

Modeling of Atmospheric Mercury Transport, Chemistry and Deposition

Krish Vijayaraghavan

*Atmospheric & Environmental Research (AER) Inc.
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Atmospheric and
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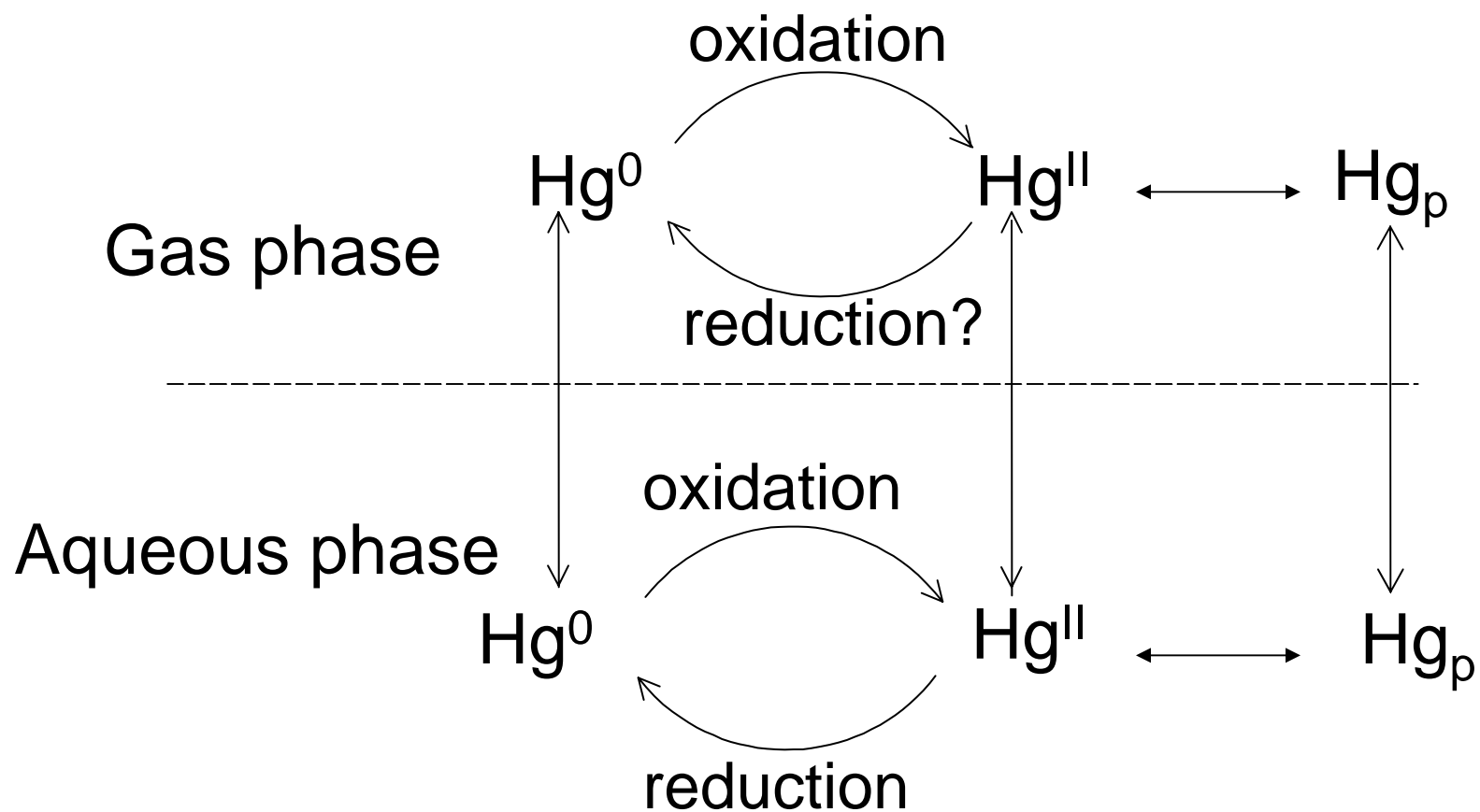
Over 50 peer-reviewed publications over the past ten years



