Public Health Impacts of Ship Emissions

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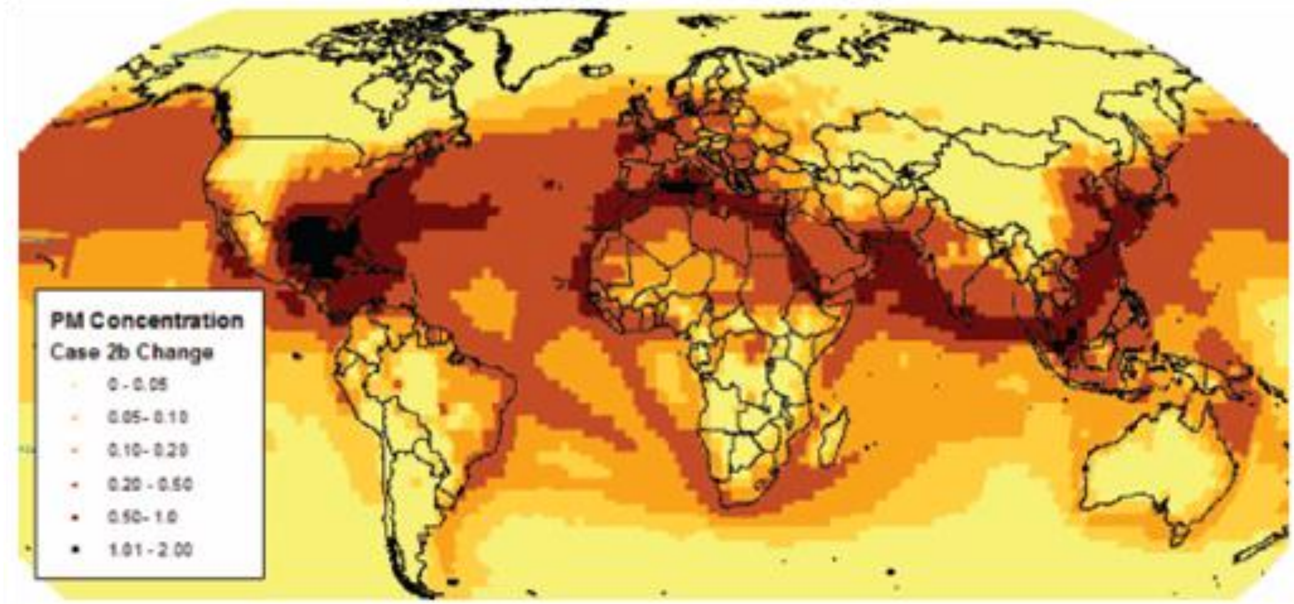
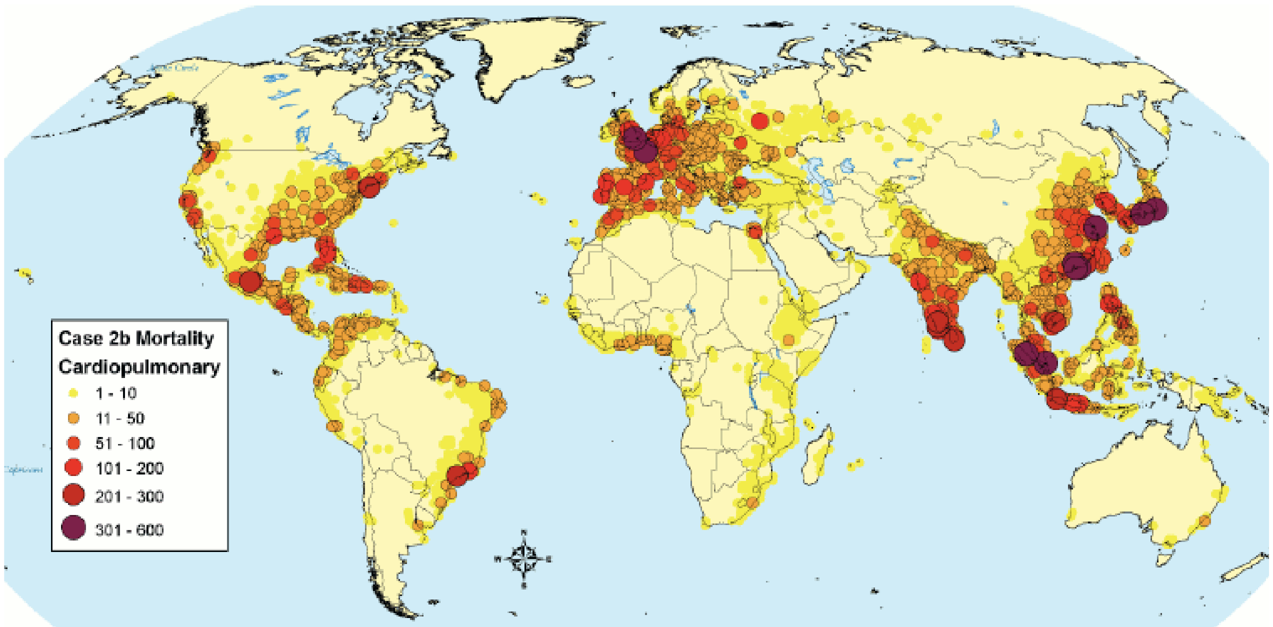
Impact of Shipping

