

Regional trends of stratospheric ozone evaluated using the MErged GRIdded Dataset of Ozone Profiles (MEGRIDOP)

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New MErged GRIdded Dataset of Ozone Profiles (MEGRIDOP)

- The dataset was developed in the ESA Ozone_cci project
- Data from 6 limb-viewing satellite instruments
 - GOMOS, MIPAS, SCIAMACHY on Envisat (2002-2012)
 - OSIRIS on Odin (2001 - present)
 - MLS on Aura (2004 - present)
 - OMPS-LP on Suomi NPP (2012 - present)
- 10° x 20° latitude x longitude bins
- 10 – 50 km
- The dataset covers years 2001-2020
- It is in open access at <https://climate.esa.int/en/projects/ozone/data/>

Merging method

- 1 step: gridded data in 10°x20° latitude-longitude bins for individual instruments
 - 2 step: computing the deseasonalized anomalies
 - estimating the seasonal cycle and removing it.
- For each instrument i , latitude-longitude bin b and altitude level z , the deseasonalized anomalies are computed as:
- $$\Delta_i(z, b, t) = \frac{\rho_i(z, b, t) - \rho_{m,i}(z, b)}{\rho_{m,i}(z, b)}, \quad (1)$$
- where $\rho_i(z, b, t)$ is the monthly mean value in this spatial bin and $\rho_{m,i}(z, b)$ is the climatological mean value for the month m . In other words, from each January we removed
- 3 step: merging the deseasonalized anomalies
 - 4 step: from merged deseasonalized anomalies to merged ozone concentrations

