

# Profiles of Ozone from EUMETSATs current and future hyperspectral sounding missions.

Stefan Stapelberg, T. Hultberg and HSIR-L2 Team  
*Eumetsat*

*IASI Conference 2024 Nancy, France*



## EUMETSAT Hyperspectral IR

O3 Products

## Validation & intercomparisons

Vs O3-Sondes

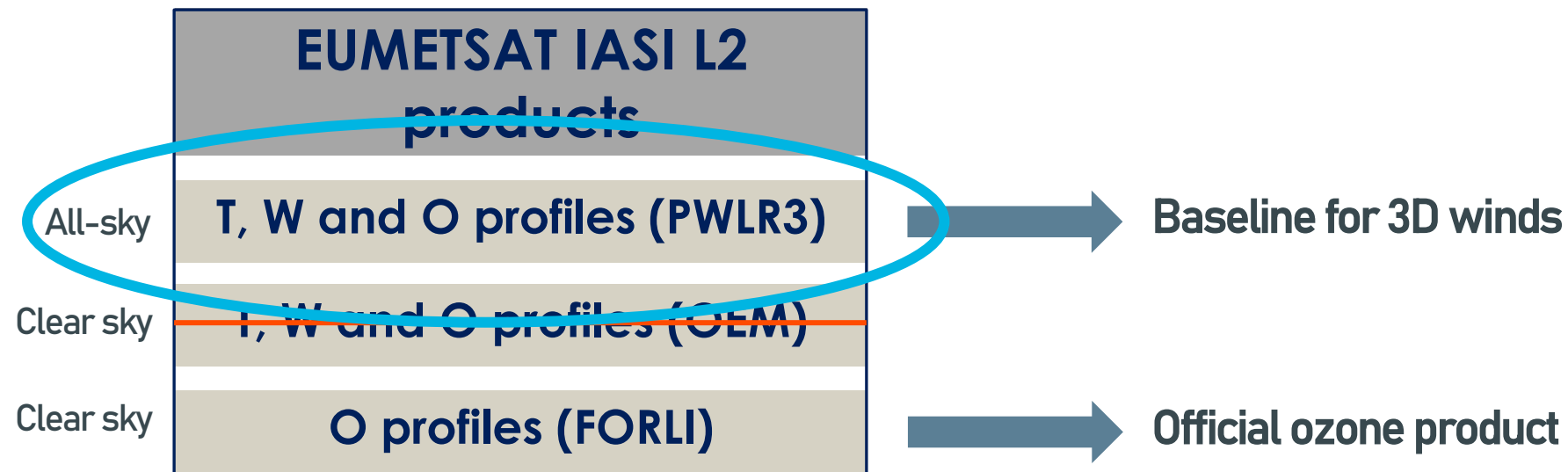
Vs Satellite Products

Vs Brewer Spectrophotometer

## Summary and Outlook



# EUMETSAT Hyperspectral Ozone Products



➔ **Extensive validation of ozone products with *in situ* measurements with the operational version**

✓ OEM to be replaced by PWLR3

- **Piece-Wise Linear Regression**

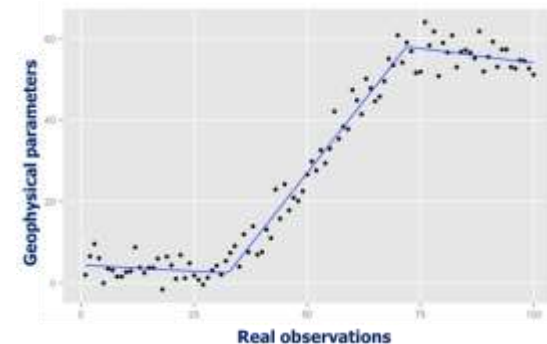
- Principle: Supervised machine learning approximating the non-linear relationships between observations and geophysical parameters with multiple linear models in classes built using K-means classification
- Characteristics:
  - ML for geophysical retrievals
  - IR-MW synergy (AMSU/MHS)
  - IASI horizontal correlation (FOV)
  - Radiances PC scores as predictors
  - Ensemble retrieval approach
  - Trained with huge ref. datasets

→ As **fast** as alternative ML (e.g. NNs)

→ All-sky retrievals (>99%)

