1. Introduction

- Rivers discharge 28 ± 13 Mmol a⁻¹ of Hg to the ocean, comparable to inputs from global atmospheric deposition (10 - 29 Mmol a⁻¹).
- Differences in the geochemical forms of Hg affect removal from the water column, redox processes, and bioavailability for methylation.
- Large spatial heterogeneity exists for riverine Hg discharge and its transport in the ocean.
- We use a 3-D model for oceanic Hg to investigate how ocean transport and interactions between Hg and natural organic matter affect the fate of river-derived Hg.
- We determine if the large observed summertime evasion from the Arctic Ocean can be reconciled with a smaller riverine source.

2. Model Description

- A new oceanic Hg simulation with the MITgcm.
- 36 km resolution and 50 vertical layers for the Arctic Ocean.
- 1°x1° resolution and 23 vertical levels elsewhere.
- Coupled with the biogeochemical cycle of organic carbon and associated marine plankton ecosystem (the DARWIN project; Dutkiewicz et al., 2009).
- Present-day river inputs based on Amos et al. (2014).
- Hg°: 0.87±0.29 Mmol a⁻¹, Hg²⁺: 27±13 Mmol a⁻¹.
- Fraction of Hg° refractory depends on suspended load (Blair and Aller, 2012).
- Burial of riverine particles in estuarine sediments using the typology system developed by Walsh and Nittouer (2009).
- Different fractions (10-60%) of sediment exported beyond the estuarine environment.

3. Model Evaluation

- The model reasonably reproduces observed spatial patterns of surface ocean total Hg concentrations.

4. Reactivity of riverine Hg

- The fate of riverine Hg is highly sensitive to the fraction of the Hg° pool that is specified as refractory in nature.
- Mid- and low-latitude riverine Hg° is dominant by refractory pool, otherwise, too high evasion unsupported by observations.
- Hg° from Arctic rivers is more labile because of the much lower suspended load and faster remineralization.

5. River signal in the ocean

6. Fate of Hg from Arctic rivers

- The two largest contributors: Yellow and Yangtze Rivers (33% of global total). Little (2.6%) is exported due to blockage of landmass.
- Reach of river plumes is enhanced by the Gulf Stream and the Kuroshio (e.g. 25% is exported from North American rivers).
- Hg from Arctic rivers preferentially accumulates in the coastal regions.

References

- Dastoor A. P. and Durnford D.A., Arctic ocean is it a sink or a source of atmospheric mercury? ES&T, 48, 1707-1717, 2014.

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