

Modeling marine mercury cycling – a discussion of current capabilities, uncertainties and limitations

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For the effectiveness evaluation of the Minamata Convention, a key question is to understand the impact of external drivers (e.g. anthropogenic emission reductions, climate change) on methylmercury accumulation in sea food. Thus, in recent years the development and improvement of marine Hg models has become a pressing issue. We argue that before we can use such models to project the fate of Hg in the marine environment it is necessary to determine and understand the predictability of mercury species. This knowledge is well established for atmospheric Hg models but currently lacking for models of Hg in water and biota. Moreover, detailed studies of Hg cycling are deemed necessary to develop simplified and thus more performant mechanisms for the use in global models.

Here, we show results of the high-resolution ocean-ecosystem-chemistry model MECOSMO. MECOSMO is the first model to explicitly resolve all known processes relevant to marine mercury cycling with resolutions of 1km to 100km. With the rigor usually applied to ‘classical’ pollutants in atmospheric chemistry transport models such as ozone and particulate matter, we investigate the capability to reproduce observed concentrations for all relevant mercury species (including short- and long-term variability). We evaluate the capabilities and limitations of models based on the current knowledge of marine Hg cycling. Using different chemical mechanisms, reaction rates, and parametrizations we identify the main sources for uncertainty in the model with the aim to inspire future observational studies to address these issues and supply central parameters needed to improve marine Hg models.

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