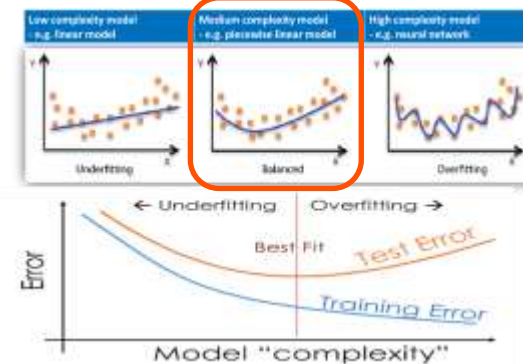
→ Use of full IASI spectral information

→ Decrease random error



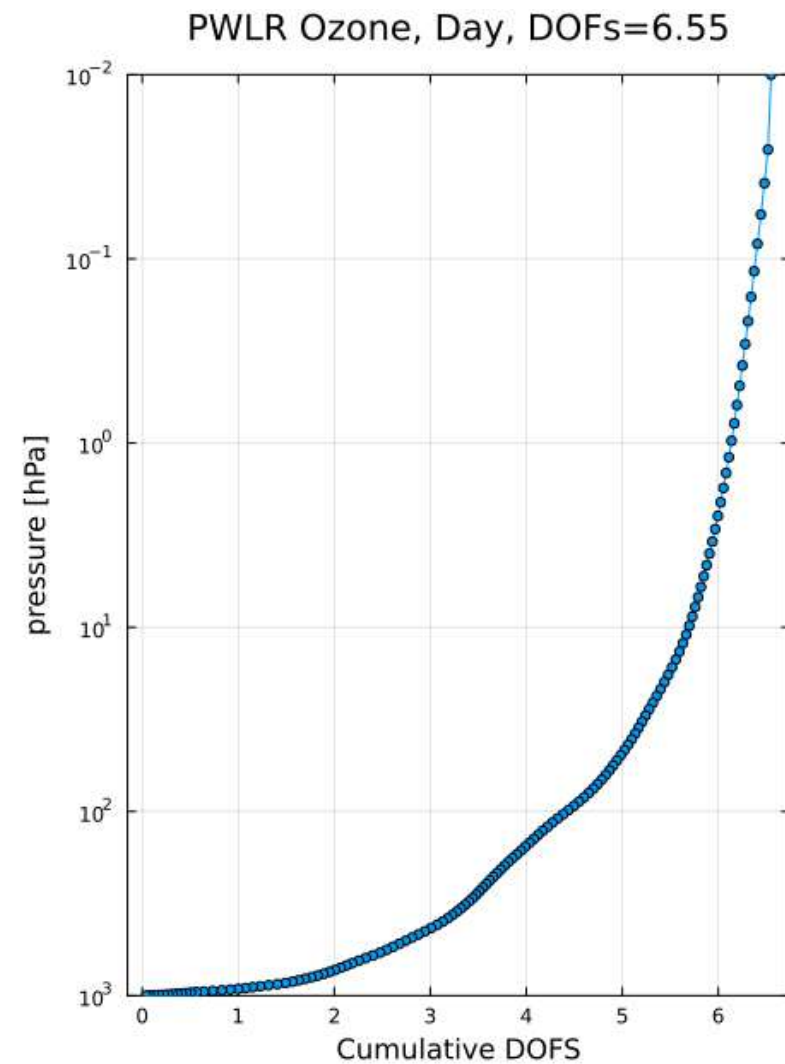
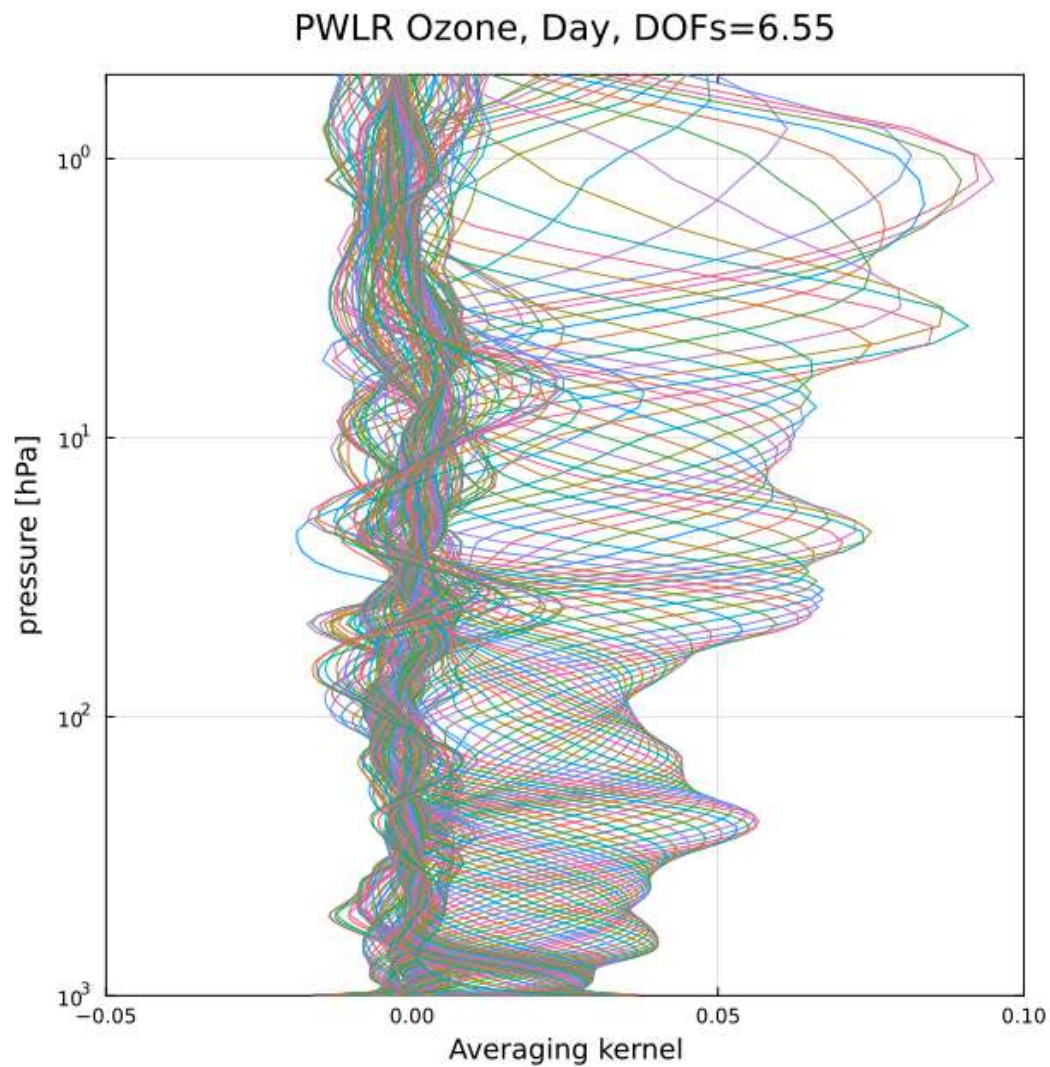
- Advantages:

- **All-sky retrieval**, allowing new type of uses like e.g. to derive **3D winds**
- **Excellent error characterisation**, including vertical characterisation for profiles
- **Versatile approach**, applicable to several types of observations and geophysical parameters
- **No use of forward model !**
- **Drawback**: Global reference data is needed for the training





