Stationary	STAMN	Manganese	.67	.33
Stationary	STAPB	Lead	.74	.26
Stationary	STABE	Beryllium	.68	.32
Stationary	CRSTA	Chromhex	.71	.29
Stationary	STARS	Arsenic	.59	.41
Stationary[1]	MNBE	Beryllium	.15	.85
Stationary[1]	MNCD	Cadmium	.15	.85
Stationary[1]	MNMN	Manganese	.15	.85
Stationary[1]	MNNI	Nickel	.15	.85
Stationary[1]	MNRS	Arsenic	.15	.85
Stationary[1]	CRMN	Chromhex	.15	.85

[1]Facility specific metal splits at United Taconite LLC - Thunderbird Mine facility in Minnesota as reported by Minnesota

Mercury was speciated using the same profiles as in the 2011 NATA modeling which included unit-specific electric generating unit profiles (ptegu sector). The data are from the “2005 Platform –CAP-BAFM 2005-Based Platform, Version 4.1” documented here. Speciation factors were based on those developed for the Clean Air Mercury Rule (CAMR). The methodology for the 2011 NATA relied on matching 2011 NEI units to identifiers used in CAMR to use the same speciation data. Units that were not found in the CAMR data were mapped to mercury speciation bins based on configuration. The unit-specific data were not updated for the 2014 NEI. In cases where unit identifiers changed from the 2011 NEI, an SCC-based speciation factor was used. About 25% of the sources in the ptegu inventory used the unit specific profiles. Table 3-21 provides the mercury profiles used for sources using SCC-based speciation factors.

Table 3-21. Speciation of Mercury

Profile Code	Description	Elemental	Divalent Gas	Particulate
HBCMB	Combustion	0.5	0.3	0.2
HGCEM	Cement	0.75	0.13	0.12
HGCHL	Chloralkali processes	0.95	0.05	0
HGGLD	Gold mining	1	0	0
HGINC	Incineration	0.22	0.58	0.2
HGMD	Mobile diesel	0.56	0.29	0.15
HGMG	Mobile gas	0.91	0.086	0.004
HGIND	Other Industrial	0.8	0.1	0.1

3.5 Temporal Allocation

Temporal allocation is the process of distributing aggregated emissions to a finer temporal resolution, thereby converting annual emissions to hourly emissions as is required by CMAQ. While the total emissions are important, the timing of the occurrence of emissions is also essential for accurately simulating ozone, PM, and other pollutant concentrations in the atmosphere. Many emissions inventories are annual or monthly in nature. Temporal allocation takes these aggregated emissions and distributes the emissions to the hours of each day. This process is typically done by applying temporal profiles to the inventories in this order: monthly, day of the week, and diurnal, with monthly and day-of-week profiles applied only if the inventory is not already at that level of detail.

The temporal factors applied to the inventory are selected using some combination of country, state, county, SCC, and pollutant. Table 3-22 summarizes the temporal aspects of emissions modeling by comparing the key approaches used for temporal processing across the sectors. In the table, "Daily temporal approach" refers to the temporal approach for getting daily emissions from the inventory using the SMOKE Temporal program. The values given are the values of the SMOKE L_TYPE setting. The "Merge processing approach" refers to the days used to represent other days in the month for the merge step. If this is not "all," then the SMOKE merge step runs only for representative days, which could include holidays as indicated by the right-most column. The values given are those used for the SMOKE M_TYPE setting (see below for more information).

Table 3-22. Temporal settings used for the platform sectors in SMOKE

Platform sector short name	Inventory resolutions	Monthly profiles used?	Daily temporal approach	Merge processing approach	Process holidays as separate days
afdust_adj	Annual	Yes	week	all	Yes
ag	Monthly	No	all	all	No
beis	Hourly	No	n/a	all	No
cmv_c1c2	Annual	Yes	aveday	aveday	No
cmv_c3	Annual	Yes	aveday	aveday	No
nonpt	Annual	Yes	week	week	Yes
nonroad	Monthly	No	mwdss	mwdss	Yes
np_oilgas	Annual	Yes	week	week	Yes
onroad	Annual & monthly[1]	No	all	all	Yes
onroad_ca_adj	Annual & monthly[1]	No	all	all	Yes
othafdust_adj	Annual	Yes	week	all	No
othar	Annual & monthly	Yes	week	week	No
onroad_can	Monthly	No	week	week	No
onroad_mex	Monthly	No	week	week	No
othpt	Annual & monthly	Yes	mwdss	mwdss	No
pt_oilgas	Annual	Yes	mwdss	mwdss	Yes
ptegu	Annual & hourly	Yes[2]	all	all	No
ptnonipm	Annual	Yes	mwdss	mwdss	Yes
ptagfire	Daily	No	all	all	No
ptfire	Daily	No	all	all	No
ptfire_othna	Daily	No	all	all	No
rail	Annual	Yes	aveday	aveday	No
rwc	Annual	No[3]	met-based	all	No[3]

[1]Note the annual and monthly "inventory" actually refers to the activity data (VMT, hoteling and VPOP) for onroad. VMT and hoteling is monthly and VPOP is annual. The actual emissions are computed on an hourly basis.

[2]Only units that do not have matching hourly CEMS data use monthly temporal profiles.

[3]Except for 2 SCCs that do not use met-based speciation

The following values are used in the table. The value “all” means that hourly emissions are computed for every day of the year and that emissions potentially have day-of-year variation. The value “week” means that hourly emissions computed for all days in one “representative” week, representing all weeks for each month. This means emissions have day-of-week variation, but not week-to-week variation within the month. The value “mwdss” means hourly emissions for one representative Monday, representative weekday (Tuesday through Friday), representative Saturday, and representative Sunday for each month. This means emissions have variation between Mondays, other weekdays, Saturdays and Sundays within the month, but not week-to-week variation within the month. The value “aveday” means hourly emissions computed for one representative day of each month, meaning emissions for all days within a month are the same. Special situations with respect to temporal allocation are described in the following subsections.

In addition to the resolution, temporal processing includes a ramp-up period for several days prior to January 1, 2014, which is intended to mitigate the effects of initial condition concentrations. The ramp-up period was 10 days (December 22-31, 2013). For most sectors, emissions from December 2014 were used to fill in emissions for the end of December 2013. In particular, December 2014 emissions (representative days) were used for December 2013. For biogenic emissions, December 2013 emissions were processed using 2013 meteorology.

3.5.1 Use of FF10 format for finer than annual emissions

The FF10 inventory format for SMOKE provides a consolidated format for monthly, daily, and hourly emissions inventories. With the FF10 format, a single inventory file can contain emissions for all 12 months and the annual emissions in a single record. This helps simplify the management of numerous inventories. Similarly, daily and hourly FF10 inventories contain individual records with data for all days in a month and all hours in a day, respectively.

SMOKE prevents the application of temporal profiles on top of the “native” resolution of the inventory. For example, a monthly inventory should not have annual-to-month temporal allocation applied to it; rather, it should only have month-to-day and diurnal temporal allocation. This becomes particularly important when specific sectors have a mix of annual, monthly, daily, and/or hourly inventories. The flags that control temporal allocation for a mixed set of inventories are discussed in the SMOKE documentation. The modeling platform sectors that make use of monthly values in the FF10 files are ag, nonroad, onroad, onroad_can, onroad_mex, and othar.

3.5.2 Electric Generating Utility temporal allocation (ptegu)

3.5.2.1 Base year temporal allocation of EGUs

The 2014NEIv2 annual EGU emissions not matched to CEMS sources use region/fuel specific profiles based on average hourly emissions for the region and fuel. Peaking units were removed during the averaging to minimize the spikes generated by those units. The non-matched units are allocated to hourly emissions using the following three-step methodology: annual value to month, month to day, and day to hour. First, the CEMS data were processed using a tool that reviewed the data quality flags that indicate the data were not measured. Unmeasured data can be filled in with maximum values and thereby cause erroneously high values in the CEMS data. The CEMCorrect tool identifies hours for which the data were not measured. When those values are found to be more than three times the annual mean for that unit, the data for those hours are replaced with annual mean values (Adelman et al., 2012). These adjusted CEMS data were then used for the remainder of the temporal allocation process described below (see Figure 3-5 for an example). Winter and summer seasons are included in the development of the diurnal profiles as opposed to using data for the entire year because analysis of the hourly CEMS data revealed that there were different diurnal patterns in winter versus summer in many areas. Typically, a single mid-day peak is visible in the summer, while there are morning and evening peaks in the winter as shown in Figure 3-6.

The temporal allocation procedure is differentiated by whether or not the source could be directly matched to a CEMS unit via ORIS facility code and boiler ID. Note that for units matched to CEMS data, annual totals of their emissions input to CMAQ may be different than the annual values in 2014NEIv2 because the CEMS data replaces the NO_x and SO_2 inventory data for the seasons in which the CEMS are operating. If a CEMS-matched unit is determined to be a partial year reporter, as can happen for sources that run CEMS only in the summer, emissions totaling the difference between the annual emissions and the total CEMS emissions are allocated to the non-summer months.

Figure 3-5. Eliminating unmeasured spikes in CEMS data

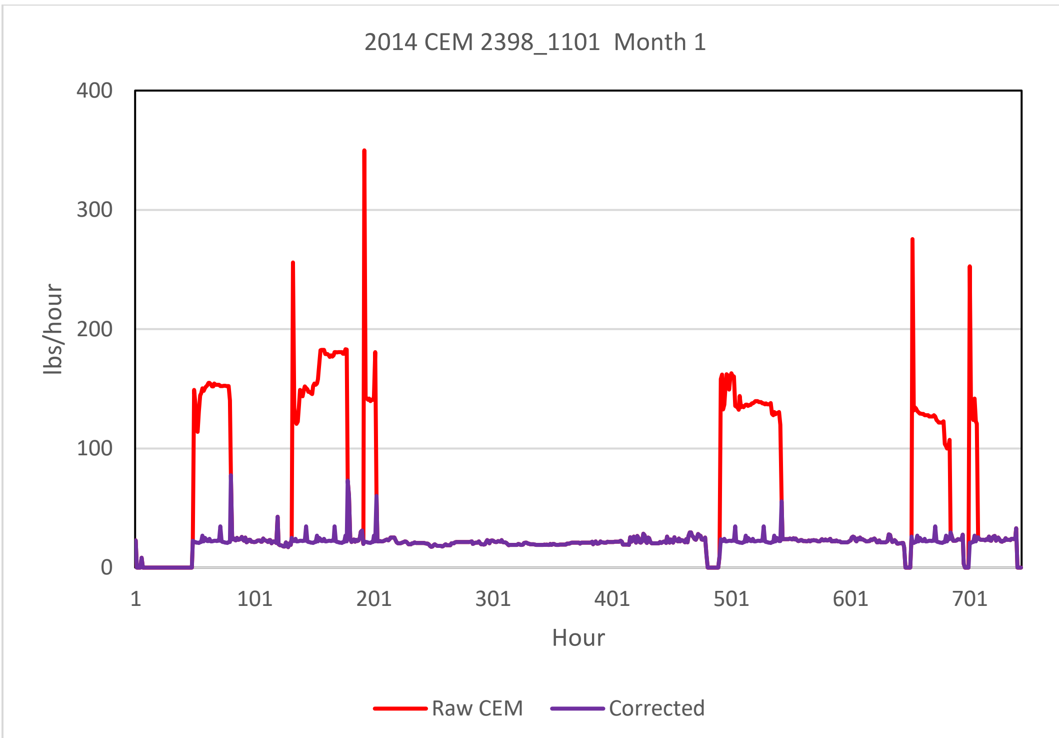
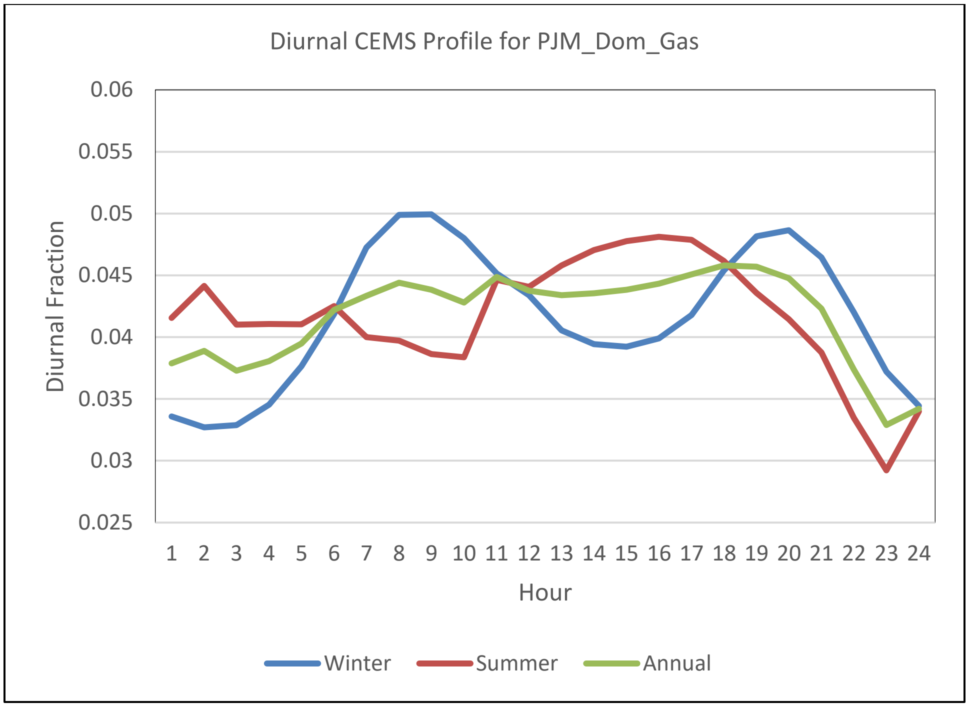


Figure 3-6. Seasonal diurnal profiles for EGU emissions in a Virginia Region



For sources not matched to CEMS units, temporal profiles are calculated that are used by SMOKE to allocate the annual emissions to hourly values. For these units, the allocation of the inventory annual emissions to months is done using average fuel-specific annual-to-month factors generated for each of the 64 IPM regions shown in Figure 3-7. These factors are based on 2014 CEMS data only. In each region, separate factors were developed for the fuels: coal, natural gas, and "other," where the types of fuels included in "other" vary by region. Separate profiles were computed for NO_X, SO_2, and heat input. An overall composite profile was also computed and used when there were no CEMS units with the specified fuel in the region containing the unit. For both CEMS-matched units and units not matched to CEMS, NO_X and SO_2 CEMS data are used to allocate NO_X and SO_2 emissions to monthly emissions, respectively, while heat input data are used to allocate emissions of all pollutants from monthly to daily emissions.

Daily temporal allocation of units matched to CEMS was performed using a procedure similar to the approach to allocate emissions to months in that the CEMS data replaces the inventory data for each pollutant. For units without CEMS data, emissions were allocated from month to day using IPM-region and fuel-specific average month-to-day factors based on the 2014 CEMS heat data. Separate month-to-day allocation factors were computed for each month of the year using heat input for the fuels coal, natural gas, and "other" in each region. For CEMS matched units, NO_X and SO_2 CEMS data are used to replace inventory NO_X and SO_2 emissions, while CEMS heat input data are used to allocate all other pollutants. An example of month-to-day profiles for gas, coal, and an overall composite for a region in western Texas is shown in Figure 3-8.

For units matched to CEMS data, hourly emissions use the hourly CEMS values for NO_X and SO_2, while other pollutants are allocated according to heat input values. For units not matched to CEMS data, temporal profiles from days to hours are computed based on the season-, region- and fuel-specific average day-to-hour factors derived from the CEMS data for those fuels and regions using the appropriate subset of data. For the unmatched units, CEMS heat input data are used to allocate all pollutants (including NO_X and SO_2) because the heat input data was generally found to be more complete than the pollutant-specific data. SMOKE then allocates the daily emissions data to hours using the temporal profiles obtained from the CEMS data for the analysis base year (i.e., 2014 in this case).

Certain sources without CEMS data, such as specific municipal waste combustors (MWCs) and cogeneration facilities (cogens), were assigned a flat temporal profile by source. The emissions for these sources have an equal value for each hour of the year.

Figure 3-7. IPM Regions used to Create Temporal Profiles

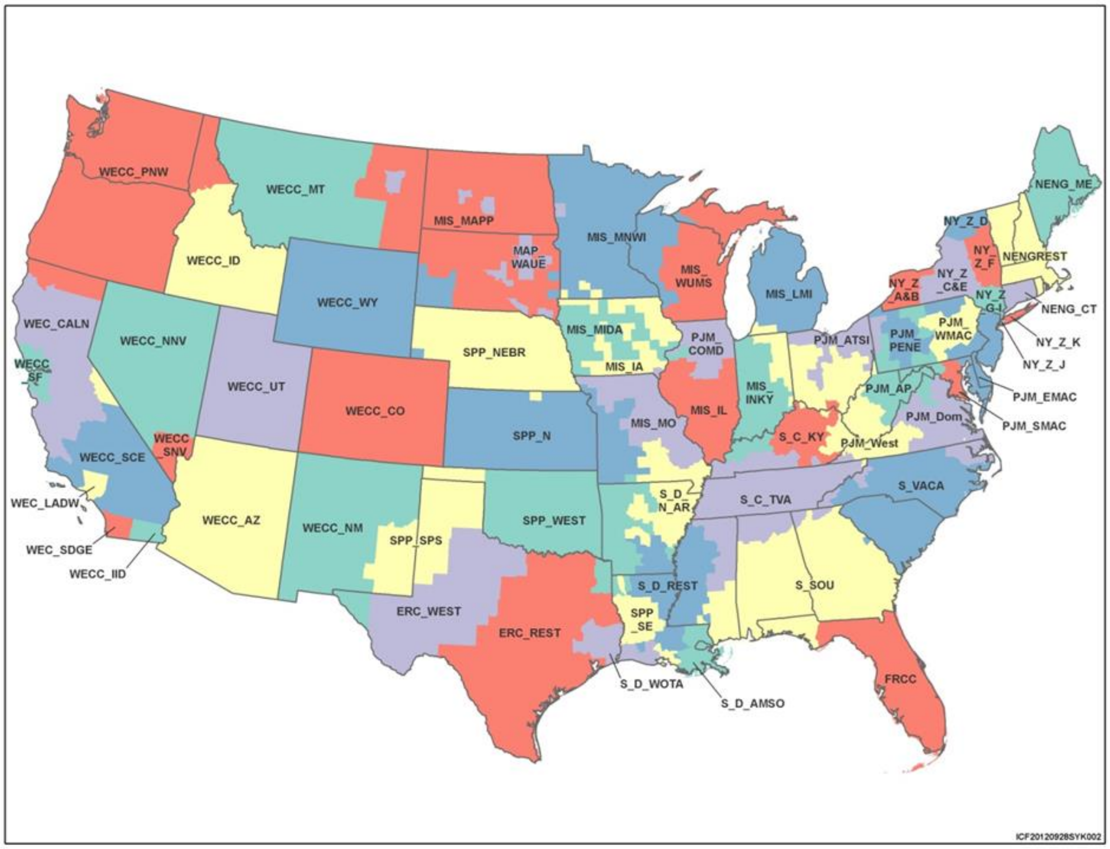
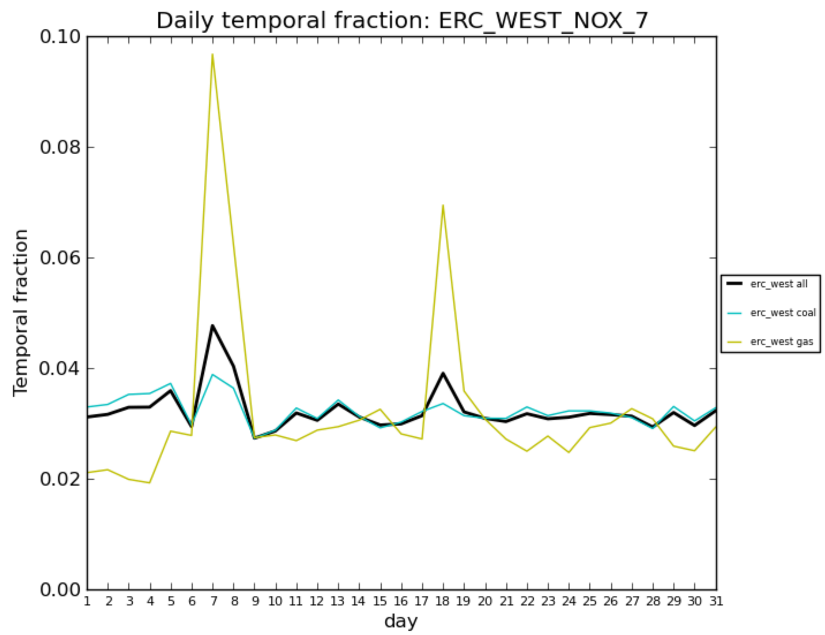


Figure 3-8. Month-to-day profiles for different fuels in a West Texas Region



3.5.3 Airport Temporal allocation (ptnonipm)

Airport temporal profiles were updated in 2014v7.0 and were kept the same for 2014v7.1. All airport SCCs (i.e., 2275*, 2265008005, 2267008005, 2268008005 and 2270008005) were given the same hourly, weekly and monthly profile for all airports other than Alaska seaplanes (which are not in the CMAQ modeling domain). Hourly airport operations data were obtained from the Aviation System Performance Metrics (ASPM) Airport Analysis website (https://aspm.faa.gov/apm/sys/AnalysisAP.asp). A report of 2014 hourly Departures and Arrivals for Metric Computation was generated. An overview of the ASPM metrics is at http://aspmhelp.faa.gov/index.php/Aviation_Performance_Metrics_%28APM%29. Figure 3-9 shows the diurnal airport profile.

Weekly and monthly temporal profiles are based on 2014 data from the FAA Operations Network Air Traffic Activity System (http://aspm.faa.gov/opsnet/sys/Terminal.asp). A report of all airport operations (takeoffs and landings) by day for 2014 was generated. These data were then summed to month and day-of-week to derive the monthly and weekly temporal profiles shown in Figure 3-9, Figure 3-10, and Figure 3-11. An overview of the Operations Network data system is at http://aspmhelp.faa.gov/index.php/Operations_Network_%28OPSNET%29.

Alaska seaplanes, which are outside the CONUS domain use the same monthly profile as in the 2011 platform shown in Figure 3-12. These were assigned based on the facility ID.