Contribution of shipping to PM2.5 concentrations (in μg/m3)

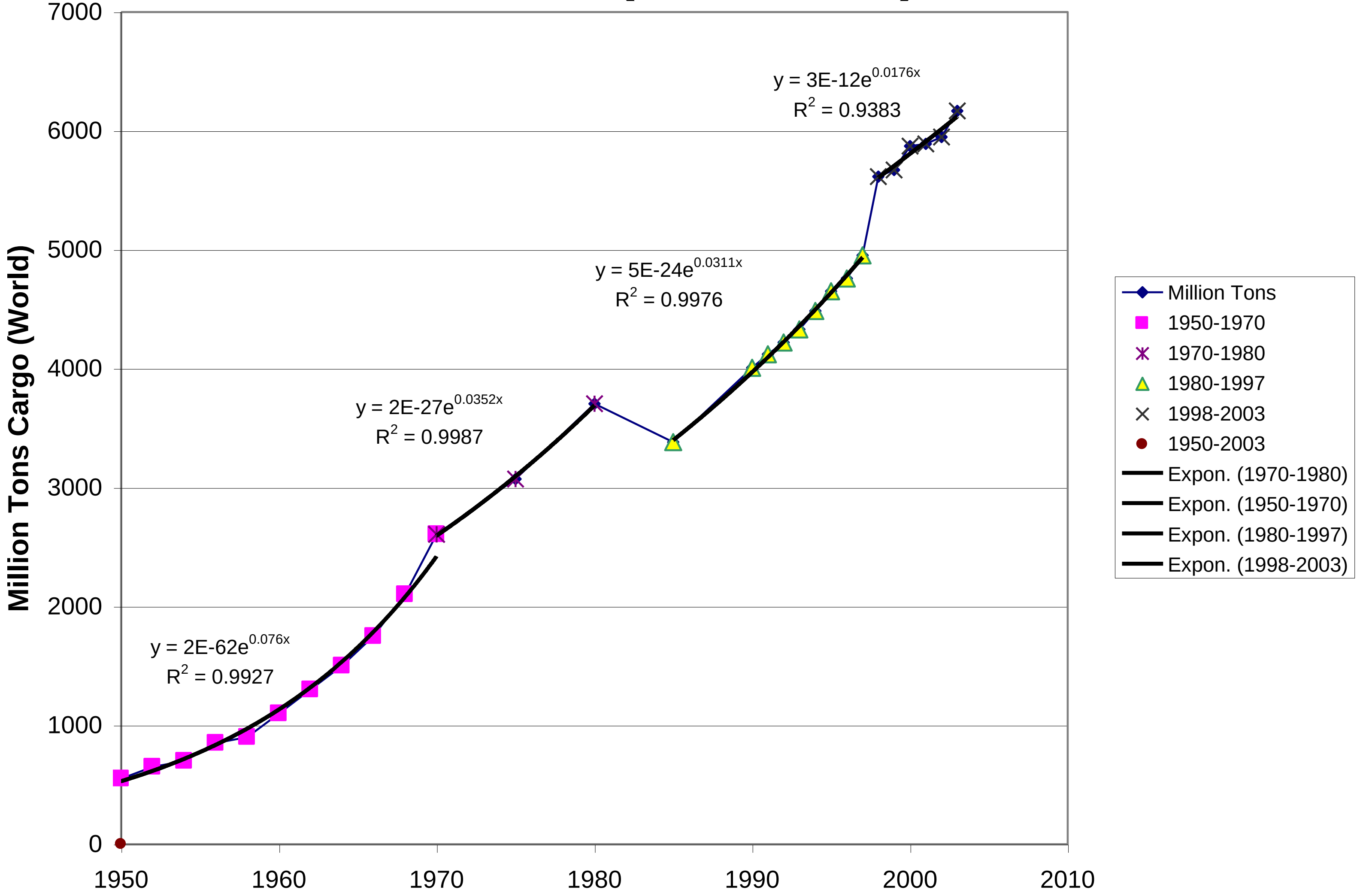




Worldwide Ship PM-Related Mortality

Source: Corbett, James J., James J. Winebrake, Erin H. Green, Prasad Kasibhatla, Veronika