3.090 Present and future mercury concentrations in Chinese rice: Insights from modeling.

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Abstract:

Rice consumption is more important methylmercury mercury exposure pathway to certain Chinese populations compared to fish consumption. However, little is known about the sources and biogeochemical processes governing rice mercury levels. We construct a rice paddy biogeochemical cycle model to simulate mercury sources and biogeochemical processes in rice paddies, and to understand factors influencing spatiotemporal variability in Chinese rice mercury concentrations. The rice paddy model takes atmospheric mercury deposition, simulated from a global atmospheric-chemistry-transport model (GEOS-Chem), and soil and irrigable surface water mercury concentrations obtained from literature to calculate rice inorganic (IHg) and methylmercury (MeHg) concentrations. We use future atmospheric mercury deposition--no-policy and strict-policy to regulate mercury emissions from Chinese coal-fired power plants under the Minamata Convention on Mercury -- to simulate future rice IHg and MeHg concentrations. Our rice paddy model suggests that a portion of IHg in rice comes directly from the atmosphere and via infiltration. The rate of internal methylation via microbial activity has the largest modeled influence on rice MeHg concentration. While atmospheric deposition is an important rice mercury source, we find that soil mercury and the rate of desorption explain observed spatial variability in rice IHg and MeHg concentrations and captures locations of rice mercury hotspots (> 20 ng/g; China National Standard Limit). Under our future scenarios, the Chinese median rice IHg and MeHg concentrations increase by 13% and decrease by 18% under no-policy and strict-policy, respectively. Central China exhibits the largest percentage decline in rice IHg and MeHg concentrations under strict-policy and demonstrates high rice mercury concentrations, rice production, and consumption. Our study suggests that addressing Chinese rice mercury contamination requires both soil remediation and regulation of anthropogenic mercury emissions.