Figure 3-9. Diurnal Profile for all Airport SCCs

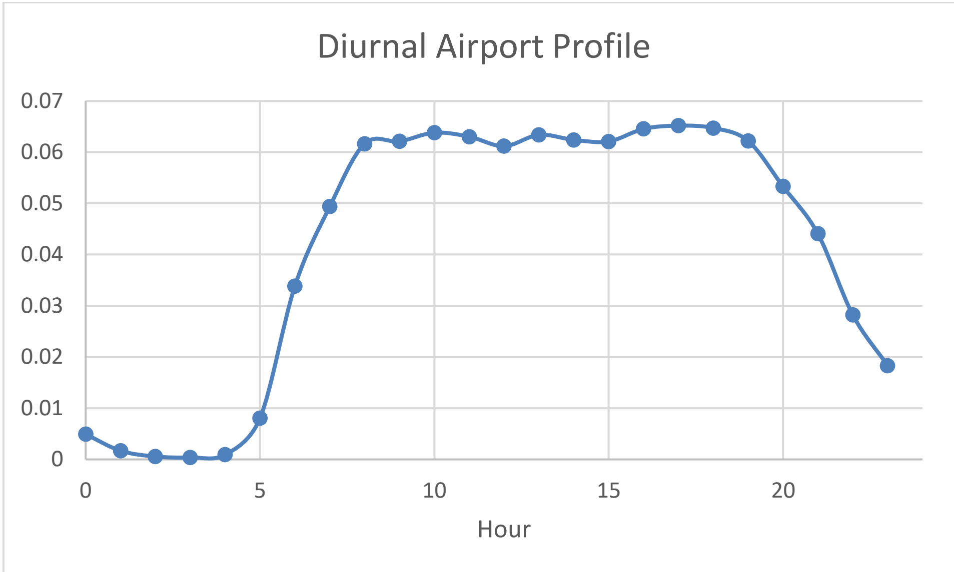


Figure 3-10. Weekly profile for all Airport SCCs

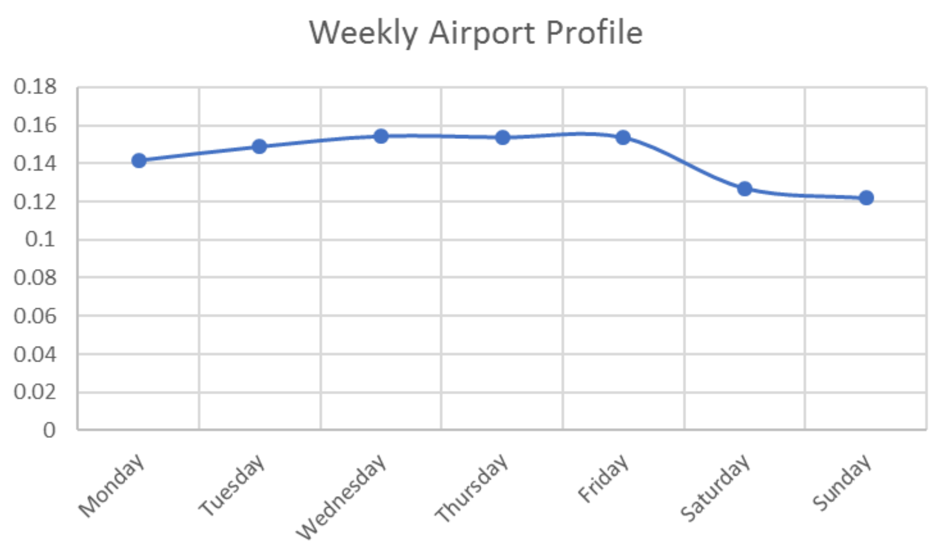


Figure 3-11. Monthly Profile for all Airport SCCs

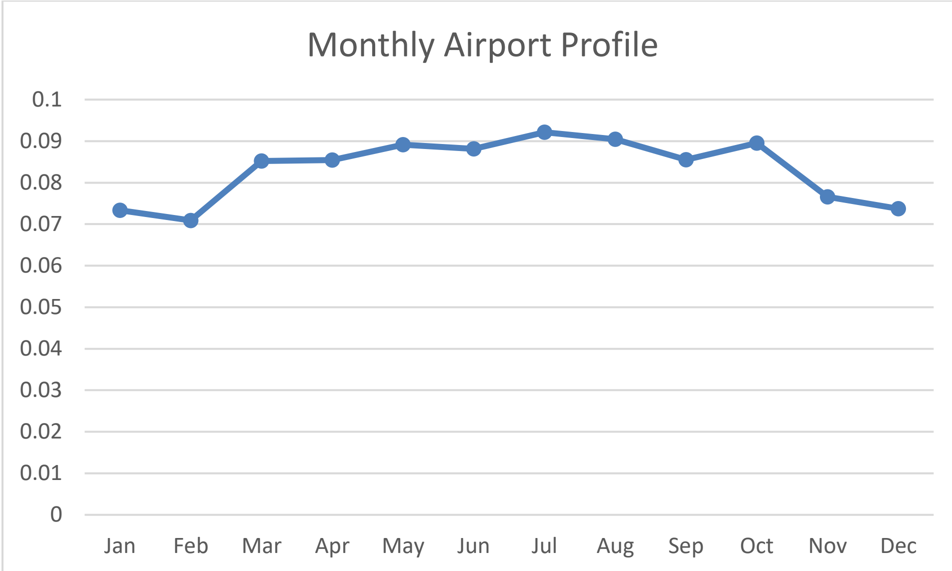
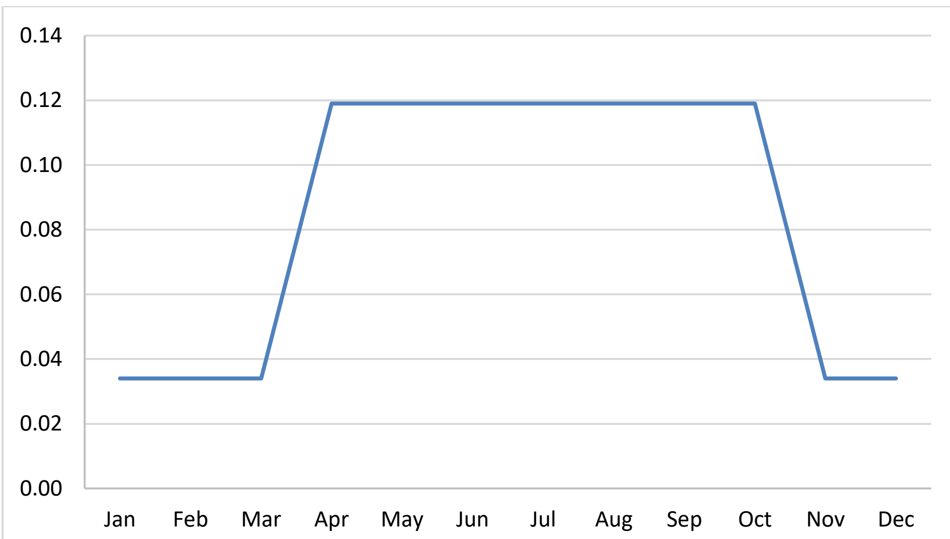


Figure 3-12. Alaska Seaplane Profile



3.5.4 Residential Wood Combustion Temporal allocation (rwc)

There are many factors that impact the timing of when emissions occur, and for some sectors this includes meteorology. The benefits of utilizing meteorology as method for temporal allocation are: (1) a meteorological dataset consistent with that used by the AQ model is available (e.g., outputs from WRF); (2) the meteorological model data are highly resolved in terms of spatial resolution; and (3) the meteorological variables vary at hourly resolution and can, therefore, be translated into hour-specific temporal allocation.

The SMOKE program Gentpro provides a method for developing meteorology-based temporal allocation. Currently, the program can utilize three types of temporal algorithms: annual-to-day temporal allocation for residential wood combustion (RWC); month-to-hour temporal allocation for agricultural livestock

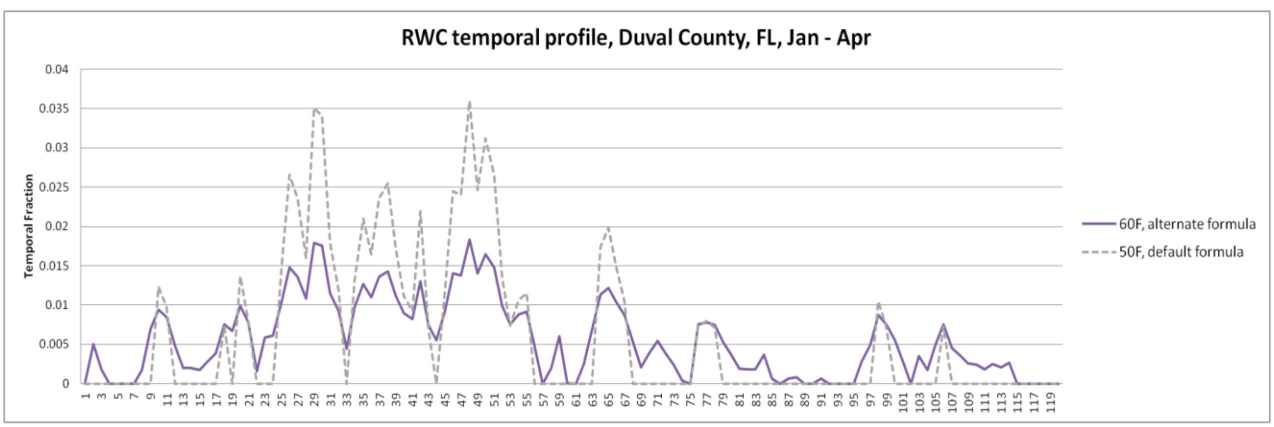
NH_3; and a generic meteorology-based algorithm for other situations. Meteorological-based temporal allocation was used for portions of the rwc sector and for livestock within the ag sector.

Gentpro reads in gridded meteorological data (output from MCIP) along with spatial surrogates, and uses the specified algorithm to produce a new temporal profile that can be input into SMOKE. The meteorological variables and the resolution of the generated temporal profile (hourly, daily, etc.) depend on the selected algorithm and the run parameters. For more details on the development of these algorithms and running Gentpro, see the Gentpro documentation and the SMOKE documentation at http://www.cmascenter.org/smoke/documentation/3.1/GenTPRO_TechnicalSummary_Aug2012_Final.pdf and https://www.cmascenter.org/smoke/documentation/4.5/html/ch05s03s05.html, respectively.

For the RWC algorithm, Gentpro uses the daily minimum temperature to determine the temporal allocation of emissions to days. Gentpro was used to create an annual-to-day temporal profile for the RWC sources. These generated profiles distribute annual RWC emissions to the coldest days of the year. On days where the minimum temperature does not drop below a user-defined threshold, RWC emissions for most sources in the sector are zero. Conversely, the program temporally allocates the largest percentage of emissions to the coldest days. Similar to other temporal allocation profiles, the total annual emissions do not change, only the distribution of the emissions within the year is affected. The temperature threshold for RWC emissions was 50 ˚F for most of the country, and 60 ˚F for the following states: Alabama, Arizona, California, Florida, Georgia, Louisiana, Mississippi, South Carolina, and Texas.

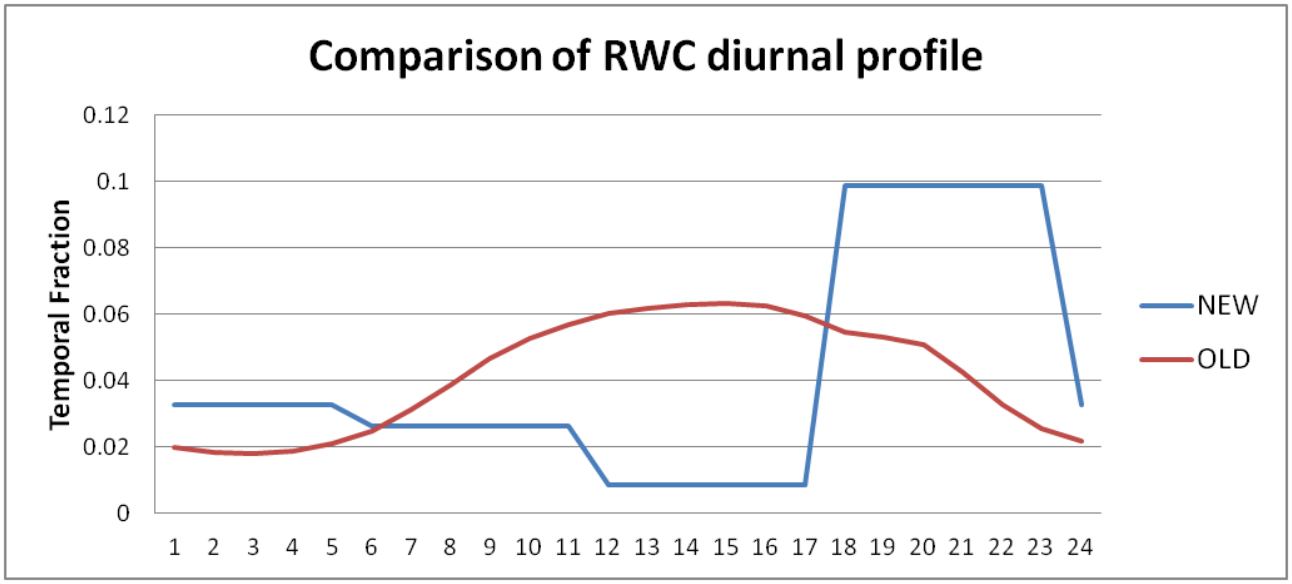
Figure 3-13 illustrates the impact of changing the temperature threshold for a warm climate county. The plot shows the temporal fraction by day for Duval County, Florida, for the first four months of 2007. The default 50 ˚F threshold creates large spikes on a few days, while the 60 ˚F threshold dampens these spikes and distributes a small amount of emissions to the days that have a minimum temperature between 50 and 60 ˚F.

Figure 3-13. Example of RWC temporal allocation in 2007 using a 50 versus 60 ˚F threshold



The diurnal profile for used for most RWC sources (see Figure 3-14) places more of the RWC emissions in the morning and the evening when people are typically using these sources. This profile is based on a 2004 MANE-VU survey based temporal profiles (see http://www.marama.org/publications_folder/ResWoodCombustion/Final_report.pdf). This profile was created by averaging three indoor and three RWC outdoor temporal profiles from counties in Delaware and aggregating them into a single RWC diurnal profile. This new profile was compared to a concentration-based analysis of aethalometer measurements in Rochester, New York (Wang *et al.* 2011) for various seasons and days of the week and was found that the new RWC profile generally tracked the concentration based temporal patterns.

Figure 3-14. RWC diurnal temporal profile



The temporal allocation for "Outdoor Hydronic Heaters" (i.e., "OHH," SCC=2104008610) and "Outdoor wood burning device, NEC (fire-pits, chimneas, etc.)" (i.e., "recreational RWC," SCC=21040087000) is not based on temperature data, because the meteorological-based temporal allocation used for the rest of the rwc sector did not agree with observations for how these appliances are used.

For OHH, the annual-to-month, day-of-week and diurnal profiles were modified based on information in the New York State Energy Research and Development Authority's (NYSERDA) "Environmental, Energy Market, and Health Characterization of Wood-Fired Hydronic Heater Technologies, Final Report" (NYSERDA, 2012), as well as a Northeast States for Coordinated Air Use Management (NESCAUM) report "Assessment of Outdoor Wood-fired Boilers" (NESCAUM, 2006). A Minnesota 2008 Residential Fuelwood Assessment Survey of individual household responses (MDNR, 2008) provided additional annual-to-month, day-of-week and diurnal activity information for OHH as well as recreational RWC usage.

The diurnal profile for OHH, shown in Figure 3-15, is based on a conventional single-stage heat load unit burning red oak in Syracuse, New York. As shown in Figure 3-16, the NESCAUM report describes how for individual units, OHH are highly variable day-to-day but that in the aggregate, these emissions have no day-of-week variation. In contrast, the day-of-week profile for recreational RWC follows a typical "recreational" profile with emissions peaked on weekends.

Annual-to-month temporal allocation for OHH as well as recreational RWC were computed from the MDNR 2008 survey and are illustrated in Figure 3-17. The OHH emissions still exhibit strong seasonal variability, but do not drop to zero because many units operate year-round for water and pool heating. In contrast to all other RWC appliances, recreational RWC emissions are used far more frequently during the warm season.

Figure 3-15. Diurnal profile for OHH, based on heat load (BTU/hr)

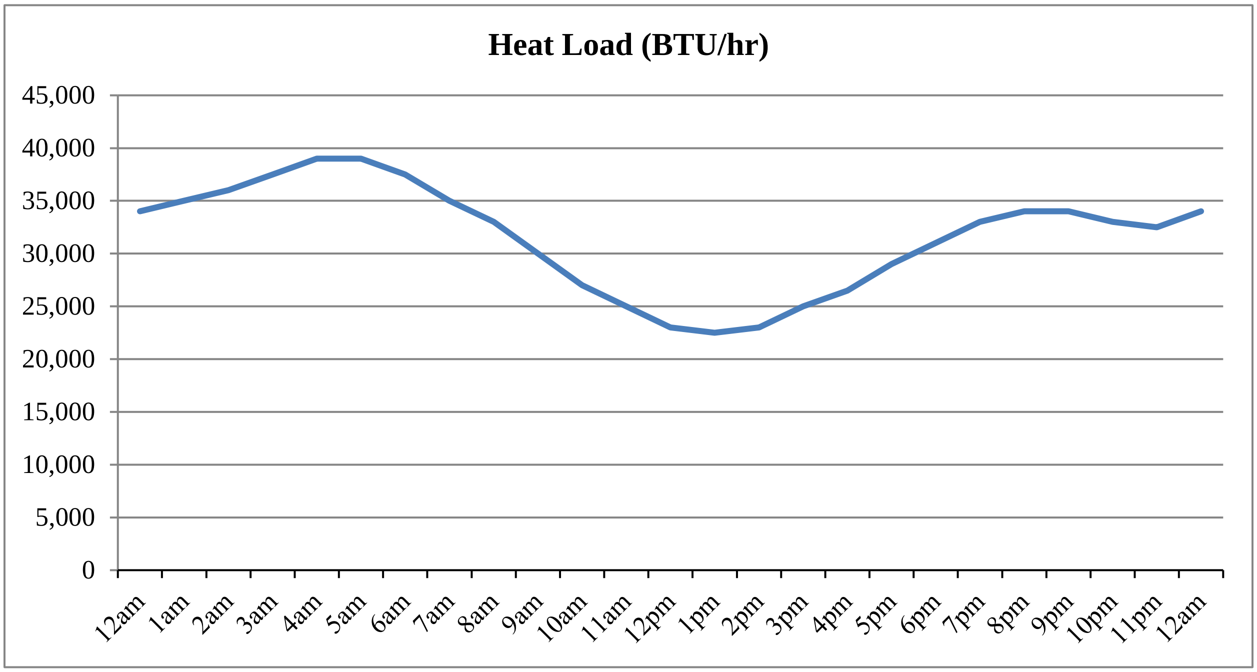


Figure 3-16. Day-of-week temporal profiles for OHH and Recreational RWC

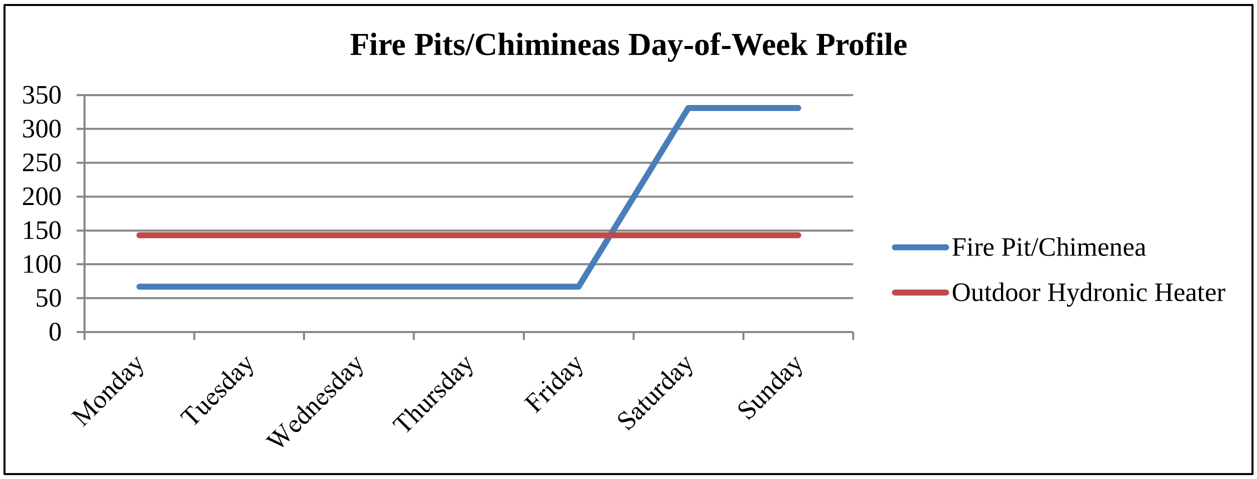
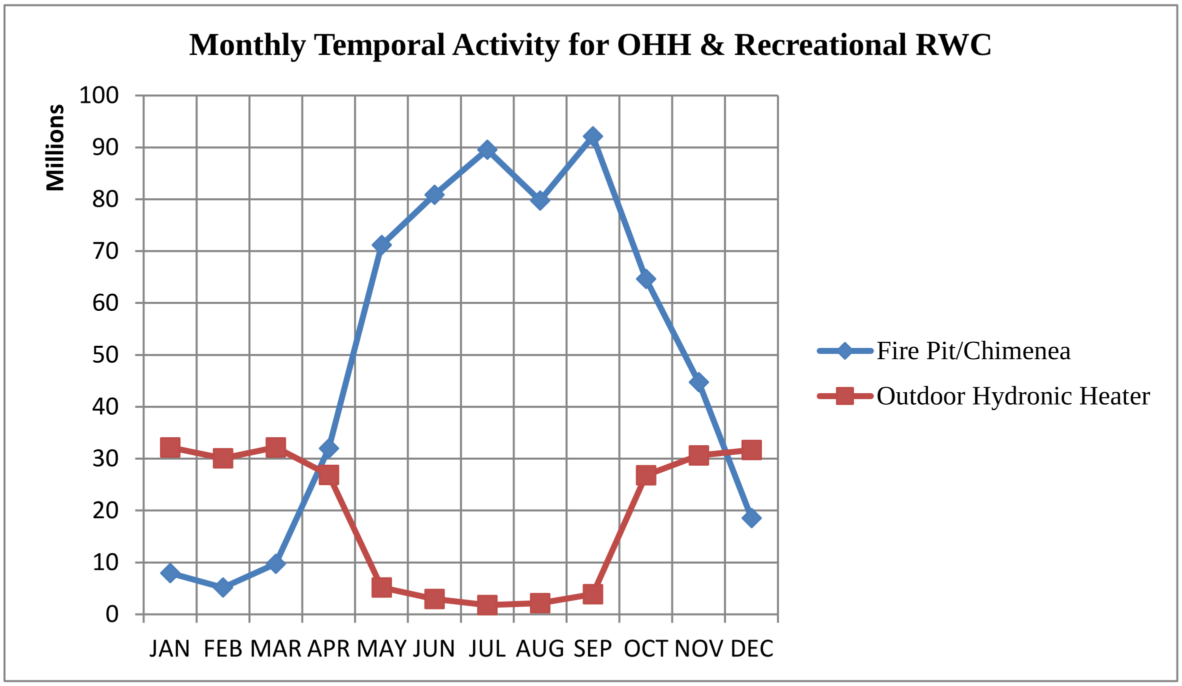


