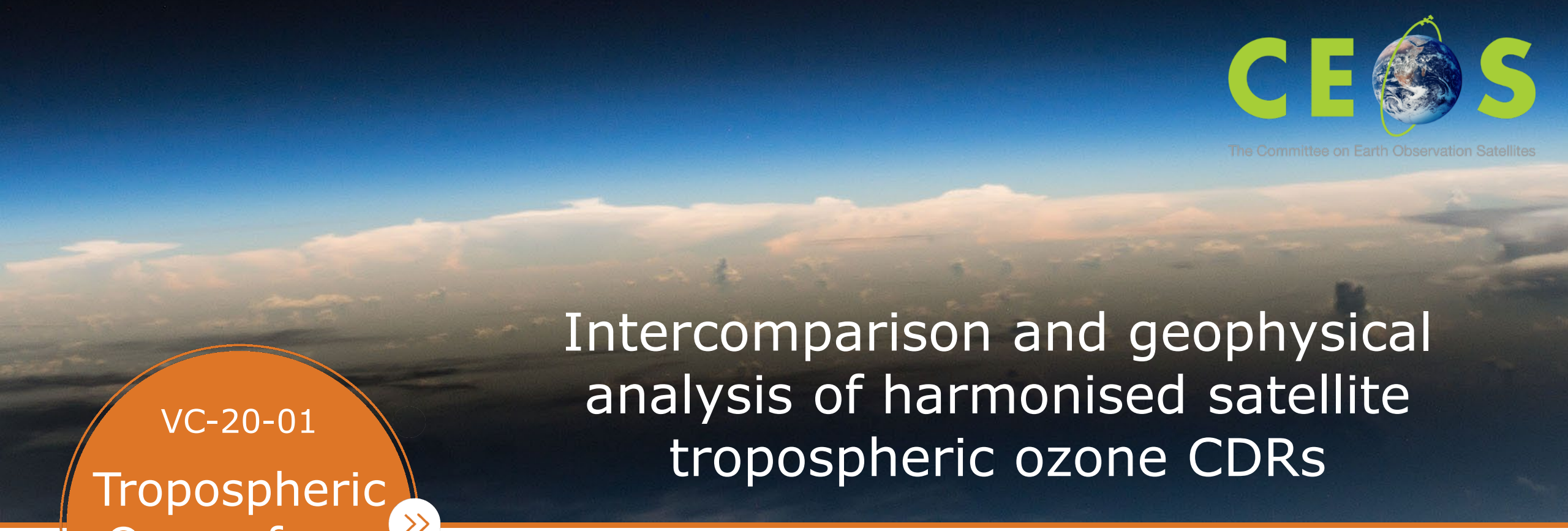


Intercomparison and geophysical analysis of harmonised satellite tropospheric ozone CDRs