Atmospheric Mercury

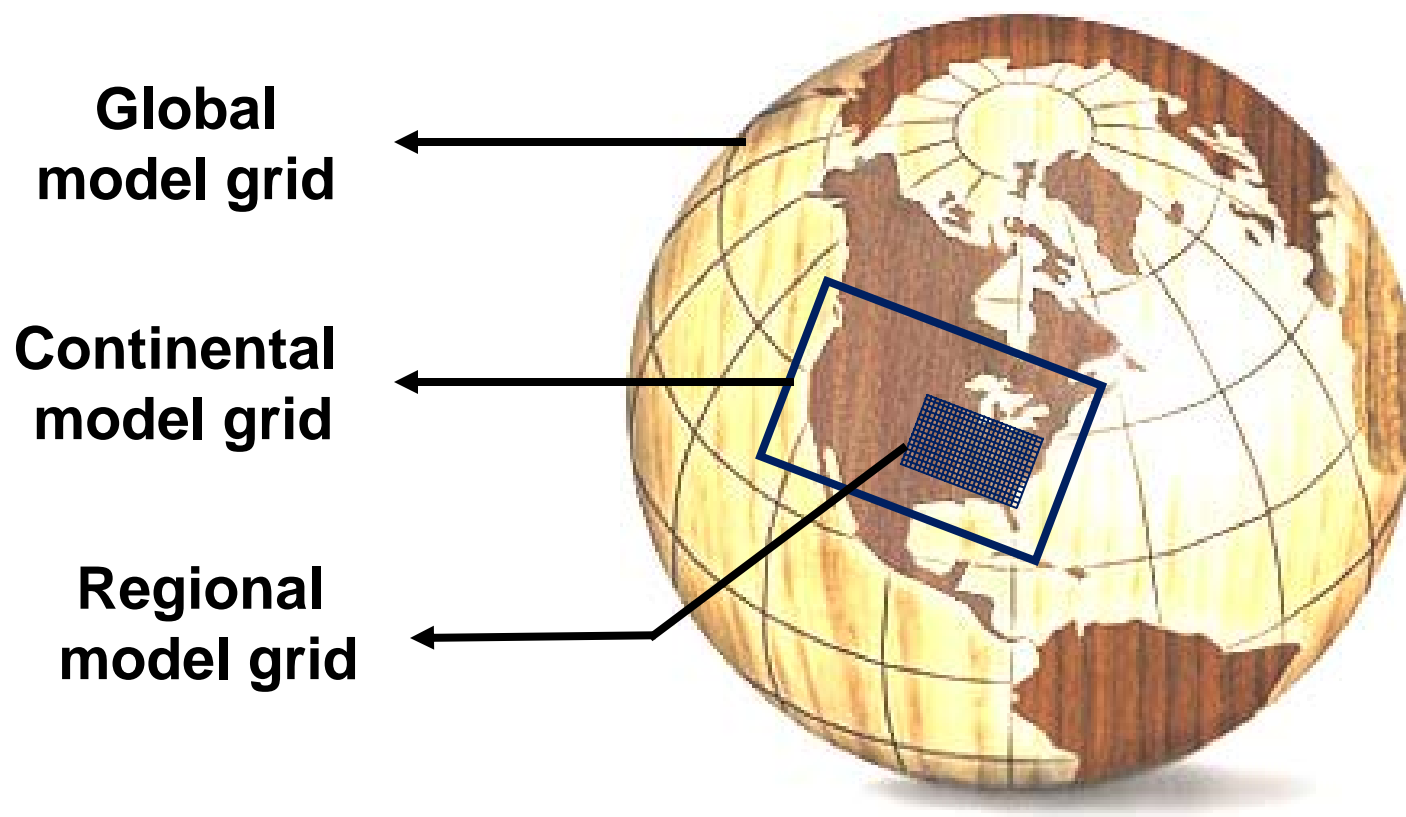
- Inorganic mercury is represented by three “species” in the model
 - Elemental mercury
 - Hg(0)
 - Divalent gaseous mercury (Hg(II) or RGM)
 - HgCl₂, HgBr₂, Hg(OH)₂, HgO, etc.
 - Particulate-bound mercury (Hg_p)
 - Hg(II) emitted as particulate Hg
 - Hg(p) adsorbed on PM