Eyring, Axel Lauer, "[Mortality from Ship Emissions: A Global Assessment](),"*Environmental Science & Technology*, 41(24), December 15, 2007, pp. 8512-8518.

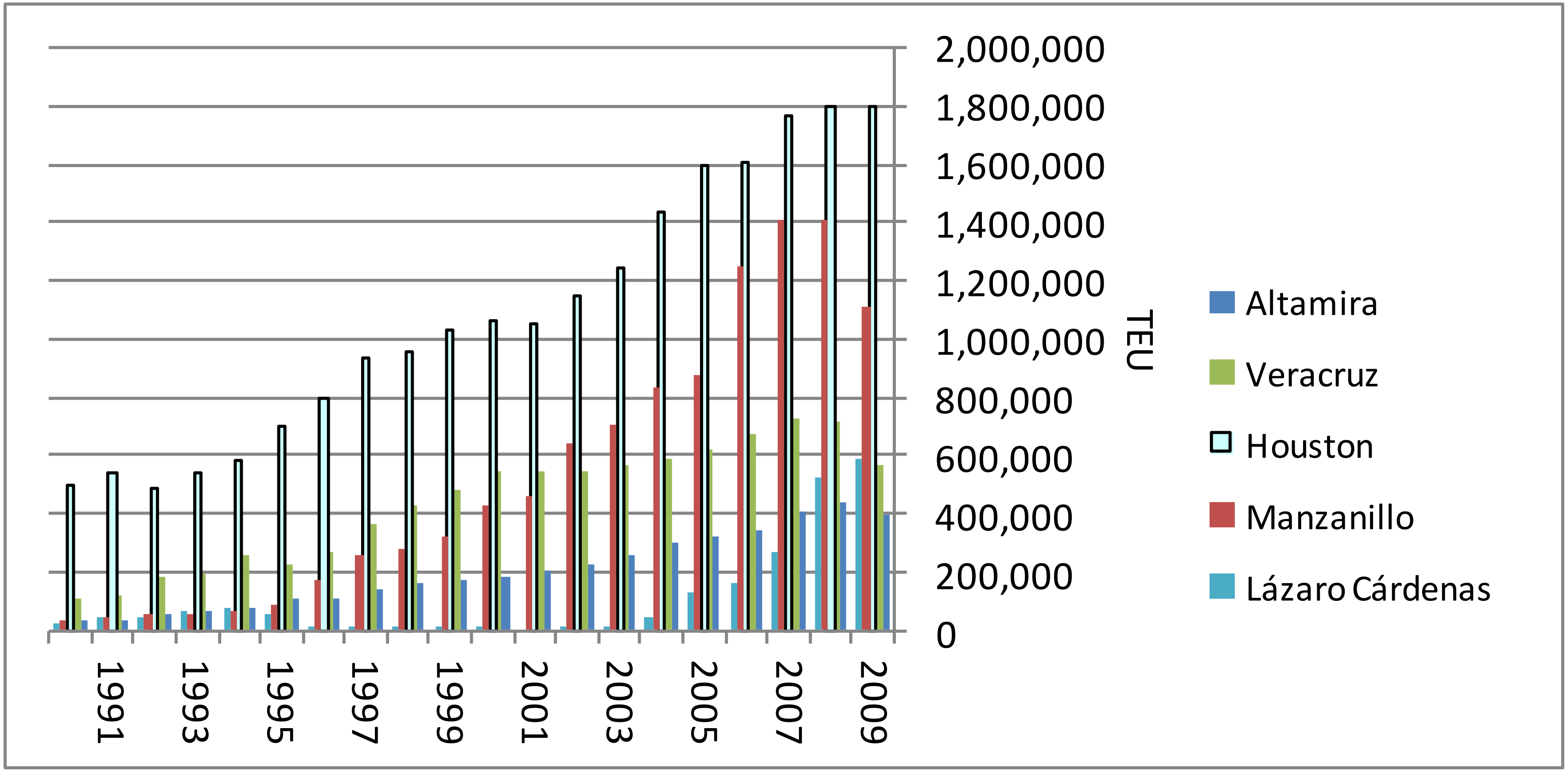
Cargo Movement Growth (Global)



