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Aircraft-borne DOAS limb observations of iodine monoxide around Borneo

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Iodine monoxide (IO) has a major impact on the photochemistry of the troposphere. It can for example catalytically destroy ozone, influence the atmospheric oxidation capacity by changing the partitioning of the HO_x and NO_x species, or contribute to the formation of ultrafine particles. Information regarding the vertical distribution of IO is still sparse since only few vertical profiles of IO exist for the troposphere.

Spectroscopic measurements were carried out from aboard the research aircraft DLR-Falcon during the SHIVA (Stratospheric ozone: Halogen Impacts in a Varying Atmosphere) campaign at Malaysian Borneo in November and December 2011 to study the abundance and transport of trace gases in the lower atmosphere. Sixteen research flights were performed covering legs near the surface in the marine boundary layer (MBL) as well as in the free troposphere (FT) up to an altitude of 13 km. The spectroscopic measurements were evaluated using the Differential Optical Absorption Spectroscopy (DOAS) technique in limb geometry, which supports observations of UV/visible absorbing trace gases, such as O_4, BrO, IO, NO_2, HCHO, CHOCHO, HONO and H_2O, and altitude information was gained via the O_4 scaling technique and/or full inversion.

The inferred vertical profiles of IO showed mixing ratios of 0.5-1.5 ppt in the MBL, which decreased to 0.1-0.3 ppt in the FT. Occasionally, the IO observed in the FT of the marine environment coincided with elevated amounts of CO, but no IO was observed over land, neither in the boundary layer, nor in the FT. This behavior strongly indicated that the major sources for IO were organic and inorganic precursor molecules emitted from the ocean, which during daytime rapidly formed a sizable amount of IO in the MBL that was occasionally transported into the FT where efficient loss processes for IO must exist. The inferred vertical profiles of IO are compared to simulations using the global 3-D chemistry transport model TOMCAT including recent fluxes of HOI and I_2 to examine possible sinks of iodine.