Atmospheric Mercury Chemistry

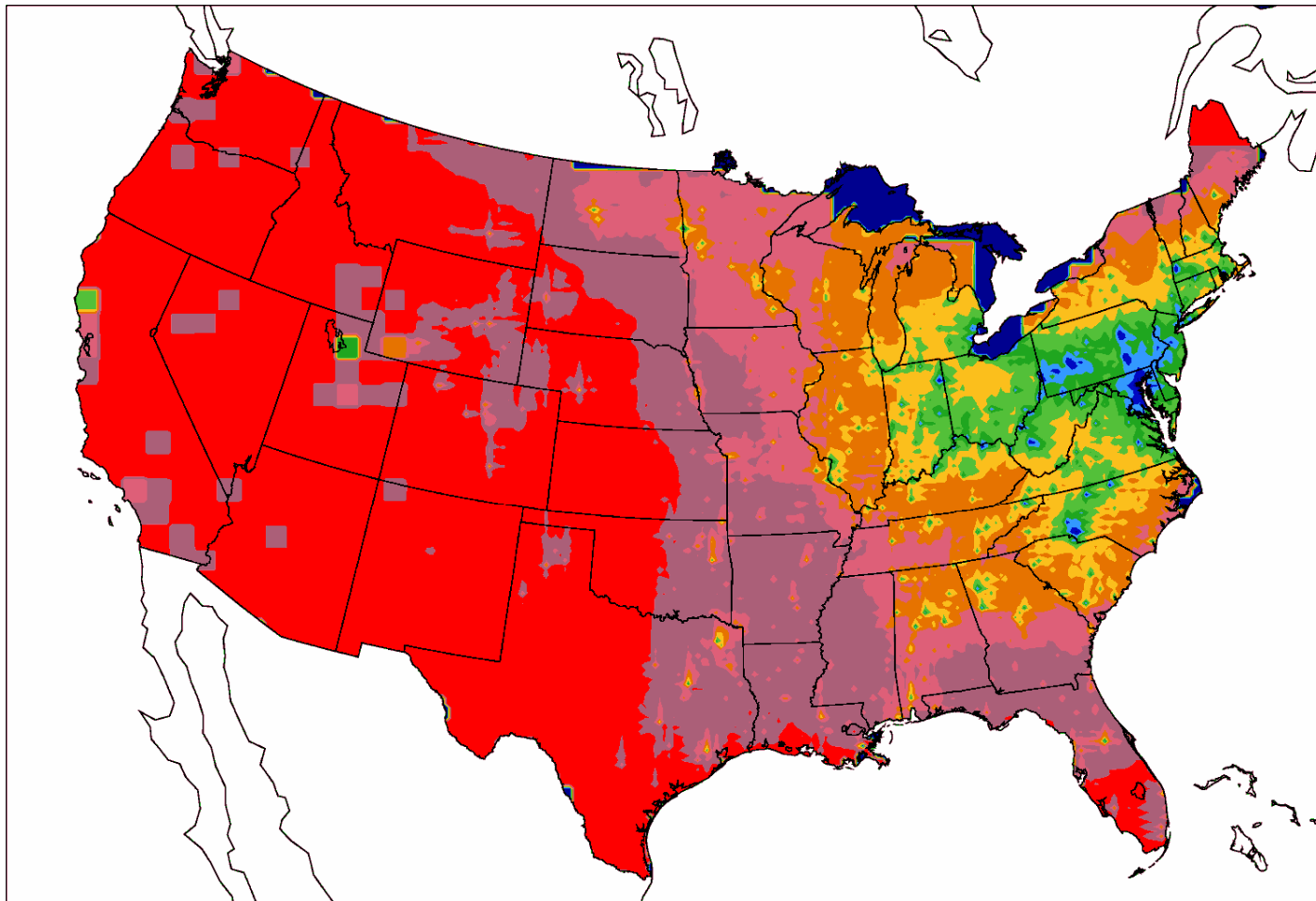


Multi-scale Modeling of Atmospheric Mercury

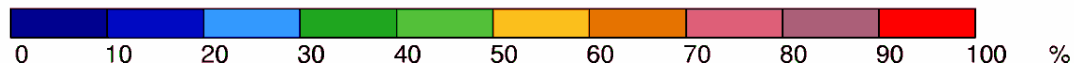
Long residence time of Hg(0) => Global contribution important



Contributions (%) of non-U.S. Sources to U.S. Mercury Deposition



SF
Bay Area*
70-90%



