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Swiss Confederation

Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

MeteoSwiss ozone timeseries

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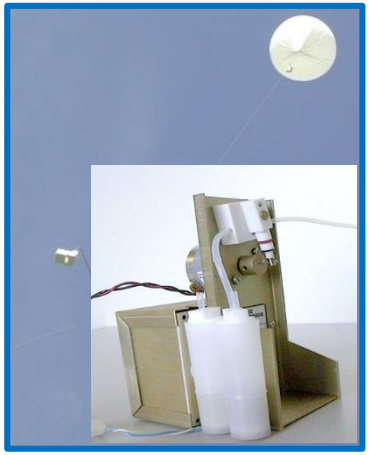
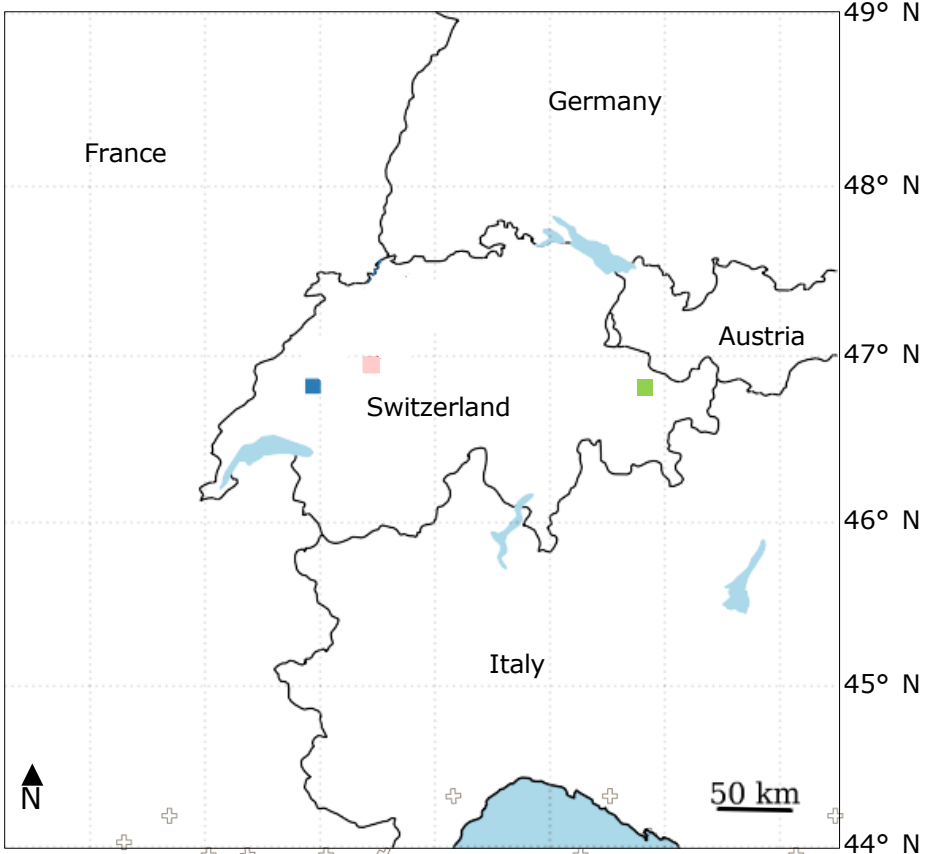
Eric Sauvageat, Antoine Vadès

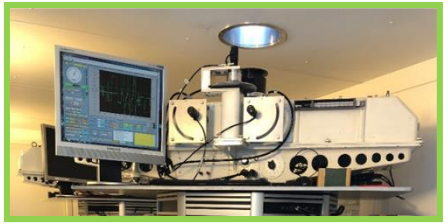
ECC ozone sonde



microwave radiometer

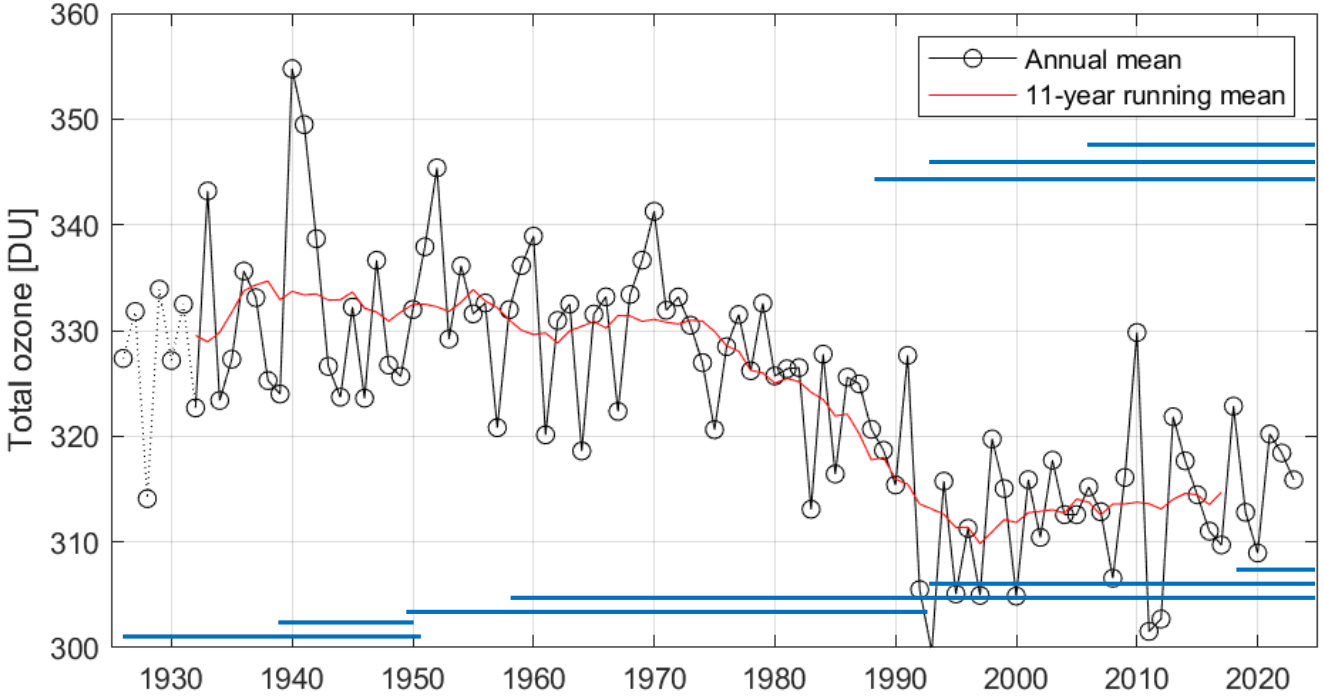


Dobson spectrophotometers (3)