Figure 3-17. Annual-to-month temporal profiles for OHH and recreational RWC



3.5.5 Agricultural Ammonia Temporal Profiles (ag)

For the agricultural livestock NH_3 algorithm, the GenTPRO algorithm is based on an equation derived by Jesse Bash of the EPA's ORD based on the Zhu, Henze, et al. (2013) empirical equation. This equation is based on observations from the TES satellite instrument with the GEOS-Chem model and its adjoint to estimate diurnal NH_3 emission variations from livestock as a function of ambient temperature, aerodynamic resistance, and wind speed. The equations are:

$$E_{i,h} = [161500/T_{i,h} \text{ x } e^{(-1380/T_{i,h})}] \text{ x } AR_{i,h}$$

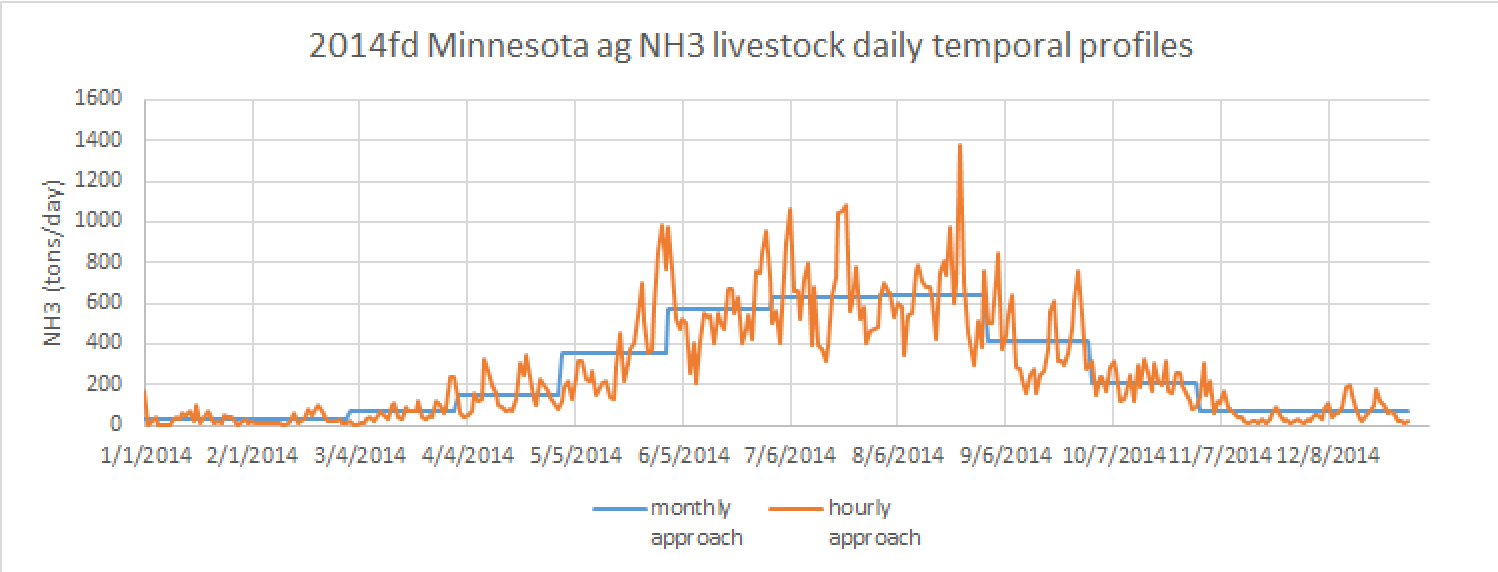
$$PE_{i,h} = E_{i,h} / \text{Sum}(E_{i,h})$$

where

- $PE_{i,h}$ = Percentage of emissions in county *i* on hour *h*
- $E_{i,h}$ = Emission rate in county *i* on hour *h*
- $T_{i,h}$ = Ambient temperature (Kelvin) in county *i* on hour *h*
- $V_{i,h}$ = Wind speed (meter/sec) in county *i* (minimum wind speed is 0.1 meter/sec)
- $AR_{i,h}$ = Aerodynamic resistance in county *i*

GenTPRO was run using the "BASH_NH3" profile method to create month-to-hour temporal profiles for these sources. Because these profiles distribute to the hour based on monthly emissions, the monthly emissions are obtained from a monthly inventory, or from an annual inventory that has been temporalized to the month. Figure 3-18 compares the daily emissions for Minnesota from the "old" approach (uniform monthly profile) with the "new" approach (GenTPRO generated month-to-hour profiles). Although the GenTPRO profiles show daily (and hourly variability), the monthly total emissions are the same between the two approaches.

Figure 3-18. Example of animal NH_3 emissions temporal allocation approach, summed to daily emissions



For the 2014v7.1 platform, the GenTPRO approach is applied to all sources in the ag sector, NH_3 and non- NH_3, livestock and fertilizer. Monthly profiles are based on the daily-based EPA livestock emissions and are the same as were used in v7.0. Profiles are by state/SCC_category, where SCC_category is one of the following: beef, broilers, layers, dairy, swine.

3.5.6 Oil and gas temporal allocation (np_oilgas)

For v2, the monthly oil and gas temporal profiles by county and SCC were updated to use 2014 activity information (v1 used 2011). These were developed at the same time as the 2014 surrogates (ERG, 2016b), and were based primarily on activity data extracted from the "DI Desktop Database powered by HPDI." (Drillinginfo, 2015). Data from state Oil and Gas Commission websites and from the RigData website (rigdata.com) were also used (RIGDATA, 2015). Weekly and diurnal profiles are flat and are based on comments received on a version of the 2011 platform.

3.5.7 Onroad mobile temporal allocation (onroad)

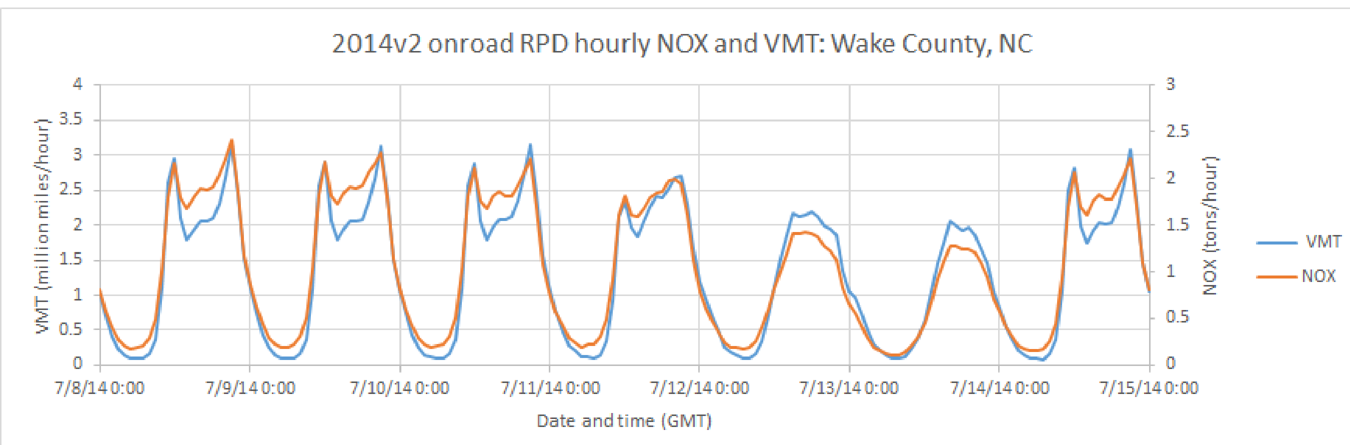
For the onroad sector, the temporal distribution of emissions is a combination of traditional temporal profiles and the influence of meteorology. This section will discuss both the meteorological influences and the development of the temporal profiles for this platform.

The "inventories" referred to in Table 3-22 consist of activity data for the onroad sector, not emissions. For the off-network emissions from the RPP and RPV processes, the VPOP activity data is annual and does not need temporal allocation. For processes that result from hoteling of combinations trucks (RPH), the HOTELING inventory is annual and was temporalized to month, day of the week, and hour of the day through temporal profiles.

For on-roadway RPD processes, the VMT activity data is annual for some sources and monthly for other sources, depending on the source of the data. Sources without monthly VMT were temporalized from annual to month through temporal profiles. VMT was also temporalized from month to day of the week, and then to hourly through temporal profiles. The RPD processes require a speed profile (SPDPRO) that consists of vehicle speed by hour for a typical weekday and weekend day. Unlike RPD, RPV, and RPH, the temporal profiles and SPDPRO will impact not only the distribution of emissions through time but also the total emissions. Because SMOKE-MOVES (for RPD) calculates emissions based on the VMT, speed and meteorology, if one shifted the VMT or speed to different hours, it would align with different temperatures and hence different emission factors. In other words, two SMOKE-MOVES runs with identical annual VMT, meteorology, and MOVES emission factors, will have different total emissions if the temporal allocation of VMT changes. Figure 3-19 illustrates the temporal allocation of the onroad activity data (i.e., VMT) and the pattern of the emissions that result after running SMOKE-MOVES. In this figure, it can be seen that the meteorologically varying emission factors add variation on top of the temporal allocation of the activity data.

Meteorology is not used in the development of the temporal profiles, but rather it impacts the calculation of the hourly emissions through the program Movesmrg. The result is that the emissions vary at the hourly level by grid cell. More specifically, the on-network (RPD) and the off-network parked vehicle (RPV, RPH, and RPP) processes use the gridded meteorology (MCIP) either directly or indirectly. For RPD, RPV, and RPH, Movesmrg determines the temperature for each hour and grid cell and uses that information to select the appropriate emission factor for the specified SCC/pollutant/mode combination. For RPP, instead of reading gridded hourly meteorology, Movesmrg reads gridded daily minimum and maximum temperatures. The total of the emissions from the combination of these four processes (RPD, RPV, RPH, and RPP) comprise the onroad sector emissions. The temporal patterns of emissions in the onroad sector are influenced by meteorology.

Figure 3-19. Example of temporal variability of NO_X emissions



New VMT day-of-week and hour-of-day temporal profiles were developed for use in the 2014NEIv2 and later platforms as part of the effort to update the inputs to MOVES and SMOKE-MOVES under CRC A-100 (Coordinating Research Council, 2017). CRC A-100 data includes profiles by region or county, road type, and broad vehicle category. There are three vehicle categories: passenger vehicles (11/21/31), commercial trucks (32/52), and combination trucks (53/61/62). CRC A-100 does not cover buses, refuse trucks, or motor homes, so those vehicle types were mapped to other vehicle types for which CRC A-100 did provide profiles as follows: 1) Intercity/transit buses were mapped to commercial trucks; 2) Motor homes were mapped to passenger vehicles for day-of-week and commercial trucks for hour-of-day; 3) School buses and refuse trucks were mapped to commercial trucks for hour-of-day and use a new custom day-of-week profile called LOWSATSUN that has a very low weekend allocation, since school buses and refuse trucks operate primarily on business days. In addition to temporal profiles, CRC A-100 data were also used to develop the average hourly speed data (SPDPRO) used by SMOKE-MOVES. In areas where CRC A-100 data does not exist, hourly speed data is based on MOVES county databases.

The CRC A-100 dataset includes temporal profiles for individual counties, Metropolitan Statistical Areas (MSAs), and entire regions (e.g. West, South). For counties without county or MSA-specific temporal profiles specific to itself, regional temporal profiles are used. Temporal profiles also vary by each of the MOVES road types, and there are distinct hour-of-day profiles for each day of the week. Plots of hour-of-day profiles for passenger vehicles in Fulton County, GA, are shown in Figure 3-20. Separate plots are shown for Monday, Friday, Saturday, and Sunday, and each line corresponds to a particular MOVES road type (i.e.,. road type 2 = rural restricted, 3 = rural unrestricted, 4 = urban restricted, and 5 = urban unrestricted). Figure 3-21 shows which counties have temporal profiles specific to that county, and which counties use regional average profiles.

Figure 3-20. Sample onroad diurnal profiles for Fulton County, GA

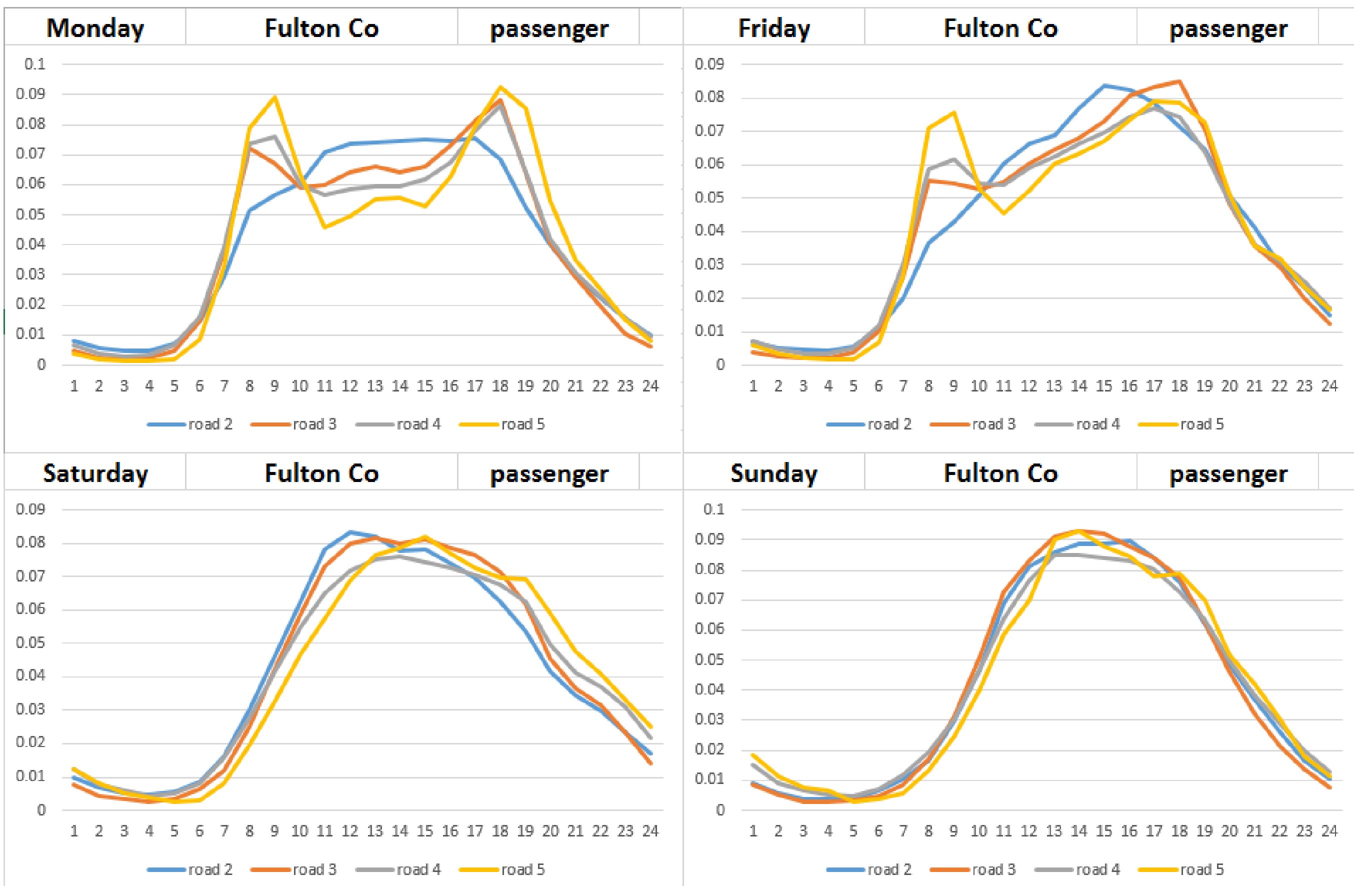
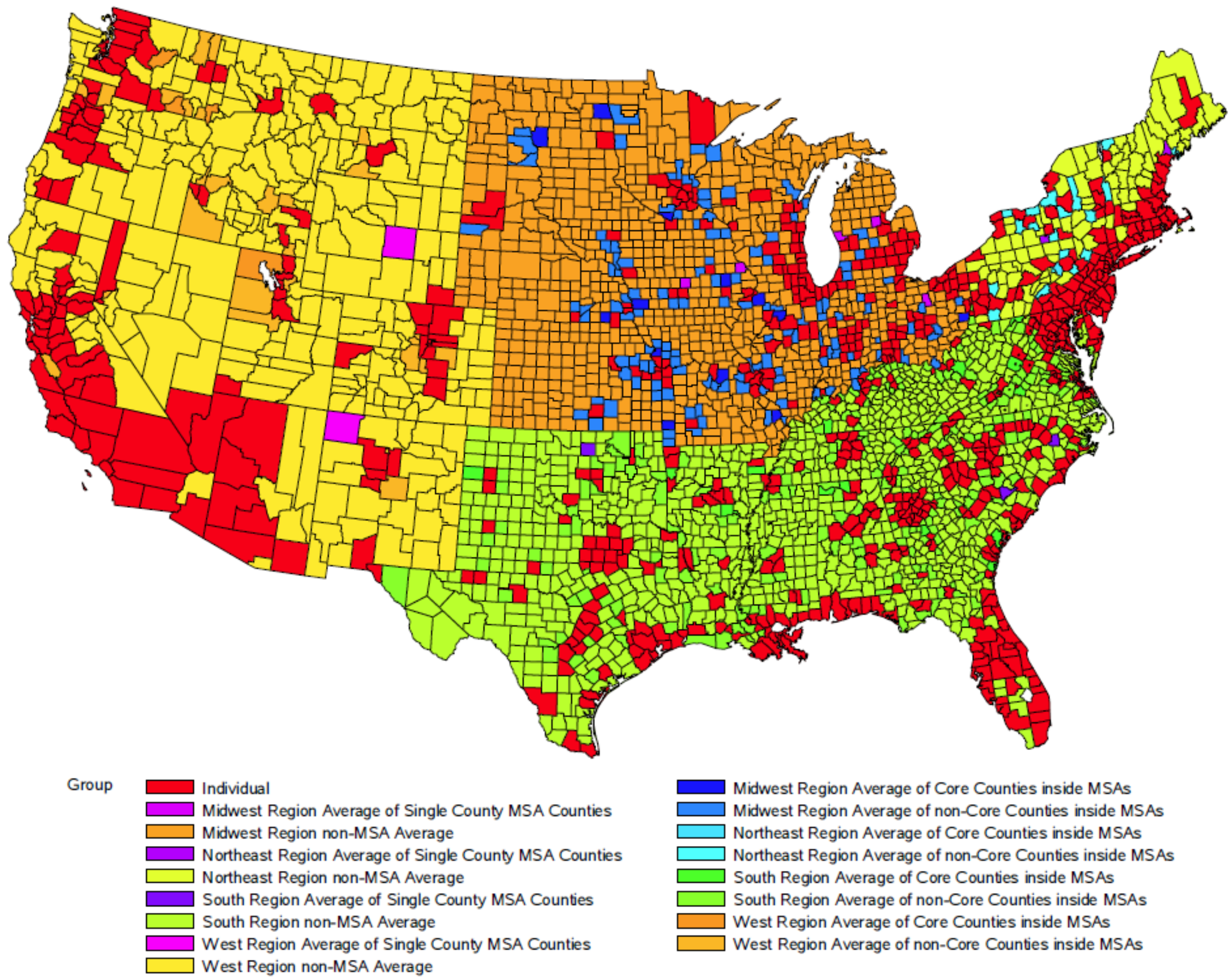


Figure 3-21. Counties for which MOVES Speeds and Temporal Profiles could be Populated

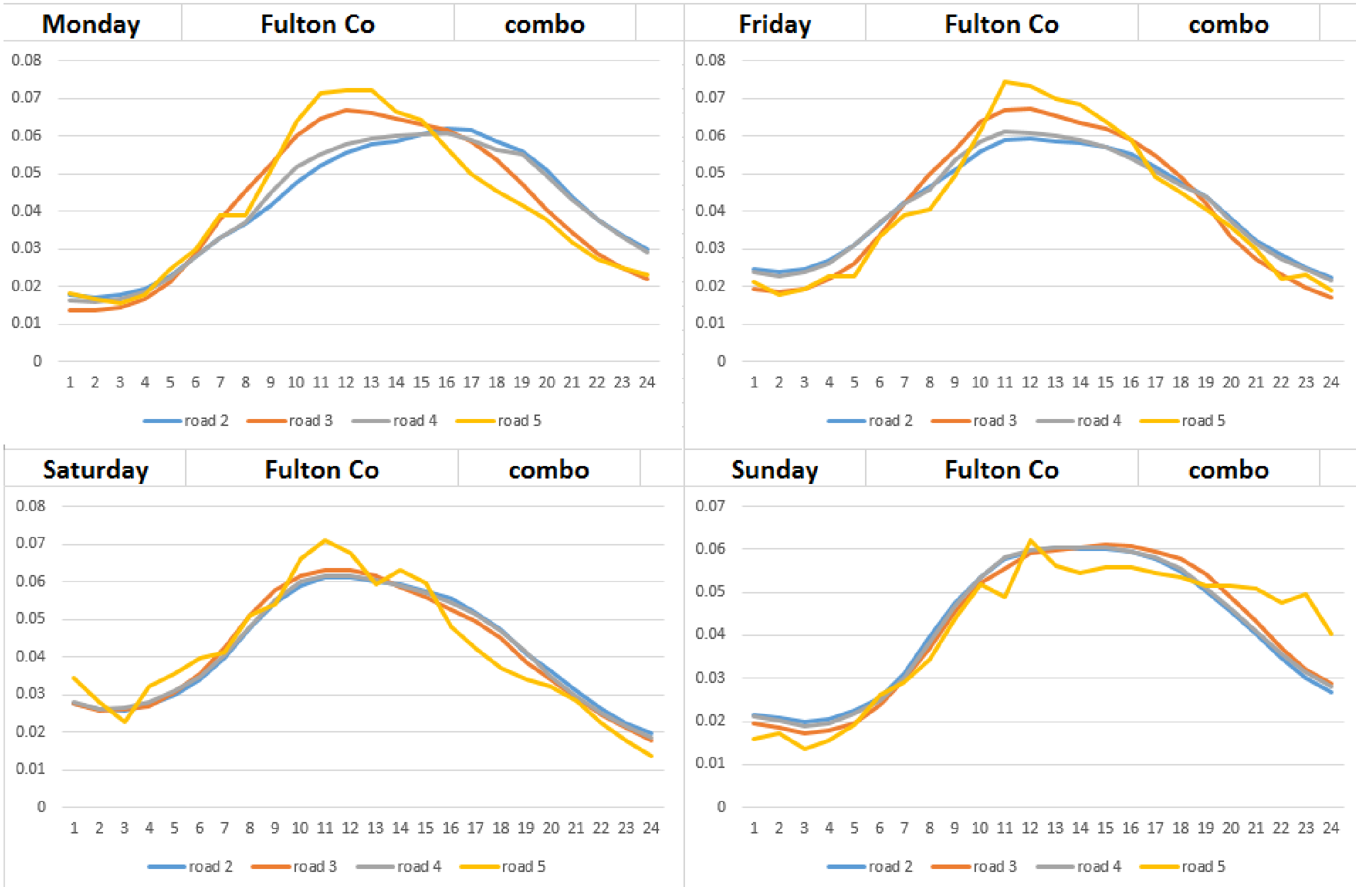


For hoteling, day-of-week profiles are the same as non-hoteling for combination trucks, while hour-of-day non-hoteling profiles for combination trucks were inverted to create new hoteling profiles that peak overnight instead of during the day. The combination truck profiles for Fulton County are shown in Figure 3-22.