* Preliminary estimate

Mercury Emissions from Biomass Fires (Wildfires and Prescribed Burns)

Estimates from fire data & emission factors by NCAR

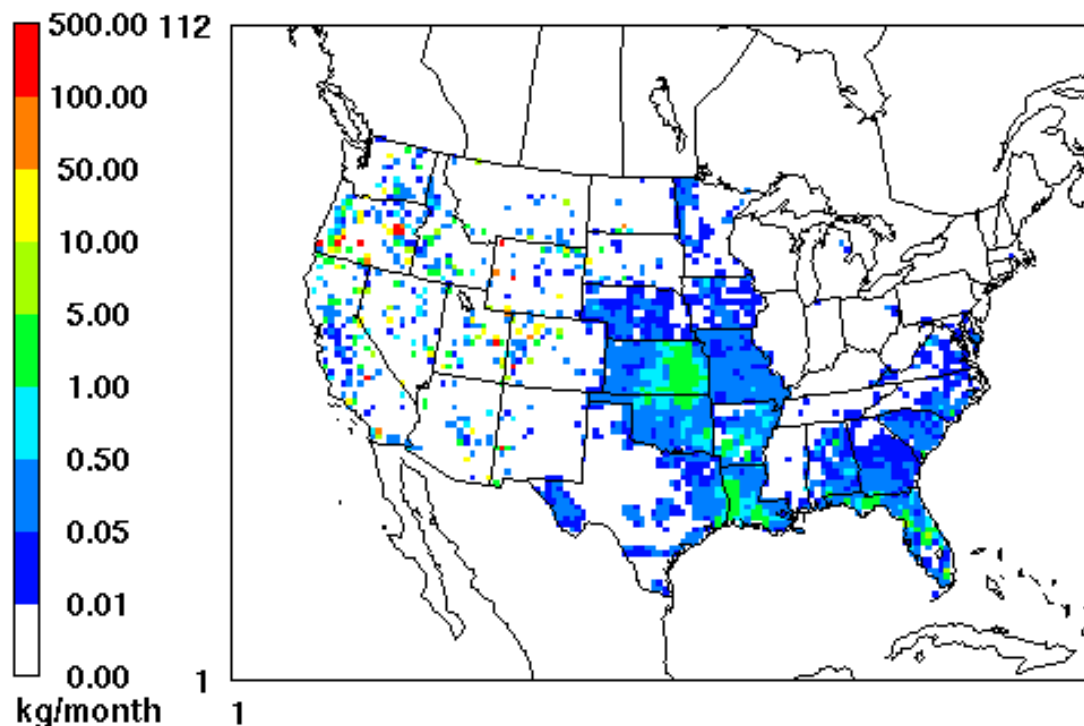
Wiedinmyer and Friedli, 2007

Average annual fire Hg emissions during 2002-2006

U.S. = 29 Mg/yr ; California = 3.4 Mg/yr (80% in Jul - Oct)

