

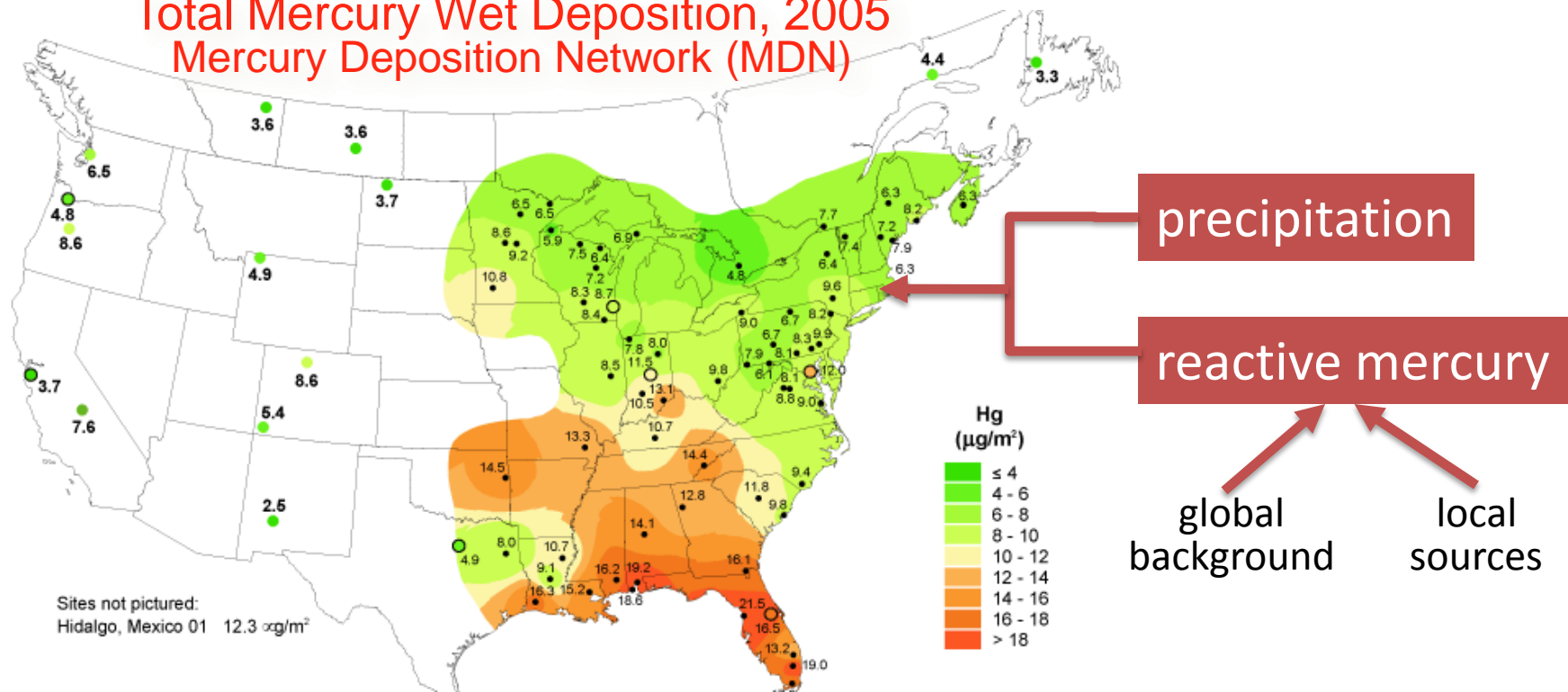
Nested-grid modeling of mercury over North America

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Collaborators: Chris Holmes (UC Irvine), Justin Parrella & Daniel Jacob (Harvard University), Aaron van Donkelaar & Randall Martin (Dalhousie University)

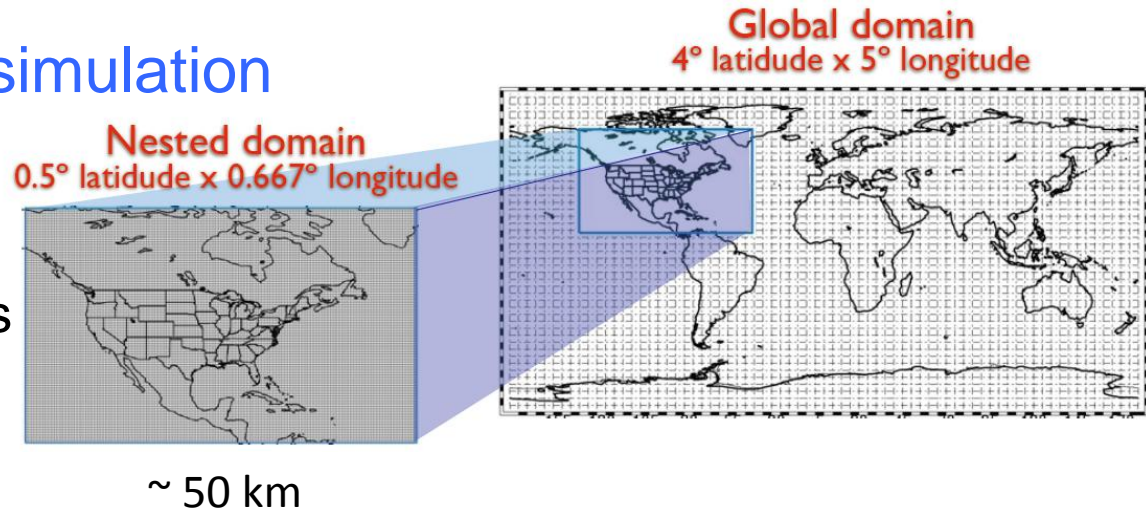
Total Mercury Wet Deposition, 2005
Mercury Deposition Network (MDN)



