5.067 Sources and impacts of short-lived OVOC in the remote tropical marine troposphere.

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Abstract:

The tropical free troposphere is a key atmospheric environment to understand chemistry-climate interactions. About 75% of the tropospheric ozone (O_3) and methane (CH_4) loss occurs at tropical latitudes. There is a particular need to understand the emissions and chemistry of tropospheric halogens and organic carbon in pristine remote environments, because they influence the reactive chemical removal pathways of climate active gases, and can modify aerosols that affect Earth’s radiation balance. About 45 per cent of the variance of aerosol forcing since about 1750 arises from uncertainties in natural emissions.
Recently, field measurements over the remote tropical Eastern Pacific ocean were conducted using aircraft and ships during the Tropical Ocean tRoposphere Exchange of Reactive halogen species and Oxygenated VOC (TORERO) field campaign (Jan/Feb 2012). We have shown that tropospheric halogen chemistry has a larger capacity to destroy O_3 and oxidize atmospheric mercury than previously recognized. Halogen chemistry is currently missing in most global and climate models, and helps explain the low O_3 levels in preindustrial times. Marine emissions of organic carbon include VOCs (isoprene, monoterpenes), primary organic aerosol (POA), dimethylsulfate (DMS), and oxygenated hydrocarbons (OVOC, i.e., acetaldehyde, acetone, methanol, aliphatic aldehydes, and

glyoxal). Notably, the sum of acetaldehyde and glyoxal emissions accounts for >60% of the overall marine organic carbon emissions. However, the source mechanism for these OVOC is currently poorly understood.

The experimental results from TORERO are summarized, and used in conjunction with models to quantify the atmospheric implications of the measured OVOC and halogen radical abundances for O_3 loss, HO_x radical sources, oxidative capacity, and bromine radical sinks. Our results suggest that ocean impacts on the upper free troposphere are underestimated, and that the chemistry of tropospheric halogens and OVOC is more closely coupled than previously believed. Our understanding of the biogeochemical cycle of marine organic carbon is incomplete.