Brewer spectrophotometers (3)

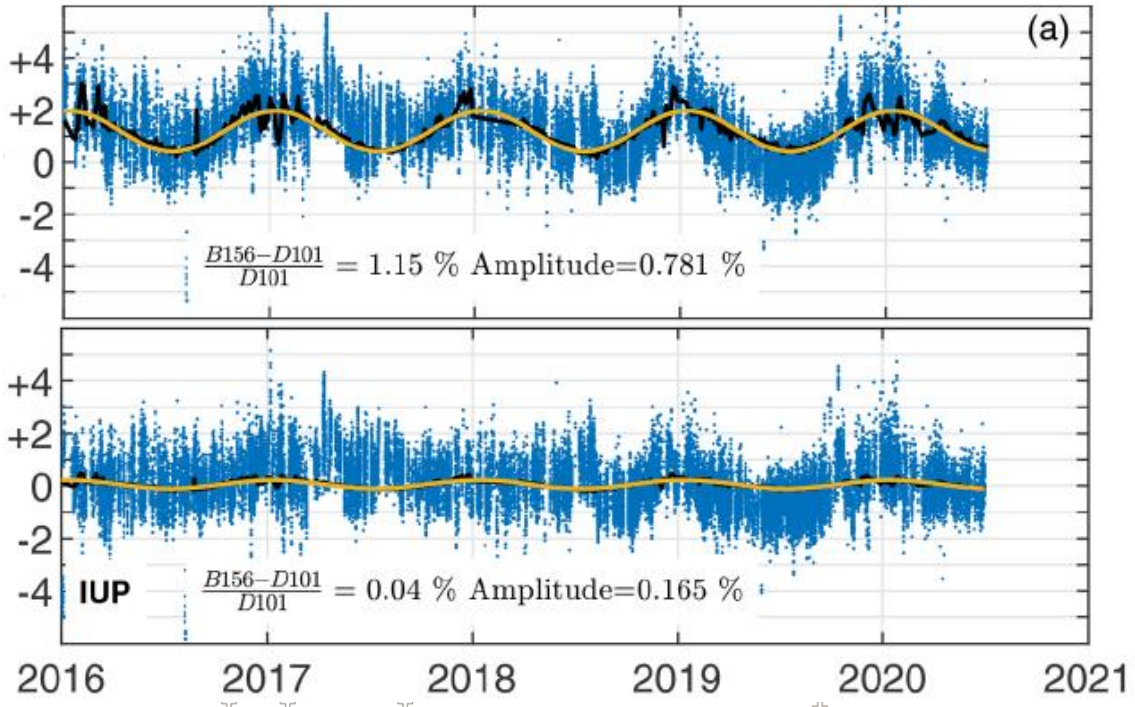
Dobson TCO timeseries: «Arosa/Davos»



On the difference Dobson – Brewer ozone column

Main reasons are:

- Ozone x-sections measured in laboratory
- Temperature sensitivity of the Ozone x-sections
- Measured slits function of Dobson



Gröbner et al, AMT, 2021

Dobson Automation

The measurements from multiple instruments are analysed on a daily basis. The ozone daily variation is fitted as a 4th order polynomial of all data within the coincident criteria.

Two variables are calculated for each instrument :

- δi: the offset of the polynomial (bias)
- σi: the standard deviation (random)

The resulting Δij= δi–δj is the difference between two instruments.

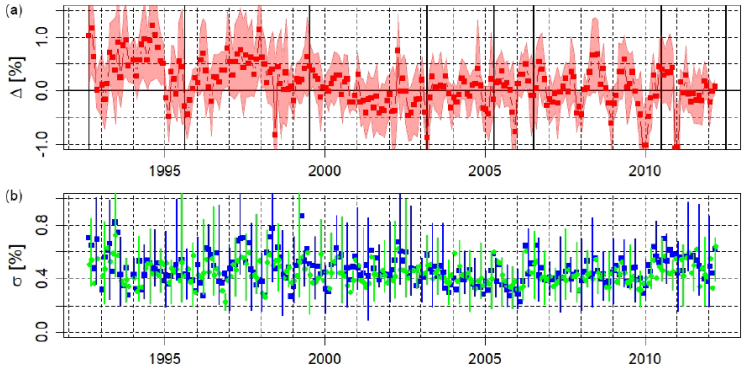


Figure 5. Daily analysis results: time series of the monthly median of the relative difference $\Delta_{062-101} = \delta D_{062} - \delta D_{101}$ **(a)** and the individual σ **(b)** between coincident measurements of the Dobson instruments D_{062} and D_{101} over the period 1992–2012. Calibration campaigns are denoted by the black lines. The shading and the error bars are for the $IPR_{97.5th-2.5th}$ interval.

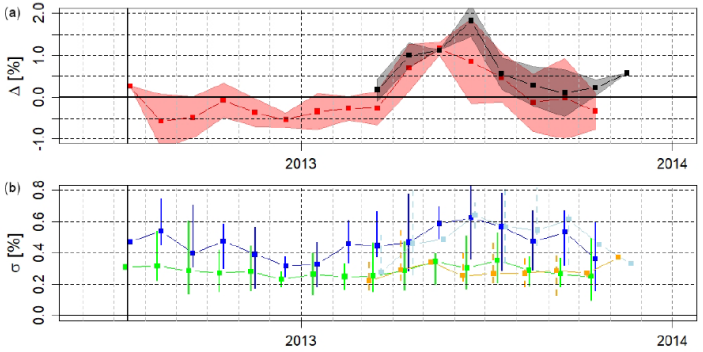


Figure 7. (a) Time series of the monthly median of $\Delta_{062-101}$ (red) and $\Delta_{051-101}$ (black). **(b)** Time series of the monthly median of σ_i of D_{101} (blue and light blue), D_{062} (green) and D_{051} (orange). The shading and the error bars correspond to the inter-percentile range $IPR_{97.5th-2.5th}$ of the various parameters.