# Averaging Kernels with PWLR (Ozone Profiles)





## EUMETSAT Hyperspectral IR

Ozone Products

### Validation & intercomparisons

Vs O3-Sondes from WOUDC/NDACC

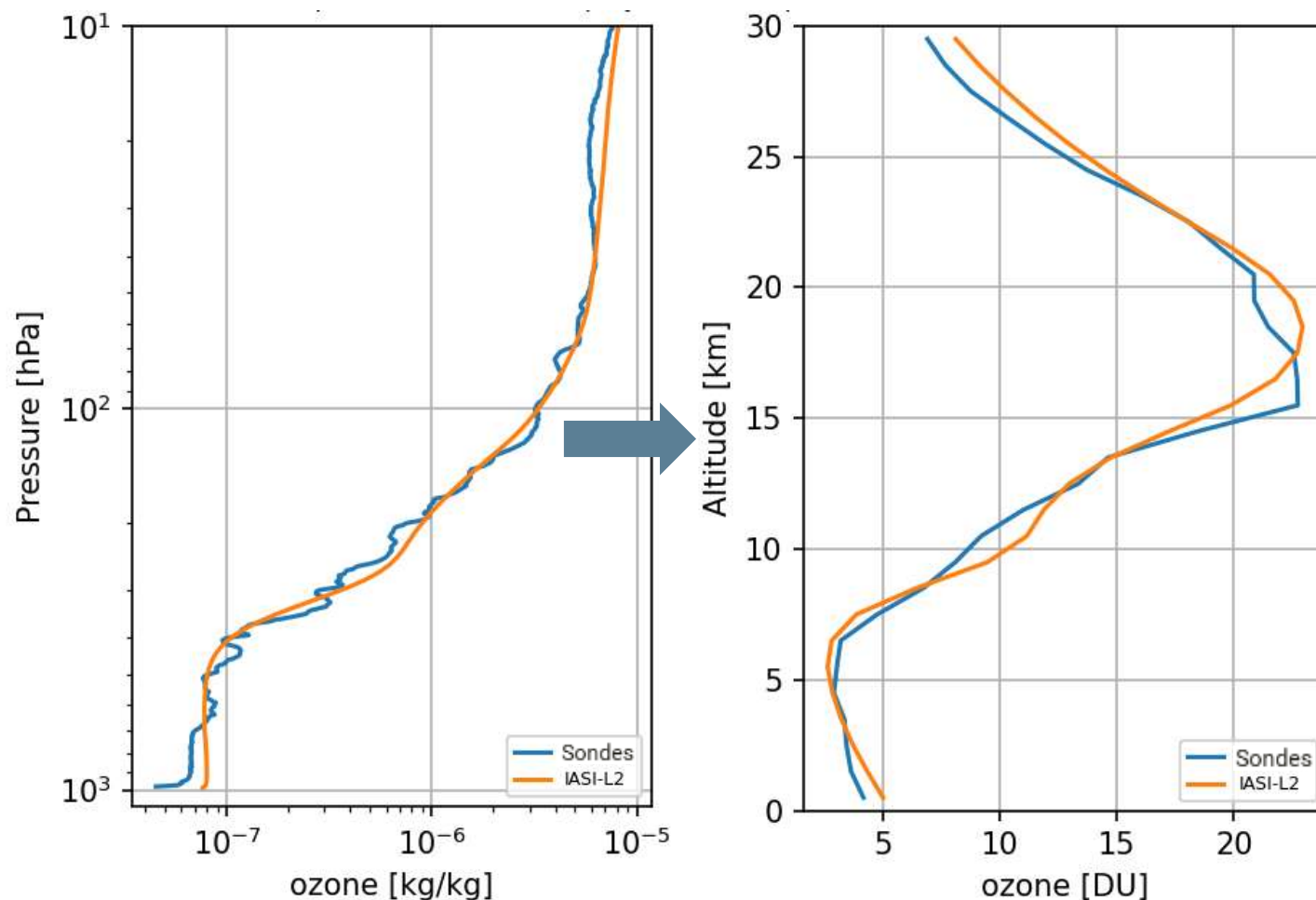
Vs Satellite Products from MLS-AURA

Vs Brewer Spectrophotometer from EUBrewNet

