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

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## INTRODUCTION

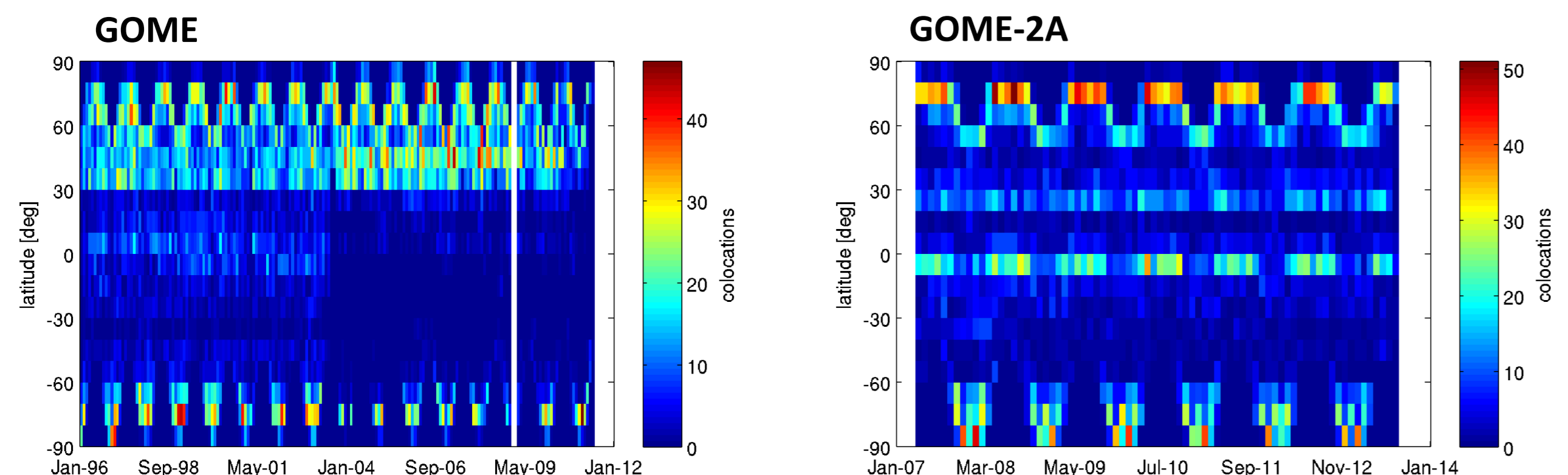
- Tropospheric ozone plays a key role in air quality and has a significant impact on the radiation budget of the Earth, both directly and indirectly.
- Tropospheric ozone observations are provided by two series of European nadir-viewing ozone profilers:
  - UV-visible spectrometers of the GOME type, launched regularly since 1995: GOME, SCIAMACHY, OMI, GOME-2 on MetOp-A/B/C, upcoming Sentinel-4/5/5p missions
  - 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 v2.14
  - 20 fixed retrieval levels (VMR & ND) → 19 layers (PC)
- IASI TIR retrievals by ULB/LATMOS:
  - FORLI v20140922
  - 41 fixed retrieval layers (PC)

| Satellite instrument | L2 ozone profile processing entity | Time period |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|----------------------|------------------------------------|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                      |                                    | 96          | 97 | 98 | 99 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 |
| GOME                 | RAL                                | delivered   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| SCIAMACHY            | RAL                                |             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| GOME2A               | RAL                                |             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| GOME2B               | RAL                                |             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| IASI                 | ULB/LATMOS                         |             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