Stübi et al, AMT, 2021

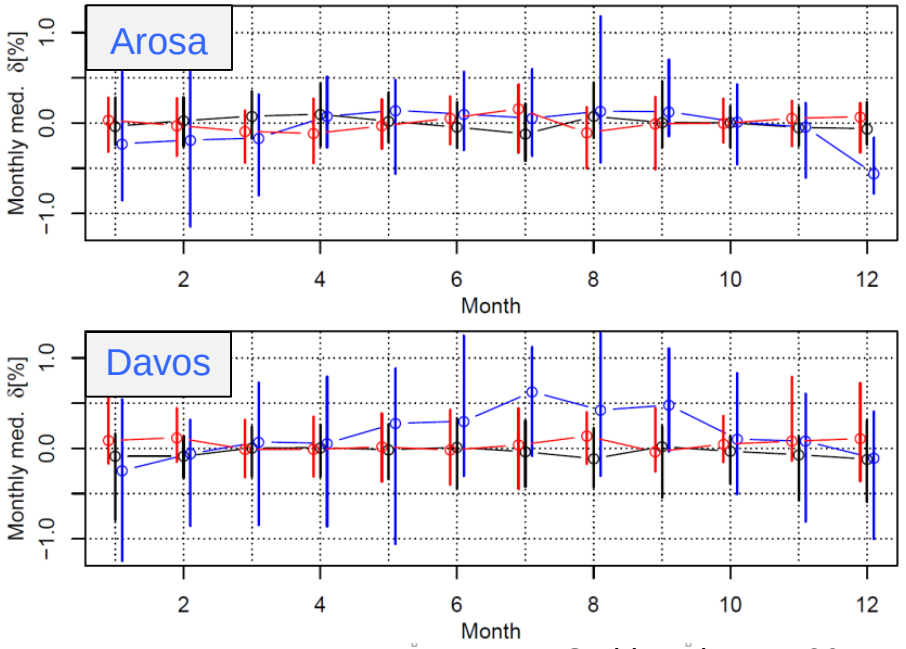
AutoDob : analysis of the Brewer sites comparison

2011 – 2017: coincident Brewer measurements collocated at Arosa, respectively at Arosa and Davos

- Reference column : B040 + B156
- Test inst. B072 Davos or Arosa

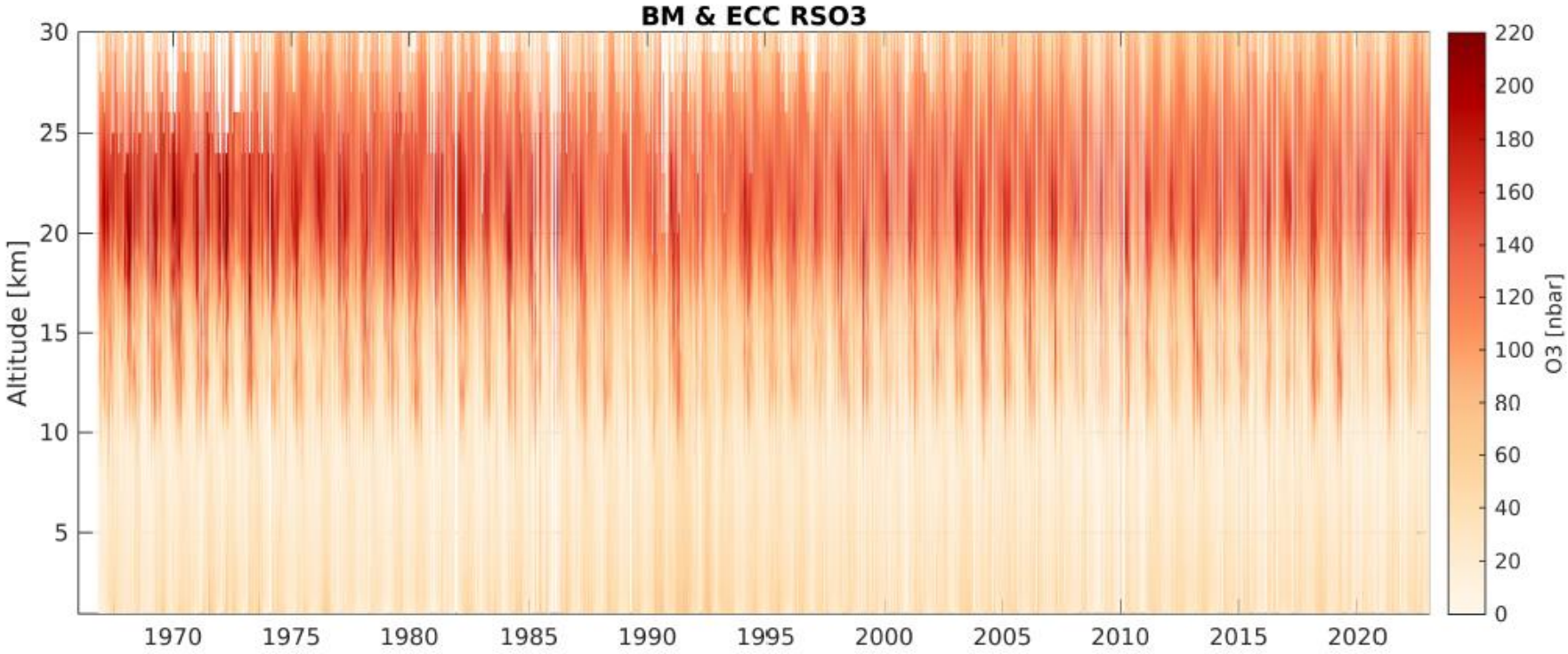
- Stray light effect induces a small annual cycle (blue line curvature)
- Partial ozone column from altitude difference (260 m) induces a small offset

No significant differences



Stübi et al, AMT, 2017

Payerne ozone sonde timeseries

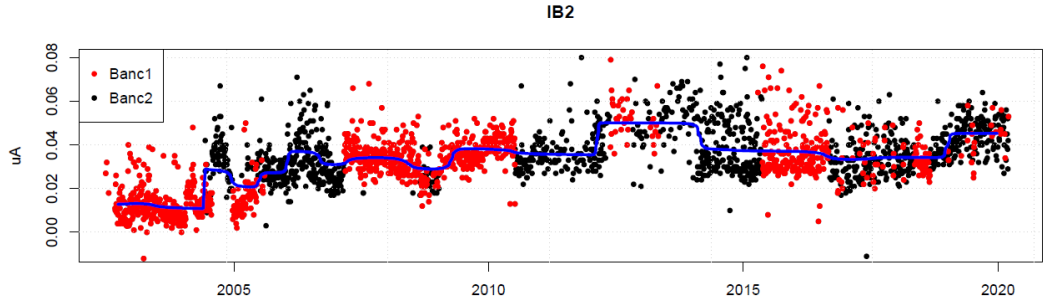


Homogenization of the ECC ozone sonde timeseries (2002-2023) following ASOPOS2.0 principles

