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Bromine and iodine observation over the tropical Eastern and Western Pacific: impacts on atmospheric ozone and mercury

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Tropospheric halogens catalytically destroy ozone, modify oxidative capacity, and oxidize atmospheric mercury. About 75% of the global tropospheric O_3 loss occurs at tropical latitudes, where O_3 radiative forcing is most sensitive to changes in O_3. Here we report on BrO and IO observations by the CU Airborne MAX-DOAS instrument aboard the NSF/NCAR GV aircraft during the Tropical Ocean tRoposphere Exchange of Reactive halogen species and Oxygenated VOC (TORERO) and CONvective TRansport of Active Species in the Tropics (CONTRAST) field campaigns. We have measured BrO and IO vertical profiles over the tropical and sub-tropical Western and Eastern Pacific Ocean, including a detection of IO in the UTLS and lower stratosphere. Observed IO abundances are 2-3 times higher in the Southern hemisphere than in the Northern hemisphere free troposphere. Measurements in the lower stratosphere and tropical UTLS provide the first quantification of IO in these layers by limb observations of scattered sunlight. BrO concentrations increase with altitude and are 2-4 times higher than predicted by models. We compare our observations with predictions from the global models CAM-Chem, GEOS-Chem and RAQMS. Our measurements indicate that these halogens are responsible for 34% of the column integrated loss of tropospheric O_3. At the observed levels bromine oxidizes mercury at up to 3.5 times faster rates, and at lower altitudes than models predict, which has implications for global mercury distributions and deposition to ecosystem.