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Do oceanic emissions account for the missing source of atmospheric carbonyl sulfide?

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Carbonyl sulfide (OCS) has a large potential to constrain terrestrial gross primary production (GPP), one of the largest carbon fluxes in the carbon cycle, as it is taken up by plants in a similar way as CO_2. To estimate GPP in a global approach, the magnitude and seasonality of sources and sinks of atmospheric OCS have to be well understood, to distinguish between seasonal variation caused by vegetation uptake and other sources or sinks. However, the atmospheric budget is currently highly uncertain, and especially the oceanic source strength is debated. Recent studies suggest that a missing source of several hundreds of Gg sulfur per year is located in the tropical ocean by a top-down approach. Here, we present highly-resolved OCS measurements from two cruises to the tropical Pacific and Indian Ocean as a bottom-up approach. The results from these cruises show that opposite to the assumed ocean source, direct emissions of OCS from the tropical ocean are unlikely to account for the missing source. To reduce uncertainty in the global oceanic emission estimate, our understanding of the production and consumption processes of OCS and its precursors, dimethylsulfide (DMS) and carbon disulphide (CS2), needs improvement. Therefore, we investigate the influence of dissolved organic matter (DOM) on the photochemical production of OCS in seawater by considering analysis of the composition of DOM from the two cruises. Additionally, we discuss the potential of oceanic emissions of DMS and CS2 to closing the atmospheric OCS budget. Especially the production and consumption processes of CS2 in the surface ocean are not well known, thus we evaluate possible photochemical or biological sources by analyzing its covariation of biological and photochemical parameters.