UNCTAD, *Review of Maritime Transport, 2004*. 2004, United Nations: New York and Geneva, http://www.unctad.org/Templates/Page.asp?intItemID=2618&lang=1

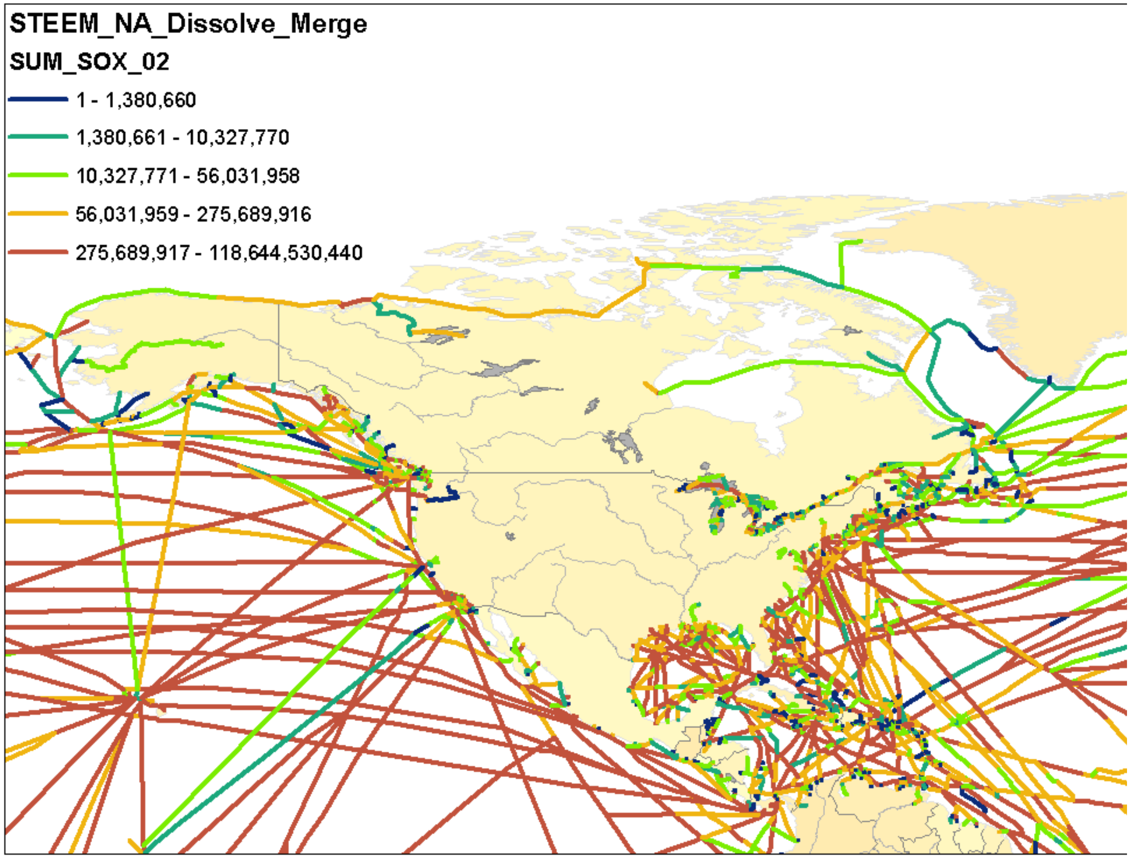
University of Delaware

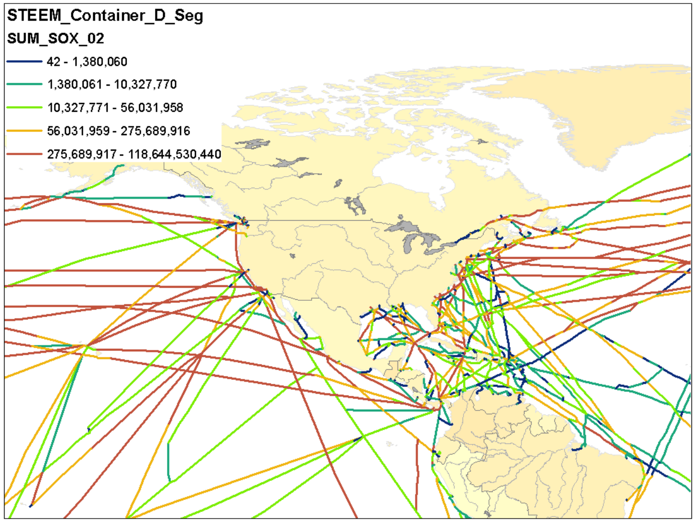
North American Port Container Traffic (1990 - 2009) by Container