VC-20-01

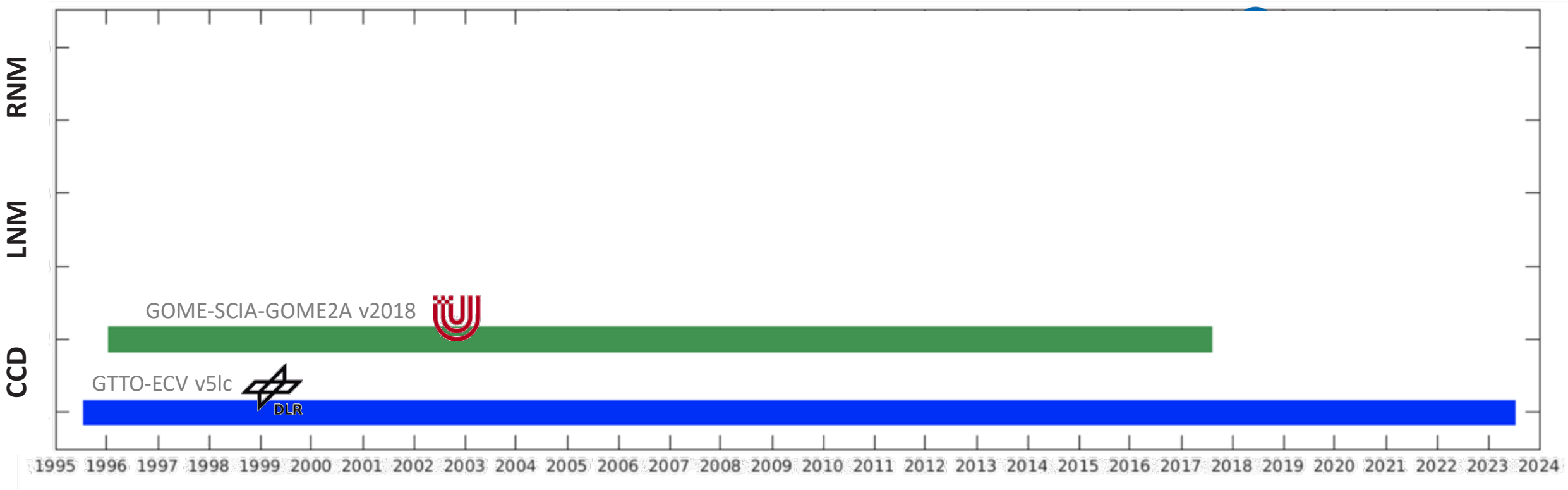
Tropospheric Ozone from Satellites

D. Hubert, A. Keppens, J.-C. Lambert, T. Verhoelst, S. Compernolle
+ many data providers

ROYAL BELGIAN INSTITUTE FOR SPACE AERONOMY

CEOS AC-VC #19, Brussels, Belgium, 24-27 October 2023

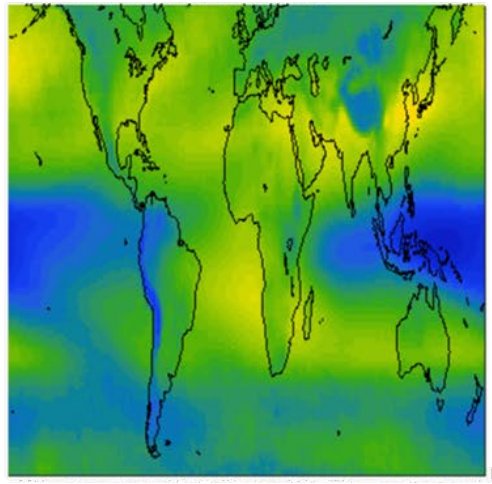
Satellite tropospheric O3 : column-based data



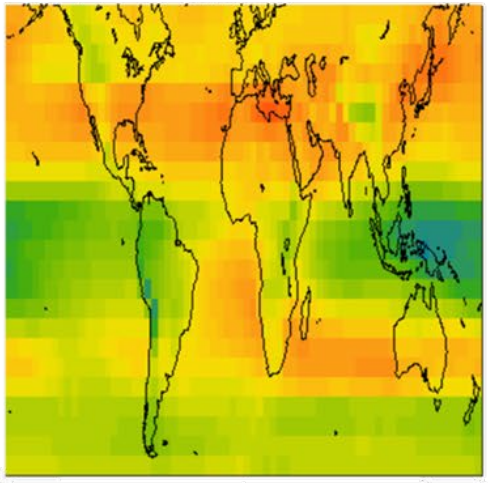
+ others not discussed here (TOMS, GTTO-ECV v5sc, OMI/GTO-LIMB, S5P-BASCOE, OMPS-LNM)

