Mercury in the Bay

Assessing the Chesapeake's response to mercury emissions regulations

Recommendations for Monitoring Mercury Pollution

Chesapeake Bay Program
Scientific and Technical Advisory Committee

The Mercury Problem

Known for swiftness and mobility, the Roman god Mercury lent his name to "quicksilver" — an element that makes frequent forays into headline news. Despite its mythologic beginnings, mercury is now better known for its toxicity and its contamination of the environment.

Our environment, the Chesapeake Bay and its watershed, is contaminated with mercury from industrial sources, mainly from the past, and from current and legacy fossil fuel combustion. Mercury is a contaminant of concern for the Chesapeake. (www.chesapeakebay.net/mercury.aspx?menuitem=19488)

Six Bay states and the District of Columbia issue fish consumption advisories for specific fish species in certain bodies of water. (www.chesapeakebay.net/fishadvisory.htm).

Methylmercury is a developmental neurotoxin. The National Academy of Sciences advises that chronic, low-dose, prenatal methylmercury exposure may reduce performance on neurobehavioral tests, including IQ. (www.nap.edu/catalog.php?record_id=9899).

The Centers for Disease Control estimates that 6% of women in the US have blood mercury levels above levels known to be without appreciable harm (www.cdc.gov/exposurereport/pdf/factsheet_mercury.pdf)

Methylmercury also acts as endocrine disrupter, affecting the health and reproduction of wild birds, mammals and fish. (www.nyserda.org/programs/environment/emep/finalweb.pdf)

Making Sure New Regulations Work

The Chesapeake Bay states have new rules in place to limit mercury emission from coal-fired power plants, one of the biggest remaining sources of new mercury pollution in the region. How can we make sure that these new regulations on mercury emissions are effective in reducing mercury risk to people and ecosystems?

In October 2007, the Chesapeake Bay Program Scientific and Technical Advisory Committee (STAC) and National Oceanic and Atmospheric Administration (NOAA) held a workshop to discuss the probable impacts of these new regulations, and to recommend ways to determine if the new regulations are effective.

Although monitoring is in place for mercury in air and rain, the workshop consensus was that existing programs will not be adequate to follow change in emissions or change in our ecosystems.

The workshop steering committee recommended the creation of a structured, watershed-wide monitoring program, based on framework that was developed for a national mercury monitoring program. A summary of recommendations is on the back page of this brochure.

STAC Mercury Workshop Steering Committee

Howard Townsend (NOAA CBO/Oxford)
Cindy Gilmour (STAC/SERC)
Gary Matlock (STAC/NOAA)
Greg Allen (EPA/CBO)
A.K. Leight (NOAA/Oxford)
Maggie Kerchner (NOAA CBO)
John Sherwell (MD DNR)
Tom Barron (PA DEP)

Editorial and layout services provided by Nina Fisher.

Did you know?

Eating smaller fish and avoiding top-level predators can help to reduce your risk from methylmercury, while retaining the benefits of omega-3 fatty acids from fish.

Why Monitor Mercury?

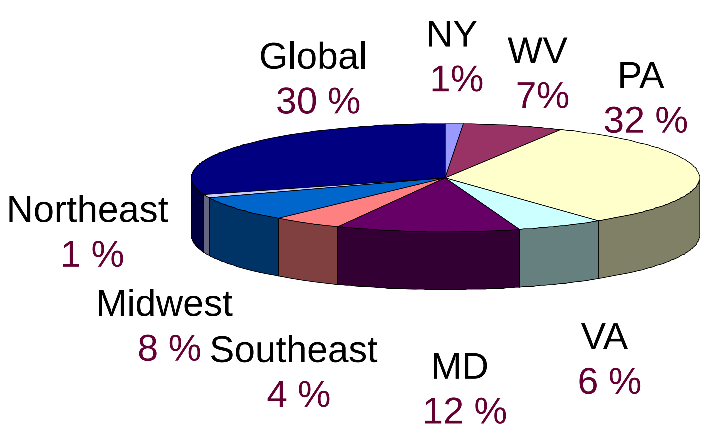
New Mercury Emissions Regulations for the Chesapeake Watershed

The table on the right shows new federal and state regulations that address mercury emissions from coal-fired power plants, the largest remaining atmospheric source in the country. The federal Clean Air Mercury Rule (CAMR) was recently vacated because it failed to meet the rigorous control requirements of the Clean Air Act (www.epa.gov/mercury/). However, many of the states in the Chesapeake watershed have their own regulations that are faster paced and more stringent than CAMR.

