**Using Quantile Regression to Detect Regional and Global Signals in Atmospheric Mercury Trends**

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Mercury (Hg) is a neurotoxic contaminant that bioaccumulates in the marine food chain. 137 countries are now parties to the Minamata Convention on Mercury, which aims to combat growing risks of Hg pollution to human health and the environment. Atmospheric Hg trends over time serve as important indicators in evaluating the effectiveness of the Minamata Convention. However, there are several challenges associated with interpreting observed atmospheric Hg time series, including: data gaps, few long-term (>10 years) time series, analytical uncertainties in the measurements, meteorological variability, and the representativeness of measurement sites for broader spatial scales. Novel statistical techniques, including generalized additive models, dynamic linear modelling, and meteorological ensembles, have shown potential in recent atmospheric trends studies for overcoming these challenges; however, many of these promising techniques have yet to be applied to Hg time series. Harnessing such state-of-the-art statistical approaches, we analyze atmospheric Hg measurements for 1990–present in a regression-based framework to produce more accurate assessments of trends and their uncertainties. We apply quantile regression to analyze difference in Hg trends from the 5th–95th percentiles. We hypothesize that lower percentile (e.g., 5th) trends are more indicative of trends in background Hg on the hemispheric scale, whereas higher percentile trends (e.g., 95th) are more indicative of local or regional emission changes. Indeed, observed and simulated trends from North American sites generally show strongly decreasing 95th percentile trends and stagnant 5th percentile trends, illustrating that regional emissions have decreased while hemispheric trends have stayed stagnant or increased. Using companion simulations in the global atmospheric Hg model GEOS-Chem, we analyze the sensitivity of available Hg measurement time series to trends in anthropogenic Hg emissions.