Enhanced ozone loss by active inorganic bromine chemistry in the tropical troposphere

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This study represents the first simultaneous airborne measurements of BrO, BrCl, Br_2 and HOBr in the tropics using a chemical ionisation mass spectrometer (CIMS). The results suggest that inorganic halogen chemistry has a more significant impact on O_3 depletion and oxidising capacity of the troposphere than previously thought. The CIMS instrument was operated on-board the BAe-146 FAAM research aircraft across 20 flights, as part of the CAST (Coordinated Airborne Studies in the Tropics) campaign based on Guam, Micronesia and was supported by measurements of O_3 and NO_x from core instruments and bromocarbons from Whole Air Samples (WAS). The mean tropospheric BrO concentration over 20 flights was calculated to be 0.69 ppt; a factor of 4 times greater than that predicted by GEOS-Chem running with a tropospheric bromine simulation. An underestimation of HOBr, Br_2 and BrCl in the model, when compared to the CIMS data, will contribute to this discrepancy, thus increasing the availability of atomic Br through photolysis, however this does not compensate for the bias currently observed. The magnitude of this discrepancy and subsequent effect on O_3 depletion in the tropics is assessed and possible mechanisms are proposed. The measurements of these halogenated species are further used to assess their impact on the HO_x budget in the tropics via steady state estimations.