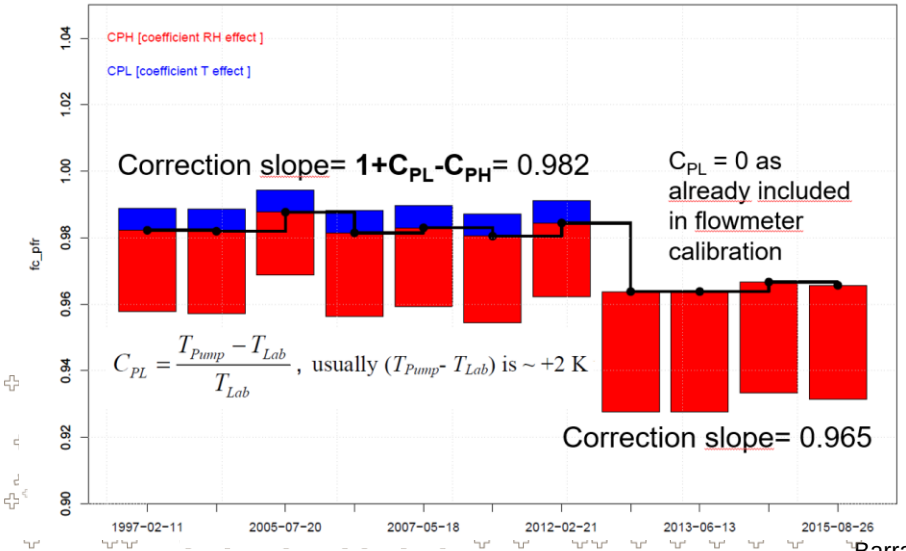
An electrical current I_M [µA] generated in the external circuit of the electrochemical cell is, after correction for a background current I_B [µA], directly related to the uptake rate of ozone in the sensing solution. By knowing the gas volume flow rate Φ_P [cm^3s^{-1}] of the air sampling pump, its temperature T_P [K] and the conversion efficiency of the ozone sensor η_C, the measured partial pressure of ozone P_{O3} [mPa] is determined from Faraday's first law of electrolysis and the ideal gas law and given by the relation:

$$P_{O3} = \frac{R}{2 \cdot F} \frac{T_P}{(\eta_C \cdot \Phi_P)} \cdot (I_M - I_B) \text{ with } \frac{R}{2 \cdot F} = 0.043085$$

I_B current, Φ_P flow rate



The I_B current is corrected for an offset of 0.02 uA during the period sept-2002 to aug-2005.

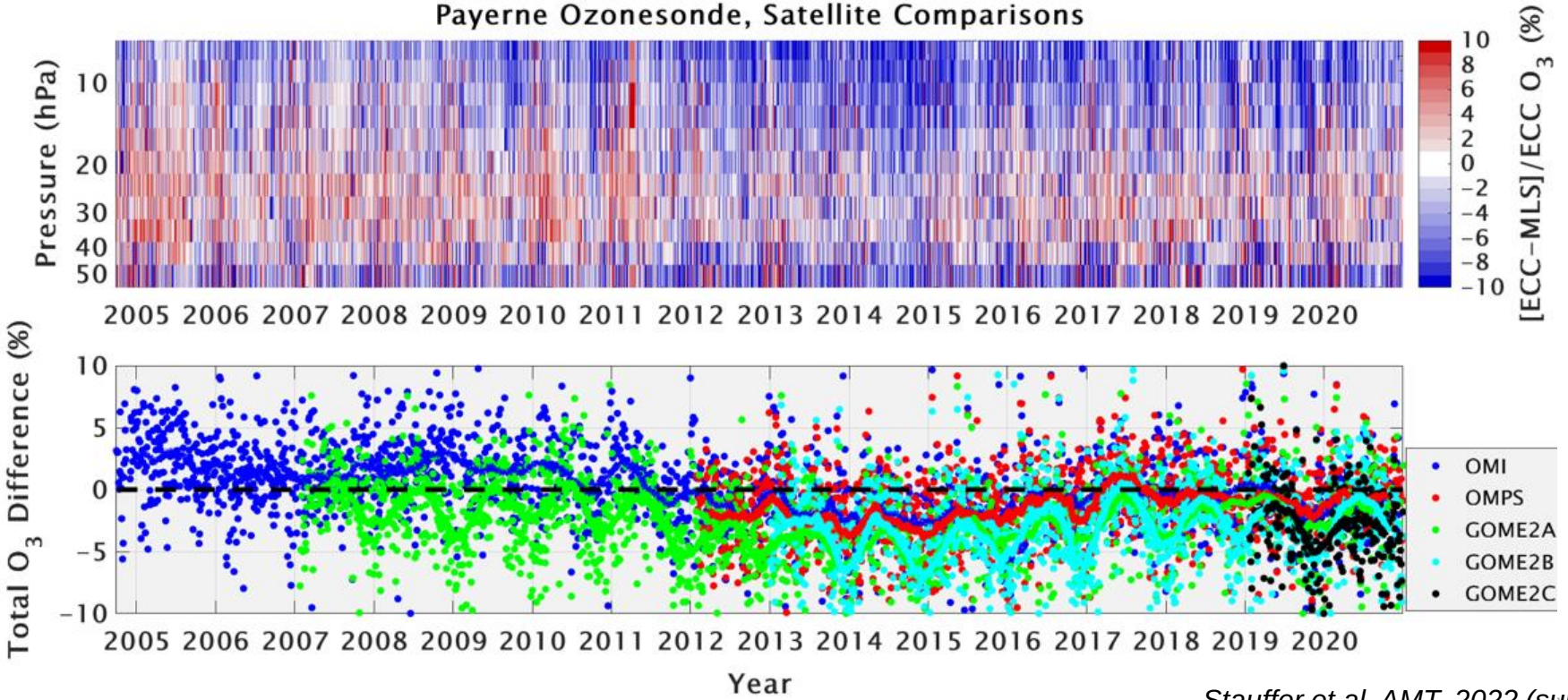


Φ_P :
two slope-corrections during 2002-2013 and from 2013 to present correction for the humidification effect