### Summary and Outlook



## Example: NY-ALESUND Station 19<sup>th</sup> Jan. 2017

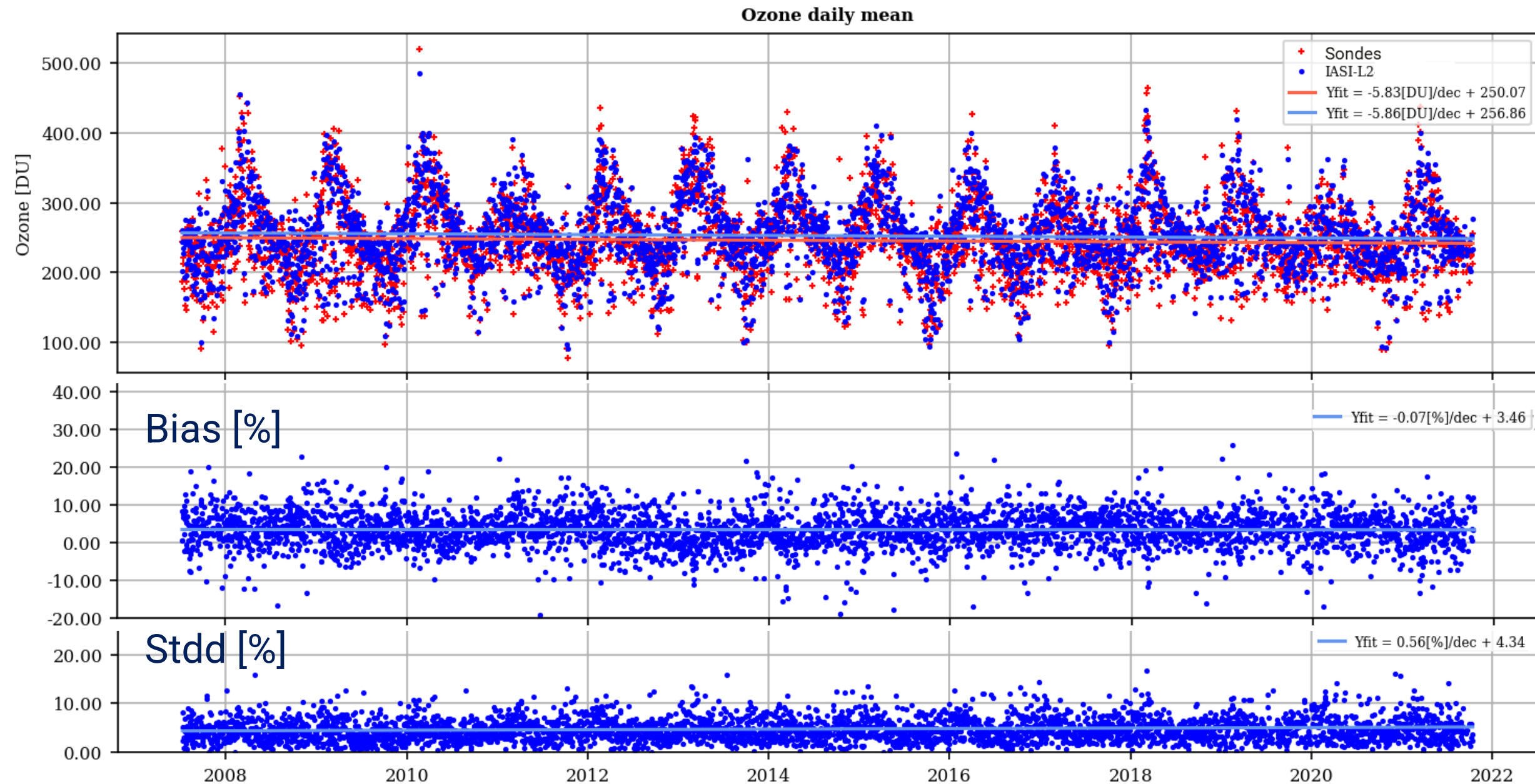


Conversion to partial columns  
profile

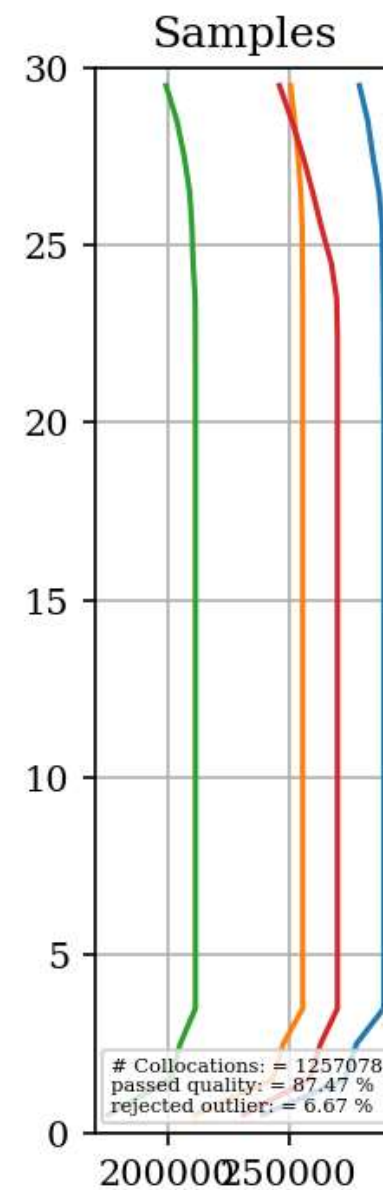
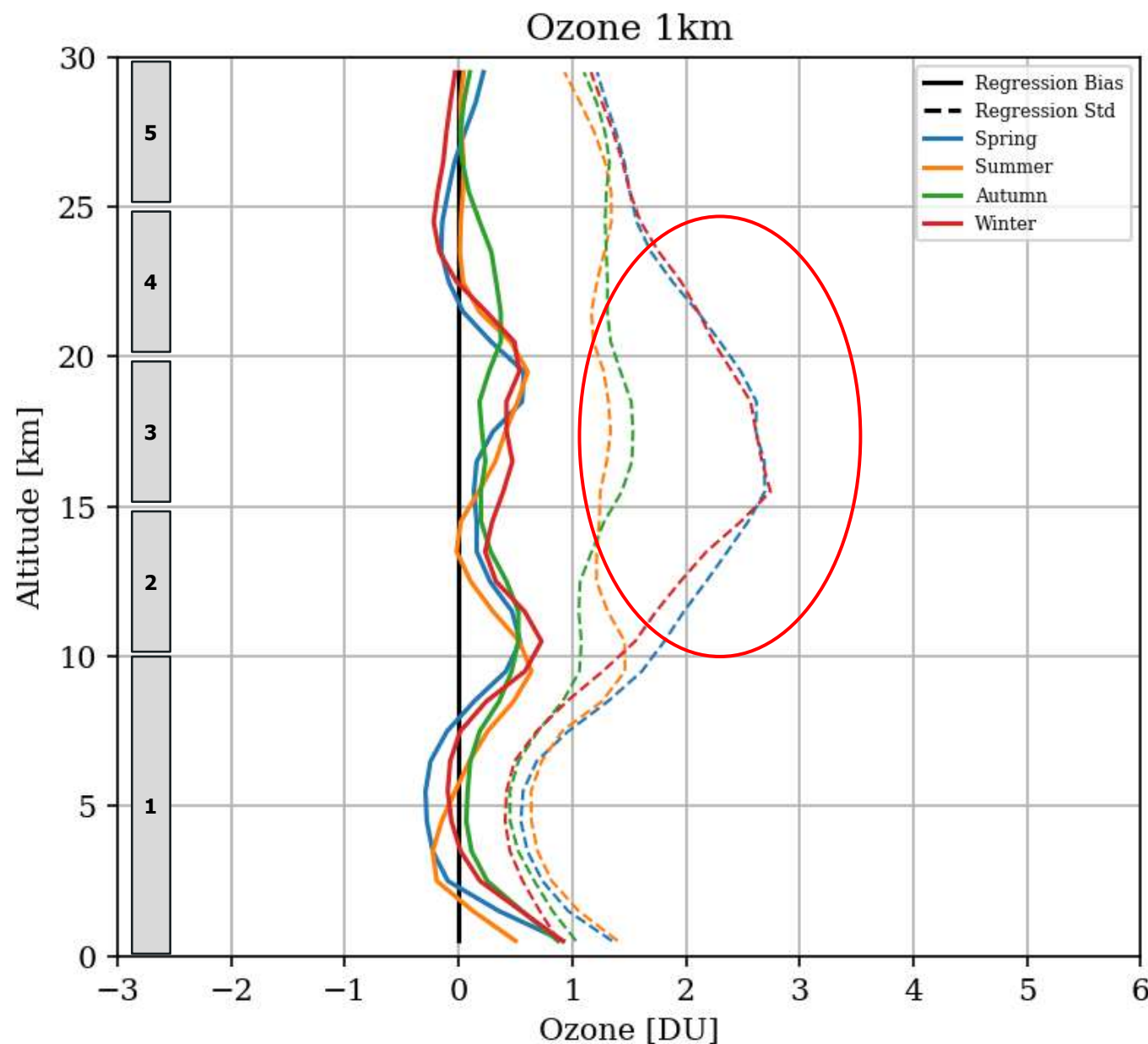
All profiles are interpolated on  
a fixed pressure levels  
(approx. 1km height) and  
converted to DU following  
Godson (1962)



