Evaluation of Potential Health Risks from Mercury Emissions from Coal Fired Power Plants

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ABSTRACT

The U.S. Environmental Protection Agency has announced plans to regulate emissions of mercury to the atmosphere from coal-fired power plants. However, there is still debate over whether the limits should be placed on a nationwide basis or a plant specific basis. A nationwide mercury emission limit would allow a Cap and Trade program similar to that for other pollutants. A Cap and Trade program would be more economically efficient than plant specific emissions limits. However, before a Cap and Trade program is selected as an acceptable approach, it must be demonstrated that local deposition of mercury from coal fired power plants does not impose an excessive health risk to the region. The principal health concern is exposure of pregnant females to methylmercury, high concentrations of which can have adverse effects on the neurological development of the fetus. The pathway of exposure is through consumption of contaminated seafood.

Although mercury is a concern, quantitative assessment of the reduction in risk that could be achieved through reduction in coal plant emissions of mercury has not been performed nor have the risks associated with local deposition been evaluated.

To address the issue of risk reduction due to mercury emission controls, a probabilistic risk assessment of mercury exposure from fish consumption has been performed for 3 regions of the U.S (Northeast, Southeast, and Midwest) identified by the EPA as regions of higher impact from coal emissions. The risk assessment addresses the effects of exposure to in utero children through consumption of fish by their mothers. Two population groups (general population and subsistence fishers) are considered. Three mercury levels were considered in the analysis, current conditions based on measured data, and hypothetical reductions in Hg levels due to a 50% and 90% reduction in mercury emissions from coal fired power plants.

To address the issue of health risks associated with local deposition of mercury, probabilistic risk assessments were performed for two power plants, Bruce Mansfield in western Pennsylvania and Monticello in eastern Texas. These plants were selected because they have high emissions rate as reported in the 1999 emissions survey conducted by EPA (Monticello had the highest mercury emissions in the country). Local hourly meteorological data was obtained for these sites and deposition modeling was performed for a region 50 Km around the site. Risk assessments were performed for two population groups (general and subsistence fishers).

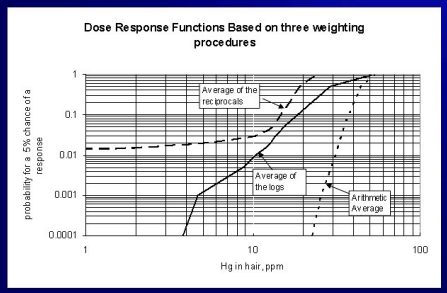
Regional Impacts of Reduction in Hg emissions from Coal-fired power plants

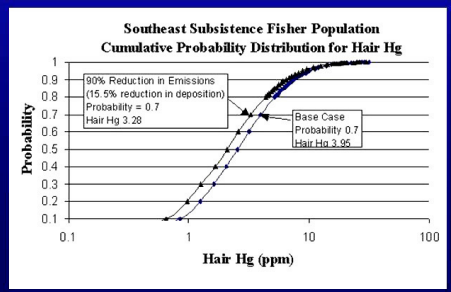
Literature estimates of the impacts of reduction in mercury emissions on regional deposition in the United States

	Reduction in Hg emissions from coal fired power plants of 50%	Reduction in Hg emissions from coal fired power plants of 70%	Reduction in Hg emissions from coal fired power plants of 90%
Range of % reduction in mercury deposition	4.2 – 8.6	6.2 – 12.9	7.5 – 15.5

Approach

a) Calculate reduction in fish Hg concentrations due to reduced deposition
b) Probabilistically calculate (reduced) mercury uptake from locally caught fish for 3 regions (Midwest, Southeast, Northeast) and 2 populations (general and subsistence fisher).
c) Using dose response curve calculate risk as a function of consumption for the distribution in Hair Hg levels.

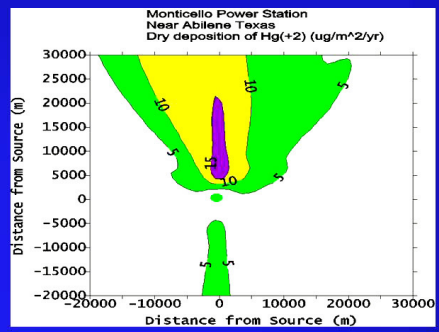


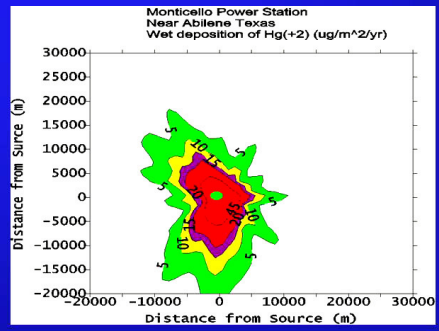


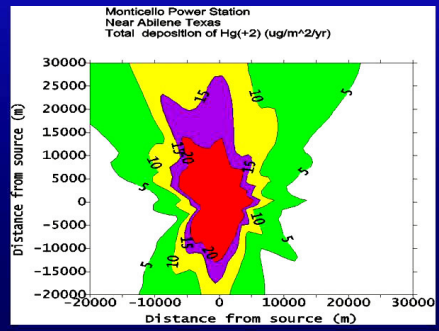
Health Impacts of Local Hg Deposition

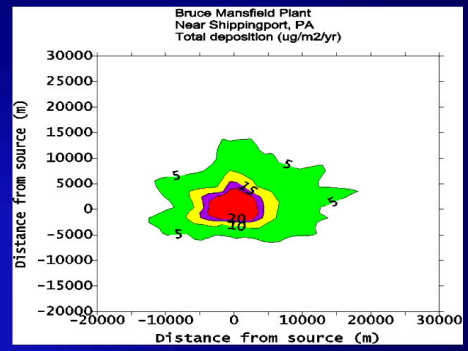
Approach:

a) Model local deposition for the Monticello, TX plant (highest Hg emissions in the US in 1999) and Bruce Mansfield PA plant using Hg speciation data on emissions, the software package ISCVIEW and deposition parameters used in EPA Report to Congress
b) Compare deposition to background which is approximately 20 $\mu g/m^2/yr$
c) Probabilistically Assess Health Impacts of Local Deposition









RESULTS

Regional Risk reduction

	General Population Risk Reduction	Subsistence Fisher Population Risk Reduction
50% Reduction in Hg emissions from coal fired power plants	6 – 16%	16 – 49%
90% Reduction in Hg emissions from coal fired power plants	12 – 32%	24 – 68%
TOTAL RISK	1E-5	3E-3

Results of Local Deposition Modeling and Risk Assessment

Deposition Results

- Approximately 2% of Hg emissions deposit within 50 Km of the plant. Remaining 98% enters global budget.
- Reactive gaseous mercury is the dominant form of deposited Hg.
- Wet deposition within a few km of a plant can lead to deposition several times background.
- Total deposition is approximately 50% wet deposition and 50% dry deposition.
- Uncertainties in deposition modeling parameters need to be addressed.

Increase in Risks due to Local Deposition

- Population Risks to the general population increase from 1E-5 to 1.7E-5
- Population Risks to subsistence fisher population increases from 6.3E-3 to 2.2E-2.
- Risk dominated by the upper 5-10% of the distribution