The CRC A-100 temporal profiles were used in the entire contiguous United States, except in California. All California temporal profiles were carried over from 2014v1, although California hoteling uses CRC A-100-based profiles just like the rest of the country, since CARB didn't have a hoteling-specific profile. Monthly profiles in all states (national profiles by broad vehicle type) were also carried over from 2014v1 and applied directly to the VMT. For California, CARB supplied diurnal profiles that varied by vehicle type, day of the week[15], and air basin. These CARB-specific profiles were used in developing EPA estimates for California. Although the EPA adjusted the total emissions to match California's submittal to the 2014NEIv1, the temporal allocation of these emissions took into account both the state-specific VMT profiles and the SMOKE-MOVES process of incorporating meteorology. For more details on the adjustments to California's onroad emissions, see Section 2.3.1.

[15] California's diurnal profiles varied within the week. Monday, Friday, Saturday, and Sunday had unique profiles and Tuesday, Wednesday, Thursday had the same profile.

Figure 3-22. Example of Temporal Profiles for Combination Trucks



3.5.8 Additional sector specific details (afdust, beis, cmv, rail, nonpt, ptnonipm, ptfire)

For the afdust sector, meteorology is not used in the development of the temporal profiles, but it is used to reduce the total emissions based on meteorological conditions. These adjustments are applied through sector-specific scripts, beginning with the application of land use-based gridded transport fractions and then subsequent zero-outs for hours during which precipitation occurs or there is snow cover on the ground. The land use data used to reduce the NEI emissions explains the amount of emissions that are subject to transport. This methodology is discussed in (Pouliot et al., 2010, http://www3.epa.gov/ttn/chief/conference/ei19/session9/pouliot_pres.pdf), and in "Fugitive Dust Modeling for the 2008 Emissions Modeling Platform" (Adelman, 2012). The precipitation adjustment is applied to remove all emissions for days where measurable rain occurs. Therefore, the afdust emissions vary day-to-day based on the precipitation and/or snow cover for that grid cell and day. Both the transport fraction and meteorological adjustments are based on the gridded resolution of the platform; therefore, somewhat different emissions will result from different grid resolutions. Application of the transport fraction and meteorological adjustments prevents the overestimation of fugitive dust impacts in the grid modeling as compared to ambient samples.

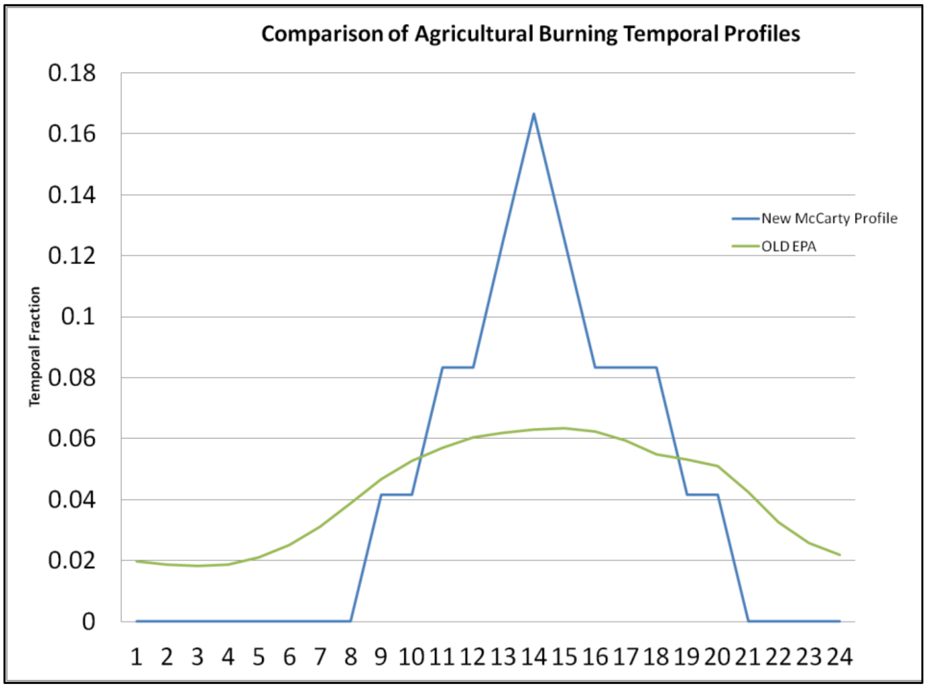
Biogenic emissions in the beis sector vary by every day of the year because they are developed using meteorological data including temperature, surface pressure, and radiation/cloud data. The emissions are computed using appropriate emission factors according to the vegetation in each model grid cell, while taking the meteorological data into account.

For the cmv sectors, emissions are allocated with flat day of week and flat hourly profiles. Updated monthly profiles were developed for the LADCO states using link-level NO_X emissions for ship traffic provided by LADCO. These data were based on activities reported by ship AIS (transponder) devices. Monthly NOx emissions were normalized to create temporal profiles for each lake. For the port SCCs, an in-port profile was developed as the average of the maneuvering and hoteling emissions. The cruising emissions were used for the underway SCCs. As some of the lakes did not include complete data for the in-port sources (Ontario, Canada, St. Claire), a hybrid profile was created as an average of the in-port NOx emissions for Lakes Michigan, Huron, Superior, and Erie. A resulting 22 profiles were developed and applied to C1, C2 and C3 ships based county and SCC (i.e., port versus underway). Only new monthly profiles were developed from these data because the weekly and diurnal variation were deemed to be comparable to the existing EPA profiles. For non-LADCO areas, C1 and C2 monthly profiles are flat and C3 monthly profiles are highest (but not significantly different from the rest of the year) in the summer.

For the rail sector, new monthly profiles were developed for the 2014 platform. Monthly temporal allocation for rail freight emissions is based on AAR Rail Traffic Data, Total Carloads and Intermodal, for 2014. For passenger trains, monthly temporal allocation is based on rail passenger miles data for 2014 from the Bureau of Transportation Statistics. Rail emissions are allocated with flat day of week profiles, and most emissions are allocated with flat hourly profiles.

For the agfire sector, we used the EPA-generated day-specific $PM_{2.5}$ emissions to develop state specific monthly profiles. For both agfire and ptagfire, the diurnal temporal profile used reflected the fact that burning occurs during the daylight hours - see Figure 3-23 (McCarty et al., 2009). This puts most of the emissions during the work day and suppresses the emissions during the middle of the night. A uniform profile for each day of the week was used for all agricultural burning emissions in the agfire sector, except in Iowa, where the EPA used state-specific day of week profiles.

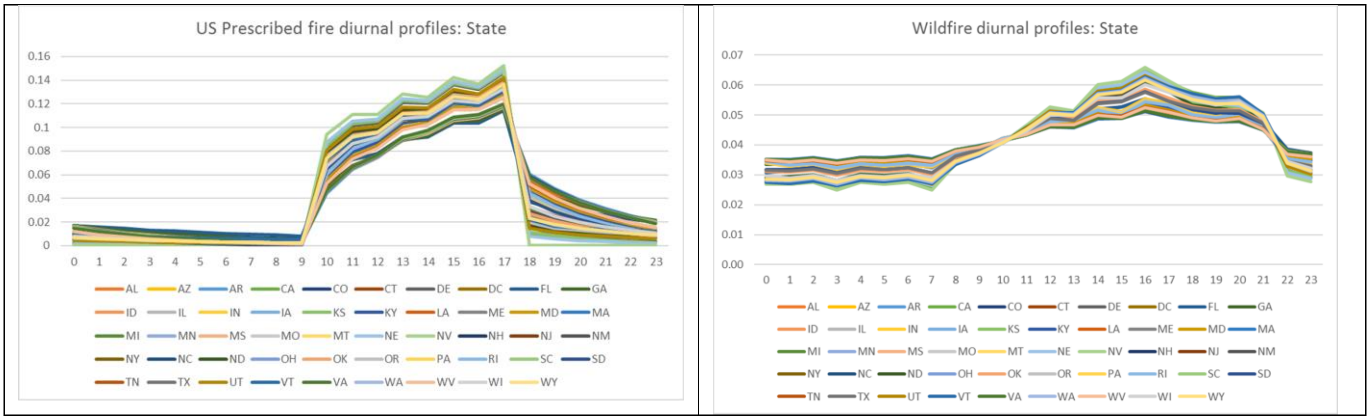
Figure 3-23. Agricultural burning diurnal temporal profile



Industrial processes that are not likely to shut down on Sundays, such as those at cement plants, use profiles that include emissions on Sundays, while those that would shut down on Sundays use profiles that reflect Sunday shutdowns.

For the ptfire sectors, the inventories are in the daily point fire format FF10 PTDAY. Separate hourly profiles for prescribed and wildfires were used. Figure 3-24 below shows the profiles used for each state for the 2014v7.0 and 2014v7.1 modeling platforms. They are similar but not the same and vary according to the average meteorological conditions in each state.

Figure 3-24. Prescribed and Wildfire diurnal temporal profiles



For the nonroad sector, while the NEI only stores the annual totals, the modeling platform uses monthly inventories from output from MOVES. For California, CARB's annual inventory was temporalized to monthly using monthly temporal profiles applied in SMOKE by SCC. This is an improvement over the 2011 platform, which applied monthly temporal allocation in California at the broader SCC7 level.

3.6 Spatial Allocation

The methods used to perform spatial allocation are summarized in this section. For the modeling platform, spatial factors are typically applied by county and SCC. As described in Section 3.1, spatial allocation was performed for a national 12-km domain. To accomplish this, SMOKE used national 12-km spatial surrogates and a SMOKE area-to-point data file. For the U.S., the EPA updated surrogates to use circa 2010-2011 data wherever possible. For Mexico, updated spatial surrogates were used as described below. For Canada, updated surrogates were provided by Environment Canada for 2014v7.1. The U.S., Mexican, and Canadian 12-km surrogates cover the entire CONUS domain 12US1 shown in Figure 3-1.

Documentation of the origin of the spatial surrogates for the platform is provided in the workbook US_SpatialSurrogate_Workbook_v07172018 which is available with the reports for the case. The remainder of this subsection summarizes the data used for the spatial surrogates and the area-to-point data which is used for airport refueling.

3.6.1 Spatial Surrogates for U.S. emissions

There are more than 100 spatial surrogates available for spatially allocating U.S. county-level emissions to the 12-km grid cells used by the air quality model. As described in Section 3.4.2, an area-to-point approach overrides the use of surrogates for a airport refueling sources. Table 3-23 lists the codes and descriptions of the surrogates. Surrogate names and codes listed in *italics* are not directly assigned to any sources for the 2014v7.1 platform, but they are sometimes used to gapfill other surrogates, or as an input for merging two surrogates to create a new surrogate that is used.

Many surrogates were updated or newly developed for use in the 2014v7.0 platform (Adelman, 2016). They include the use of the 2011 National Land Cover Database (the previous platform used 2006) and development of various development density levels such as open, low, medium high and various combinations of these. These landuse surrogates largely replaced the FEMA category surrogates that were used in the 2011 platform. Additionally, onroad surrogates were developed using average annual daily traffic counts from the highway monitoring performance system (HPMS). Previously, the "activity" for the onroad surrogates was length of road miles. This and other surrogates are described in a reference (Adelman, 2016).

Several surrogates were updated or developed as new surrogates for 2014v7.1:

- c1/c2 ships at ports uses a surrogate based on 2014 NEI ports activity data based on use of the 2014NEIv1 (surrogate 820); previously, just the port shapes (801) were used.
- c1/c2 ships underway uses a 2013-shipping density surrogate (surrogate 808); previously Offshore Shipping NEI2014 Activity (808) was used.
- Oil and gas surrogates were updated to correct errors found after they were used for 2014v7.0;
- Onroad surrogates that do not distinguish between urban and rural road types, correcting the issue arising in some counties due to the inconsistent urban and rural definitions between MOVES and the surrogate data.
- Correction was made to the water surrogate to gap fill missing counties using 2006 NLCD

The surrogates for the U.S. were mostly generated using the Surrogate Tool to drive the Spatial Allocator, but a few surrogates were developed directly within ArcGIS or using scripts that manipulate spatial data in PostgreSQL . The tool and documentation for the Surrogate Tool is available at https://www.cmascenter.org/sa-tools/documentation/4.2/SurrogateToolUserGuide_4_2.pdf.

Table 3-23. U.S. Surrogates available for the 2014v7.1 modeling platform

Code	Surrogate Description	Code	Surrogate Description
N/A	Area-to-point approach (see 3.6.2)	505	Industrial Land
100	Population	506	Education
110	*Housing*	*507*	*Heavy Light Construction Industrial Land*
131	*urban Housing*	*510*	*Commercial plus Industrial*
132	*Suburban Housing*	*515*	*Commercial plus Institutional Land*
134	*Rural Housing*	*520*	*Commercial plus Industrial plus Institutional*
137	*Housing Change*	*525*	*Golf Courses plus Institutional plus Industrial plus Commercial*
140	*Housing Change and Population*	*526*	*Residential - Non-Institutional*
150	Residential Heating - Natural Gas	*527*	*Single Family Residential*
160	*Residential Heating - Wood*	535	Residential + Commercial + Industrial + Institutional + Government
170	Residential Heating - Distillate Oil	*540*	*Retail Trade (COM1)*
180	Residential Heating - Coal	*545*	*Personal Repair (COM3)*
190	Residential Heating - LP Gas	*555*	*Professional/Technical (COM4) plus General Government (GOV1)*
201	*Urban Restricted Road Miles*	560	Hospital (COM6)
202	Urban Restricted AADT	*575*	*Light and High Tech Industrial (IND2 + IND5)*
205	Extended Idle Locations	*580*	*Food Drug Chemical Industrial (IND3)*
211	*Rural Restricted Road Miles*	*585*	*Metals and Minerals Industrial (IND4)*
212	*Rural Restricted AADT*	*590*	*Heavy Industrial (IND1)*
221	*Urban Unrestricted Road Miles*	*595*	*Light Industrial (IND2)*
222	*Urban Unrestricted AADT*	*596*	*Industrial plus Institutional plus Hospitals*
231	*Rural Unrestricted Road Miles*	650	Refineries and Tank Farms
232	*Rural Unrestricted AADT*	670	Spud Count - CBM Wells
239	Total Road AADT	671	Spud Count - Gas Wells
240	Total Road Miles	672	Gas Production at Oil Wells
241	*Total Restricted Road Miles*	673	Oil Production at CBM Wells
242	All Restricted AADT	674	Unconventional Well Completion Counts
243	*Total Unrestricted Road Miles*	*676*	*Well Count - All Producing*
244	All Unrestricted AADT	*677*	*Well Count - All Exploratory*
258	Intercity Bus Terminals	678	Completions at Gas Wells
259	Transit Bus Terminals	679	Completions at CBM Wells
260	*Total Railroad Miles*	681	Spud Count - Oil Wells
261	NTAD Total Railroad Density	683	Produced Water at All Wells
271	NTAD Class 1 2 3 Railroad Density	685	Completions at Oil Wells
272	*NTAD Amtrak Railroad Density*	*686*	*Completions at All Wells*
273	*NTAD Commuter Railroad Density*	687	Feet Drilled at All Wells
275	*ERTAC Rail Yards*	691	Well Counts - CBM Wells
280	*Class 2 and 3 Railroad Miles*	692	Spud Count - All Wells
300	NLCD Low Intensity Development	693	Well Count - All Wells
301	*NLCD Med Intensity Development*	694	Oil Production at Oil Wells

Code	Surrogate Description	Code	Surrogate Description
302	*NLCD High Intensity Development*	695	Well Count - Oil Wells
303	*NLCD Open Space*	696	Gas Production at Gas Wells
304	NLCD Open + Low	697	Oil Production at Gas Wells
305	NLCD Low + Med	698	Well Count - Gas Wells
306	NLCD Med + High	699	Gas Production at CBM Wells
307	NLCD All Development	*710*	*Airport Points*
308	NLCD Low + Med + High	711	Airport Areas
309	NLCD Open + Low + Med	801	Port Areas
310	NLCD Total Agriculture	*805*	*Offshore Shipping Area*
318	*NLCD Pasture Land*	*806*	*Offshore Shipping NEI2014 Activity*
319	NLCD Crop Land	*807*	*Navigable Waterway Miles*
320	NLCD Forest Land	808	2013 Shipping Density
321	NLCD Recreational Land	820	Ports NEI2014 Activity
340	*NLCD Land*	850	Golf Courses
350	NLCD Water	860	Mines
500	*Commercial Land*	*890*	*Commercial Timber*

For the onroad sector, the on-network (RPD) emissions were allocated differently from the off-network (RPP and RPV). On-network used average annual daily traffic (AADT) data and off network used land use surrogates as shown in Table 3-24. Emissions from the extended (i.e., overnight) idling of trucks were assigned to surrogate 205 that is based on locations of overnight truck parking spaces. This surrogate's underlying data were updated for use in the 2014 NATA modeling to include additional data sources and corrections based on comments received on the 2011 NATA.

Table 3-24. Off-Network Mobile Source Surrogates

Source type	Source Type name	**Surrogate ID**	**Description**
11	Motorcycle	307	NLCD All Development
21	Passenger Car	307	NLCD All Development
31	Passenger Truck	307	NLCD All Development
32	Light Commercial Truck	308	NLCD Low + Med + High
41	Intercity Bus	258	Intercity Bus Terminals
42	Transit Bus	259	Transit Bus Terminals
43	School Bus	506	Education
51	Refuse Truck	306	NLCD Med + High
52	Single Unit Short-haul Truck	306	NLCD Med + High
53	Single Unit Long-haul Truck	306	NLCD Med + High
54	Motor Home	304	NLCD Open + Low
61	Combination Short-haul Truck	306	NLCD Med + High
62	Combination Long-haul Truck	306	NLCD Med + High

For the oil and gas sources in the np_oilgas sector, the spatial surrogates were updated to those shown in Table 3-25 using 2014 data consistent with what was used to develop the 2014NEI nonpoint oil and gas emissions. The primary activity data source used for the development of the oil and gas spatial surrogates was data from Drilling Info (DI) Desktop's HPDI database (Drilling Info, 2015). This database contains well-level location, production, and exploration statistics at the monthly level.
Due to a proprietary agreement with DI Desktop, individual well locations and ancillary

production cannot be made publicly available, but aggregated statistics are allowed. These data were supplemented with data from state Oil and Gas Commission (OGC) websites (Illinois, Idaho, Indiana, Kentucky, Missouri, Nevada, Oregon and Pennsylvania, Tennessee). In many cases, the correct surrogate parameter was not available (e.g., feet drilled), but an alternative surrogate parameter was available (e.g., number of spudded wells) and downloaded. Under that methodology, both completion date and date of first production from HPDI were used to identify wells completed during 2011. In total, over 1.43 million unique wells were compiled from the above data sources. The wells cover 34 states and 1,158 counties. (ERG, 2016b). Corrections to these data were made for the 2014v7.1 platform after errors were discovered in some counties.

Table 3-25. Spatial Surrogates for Oil and Gas Sources

Surrogate Code	Surrogate Description
670	Spud Count - CBM Wells
671	Spud Count - Gas Wells
672	Gas Production at Oil Wells
673	Oil Production at CBM Wells
674	Unconventional Well Completion Counts
676	Well Count - All Producing
677	Well Count - All Exploratory
678	Completions at Gas Wells
679	Completions at CBM Wells
681	Spud Count - Oil Wells
683	Produced Water at All Wells
685	Completions at Oil Wells
686	Completions at All Wells
687	Feet Drilled at All Wells
691	Well Counts - CBM Wells
692	Spud Count - All Wells
693	Well Count - All Wells
694	Oil Production at Oil Wells
695	Well Count - Oil Wells
696	Gas Production at Gas Wells
697	Oil Production at Gas Wells
698	Well Count - Gas Wells
699	Gas Production at CBM Wells

Not all of the available surrogates are used to spatially allocate sources in the modeling platform; that is, some surrogates shown in Table 3-23 were not assigned to any SCCs, although many of the "unused" surrogates are actually used to "gap fill" other surrogates that are used. When the source data for a surrogate has no values for a particular county, gap filling is used to provide values for the surrogate in those counties to ensure that no emissions are dropped when the spatial surrogates are applied to the emission inventories. Table 3-26 shows the CAP emissions (i.e., NH_3, NOx, $PM_{2.5}$, SO_2, and VOC) by sector, with rows for each sector listed in order of most emissions to least CAP emissions. To look at the relative importance of the surrogates within the platform sectors for HAPs, we computed the toxicity-weighted emissions for the CMAQ HAPs for the surrogates used in CMAQ (i.e., based on the SCC-to-surrogate assignments for CMAQ); these are shown in Table 3-27.

