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Updated global and oceanic Hg budgets for the United Nations 2018 Global Mercury Assessment

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In support of efforts to reduce Hg levels in humans and wildlife, United Nations - Environment (UNE) is undertaking on-going 5-yearly reviews of the latest science concerning the impacts of anthropogenic emissions on the global Hg cycle. This presentation summarizes the new global and oceanic Hg budgets to be used for the 2018 UNE Global Mercury Assessment.

A major recent debate has been the impact of historical atmospheric emissions on current environmental Hg levels, especially in the oceans. An evaluation of historical information (particularly concerning New World Ag/Au mining in the 15th to late 19th centuries), and atmospheric Hg fluxes in environmental archives, strongly supports the 'low mining emission' scenario proposed by Zhang et al. (2014). Building on a global model using this scenario, this assessment estimates human activities have increased atmospheric Hg concentrations by about 450% above natural levels (here defined as before 1450 AD). This represents an increase of 3600 t in atmospheric Hg mass above the natural value of 800 t, for a total current mass of 4400 t. Current anthropogenic emissions to air are estimated at 2500+/-500 t/y.

The increase in atmospheric Hg concentrations has driven a ∼300% increase in average deposition rates to the Earth's surface. This is the largest source of Hg (∼90%) entering the surface ocean; rivers are a minor contribution. Surface marine waters have shown a 230% increase above natural levels. The anthropogenic effect on Hg in surface soils (∼15% increase) is an order of magnitude lower due to the large mass of natural Hg present in soils from rock weathering. Deeper marine waters show increases of only 12–25% above natural levels owing to the slow rate of penetration of anthropogenic Hg into the large deep water reservoir. Even using the low mining emission scenario, the cumulative effect on today's oceanic Hg cycle of several centuries of anthropogenic emissions has been dramatic, with about two-thirds of the overall increase in marine Hg concentrations estimated to have occurred before 1920 (mainly due to precious metal mining and associated cinnabar refining). About 20% of the overall increase is due to coal combustion since 1920, and another ∼10% to other industrial activities. Marine Hg concentrations are expected to show a slow recovery following regulatory reductions in global anthropogenic Hg emissions (on the order of decades to centuries depending on the ocean basin and the trajectory of reductions).