GEOS-Chem nested grid Hg simulation

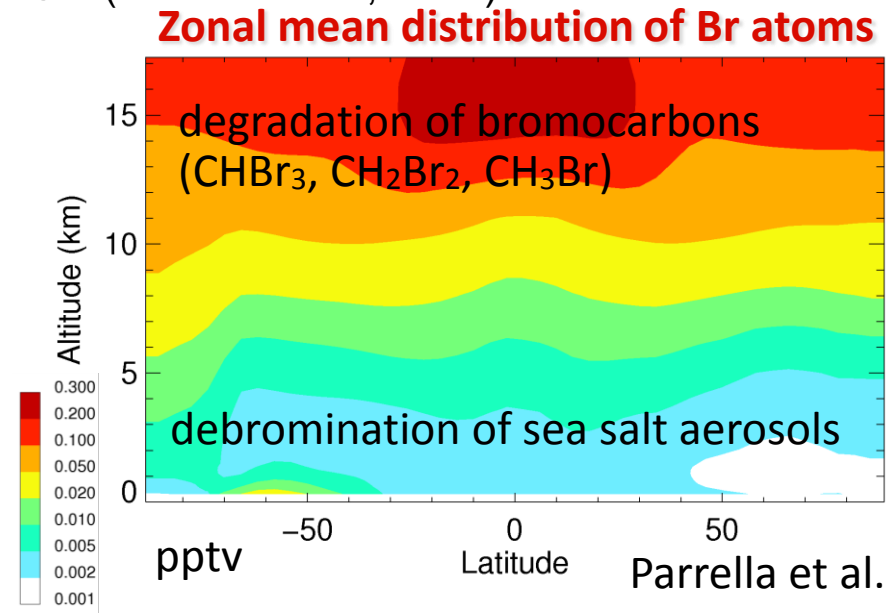
Nested GEOS-Chem Hg simulation

- Same emission, chemistry, deposition, transport as global model
- Global Hg simulation provides boundary and initial conditions

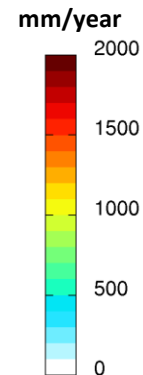
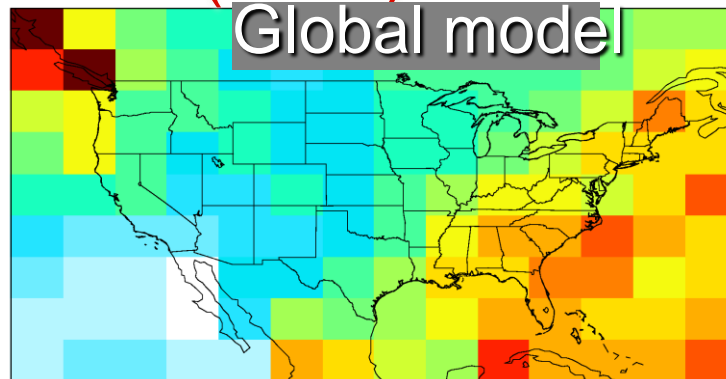
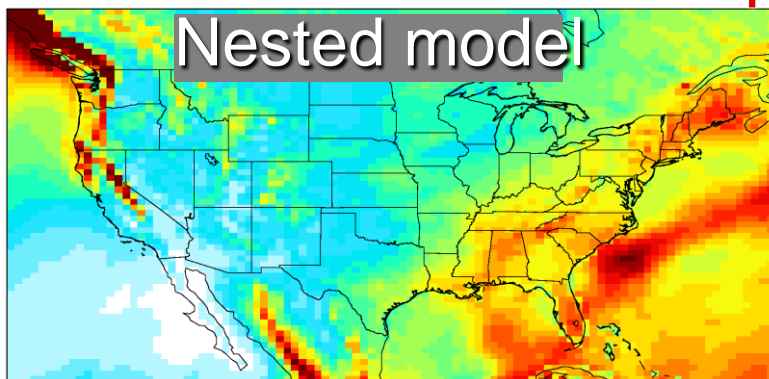


Global and nested model

- GEOS-Chem Hg simulation with Br oxidation (Holmes et al., 2010)
- Br fields from GEOS-Chem (Parrella et al., 2011)
- No in-cloud reduction
- GEIA global anthropogenic emissions (Pacyna et al., 2006) scaled to 2006 (Streets et al., 2009)
- Anthropogenic emissions over US updated to EPA's NEI 2005