Biases between satellite tropospheric O3

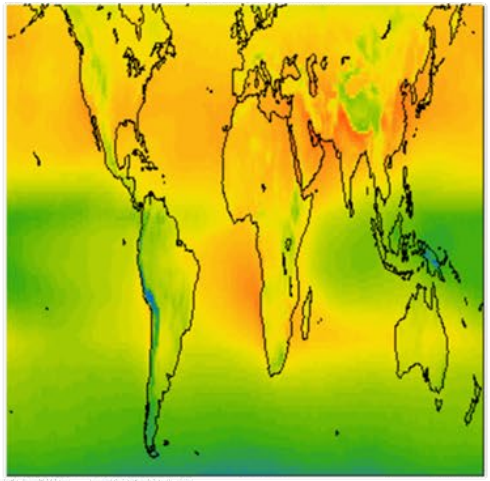
OMI-SUNLIT



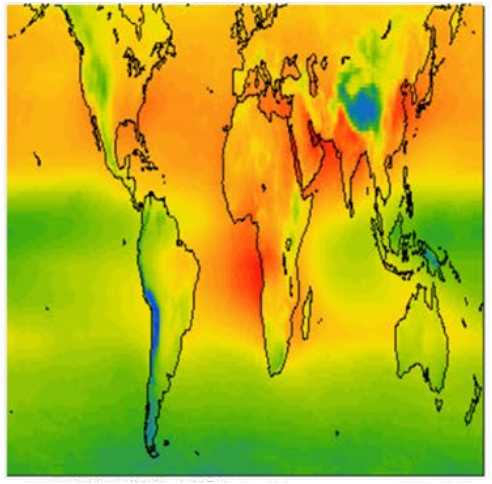
OMI-MLS



OMPS-MERRA2



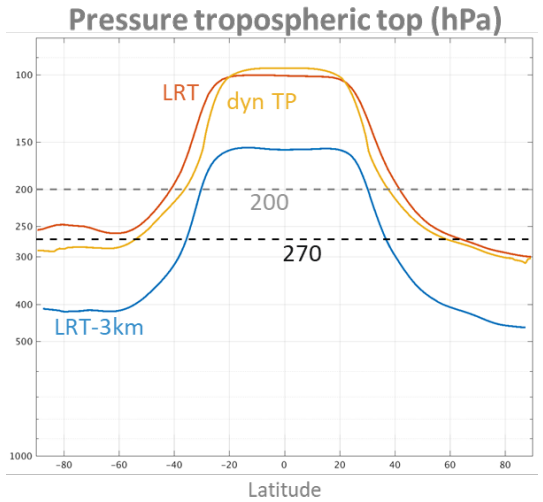
EPIC-MERRA2



OMI-SUNLIT
LRT - 3 km

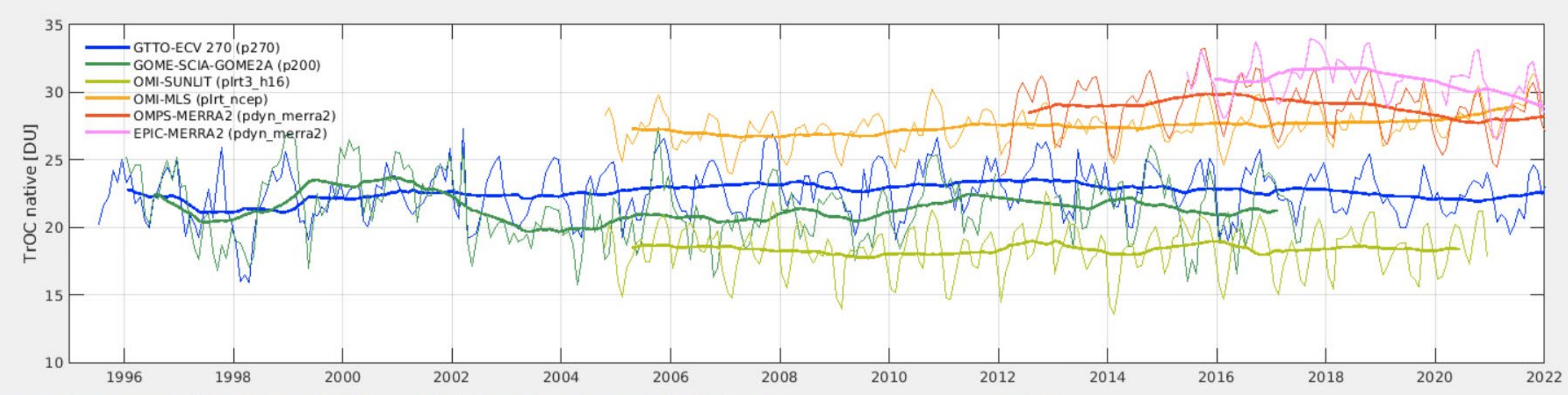
OMPS-MERRA2
dyn TP

EPIC-MERRA2
dyn TP



SAT minus OMI-MLS [%]

Satellite time series (20°S-20°N)



Objectives

- Can harmonisation improve agreement between satellite data sets?
  - Test several, complementary methods
  - Multi-annual mean, short-term variability, long-term changes
  - Global and regional scale

https://tapiowca.aeronomie.be

- Interaction with CEOS VC-20-01
  - Estimate bias due to different vertical level, smoothing, local time, …
  - More complete understanding of uncertainty budget
  - Assist in product development (inclusion of metadata, XO3, …)

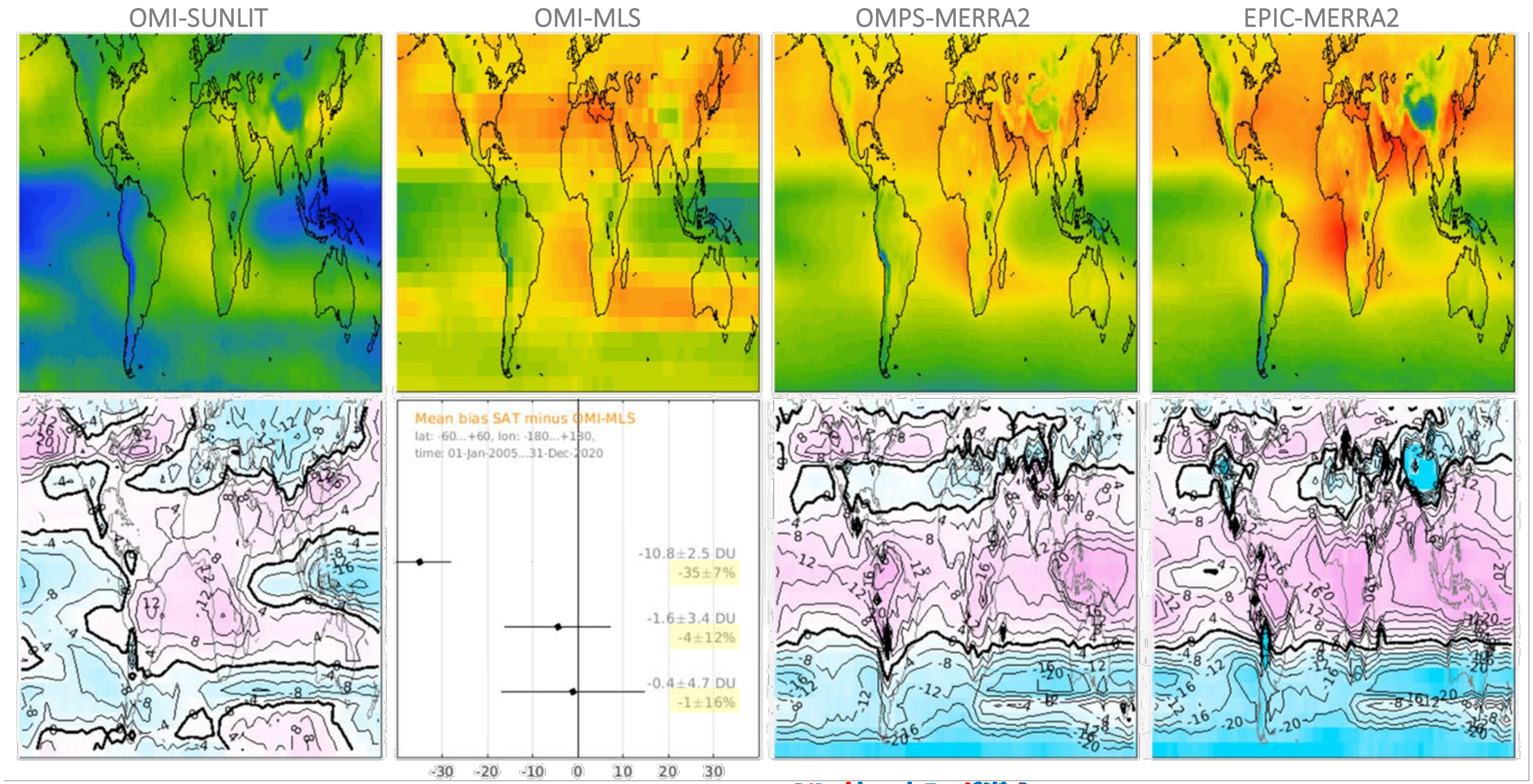
The Committee on Earth Observation Satellites