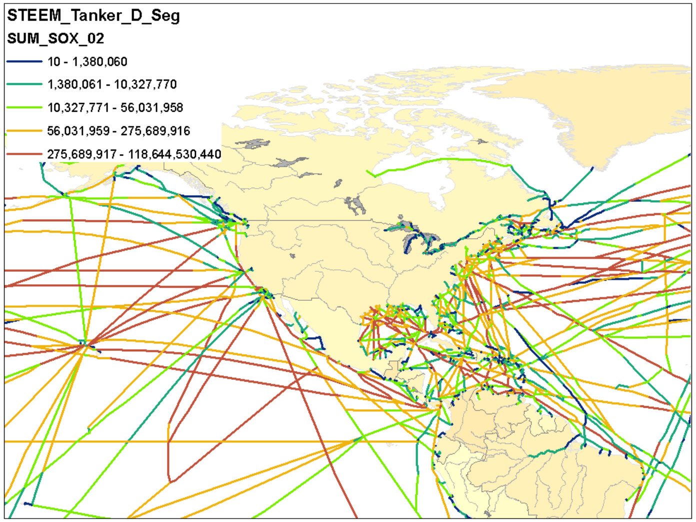


Source: AAPA, North American Port Container Traffic 1990-2009

Ship Emissions by Ship Route





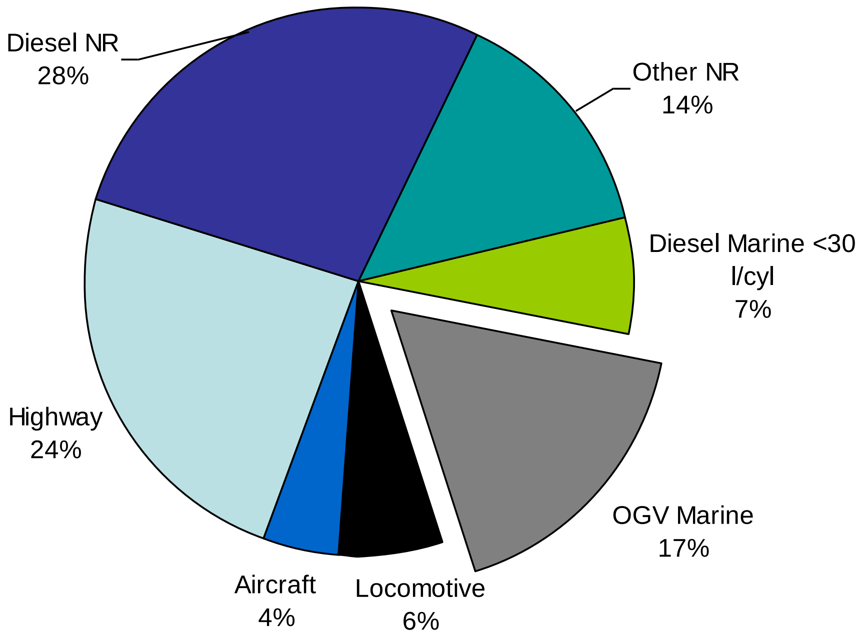


Units: grams/year by segment.

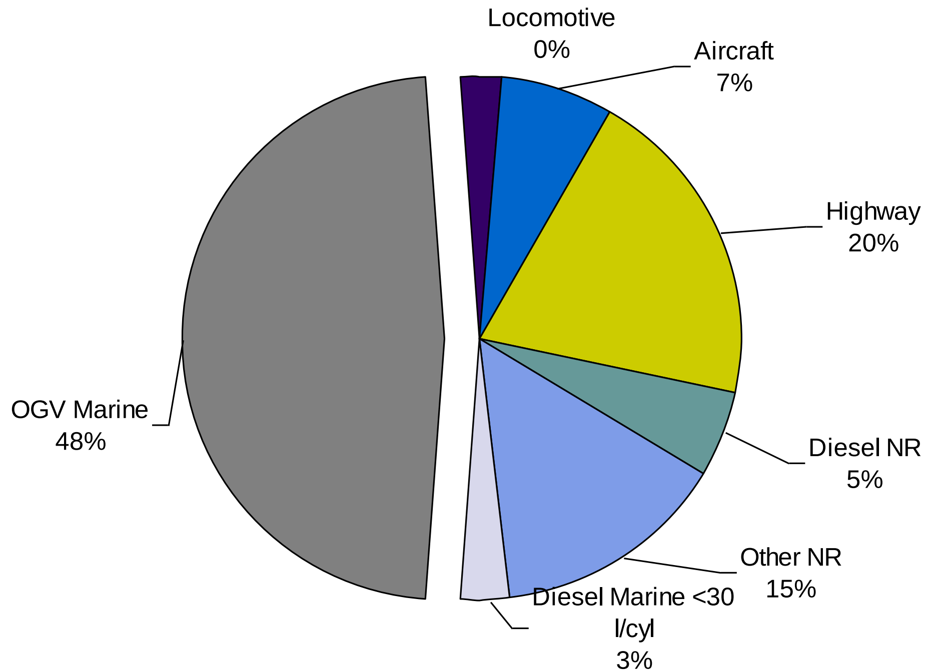
Ship Emissions in a No Action Scenario

Ship Emissions Relative to Other Transport Sources in U.S.

