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SUPPORTING THE WORLD'S LEADING STUDY OF ECOSYSTEM SCIENCE

January 19, 2007

On January 3, 2007, a team of 11 scientists published two mercury papers in the peer-reviewed journal *BioScience*, including: Evers, D.C., Y-J. Han, C.T. Driscoll, N.C. Kamman, W.M. Goodale, K.F. Lambert, T.M. Holsen, C.Y. Chen, T.A. Clair and T. Butler. 2007. Biological mercury hotspots in the Northeastern United States and Southeastern Canada. *BioScience* 57:1-15.

This manuscript is part of a three-year Science Links project on mercury pollution conducted by the Hubbard Brook Research Foundation (HBRF). Importantly, the project involves more detailed analysis than presented in the Evers et al. paper, including additional peer-reviewed papers.

On January 9, 2007, the Electric Power Research Institute (EPRI) issued a statement in response to the *BioScience* article cited above. The statement included many false and misleading arguments, which we address below.

EPRI statement: The Modeling Does Not Fully Include Important Sources of Mercury

HBRF response: The Model Estimates Deposition from All Major Source Categories within the Model Domain

The objective of the HBRF analysis was to determine whether biological mercury hotspots exist, where they are located, and what causes these spatial patterns. The modeling analysis was conducted to examine mercury deposition associated with local sources potentially contributing to the biological mercury hotspot in southeastern New Hampshire.

We used the 2002 NESCAUM mercury emissions inventory, including all sources categories and a local scale deposition model (ISCST3) to evaluate a biological mercury hotspot in New Hampshire. ISCST3 is a steady-state Gaussian plume model developed by the U.S. Environmental Protection Agency (EPA) for regulatory use in the review and preparation of new source permits and State Implementation Plan (SIP) revisions. This model can be used to assess pollutant concentrations from a wide variety of sources and can account for the following: settling and dry deposition of particles; downwash; point, area, line, and volume sources; plume rise as a function of downwind distance; separation of point sources; and limited terrain adjustment.

As indicated below, the modeling results compared well with wet deposition measured as part of the Mercury Deposition Network (MDN). We then determined the relative contribution of coal-fired power plants to the mercury deposition attributable to all local and regional sources, by running a model scenario that reduces mercury deposition from the four coal-fired power plants in the model domain by 90 percent.

EPRI statement: Mercury Emissions Trading Will Not Exacerbate "Hotspots"

HBRF response: Mercury Emissions Trading Could Perpetuate Areas of High Deposition and Associated Biological Mercury Hotspots If Emissions Are Not Adequately Reduced

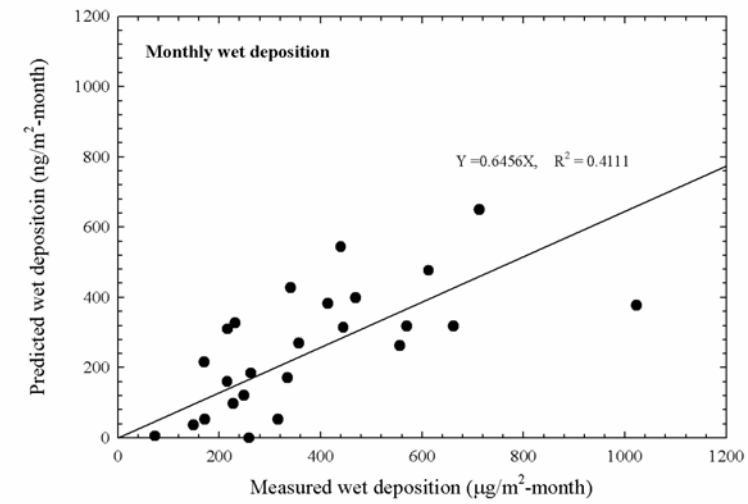
HBRF is aware of the EPRI and U.S. EPA analysis, but these projections are not published in the peer-reviewed literature and represent a best guess about the future. Such projections cannot account for all the vagaries of economic markets, therefore it is critical to recognize current local scale impacts, and the potential for these to continue in the future. While some power plants will undoubtedly reduce their emissions, there is no telling at this time whether these reductions would be sufficient to eliminate hotspots. The data clearly demonstrate that biological mercury hotspots ***do*** exist, and changes in local mercury emissions can result in changes in mercury concentrations in aquatic biota near these local sources. If biological mercury hotspots exist in the Northeast, they also likely exist in other regions of the country. It is imprudent to embark on an unconstrained cap-and-trade program with virtually no understanding of: 1) the sensitivity of the landscape to atmospheric mercury deposition; 2) the extent of areas that are sensitive of mercury deposition near local and regional mercury sources; and 3) the extent of mercury deposition near local sources. Finally, it is also imprudent to proceed with cap-and-trade when no program exists to track ecosystem response to changes in mercury emissions.

