

NONROAD EQUIPMENT EMISSION INVENTORIES

OVERVIEW

The WRAP Mobile Sources Forum (MSF) funded a project to develop a mobile source emission inventory with regionally consistent methods. This emission inventory was used in a complete comprehensive emission inventory for Regional Haze Modeling efforts in the Western Region of the U.S. State and local air quality planning agencies were surveyed to provide up-to-date estimates of modeling inputs. The regulatory mobile source emissions models used contain all federally promulgated on-road vehicle controls, and local control programs were incorporated via modeling inputs.

Nonroad vehicle emissions are an important contributor to regional emissions, especially for NOx. Despite large increases in population and activity from 2002 to 2018, most nonroad emissions decrease because of fleet turnover to newer engines and equipment that meet more stringent federal standards.

SIP DEVELOPERS AND POLICY MAKERS

- Inventory is a regionally consistent inventory (consistent approach and methods)
- Includes all "on the books" federal and state controls – significant reductions in average equipment emissions
- Inventories can be used in local, state, regional applications
- Surveyed state/local agencies to get up-to-date modeling inputs
- Tier 4 standards mandated significant reduction in nonroad diesel sulfur levels

STATE AND LOCAL EMISSION INVENTORY DEVELOPERS

New NONROAD modeling tools are available -- key is defining/refining/getting accurate/complete/representative modeling inputs

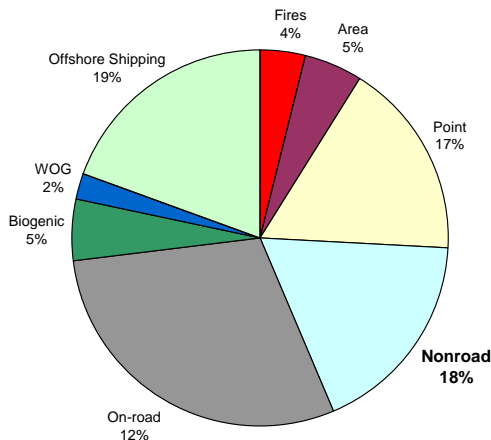
BACKGROUND

- WRAP MSEI originally completed in 2003, then EPA promulgated Tier 4 nonroad equipment regulations, and released a final version of their NONROAD emissions model. This project updated the original nonroad emissions estimates.
- Emission inventory scope:
 - Pollutants: NOx, SO2, VOC, CO, PM10, PM2.5, NH3.
 - Equipment engines in so-called traditional nonroad – diesel, 2-stroke, 4-stroke does not include commercial marine, locomotive, aircraft
 - Geographic resolution: WRAP states and tribes, county level
 - Temporal resolution: 2002 base year, 2008/2013/2018 future years, seasonal

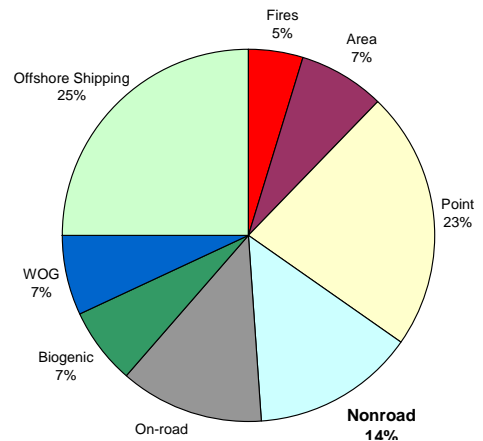
Western States Total Nonroad Emissions (tons)

	VOC	NOx	CO	PM 10	PM 2.5	SO2	NH3
2002	544,132	968,241	4,042,284	76,763	71,598	65,314	967
2018	341,313	602,773	4,469,775	44,474	40,440	4,411	1,410
% Change	-37%	-38%	11%	-42%	-44%	-93%	46%

WRAP Total NOx Emissions Plan02b



WRAP Total NOx Emissions Base 18b



METHODS

- **General approach:**

*Emissions = Equipment population * load factor * activity * emission factor,*
by equipment type/application, age, horsepower
Defaults for all inputs are built into NONROAD model

