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Comprehensive quality assessment of GOME- and IASI-type multi-mission tropospheric ozone data records

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INTRODUCTION
- Tropospheric ozone plays a key role in air quality and has a significant impact on the radiation budget of the Earth, both directly and indirectly.
- Tropospheric ozone observations are provided by two series of European nadir-viewing ozone profilers:
  - Thermal infrared sounders of the IASI type, launched regularly since 2006: IASI on MetOp platforms and IASI-NG on MetOp-SG
- Several tropospheric ozone data products have been improved and harmonised in the context of the ESA’s Climate Change Initiative (CCI) on ozone.
- To verify their fitness-for-purpose, we have applied to the Ozone CCI datasets a QA/validation expert system developed over years in the context of ESA’s Multi-TASTE and CCI projects, EUMETSAT’s O3M-SAF, and the European Commission’s GEOmon and QA4ECV.

DATA SELECTION / CO-LOCATION / HARMONISATION
- GOME and GOME-2 nadir UV retrievals by RAL:
  - RAL v3.24
  - 20 fixed retrieval levels (VMR & ND) → 19 layers (PC)
- IASI TIR retrievals by ULB/LATMOS:
  - FORLI v20140922
  - 41 fixed retrieval layers (PC)

- 100 km and 3 h co-locations with ozonesonde data at 149 stations from WMO GAW contributing networks like NDACC and SHADOZ
- Mass-conservation regirding before optional AK-based vertical smoothing.
- Tropocolumn from direct summation over partial column profiles
- Two ‘tropopause’ products are considered:
  - Lapse-rate tropopause (LRT WMO def.) based on ozonesonde T profile
  - Fixed-level cut-off at 6 km (adopted within CCI)

INFORMATION CONTENT STUDY
- From fractional averaging kernel matrices!
- Number of independent layers (EHS) shows meridian and temporal dependence.
- Variations of vertical sensitivity and other information content measures are directly related to slant column density (SCD), affected by solar zenith angle (SZA), latitude...
- Impact of instrument degradation on information content appears clearly.
- Poor sensitivity below tropopause (TP) increases tropocolumn uncertainty.

GROUND-BASED NETWORK VALIDATION
Half-year running median relative difference (thick lines) and 68 % IP spread (thin lines) for LRT-integrated tropospheric ozone column comparison with sonde network data:
- BIAS: GOME(2A) bias of 10-25 % with stronger outliers, smaller (5-10 % negative) IASI bias due to higher sensitivity below TP.
- SMOOTH: Impact of vertical smoothing up to same 25 % order as GOME(2A) bias
- DRIFT: Pos. for GOME(2A), neg. for GOME, strongest drift for GOME at low latitudes (from 3-year median as green stairs for vertically smoothed data)
- TP-DEF: 6 km fixed cut-off bias (not shown) typically slightly larger, with amplified seasonal bias variation for all instruments

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