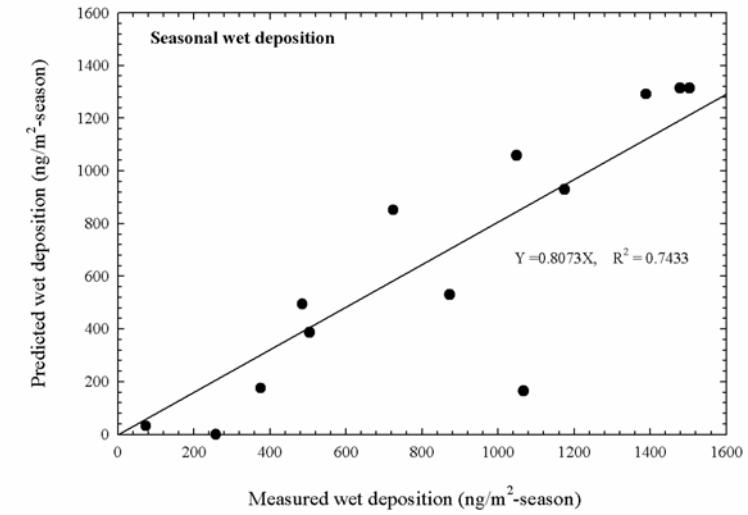
EPRI statement: In the Analysis No Comparison of Modeled Deposition to Observed Data is Carried Out

HBRF response: Modeled Wet Deposition Was Compared to MDN Wet Deposition Data

We used MDN data in the study area to evaluate model performance. A plot of measured and model-calculated values of wet deposition is shown below. In general, model-calculated values of wet mercury deposition somewhat underestimate measured values. To evaluate the modeling results, the wet deposition measured as part of the MDN were compared with modeled values. There are three MDN sites in New Hampshire including Laconia, Hubbard Brook, and New Castle. Hubbard Brook has only been operating since 2004, therefore wet Hg deposition measured at Laconia and New Castle were used for comparison with 1999 and 2002 model calculations. The correlations (r^2) between observed and simulated wet deposition are 0.41 and 0.74, and the slopes of the regression line are 0.65 and 0.81 on a monthly and seasonal basis, respectively, when the y-axis intercept is forced to zero.

The underestimated wet deposition is probably due to the inclusion of only local sources and the exclusion of Hg^0 in model simulations. While we used available wet deposition data to evaluate model performance, we acknowledge that if air chemistry, dry deposition, or event-based wet deposition data were available, we could do a better job assessing our ability to calculate local deposition from local sources. These measurements are sorely needed to assess the impacts or local and regional mercury deposition. We would welcome the opportunity to conduct a more rigorous evaluation of model results.





EPRI Statement: The Modeling Used Does Not Consider Mercury Chemistry

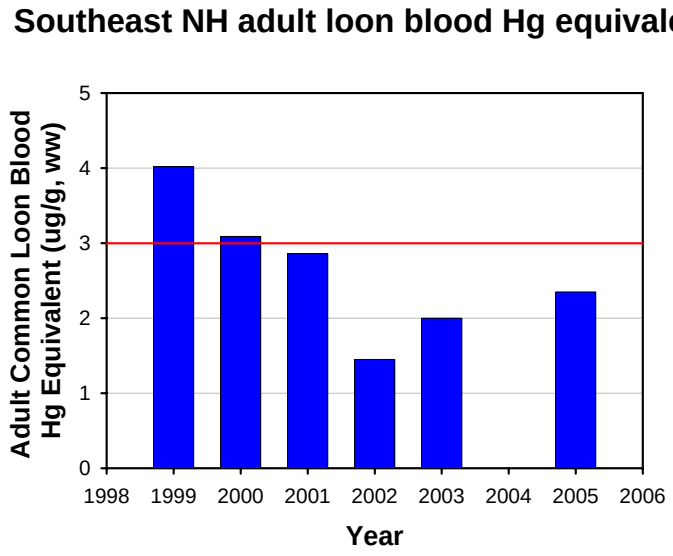
HBRF response: Detailed Mercury Chemistry Would Likely Increase Deposition Estimates

While the HBRF model calculations do not consider conversion between mercury forms, we expect that if they did, the estimate of mercury deposition would increase. Our comparison with wet mercury deposition data suggests that we essentially calculate wet mercury deposition correctly. Moreover, most mercury transfer processes convert reduced mercury to oxidized species. These reactions would probably occur in the New Hampshire study area because this region has relatively high concentrations of ozone and chloride. As a result our model calculations are likely a conservative analysis of local deposition from local sources, because we would expect with local air chemistry conditions that some emissions of elemental mercury would be converted to oxidized mercury and be deposited locally. Moreover, recent measurements of the speciation of mercury sources in the study area by the New Hampshire Department of Environmental Services suggest that we underestimate the quantity of oxidized mercury from local sources and therefore have likely underestimated mercury deposition from these sources.

EPRI Statement: No Link Between Mercury Deposition and Mercury in Ecosystems Is Provided

HBRF response: Detailed Time Series Data Were Used to Link Mercury Emissions and Deposition to Mercury in Yellow Perch and Common Loons

This EPRI statement is incorrect. As part of our analysis, the HBRF team used the mercury emissions inventory to model changes in mercury deposition from local sources from 1996 and 2002. During this period mercury emissions from upwind sources in the study region declined 45 percent. We measured concentrations of mercury in the blood of the common loon during this same time period and found that values decreased 65 percent in 10 study lakes in the adjacent biological mercury hotspot, coincident with this decrease in emissions, as shown below. Likewise, colleagues from the State of Massachusetts observed a 32 percent decreases in mercury concentrations in yellow perch in northeastern Massachusetts during the same time period. While we would welcome additional monitoring data to confirm the connection between local atmospheric emissions of mercury and adjacent ecosystem response, we believe our monitoring data are compelling evidence of this linkage.



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