SIMULATING MERCURY AND METHYL MERCURY STREAM CONCENTRATIONS AT MULTIPLE SCALES IN A WETLAND INFLUENCED COASTAL PLAIN WATERSHED (McTIER CREEK, SC, USA)

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Mercury (Hg) is the toxicant responsible for the most fish advisories across the United States, with 1.1 million river miles under advisory. The processes governing fate, transport, and transformation of mercury in streams and rivers are not well understood, in large part, because these systems are intimately linked with their surrounding watersheds and are often highly spatially variable. In this study, we apply a linked watershed hydrology and biogeochemical cycling (N, C, and Hg) model (VELMA, Visualizing Ecosystems for Land Management Assessment) to simulate daily flow, fluxes, and soil and stream concentrations of total mercury (THg) and methyl mercury (MeHg) at multiple spatial scales in McTier Creek within the Edisto River basin. The Edisto River basin is in the Coastal Plain of South Carolina, USA, and is characterized by low stream-gradients and extensive riparian wetlands with some of the highest top predator fish tissue Hg concentrations in the USA. By linking hydrology with N, C, and Hg cycling, the VELMA model can capture the importance of hydrology in linking watershed and wetland Hg to the stream Hg concentrations as well as the importance of dissolved organic carbon in transport. In this study, we (1) used field study data to calibrate and simulate Hg fate and transport processes at a reach scale (0.1 km^2), (2) applied this calibrated parameter set at larger watershed scales including two headwater sub-watersheds (28 km^2 and 25 km^2) nested within the McTier Creek watershed (79 km^2), and (3) evaluated how accurate the reach-scale parameters and processes are when scaled up to larger scales. The results of the VELMA multi-scale simulations suggest that water column stream THg concentration predictions matched observations reasonably well at different scales using reach-scale calibrations, but the model simulations of MeHg stream concentrations at reach, sub-watershed, and watershed pour points are out-of-phase with observed MeHg concentrations. This result suggests that processes governing MeHg loading to the main channel may not be fully represented in the current model structure and underscores the complexity of simulating MeHg dynamics in watershed models as well as the need for a better understanding of processes governing methylation and MeHg transport. This work demonstrates the importance of hydrology in understanding Hg fate in watersheds and streams and the influence of out-of-channel versus in-channel processes.

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