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Asia pumps out more mercury than previously thought

Airborne concentrations of mercury traveling westward from Asia are double previous best estimates, according to the first direct measurements of these emissions, collected last summer on the island of Okinawa by a team of U.S. and Japanese scientists. "These data provide further evidence that we are way off in estimating the global mercury cycle," says chemist Steve Lindberg at the Oak Ridge National Laboratory. "We keep finding new and bigger sources, but we think that levels of elemental mercury in the atmosphere are not increasing."

Asia is the largest source of atmospheric mercury emissions on the planet, according to team member Daniel Jaffe, an atmospheric scientist at the University of Washington in Bothell. During the past 20 years, as mercury emissions have decreased in North America and Europe, mercury levels in Asia have grown steadily, mainly from sources in China, Korea, and Japan. More than half of the global anthropogenic emissions are now from Asia, while Europe and North America contribute about 10% each, according to U.S. EPA estimates. With new mercury point-source regulations expected for the United States this spring, sources from other countries are likely to face increased scrutiny, Jaffe notes.

Atmospheric scientists previously estimated Asian emissions at about 770 tons/year (t/yr) of mercury emissions; however, based on the Okinawa measurements, Jaffe and colleagues now calculate the amount to be 1460 t/yr. Their results were presented in November at the Society of Environmental Toxicology and Chemistry meeting in Portland, Ore.

The scientists monitored emissions at Cape Hedo, the remote northernmost tip of Okinawa. From March 23 to May 2, they measured gaseous elemental mercury, reactive gaseous mercury [Hg(II), RGM], and particulate-bound mercury, along with other combustion pollutants, such as ozone and carbon monoxide. According to Jaffe, the ratio of gaseous elemental mercury to carbon monoxide appears to be a good marker for mercury emissions from Asia. Such a marker provides a signature that can be used in models and at other monitoring stations. Jaffe's group has determined the same ratio at the high-elevation mercury monitoring station on Mt. Bachelor, Ore., and the signature value was previously measured during airplane sampling in 2001.

Levels of RGM were surprisingly low, says Jaffe. "This suggests that mainland China gets hit with high mercury deposition and that mercury may be high in Chinese waters," he adds. The scientists also observed a daily pattern that strongly correlated peak values of RGM with the highest levels of sunlight. This finding suggests that RGM may be related to reactions with halides in the marine boundary layer.

Although Asian sources are major contributors to the global pool of mercury, the low levels of RGM imply that direct long-range transport of Asian mercury is not likely to be a major factor on western North American mercury deposition, says Jaffe. The scientists plan to test this hypothesis in 2005 by measuring mercury species during long-range transport events on the U.S. West Coast. —REBECCA RENNER