- Interaction with TOAR II
  - Provide harmonised satellite data to multiple Working Groups
  - Assess (distribution) climatological mean, variability & long-term changes

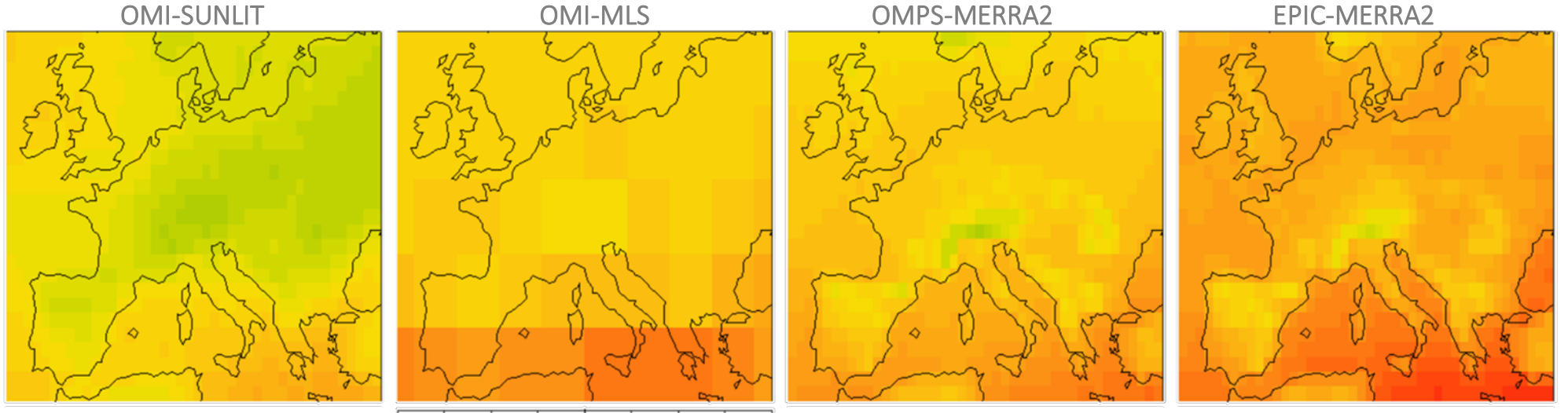
IGAC

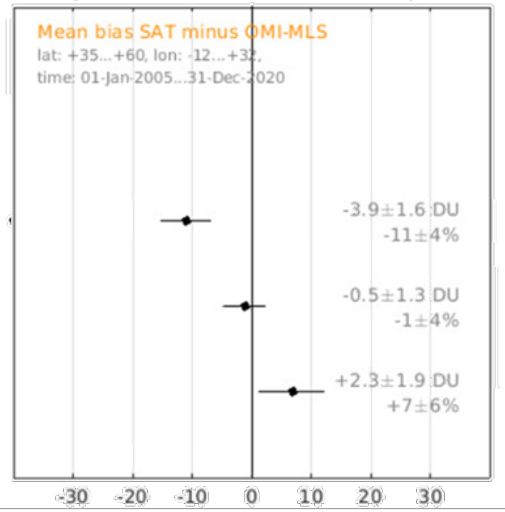
TOAR tropospheric ozone assessment report

Bias before/after harmonisation (60°S-60°N)



Bias before/after harmonisation (Europe)





