



Inorganic bromine and iodine in the TTL and in the mid-latitude lower stratosphere

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Tropospheric chemistry of halogens (bromine and iodine) over tropical oceans modifies ozone and atmospheric aerosols, yet atmospheric models remain largely untested for lack of vertically resolved measurements of bromine monoxide (BrO) and iodine monoxide (IO) in the tropical troposphere. We present recent field measurements of BrO, IO, and their organic precursors that were conducted within the framework of the Tropical Ocean Troposphere Exchange of Reactive halogen species and Oxygenated volatile organic compounds (TORERO, Jan/Feb 2012) over the tropical Eastern Pacific Ocean (tEPO). TORERO deployed an innovative payload of optical spectroscopic-, mass spectrometric-, and remote sensing instruments aboard the NSF/NCAR GV aircraft (HIAPER) with the objective to probe the composition of the TTL. BrO and IO were measured by the University of Colorado Airborne Multi AXis Differential Optical Absorption Spectroscopy (CU AMAX-DOAS) instrument, organic precursor gases by the Trace Organic Gas Analyzer (TOGA), and in situ aerosol size distributions by an Ultra High Sensitivity Aerosol Spectrometer (UHSAS); other parameters were also measured on the aircraft and used to constrain a photochemical box model to infer BrY. The measured BrO concentration strongly increased with altitude to 3.0 pptv BrO at 14.5 km (RF12, 9.1 to 8.6°N; 101.2 to 97.4°W). The average tropospheric BrO VCD in the tropics was 1.5×10^{13} molec cm⁻², which is in reasonable agreement with earlier satellite observations in the study area ($\sim 1.6 \times 10^{13}$ molec cm⁻², Theys et al., 2011). However, the observed BrO VCD is 2-4 times higher than predictions from the GEOS-Chem model. Early results from the recent CONTRAST field campaign (CONvective TRANsport of Active Species in the Tropics, Jan/Feb 2014) suggest lower tropospheric BrO over the Western Pacific Ocean (compared to the tEPO), but BrO is still higher than predicted by the CAM-Chem model. The largest model-measurement differences are observed in the TTL over the tEPO, where elevated BrO correlates with stratospheric tracers (low H₂O/O₃ ratio). BrO in the lower stratosphere at mid-latitudes (Southern hemisphere) is found to be in closer agreement with models, and is only slightly higher than predicted. We constrain a box-model with observations from TORERO to estimate BrY in the TTL, assess the stratospheric BrY boundary condition in GEOS-Chem, and assess sensitivities in BrY partitioning to variations in the heterogeneous bromine recycling on aerosol/ice surfaces.