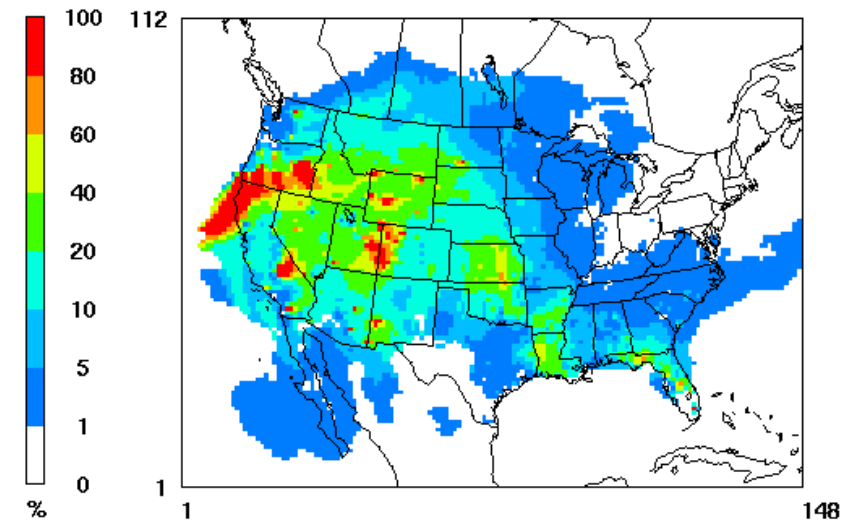
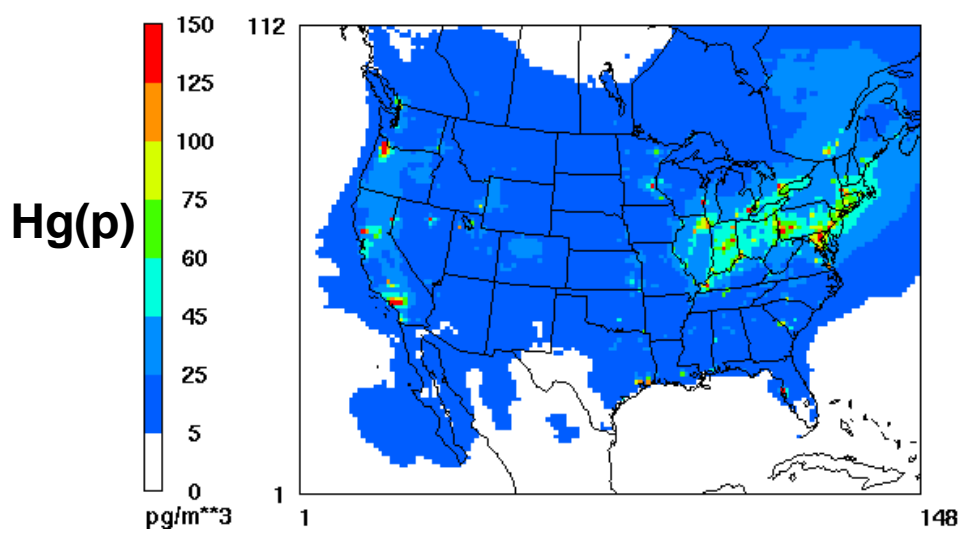
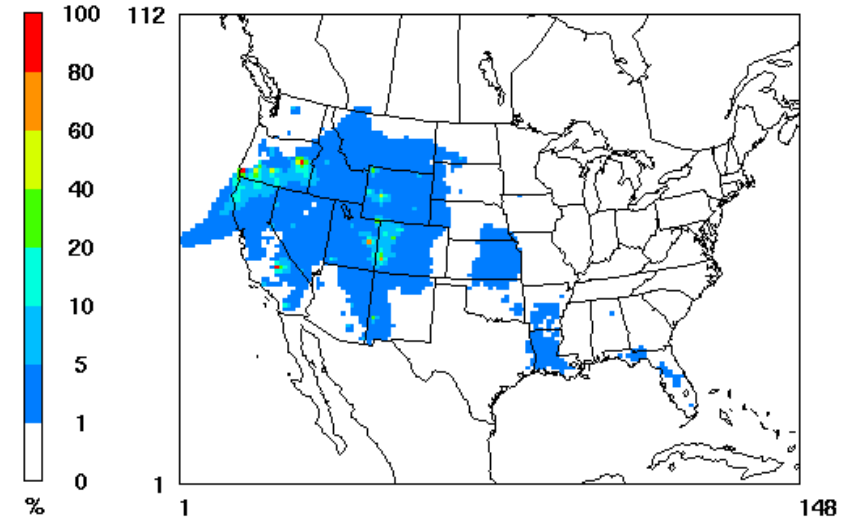