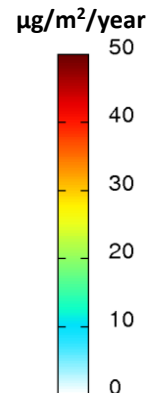
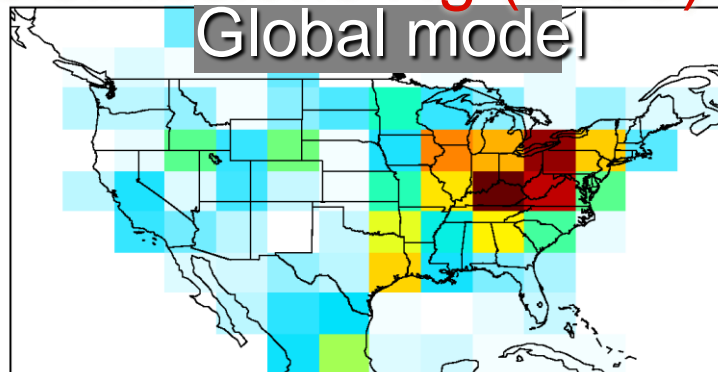
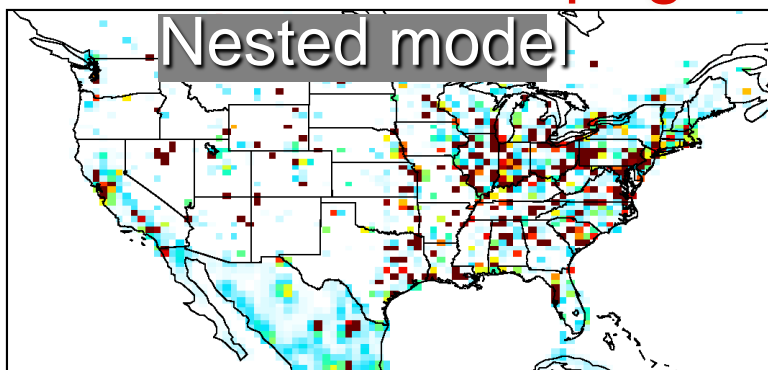


Precipitation (2005)

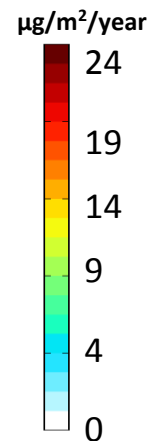
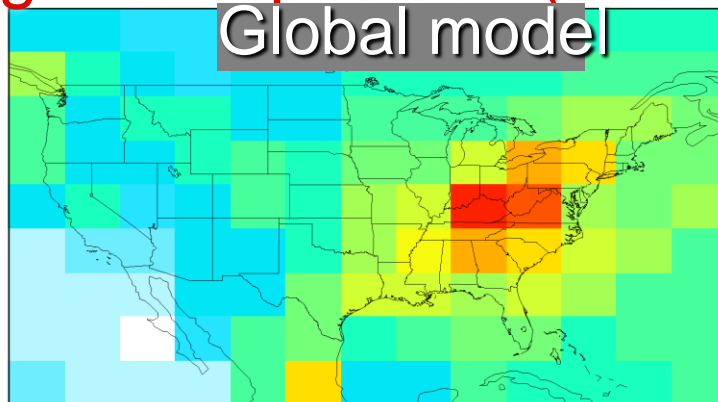
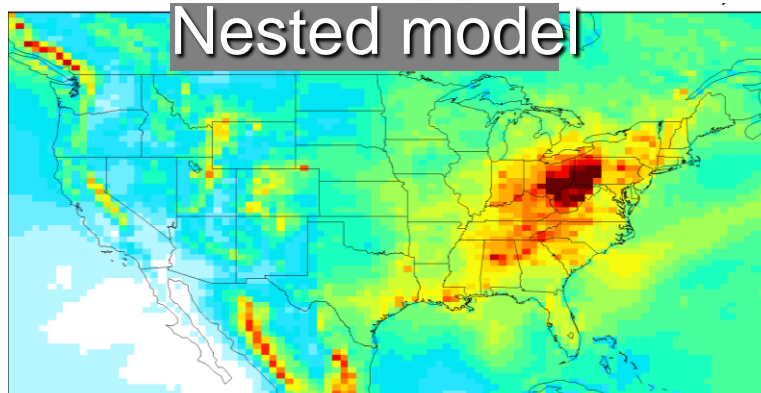


Anthropogenic emissions Hg (2005)

