NOAA ARL Modeling Shows Large Contribution of Mercury to Great Lakes from Nearby Sources (revised March 30, 2012)

NOAA Air Resources Laboratory (ARL) modelers are using a modeling framework that provides computer simulations of mercury deposition from local, regional, and global emission sources. The modeling is being conducted as part of the Great Lakes Restoration Initiative (GLRI), which is funded through an Interagency Agreement with the US Environmental Protection Agency. The overall goal of the project is to estimate the amount of atmospheric mercury loading to the Great Lakes and where this loading comes from. The modeling project includes estimates of mercury deposition to the Great Lakes from individual emission sources, or whatever level of detail is available in emissions inventories used as model input. Illustrative examples were developed showing the dramatic differences in Great Lakes impacts from sources in different parts of the world. For example, a typical coal-fired power plant near the Great Lakes was estimated to contribute more than 100 times the mercury deposition than a comparable facility in China because some forms of mercury deposit rapidly near the emission source rather than becoming part of the global atmospheric background. A key finding is that while regional, national, and global mercury emissions are all important contributors to mercury deposition in the Great Lakes Basin, they have varying relative source attribution patterns. ARL modelers found that U.S. mercury emission sources have the greatest impact to Lake Erie which is surrounded by large mercury emissions sources, representing approximately 50 percent of the modeled deposition. The impacts of U.S. sources on Lake Superior were found to be much smaller, representing approximately 10% of the total modeled deposition. Estimates of mercury deposition to the Great Lakes basin (the lakes and their watersheds) were also produced. Results show that U.S. mercury emissions contribute about 30% of the overall deposition to the Great Lakes Basin, while Chinese mercury emissions contribute approximately 15%. U.S sources have disproportionately much greater atmospheric deposition contributions than their emissions, as a fraction of total global mercury emissions, might suggest. Findings from the first year of this project can be found in the report: Modeling Atmospheric Mercury Deposition to the Great Lakes

http://www.arl.noaa.gov/documents/reports/GLRI_FY2010_Atmospheric_Mercury_Final_Report_2011_Dec_16.pdf

Background:
This project is the first year of a multi-year mercury modeling project for the GLRI. ARL integrated its HYSPLIT-Hg model (a mercury version of ARL's Hybrid Single-Particle Lagrangian Integrated Trajectory model) with a global Eulerian model to produce a modeling framework with multiple capabilities for conducting simulations from local to global scales. Despite numerous uncertainties in model input data and other modeling aspects, the model results were found to be reasonably consistent with mercury deposition measurements collected in the Great Lakes region. The 2nd year of the project involves carrying out detailed sensitivity analyses to further examine the uncertainties.

Significance:
The Great Lakes Basin is widely contaminated with mercury, posing an important public and wildlife health concern, as well as an economic issue. Each Great Lakes state has issued state-wide mercury-related fish consumption advisories. Because major point source mercury discharges directly to water bodies have largely been cleaned up, atmospheric deposition is now the dominant loading pathway of mercury to the Great Lakes. Thus, policy and decision makers need to understand how much mercury is deposited to each of the lakes and their watersheds and the relative importance of different emission sources in contributing to this deposition.