Many industrial uses of mercury have been significantly reduced. Manufacturers have removed the mercury in many products including thermometers, switches, and batteries, and mercury concentrations in rain are starting to decline (http://nadp.sws.uiuc.edu/mdn). However, mercury levels in fish in most US states remain unacceptably high (www.epa.gov/mercury/advisories.htm).

Fortunately, new technologies can remove more than 90 percent of mercury from power plant stacks. Activated carbon injection (ACI) is often more than 90% efficient, and is less expensive than anticipated (www.netl.doe.gov/technologies/coalpower/ewr/mercury/index.html). This means that the emissions reductions called for in many state rules are achievable at reasonable cost (0.01 to 0.5 cents/kWh increase in electricity cost). More than 10 percent of U.S. power plants to plan to install ACI by 2008 (www.icac.com/files/public/Commercial_Hg_Equipment_060608.pdf).

Sources of Atmospheric Mercury to the Chesapeake Bay Watershed	
Chesapeake Watershed States	57%
Other US	13%
Global	30%



Regulations by State	
Virginia	64% reduction by 2015
Pennsylvania	80% reduction by 2010 90% reduction by 2015
New York	50% reduction by 2010 90% reduction by 2015
West Virginia	Pending Federal Rule
Maryland	80% reduction by 2010 90% reduction by 2013
U.S. EPA Clean Air Mercury Rule	Vacated

For more information, visit the following websites:

The Chesapeake Bay Program
www.chesapeakebay.net/mercury.aspx?menuitem=19488

Maryland Department of the Environment:
www.mde.state.md.us/air/MD_HAA.asp
http://www.mde.state.md.us/Programs/LandPrograms/Hazardous_Waste/mercury/index.asp

Natural Resources Defense Council
www.nrdc.org/health/effects/mercury/sources.asp

Virginia Department of Environmental Quality
www.deq.state.va.us/p2/mercury/

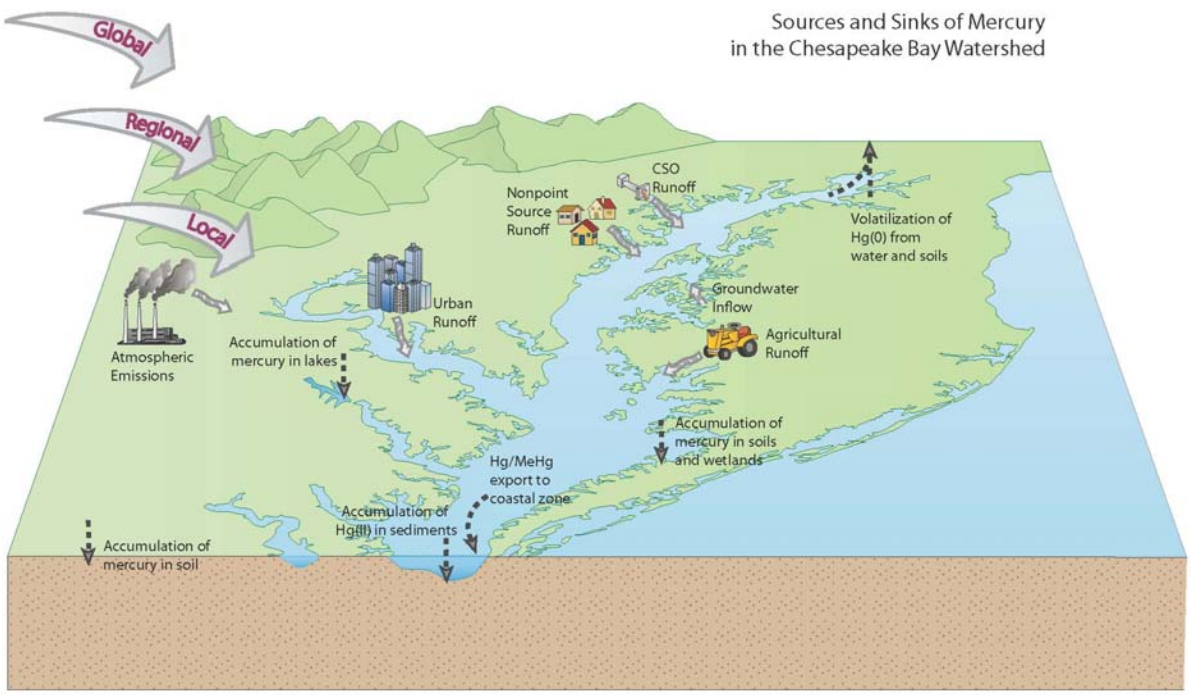
Where does mercury in the Chesapeake watershed come from?