Residual column determination

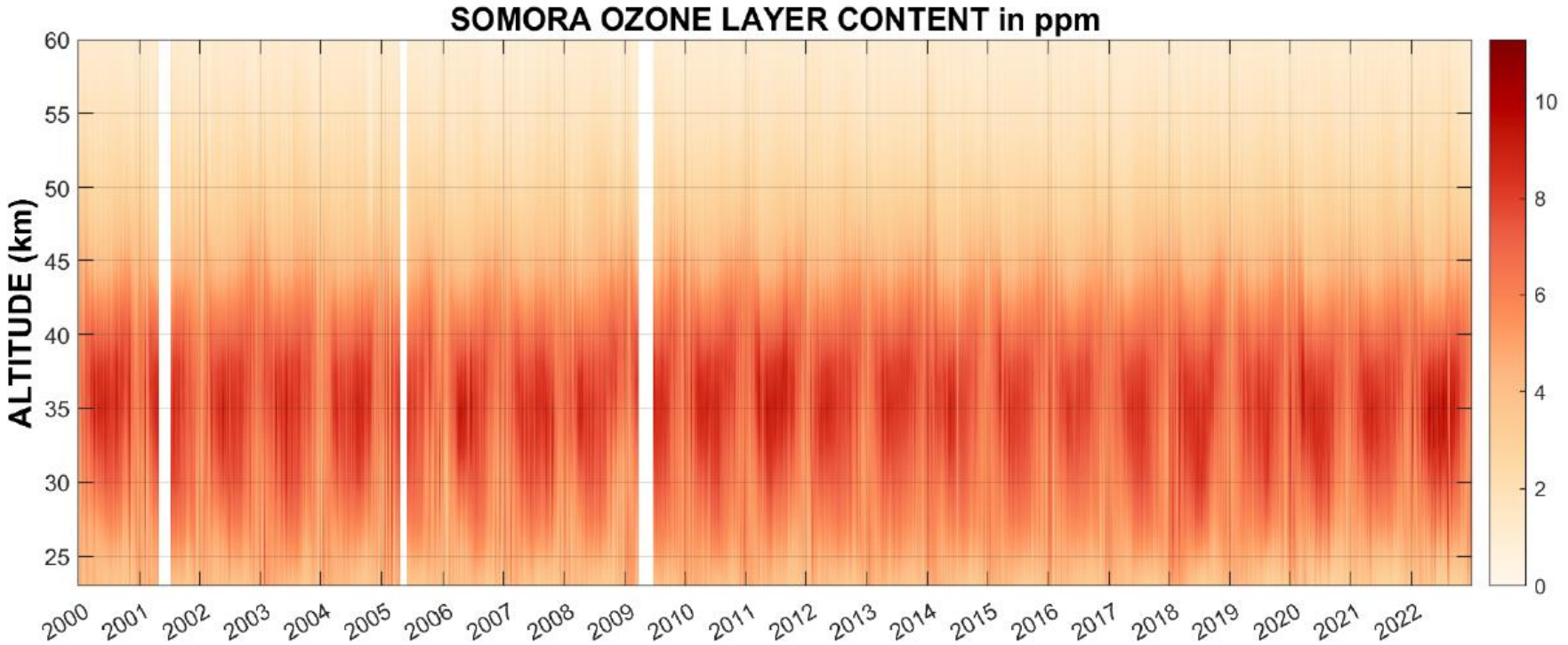
Romanens and Martucci, unpublished, 2020

PAY ozone sonde vs satellite

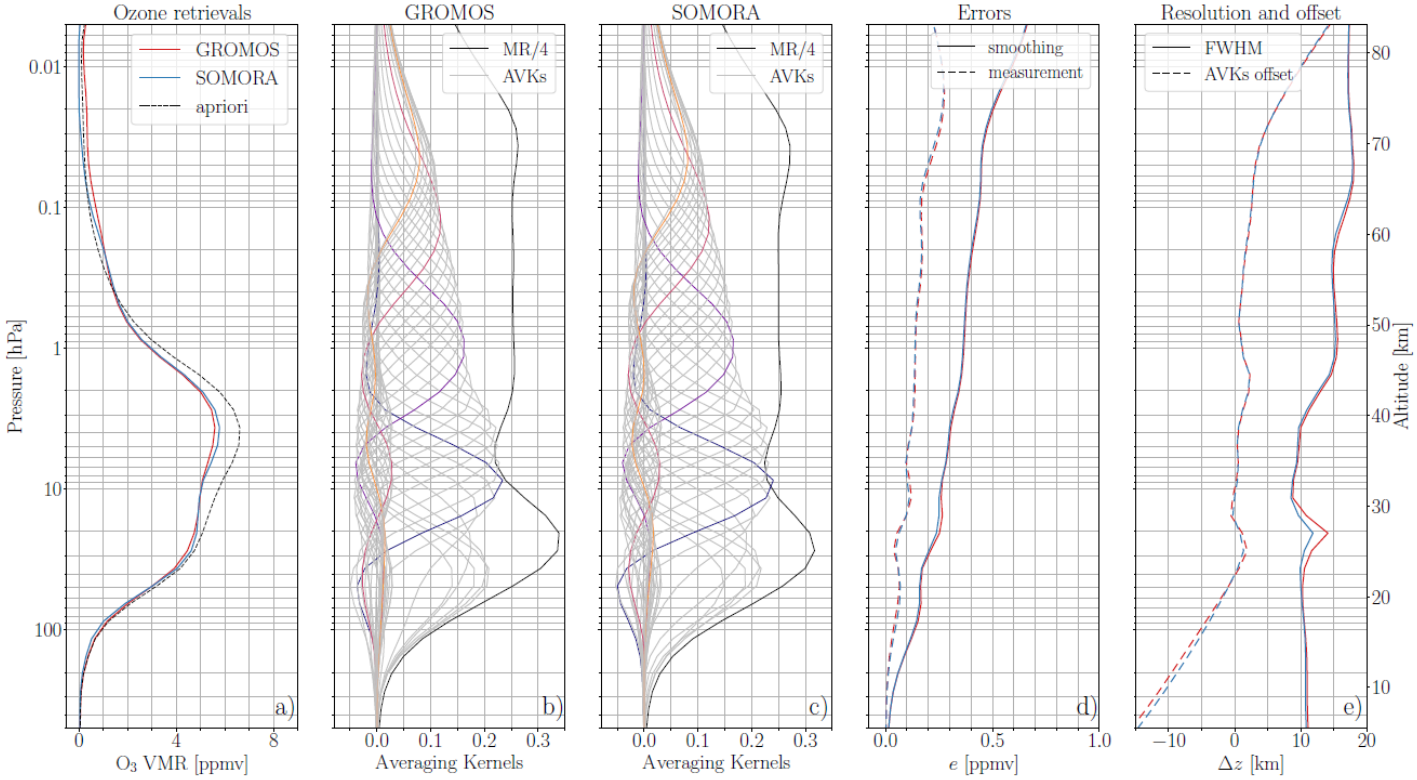


Stauffer et al, AMT, 2022 (suppl.)