- Surveyed state and local agencies for base and future years NONROAD fuel and met inputs, fuels control programs, and also requested any available equipment population data.
 - Responses received from all state agencies and key local agencies
 - Very little local equipment population data available
- NONROAD2005 model used (except for CA) to generate emissions for each equipment type in each county
 - Estimates vehicle exhaust and evaporative emissions
 - Incorporates all “on the books” federal controls:

- Emission standards for new nonroad spark-ignition engines below 25 hp
- Phase 2 emission standards for new spark-ignition hand-held engines below 25 hp
- Phase 2 emission standards for new spark-ignition nonhandheld engines below 25 hp
- Emission standards for new gasoline spark-ignition marine engines
- Tier 1 emission standards for new nonroad compression-ignition engines above 50 hp
- Tier 1 and Tier 2 emission standards for new nonroad compression-ignition engines below 50 hp including recreational marine engines
- Tier 2 and Tier 3 standards for new nonroad compression-ignition engines of 50 hp and greater not including recreational marine engines greater than 50 hp
- Tier 4 emissions standards for new nonroad compression-ignition engines above 50 hp, and reduced nonroad diesel fuel sulfur levels

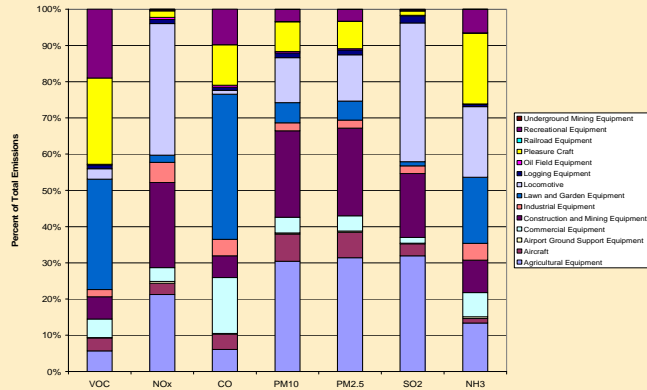
- Models state/local fuels control programs
- California nonroad emissions
 - California ARB has been developing CA-specific OFFROAD model
 - OFFROAD was not completed when the emission inventory was needed; ARB provided nonroad category emissions based on internal model and rulemaking files

EMISSIONS SUMMARY FILES AVAILABLE ON PROJECT WEB SITE:

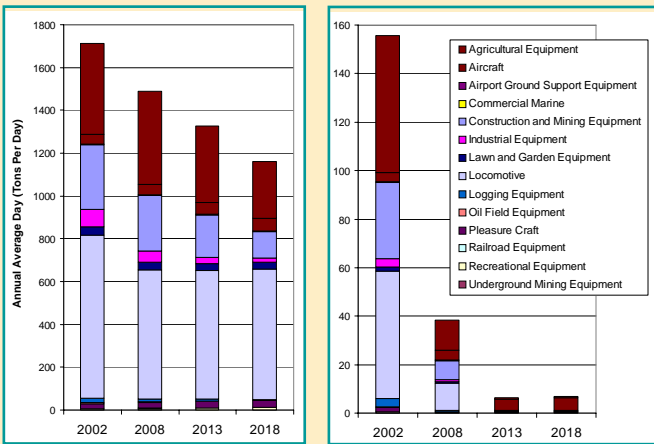
- Excel files with detailed emissions by county and equipment category for each state, 2002 and 2018
- Excel files with plots and data tables of emissions by state for each year
- SMOKE IDA files, 2002 and 2018

<http://www.wrapair.org/forums/ef/UMSI/index.html>

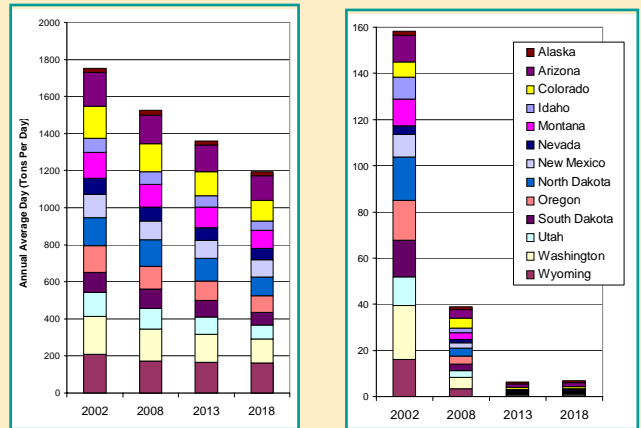
WRAP states 2002 nonroad emissions, % contribution by source category