OMI-SUNLIT
LRT - 3 km

OMPS-MERRA2
dyn TP

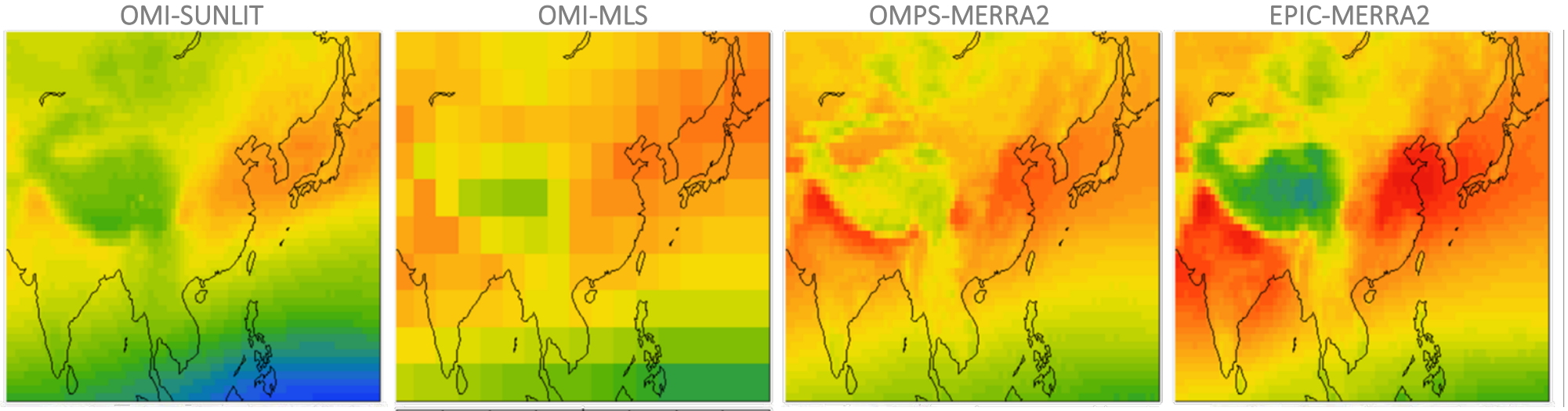
EPIC-MERRA2
dyn TP

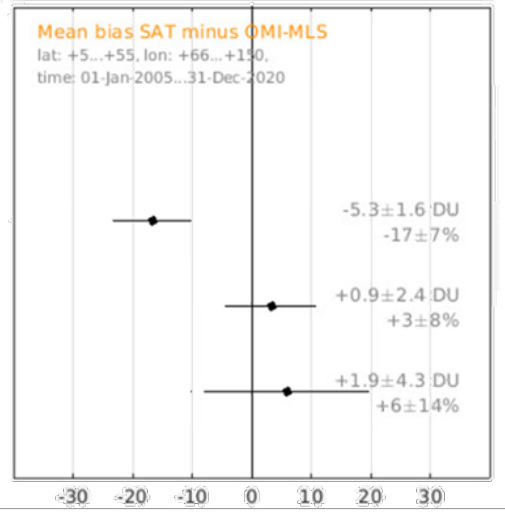
No harmonisation

Method A : XO3 = TrOC / (p_{sfc}-p_{top})

Method B : fill-in = TrOC + $\Delta TrOC_{CAMSRA}$

Bias before/after harmonisation (Asia)





