Modeling Bank Erosion, Mercury Methylation/Demethylation, and Subsequent Receiving Water Impacts

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The Carson River in west-central Nevada is one of the most mercury contaminated fluvial systems in North America. Most of its mercury is affiliated with channel bank material and floodplain deposits, with the movement of mercury through this system being highly dependent on sediment transport processes. Laboratory experiments and field data collection have independently led to an understanding of the relationship between bank moisture history and mercury methylation/demethylation. Prior efforts have resulted in an integrated mercury modeling program which incorporates the U.S. EPA hydrodynamic model (RIVMOD) and water quality model (WASP5/MERC4). The dynamic response of methylating and demethylating microbial communities to bank moisture drove the development of bank elements that predict soil moisture history and its impact on methyl-mercury formation. The agreement between model predictions and water column mercury observations, over extensive spatial and temporal domains with flow regimes varying by three orders of magnitude, is quite good. The degree of agreement is particularly satisfying in light of the limited number of model calibration parameters. Finally, Monte Carlo simulation will be used to define the range of model outcomes based upon uncertainty in channel bank erosion rates, with the envelope of predicted outcomes defining our ability to accurately predict system state.