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Oxygenated hydrocarbon observations in the tropical free troposphere: Field evidence for a missing biogeochemical cycle of marine organic carbon?

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The amount of dissolved organic carbon (DOC) contained in the world's oceans is comparable to that of atmospheric CO_2. Yet oceans are currently believed to be a net-receptor for organic carbon that is emitted over land. Organic carbon is relevant in the atmosphere because it influences the reactive chemical removal pathways of climate active gases (i.e. ozone, methane, dimethyl-sulfide), and can modify aerosols (e.g., secondary organic aerosol, SOA). Recent our observations of very short-lived and very water soluble oxygenated hydrocarbons, like glyoxal, in the remote marine boundary layer (MBL) above the Pacific Ocean (Sinreich et al., 2010, ACP) remain as of yet unexplained by atmospheric models. Here we present recent measurements of trace-gases over the Eastern tropical and subtropical Pacific Ocean in the Southern Hemisphere, and show that small oxygenated molecules (glyoxal, methyl ethyl ketone, butanal) from marine sources are widespread over the remote oligotrophic ocean, and also in the free troposphere. The data were collected as part of the Tropical Ocean tRoposphere Exchange experiment TORERO during Jan/Feb 2012 by means of an innovative payload of optical spectroscopic-, mass spectrometric-, and remote sensing instruments aboard the NSF/NCAR GV aircraft (HIAPER), and aboard a NOAA ship. We investigate the source mechanism, present source estimates of the organic carbon flux, and compare it with other sources of organic carbon from marine sources. We also present results from numerical models that suggest a strong impact of these molecules on the oxidative capacity of the tropical free troposphere, where most of tropospheric ozone mass resides, 60-80% of the global methane destruction occurs, and mercury oxidation rates are accelerated at low temperatures.