Hydrological Controls on Methylmercury Distribution and Flux in a Tidal Marsh

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Methylmercury (MeHg) is a global pollutant that affects human and ecosystem health. It is recognized that coastal environments significantly contribute to the net production of MeHg and regional mercury cycling. We combined field measurements, geochemical analyses, and 3-D surface water-groundwater numerical modeling to study the distribution and flux of "dissolved" (0.45 μm filter-passing) MeHg and associated hydrological factors in a tidal marsh in the San Francisco Bay Estuary. We found surface water MeHg concentrations varied in the tidal channel sytem during low tide and reflected the combined effects of groundwater exfiltration and shallow pond discharge to tidal channels. Pore water MeHg concentrations were elevated in the root zone of marsh vegetation with low hydraulic conductivity sediments where unsaturated conditions were persistent over a tidal cycle. Overland flow played an important role in marsh-estuary exchange of filter-passing MeHg, accounting for 20.4% of total exchange during flood tide and 82.2% during ebb tide. Estuary-ward net flux of filter-passing MeHg was 5.3±2.6 ng m^{-2} during a 12-hr tidal cycle. This indicates an annual load of 0.62±0.30 kg from all present tidal marshes in this estuary, which is lower than prior estimates of MeHg loads from tidal marshes, estuary sediment, local watersheds, or submarine groundwater discharge.