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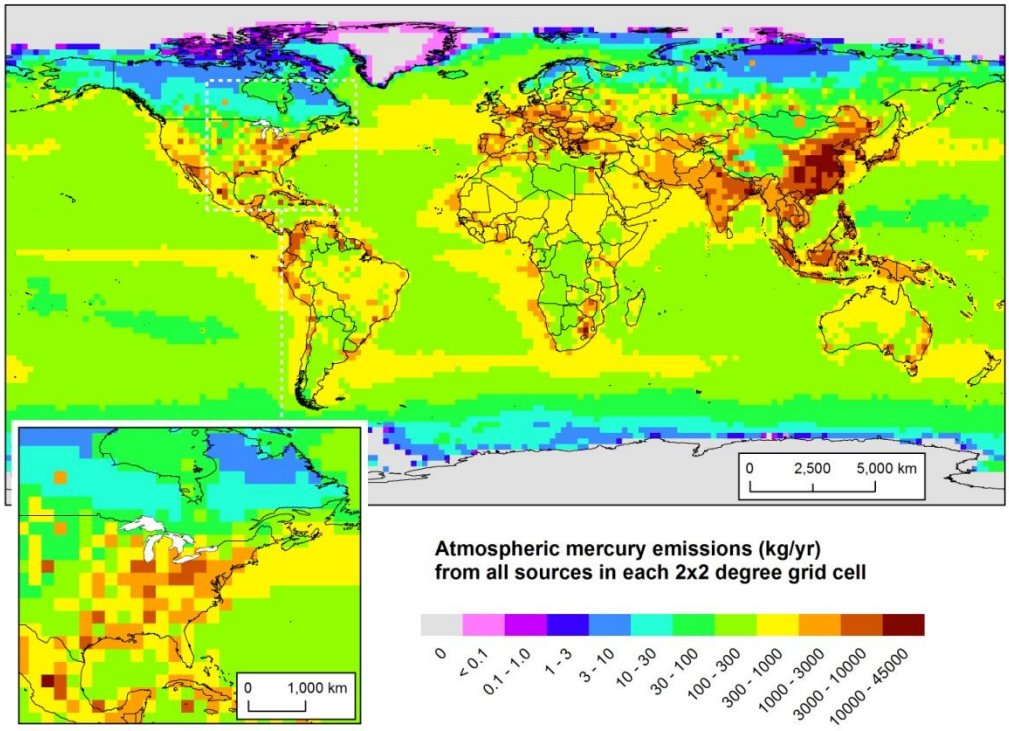
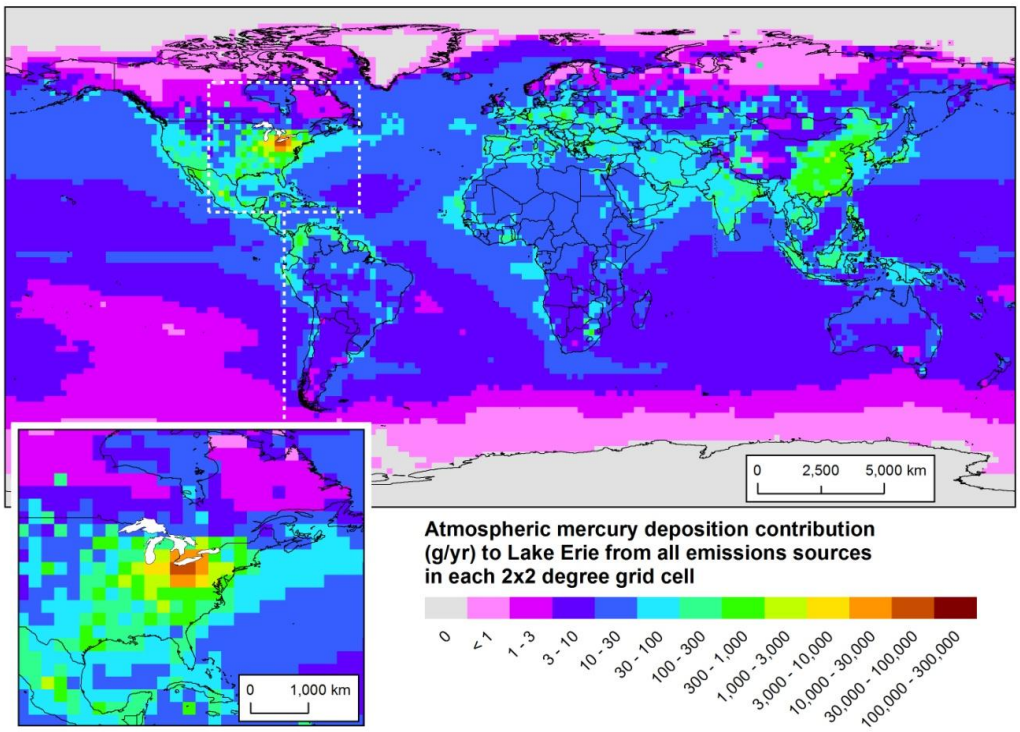
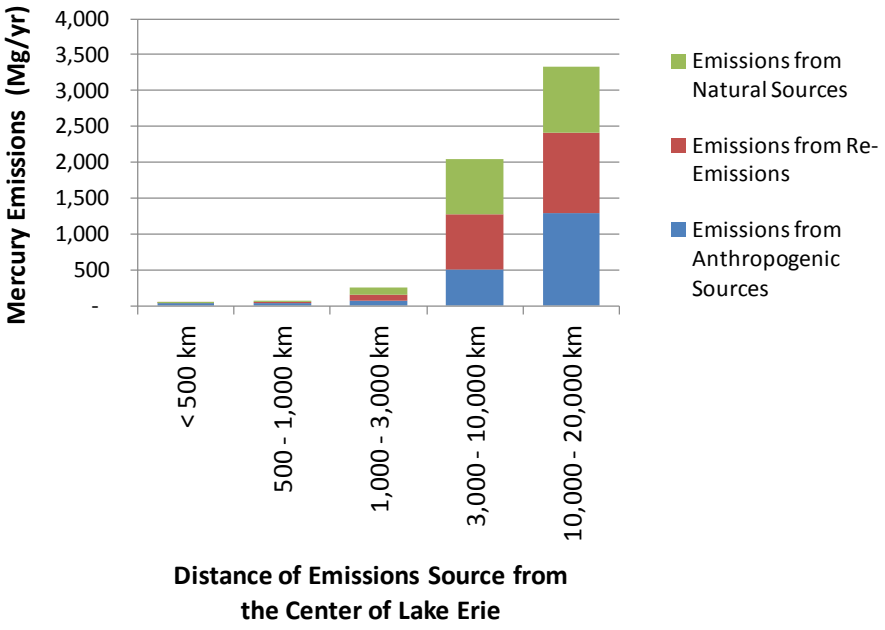