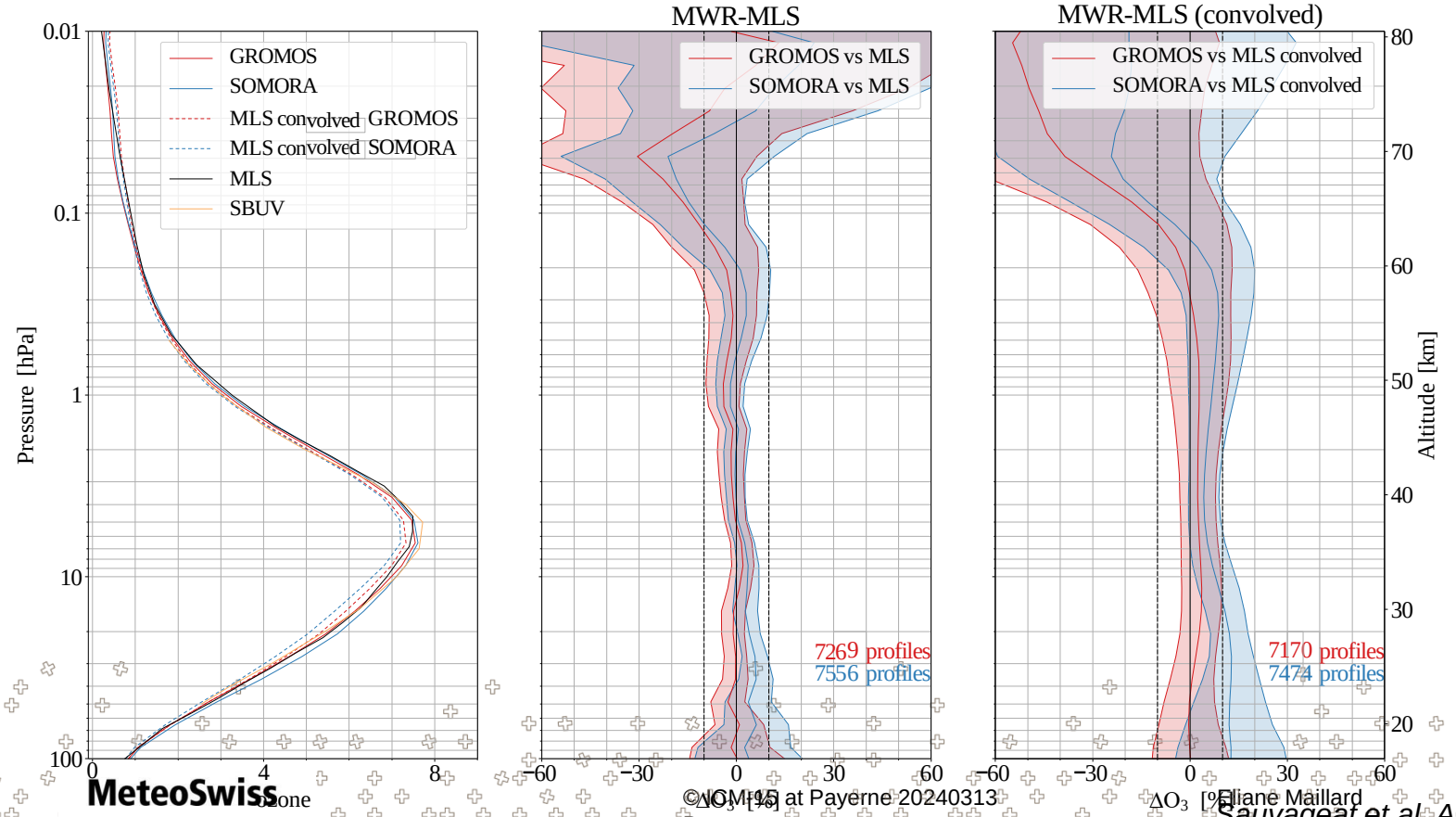
Microwave radiometer



Harmonized O3 retrievals

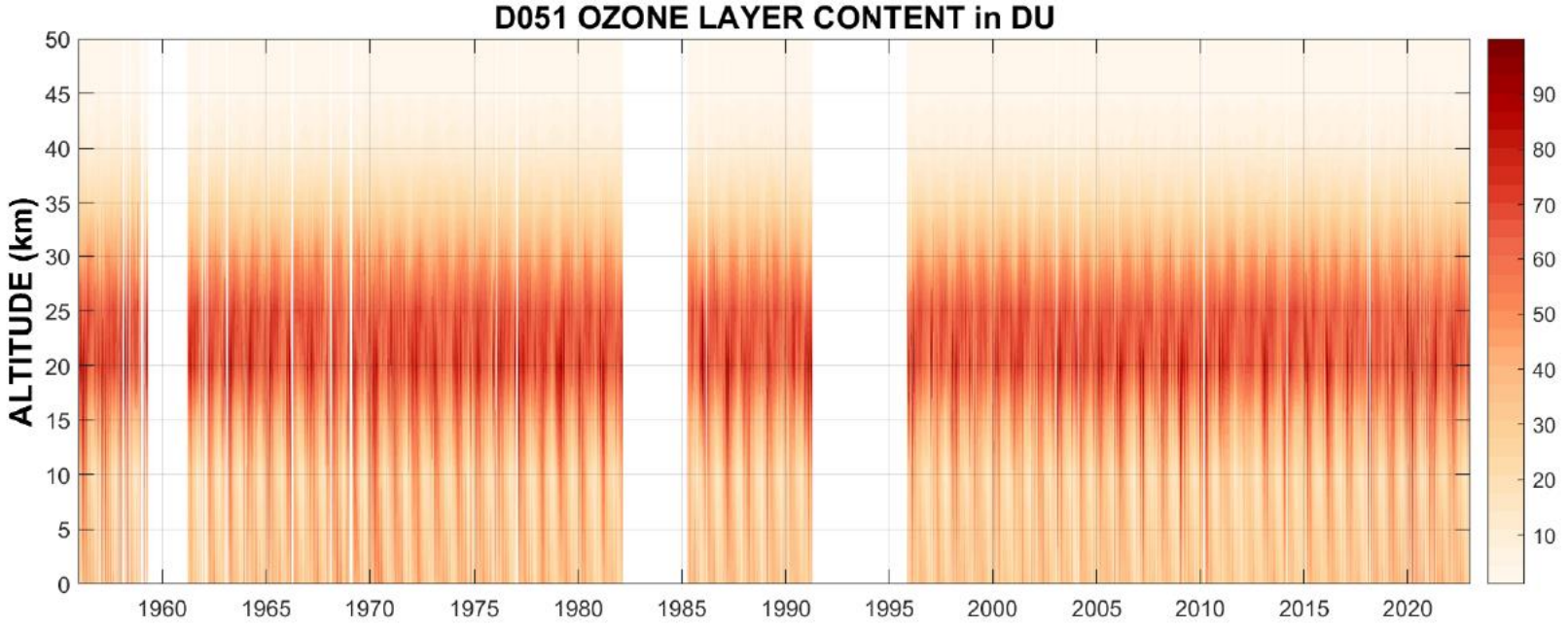


Satellites-based validation

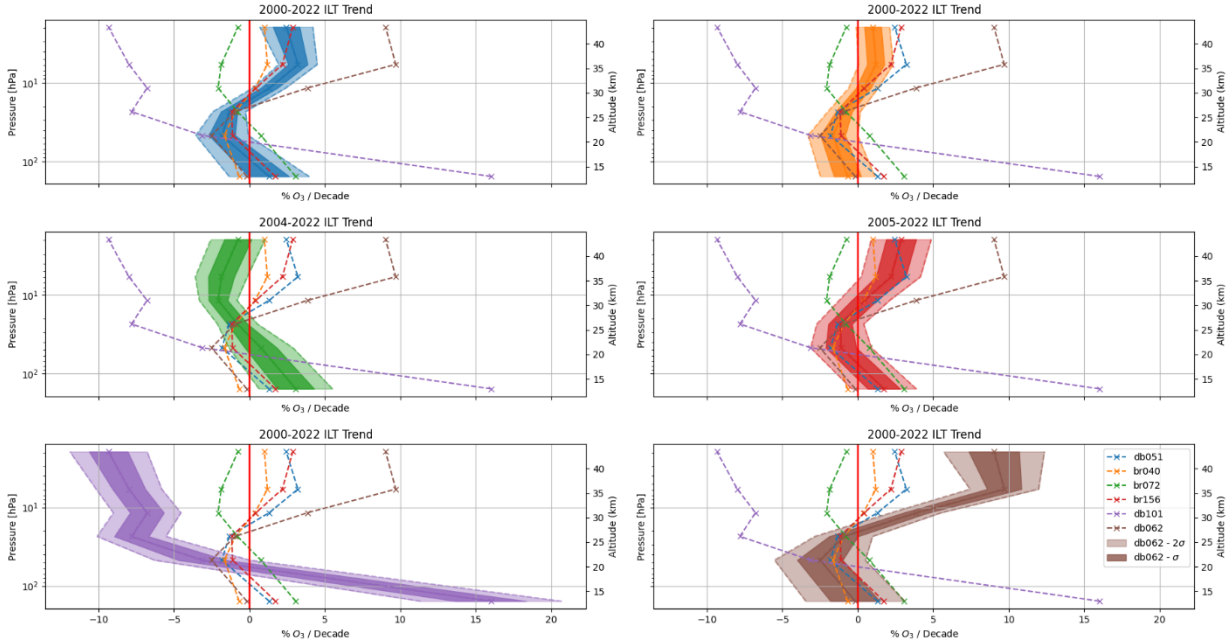


