Geophysical Research Abstracts
Vol. 18, EGU2016-7918-1, 2016
EGU General Assembly 2016

Interactions between volatile organic compounds and reactive halogen in the tropical marine atmosphere using WRF-Chem

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Halogen species (chlorine, bromine and iodine) are known to play an important role in the chemistry and oxidizing capacity of the troposphere, particularly in the marine boundary layer (MBL). Reactive halogens cause ozone (O_3) destruction, change the HO_x and NO_X partitioning, affect the oxidation of volatile organic compounds (VOCs) and mercury, reduce the lifetime of methane, and take part in new particle formation. Numerical models predicted that reactive halogen compounds account for 30% of O_3 destruction in the MBL and 5-20% globally.

There are indications that the chemistry of reactive halogens and oxygenated VOCs (OVOCs) in the tropics are inter-related. Moreover, the presence of aldehydes, such as glyoxal (CHOCHO), has a potential impact on radical cycling and secondary organic aerosol (SOA) formation in the MBL and free troposphere (FT). Model calculations suggest aldehydes to be an important sink for bromine atoms and hence competition for their reaction with O_3 forming BrO and so illustrating a link between the cycles of halogens and OVOCs in the marine atmosphere.

The main objective of this contribution is to investigate the atmospheric chemistry in the tropical East Pacific with a focus on reactive halogens and OVOCs and their links using the latest version of the Weather Research and Forecasting (WRF) model coupled with Chemistry (WRF-Chem) and field data from the TORERO campaign. WRF-Chem is a highly flexible community model for atmospheric research where aerosol-radiation-cloud feedback processes are taken into account. Our current reaction mechanism in WRF-Chem is based on the MOZART mechanism and has been extended to include bromine, chlorine and iodine chemistry. The MOZART mechanism includes detailed gas-phase chemistry of CHOCHO formation as well as state-of-the-science pathways to form SOA. Oceanic emissions of aldehydes, including CHOCHO, and of organic halogens based on measurements from the TORERO campaign have been added into the model. Sea surface emissions of inorganic iodine are calculated using the parameterisation of Carpenter et al., 2013.

Focusing on TORERO observations from the ships and a selected number of flights we present an evaluation of the relevant tropospheric gas-phase chemistry (O_3, H_2O), inorganic halogen species (BrO, IO), aldehydes (CH_3CHO, CHOCHO) and Very Short Lived Halocarbons (VSLH).