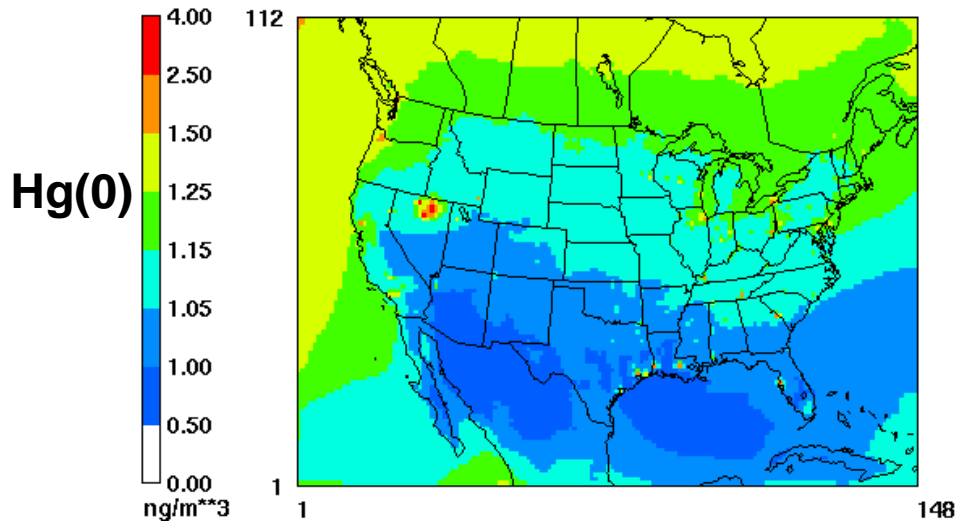
Hg emissions in each
36x36 km² grid cell
in July 2002