EPA NEI 2005

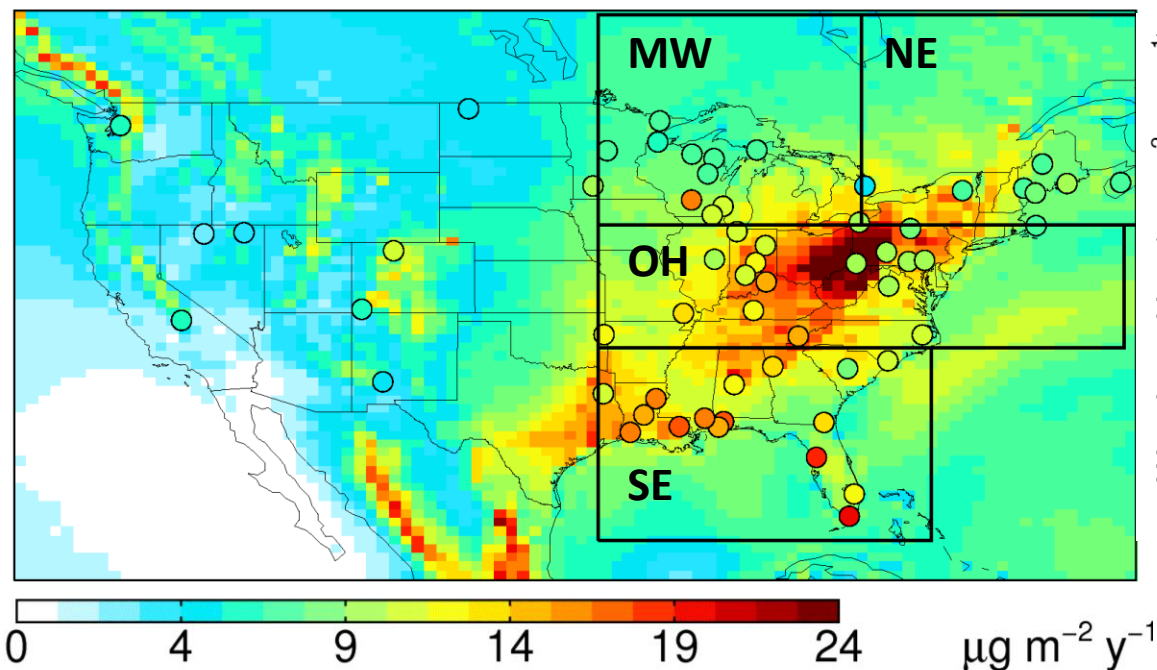


Annual mean Hg wet deposition (2005)

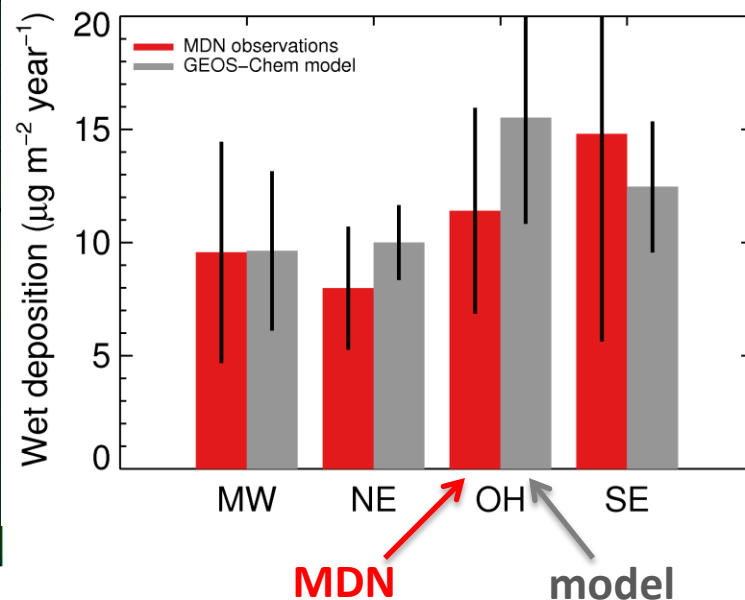


Mercury wet deposition

GEOS-Chem annual mean mercury wet deposition (2004-2007)



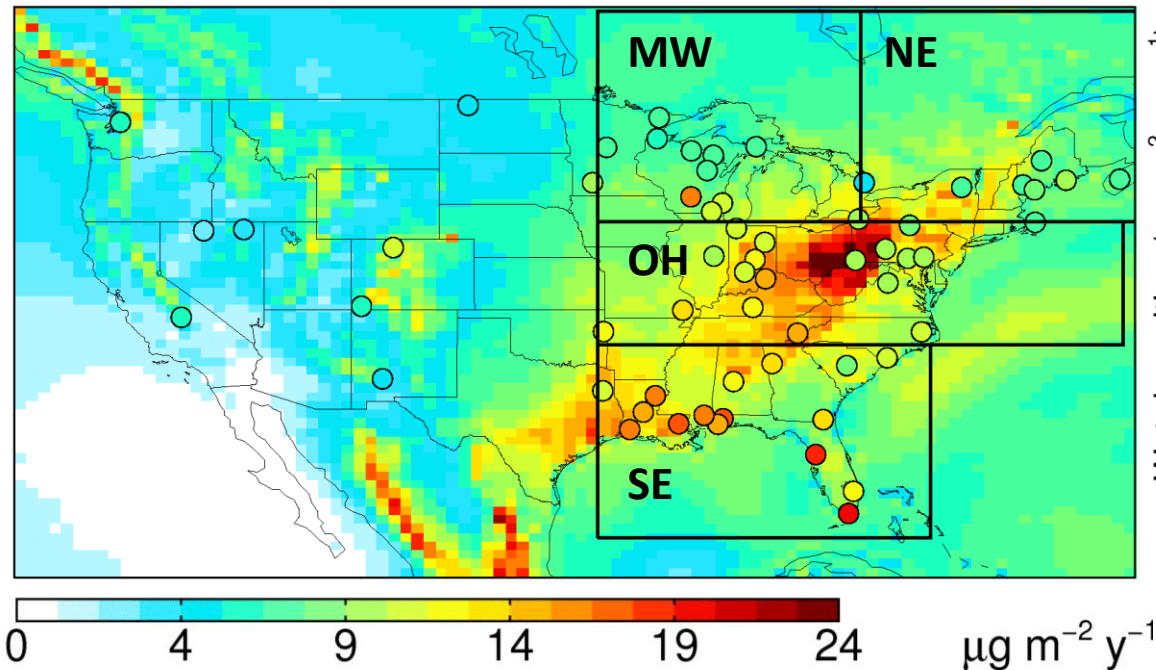
Circles = Observations from Mercury Wet Deposition Network (MDN). 61 sites.



