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Importance of reactive halogens 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 participate in catalytic reaction cycles that efficiently destroy O_3, 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. Up to 34% of O_3 loss in the tropical East Pacific is due to I and Br combined. Recent studies have highlighted the key role that heterogeneous chemistry plays in explaining observations of BrO and IO abundances in the tropical troposphere.

The main objective of this study is to investigate the atmospheric chemistry in the tropical East Pacific with a focus on reactive halogens using the Weather Research and Forecasting model coupled with Chemistry (WRF-Chem) and field data from the TORERO campaign. Our reaction mechanism in WRF-Chem is based on the MOZART mechanism and has been extended to include bromine, chlorine and iodine chemistry. Heterogeneous recycling reactions involving sea-salt aerosol and other particles have been included into the model, along with oceanic emissions of important OVOCs and halocarbons. 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 the tropospheric impacts of halogens (BrO, IO) in the tropospheric chemistry of relevant species (O_3, OH and OVOCS). Sensitivity runs are made in order to study the impact of heterogeneous chemistry in the iodine and bromine species partitioning. A comparison between the online calculation of Very Short Lived Halocarbons (VSLH) oceanic emissions with prescribed oceanic emissions is also presented.

Results show that a better performance in O_3 concentrations is obtained with the inclusion of halogens. We see a big impact on the Bry partitioning with an improvement of modelled BrO when the heterogeneous chemistry is included. An improvement of our model results is seen when online oceanic emissions are computed.