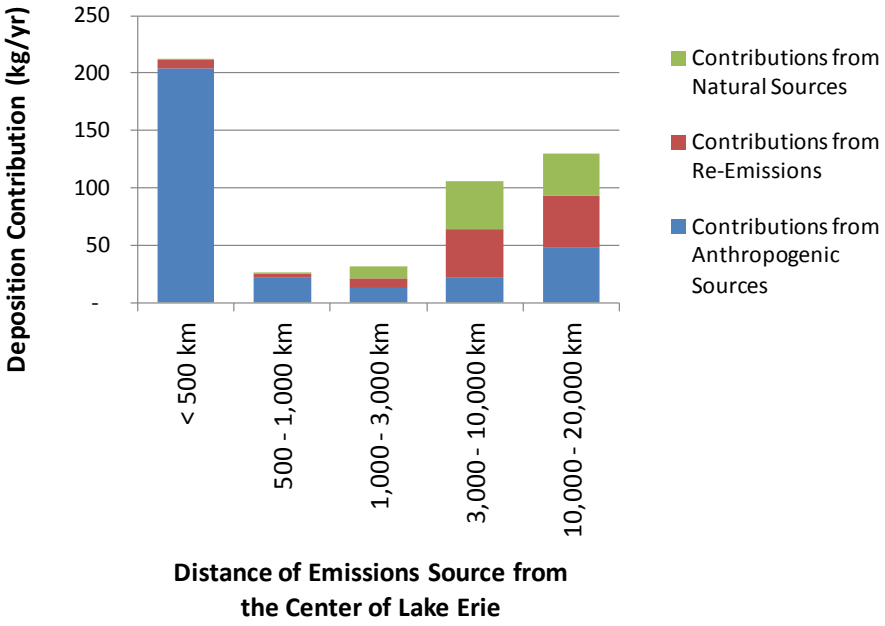
Global Geographical Distribution of Atmospheric Mercury Emissions from All Modeled Sources



Global Geographical Distribution of Atmospheric Mercury Deposition Contributions to Lake Erie from All Modeled Sources

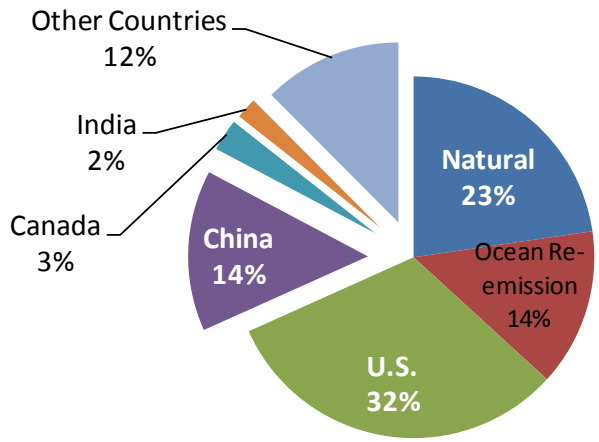


Atmospheric Emissions from Direct Anthropogenic, Re-emitted Anthropogenic and Natural Mercury Emissions as a Function of Distance from the Center of Lake Erie



Atmospheric Deposition Contributions to Lake Erie from Direct Anthropogenic, Re-emitted Anthropogenic and Natural Mercury Emissions as a Function of Distance from the Center of the Lake

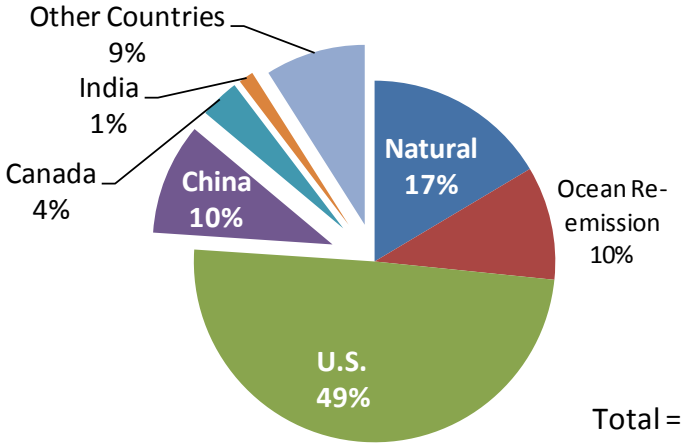
Sources of Mercury Deposition to the Great Lakes Basin



Total = 11,300 kg/yr

Data source:
http://www.arl.noaa.gov/documents/reports/GLRI_FY2010_Atmospheric_Mercury_Final_Report_2011_Dec_16.pdf

Sources of Mercury Deposition to the Lake Erie Basin



Total = 2,300 kg/yr

Data source:
http://www.arl.noaa.gov/documents/reports/GLRI_FY2010_Atmospheric_Mercury_Final_Report_2011_Dec_16.pdf