2009 Mobile Source PM2.5 Inventory



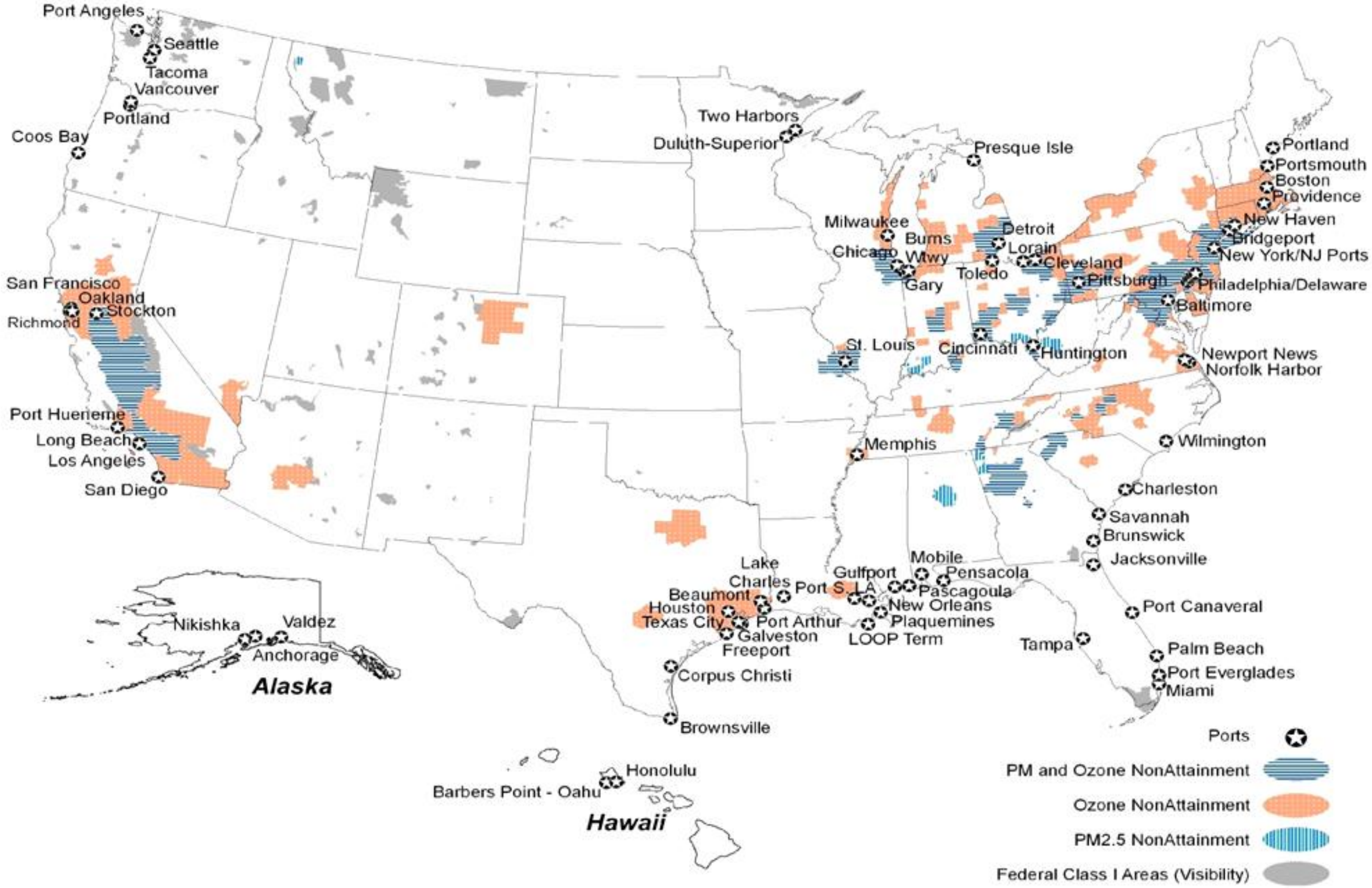
2030 Mobile Source PM2.5 Inventory



Source of inventory estimates: C3 Marine NPRM (July, 2009)
Does not reflect IMO MARPOL Annex VI Amendments (October 2008)