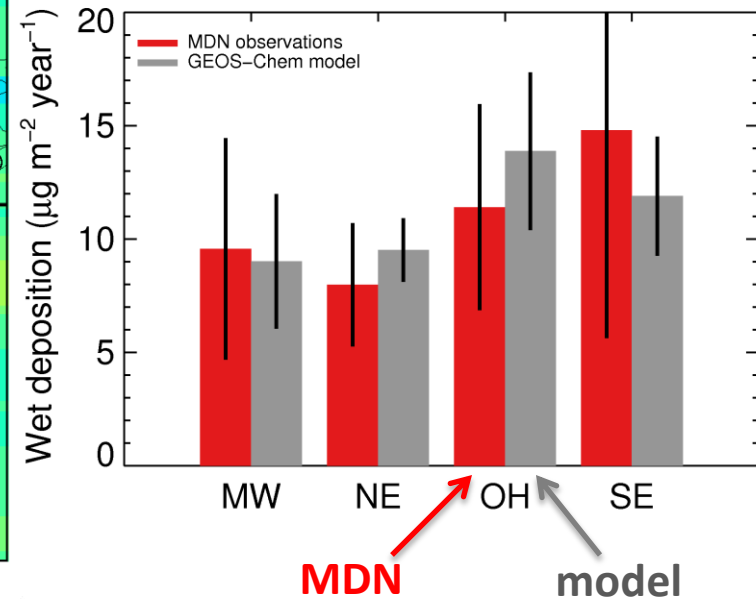
- West-East gradient: increasing precipitation + local anthropogenic emissions in NE US
- Model overestimates Hg deposition over Ohio River Valley (+36%) and NE (+25%)
- Previous studies: Reduction of Hg^{II} to Hg^0 in power plant plumes (Edgerton et al., 2005)

Mercury wet deposition

GEOS-Chem annual mean mercury wet deposition (2004-2007)



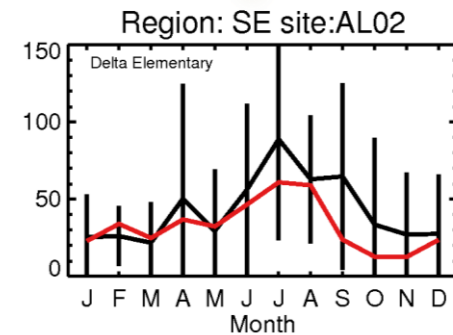
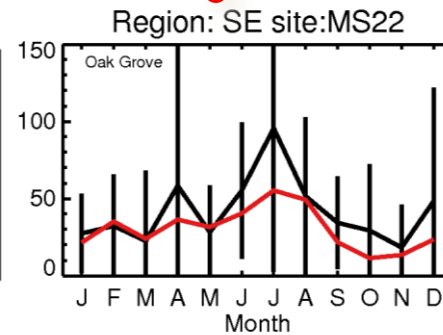
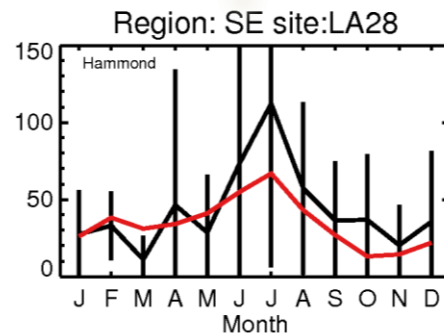
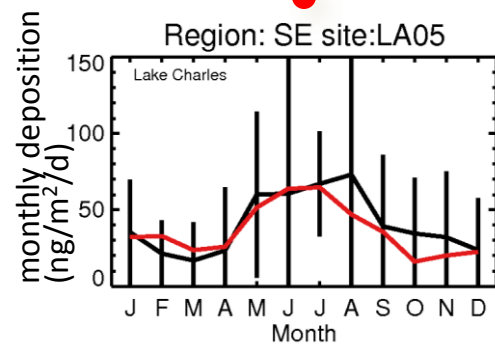
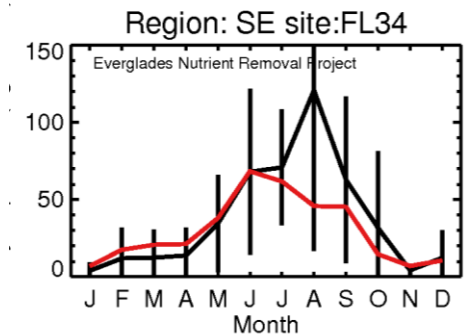
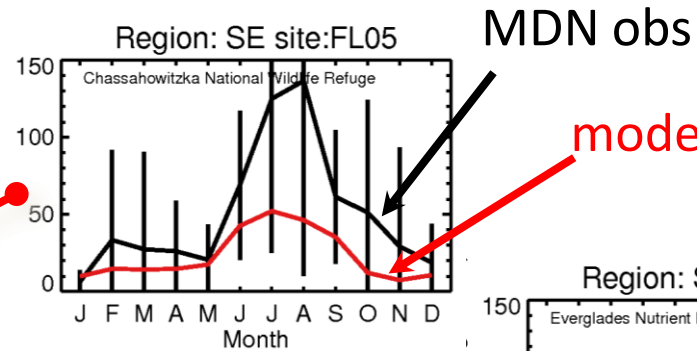
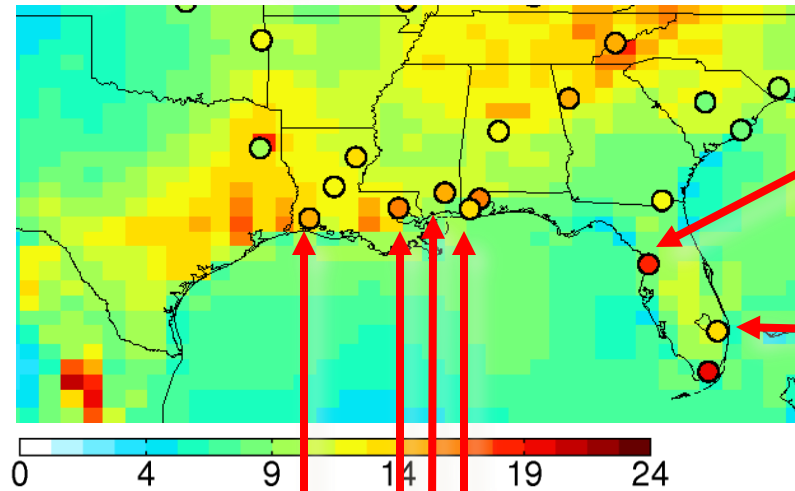
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- Change power plant Hg partitioning: 57%, 40%, 3% ($\text{Hg}^0/\text{Hg}^{\text{II}}/\text{Hg}^{\text{P}}$) → 77%, 20%, 3%
- 10% reduction in deposition over Ohio River valley, 5% in other regions.