Table 3-26. Selected 2014 CAP emissions by sector for U.S. Surrogates (CONUS domain totals)

Sector	ID	Description	NH3	NOX	PM2_5	SO2	VOC
afdust	240	Total Road Miles	--	--	283,210	--	--
afdust	304	NLCD Open + Low	--	--	1,053,145	--	--
afdust	306	NLCD Med + High	--	--	43,636	--	--
afdust	308	NLCD Low + Med + High	--	--	122,943	--	--
afdust	310	NLCD Total Agriculture	--	--	987,447	--	--
ag	310	NLCD Total Agriculture	2,823,395	--	--	--	179,970
cmv_c1c2	808	2013 Shipping Density	287	509,784	14,053	4,158	8,953
cmv_c1c2	820	Ports NEI2014 Activity	11	23,201	729	1,482	972
nonpt	100	Population	32,842	0	0	0	1,222,980
nonpt	150	Residential Heating - Natural Gas	47,819	227,291	3,837	1,494	13,756
nonpt	170	Residential Heating - Distillate Oil	1,861	35,101	3,978	56,026	1,241
nonpt	180	Residential Heating - Coal	20	101	53	1,086	111
nonpt	190	Residential Heating - LP Gas	121	34,432	183	762	1,332
nonpt	239	Total Road AADT	0	25	551	0	274,177
nonpt	240	Total Road Miles	0	0	0	0	34,027
nonpt	242	All Restricted AADT	0	0	0	0	5,451
nonpt	244	All Unrestricted AADT	0	0	0	0	95,292
nonpt	271	NTAD Class 1 2 3 Railroad Density	0	0	0	0	2,252
nonpt	300	NLCD Low Intensity Development	5,184	27,632	103,906	3,720	74,580
nonpt	304	NLCD Open + Low	0	0	0	0	0
nonpt	306	NLCD Med + High	28,046	200,320	238,731	65,131	948,148
nonpt	307	NLCD All Development	24	46,331	126,722	14,185	596,598
nonpt	308	NLCD Low + Med + High	1,166	185,948	16,915	19,736	65,608
nonpt	310	NLCD Total Agriculture	0	0	37	0	204,819
nonpt	319	NLCD Crop Land	0	0	95	71	293
nonpt	320	NLCD Forest Land	4,143	378	1,289	9	474
nonpt	505	Industrial Land	0	0	0	0	174
nonpt	535	Residential + Commercial + Industrial + Institutional + Government	5	2	130	0	39
nonpt	560	Hospital (COM6)	0	0	0	0	0
nonpt	650	Refineries and Tank Farms	0	22	0	0	98,989
nonpt	711	Airport Areas	0	0	0	0	282
nonpt	801	Port Areas	0	0	0	0	8,059
nonroad	261	NTAD Total Railroad Density	3	2,585	273	4	503
nonroad	304	NLCD Open + Low	4	2,205	191	6	3,245
nonroad	305	NLCD Low + Med	110	23,011	4,557	146	149,869
nonroad	306	NLCD Med + High	344	241,634	15,639	523	126,166
nonroad	307	NLCD All Development	101	36,099	15,363	132	169,756
nonroad	308	NLCD Low + Med + High	664	454,788	37,766	875	69,096

Sector	ID	Description	NH3	NOX	PM2_5	SO2	VOC
nonroad	309	NLCD Open + Low + Med	111	22,347	1,257	148	44,489
nonroad	310	NLCD Total Agriculture	477	417,452	31,814	664	47,949
nonroad	320	NLCD Forest Land	19	8,796	1,338	24	8,373
nonroad	321	NLCD Recreational Land	157	20,836	15,120	229	553,775
nonroad	350	NLCD Water	215	144,245	8,857	362	448,580
nonroad	850	Golf Courses	13	2,174	115	17	5,668
nonroad	860	Mines	2	2,760	298	4	549
np_oilgas	670	Spud Count - CBM Wells	0	0	0	0	179
np_oilgas	671	Spud Count - Gas Wells	0	0	0	0	9,749
np_oilgas	672	Gas Production at Oil Wells	0	2,861	0	21,703	123,406
np_oilgas	673	Oil Production at CBM Wells	0	60	0	0	3,510
np_oilgas	674	Unconventional Well Completion Counts	0	46,312	1,793	237	3,368
np_oilgas	678	Completions at Gas Wells	0	3,557	26	6,768	67,486
np_oilgas	679	Completions at CBM Wells	0	13	0	483	1,581
np_oilgas	681	Spud Count - Oil Wells	0	0	0	0	66,402
np_oilgas	683	Produced Water at All Wells	0	10	0	0	95,569
np_oilgas	685	Completions at Oil Wells	0	3,134	129	2,266	51,457
np_oilgas	687	Feet Drilled at All Wells	0	107,759	3,995	449	8,797
np_oilgas	691	Well Counts - CBM Wells	0	32,515	483	12	27,146
np_oilgas	692	Spud Count - All Wells	0	8,362	255	113	341
np_oilgas	693	Well Count - All Wells	0	0	0	0	166
np_oilgas	694	Oil Production at Oil Wells	0	4,923	0	6,337	1,063,684
np_oilgas	695	Well Count - Oil Wells	0	117,375	2,892	80	436,392
np_oilgas	696	Gas Production at Gas Wells	0	47,848	2,123	163	52,113
np_oilgas	697	Oil Production at Gas Wells	0	1,362	0	25	368,078
np_oilgas	698	Well Count - Gas Wells	15	309,706	5,457	299	648,995
np_oilgas	699	Gas Production at CBM Wells	0	2,489	325	26	4,837
onroad	205	Extended Idle Locations	496	181,202	2,778	72	36,953
onroad	239	Total Road AADT	--	--	--	--	7,253
onroad	242	All Restricted AADT	37,863	1,565,526	51,043	8,651	247,736
onroad	244	All Unrestricted AADT	69,324	2,383,842	91,652	18,255	648,240
onroad	258	Intercity Bus Terminals	--	164	2	0	39
onroad	259	Transit Bus Terminals	--	101	5	0	226
onroad	304	NLCD Open + Low	--	783	23	1	2,568
onroad	306	NLCD Med + High	--	16,251	365	18	19,685
onroad	307	NLCD All Development	--	641,291	14,961	1,028	1,311,192
onroad	308	NLCD Low + Med + High	--	45,638	879	67	71,800
onroad	506	Education	--	597	25	1	928
rail	261	NTAD Total Railroad Density	4	15,222	368	286	873
rail	271	NTAD Class 1 2 3 Railroad Density	359	657,335	18,786	415	33,866
rwc	300	NLCD Low Intensity Development	15,331	30,493	313,945	7,684	338,465

Table 3-27. Total and Toxicity-weighted Emissions of CMAQ HAPs Based on the CMAQ Surrogate Assignments

Surrogate Code	Surrogate Description	Total CMAQ Emissions (HAP and Diesel PM): Fraction of Sector and Total									Cancer-weighted CMAQ Emissions: Fraction of Sector and Total									Respiratory-weighted CMAQ Emissions: Fraction of Sector and Total								
		ag	cmv_c1c2	nonpt	nonroad	np_oilgas	onroad	rail	rwc	Total (TPY)	ag	cmv_c1c2	nonpt	nonroad	np_oilgas	onroad	rail	rwc	Total (TPY)	ag	cmv_c1c2	nonpt	nonroad	np_oilgas	onroad	rail	rwc	Total (TPY)
100	Population			1.00						128,420			1.00						39,878			1.00						137
150	Residential Heating - Natural Gas			1.00						857			1.00						2,358			1.00						998
170	Residential Heating - Distillate Oil			1.00						88			1.00						4,243			1.00						234
180	Residential Heating - Coal			1.00						13			1.00						10			1.00						4
190	Residential Heating - LP Gas			1.00						46			1.00						233			1.00						44
205	Extended Idle Locations						1.00			11,969						1.00			32,606						1.00			62,985
239	Total Road AADT			0.89			0.11			18,477			0.97			0.03			6,136			1.00			0.00			2,550
240	Total Road Miles			1.00						1,480			1.00						1			1.00						0
242	All Restricted AADT			0.00			1.00			101,740			0.00			1.00			86,634			0.00			1.00			123,327
244	All Unrestricted AADT			0.02			0.98			235,645			0.00			1.00			193,525			0.00			1.00			238,187
258	Intercity Bus Terminals						1.00			11						1.00			31						1.00			62
259	Transit Bus Terminals						1.00			61						1.00			98						1.00			140
261	NTAD Total Railroad Density				0.54			0.46		921				0.83			0.17		766				0.80			0.20		2,798
271	NTAD Class 1 2 3 Railroad Density			0.00				1.00		23,010			0.00				1.00		9,626			0.00				1.00		34,179
300	NLCD Low Intensity Development			0.37					0.63	78,837			0.19					0.81	310,452			0.19					0.81	217,658
304	NLCD Open + Low			0.00	0.62		0.38			1,809			0.00	0.75		0.25			1,593			0.00	0.90		0.10			2,248
305	NLCD Low + Med				1.00					43,822				1.00					35,026				1.00					8,801
306	NLCD Med + High			0.70	0.27		0.03			179,659			0.57	0.39		0.04			161,445			0.12	0.80		0.08			115,197
307	NLCD All Development			0.07	0.13		0.80			450,863			0.14	0.10		0.75			425,898			0.13	0.11		0.76			252,684
308	NLCD Low + Med + High			0.03	0.75		0.22			88,957			0.07	0.74		0.18			108,965			0.01	0.94		0.06			237,834
309	NLCD Open + Low + Med				1.00					14,384				1.00					16,896				1.00					5,799
310	NLCD Total Agriculture	0.18		0.03	0.79					67,003	0.07		0.04	0.89					68,742	0.01		0.09	0.89					210,516
319	NLCD Crop Land			1.00						23			1.00						1,371			1.00						6
320	NLCD Forest Land			0.00	1.00					3,443			0.00	1.00					3,105			0.06	0.94					3,852
321	NLCD Recreational Land				1.00					182,270				1.00					96,158				1.00					47,238
350	NLCD Water				1.00					139,945				1.00					90,072				1.00					52,644
505	Industrial Land									0									0									0
506	Education						1.00			252						1.00			441						1.00			669

Surrogate Code	Surrogate Description	Total CMAQ Emissions (HAP and Diesel PM): Fraction of Sector and Total									Cancer-weighted CMAQ Emissions: Fraction of Sector and Total									Respiratory-weighted CMAQ Emissions: Fraction of Sector and Total								
		ag	cmv_c1c2	nonpt	nonroad	np_oilgas	onroad	rail	rwc	Total (TPY)	ag	cmv_c1c2	nonpt	nonroad	np_oilgas	onroad	rail	rwc	Total (TPY)	ag	cmv_c1c2	nonpt	nonroad	np_oilgas	onroad	rail	rwc	Total (TPY)
535	Residential + Commercial + Industrial + Institutional + Government									0									0									0
560	Hospital (COM6)			1.00						0			1.00						353									0
650	Refineries and Tank Farms			1.00						4,244			1.00						1,454			1.00						0
670	Spud Count - CBM Wells					1.00				1					1.00				1									0
671	Spud Count - Gas Wells					1.00				28					1.00				36									0
672	Gas Production at Oil Wells					1.00				513					1.00				2,103					1.00				155
673	Oil Production at CBM Wells					1.00				103					1.00				387					1.00				29
674	Unconventional Well Completion Counts					1.00				706					1.00				1,938					1.00				244
678	Completions at Gas Wells					1.00				456					1.00				1,924					1.00				144
679	Completions at CBM Wells					1.00				21					1.00				82					1.00				6
681	Spud Count - Oil Wells					1.00				179					1.00				300									0
683	Produced Water at All Wells					1.00				307					1.00				524									0
685	Completions at Oil Wells					1.00				855					1.00				3,751					1.00				287
687	Feet Drilled at All Wells					1.00				1,857					1.00				5,629					1.00				2,652
691	Well Counts - CBM Wells					1.00				1,253					1.00				4,082					1.00				13,035
692	Spud Count - All Wells					1.00				38					1.00				75					1.00				16
693	Well Count - All Wells					1.00				0					1.00				0					1.00				0
694	Oil Production at Oil Wells					1.00				28,400					1.00				56,971					1.00				1,421
695	Well Count - Oil Wells					1.00				6,644					1.00				18,941					1.00				59,647
696	Gas Production at Gas Wells					1.00				26,845					1.00				25,787					1.00				13,098
697	Oil Production at Gas Wells					1.00				6,173					1.00				14,921					1.00				924
698	Well Count - Gas Wells					1.00				18,115					1.00				41,271					1.00				158,261
699	Gas Production at CBM Wells					1.00				1,051					1.00				849					1.00				163
711	Airport Areas			1.00						12			1.00						10			1.00						0
801	Port Areas			1.00						4			1.00						2			1.00						0
808	2013 Shipping Density		1.00							16,254		1.00							10,123		1.00							17,025
820	Ports NEI2014 Activity		1.00							1,034		1.00							938		1.00							1,107
850	Golf Courses				1.00					1,816				1.00					2,088				1.00					468
860	Mines				1.00					573				1.00					863				1.00					3,063

3.6.2 Allocation method for airport-related sources in the U.S.

There are numerous airport-related emission sources in the NEI, such as aircraft, airport ground support equipment, and jet refueling. The modeling platform includes the aircraft and airport ground support equipment emissions as point sources. For the modeling platform, the EPA used the SMOKE "area-to-point" approach for only jet refueling in the nonpt sector. The following SCCs use this approach: 2501080050 and 2501080100 (petroleum storage at airports), and 2810040000 (aircraft/rocket engine firing and testing). The ARTOPNT approach is described in detail in the 2002 platform documentation: http://www3.epa.gov/scram001/reports/Emissions%20TSD%20Vol1_02-28-08.pdf. The ARTOPNT file that lists the nonpoint sources to locate using point data were unchanged from the 2005-based platform.

3.6.3 Surrogates for Canada and Mexico emission inventories

Spatial surrogates for allocating Canada and Mexico province/sub-province and municipio level emissions have been updated in the 2014v7.1 platform. A new set of Canada shapefiles were provided by Environment Canada along with cross references spatially allocate the new 2013 Canadian emissions. Gridded surrogates were generated using the Surrogate Tool (previously refernced); Table 3-28 provides a list. Due to computational reasons, total roads (1263) were used insetad of the unpaved rural road surrogate provided. The population surrogate was updated for Mexico. Surrogate code 11, which uses 2015 population data at 1 km resolution, replaces the previous population surrogate code 10. The other surrogates for Mexico are circa 1999 and 2000 and were based on data obtained from the Sistema Municpal de Bases de Datos (SIMBAD) de INEGI and the Bases de datos del Censo Economico 1999. Most of the CAPs allocated to the Mexico and Canada surrogates are shown in Table 3-29.

Table 3-28. Canadian Spatial Surrogates

Code	Canadian Surrogate Description	Code	Description
100	Population	941	PAVED ROADS
101	total dwelling	942	UNPAVED ROADS
106	ALL_INDUST	945	Commercial Marine Vessels
113	Forestry and logging	950	Combination of Forest and Dwelling
115	Agriculture and forestry activities	955	UNPAVED_ROADS_AND_TRAILS
200	Urban Primary Road Miles	960	TOTBEEF
210	Rural Primary Road Miles	965	TOTBEEF_CD
212	Mining except oil and gas	966	TOTPOUL_CD
220	Urban Secondary Road Miles	967	TOTSWIN_CD
221	Total Mining	968	TOTFERT_CD
222	Utilities	970	TOTPOUL
230	Rural Secondary Road Miles	980	TOTSWIN
240	Total Road Miles	990	TOTFERT
308	Food manufacturing	996	urban_area
321	Wood product manufacturing	1211	Oil and Gas Extraction
323	Printing and related support activities	1212	OilSands
324	Petroleum and coal products manufacturing	1251	OFFR_TOTFERT
326	Plastics and rubber products manufacturing	1252	OFFR_MINES

Code	Canadian Surrogate Description	Code	Description
327	Non-metallic mineral product manufacturing	1253	OFFR Other Construction not Urban
331	Primary Metal Manufacturing	1254	OFFR Commercial Services
412	Petroleum product wholesaler-distributors	1255	OFFR Oil Sands Mines
416	Building material and supplies wholesaler-distributors	1256	OFFR Wood industries CANVEC
448	clothing and clothing accessories stores	1257	OFFR Unpaved Roads Rural
562	Waste management and remediation services	1258	OFFR_Utilities
921	Commercial Fuel Combustion	1259	OFFR total dwelling
923	TOTAL INSTITUTIONAL AND GOVERNEMNT	1260	OFFR_water
924	Primary Industry	1261	OFFR_ALL_INDUST
925	Manufacturing and Assembly	1262	OFFR Oil and Gas Extraction
926	Distribtution and Retail (no petroleum)	1263	OFFR_ALLROADS
927	Commercial Services	1264	OFFR_OTHERJET
931	OTHERJET	1265	OFFR_CANRAIL
932	CANRAIL	--	--

Table 3-29. CAPs Allocated to Mexican and Canadian Spatial Surrogates

Code	Mexican or Canadian Surrogate Description	NH_3	NO_X	PM_{2_5}	SO_2	VOC
11	MEX 2015 Population	23,110	104,309	3,740	420	128,001
14	MEX Residential Heating - Wood	0	1,047	13,415	161	92,226
16	MEX Residential Heating - Distillate Oil	0	11	0	3	0
20	MEX Residential Heating - LP Gas	0	5,043	153	0	87
22	MEX Total Road Miles	2,324	314,011	8,477	4,788	65,593
24	MEX Total Railroads Miles	0	18,474	413	162	721
26	MEX Total Agriculture	151,745	106,403	22,474	5,170	8,474
32	MEX Commercial Land	0	65	1,405	0	18,989
34	MEX Industrial Land	4	1,003	1,726	0	103,122
36	MEX Commercial plus Industrial Land	0	1,782	26	4	87,825
38	MEX Commercial plus Institutional Land	3	1,611	77	4	51
40	MEX Residential (RES1-4)+Comercial+Industrial+Institutional+Government	0	4	9	0	66,174
42	MEX Personal Repair (COM3)	0	0	0	0	4,833
44	MEX Airports Area	0	2,489	67	316	793
50	MEX Mobile sources - Border Crossing	4	130	1	2	241
100	CAN Population	593	50	585	11	263
101	CAN total dwelling	272	25,282	1,881	2,447	113,365
106	CAN ALL_INDUST	0	0	6,828	0	70
113	CAN Forestry and logging	268	1,693	0	77	5,056
115	CAN Agriculture and forestry activities	15	180	905	4	504
200	CAN Urban Primary Road Miles	1,460	65,668	2,918	261	8,929
210	CAN Rural Primary Road Miles	572	39,595	1,597	104	3,819

Code	Mexican or Canadian Surrogate Description	NH_3	NO_X	PM_{2_5}	SO_2	VOC
212	CAN Mining except oil and gas	0	0	2,108	0	0
220	CAN Urban Secondary Road Miles	2,713	98,357	5,484	553	21,628
221	CAN Total Mining	0	0	34,755	0	0
222	CAN Utilities	56	8,298	31,964	2,969	175
230	CAN Rural Secondary Road Miles	1,551	70,822	3,091	286	10,314
240	CAN Total Road Miles	31	58,111	2,036	66	93,693
308	CAN Food manufacturing	0	0	8,783	0	5,563
321	CAN Wood product manufacturing	182	1,613	0	85	5,802
323	CAN Printing and related support activities	0	0	0	0	10,739
324	CAN Petroleum and coal products manufacturing	0	529	645	238	2,268
326	CAN Plastics and rubber products manufacturing	0	0	0	0	16,066
327	CAN Non-metallic mineral product manufacturing	0	0	5,213	0	0
331	CAN Primary Metal Manufacturing	0	140	5,183	45	72
412	CAN Petroleum product wholesaler-distributors	0	0	0	0	29,688
448	CAN clothing and clothing accessories stores	0	0	0	0	81
562	CAN Waste management and remediation services	182	1,384	1,755	2,166	13,644
921	CAN Commercial Fuel Combustion	132	18,212	1,741	1,814	856
923	CAN TOTAL INSTITUTIONAL AND GOVERNEMNT	0	0	0	0	10,965
924	CAN Primary Industry	0	0	0	0	25,807
925	CAN Manufacturing and Assembly	0	0	0	0	56,439
926	CAN Distribtution and Retail (no petroleum)	0	0	0	0	5,642
927	CAN Commercial Services	0	0	0	0	24,387
932	CAN CANRAIL	30	66,583	1,550	240	3,317
941	CAN PAVED ROADS	0	0	211,630	0	0
945	CAN Commercial Marine Vessels	77	63,283	2,338	14,649	3,598
950	CAN Combination of Forest and Dwelling	1,178	13,084	107,783	1,869	152,930
955	CAN UNPAVED_ROADS_AND_TRAILS	0	0	254,039	0	0
960	CAN TOTBEEF	0	0	791	0	164,204
965	CAN TOTBEEF_CD	177,639	0	0	0	0
966	CAN TOTPOUL_CD	20,316	0	0	0	0
967	CAN TOTSWIN_CD	59,389	0	0	0	0
968	CAN TOTFERT_CD	77,875	0	0	0	0
970	CAN TOTPOUL	0	0	156	0	209
980	CAN TOTSWIN	0	0	655	0	2,251
990	CAN TOTFERT	0	3,281	238,190	6,686	124
996	CAN urban_area	0	0	778	0	0
1211	CAN Oil and Gas Extraction	0	29	54,361	50	444
1212	CAN OilSands	0	0	0	0	0
1251	CAN OFFR_TOTFERT	71	77,265	5,716	52	7,081
1252	CAN OFFR_MINES	30	29,069	2,413	22	2,947
1253	CAN OFFR Other Construction not Urban	20	18,131	2,929	15	7,169
1254	CAN OFFR Commercial Services	28	14,618	1,804	23	18,309
1255	CAN OFFR Oil Sands Mines	0	0	0	0	0
1256	CAN OFFR Wood industries CANVEC	11	9,857	932	8	1,619
1257	CAN OFFR Unpaved Roads Rural	22	6,773	1,157	19	44,093

Code	Mexican or Canadian Surrogate Description	NH_3	NO_X	PM_{2_5}	SO_2	VOC
1258	CAN OFFR_Utilities	14	7,109	447	12	8,519
1259	CAN OFFR total dwelling	14	4,374	1,131	12	27,742
1260	CAN OFFR_water	2	603	93	3	5,663
1261	CAN OFFR_ALL_INDUST	3	3,672	238	3	749
1262	CAN OFFR Oil and Gas Extraction	0	509	31	0	101
1263	CAN OFFR_ALLROADS	1	932	65	1	399
1264	CAN OFFR_OTHERJET	1	781	65	1	66
1265	CAN OFFR_CANRAIL	0	65	6	0	11

4 Emission Summaries

The following tables summarize emissions for the 2014v7.1 platform. These summaries are provided at the national level by sector for the contiguous U.S. and for the portions of Canada and Mexico inside the smaller 12km domain (12US2) discussed in Section 3.1. The afdust sector emissions represent the summaries *after* application of both the land use (transport fraction) and meteorological adjustments (see Section 2.2.1); therefore, this sector is called "afdust_adj" in these summaries. The onroad sector totals are post-SMOKE-MOVES totals, representing air quality model-ready emission totals, and include CARB emissions for California (except HAPs were adjusted as discussed in 2.3.1). The cmv sectors include U.S. emissions within state waters only; these extend to roughly 3-5 miles offshore and includes CMV emissions at U.S. ports. "Offshore" represents CMV emissions that are within the (up to) 200 nautical mile Exclusive Economic Zone (EEZ) boundary but are outside of U.S. state waters. Canadian CMV emissions are included in the othar sector.