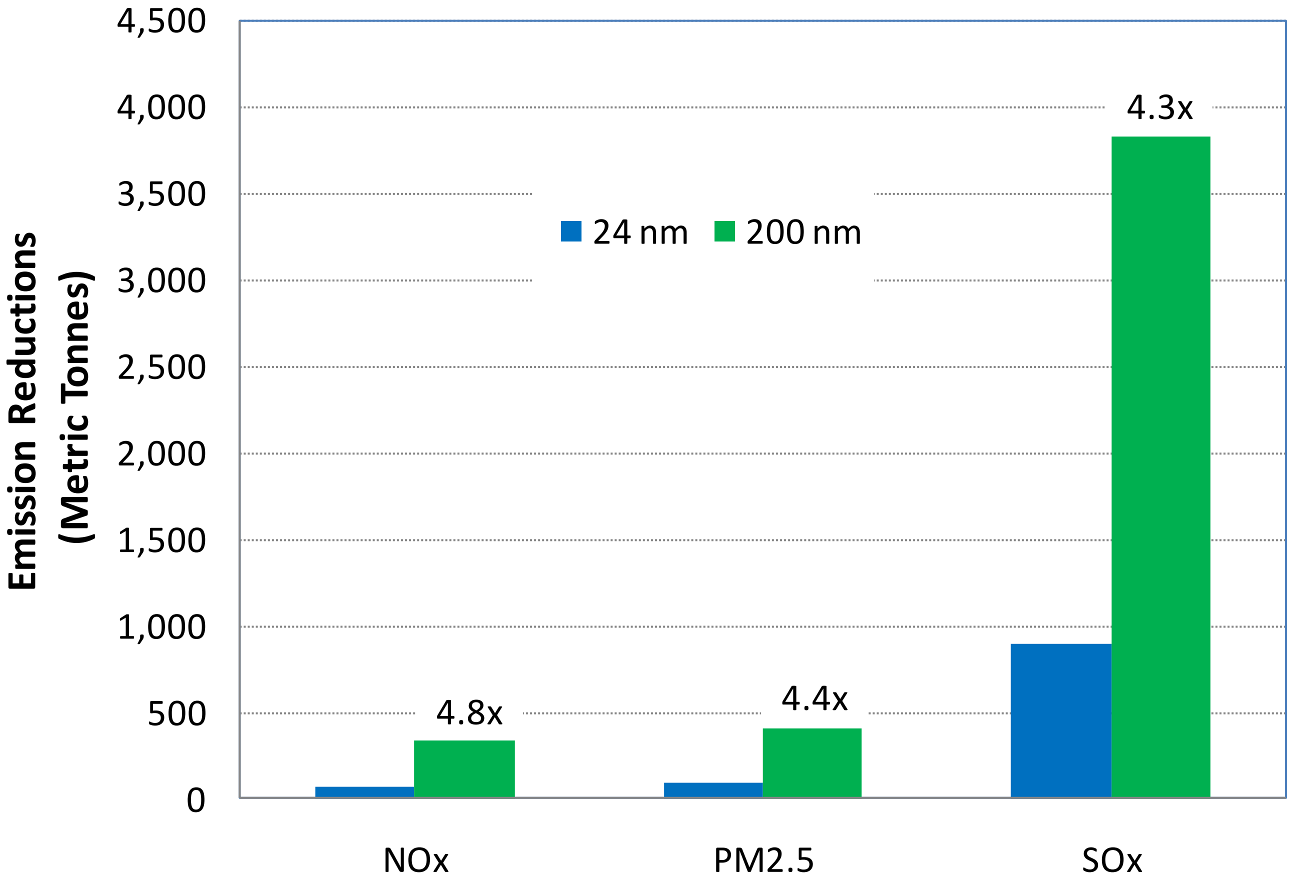
U.S. Ports and Nonattainment Areas

- More than 40 major ports are located in $PM_{2.5}$ or ozone nonattainment areas
- About 88 million people live in 39 areas that do not meet the $PM_{2.5}$ NAAQS or that contribute to violations in other counties



2009/2010 Fuel Switching Demonstrations

Modeling: Significant Benefit of 200 nm Fuel Switching Zone Size for Port of Veracruz



Fuel Switching

Documented pollutant reductions