Wet deposition along Gulf Coast

GEOS-Chem annual mean mercury wet deposition (2004-2007)

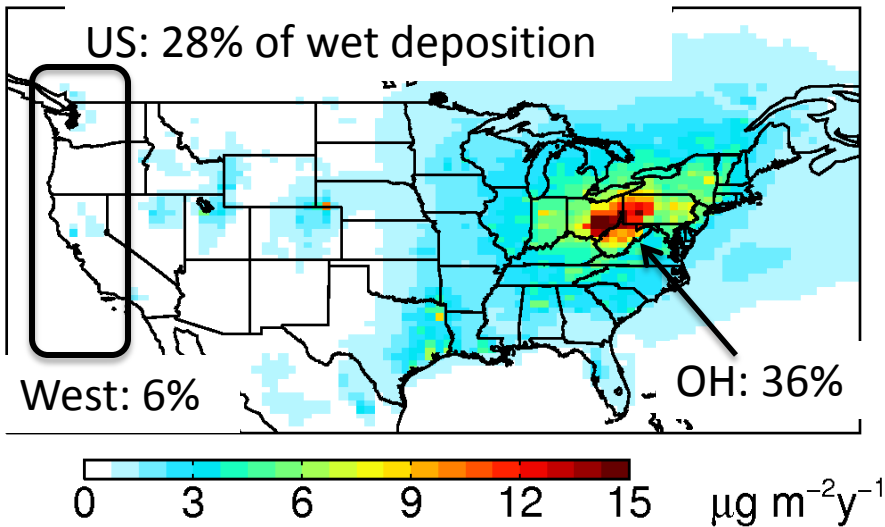


- Gulf Coast: good agreement on a monthly basis, a bit low
- Florida: model still underestimates wet dep

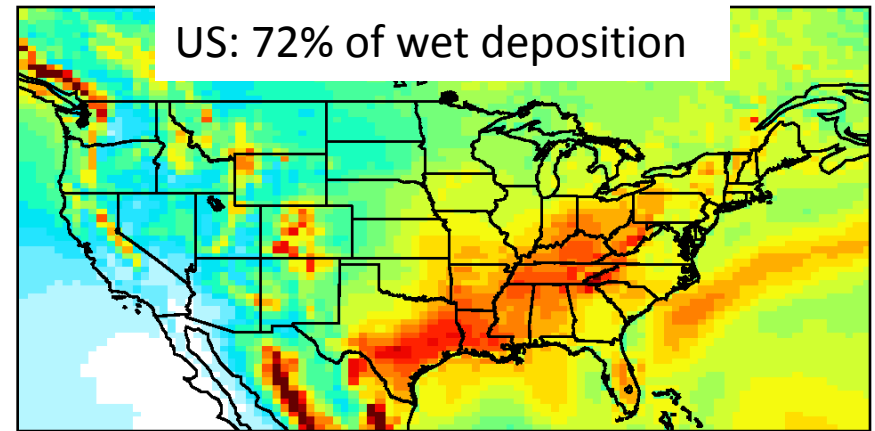
Global and regional source contribution

GEOS-Chem mercury wet deposition (2004-2007)

