

# COMMERCIAL MARINE VESSEL EMISSION INVENTORIES

## OVERVIEW

The WRAP Mobile Sources Forum (MSF) funded a project to develop a comprehensive mobile sources emission inventory for use in Regional Haze Modeling efforts in the Western Region of the U.S. Commercial marine emissions were estimated for in- and near-port activity, and also for transit activity in offshore shipping lanes. In- and near-port emissions were estimated based on activity data provided by the ports. Shipping lane emissions were estimated from a global ship positioning data set.

### SIP DEVELOPERS AND POLICY MAKERS

Large ocean-going vessels (OGV) are a very large source of SO<sub>x</sub> and PM emissions (burn very high sulfur residual fuels)

OGV are primarily foreign flagged and outside US EPA control

Smaller harbor craft are US-flagged and EPA has proposed new controls

Activity projections are controversial and highly variable

For 2018 modeling to date, emissions have been held at 2002 levels

### STATE & LOCAL EMISSION INVENTORY DEVELOPERS

OGV emissions can be estimated using port call data

Smaller vessel activity data is more difficult to obtain

Most West Coast ports are conducting emission inventory efforts

WRAP commercial marine emissions files are available as gridded emissions by fuel type

## BACKGROUND

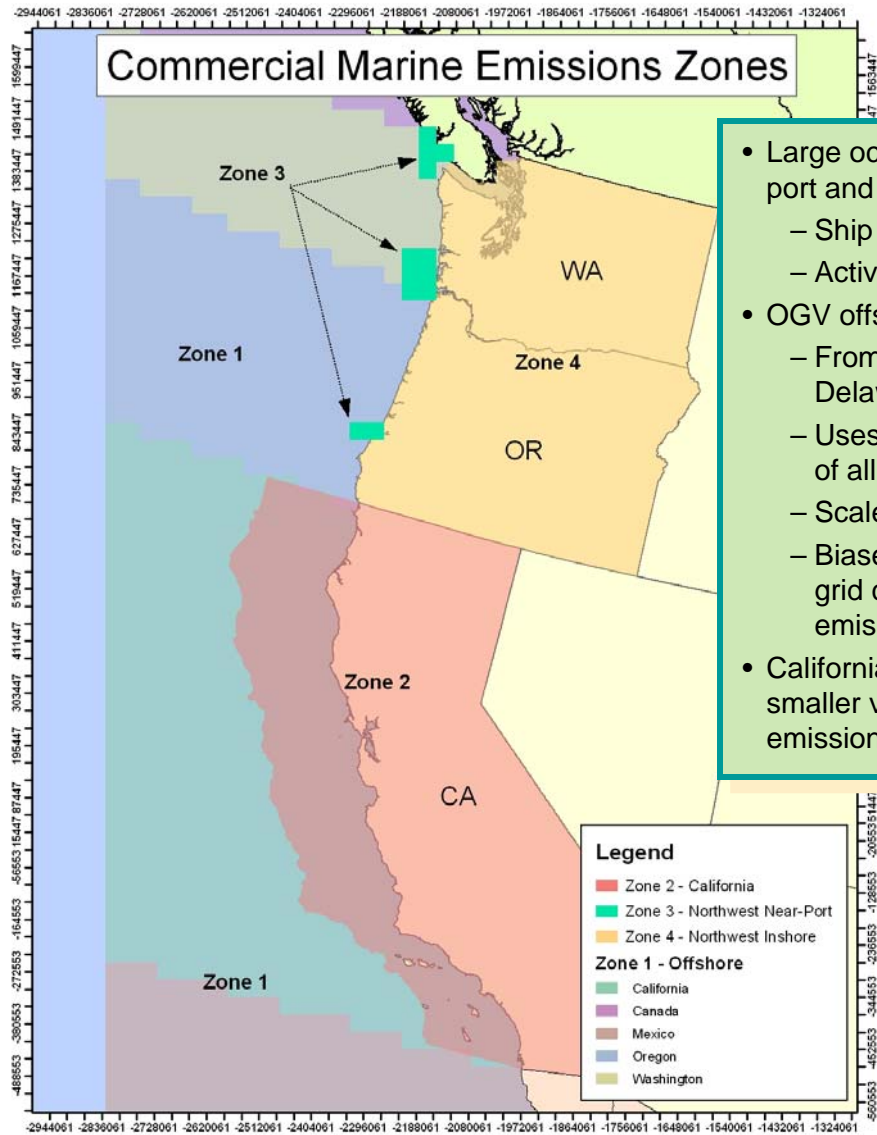
### Vessel types:

Source Definition	Purpose	Engine Application	EPA Engine Category Type
Deep draft	Ocean-going large vessels	Propulsion	3
		Auxiliary	2
Tow or Push Boats	Barge Freight	Propulsion	1 or 2
		Auxiliary	1
Tugs	Vessel assist and support functions	All engines	1 or 2
Ferries	Passenger and car ferries	All engines	1 or 2
Other Vessels	Support vessels or excursion boats	All engines	1 or 2
Dredges	Dredging projects	All engines	1 or 2
Commercial Fishing	Market fishing	All engines	1
Military	Coast Guard and Navy	All engines	Gas Turbine, 1, or 2

### Emission inventory scope:

- Pollutants: NO<sub>x</sub>, SO<sub>2</sub>, VOC, CO, PM<sub>10</sub>
- OGV in AK, OR, and WA; OGV and smaller vessels in CA.
- Offshore transit emissions
- Temporal resolution: 2002 base year, 2008/2013/2018 future years, annual. But for 2018 modeling to date, emissions were held at 2002 levels

# METHODS



- Large ocean-going vessel (OGV) near port and within shore
  - Ship calls and vessel power
  - Activity per call
- OGV offshore
  - From work of James Corbett, Univ. of Delaware
  - Uses ship positioning data (a subset of all vessels from a global database)
  - Scaled to all vessels
  - Biased low near shore, so near port grid cells replaced with near port emissions estimates
- California provided OGV and some smaller vessel emissions, including transit emissions within 100 miles of coast

