

## A Great Lakes Atmospheric Mercury Monitoring Network

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As many as 51 mercury (Hg) wet-deposition-monitoring sites from 4 networks operated in 8 USA states and Ontario, Canada in the Great Lakes Region from 1996-2010. By 2013, 39 percent of those sites were no longer in operation and approximately half the geographic area of the Region was represented by a single Hg-monitoring site. In response, a Great Lakes Atmospheric Mercury Monitoring (GLAMM) network has been proposed as a framework for regional collaboration in Hg-deposition monitoring. The purpose of the GLAMM network is to detect changes in regional atmospheric Hg deposition related to decreases in Hg emissions. An optimized design for the network was determined to be a minimum of 21 sites in a representative and approximately uniform geographic distribution. A majority of the active and historic Hg-monitoring sites in the Great Lakes Region are part of the National Atmospheric Deposition Program (NADP) Mercury Deposition Network (MDN) in North America and the GLAMM network is planned to be part of the MDN.

To determine an optimized network design, active and historic Hg-monitoring sites in the Great Lakes Region were rated based on 21 factors that included characteristics of the monitoring locations and available Hg data. Monitoring sites were rated according to the number of Hg emissions sources and annual Hg emissions in a geographic polygon centered on each site. Also, monitoring locations were evaluated for proximity to areas with high annual Hg emissions and areas with high average weekly Hg wet deposition. Site ratings considered locations in protected natural areas, urban areas, and Great Lakes watersheds. Hg-monitoring data for the sites were compared based on the magnitude of long-term averages for weekly Hg concentrations in precipitation and weekly Hg-wet deposition, and on significant temporal trends in Hg concentrations and Hg deposition. A cluster analysis method was used to group sites with similar variability in their Hg data in order to identify sites that were unique for explaining Hg data variability in the Region. In a statistical analysis, meaningful correlations in the wet deposition of Hg and sulfate were shown for co-located NADP Hg-monitoring and acid-rain monitoring sites in the Region. This finding indicated that efficiency in regional Hg monitoring can be improved by adding new Hg monitoring to existing NADP acid-rain monitoring sites.

Implementation of the GLAMM network design will require Hg-wet-deposition monitoring to be: (a) continued at 12 MDN sites active in 2013 and (b) restarted or added at 9 NADP sites where it is absent in 2013. Ongoing discussions between the USA states in the Great Lakes Region, the Lake Michigan Air Directors Consortium (a regional planning entity), the NADP, the U.S. Environmental Protection Agency, and the U.S. Geological Survey are aimed at funding and coordinating the GLAMM network.

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