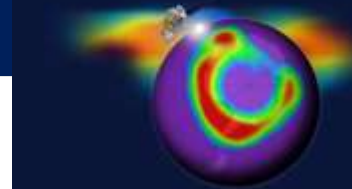
# Validation with O3-Sondes: Partial Column Ozone [0-30km]



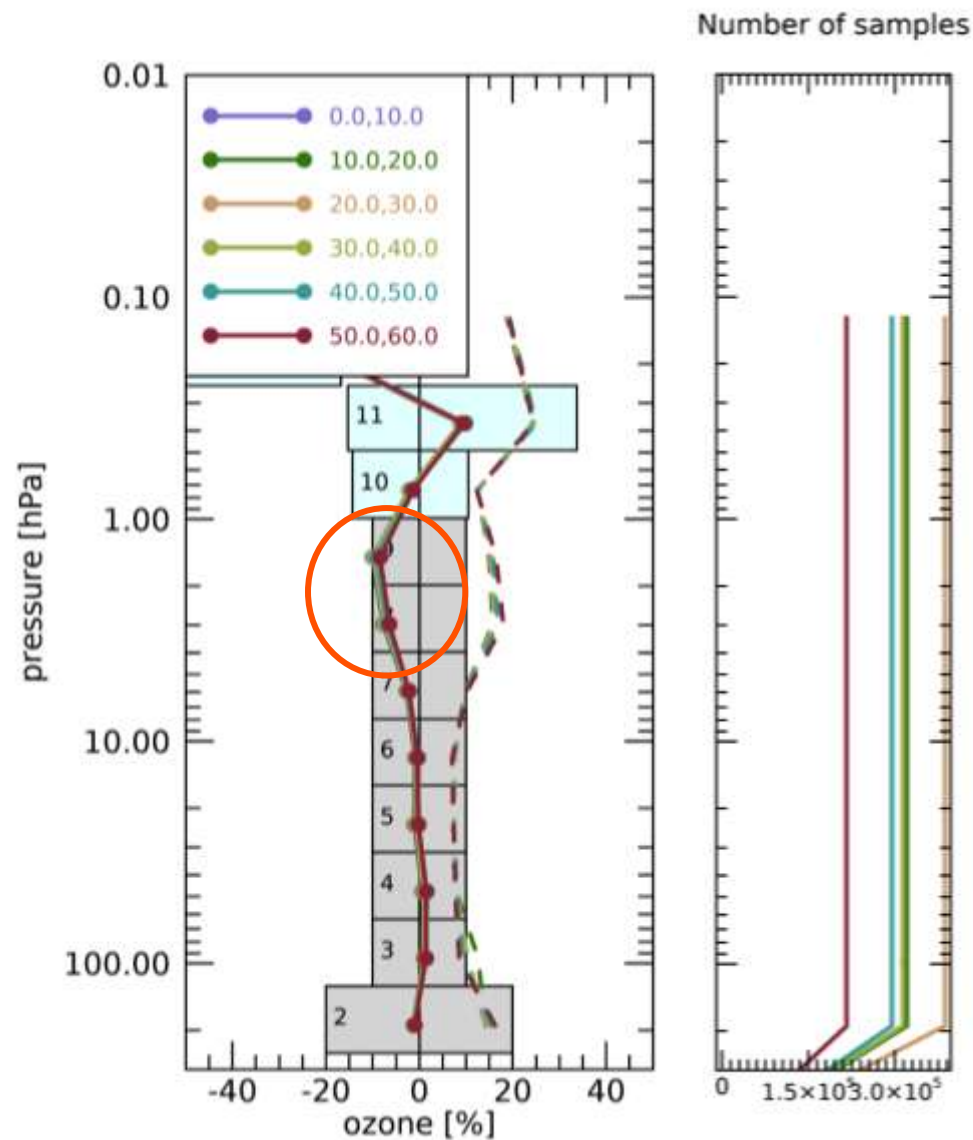




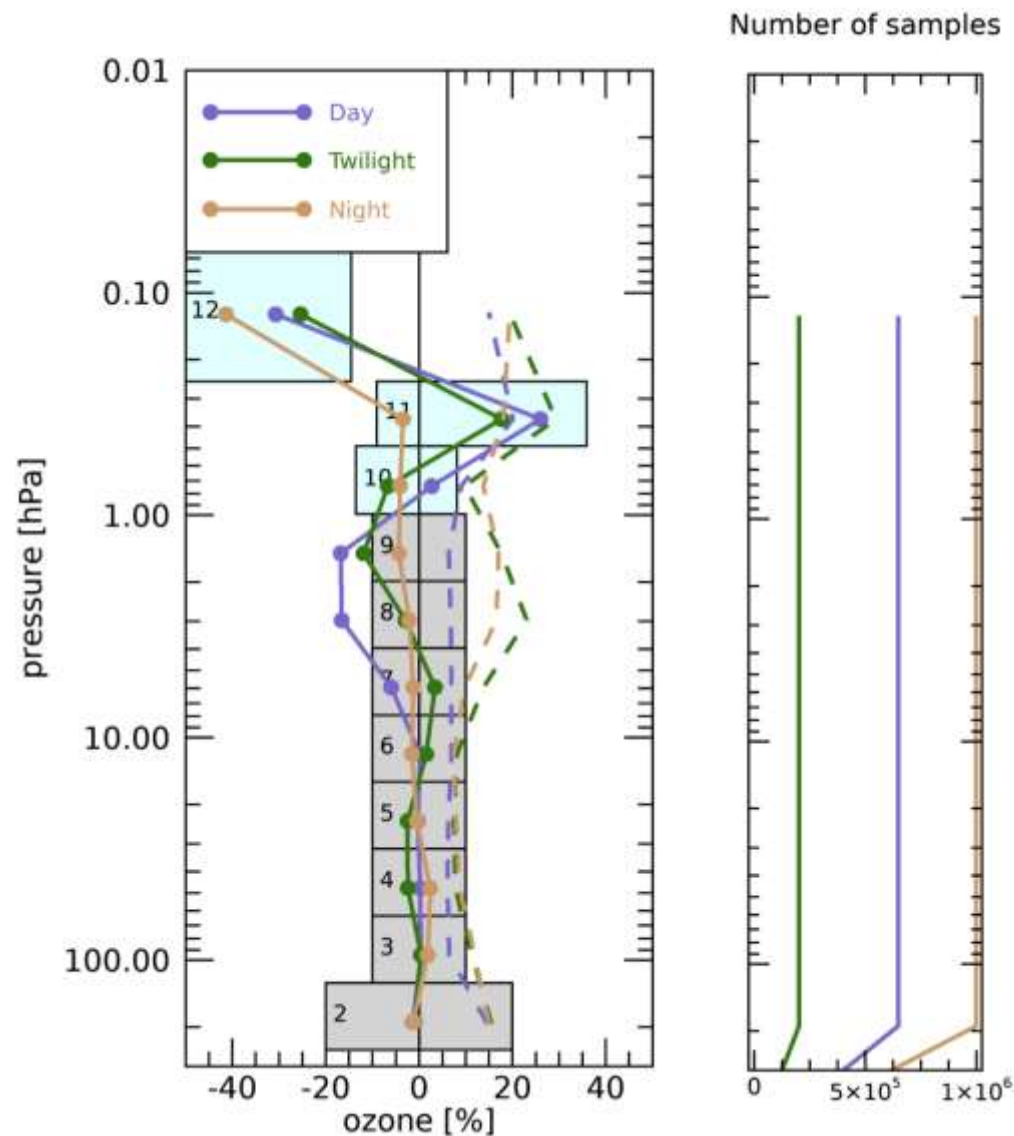
IASI – SONDES  
2007-2021  
Global  