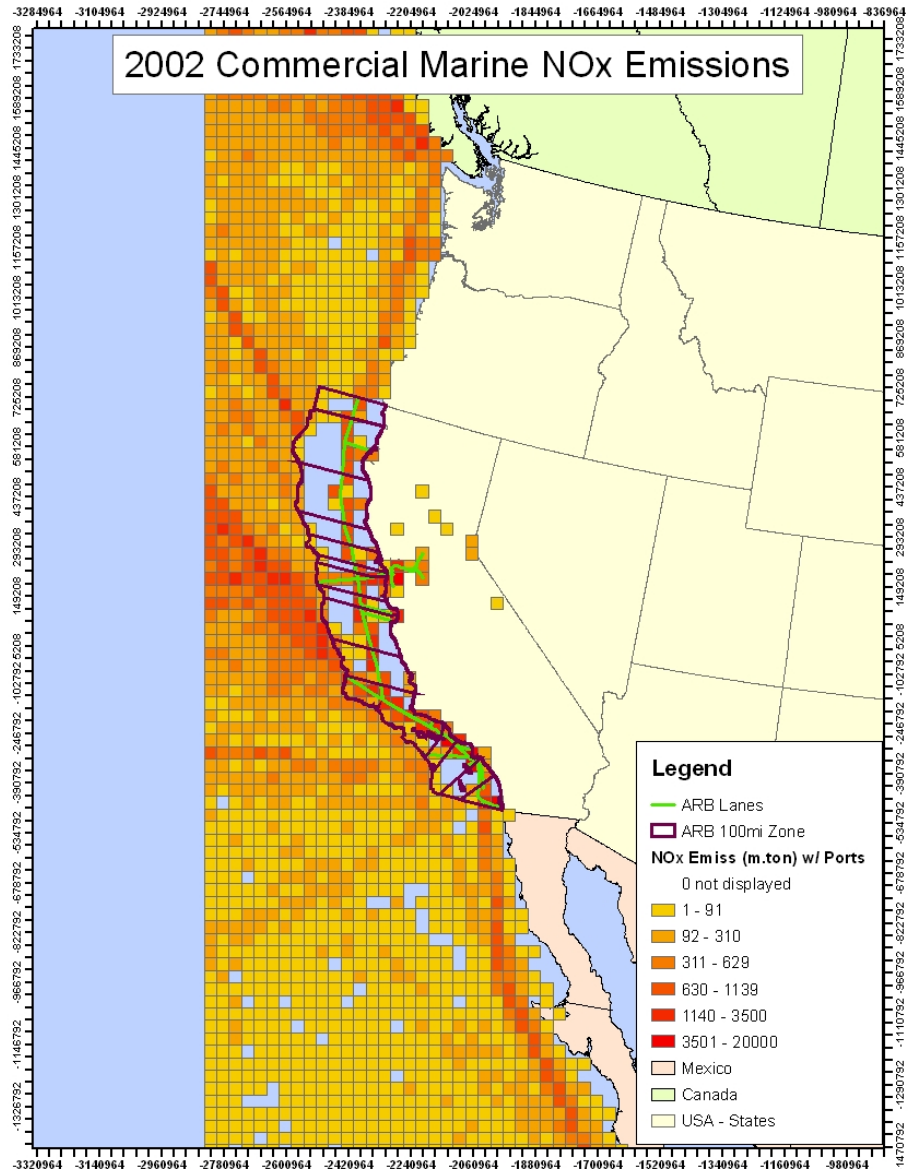


# RESULTS

Summary of 2002 West Coast NOx Emissions (tons per year)					
State	Commercial Marine				
	Total	Offshore - Zone 1	Coastal/In-Shore - Zones 2,3,4		
			Total	Near-Port - Zone 3	Inshore - Zone 4
California	243,480	131,930	111,550	NA	NA
Oregon	43,265	41,113	2,152	736	1,415
Washington	58,922	44,692	14,231	3,467	10,764
<b>Total</b>	<b>345,667</b>	<b>217,734</b>	<b>127,933</b>	<b>4,204</b>	<b>12,179</b>

Summary of 2002 West Coast SO2 Emissions (tons per year)					
State	Commercial Marine				
	Total	Offshore - Zone 1	Coastal/In-Shore - Zones 2,3,4		
			Total	Near-Port - Zone 3	Inshore - Zone 4
California	120,240	74,181	46,059	NA	NA
Oregon	23,863	23,119	744	532	212
Washington	32,964	25,130	7,835	2,483	5,352
<b>Total</b>	<b>177,068</b>	<b>122,430</b>	<b>54,637</b>	<b>3,015</b>	<b>5,564</b>

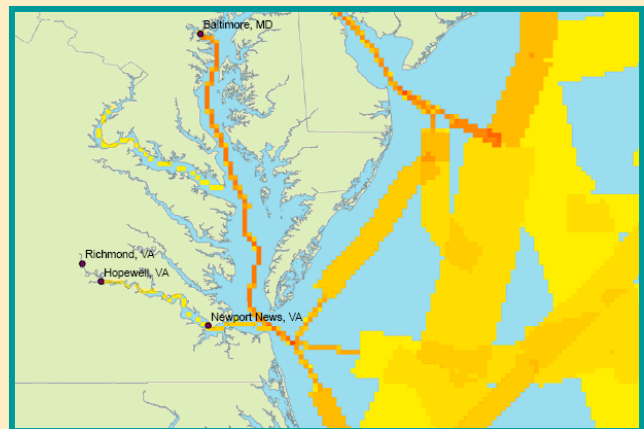
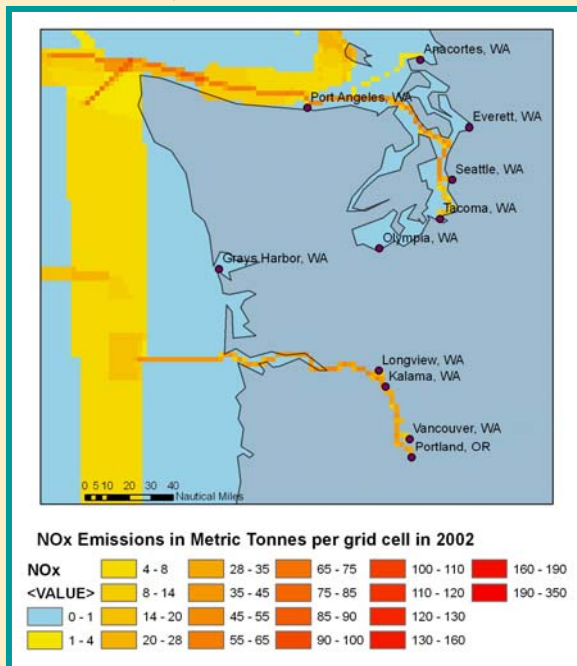


## COMMERCIAL MARINE RULEMAKINGS

- OGV – US application for Sulfur dioxide emissions control area (SECA) not yet petitioned
  - SECA level of 1.5% sulfur maximum (from current average levels of 2.7% sulfur) may not be the end point
  - Lower sulfur levels might be considered
  - Areal extent of SECA may be as far as 200 nm from shore
- Washington and British Columbia are investigating voluntary options to lower sulfur levels
- California has regulations for auxiliary engines and is proposing low sulfur fuel for propulsion engines within 24 nm of coast.
- EPA has proposed smaller vessel emission standards for NO<sub>x</sub> and PM and ultra low sulfur fuel.

## ONGOING AND FUTURE WORK

- Large vessel inventory developments – nearly all of more important West Coast ports have or will conduct emission inventory efforts
- Smaller vessel activity more difficult to determine
- EPA is developing a national 4k gridded emissions inventory as part of SECA analysis; EPA SECA inventory (and any other state/local rules) should be incorporated into future modeling efforts



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