OMI-SUNLIT
LRT - 3 km

OMPS-MERRA2
dyn TP

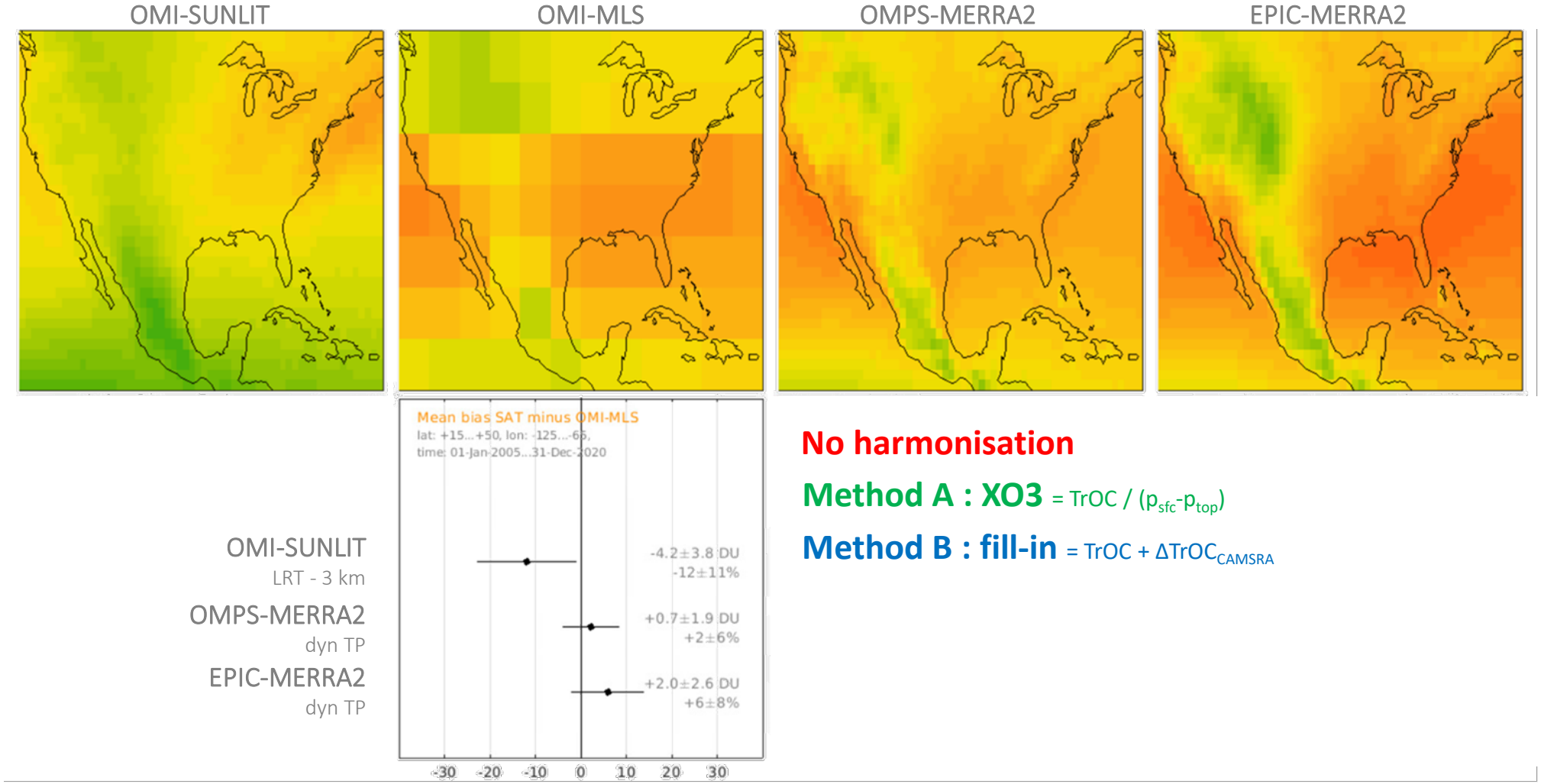
EPIC-MERRA2
dyn TP

No harmonisation

Method A : XO3 = TrOC / (p_{sfc}-p_{top})

Method B : fill-in = TrOC + $\Delta TrOC_{CAMSRA}$

Bias before/after harmonisation (US)



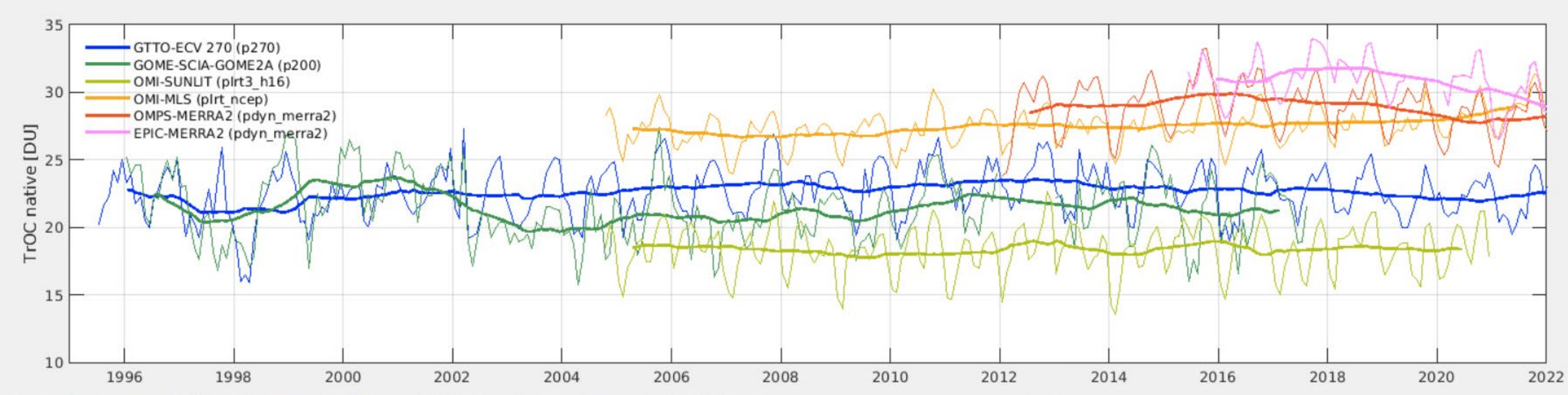
No harmonisation

Method A : XO3 = TrOC / (p_{sfc}-p_{top})

Method B : fill-in = TrOC + $\Delta TrOC_{CAMSRA}$

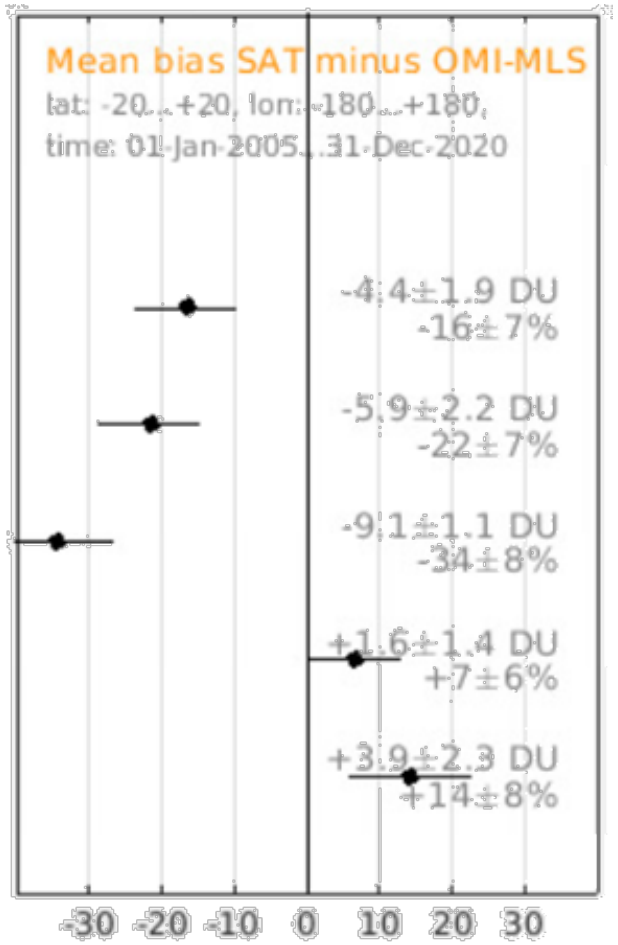
Time series before/after harmonisation (20°S-20°N)

