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Using eddy covariance and Earth observation products to investigate the Indian Ocean as a source/sink of trace gases to the atmosphere

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According to well known climatologies for CO_2 and DMS, the southwest Indian Ocean shows strong seasonality in surface water concentrations. Available CO_2 observations show values around equilibrium from November to April, followed by a strong decrease that results in an undersaturation of around 80 μatm in July/August. Consequently, this area is an important sink for atmospheric CO_2. In contrast this region is predicted to be a hotspot for DMS emissions. Maximum surface concentrations are expected in northern hemisphere winter (NH). However, the air-sea gas exchange is largely influenced by the monsoon circulation, hence it is computed to peak in June/July. Furthermore these climatologies are based on low spatial and temporal resolution observations, which is especially important when dealing with a seasonally reversing ocean-atmosphere system. Given the evidence that the Indian Ocean is changing faster than other ocean basins, it is important to understand the mechanisms that drive air-sea exchange in this significant sink/source region.

Here we present preliminary data obtained during a cruise starting in Durban, South Africa and ending in Male, Maledives, from July to August 2014. For the first time, eddy covariance air-sea fluxes and concentration gradient measurements for CO_2 and DMS were obtained simultaneously in the southwestern Indian Ocean. We will derive gas transfer coefficients (k) from these direct measurements and correlate with wind speed (u) and other parameters measured on board in order to investigate the mechanisms behind gas transfer. Furthermore, we will examine the intercomparison of DMS and CO_2 so as to focus on the effect of solubility on gas exchange. In addition, we will use a range of outputs from remote sensing platforms to assist the interpretation of the in situ data (e.g. significant wave heights, existence of diurnal warming, impact of SST skin on the CO_2 fluxes, rain frequency and intensity, existence of SST fronts). The correction of k values for the ocean skin temperature and the effect of rain on gas transfer processes are of special interest in this region, given the high degree of warming and the monsoon circulation in the Indian Ocean.