stratified by season



by Satellite zenith angle



By daytime

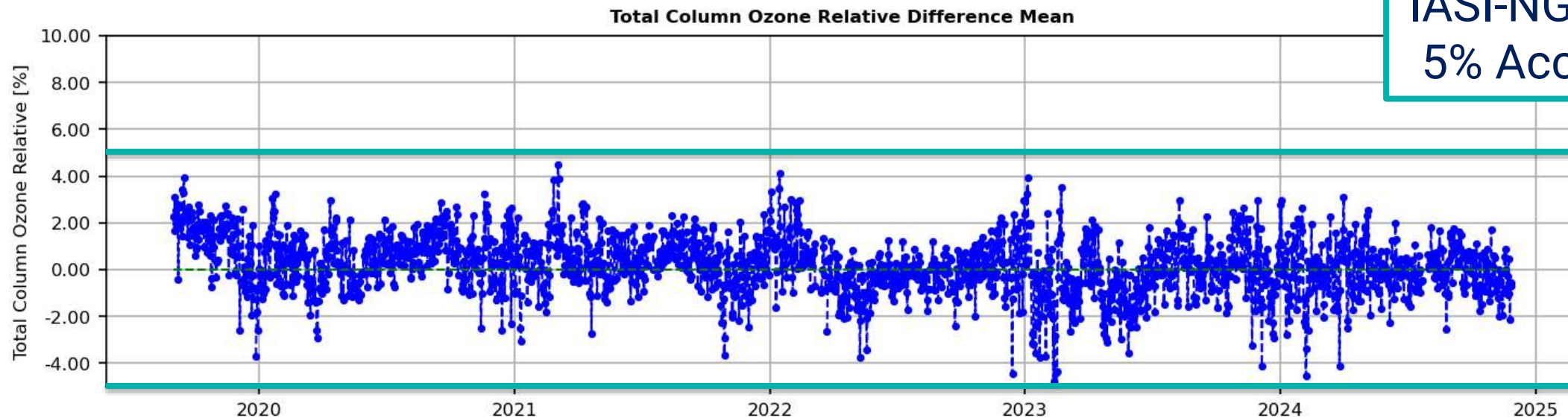




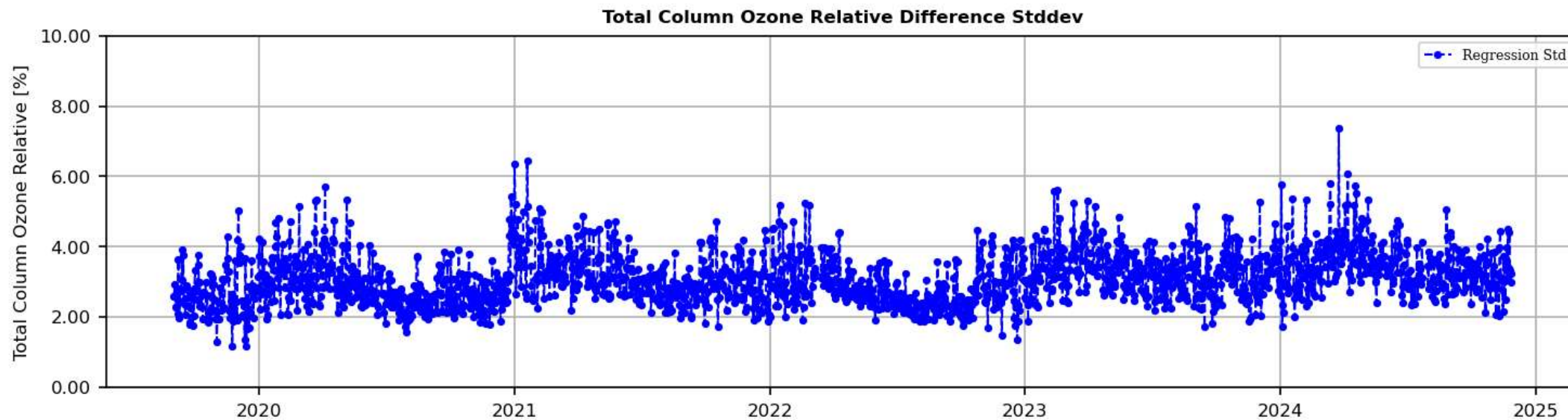
# PWLR3 Total Column Ozone vs Brewer spectrometer (EuBrewNet) – IASI-B

