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ABSTRACT

In March 2005, the EPA created new allowances and standards for mercury emissions in coal-fired power plants. However, there is still debate over whether the limits should be on a plant specific basis or a nationwide basis. The nationwide basis allows a Cap and Trade program similar to that for other air pollutants. If Cap and Trade is allowed, there is a potential for mercury 'hot-spots' around coal-fired power plants. This program has two major objectives. First, it examines mercury deposition around coal-fired power plants. Modeling suggests that increased mercury deposition close to the plant (within 10 – 15 Km) may occur due to wet deposition. Literature review on mercury deposition and soil characterization near a 1200 MW Midwest power plant suggest increases of 20 – 30% over background deposition. The intent of this program is to collect data to characterize the increase in local deposition in the vicinity of coal-fired power plants through measurement of soil mercury levels near a coal-fired power plant. A site in Texas, near the Monticello power plant that burns lignite coal was chosen for assessment studies of mercury in surrounding soils and vegetation. Second, it examines the literature to determine the health impacts of mercury and fish consumption, the major pathway for mercury exposure.

Local Deposition Measurement Approach

- Select Coal-fired power plant for analysis
- Perform deposition modeling based on plant parameters.
- Design and conduct soil and vegetation sampling program
- Examine data for 'hot spots' and correlation with modeling

A) Coal-Fired Power Plant

Monticello power plant in Texas. Consistently among the top 5 Hg emitters in the U.S. A large fraction of RGM was measured in stack tests. 12 miles to the southeast, another large power plant exists. Monticello Plant:

- Annual Hg emissions 954 kg/yr.
- Fraction of Hg(+2) = 0.6 (576 kg/yr).
- Stack Height – 223 m

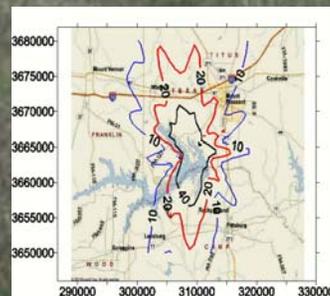
Mortality versus fish consumption

B) Deposition Modeling

Used representative year for meteorological data based on five years of data. Modeled wet and dry deposition.

Wet deposition localized near plant. High rates of deposition during precipitation events. Dry deposition maximum away from the plant but < 10% of expected background deposition.

Wet deposition dominates the deposition rates pattern and is predicted to be 2 – 4 times background deposition within 5 miles of the plant in the direction of the prevailing wind (N/S).



DEPOSITION MODELING RESULTS

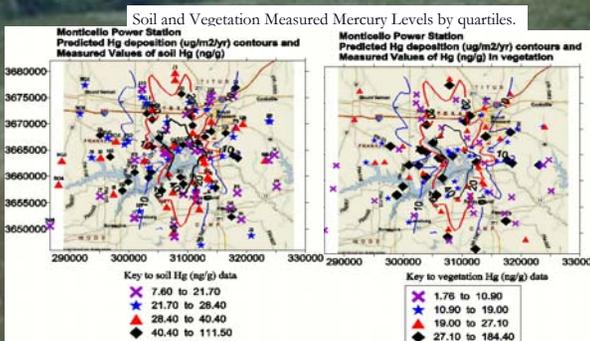
- Modeled Wet, Dry, and Total Deposition
- Wet deposition above expected background near the plant (within 5 km).
- Dry Deposition maximum away from the plant ((10 – 20 Km) and predicted to be much lower than background deposition rates
- Over the 10 mile sampled region, predicted deposition is approximately equal to background wet deposition. (e.g. 50% of deposition from the plant).

C) SAMPLING

- Sampled 1 mile grid for ten miles around the plant
- Five 'background' samples were taken ~ 20 miles from the plant
- 107 locations with 3 surface soil, (0 – 2 “), 1 deep soil (2 – 4 “), and 1 vegetation sample.
- Blind duplicate on 10% of the samples.

Hg ANALYSIS

Samples sent to BNL for analysis.
Samples analyzed on Direct Mercury Analyzer
Samples analyzed in duplicate
Over 1400 samples analyzed.
QA: 10% blind duplicates and 10% standards



LOCAL DEPOSITION CONCLUSIONS

- No statistically significant evidence of large regions of elevated concentration 'hot spots' in soil and vegetation.
- Several soil and vegetation samples had elevated levels of Hg as compared to the mean
- Higher levels of Hg were correlated with soil characteristics (soil color, clay content) and location (near the lake).
- Soil and vegetation mercury patterns show similar trends.
- Soil and vegetation Hg concentrations are not consistent with modeled deposition pattern. Modeled pattern had north/south orientation, measured Hg levels were higher near the lake, (east/west pattern).

What's New on Mercury Health Effects?

- BNL continues to track and evaluate the literature for new evidence. NIH's MEDLINE database cites 143 new papers on MeHg and 919 on Hg published in the last year.
- These include a new Polish study on infant neurological effects at low exposure levels and several well publicized papers on adult cardiovascular effects.
 - Advocates selectively use the results showing a health impact to argue for stronger Hg controls on US power plants.

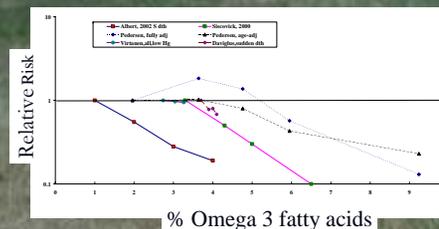
Why the Concern over Cardiovascular Health Effects?

- The (adult) population at risk is potentially much larger than that for fetal effects.
- Premature mortality carries a higher price tag than loss of IQ (the current basis for cost-benefit analysis).
 - Simplistic (no threshold level for effects) cost-benefit analyses may support more stringent Hg emission controls.

What Has BNL Concluded about MeHg and Cardiovascular Disease (CVD)?

- The underlying issue is competition between adverse effects of MeHg and beneficial effects of omega-3 fatty acids and whether there are thresholds. Published studies of this competition have produced mixed findings.
- Eating fish involves intake of both agents, but the relative amounts vary based on the fish species.
- Nevertheless, studies of fish consumption per se tend to show net benefits. There may be questions as to whether eating fish promotes health or that people who tend to eat more fish have better health habits.

Effects of omega-3 fatty acids on mortality



- Beneficial CVD effects of fish are based on specific long-chain ω-3 fatty acids.
- Adverse effects of MeHg on CVD are limited to a cohort in East Finland who consume lake fish. A threshold of 2 ppm hair Hg was shown.
- The most reliable CVD studies use blood or tissue (biomarker) concentrations of these compounds, as opposed to estimating intake based on dietary recall. The uncertainty of recall tends to make true effects harder to find.
- BNL's analysis of these studies suggests that there may be a minimum threshold level of fatty acids to achieve CVD. Biomarker data are required to show this effect.

BNL's Bottom Line:

The competition between MeHg and fatty acids must be evaluated on a level playing field. This means either large scale (national) studies of fish consumption or use of biomarker data for both Hg and fatty acids in cohort studies. The story is still unfolding.