METHYLMERCURY CYCLING AT THE SURFACE OF THE SEA: INTERACTION OF RAIN AND SEAWATER

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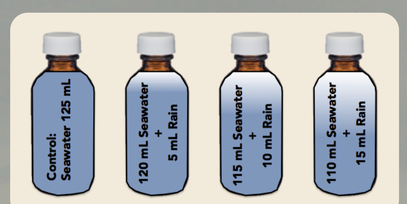
MOTIVATION:
Methylated mercury can efficiently bioaccumulate in marine organisms even when seawater concentrations are extremely low (pg/L). It is therefore critical to understand which factors can significantly influence its stability in surface ocean. While photodegradation has been the main process reported to degrade MeHg in surface ocean (DiMento & Mason 2017), we suggest that there are additional mechanisms to be considered.

STUDY AIM:
Evaluate the interaction of rain with seawater in microcosm experiments.

OVERARCHING HYPOTHESIS:
Wet deposition, i.e. rain, to the sea surface could cause changes in mercury (Hg) speciation through processes other than dilution.

EXPERIMENTAL DESIGN:
Seawater and rain mixed at different proportions with final volume of 125 mL per bottle (x3 replicates per treatment –see cartoon below) and immediately acidified (hydrochloric acid final conc. 0.5% v/v). Samples were digested with sulfuric acid (final conc. 1% v/v) prior to analysis by direct ethylation using Tekran 2700 system (Munson et al. 2014).



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Mixing of seawater with rain can result in an 80% decline of total methylmercury concentration through processes other than dilution.

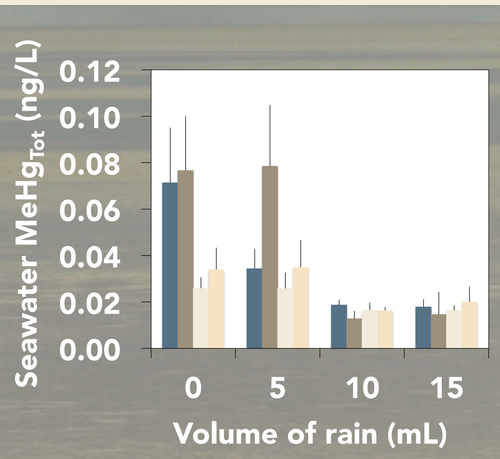

FIGURE 1: Declining mean (error bar = 1 standard deviations) as the proportion of rain increases. Max average decline of 81%. Find the color legend in Table 1. Detection limit for $MeHg_{Tot}$ was 0.011 ng/L.

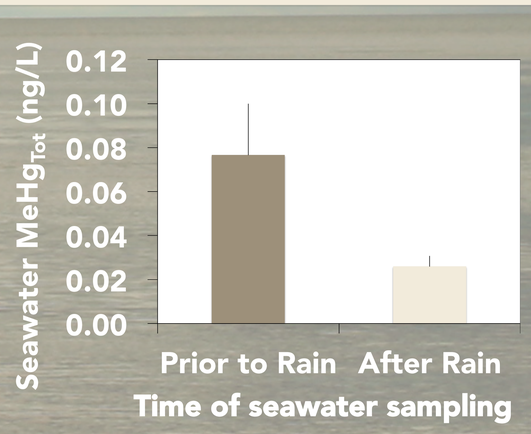

FIGURE 2: A 77% decline in $MeHg_{Tot}$ concentration from before to after the rain. Colors correspond to Experiments 2 and 3 – see Table 1.

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Table 1: Information about the experiments including characterization of storm types and rain properties. Left - color legend relates to Figure 1.

Experiment	Rain Date	Storm Type	THg in Rain (ng/L)	NO_3^- in Rain (μM)	Seawater collected Before or After Rain
Expt.1	9/6/18	Squall Line	30.7	37.7	Before
Expt.2	9/10/18	Hurricane Remnants	3.5	4.6	Before
Expt.3					After
Expt.4	9/17/18	Extratropical Cyclone	1.7	7.2	Before

Table 2: The % of initial $MeHg_{Tot}$ concentration as proportion of rain increases from 0 to 12.5% (i.e. 15 mL rain in 125 mL of seawater) for each of the 4 experiments – see Table 2.

Volume of rain added to seawater (mL)	Expt. 1	Expt. 2	Expt. 3	Expt. 4
	% of initial $MeHg_{Tot}$ concentration			
0	100	100	100	100
5	48	102	100	103
10	26	17	63	48
15	25	19	63	59

References: B. DiMento and R.P. Mason (2017) Factors controlling the photochemical degradation of methylmercury in coastal and oceanic waters. Marine Chemistry 196; 116-125. Munson, K.M., Babi, D., Lamborg, C.H., 2014. Determination of monomethylmercury from seawater with ascorbic acid-assisted direct ethylation. Limnology and Oceanography: Methods 12 (1); 1-9.