Bias

IASI-NG EURD  
5% Accuracy



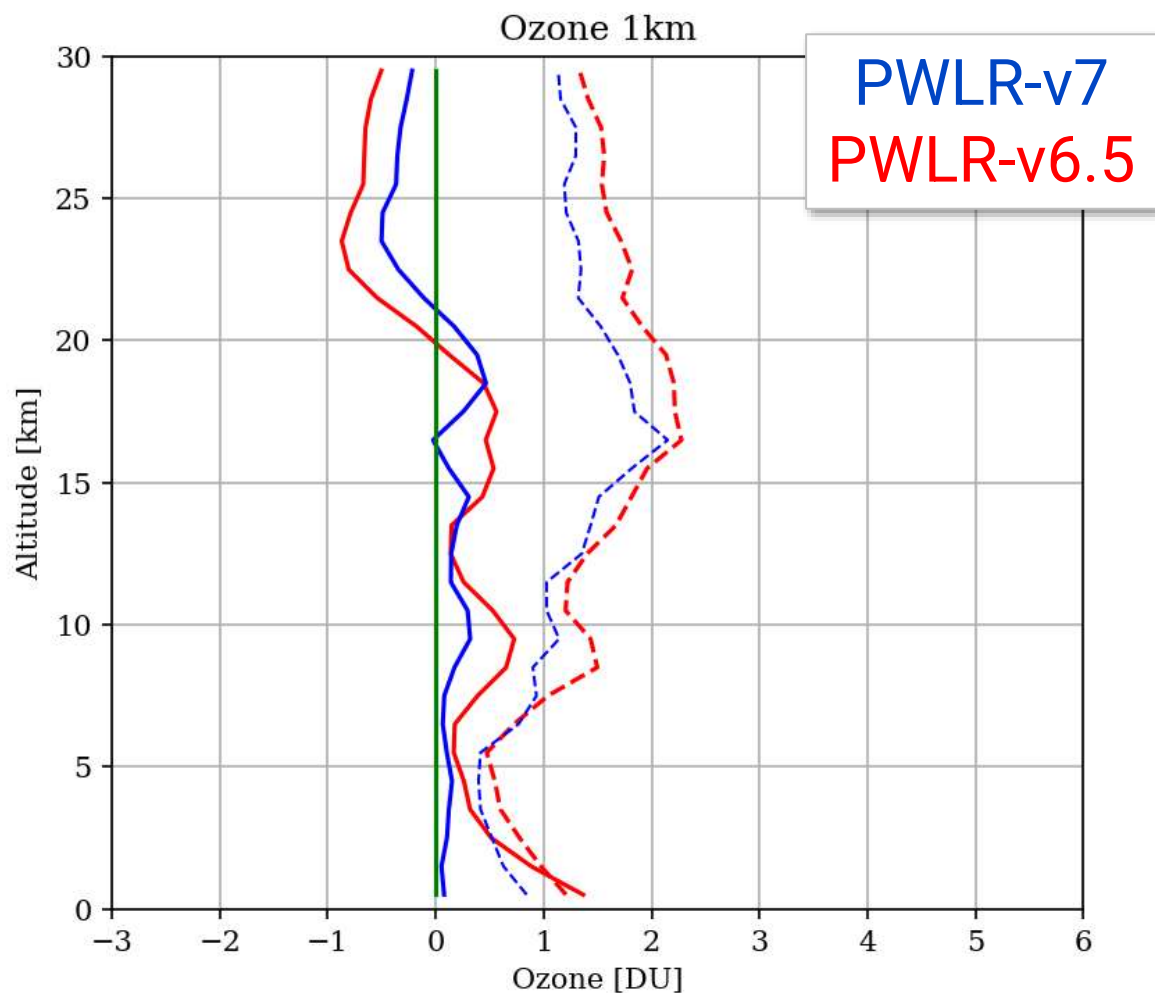
Stdd



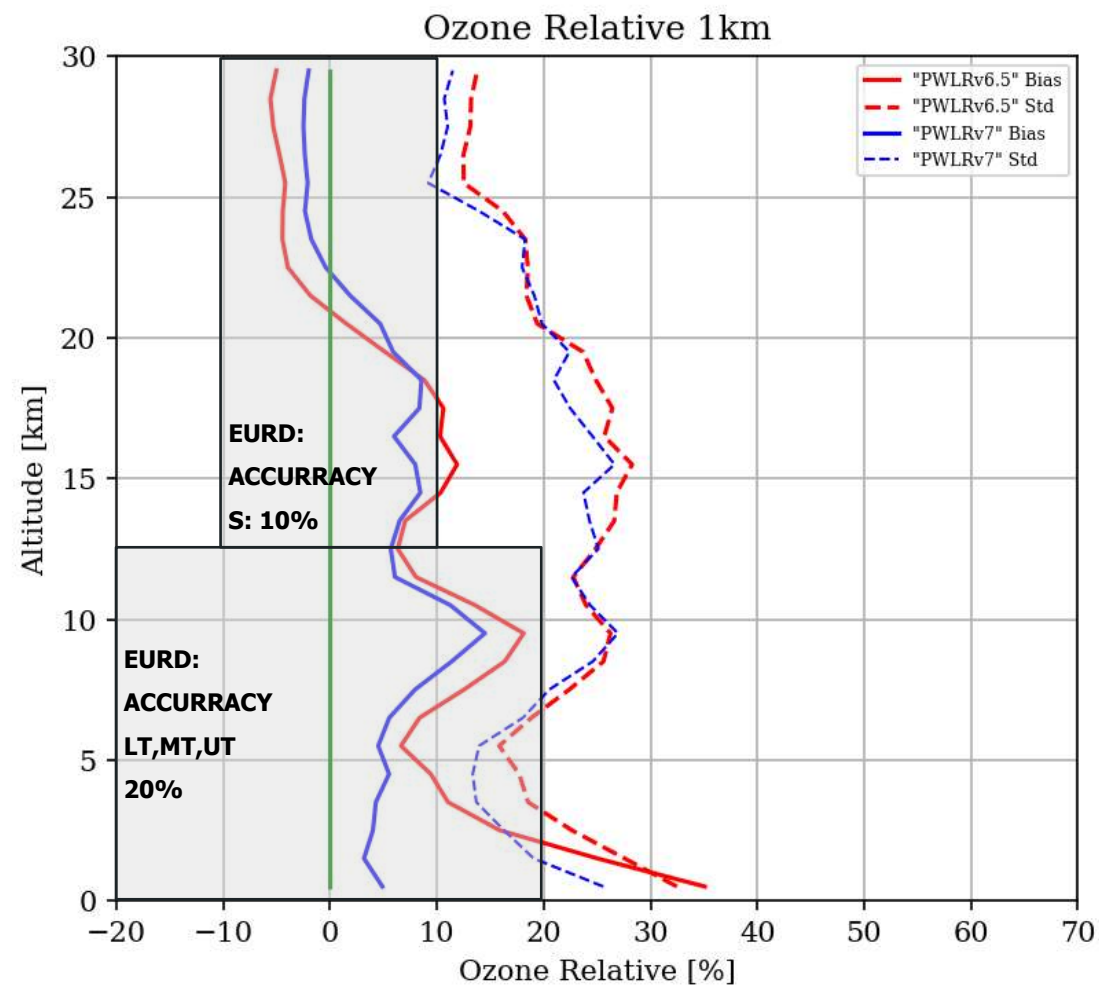


# Towards PWLR v7 : PWLR-v6.5 and v7 vs O3-Sondes (IASI-B 2021-2022)

## Global Differences [DU]



## Relative Differences [%]







# Summary and Outlook

EUMETSAT provides an **All-sky** Ozone profile product which serves as base line for 3D Winds and fulfills timeliness demands for **NRT disseminations**

Comparisons to Ozone-Sondes show very good and stable results in troposphere and UTLS - with some seasonal dependencies in precision

Inter-comparison to MLS show **very good agreement in the Stratosphere up to 40 km**; work in progress above to capture strong diurnal variations of ozone in the stratosphere – training data problem? any suggestions on a global reference dataset for trainings are most welcome