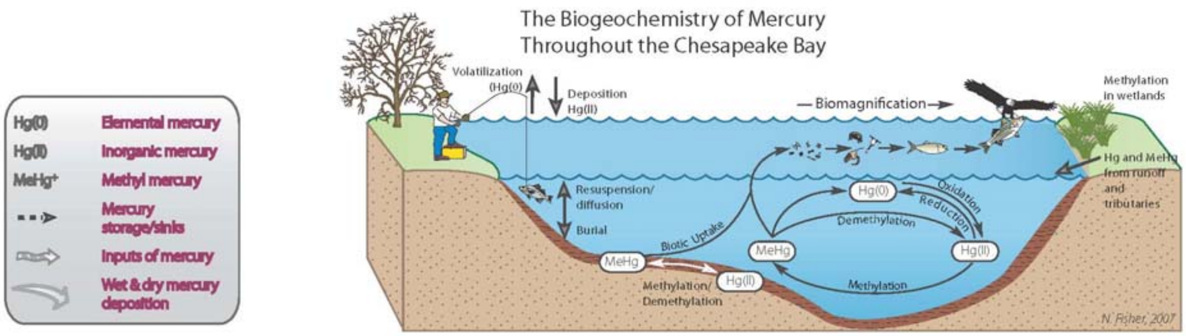
Coal-fired power plants produce roughly 40% of the mercury emissions in the U.S. and in the Chesapeake watershed (http://www.mde.state.md.us/assets/document/mercury.pdf). Other sources include industries that use mercury, re-release from historically contaminated sediment and soils, and natural geological sources. Industrial and household uses that have released mercury include chlorine production, cement production, waste incineration, dentistry, batteries, mercury switches, and paints. Although, many of these sources have been substantially reduced in the US, they have left a legacy of mercury pollution in sediments and soils.

The pie chart and table to the left show the sources of mercury deposited to the Chesapeake Bay watershed. The data come from an atmospheric transport and deposition model constructed for the Maryland Department of Natural Resources (http://www.chesapeake.org/stac/MercuryMaterials/SherwellJohn.pdf).

Although little can be done locally to reduce global sources, controls on those of regional origin should reduce mercury loads to the Chesapeake watershed.

The Mercury Cycle in the Chesapeake and its Watershed





Mercury moves through an elaborate natural biogeochemical cycle. Like opening Pandora's box, human activities have released mercury stored in ores and coal into the biosphere.

Mercury enters the atmosphere through natural processes and from pollution sources. Atmospheric processes can convert mercury to forms that fall to land and water in either rain or through dry deposition. Mercury deposited to the Chesapeake watershed accumulates in soils, and in sediments of lakes, rivers, and the estuary.

A small percentage of the mercury in the environment is converted to the highly toxic and highly bioaccumulated organic form known as methylmercury. Worldwide, methylmercury contamination of fisheries has resulted in more consumption advisories than any other contaminant. Methylmercury production is a natural microbial process, occurring mainly under the anoxic conditions found in aquatic sediments, wetlands, and other wet soils.