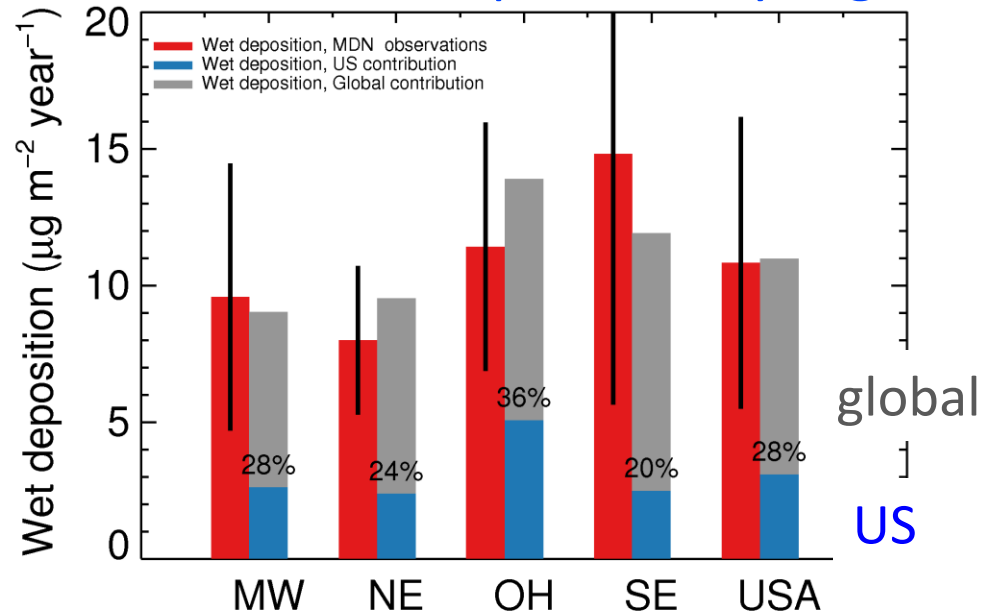
N. American contribution



Global contribution



Annual wet deposition by region

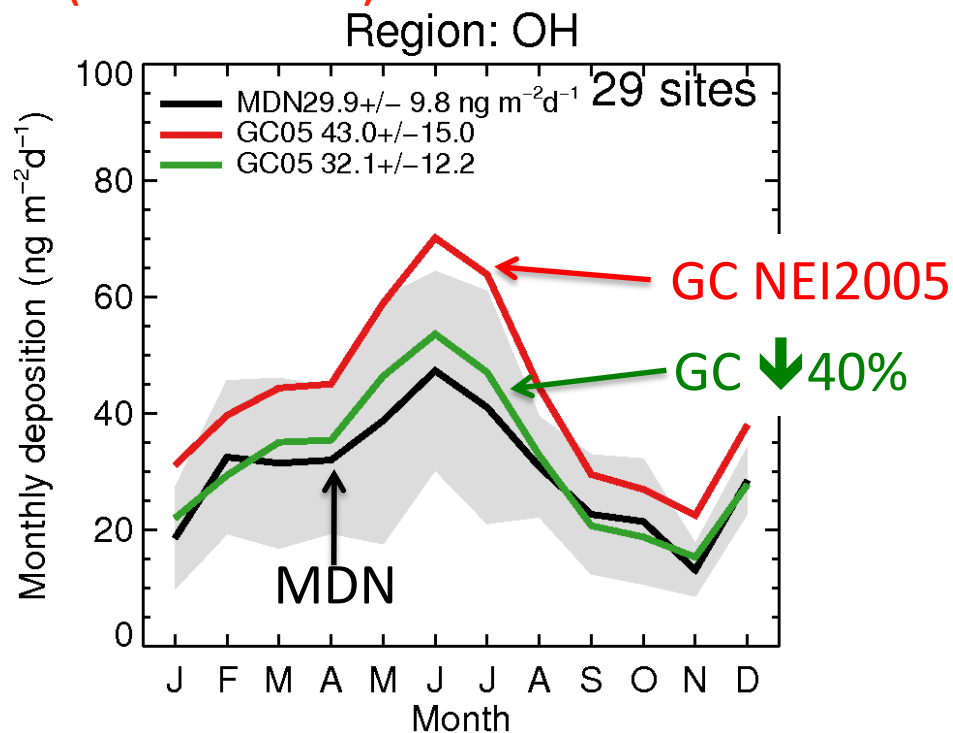
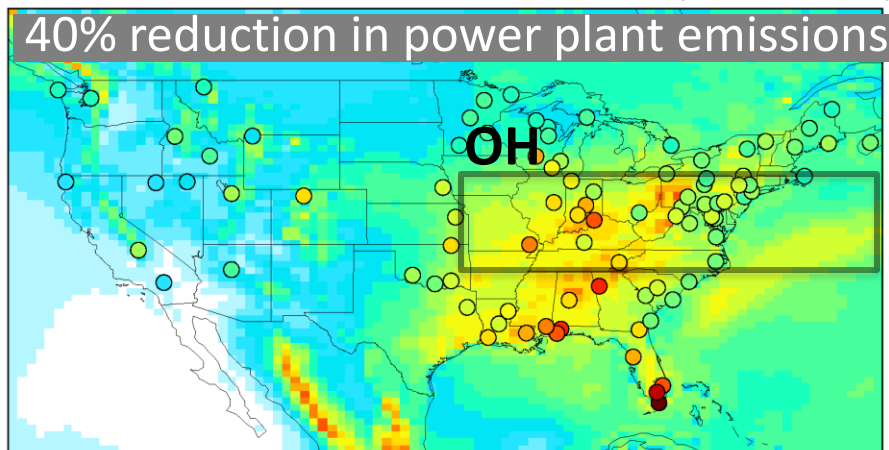
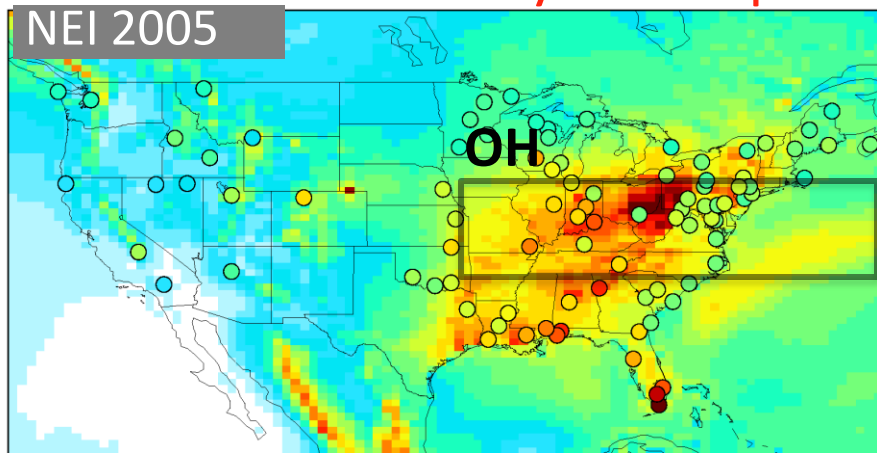