Sauvageat et al, AMT, 2021

Dobson and Brewer spectrophotometers: Umkehr O3 profiles



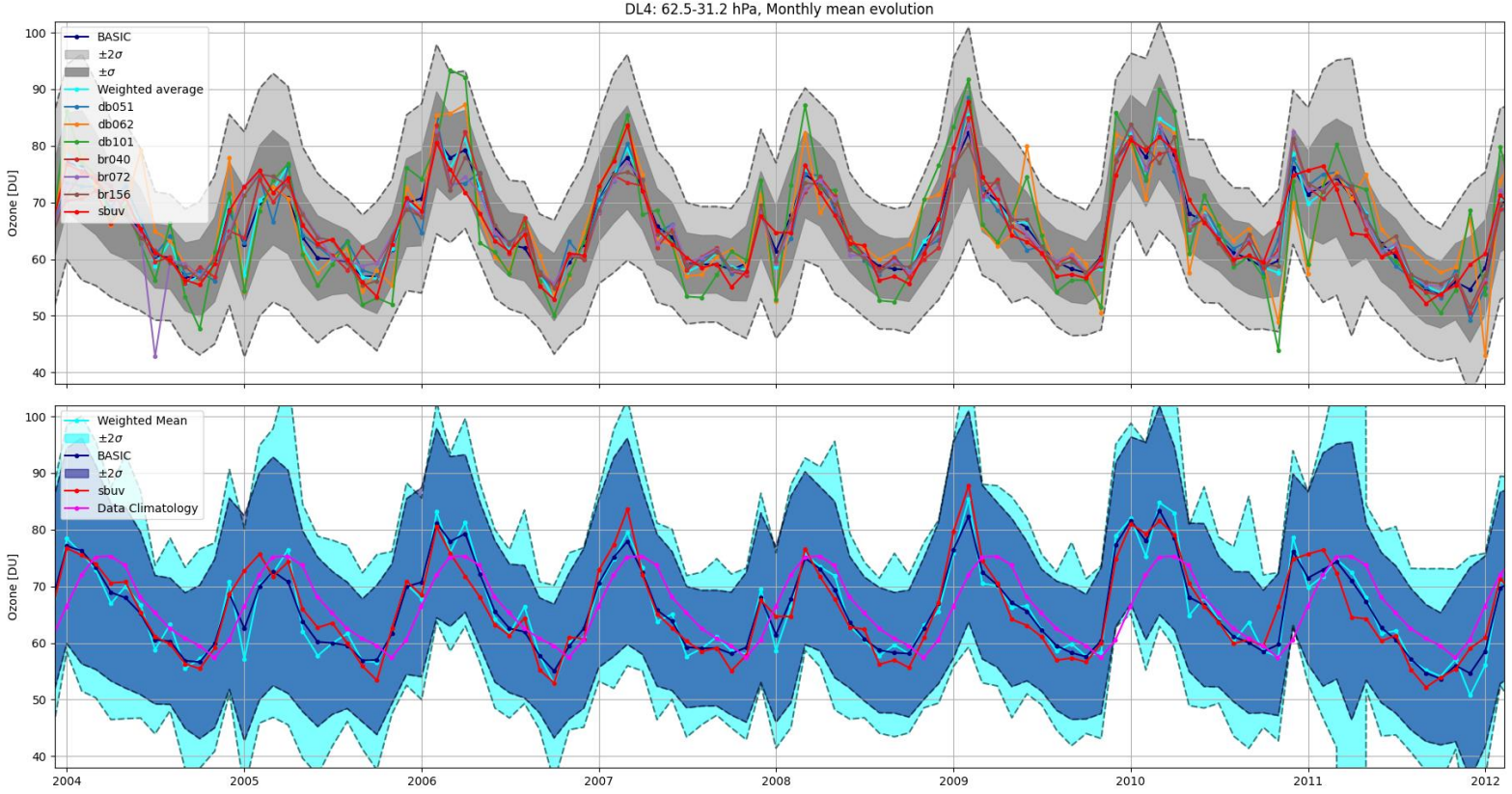
Merging 6 collocated timeseries with BASIC