National emission totals by air quality model-ready sector are provided for all CAP emissions in Table 4-1. The total of all sectors is listed as "Con U.S. Total." Table 4-2 provides summaries of select VOC HAPs: NBAFM (including post-speciated NBAFM in the U.S., Canada and Mexico) and 1,3 butadiene and acrolein. Table 4-3 provides a summary of diesel PM and selected metal HAPs.

Table 4-1. National by-sector CAP emissions summaries for the 2014v7.1 Platform

Sector	CO	NH_3	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC
afdust_adj	--	--	--	6,027,981	848,139	--	--
ag	--	2,823,395	--	--	--	--	179,970
cmv_c1c2	47,183	120	260,338	6,493	6,168	3,453	4,840
cmv_c3	10,885	25	108,268	4,248	3,832	38,826	5,043
nonpt	2,680,775	121,229	758,152	608,827	496,454	162,231	3,672,687
nonroad	12,381,310	2,222	1,378,933	140,058	132,585	3,134	1,628,016
np_oilgas	661,226	15	688,288	17,746	17,480	38,963	3,033,266
onroad	24,141,957	107,684	4,835,324	301,465	161,731	28,094	2,346,605
ptegu	734,501	26,068	1,759,765	233,720	182,913	3,243,038	35,590
ptagfire	569,166	90,763	19,734	85,962	63,411	6,188	38,630
ptfire	16,949,690	273,907	246,868	1,746,202	1,481,916	130,082	3,921,161
ptnonipm	2,052,221	63,631	1,148,900	439,316	283,883	883,683	824,562
pt_oilgas	198,493	1,325	415,687	12,979	12,360	47,492	135,713
rail	118,367	363	672,558	20,728	19,154	700	34,739
rwc	2,098,907	15,331	30,493	314,466	313,945	7,684	338,465
Con U.S. Total	**62,644,682**	**3,526,078**	**12,323,308**	**9,960,191**	**4,023,971**	**4,593,568**	**16,199,286**
Canada othafdust	--	--	--	1,008,135	203,060	--	--
Canada othar	2,040,936	338,407	376,724	288,061	157,210	33,499	776,955
Canada onroad_can	1,507,806	6,326	332,576	20,136	15,120	1,270	138,345
Canada othpt	512,668	11,400	231,638	51,191	25,792	522,591	295,820
Canada ptfire_othna	701,694	1,301	17,979	74,803	63,267	6,868	186,345
Mexico othar	189,852	174,864	176,226	91,846	42,949	6,101	435,928
Mexico onroad_mex	1,590,861	2,324	380,211	12,596	9,027	4,929	141,141
Mexico othpt	184,332	4,184	449,067	68,984	54,925	525,750	63,694
Mexico ptfire_othna	189,469	3,668	8,596	21,413	17,972	1,305	67,674
Offshore cmv_c1c2	54,288	178	272,645	8,880	8,613	2,187	5,085
Offshore cmv_c3	56,769	62	616,802	29,262	27,095	225,191	25,197
Offshore pt_oilgas	50,046	15	48,688	668	666	502	48,167
Non-US Total	**7,078,722**	**542,729**	**2,911,153**	**1,675,975**	**625,697**	**1,330,193**	**2,184,350**

Table 4-2. National by-sector VOC HAP emissions summaries for the 2014v7.1 Platform

Sector	Acetaldehyde	Benzene	Formaldehyde	Methanol	Naphthalene	Acrolein	1,3-Butadiene
afdust_adj	0	0	0	0	0	0	0
ag	1,180	363	--	8,600	0	--	--
cmv_c1c2	283	77	569	0.5	6.4	10	3
cmv_c3	1	0	8	0.0	0.1	--	--
nonpt	5,086	12,705	6,134	147,362	5,183	422	629
nonroad	15,295	37,599	38,575	1,982	2,993	2,738	6,235
np_oilgas	2,218	25,365	17,890	1,221	48	1,193	278
onroad	27,974	58,593	37,414	3,357	5,087	2,579	9,401
ptegu	406	712	2,101	73	73	324	2
ptagfire	3,376	2,752	13,007	90	0	964	828
ptfire	112,866	37,200	220,450	192,234	33,250	39,310	23,361
ptnonipm	7,467	3,936	10,245	55,236	1,581	1,789	1,304
pt_oilgas	2,395	1,379	10,971	2,091	24	1,849	150
rail	506	70	1,165	0	51	84	87
rwc	7,741	16,747	15,814	0	2,018	809	2,198
Con U.S. Total	**186,794**	**197,499**	**374,343**	**412,246**	**50,315**	**52,072**	**44,477**
Canada othafdust	0	0	0	0	0	0	0
Canada othar	21,274	13,466	16,725	5,952	3,636	0	0
Canada onroad_can	2,058	6,364	2,913	0	53	0	0
Canada othpt	923	19,775	4,412	21,239	36	0	0
Canada ptfire_othna	8,119	4,267	19,233	14,743	0	0	0
Mexico othar	12,724	6,034	8,909	10,547	1,742	0	0
Mexico onroad_mex	630	3,597	1,472	420	221	103	549
Mexico othpt	280	2,027	5,734	411	32	0	0
Mexico ptfire_othna	6,428	1,364	6,170	1,944	0	0	0
Offshore cmv_c1c2	236	65	475	0	8	11	0
Offshore cmv_c3	6	0	40	0	0		
Offshore pt_oilgas	0	0	0	0	0	0	0
Non-US Total	**52,678**	**56,959**	**66,083**	**55,256**	**5,727**	**114**	**549**

Table 4-3. National by-sector Diesel PM and metal emissions summaries for the 2014v7.1 Platform

Sector	Diesel PM_{10}	Diesel $PM_{2.5}$	Chromium Hex	Arsenic	Cadmium	Nickel	Manganese
afdust_adj	--	--	--	--	--	--	--
ag	--	--	0.33	0.06	0.06	0.28	6.71
cmv_c1c2	6,493	6,168	0.10	0.17	0.04	5.53	0.03
cmv_c3	4,248	3,832	0.41	0.95	0.08	33.95	0.24
nonpt	--	--	3.49	14.50	7.12	20.10	27.34
nonroad	84,603	81,811	0.01	0.82	--	6.42	1.75
np_oilgas	--	--	0.12	0.47	0.26	0.12	0.25
onroad	100,948	92,986	0.09	6.94	--	16.67	48.62
ptegu	--	--	12.52	41.13	7.27	141.96	203.72
ptagfire	--	--	--	0.01	0.08	0.01	0.74
ptfire	--	--	--	--	--		--
ptnonipm	1,151	1,114	21.17	29.90	15.16	159.01	600.02
pt_oilgas	--	--	0.03	0.09	0.27	7.44	2.07
rail	20,728	19,154	0.04	0.01	0.58	0.13	0.04
rwc	--	--	0.00	0.02	0.13	0.08	0.96
Con U.S. Total	**218,170**	**205,064**	**38.32**	**95.08**	**31.05**	**391.71**	**892.52**
Offshore cmv_c1c2	8,880	8,614	0.15	0.27	0.05	8.88	0.01
Offshore cmv_c3	29,254	27,088	0.85	2.28	0.29	76.75	0.75

*Canada and Mexico do not have any of these pollutants

5 References

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Appendix A: Air Toxics in the 2014v7.1 Platform Used for NATA

The below table provides the air toxics included in the 2014v7.1 platform.

2014 CMAQ species name(s)	Pollutant Code (NEI)	2014 NEI -Event	2014NEI-Nonpoint	2014NEI - Point	2014NEI - Nonroad	2014NEI - Onroad	NEI Pollutant Category Name (if different from description)	NEI Pollutant Description	SMOKE name
PAH_880E5	83329		1	1	1	1	Polycyclic Organic Matter	Acenaphthene	PAH_880E5
PAH_880E5	208968		1	1	1	1	Polycyclic Organic Matter	Acenaphthylene	PAH_880E5
ALD2,ALD2_PRIMARY	75070	1	1	1	1	1		Acetaldehyde	ACETALD
ACETONITRILE	75058	1	1	1				Acetonitrile	ACETONIT
ACROLEIN, ACROLEIN_PRIMARY	107028	1	1	1	1	1		Acrolein	ACROLEI
ACRYLICACID	79107	1	1	1				Acrylic Acid	ACRYLCACID
ACRYLONITRILE	107131		1	1				Acrylonitrile	ACRYLONITRL
PAH_000E0	120127	1	1	1	1	1	Polycyclic Organic Matter	Anthracene	PAH_000E0
AASI, AASJ, and ASSK	7440382		1	1	1	1	Arsenic Compounds	Arsenic	ARSENIC
PAH_176E4	56553	1	1	1	1	1	Polycyclic Organic Matter	Benz[a]Anthracene	PAH_176E4
BENZENE	71432	1	1	1	1	1		Benzene	BENZENE
PAH_880E5	203338	1	1	1			Polycyclic Organic Matter	Benzo(a)Fluoranthene	PAH_880E5
PAH_880E5	195197	1	1				Polycyclic Organic Matter	Benzo(c)phenanthrene	PAH_880E5
PAH_880E5	192972	1	1	1			Polycyclic Organic Matter	Benzo[e]Pyrene	PAH_880E5
PAH_880E5	203123		1	1			Polycyclic Organic Matter	Benzo(g,h,i)Fluoranthene	PAH_880E5
PAH_880E5	191242	1	1	1	1	1	Polycyclic Organic Matter	Benzo[g,h,i,]Perylene	PAH_880E5
PAH_176E3	50328	1	1	1	1	1	Polycyclic Organic Matter	Benzo[a]Pyrene	PAH_176E3
PAH_176E4	205992		1	1	1	1	Polycyclic Organic Matter	Benzo[b]Fluoranthene	PAH_176E4
PAH_176E4	205823			1			Polycyclic Organic Matter	Benzo[j]fluoranthene	PAH_176E4
PAH_176E5	207089	1	1	1	1	1	Polycyclic Organic Matter	Benzo[k]Fluoranthene	PAH_176E5
PAH_880E5	56832736	1	1	1			Polycyclic Organic Matter	Benzofluoranthenes	PAH_880E5
ABEK, ABEI, ABEJ	7440417		1	1			Beryllium Compounds	Beryllium	BERYLLIUM
BUTADIENE13	106990	1	1	1	1	1		1,3-Butadiene	BUTADIE
ACDI,ACDJ,ACDK	7440439		1	1			Cadmium Compounds	Cadmium	CADMIUM
PAH_176E5	86748		1	1			Polycyclic Organic Matter	Carbazole	PAH_176E5
CARBONTET	56235		1	1				Carbon Tetrachloride	CARBONTET
CARBONYLSULFIDE	463581	1	1	1				Carbonyl Sulfide	CARBNYLSUL
CL2	7782505		1	1				Chlorine	CHLORINE
CHCL3	67663		1	1				Chloroform	CHCL3
PAH_880E5	91587		1	1			Polycyclic Organic Matter	2-Chloronaphthalene	PAH_880E5
CHLOROPRENE	126998		1	1				Chloroprene	CHLOROPRENE
ACR_VIK,ACR_VIJ,ACR_VII	7738945			1			Chromium Compounds	Chromic Acid (VI)	CHROMHEX

2014 CMAQ species name(s)	Pollutant Code (NEI)	2014 NEI -Event	2014NEI-Nonpoint	2014NEI - Point	2014NEI - Nonroad	2014NEI - Onroad	NEI Pollutant Category Name (if different from description)	NEI Pollutant Description	SMOKE name
ACR_IIIK,ACR_IIII,ACR_IIIJ	16065831		1	1	1	1	Chromium Compounds	Chromium III	CHROMTRI
ACR_VIK,ACR_VIJ,ACR_VII	18540299		1	1	1	1	Chromium Compounds	Chromium (VI)	CHROMHEX
ACR_VIK,ACR_VIJ,ACR_VII	1333820			1			Chromium Compounds	Chromium Trioxide	CHROMHEX
PAH_176E5	218019	1	1	1	1	1	Polycyclic Organic Matter	Chrysene	PAH_176E5
PAH_192E3	8007452			1			Polycyclic Organic Matter	Coal Tar	PAH_192E3
PAH_176E4	226368			1			Polycyclic Organic Matter	Dibenz[a,h]acridine	PAH_176E4
PAH_176E4	224420			1			Polycyclic Organic Matter	Dibenzo[a,j]Acridine	PAH_176E4
PAH_176E3	192654			1			Polycyclic Organic Matter	Dibenzo[a,e]Pyrene	PAH_176E3
PAH_176E3	53703		1	1	1	1	Polycyclic Organic Matter	Dibenzo[a,h]Anthracene	PAH_176E3
PAH_176E2	189640			1			Polycyclic Organic Matter	Dibenzo[a,h]Pyrene	PAH_176E2
PAH_176E2	189559			1			Polycyclic Organic Matter	Dibenzo[a,i]Pyrene	PAH_176E2
PAH_176E2	191300			1			Polycyclic Organic Matter	Dibenzo[a,l]Pyrene	PAH_176E2
PAH_176E3	194592			1			Polycyclic Organic Matter	7H-Dibenzo[c,g]carbazole	PAH_176E3
DICHLOROBENZENE	106467		1	1				1,4-Dichlorobenzene	DICHLRBNZN
DICHLOROPROPENE	542756		1	1				1,3-Dichloropropene	DICLPRO13
PAH_114E1	57976		1	1			Polycyclic Organic Matter	7,12-Dimethylbenz[a]Anthracene	PAH_114E1
ETHYLBENZ	100414		1	1	1	1		Ethyl Benzene	ETHYLBENZ
BR2_C2_12	106934		1	1				Ethylene Dibromide	ETHDIBROM
CL2_C2_12	107062		1	1				Ethylene Dichloride	CL2_C2_12
ETOX	75218		1	1				Ethylene Oxide	ETOX
PAH_880E5	284		1	1			POM as non-15 PAH	Extractable Organic Matter (EOM)	PAH_880E5
PAH_880E5	206440	1	1	1	1	1	Polycyclic Organic Matter	Fluoranthene	PAH_880E5
PAH_880E5	86737		1	1	1	1	Polycyclic Organic Matter	Fluorene	PAH_880E5
FORM, FORM_PRIMARY	50000	1	1	1	1	1		Formaldehyde	FORMALD
HEXAMETHY_DIIS	822060		1	1				Hexamethylene Diisocyanate	HEXAMTHLE
HEXANE	110543	1	1	1	1	1		Hexane	HEXANE
HYDRAZINE	302012			1				Hydrazine	HYDRAZINE
HCL	7647010		1	1				Hydrochloric Acid	HCL
PAH_176E4	193395	1	1	1	1	1	Polycyclic Organic Matter	Indeno[1,2,3-c,d]Pyrene	PAH_176E4
APBK,APBJ,APBI	7439921		1	1			Lead Compounds	Lead	LEAD
MAL_ANHYDRIDE	108316		1	1				Maleic Anhydride	MALANHYD
AMN_HAPSK,AMN_HAPSJ,AMN_HAPSI	7439965		1	1	1	1	Manganese Compounds	Manganese	MANGANESE
HG,HGIIGAS,APHGI,APHGJ (there is no APHGK)	7439976		1	1	1	1	Mercury Compounds	Mercury	HGSUM
MEOH	67561	1	1	1				Methanol	METHANOL
PAH_880E5	779022						Polycyclic Organic Matter	9-Methyl Anthracene	PAH_880E5
METHYLCHLORIDE	74873	1	1	1				Methyl Chloride	MTHYLCHLRD
PAH_880E5	26914181	1	1	1			Polycyclic Organic Matter	Methylanthracene	PAH_880E5
PAH_880E5	2422799						Polycyclic Organic Matter	12-Methylbenz(a)Anthracene	PAH_880E5

2014 CMAQ species name(s)	Pollutant Code (NEI)	2014 NEI -Event	2014NEI-Nonpoint	2014NEI - Point	2014NEI - Nonroad	2014NEI - Onroad	NEI Pollutant Category Name (if different from description)	NEI Pollutant Description	SMOKE name
PAH_880E5	65357699	1	1				Polycyclic Organic Matter	Methylbenzopyrene	PAH_880E5
PAH_101E2	56495		1	1			Polycyclic Organic Matter	3-Methylcholanthrene	PAH_101E2
PAH_176E3	3697243		1	1			Polycyclic Organic Matter	5-Methylchrysene	PAH_176E3
CL2_ME	75092		1	1				Methylene Chloride	MECL
PAH_880E5	90120		1	1			Polycyclic Organic Matter	1-Methylnaphthalene	PAH_880E5
PAH_880E5	91576		1	1	1		Polycyclic Organic Matter	2-Methylnaphthalene	PAH_880E5
PAH_880E5	832699		1				Polycyclic Organic Matter	1-Methylphenanthrene	PAH_880E5
PAH_880E5	2531842			1			Polycyclic Organic Matter	2-Methylphenanthrene	PAH_880E5
PAH_880E5	2381217	1	1				Polycyclic Organic Matter	1-Methylpyrene	PAH_880E5
NAPHTHALENE	91203	1	1	1	1	1		Naphthalene	NAPHTH
ANIK, ANII, ANIJ	7440020		1	1	1	1	Nickel Compounds	Nickel	NICKEL
ANIK, ANII, ANIJ	1313991			1			Nickel Compounds	Nickel Oxide	NICKEL
ANIK, ANII, ANIJ	604			1			Nickel Compounds	Nickel Refinery Dust	NICKEL
PAH_176E4	5522430						Polycyclic Organic Matter	1-Nitropyrene	PAH_176E4
PAH_880E5	1.3E+08		1	1	1	1	Polycyclic Organic Matter	PAH, total	PAH_880E5
PAH_880E5	198550	1	1	1			Polycyclic Organic Matter	Perylene	PAH_880E5
PAH_000E0	85018	1	1	1	1	1	Polycyclic Organic Matter	Phenanthrene	PAH_000E0
PROPDICHLORIDE	78875		1	1				Propylene Dichloride	PROPDICLR
PAH_000E0	129000	1	1	1	1	1	Polycyclic Organic Matter	Pyrene	PAH_000E0
QUINOLINE	91225			1				Quinoline	QUINOLINE
STYRENE	100425	1	1	1	1	1		Styrene	STYRENE
CL4_ETHANE1122	79345		1	1				1,1,2,2-Tetrachloroethane	TTCLE1122
CL4_ETHE	127184		1	1				Tetrachloroethylene	PERC
TOLU	108883	1	1	1	1	1		Toluene	TOLUENE
TOL_DIIS	584849		1	1				2,4-Toluene Diisocyanate	TOL_DIIS
CL3_ETHE	79016		1	1				Trichloroethylene	CL3_ETHE
TRIETHYLAMINE	121448		1	1				Triethylamine	TRIETHLAMN
CL_ETHE	75014		1	1				Vinyl Chloride	VINYCHLRI
XYLENES	108383		1	1	1	1	Xylenes (Mixed Isomers)	m-Xylene	XYLENES
XYLENES	95476		1	1	1	1	Xylenes (Mixed Isomers)	o-Xylene	XYLENES
XYLENES	106423		1	1	1	1	Xylenes (Mixed Isomers)	p-Xylene	XYLENES
XYLENES	1330207	1	1	1	1	1	Xylenes (Mixed Isomers)	Xylenes (Mixed Isomers)	XYLENES
ADE_ECI,ADE_ECJ,ADE_OCI,ADE_OCJ,ADE_SO4J,ADE_NO3J,ADE_OTHRI,ADE_OTHRK,ADE_K	DIESEL-PM10		1	1	1	1		PM10-Primary from certain diesel engines	DIESEL_PM10
PAH_176E3	41637905	1	1				Polycyclic Organic Matter	Methylchrysene	PAH_176E3
PAH_880E5	250		1	1			Polycyclic Organic Matter	PAH/POM - Unspecified	PAH_880E5
ADE_ECI,ADE_ECJ,ADE_OCI,ADE_OCJ,ADE_SO4J,ADE_NO3J,ADE_OTHRI,ADE_OTHRK,ADE_K	DIESEL-PM25		1	1	1	1		PM25-Primary from certain diesel engines	DIESEL_PM25

2014 CMAQ species name(s)	Pollutant Code (NEI)	2014 NEI -Event	2014NEI-Nonpoint	2014NEI - Point	2014NEI - Nonroad	2014NEI - Onroad	NEI Pollutant Category Name (if different from description)	NEI Pollutant Description	SMOKE name

Appendix B: Nonpoint Oil and Gas (np_oilgas) SCCs

The table below shows the SCCs in the nonpoint oil and gas sector (np_oilgas).