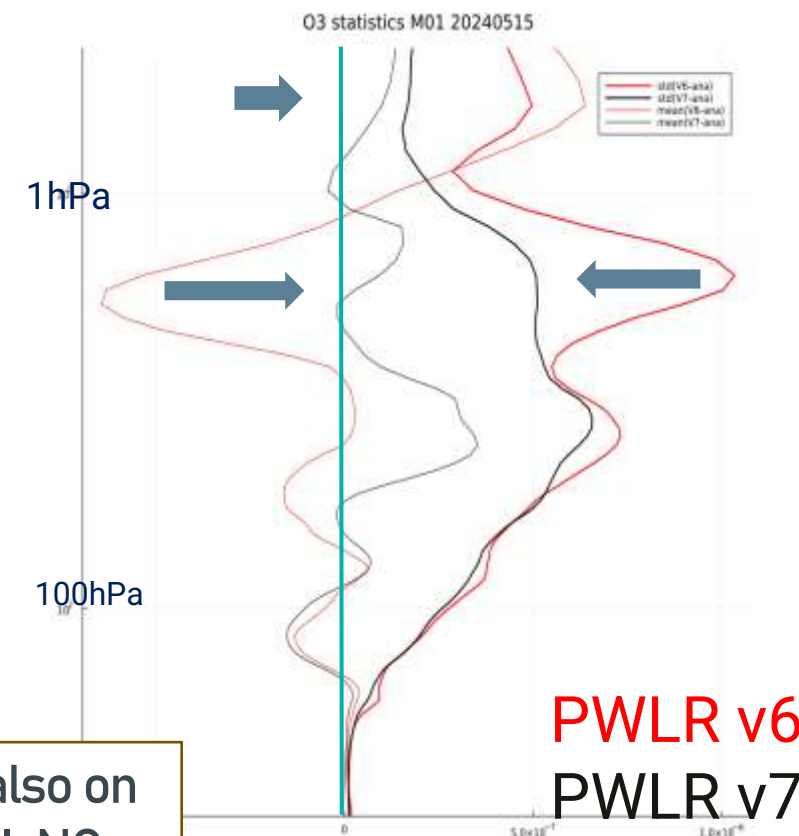
Comparisons to Brewer Photo-spectrometer show that the current version already fulfills the demanding accuracy requirements of IASI-NG

PWLR v7: work in (good) progress

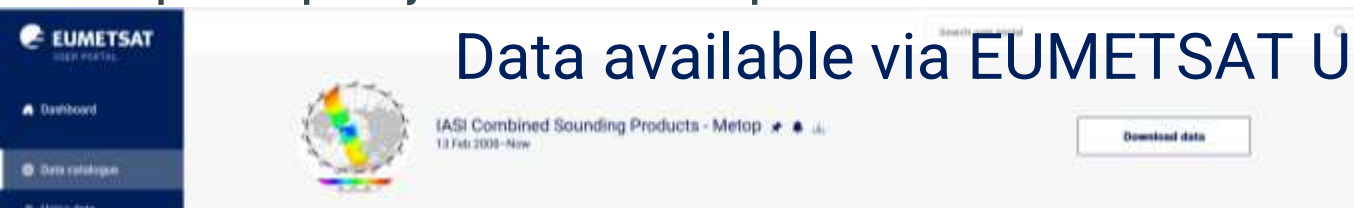
- Extended Training-Set
- More regression classes
- improved classification scheme
- Update quality indicators into profiles

PWLR retrieval will be deployed also on the new EUMETSAT missions IASI-NG on EPS-SG and IRS on MTG-S

New PWLR3 coefficients vs ECMWF analysis



Data available via EUMETSAT User Portal : <https://user.eumetsat.int/>







# Thank you!

Questions are welcome.

[stefan.stapelberg@eumetsat.int](mailto:stefan.stapelberg@eumetsat.int)