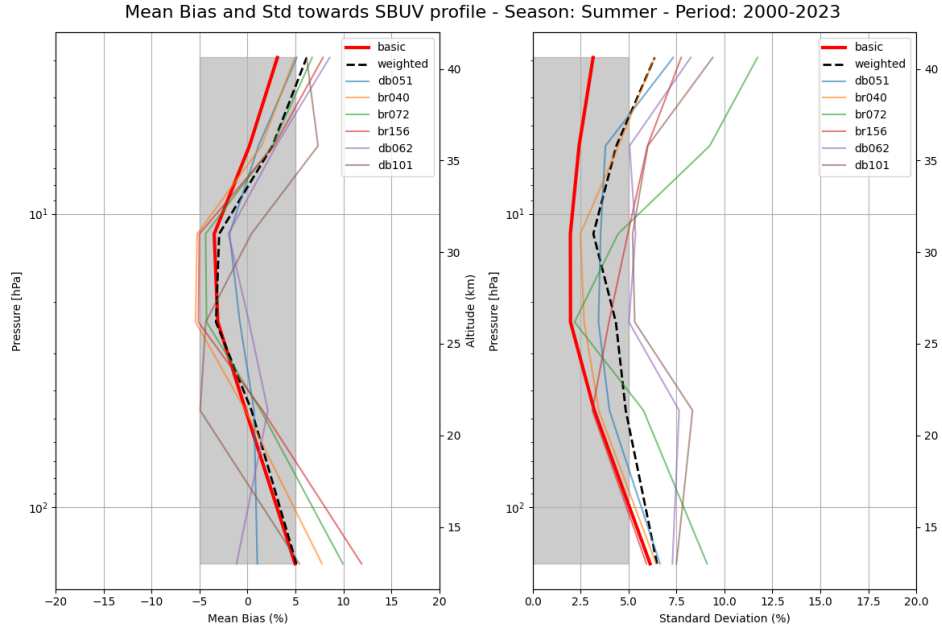
- Remove Artefacts in time-series: Steps and artificial sub-decadal trends in the underlying instrument data and estimate robust trends

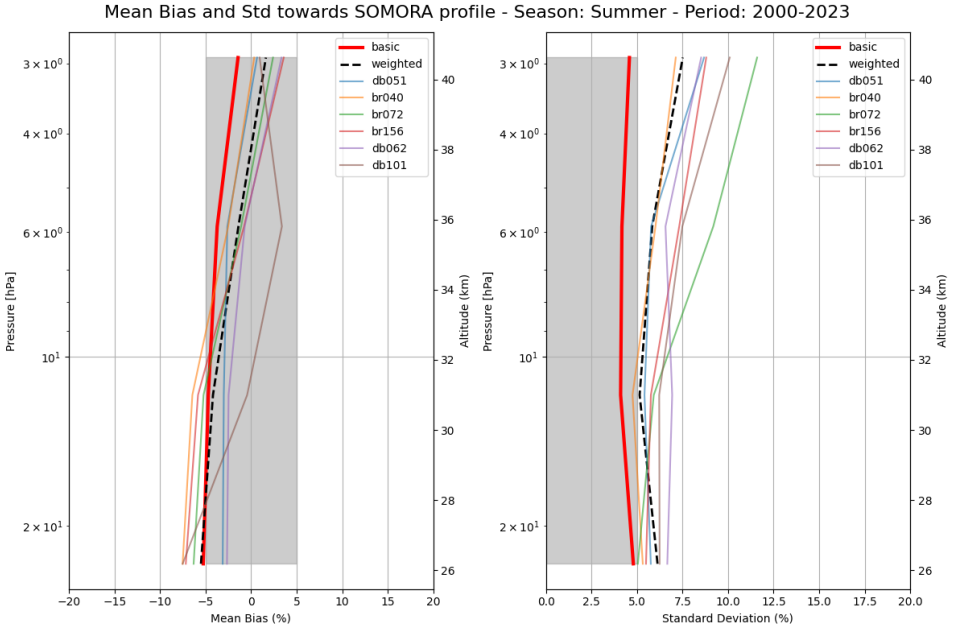
- Use and combine all the information possible to reduce uncertainties of the time-series.

Merged dataset: BASIC (BAyeSian Integrated and Consolidated by Ball et al, ACP,2017)

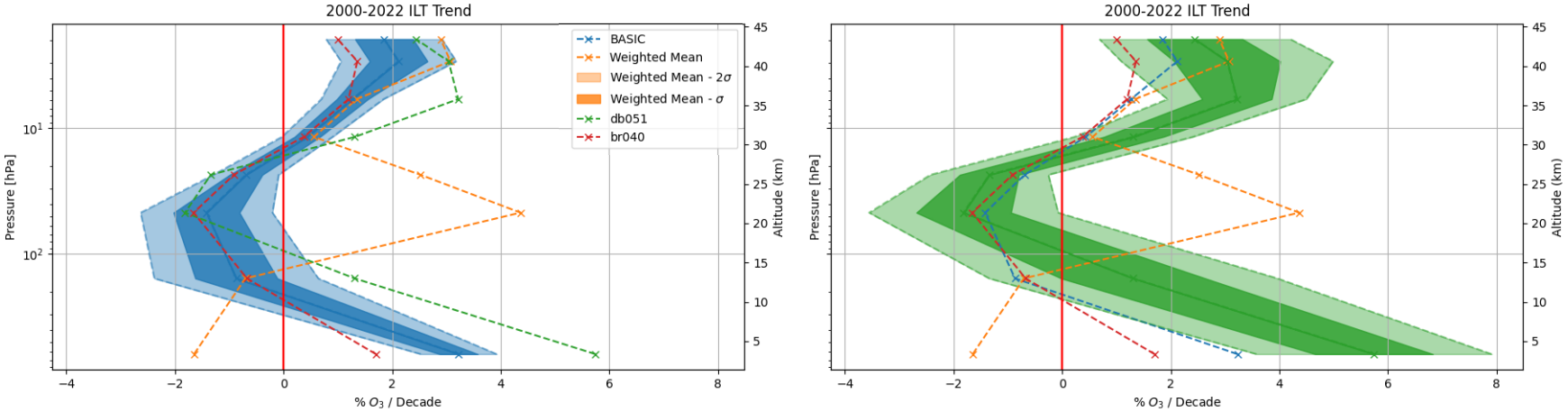


Validation with SBUV satellite and SOMORA MWR





MLR trend estimation



MLR trend 2000-2022 Merge & Data prior
MM weighted & Heteroscedasticity correction