Method B infill: $TrOC = TrOC + \Delta TrOC_{CAMSRA}$

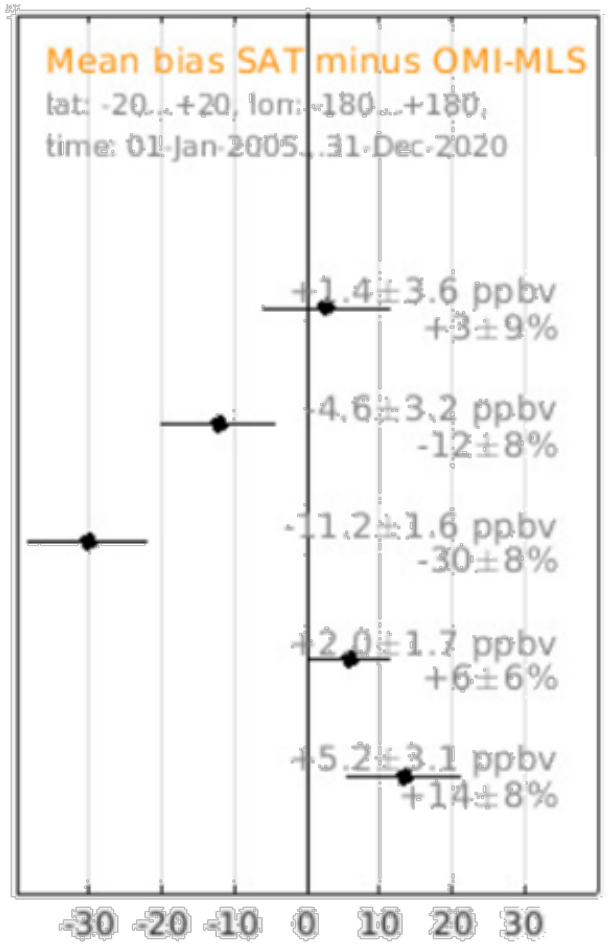


Bias before/after harmonisation (20°S-20°N)

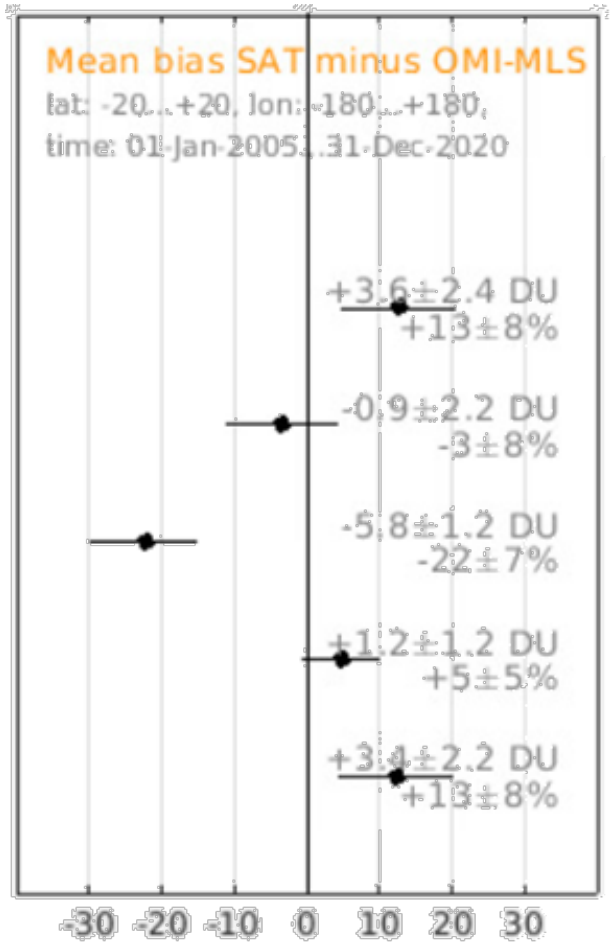
No harmonisation



Method A : XO3 = TrOC / (p_{sfc}-p_{top})



