Retrieval quality and column densities of iodine monoxide from multiple satellite sensors – from SCIAMACHY to TROPOMI

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Iodine compounds are mainly emitted from the oceans through organic and inorganic pathways followed by photolysis and reaction with ozone to create iodine monoxide (IO) molecules. Emission sources of iodine species include the sea surface, phytoplankton and macroalgae as well as volcanic eruptions. IO is an indicator of active iodine chemistry, which may be relevant for tropospheric composition due to its impact on ozone levels, the NO/NO₂ ratio and potential particle formation. Rapid changes in Polar sea ice coverage and conditions may have an impact on iodine levels in Polar Regions with respective consequences for tropospheric composition in the Arctic and Antarctic.

Differential Optical Absorption Spectroscopy is used to retrieve IO column densities from various satellite sensors, including SCIAMACHY (2002 to 2012), GOME-2 (since 2006) and TROPOMI (since 2017). Case studies are presented with a focus on the intercomparison of the retrieval quality and IO column densities from the applied instruments. Previous satellite studies have shown slightly enhanced IO column densities mainly above the Antarctic Region and within one occasion of a strong volcanic plume, while IO column densities in the Arctic remain mostly below the detection limit of the applied instruments.

Reported column densities of tropospheric IO, as previously measured from ground and from space, are fairly small and close to the detection limits of current and former satellite sensors. Optical depth values of IO absorption are on the order of a few times 10⁻⁴. Individual satellite spectra allow trace gas retrievals with residual RMS values which lie around and often above the expected IO absorption optical depth. This is a challenge for the identification of optimal retrieval settings, especially the choice of an adequate wavelength window. Several aspects for quality control are discussed. In addition to the immediate retrieval RMS, the IO standard deviation in areas with expected low IO absorption, consistency checks with other retrieval parameters as well as plausibility of IO column density results are considered.

How to cite: Schoenhardt, A., Richter, A., Blechschmidt, A.-M., Bracher, A., and Burrows, J. P.: Retrieval quality and column densities of iodine monoxide from multiple satellite sensors – from SCIAMACHY to TROPOMI, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-17183,