Tiny aquatic plants and animals can easily sop up this type of mercury, which concentrates as it moves to higher echelons of the web. Larger, predatory fish can concentrate MeHg until it exceeds levels in the surrounding water by more than a million times.

The sensitivity of an ecosystem to mercury is determined by the ability of that ecosystem to transform mercury deposition into methylmercury in biota. Some ecosystems are much more sensitive than others. The Chesapeake watershed is sensitive to mercury pollution, and it receives a relatively high rate of Hg deposition. The Chesapeake watershed has a high percentage of impervious surfaces that enhance Hg transport into our waters. It also contains large areas of wetlands and aquatic sediments where MeHg production is highest.

The complexity of the atmospheric and biogeochemical cycles of this element, and the widespread impact of Hg on people and ecosystems, necessitates the development of carefully designed Hg monitoring programs to assess the effectiveness of our regulatory actions.

How can we make sure that new regulations on Hg emissions are effective in reducing mercury risk to people and ecosystems?

STAC Workgroup Recommendations for Monitoring the Response to Mercury Emissions Regulations

The only way to determine if new mercury emissions regulations are effective is to monitor mercury and methylmercury in the environment. Although monitoring is in place for mercury in air and rain, the workshop consensus was that existing programs will not be adequate to follow change in emissions or change in our ecosystems.

The workshop steering committee recommended the creation of a structured, watershed-wide monitoring program, based on framework that was developed for a national mercury monitoring program ("Ecosystem Responses to Mercury Contamination: Indicators of Change." (R. Harris, editor, 2007, CRC Press) and Mason et al. 2005 (Monitoring the environmental response to changing atmospheric mercury deposition. Environ. Sci. Technol. 39 14A-22A).

Key components should include:

Emissions Inventories

Require continuous emission monitors for power plants, before and after emissions controls are installed.

Air and Deposition Monitoring

Air, rain and dry deposition monitoring and sites both close to, and remote from sources. Most current deposition sites are remote from sources. Develop methods to measure dry deposition.

Long-term Ecosystem Monitoring

Intensive monitoring at a few long-term ecosystem study sites. Choose sites with a historical record, and local expertise.

Tributary Monitoring

Monitor mercury and methylmercury loads from the tributaries entering the Chesapeake.

Fish Monitoring Programs

All of the Chesapeake Bay states measure mercury levels in fish that people catch and consume, in order to protect public health. The workshop recommended these approaches to strengthen existing fish monitoring programs and to follow change in fish mercury levels through time:

- Begin young-of-the year monitoring to provide information on change in fish mercury levels over time.
- Formalize sampling design and standardize across the region
- Assure that programs collect and report fish size data.
- Analyze total Hg in individual fish or in single-species composites in narrow size range.
- Include formal quality assurance and external expert review of study design and data collection.
- Provide raw data and annual reports of progress online

Wildlife

Assess methylmercury concentrations in terrestrial and aquatic wildlife in the Chesapeake Bay watershed, focusing on species identified as sensitive in other areas of the US.

Funding

Create a long-term funding structure for monitoring programs, including existing monitoring programs like the Mercury Deposition Network. Support pending federal legislation to strengthen funding for programs.

Modeling Mercury in the Chesapeake

Develop numerical modeling tools to predict the impact of mercury pollution reduction programs. Use the Chesapeake Bay Fisheries Ecosystem Model to model mercury flows in food webs. Construct mercury and methylmercury budgets for the Chesapeake Bay. Develop existing biogeochemical modeling framework for the Bay and its watershed.

The group also recommended that Chesapeake Bay Program and Bay State agencies coordinate the mercury monitoring program through a committee of experts and stakeholder, and that the program participate in the developing national mercury monitoring network.

Workshop presentations and detailed recommendations can be found on the STAC workshop web page.
http://www.chesapeake.org/stac/MercuryWorkshop.html