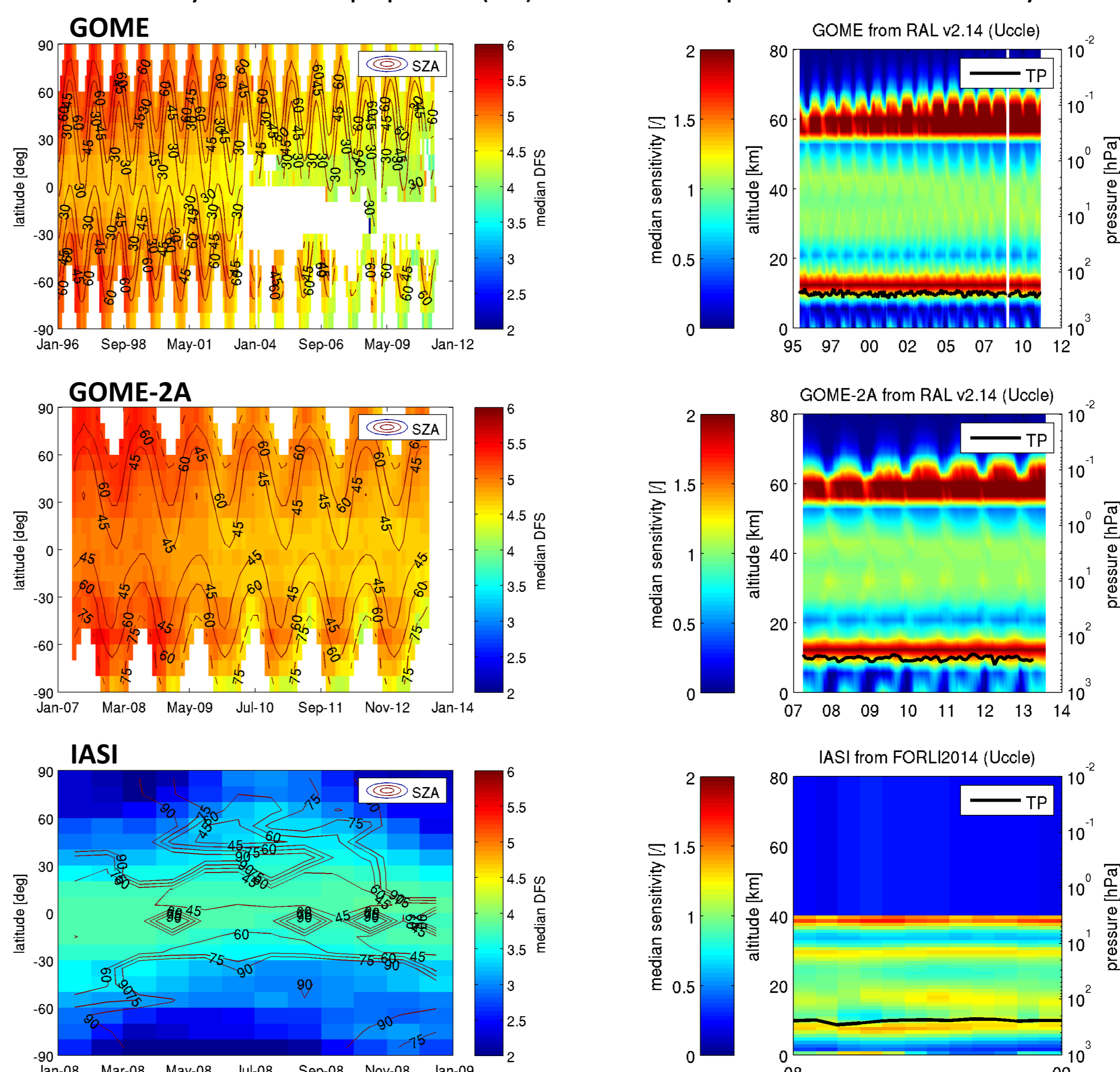
- 100 km and 3 h co-locations with ozonesonde data at 149 stations from WMO GAW contributing networks like NDACC and SHADOZ



- Mass-conservation regridding 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