Assumed fraction
75% Hg(0), 25% Hg(p)



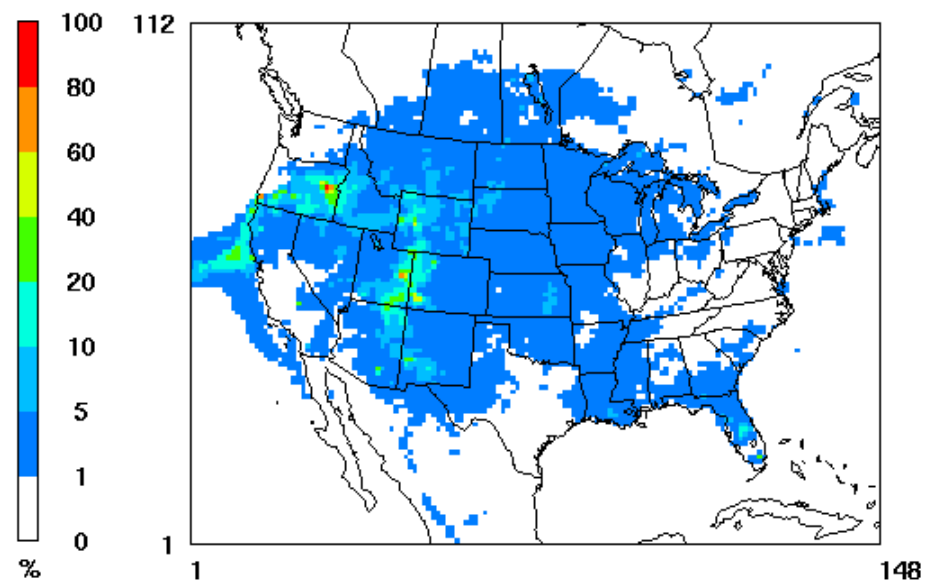
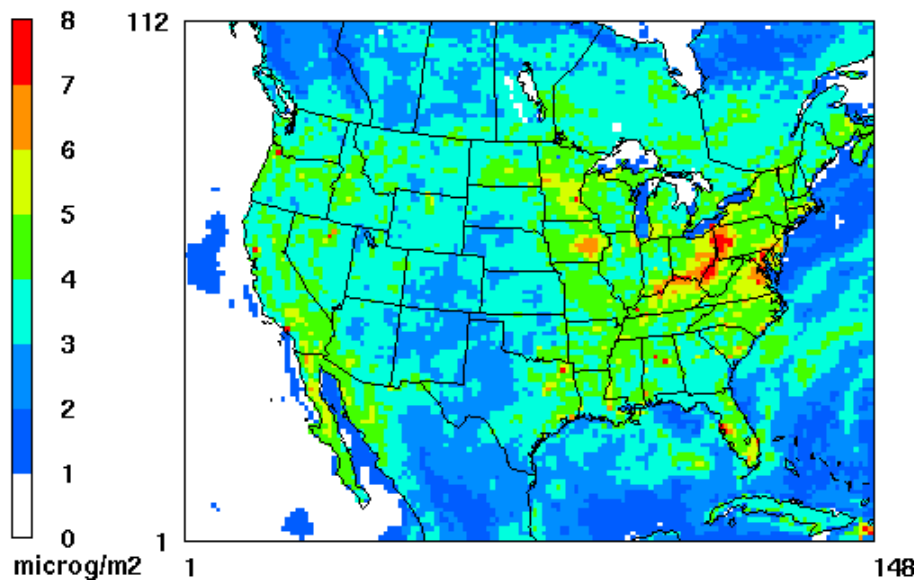
Effect of Biomass Fires on Surface Air Concentrations in July 2002

