IMPACT OF BASIN SCALE AND TIME-WEIGHTED MERCURY METRICS ON INTRA-/INTER-BASIN MERCURY COMPARISONS

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Understanding anthropogenic and environmental controls on fluvial Mercury (Hg) bioaccumulation over global and national gradients can be challenging due to the need to integrate discrete-sample results from numerous small scale investigations. Two fundamental issues for such integrative Hg assessments are the wide range of basin scales for included studies and how well discrete samples capture the characteristically high temporal variability of fluvial biogeochemistry, seasonally and over shorter time spans.

To assess inter-comparability of fluvial Hg observations at substantially different scales, Hg concentrations, yields, and bivariate-relations were evaluated at nested-basin locations in the Edisto River, South Carolina and Hudson River, New York. Differences between scales were observed for filtered methylmercury (FMeHg) in the Edisto (attributed to wetland coverage differences) but not in the Hudson. Total mercury (THg) concentrations and bivariate-relationships did not vary substantially with scale in either basin. Results indicated that small (<80 km^2) basin studies provide a reasonable foundation for development of orders of magnitude up-scaled conceptual or numerical models for application at large-basin and regional scales with comparable landscape characteristics. Combined with the lack of significant correlation between study basin size and estimates of mean annual FMeHg concentration across a national gradient, these results indicate that differences in basin scale as such are not a primary concern when integrating individual study results over global and national gradients if geospatial measures of wetland coverage and stream connectivity are included.

The inability to use automated sampling procedures for ultra-clean MeHg sampling and the cost of MeHg analyses preclude continuous or near-continuous MeHg sampling and substantially limit the number of collected discrete MeHg water samples. Thus, the representativeness of discrete sampling regimes is a fundamental concern in fluvial environments, which typically exhibit much more spatial and temporal variability in Hg concentrations than do lacustrine systems. Consistent with numerous previous studies, fish Hg correlated strongly with sampled water FMeHg concentration ($\rho = 0.78$; $p = 0.003$). However, improved correlation ($\rho = 0.88$; $p < 0.0001$) was achieved with time-weighted mean annual FMeHg concentrations estimated from basin-specific LOADEST models and daily streamflow. The results of this study illustrated that continued optimization of numerical tools to interpolate Hg concentrations over select life-cycle time periods will improve our understanding of the linkages between fluvial Hg concentrations and bioaccumulation.

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Citation for proceedings: Stringer, Christina E.; Krauss, Ken W.; Latimer, James S., eds. 2016. Headwaters to estuaries: advances in watershed science and management—Proceedings of the Fifth Interagency Conference on Research in the Watersheds. March 2-5, 2015, North Charleston, South Carolina. e-Gen. Tech. Rep. SRS-211. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 302 p.