Illustration of merging

- Off-setting OMPS
- Median of individual anomalies

$$\Delta_{\text{merged}}(z, b, t) = \text{median}(\Delta_i(z, b, t))$$

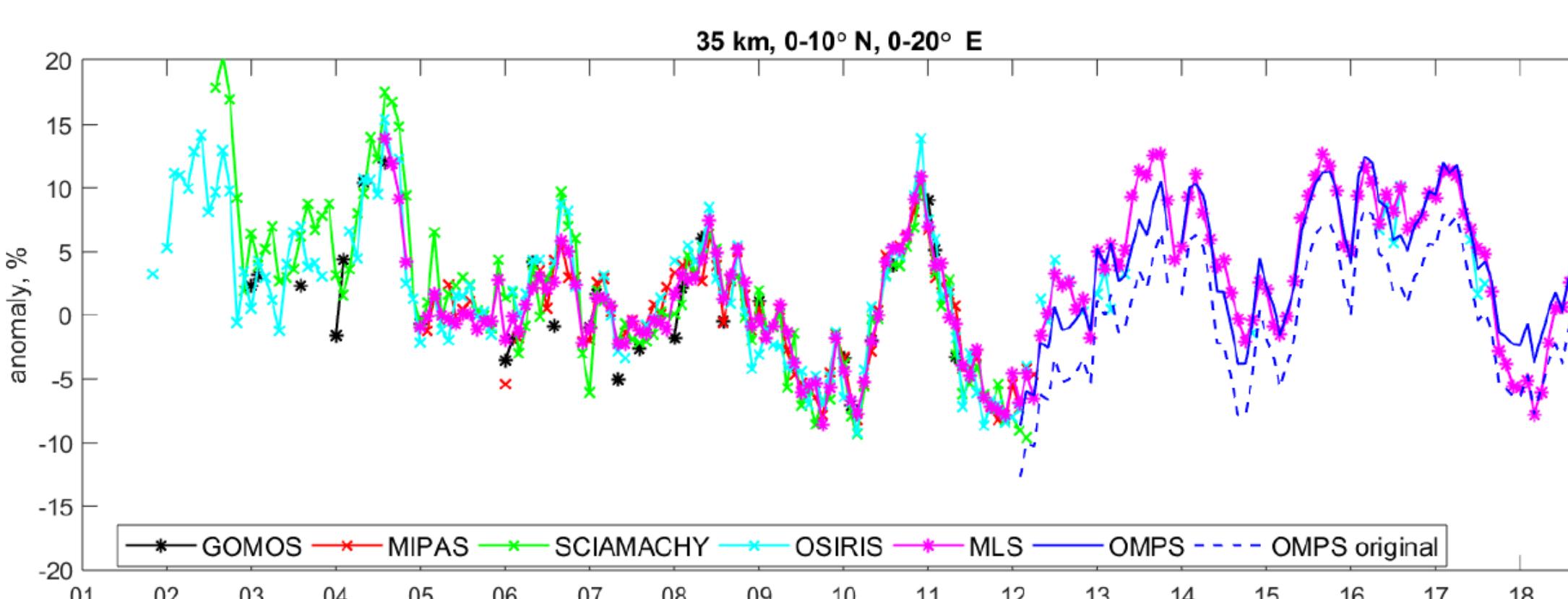


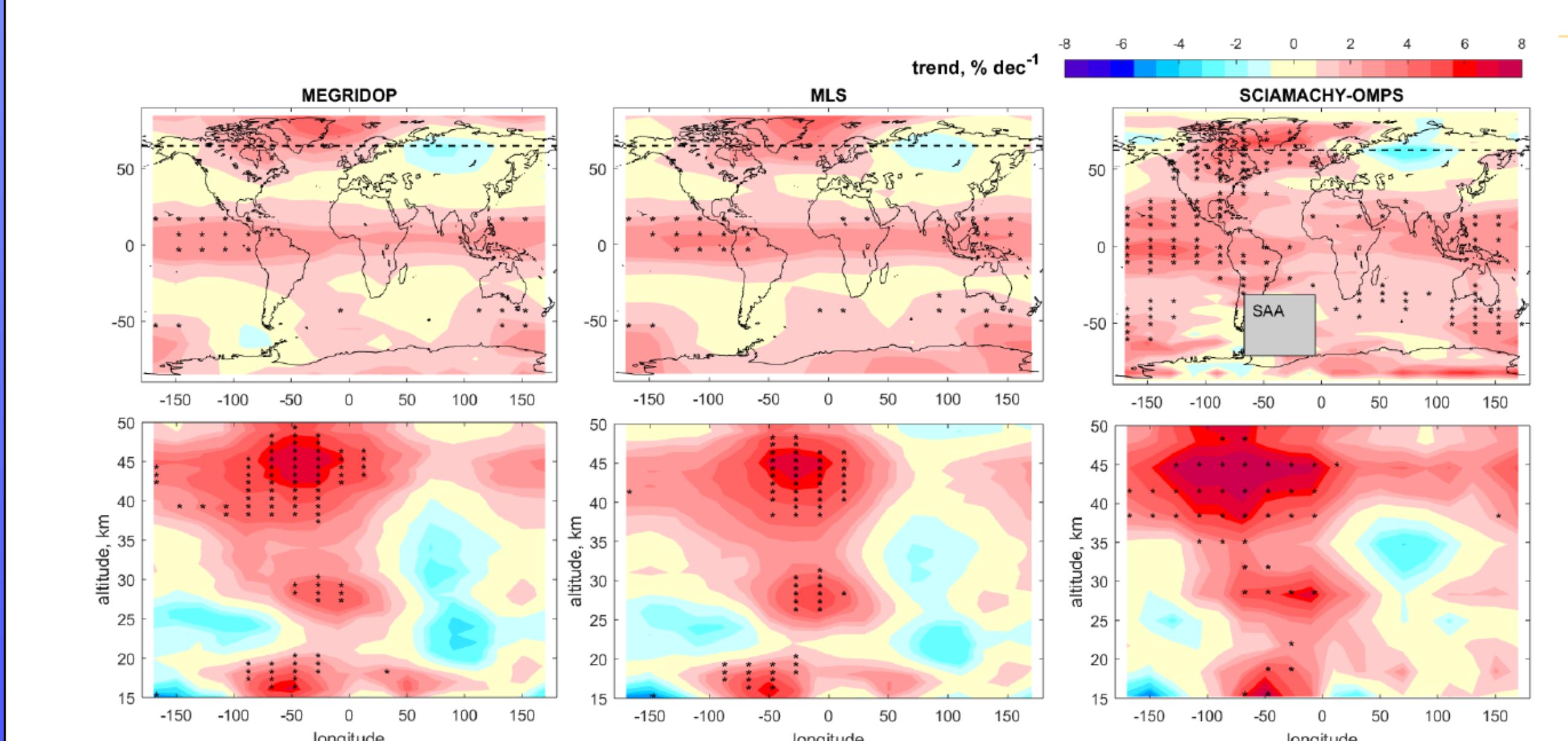
Illustration of offsetting the OMPS deseasonalized anomalies. The data are shown altitude 35 km, 0-10° N, 0-20° E.

Evaluation of ozone trends

- Multiple linear regression $O_3(t) = at + b + q_1 QBO_{30}(t) + q_2 QBO_{50}(t) + s F_{10.7}(t) + d ENSO(t)$,
- the statistically significant trends in the upper stratosphere.
- A longitudinal structure is clearly visible in the NH mid-latitude trends above 40 km: the trends are significantly larger over Scandinavia/Atlantic ocean (5-6 % dec⁻¹) than over Siberia (~1 % dec⁻¹). The same feature is observed also by Arosio et al. (2019).
- Positive statistically significant trends (1-2 % dec⁻¹) are observed also at SH mid-latitudes (~40°-50°S) at 25 km.
- the trends are larger in the sector 50°W - 10°E.

The first attempt to evaluate ozone trends in polar regions

Comparison of ozone trends



Top: ozone trends in late 2004- 2018 (% decade-1) at 35 km, bottom: longitude –altitude cross section of the ozone trends at ~65 °N (the latitude is indicated by dashed line on top panels).

Summary

- The merged gridded dataset of ozone profiles (MEGRIDOP) combines the data from 6 limb-viewing satellite instruments
 - The merged gridded ozone profiles are the monthly means in 10x20 latitude-longitude bins and altitudes 10-50 km.
 - The dataset covers the years 2001-2020 and will be extended regularly in future.
- Both deseasonalized anomalies and ozone concentrations are provided in MEGRIDOP
- The MEGRIDOP dataset can be used in different analyses:
 - Climatology distribution
 - Trend analyses
 - Comparisons with other datasets (particularly important for ground-based datasets)

Reference

Sofieva, V. F., Szelag, M., Tamminen, J., Kyrölä, E., Degenstein, D., Roth, C., Zawada, D., Rozanov, A., Arosio, C., Burrows, J. P., Weber, M., Laeng, A., Stiller, G. P., von Clarmann, T., Froidevaux, L., Livesey, N., van Roozendael, M., and Retscher, C.: Measurement report: regional trends of stratospheric ozone evaluated using the MErged GRIdded Dataset of Ozone Profiles (MEGRIDOP), Atmos. Chem. Phys., 21, 6707–6720, <https://doi.org/10.5194/acp-21-6707-2021>, 2021.