Change (%) after accounting for fires



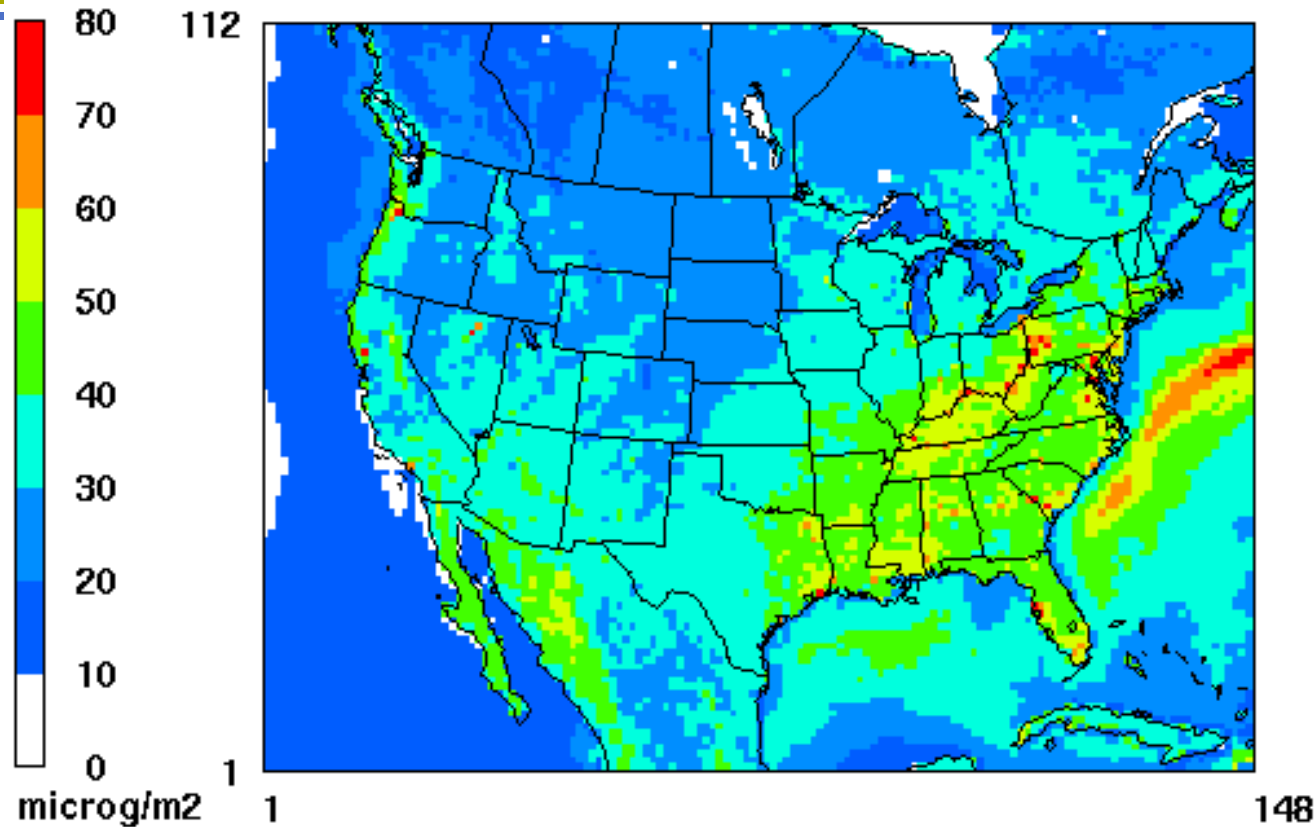
Effect of Biomass Fires on Simulated Hg deposition in July 2002

Change (%) after accounting for fires



California state-wide average = 2%
Maximum = 22% (near OR border)

Simulated Annual Hg Deposition in 2002



How much atmospheric deposition to the San Francisco Estuary?

Back of the envelope calculation:

10-30 $\mu\text{g}/\text{m}^2/\text{yr}$ \Rightarrow **11-34 kg/yr** * (over 1133 km^2 area)

Consistent with Tsai and Hoenicke (2001) who estimate 27 kg/yr.

**preliminary estimate (do not cite or quote)*



Air/Water Model Linkage for Mercury

- Air Model - AMSTERDAM (AER, Inc.)
 - Advanced air quality model which simulates atmospheric inorganic mercury and other pollutants
- Aquatic Model - WARMF (Systech, Inc.)
 - Advanced model for watershed planning and TMDL analysis
- Dry and wet deposition fluxes and air concentrations of Hg(0), Hg(II) and Hg(p), and meteorology are transferred from air to water model
- Aquatic model calculates methylation and ecosystem impacts.
- Work in progress

Summary

- Multi-scale global/regional chemistry transport modeling is useful to quantify distant and regional source contributions.
- Non-U.S. sources likely contribute 70-90% to mercury deposition on average in the San Francisco Bay area.
- The effect of biomass fires is seen primarily in the atmospheric concentrations and deposition of Hg(p) and, to a lesser extent, Hg(0).
- Contribution of biomass fires to Hg deposition in California in July 2002: State-wide average = 2%, Peak = 22%
- Dry deposition likely more important than wet deposition in the San Francisco Bay area
- Air/Water Model Linkage available to calculate methylmercury contribution due to atmospheric deposition sources

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Questions ?

- Krish Vijayaraghavan

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krish@aer.com