

Remote Tropical Island Mountaintop Measurements of Halogen Radicals and OVOCs

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The remote tropical troposphere is responsible for about 75% of the chemical removal of ozone and methane, two important greenhouse gases. Yet the atmospheric chemistry of tropospheric halogens over remote oceans is largely constrained in the free troposphere (FT), where natural background processes can be probed in absence of local impacts from pollution. Inorganic bromine and iodine radicals from ocean sources are responsible for about 20% of the global tropospheric ozone loss, equivalent to about 900 Tg O_x yr⁻¹ (similar to the O_x loss from HO_2). Halogens oxidize atmospheric mercury, modify aerosols, and iodine can form new particles.

The Volkamer group at CU Boulder is developing a small network of mountaintop Multiple AXis Differential Optical Absorption Spectroscopy (MAX-DOAS) instruments to probe hemispheric gradients in the remote tropical FT by long-term measurements of trace gases. Since February 2017 we have deployed MAX-DOAS instruments at two sites: 1) Mauna Loa Observatory (MLO) at 19.5°N, 155.6°W, at 3.4 km altitude in the northern hemisphere tropics, and 2) Maïdo Observatory (Maïdo) at 21.1°S, 55.4°E, at 2.2 km altitude in the southern hemisphere tropics. We measure the halogen oxide radicals BrO and IO, small OVOC (e.g. HCHO and CHOCHO), as well as total columns of O_3 , and NO_2 , and aerosol optical depth, which can be used for satellite validation. Combining MAX-DOAS measurements that probe the lower troposphere with zenith measurements at twilight to probe the stratosphere, we aim to develop retrievals of vertical columns and atmospheric profiles of trace gases that can have up to 5 degrees of freedom. First results from both sites are presented.

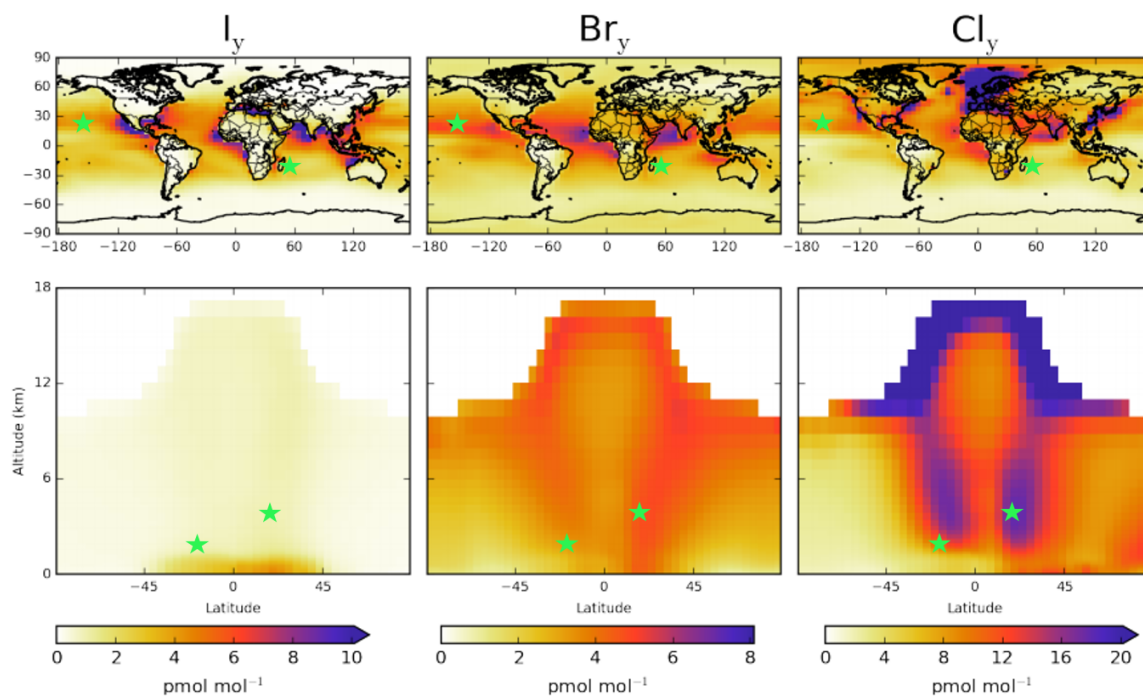


Figure 1. Tropospheric annual average inorganic halogen concentration as modeled in GEOS-Chem from Sherwen et al., 2016. Marked with green stars, the locations of the mountaintop observatories set up. While most apparent in chlorine, all halogens are predicted to be abundant in the tropical FT. Measurements of BrO and IO can be used to constrain the Br_y and I_y budget, while measurements of small HCHO and CHOCHO will inform the partitioning of Br_y .