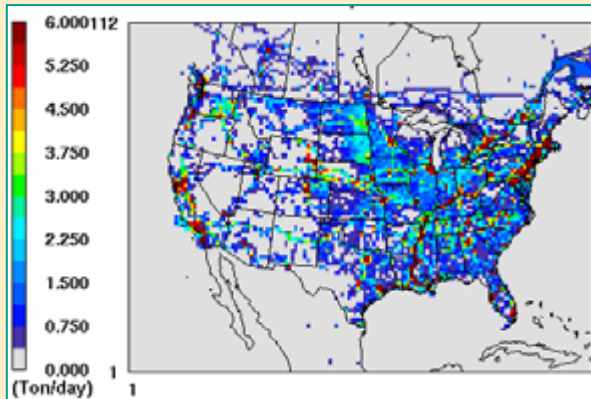
WRAP States Average Annual Nonroad NOx and SO2 Emissions by Category (excludes CA)



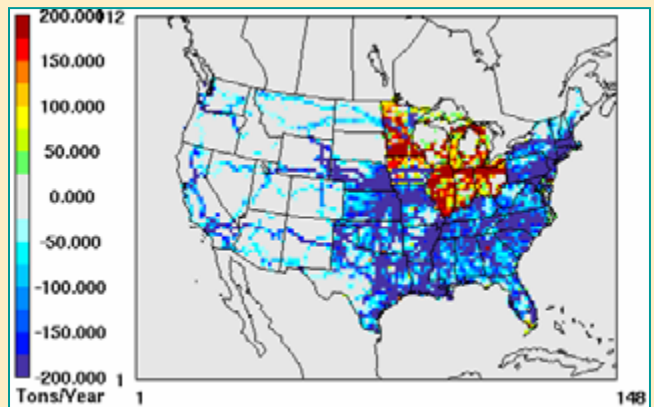
WRAP States Average Annual Nonroad NOx and SO2 Emissions by State (excludes CA)



Spatial distribution of all RPO nonroad NO emissions, 2002 July weekday.



Spatial distribution of all RPO nonroad NO emissions, 2002-2018 July weekday



OTHER RELEVANT POINTS

- CARB released OFFROAD model in December of 2006; however does not include all current CARB rulemakings
- EPA NMIM model, under development when the project was underway, is now complete and available for generating state and county on-road and off-road emission inventories. <http://www.epa.gov/otag/nmim.htm>
- In April 2007, EPA released proposed regulations for small spark ignition engines and marine gasoline engines; these regulations would phase in beginning in 2011.

RESEARCH/INFORMATION NEEDS

- NONROAD model population estimates are estimated from national level sales estimates to county level using allocation surrogates, thus very uncertain at local level. Local population data would greatly improve estimates, but such data are difficult and expensive to obtain via survey. There are currently no nonroad equipment registration programs.

CONTACT INFORMATION

- Alison Pollack (ENVIRON): apollack@environcorp.com, 415-899-0700
- Tom Moore (WRAP): mooret@cira.colostate.edu, 970-491-8837
- Lee Gribovicz (WRAP): lg@westgov.org, (307) 778-4927

Project web page: <http://www.wrapair.org/forums/ef/UMSI/index.html>

RECOMMENDATIONS FOR FUTURE WORK

- Currently WRAP is working with CARB to get the latest CARB nonroad emissions model for 2002 and 2018; will be incorporated into PRP modeling.
- For state/local agencies planning to update nonroad emission inventories in the future, recommendation is to use NMIM. Easy to use, has post-processing tools.
- Key is to review and update the NMIM county data base with the modeling inputs, especially fuel parameters, and with local equipment population data if available.