Total stratospheric bromine inferred from balloon-borne solar occultation bromine oxide (BrO) measurements using the new TotalBrO instrument



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Why is stratospheric BrO relevant?



- Bromine depletes ozone in catalytic cycles
- Bromine accounts for about 35% of global stratospheric ozone depletion⁶
- Montreal Protocol 1987 aims at reducing ozone depleting substances and monitor them over time
- Total stratospheric bromine can be inferred from stratospheric BrO measurements²
- Yet unclear if bromine partially sediments out from lower stratosphere^{5,7}

How is stratospheric BrO measured?

Sun position 1

Trace gas profile

Sun position 2

- Direct sun/solar occultation geometry
 - Data retrieval via DOAS (Differential Optical Absorption Spectroscopy)
 - Active solar tracker ($\sim 12 \text{ kg}$)⁴
 - Based on two cameras
- Feeds light into two spectrometers via glass fibers
- Spectrometer unit with 2 commercial spectrometers (~25 kg)
 - UV: 300-400 nm with 0.5 nm resolution
 - VIS: 400-500 nm with 0.5 nm resolution
 - Within evacuated chamber
 - Temperature stabilized by ice-water bath

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Preliminary result:



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(a)

Total stratospheric bromine inferred from the 2022 HEMERA flight at Timmins (Canada) by the novel **TotalBrO** instrument: $[Br_y] = (17.3 \pm 3.0) \text{ ppt}$ injected around mid 2017

+ 3 ppt



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Spectrometer unit



SZA 2

Solar tracker

ice-water filling hole

ice-water bath

open-cell insulation foam



 Retrieval of trace gas profiles from solar occultation and balloon ascent measurements

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Background photo: courtesy by KIT (IMK-ASF)

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