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Oceanic isoprene and DMS distributions during low-productive conditions in the Indian Ocean

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Despite their low abundances compared to the long lived greenhouse gases such as carbon dioxide and methane, short-lived trace gases produced in the oceans have been recognized as playing an important role in atmospheric chemistry and climate. Both isoprene and dimethylsulfide (DMS) are biogenic trace gases produced in the ocean and due to their supersaturation in the surface ocean are emitted to the atmosphere. Once emitted, they produce secondary organic aerosols via fast oxidation processes in the atmosphere (isoprene has a lifetime on approximately 1 hour and DMS 1 day). Consequently, both are hypothesized to significantly impact the radiative balance of the marine atmosphere. However, the strength of this impact is controversial. It is known that the emissions of these compounds to the atmosphere are critically controlled by surface ocean biogeochemical and physical factors which are, especially for isoprene, poorly quantified and unpredictable. Therefore, in order to more fully understand the role of isoprene and DMS on the marine atmosphere, more studies of their distributions, controlling factors, and air-sea exchange are urgently needed.

Here we present preliminary measurements of isoprene and DMS concentrations from the SPACES and OASIS campaigns onboard the R/V Sonne that took place from July 8th to August 7th starting in Durban, South Africa and ending in Malé, Maledives. An improved purge and trap technique coupled with a gas chromatograph-mass spectrometer (GC-MS) was used to measure isoprene and DMS in one run for both surface and depth profile samples. In addition, an atmospheric pressure chemical ionization mass spectrometer (AP-CIMS) was used to perform continuous surface measurements of these compounds. The discrete surface measurements were made every three hours using a submersible pump located in the ship's moonpool at 6 m depth. For depth profile measurements samples were taken from 5 m to about 100 m depth. There have been no reported measurements of isoprene concentrations in this part of the Indian Ocean. The mean measured concentrations of isoprene and DMS generally stayed at low levels of $<$ 20 pmolL-1 and average levels of $\sim$ 1 nmolL-1, respectively. During three 24 hour stations with 3 hourly underway sampling and 6 hourly CTD-casts, we observed that isoprene concentrations were highest in the same depth as the chlorophyll-a maximum, while DMS concentrations always peaked slightly above the chlorophyll-a maximum. During a 48h-station we performed 8 CTD stations in order to investigate isoprene and DMS diurnal cycling within the 2 days in the euphotic zone. With this analysis we contribute to a better understanding of distributions of isoprene and DMS as well as biogeochemical cycling of these volatile compounds and their possible impact on the chemistry of the atmosphere by air-sea gas exchange.