Global satellite observations of iodine monoxide and the seasonal cycle above Antarctica

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Introduction

General importance of iodine:
• Halogens are involved in ozone destruction cycles (esp. Br in troposphere, CI in stratosphere) → influence on oxidation capacity
• Ionde shows high O3 depletion potential (I + O3 → IO + O2)
• IO can lead to enhanced release of other halogens (e.g., via IO + XO)
• Precursor concentrations are not well known, emissions from ice

Observations of iodine species:
Iodine species have been observed in several locations (coastal areas, polar regions).
• Components: IO, I2, I, I2, organic iodine (e.g. CH4, C2H4), and others.
• Abundances: for IO typically amounts of a few pptv (range: approx. 0-20 pptv)
• Occurrence: not widely reported in space (some data for specific regions).
• Sources: not well understood, possibly biogenic iodine compounds.

I – global map and special regions

Global IO map
• IO columns have been retrieved from more than four years of SCIAMACHY data. The detection limit for IO depends on, e.g., albedo and temporal/long-term variability. For 90% albedo and a ground scene size of 60x120 km2, the limit is 3 x 1010 molec/cm² for a single measurement.

Interesting regions for IO detection:
• Upwelling regions in the tropical oceans (1)
• Sources inland: unknown up to now

Towards the North, the IO fit shows a tendency for enhanced IO.

Influencing factors for the seasonal cycle:
• Precursor emissions (e.g. organohalogen emissions)
• Localised emissions at European coasts in the marine boundary layer remain undetected so far.

Conclusions
• IO columns with amounts up to 8 x 1010 molec/cm² in the monthly average have been observed. The highest IO columns are detected close to Antarctica.
• The observed seasonal cycle repeats in each of the four analysed years with maxima in spring and autumn, probably caused by a combination of precursor concentration and actinic radiation.
• Surprisingly high IO values over the Antarctic continent are not well understood, but may be affected by biologically processes on aerosol/snow surfaces and by transport. Further studies are needed.
• Localised emissions at European coasts in the marine boundary layer remain undetected so far.
• Over the Arctic region, much lower IO values are observed than over the Antarctic. These weak indications for IO detections in the Arctic need to be further investigated.

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References