Method B : fill-in = TrOC + $\Delta TrOC_{CAMSRA}$



GTTO-ECV
270 hPa

GOME-SCIA-GOME2A
200 hPa

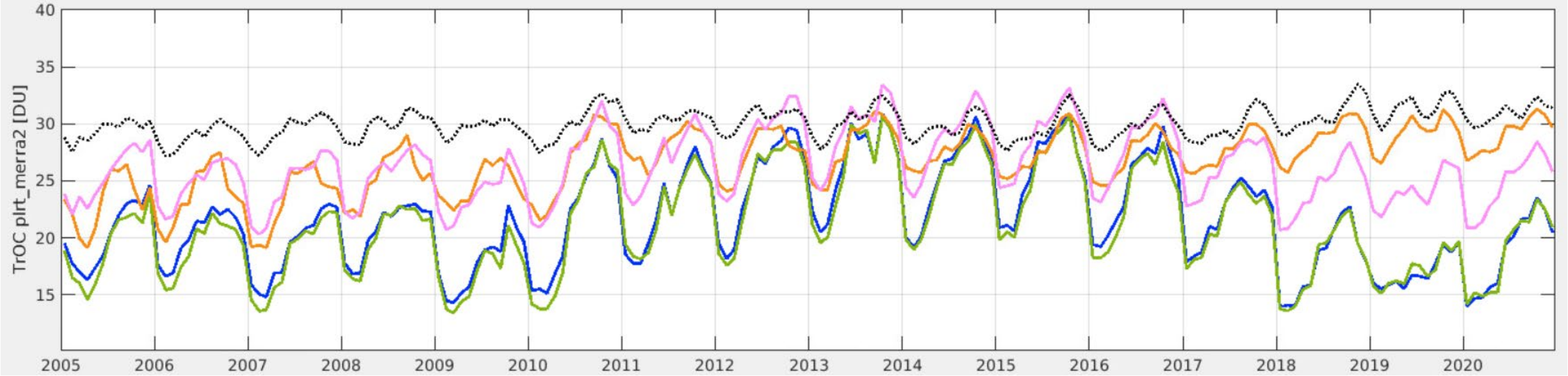
OMI-SUNLIT
LRT - 3 km

OMPS-MERRA2
dyn TP

EPIC-MERRA2
dyn TP

Harmonisation of OMI profile

Column surface – lapse rate tropopause (MERRA2)

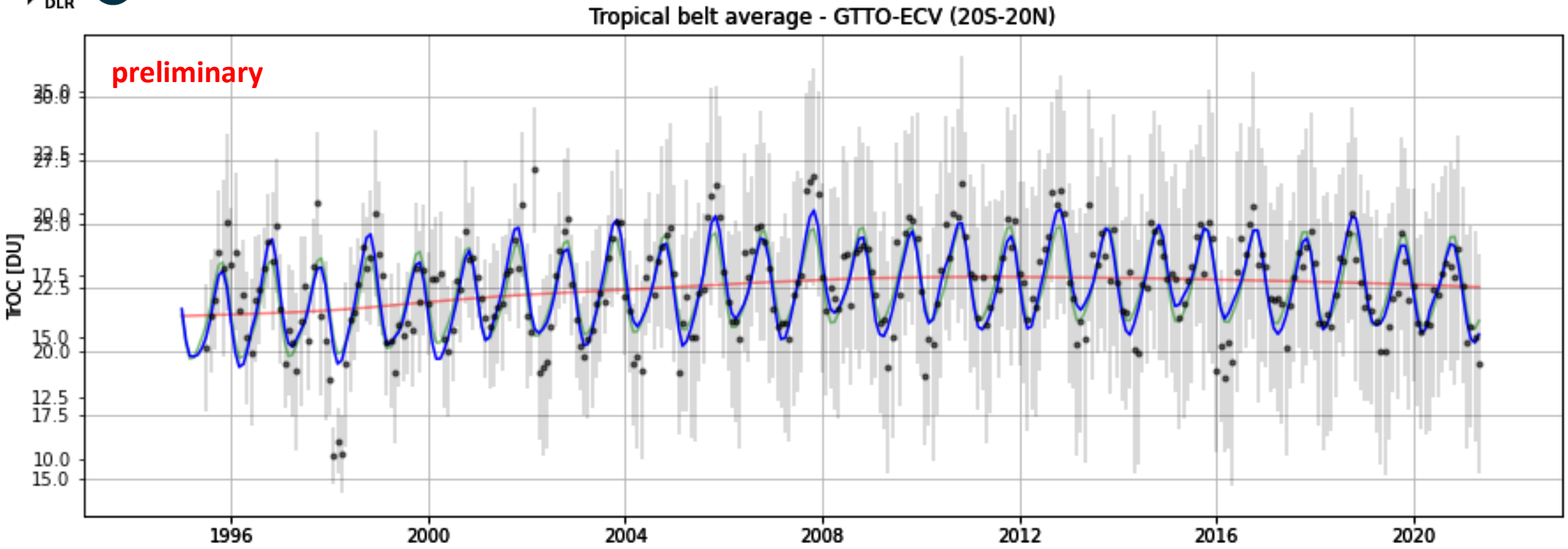


Original OMI

Harmonised OMI : AP CDF1 TrOC

Transfer standard CAMSRA

Time series analysis : GTTO-ECV v5Ic (before harm.)



Conclusions & outlook

- Comprehensive intercomparison of nearly all satellite tropospheric O3 datasets
  (please send us updated / new data)
- Preliminary findings
  - Fill-in harmonisation is more successful than XO3 harmonisation for **column-based products** (though success depends on location)
  - Harmonisation method affects temporal structure of **profile-based products**
- Next steps
  - Add all profile-based satellite data (see talk by A. Keppens)
  - Finalise harmonisation scheme
  - Analyze distribution of multi-annual mean and long-term changes