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Free tropospheric observations of Carbonyl Sulfide from Aura Tropospheric Emission Spectrometer over ocean

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Carbonyl sulfide (OCS) is the most abundant sulfur gas in the troposphere with a global averaging mixing ratio of about 500 part per trillion (ppt). The ocean is the primary source of OCS, emitting OCS directly or its precursors, carbon disulfide and dimethyl sulfide. The most important atmospheric sink of OCS is uptake by terrestrial plants via photosynthesis. Although the global budget of atmospheric OCS has been studied, the global integrated OCS fluxes have large uncertainties, e.g. the uncertainties of the ocean fluxes are as large as 100% or more and how the ocean sources are distributed is not well known.

We developed a retrieval algorithm for free tropospheric carbonyl sulfide (OCS) observations above the ocean using radiance measurements from the Tropospheric Emission Spectrometer (TES). These first observations of the free tropospheric OCS provide global maps with information of OCS seasonal and spatial variability in the mid troposphere. These data will help to characterize ocean OCS fluxes. Evaluation of the biases and uncertainties in the TES OCS estimates against aircraft profiles from the HIPPO campaign and ground data from the NOAA Mauna Loa site suggests that the OCS retrievals (1) have less than 1.0 degree of freedom for signals (DOFs), (2) are sensitive in the mid-troposphere with a peak sensitivity typically between 300 to 500 hPa, (3) and have much smaller systematic errors from temperature, CO_2 and H_2O calibrations relative to random errors from measurement noise. Here we estimate the monthly means from TES measurements averaged over multiple years so that random errors are reduced and useful information about OCS seasonal and latitudinal variability can be derived. With this averaging, TES OCS data are found to be consistent (within the calculated uncertainties) with NOAA ground observations and HIPPO aircraft measurements and captures the seasonal and latitudinal variations observed by these in situ data within the estimated uncertainties. This TES OCS monthly data will be used to constrain the ocean flux, understand the tropical ocean variability (e.g., west-east contrast over the Pacific).