SCC	SCC description
2310000000	Industrial Processes;Oil and Gas Exploration and Production;All Processes;Total: All Processes
2310000220	Industrial Processes;Oil and Gas Exploration and Production;All Processes;Drill Rigs
2310000230	Industrial Processes;Oil and Gas Exploration and Production;All Processes;Workover Rigs
2310000330	Industrial Processes;Oil and Gas Exploration and Production;All Processes;Artificial Lift
2310000550	Industrial Processes;Oil and Gas Exploration and Production;All Processes;Produced Water
2310000660	Industrial Processes;Oil and Gas Exploration and Production;All Processes;Hydraulic Fracturing Engines
2310001000	Industrial Processes;Oil and Gas Exploration and Production;All Processes : On-shore;Total: All Processes
2310002000	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil And Gas Production;Total: All Processes
2310002401	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil And Gas Production;Pneumatic Pumps: Gas And Oil Wells
2310002411	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil And Gas Production;Pressure/Level Controllers
2310002421	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil And Gas Production;Cold Vents
2310010000	Industrial Processes;Oil and Gas Exploration and Production;Crude Petroleum;Total: All Processes
2310010100	Industrial Processes;Oil and Gas Exploration and Production;Crude Petroleum;Oil Well Heaters
2310010200	Industrial Processes;Oil and Gas Exploration and Production;Crude Petroleum;Oil Well Tanks - Flashing & Standing/Working/Breathing
2310010300	Industrial Processes;Oil and Gas Exploration and Production;Crude Petroleum;Oil Well Pneumatic Devices
2310010700	Industrial Processes;Oil and Gas Exploration and Production;Crude Petroleum;Oil Well Fugitives
2310010800	Industrial Processes;Oil and Gas Exploration and Production;Crude Petroleum;Oil Well Truck Loading
2310011000	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Total: All Processes
2310011020	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Storage Tanks: Crude Oil
2310011100	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Heater Treater
2310011201	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Tank Truck/Railcar Loading: Crude Oil
2310011500	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Fugitives: All Processes
2310011501	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Fugitives: Connectors
2310011502	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Fugitives: Flanges
2310011503	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Fugitives: Open Ended Lines
2310011504	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Fugitives: Pumps
2310011505	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Fugitives: Valves
2310011506	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Fugitives: Other
2310011600	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Artificial Lift Engines
2310012000	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil Production;Total: All Processes
2310012020	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil Production;Storage Tanks: Crude Oil
2310012525	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil Production;Fugitives, Valves: Oil/Water
2310012526	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil Production;Fugitives, Other: Oil/Water
2310020000	Industrial Processes;Oil and Gas Exploration and Production;Natural Gas;Total: All Processes

SCC	SCC description
2310020600	Industrial Processes;Oil and Gas Exploration and Production;Natural Gas;Compressor Engines
2310020700	Industrial Processes;Oil and Gas Exploration and Production;Natural Gas;Gas Well Fugitives
2310020800	Industrial Processes;Oil and Gas Exploration and Production;Natural Gas;Gas Well Truck Loading
2310021010	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Storage Tanks: Condensate
2310021011	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Condensate Tank Flaring
2310021030	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Tank Truck/Railcar Loading: Condensate
2310021100	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Heaters
2310021101	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 2Cycle Lean Burn Compressor Engines < 50 HP
2310021102	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 2Cycle Lean Burn Compressor Engines 50 To 499 HP
2310021103	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 2Cycle Lean Burn Compressor Engines 500+ HP
2310021201	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 4Cycle Lean Burn Compressor Engines <50 HP
2310021202	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 4Cycle Lean Burn Compressor Engines 50 To 499 HP
2310021203	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 4Cycle Lean Burn Compressor Engines 500+ HP
2310021251	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Lateral Compressors 4 Cycle Lean Burn
2310021300	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Pneumatic Devices
2310021301	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 4Cycle Rich Burn Compressor Engines <50 HP
2310021302	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP
2310021303	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 4Cycle Rich Burn Compressor Engines 500+ HP
2310021310	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Pneumatic Pumps
2310021351	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Lateral Compressors 4 Cycle Rich Burn
2310021400	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Dehydrators
2310021402	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Nat Gas Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP w/NSCR
2310021403	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Nat Gas Fired 4Cycle Rich Burn Compressor Engines 500+ HP w/NSCR
2310021411	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Dehydrators - Flaring
2310021450	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Wellhead
2310021500	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Completion - Flaring
2310021501	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Fugitives: Connectors
2310021502	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Fugitives: Flanges
2310021503	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Fugitives: Open Ended Lines
2310021504	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Fugitives: Pumps
2310021505	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Fugitives: Valves

SCC	SCC description
2310021506	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Fugitives: Other
2310021509	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Fugitives: All Processes
2310021600	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Venting
2310021601	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Venting - Initial Completions
2310021602	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Venting - Recompletions
2310021603	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Venting - Blowdowns
2310021604	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Venting - Compressor Startups
2310021605	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Venting - Compressor Shutdowns
2310021700	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Miscellaneous Engines
2310022000	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Total: All Processes
2310022010	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Storage Tanks: Condensate
2310022051	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Turbines: Natural Gas
2310022090	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Boilers/Heaters: Natural Gas
2310022105	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Diesel Engines
2310022410	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Amine Unit
2310022420	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Dehydrator
2310022506	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Fugitives, Other: Gas
2310023010	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Storage Tanks: Condensate
2310023030	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Tank Truck/Railcar Loading: Condensate
2310023100	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;CBM Well Heaters
2310023102	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;CBM Fired 2Cycle Lean Burn Compressor Engines 50 To 499 HP
2310023202	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;CBM Fired 4Cycle Lean Burn Compressor Engines 50 To 499 HP
2310023251	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Lateral Compressors 4 Cycle Lean Burn
2310023300	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Pneumatic Devices
2310023302	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;CBM Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP
2310023310	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Pneumatic Pumps
2310023351	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Lateral Compressors 4 Cycle Rich Burn
2310023400	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Dehydrators
2310023509	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Fugitives
2310023511	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Fugitives: Connectors
2310023512	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Fugitives: Flanges

SCC	SCC description
2310023513	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Fugitives: Open Ended Lines
2310023515	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Fugitives: Valves
2310023516	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Fugitives: Other
2310023600	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;CBM Well Completion: All Processes
2310023603	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;CBM Well Venting - Blowdowns
2310023606	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Mud Degassing
2310030300	Industrial Processes;Oil and Gas Exploration and Production;Natural Gas Liquids;Gas Well Water Tank Losses
2310030401	Industrial Processes;Oil and Gas Exploration and Production;Natural Gas Liquids;Gas Plant Truck Loading
2310111100	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Exploration;Mud Degassing
2310111401	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Exploration;Oil Well Pneumatic Pumps
2310111700	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Exploration;Oil Well Completion: All Processes
2310112401	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil Exploration;Oil Well Pneumatic Pumps
2310121100	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Exploration;Mud Degassing
2310121401	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Exploration;Gas Well Pneumatic Pumps
2310121700	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Exploration;Gas Well Completion: All Processes
2310122100	Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Exploration;Mud Degassing
2310321010	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production - Conventional;Storage Tanks: Condensate
2310321400	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production - Conventional;Gas Well Dehydrators
2310321603	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production - Conventional;Gas Well Venting - Blowdowns
2310400220	Industrial Processes;Oil and Gas Exploration and Production;All Processes - Unconventional;Drill Rigs
2310421010	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production - Unconventional;Storage Tanks: Condensate
2310421100	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production - Unconventional;Gas Well Heaters
2310421400	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production - Unconventional;Gas Well Dehydrators
2310421603	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production - Unconventional;Gas Well Venting - Blowdowns

Appendix C: Profiles (other than onroad) that are new or revised in SPECIATE4.5 that were used in the 2014 v7.1 Platform

Sector	Pollutant	Profile code	Profile description	SPECIATE version	comment
nonpt	VOC	G95223TOG	Poultry Production - Average of Production Cycle with gapfilled methane and ethane	5.0 (not yet released)	Replacement for v4.5 profile 95223; Used 70% methane, 20% ethane, and the 10% remaining VOC is from profile 95223
Nonpt, ptnonipm	VOC	G95240TOG	Beef Cattle Farm and Animal Waste with gapfilled methane and ethane	5.0 (not yet released)	Replacement for v4.5 profile 95240. Used 70% methane, 20% ethane; the 10% remaining VOC is from profile 95240.
nonpt	VOC	G95241TOG	Swine Farm and Animal Waste	5.0 (not yet released)	Replacement for v4.5 profile 95241. Used 70% methane, 20% ethane; the 10% remaining VOC is from profile 95241
nonpt, ptnonipm, pt_oilgas, ptegu	PM2.5	95475	Composite -Refinery Fuel Gas and Natural Gas Combustion	5.0 (not yet released)	Composite of AE6-ready versions of SPECIATE4.5 profies 95125, 95126, and 95127
nonroad	VOC	95328	Spark-Ignition Exhaust Emissions from 2-stroke off-road engines - E10 ethanol gasoline	4.5	
nonroad	VOC	95330	Spark-Ignition Exhaust Emissions from 4-stroke off-road engines - E10 ethanol gasoline	4.5	
nonroad	VOC	95331	Diesel Exhaust Emissions from Pre-Tier 1 Off-road Engines	4.5	
nonroad	VOC	95332	Diesel Exhaust Emissions from Tier 1 Off-road Engines	4.5	
nonroad	VOC	95333	Diesel Exhaust Emissions from Tier 2 Off-road Engines	4.5	
np_oilgas	VOC	95087a	Oil and Gas - Composite - Oil Field - Oil Tank Battery Vent Gas	4.5	
np_oilgas	VOC	95109a	Oil and Gas - Composite - Oil Field - Condensate Tank Battery Vent Gas	4.5	
np_oilgas	VOC	95398	Composite Profile - Oil and Natural Gas Production - Condensate Tanks	4.5	
np_oilgas	VOC	95403	Composite Profile - Gas Wells	4.5	
np_oilgas	VOC	95417	Oil and Gas Production - Composite Profile - Untreated Natural Gas, Uinta Basin	4.5	
np_oilgas	VOC	95418	Oil and Gas Production - Composite Profile - Condensate Tank Vent Gas, Uinta Basin	4.5	
np_oilgas	VOC	95419	Oil and Gas Production - Composite Profile - Oil Tank Vent Gas, Uinta Basin	4.5	
np_oilgas	VOC	95420	Oil and Gas Production - Composite Profile - Glycol Dehydrator, Uinta Basin	4.5	

Sector	Pollutant	Profile code	Profile description	SPECIATE version	comment
np_oilgas	VOC	DJVNT_R	Oil and Gas -Denver-Julesburg Basin Produced Gas Composition from Non-CBM Gas Wells	4.5	
np_oilgas	VOC	FLR99	Natural Gas Flare Profile with DRE >98%	4.5	
np_oilgas	VOC	PNC01_R	Oil and Gas -Piceance Basin Produced Gas Composition from Non-CBM Gas Wells	4.5	
np_oilgas	VOC	PNC02_R	Oil and Gas -Piceance Basin Produced Gas Composition from Oil Wells	4.5	
np_oilgas	VOC	PNC03_R	Oil and Gas -Piceance Basin Flash Gas Composition for Condensate Tank	4.5	
np_oilgas	VOC	PNCDH	Oil and Gas Production - Composite Profile - Glycol Dehydrator, Piceance Basin	4.5	
np_oilgas	VOC	PRBCB_R	Oil and Gas -Powder River Basin Produced Gas Composition from CBM Wells	4.5	
np_oilgas	VOC	PRBCO_R	Oil and Gas -Powder River Basin Produced Gas Composition from Non-CBM Wells	4.5	
np_oilgas	VOC	PRM01_R	Oil and Gas -Permian Basin Produced Gas Composition for Non-CBM Wells	4.5	
np_oilgas	VOC	SSJCB_R	Oil and Gas -South San Juan Basin Produced Gas Composition from CBM Wells	4.5	
np_oilgas	VOC	SSJCO_R	Oil and Gas -South San Juan Basin Produced Gas Composition from Non-CBM Gas Wells	4.5	
np_oilgas	VOC	SWFLA_R	Oil and Gas -SW Wyoming Basin Flash Gas Composition for Condensate Tanks	4.5	
np_oilgas	VOC	SWVNT_R	Oil and Gas -SW Wyoming Basin Produced Gas Composition from Non-CBM Wells	4.5	
np_oilgas	VOC	UNT01_R	Oil and Gas -Uinta Basin Produced Gas Composition from CBM Wells	4.5	
np_oilgas	VOC	WRBCO_R	Oil and Gas -Wind River Basin Produced Gas Composition from Non-CBM Gas Wells	4.5	
pt_oilgas	VOC	95325	Chemical Manufacturing Industry Wide Composite	4.5	
pt_oilgas	VOC	95326	Pulp and Paper Industry Wide Composite	4.5	
pt_oilgas, ptnonipm	VOC	95399	Composite Profile - Oil Field - Wells	4.5	
pt_oilgas	VOC	95403	Composite Profile - Gas Wells	4.5	
pt_oilgas	VOC	95417	Oil and Gas Production - Composite Profile - Untreated Natural Gas, Uinta Basin	4.5	
pt_oilgas	VOC	DJVNT_R	Oil and Gas -Denver-Julesburg Basin Produced Gas Composition from Non-CBM Gas Wells	4.5	
pt_oilgas, ptnonipm	VOC	FLR99	Natural Gas Flare Profile with DRE >98%	4.5	
pt_oilgas	VOC	PNC01_R	Oil and Gas -Piceance Basin Produced Gas Composition from Non-CBM Gas Wells	4.5	
pt_oilgas	VOC	PNC02_R	Oil and Gas -Piceance Basin Produced Gas Composition from Oil Wells	4.5	
pt_oilgas	VOC	PNCDH	Oil and Gas Production - Composite Profile - Glycol Dehydrator, Piceance Basin	4.5	

Sector	Pollutant	Profile code	Profile description	SPECIATE version	comment
pt_oilgas, ptnonipm	VOC	PRBCO_R	Oil and Gas -Powder River Basin Produced Gas Composition from Non-CBM Wells	4.5	
pt_oilgas, ptnoniom	VOC	PRM01_R	Oil and Gas -Permian Basin Produced Gas Composition for Non-CBM Wells	4.5	
pt_oilgas, ptnonipm	VOC	SSJCO_R	Oil and Gas -South San Juan Basin Produced Gas Composition from Non-CBM Gas Wells	4.5	
pt_oilgas, ptnonipm	VOC	SWVNT_R	Oil and Gas -SW Wyoming Basin Produced Gas Composition from Non-CBM Wells	4.5	
ptfire	VOC	95421	Composite Profile - Prescribed fire southeast conifer forest	4.5	
ptfire	VOC	95422	Composite Profile - Prescribed fire southwest conifer forest	4.5	
ptfire	VOC	95423	Composite Profile - Prescribed fire northwest conifer forest	4.5	
ptfire	VOC	95424	Composite Profile - Wildfire northwest conifer forest	4.5	
ptfire	VOC	95425	Composite Profile - Wildfire boreal forest	4.5	
ptnonipm	VOC	95325	Chemical Manufacturing Industry Wide Composite	4.5	
ptnonipm	VOC	95326	Pulp and Paper Industry Wide Composite	4.5	
onroad	PM2.5	95462	Composite - Brake Wear	4.5	Used in SMOKE-MOVES
onroad	PM2.5	95460	Composite - Tire Dust	4.5	Used in SMOKE-MOVES

Appendix D: CB6 Assignment for New Species

RAMBOLL ENVIRON

September 27, 2016

MEMORANDUM

To: Alison Eyth and Madeleine Strum, OAQPS, EPA
From: Ross Beardsley and Greg Yarwood, Ramboll Environ
Subject: Species Mappings for CB6 and CB05 for use with SPECIATE 4.5

Summary

Ramboll Environ (RE) reviewed version 4.5 of the SPECIATE database, and created CB05 and CB6 mechanism species mappings for newly added compounds. In addition, the mapping guidelines for Carbon Bond (CB) mechanisms were expanded to promote consistency in current and future work.

Background

The Environmental Protection Agency's SPECIATE repository contains gas and particulate matter speciation profiles of air pollution sources, which are used in the generation of emissions data for air quality models (AQM) such as CMAQ (http://www.cmascenter.org/cmaq/) and CAMx (http://www.camx.com). However, the condensed chemical mechanisms used within these photochemical models utilize fewer species than SPECIATE to represent gas phase chemistry, and thus the SPECIATE compounds must be assigned to the AQM model species of the condensed mechanisms. A chemical mapping is used to show the representation of organic chemical species by the model compounds of the condensed mechanisms.

This memorandum describes how chemical mappings were developed from SPECIATE 4.5 compounds to model species of the CB mechanism, specifically CB05 (http://www.camx.com/publ/pdfs/CB05_Final_Report_120805.pdf) and CB6 (http://aqrp.ceer.utexas.edu/projectinfoFY12_13/12-012/12-012%20Final%20Report.pdf).

Methods

CB Model Species

Organic gases are mapped to the CB mechanism either as explicitly represented individual compounds (e.g. ALD2 for acetaldehyde), or as a combination of model species that represent common structural groups (e.g. ALDX for other aldehydes, PAR for alkyl groups). Table 1 lists all of the explicit and structural model species in CB05 and CB6 mechanisms, each of which represents a defined number of carbon atoms allowing for carbon to be conserved in all cases. CB6 contains four more explicit model species than CB05 and an additional structural group to represent ketones. The CB05 representation of the five additional CB6 species is provided in the '*Included in CB05*' column of Table 1.

Ramboll Environ, 773 San Marin Drive, Suite 2115, Novato, CA 94998
V +1 415.899.0700 F +1 415.899.0707

UNC-EMAQ(4-02)-16

In addition to the explicit and structural species, there are two model species that are used to represent organic gases that are not treated by the CB mechanism:

NVOL – Very low volatility SPECIATE compounds that reside predominantly in the particle phase and should be excluded from the gas phase mechanism. These compounds are mapped by setting NVOL equal to the molecular weight (e.g. decabromodiphenyl oxide is mapped as 959.2 NVOL), which allows for the total mass of all NVOL to be determined.

UNK – Compounds that are unable to be mapped to CB using the available model species. This approach should be avoided unless absolutely necessary, and will lead to a warning message in the speciation tool.

Table 1. Model species in the CB05 and CB6 chemical mechanisms.

Model Species Name	Description	Number of Carbons	Included in CB05 (structural mapping)	Included in CB6
Explicit model species				
ACET	Acetone (propanone)	3	No (3 PAR)	Yes
ALD2	Acetaldehyde (ethanal)	2	Yes	Yes
BENZ	Benzene	6	No (1 PAR, 5 UNR)	Yes
CH4	Methane	1	Yes	Yes
ETH	Ethene (ethylene)	2	Yes	Yes
ETHA	Ethane	2	Yes	Yes
ETHY	Ethyne (acetylene)	2	No (1 PAR, 1 UNR)	Yes
ETOH	Ethanol	2	Yes	Yes
FORM	Formaldehyde (methanal)	1	Yes	Yes
ISOP	Isoprene (2-methyl-1,3-butadiene)	5	Yes	Yes
MEOH	Methanol	1	Yes	Yes
PRPA	Propane	3	No (1.5 PAR, 1.5 UNR)	Yes
Common Structural groups				
ALDX	Higher aldehyde group (-C-CHO)	2	Yes	Yes
IOLE	Internal olefin group (R_1R_2>C=C<R_3R_4)	4	Yes	Yes
KET	Ketone group (R_1R_2 >C=O)	1	No (1 PAR)	Yes
OLE	Terminal olefin group (R_1R_2>C=C)	2	Yes	Yes
PAR	Paraffinic group (R_1-C<R_2R_3)	1	Yes	Yes
TERP	Monoterpenes	10	Yes	Yes
TOL	Toluene and other monoalkyl aromatics	7	Yes	Yes
UNR	Unreactive carbon groups (e.g., halogenated carbons)	1	Yes	Yes
XYL	Xylene and other polyalkyl aromatics	8	Yes	Yes
Not mapped to CB model species				
NVOL	Very low volatility compounds	*	Yes	Yes
UNK	Unknown	*	Yes	Yes

*Each NVOL represents 1 g mol^{-1} and low volatility compounds are assigned to NVOL based on molecular weight. UNK is unmapped and thus does not represent any carbon.

Mapping guidelines for non-explicit organic gases using CB model species

SPECIATE compounds that are not treated explicitly are mapped to CB model species that represent common structural groups. Table 2 lists the carbon number and general mapping guidelines for each of the structure model species.

Table 2. General Guidelines for mapping using CB6 structural model species.

CB6 Species Name	Number of Carbons	Represents
ALDX	2	Aldehyde group. ALDX represents 2 carbons and additional carbons are represented as alkyl groups (mostly PAR), e.g. propionaldehyde is ALDX + PAR
IOLE	4	Internal olefin group. IOLE represents 4 carbons and additional carbons are represented as alkyl groups (mostly PAR), e.g. 2-pentene isomers are IOLE + PAR. *Exceptions:* • IOLE with 2 carbon branches on both sides of the double bond are downgraded to OLE
KET	1	Ketone group. KET represents 1 carbon and additional carbons are represented as alkyl groups (mostly PAR), e.g. butanone is 3 PAR + KET
OLE	2	Terminal olefin group. OLE represents 2 carbons and additional carbons are represented as alkyl groups (mostly PAR), e.g. propene is OLE + PAR. Alkyne group, e.g. butyne isomers are OLE + 2 PAR.
PAR	1	Alkanes and alkyl groups. PAR represents 1 carbon, e.g. butane is 4 PAR. See UNR for exceptions.
TERP	10	All monoterpenes are represented as 1 TERP.
TOL	7	Toluene and other monoalkyl aromatics. TOL represents 7 carbons and any additional carbons are represented as alkyl groups (mostly PAR), e.g. ethylbenzene is TOL + PAR. Cresols are represented as TOL and PAR. Styrenes are represented using TOL, OLE and PAR.
UNR	1	Unreactive carbons are 1 UNR such as quaternary alkyl groups (e.g., neo-pentane is 4 PAR + UNR), carboxylic acid groups (e.g., acetic acid is PAR + UNR), ester groups (e.g., methyl acetate is 2 PAR + UNR), halogenated carbons (e.g., trichloroethane isomers are 2 UNR), carbons of nitrile groups (-C≡N).
XYL	8	Xylene isomers and other polyalkyl aromatics. XYL represents 8 carbons and any additional carbons are represented as alkyl groups (mostly PAR), e.g. trimethylbenzene isomers are XYL + PAR

Some compounds that are multifunctional and/or include hetero-atoms lack obvious CB mappings. We developed guidelines for some of these compound classes to promote consistent representation in this work and future revisions. Approaches for several compound classes are explained in Table 3. We developed guidelines as needed to address newly added species in SPECIATE 4.5 but did not systematically review existing mappings for "difficult to assign" compounds that could benefit from developing a guideline.