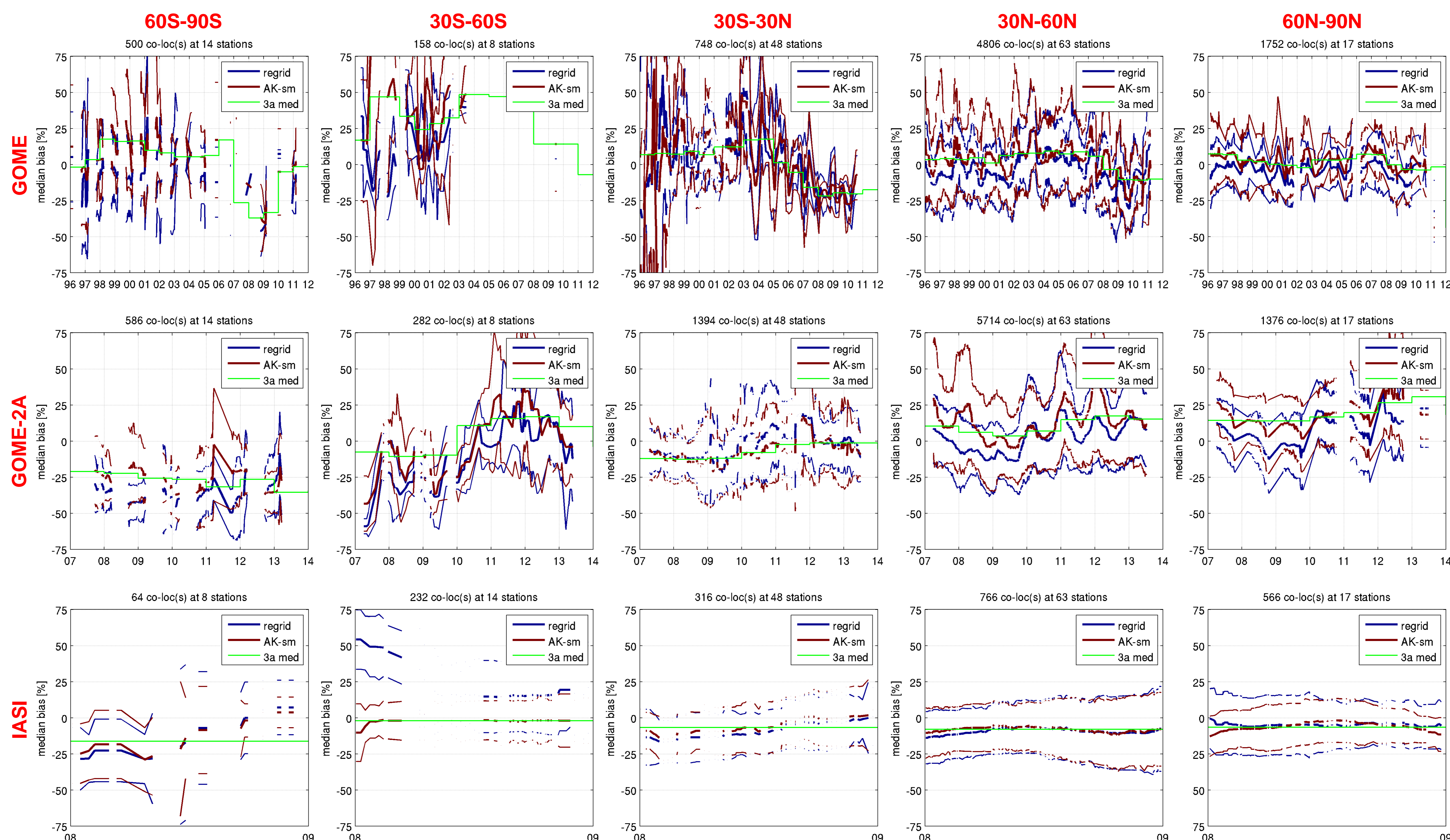
- From fractional averaging kernel matrices!
- Number of independent layers (DFS) shows meridian and temporal dependence.
- Variations of vertical sensitivity and other information content measures are directly related to slant column density (SCD), affected by solar zenith angle (SZA), latitude...
- 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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