- Sensitivity study with N. American anthropogenic emissions turned off
- N. American contribution to wet deposition: 36% over Ohio River Valley, 24% over SE, 6% over West Coast

Recent decrease in US power plant Hg

53 tons (2005) → 20 tons (2010) EPA, ICR

GEOS-Chem mercury wet deposition (2008-2009)

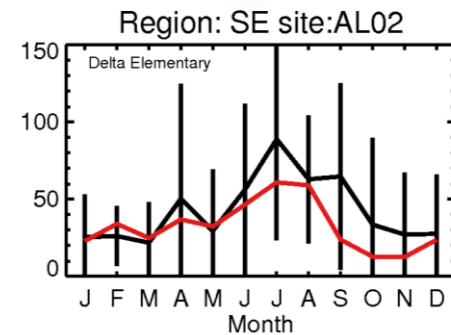
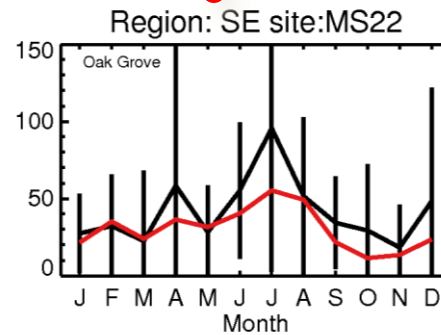
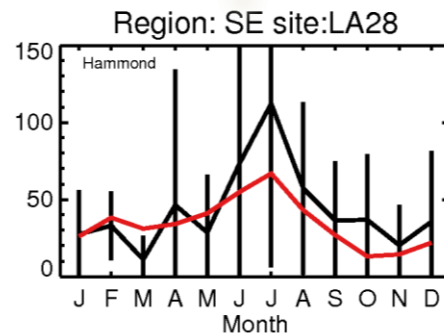
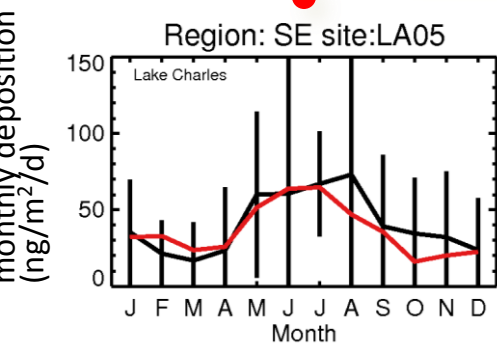
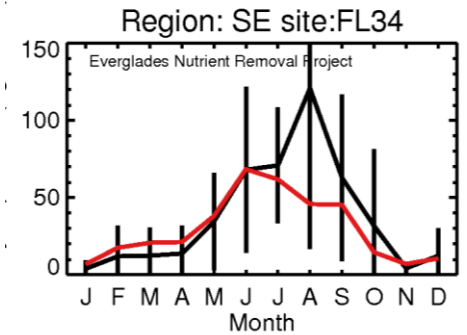
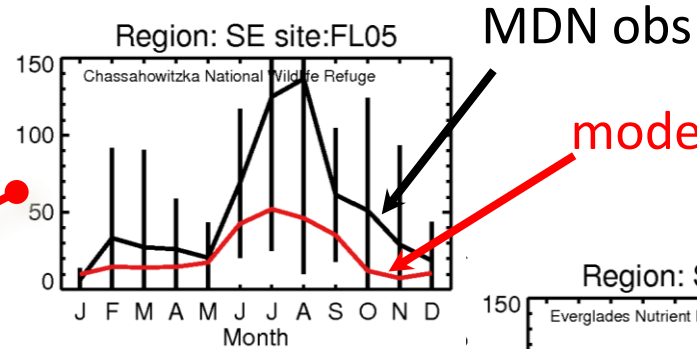
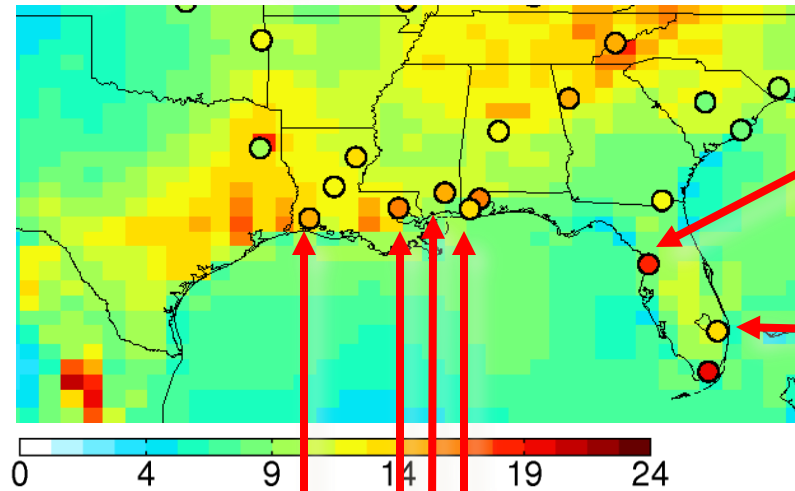


Model wet dep decreases by 25% over Ohio River Valley!

Funding: EPRI, Dr. Leonard Levin

Wet deposition along Gulf Coast

GEOS-Chem annual mean mercury wet deposition (2004-2007)



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