Table 3. Mapping guidelines for some difficult to map compound classes and structural groups

Compound Class/Structural group	CB model species representation
Chlorobenzenes and other halogenated benzenes	Guideline: • 3 or less halogens – 1 PAR, 5 UNR • 4 or more halogens – 6 UNR Examples: • 1,3,5-Chlorobenzene – 1 PAR, 5 UNR • Tetrachlorobenzenes – 6 UNR
Cyclodienes	Guideline: • 1 IOLE with additional carbons represented as alkyl groups (generally PAR) Examples: • Methylcyclopentadiene – 1 IOLE, 2 PAR • Methylcyclohexadiene – 1 IOLE, 3 PAR
Furans/Pyrroles	Guideline: • 2 OLE with additional carbons represented as alkyl groups (generally PAR) Examples: • 2-Butylfuran – 2 OLE, 4 PAR • 2-Pentylfuran – 2 OLE, 5 PAR • Pyrrole – 2 OLE • 1-Methylpyrrole – 2 OLE, 1 PAR
Heterocyclic aromatic compounds containing 2 non-carbon atoms	Guideline: • 1 OLE with remaining carbons represented as alkyl groups (generally PAR) Examples: • Ethylpyrazine – 1 OLE, 4 PAR • 1-methylpyrazole – 1 OLE, 2 PAR • 4,5-Dimethyloxazole – 1 OLE, 3 PAR
Triple bond(s)	Guideline: • Triple bonds are treated as PAR unless they are the only reactive functional group. If a compound contains more than one triple bond and no other reactive functional groups, then one of the triple bonds is treated as OLE with additional carbons treated as alkyl groups. Examples: • 1-Penten-3-yne – 1 OLE, 3 PAR • 1,5-Hexadien-3-yne – 2 OLE, 2 PAR • 1,6-Heptadiyne – 1 OLE, 5 PAR

These guidelines were used to map the new species from SPEICATE4.5, and also to revise some previously mapped compounds. Overall, a total of 175 new species from SPECIATEv4.5 were mapped and 7 previously mapped species were revised based on the new guidelines.

Recommendation

1. Complete a systematic review of the mapping of all species to ensure conformity with current mapping guidelines. The assignments of existing compounds that are similar to new species were reviewed and revised to promote consistency in mapping approaches, but the majority of existing species mappings were not reviewed as it was outside the scope of this work.
2. Develop a methodology for classifying and tracking larger organic compounds based on their volatility (semi, intermediate, or low volatility) to improve support for secondary organic aerosol (SOA) modeling using the volatility basis set (VBS) SOA model, which is available in both CMAQ and CAMx. A preliminary investigation of the possibility of doing so has been performed, and is discussed in a separate memorandum.

Appendix E: NONHAPTOG profiles that that produce NBAFM via compound mixtures

Profile code	Inventory Species	Mechanism species	Numerator	Divisor	Mass Fraction	Used in 2014v7.1 platform?
0000	NONHAPTOG	ALD2	5.67E-04	40.1466	5.67E-04	YES
1089	NONHAPTOG	ALD2	0.1651	40.1466	0.1651	YES
4710	NONHAPTOG	ALD2	2.01E-06	40.1466	2.01E-06	
4715	NONHAPTOG	ALD2	5.22E-06	40.1466	5.22E-06	
4716	NONHAPTOG	ALD2	2.81E-06	40.1466	2.81E-06	
8861	NONHAPTOG	ALD2	2.41E-06	40.1466	2.41E-06	
8862	NONHAPTOG	ALD2	4.82E-06	40.1466	4.82E-06	
8500	NONHAPTOG	FORM	2.12E-04	30.026	2.12E-04	
8526	NONHAPTOG	FORM	9.22E-04	30.026	9.22E-04	
8530	NONHAPTOG	FORM	6.13E-03	30.026	6.13E-03	
3001	NONHAPTOG	BENZ	9.02E-04	86.0788	9.02E-04	YES
8500	NONHAPTOG	BENZ	8.00E-04	86.0788	8.00E-04	
8511	NONHAPTOG	BENZ	6.28E-05	86.0788	6.28E-05	
8512	NONHAPTOG	BENZ	7.75E-05	86.0788	7.75E-05	
8514	NONHAPTOG	BENZ	1.46E-05	86.0788	1.46E-05	
8516	NONHAPTOG	BENZ	9.21E-05	86.0788	9.21E-05	
8517	NONHAPTOG	BENZ	3.87E-05	86.0788	3.87E-05	
8519	NONHAPTOG	BENZ	1.64E-04	86.0788	1.64E-04	
8520	NONHAPTOG	BENZ	5.93E-03	86.0788	5.93E-03	YES
8521	NONHAPTOG	BENZ	5.89E-03	86.0788	5.89E-03	
8522	NONHAPTOG	BENZ	5.93E-03	86.0788	5.93E-03	
8523	NONHAPTOG	BENZ	4.82E-05	86.0788	4.82E-05	
8524	NONHAPTOG	BENZ	5.34E-05	86.0788	5.34E-05	
8526	NONHAPTOG	BENZ	9.55E-04	86.0788	9.55E-04	
8527	NONHAPTOG	BENZ	9.61E-04	86.0788	9.61E-04	
8528	NONHAPTOG	BENZ	1.82E-03	86.0788	1.82E-03	
8529	NONHAPTOG	BENZ	1.43E-03	86.0788	1.43E-03	
8530	NONHAPTOG	BENZ	1.46E-05	86.0788	1.46E-05	
8532	NONHAPTOG	BENZ	1.37E-04	86.0788	1.37E-04	
8534	NONHAPTOG	BENZ	3.74E-04	86.0788	3.74E-04	
8535	NONHAPTOG	BENZ	1.23E-04	86.0788	1.23E-04	
8536	NONHAPTOG	BENZ	3.52E-04	86.0788	3.52E-04	
2543	NONHAPTOG	MEOH	1.66E-03	14.3806	1.66E-03	
2544	NONHAPTOG	MEOH	1.66E-03	14.3806	1.66E-03	YES
3018	NONHAPTOG	MEOH	1.84E-05	14.3806	1.84E-05	
3020	NONHAPTOG	MEOH	7.49E-05	14.3806	7.49E-05	
3021	NONHAPTOG	MEOH	1.09E-04	14.3806	1.09E-04	
3022	NONHAPTOG	MEOH	4.31E-05	14.3806	4.31E-05	
3023	NONHAPTOG	MEOH	5.46E-05	14.3806	5.46E-05	
3029	NONHAPTOG	MEOH	3.80E-05	14.3806	3.80E-05	
3030	NONHAPTOG	MEOH	3.66E-04	14.3806	3.66E-04	
3031	NONHAPTOG	MEOH	3.11E-04	14.3806	3.11E-04	
3048	NONHAPTOG	MEOH	8.10E-04	14.3806	8.10E-04	
3049	NONHAPTOG	MEOH	1.45E-03	14.3806	1.45E-03	
3050	NONHAPTOG	MEOH	1.45E-03	14.3806	1.45E-03	

Profile code	Inventory Species	Mechanism species	Numerator	Divisor	Mass Fraction	Used in 2014v7.1 platform?
3051	NONHAPTOG	MEOH	4.10E-04	14.3806	4.10E-04	
3052	NONHAPTOG	MEOH	1.07E-04	14.3806	1.07E-04	
3053	NONHAPTOG	MEOH	9.30E-04	14.3806	9.30E-04	
3054	NONHAPTOG	MEOH	9.31E-04	14.3806	9.31E-04	
3055	NONHAPTOG	MEOH	8.05E-04	14.3806	8.05E-04	
3064	NONHAPTOG	MEOH	4.09E-04	14.3806	4.09E-04	
3066	NONHAPTOG	MEOH	1.50E-04	14.3806	1.50E-04	YES
3067	NONHAPTOG	MEOH	1.46E-04	14.3806	1.46E-04	
3078	NONHAPTOG	MEOH	1.37E-03	14.3806	1.37E-03	
3079	NONHAPTOG	MEOH	1.38E-03	14.3806	1.38E-03	
3081	NONHAPTOG	MEOH	4.72E-04	14.3806	4.72E-04	
3082	NONHAPTOG	MEOH	4.69E-04	14.3806	4.69E-04	
3086	NONHAPTOG	MEOH	4.40E-05	14.3806	4.40E-05	
3087	NONHAPTOG	MEOH	4.50E-05	14.3806	4.50E-05	
3089	NONHAPTOG	MEOH	7.36E-05	14.3806	7.36E-05	
3091	NONHAPTOG	MEOH	3.11E-04	14.3806	3.11E-04	
3092	NONHAPTOG	MEOH	7.09E-04	14.3806	7.09E-04	
3143	NONHAPTOG	MEOH	4.73E-05	14.3806	4.73E-05	
3145	NONHAPTOG	MEOH	5.35E-04	14.3806	5.35E-04	YES
3146	NONHAPTOG	MEOH	9.51E-05	14.3806	9.51E-05	YES
8500	NONHAPTOG	MEOH	5.46E-05	14.3806	5.46E-05	
8501	NONHAPTOG	MEOH	2.57E-05	14.3806	2.57E-05	
8507	NONHAPTOG	MEOH	3.72E-05	14.3806	3.72E-05	
8509	NONHAPTOG	MEOH	4.03E-06	14.3806	4.03E-06	
8510	NONHAPTOG	MEOH	1.89E-04	14.3806	1.89E-04	
8511	NONHAPTOG	MEOH	6.57E-05	14.3806	6.57E-05	
8512	NONHAPTOG	MEOH	1.28E-05	14.3806	1.28E-05	
8513	NONHAPTOG	MEOH	4.26E-05	14.3806	4.26E-05	
8514	NONHAPTOG	MEOH	4.63E-05	14.3806	4.63E-05	
8516	NONHAPTOG	MEOH	6.39E-05	14.3806	6.39E-05	
8517	NONHAPTOG	MEOH	4.31E-07	14.3806	4.31E-07	
8518	NONHAPTOG	MEOH	4.31E-06	14.3806	4.31E-06	
8519	NONHAPTOG	MEOH	2.24E-04	14.3806	2.24E-04	
8520	NONHAPTOG	MEOH	9.17E-05	14.3806	9.17E-05	YES
8521	NONHAPTOG	MEOH	2.02E-04	14.3806	2.02E-04	
8522	NONHAPTOG	MEOH	8.15E-05	14.3806	8.15E-05	
8523	NONHAPTOG	MEOH	7.42E-05	14.3806	7.42E-05	
8524	NONHAPTOG	MEOH	7.89E-05	14.3806	7.89E-05	
8525	NONHAPTOG	MEOH	3.51E-05	14.3806	3.51E-05	
8526	NONHAPTOG	MEOH	8.15E-05	14.3806	8.15E-05	
8527	NONHAPTOG	MEOH	3.00E-04	14.3806	3.00E-04	
8528	NONHAPTOG	MEOH	3.12E-05	14.3806	3.12E-05	
8529	NONHAPTOG	MEOH	5.75E-06	14.3806	5.75E-06	
8531	NONHAPTOG	MEOH	4.31E-05	14.3806	4.31E-05	
8532	NONHAPTOG	MEOH	2.37E-05	14.3806	2.37E-05	
8533	NONHAPTOG	MEOH	7.19E-07	14.3806	7.19E-07	
8534	NONHAPTOG	MEOH	6.43E-05	14.3806	6.43E-05	
8535	NONHAPTOG	MEOH	2.24E-05	14.3806	2.24E-05	
8536	NONHAPTOG	MEOH	6.40E-05	14.3806	6.40E-05	

Appendix F: Mapping of Fuel Distribution SCCs to BTP, BPS and RBT

The table below provides a crosswalk between fuel distribution SCCs and classification type for portable fuel containers (PFC), fuel distribution operations associated with the bulk-plant-to-pump (BTP), refinery to bulk terminal (RBT) and bulk plant storage (BPS).

SCC	Type	Description
40301001	RBT	Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Fixed Roof Tanks (Varying Sizes); Gasoline RVP 13: Breathing Loss (67000 Bbl. Tank Size)
40301002	RBT	Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Fixed Roof Tanks (Varying Sizes); Gasoline RVP 10: Breathing Loss (67000 Bbl. Tank Size)
40301003	RBT	Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Fixed Roof Tanks (Varying Sizes); Gasoline RVP 7: Breathing Loss (67000 Bbl. Tank Size)
40301004	RBT	Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Fixed Roof Tanks (Varying Sizes); Gasoline RVP 13: Breathing Loss (250000 Bbl. Tank Size)
40301006	RBT	Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Fixed Roof Tanks (Varying Sizes); Gasoline RVP 7: Breathing Loss (250000 Bbl. Tank Size)
40301007	RBT	Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Fixed Roof Tanks (Varying Sizes); Gasoline RVP 13: Working Loss (Tank Diameter Independent)
40301101	RBT	Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Floating Roof Tanks (Varying Sizes); Gasoline RVP 13: Standing Loss (67000 Bbl. Tank Size)
40301102	RBT	Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Floating Roof Tanks (Varying Sizes); Gasoline RVP 10: Standing Loss (67000 Bbl. Tank Size)
40301103	RBT	Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Floating Roof Tanks (Varying Sizes); Gasoline RVP 7: Standing Loss (67000 Bbl. Tank Size)
40301105	RBT	Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Floating Roof Tanks (Varying Sizes); Gasoline RVP 10: Standing Loss (250000 Bbl. Tank Size)
40301151	RBT	Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Floating Roof Tanks (Varying Sizes); Gasoline: Standing Loss - Internal
40301202	RBT	Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Variable Vapor Space; Gasoline RVP 10: Filling Loss
40301203	RBT	Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Variable Vapor Space; Gasoline RVP 7: Filling Loss
40400101	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank
40400102	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank
40400103	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank
40400104	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Breathing Loss (250000 Bbl Capacity)-Fixed Roof Tank
40400105	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Breathing Loss (250000 Bbl Capacity)-Fixed Roof Tank
40400106	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Breathing Loss (250000 Bbl Capacity) - Fixed Roof Tank
40400107	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Working Loss (Diam. Independent) - Fixed Roof Tank
40400108	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Working Loss (Diameter Independent) - Fixed Roof Tank
40400109	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Working Loss (Diameter Independent) - Fixed Roof Tank
40400110	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Standing Loss (67000 Bbl Capacity)-Floating Roof Tank
40400111	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Standing Loss (67000 Bbl Capacity)-Floating Roof Tank

SCC	Type	Description
4040011 2	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Standing Loss (67000 Bbl Capacity)- Floating Roof Tank
4040011 3	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank
4040011 4	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank
4040011 5	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank
4040011 6	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Cap.) - Float Rf Tnk
4040011 7	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13/10/7: Withdrawal Loss (250000 Bbl Cap.) - Float Rf Tnk
4040011 8	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
4040011 9	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
4040012 0	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
4040013 0	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Specify Liquid: Standing Loss - External Floating Roof w/ Primary Seal
4040013 1	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Primary Seal
4040013 2	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Primary Seal
4040013 3	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal
4040014 0	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Specify Liquid: Standing Loss - Ext. Float Roof Tank w/ Secondy Seal
4040014 1	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Secondary Seal
4040014 2	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Secondary Seal
4040014 3	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Standing Loss - Ext. Floating Roof w/ Secondary Seal
4040014 8	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13/10/7: Withdrawal Loss - Ext. Float Roof (Pri/Sec Seal)
4040014 9	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Specify Liquid: External Floating Roof (Primary/Secondary Seal)
4040015 0	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Miscellaneous Losses/Leaks: Loading Racks
4040015 1	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Valves, Flanges, and Pumps
4040015 2	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Vapor Collection Losses
4040015 3	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Vapor Control Unit Losses
4040016 0	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Specify Liquid: Standing Loss - Internal Floating Roof w/ Primary Seal
4040016 1	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Primary Seal
4040016 2	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Primary Seal
4040016 3	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Primary Seal
4040017 0	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Specify Liquid: Standing Loss - Int. Floating Roof w/ Secondary Seal

SCC	Type	Description
4040017 1	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Secondary Seal
4040017 2	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Secondary Seal
4040017 3	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Standing Loss - Int. Floating Roof w/ Secondary Seal
4040017 8	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13/10/7: Withdrawal Loss - Int. Float Roof (Pri/Sec Seal)
4040017 9	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Specify Liquid: Internal Floating Roof (Primary/Secondary Seal)
4040019 9	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; See Comment **
4040020 1	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank
4040020 2	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank
4040020 3	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank
4040020 4	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank
4040020 5	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank
4040020 6	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 7: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank
4040020 7	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank
4040020 8	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank
4040021 0	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Cap.) - Float Rf Tnk
4040021 1	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
4040021 2	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
4040021 3	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 7: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
4040023 0	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Specify Liquid: Standing Loss - External Floating Roof w/ Primary Seal
4040023 1	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Primary Seal

SCC	Type	Description
40400232	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Primary Seal
40400233	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal
40400240	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Specify Liquid: Standing Loss - Ext. Floating Roof w/ Secondary Seal
40400241	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Secondary Seal
40400248	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10/13/7: Withdrawal Loss - Ext. Float Roof (Pri/Sec Seal)
40400249	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Specify Liquid: External Floating Roof (Primary/Secondary Seal)
40400250	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Loading Racks
40400251	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Valves, Flanges, and Pumps
40400252	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Miscellaneous Losses/Leaks: Vapor Collection Losses
40400253	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Miscellaneous Losses/Leaks: Vapor Control Unit Losses
40400260	RBT	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Specify Liquid: Standing Loss - Internal Floating Roof w/ Primary Seal
40400261	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Primary Seal
40400262	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Primary Seal
40400263	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Primary Seal
40400270	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Specify Liquid: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400271	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400272	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400273	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 7: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400278	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10/13/7: Withdrawal Loss - Int. Float Roof (Pri/Sec Seal)

SCC	Type	Description
40400279	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Specify Liquid: Internal Floating Roof (Primary/Secondary Seal)
40400401	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Petroleum Products - Underground Tanks; Gasoline RVP 13: Breathing Loss
40400402	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Petroleum Products - Underground Tanks; Gasoline RVP 13: Working Loss
40400403	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Petroleum Products - Underground Tanks; Gasoline RVP 10: Breathing Loss
40400404	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Petroleum Products - Underground Tanks; Gasoline RVP 10: Working Loss
40400405	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Petroleum Products - Underground Tanks; Gasoline RVP 7: Breathing Loss
40400406	BTP/BPS	Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Petroleum Products - Underground Tanks; Gasoline RVP 7: Working Loss
40600101	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Splash Loading **
40600126	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Submerged Loading **
40600131	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Submerged Loading (Normal Service)
40600136	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Splash Loading (Normal Service)
40600141	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Submerged Loading (Balanced Service)
40600144	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Splash Loading (Balanced Service)
40600147	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Submerged Loading (Clean Tanks)
40600162	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Loaded with Fuel (Transit Losses)
40600163	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Return with Vapor (Transit Losses)
40600199	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Not Classified **
40600231	RBT	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Loading Tankers: Cleaned and Vapor Free Tanks
40600232	RBT	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Loading Tankers

SCC	Type	Description
40600233	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Loading Barges: Cleaned and Vapor Free Tanks
40600234	RBT	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Loading Tankers: Ballasted Tank
40600235	BTP/BPS	Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Ocean Barges Loading - Ballasted Tank
40600236	RBT	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Loading Tankers: Uncleaned Tanks
40600237	RBT	Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Ocean Barges Loading - Uncleaned Tanks
40600238	RBT	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Loading Barges: Uncleaned Tanks
40600239	RBT	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Tankers: Ballasted Tank
40600240	RBT	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Loading Barges: Average Tank Condition
40600241	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Tanker Ballasting
40600299	RBT	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Not Classified **
40600301	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Gasoline Retail Operations - Stage I; Splash Filling
40600302	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Gasoline Retail Operations - Stage I; Submerged Filling w/o Controls
40600305	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Gasoline Retail Operations - Stage I; Unloading **
40600306	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Gasoline Retail Operations - Stage I; Balanced Submerged Filling
40600307	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Gasoline Retail Operations - Stage I; Underground Tank Breathing and Emptying
40600399	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Gasoline Retail Operations - Stage I; Not Classified **
40600401	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Filling Vehicle Gas Tanks - Stage II; Vapor Loss w/o Controls
40600501	RBT	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Pipeline Petroleum Transport - General - All Products; Pipeline Leaks
40600502	RBT	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Pipeline Petroleum Transport - General - All Products; Pipeline Venting
40600503	RBT	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Pipeline Petroleum Transport - General - All Products; Pump Station
40600504	RBT	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Pipeline Petroleum Transport - General - All Products; Pump Station Leaks
40600602	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Consumer (Corporate) Fleet Refueling - Stage II; Liquid Spill Loss w/o Controls

SCC	Type	Description
40600701	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Consumer (Corporate) Fleet Refueling - Stage I; Splash Filling
40600702	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Consumer (Corporate) Fleet Refueling - Stage I; Submerged Filling w/o Controls
40600706	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Consumer (Corporate) Fleet Refueling - Stage I; Balanced Submerged Filling
40600707	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Consumer (Corporate) Fleet Refueling - Stage I; Underground Tank Breathing and Emptying
40688801	BTP/BPS	Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Fugitive Emissions; Specify in Comments Field
2501050120	RBT	Storage and Transport; Petroleum and Petroleum Product Storage; Bulk Terminals: All Evaporative Losses; Gasoline
2501055120	BTP/BPS	Storage and Transport; Petroleum and Petroleum Product Storage; Bulk Plants: All Evaporative Losses; Gasoline
2501060050	BTP/BPS	Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Stage 1: Total
2501060051	BTP/BPS	Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Stage 1: Submerged Filling
2501060052	BTP/BPS	Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Stage 1: Splash Filling
2501060053	BTP/BPS	Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Stage 1: Balanced Submerged Filling
2501060200	BTP/BPS	Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Underground Tank: Total
2501060201	BTP/BPS	Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Underground Tank: Breathing and Emptying
2501995000	BTP/BPS	Storage and Transport; Petroleum and Petroleum Product Storage; All Storage Types: Working Loss; Total: All Products
2505000120	RBT	Storage and Transport; Petroleum and Petroleum Product Transport; All Transport Types; Gasoline
2505020120	RBT	Storage and Transport; Petroleum and Petroleum Product Transport; Marine Vessel; Gasoline
2505020121	RBT	Storage and Transport; Petroleum and Petroleum Product Transport; Marine Vessel; Gasoline - Barge
2505030120	BTP/BPS	Storage and Transport; Petroleum and Petroleum Product Transport; Truck; Gasoline
2505040120	RBT	Storage and Transport; Petroleum and Petroleum Product Transport; Pipeline; Gasoline
2660000000	BTP/BPS	Waste Disposal, Treatment, and Recovery; Leaking Underground Storage Tanks; Leaking Underground Storage Tanks; Total: All Storage Types