

Analysis and improvement of SCIAMACHY limb data for tropospheric ozone retrieval



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1. Objective

➤ The work presented in this poster shows the improvement of one parameter — stratospheric ozone (retrieved from SCIAMACHY limb data) — for tropospheric ozone (hereafter trop.O₃) retrieval, the accuracy of which is subsequently also improved.

2. SCIAMACHY limb data and trop.O₃

SCIAMACHY

SCIAMACHY on-board ENVISAT was launched in a sun-synchronous polar orbit in March 2002. It uses three viewing modes: nadir, limb and occultation to detect, among other things, both the total and stratospheric amounts of O₃. More than 10 years of data are available, up through the year 2012.

Limb-Nadir Matching (LNM) method

[Sierk, Richter et al. 2006]

$$\text{tropo.}(O_3) = \text{tot.}(O_3) - \text{strato.}(O_3)$$

Expectation

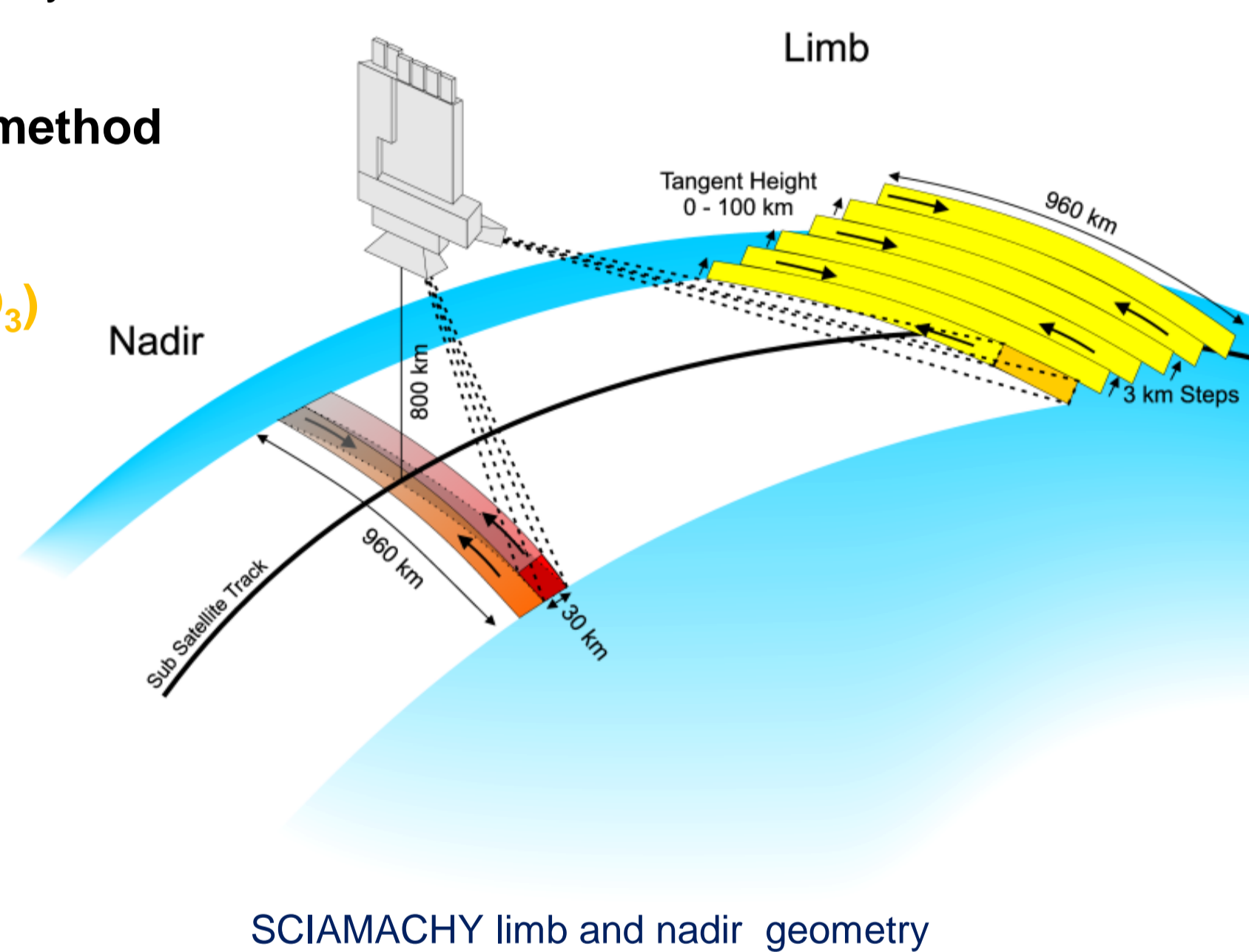
Accuracy improvement in

strato.(O₃)

leads to

Accuracy improvement in

tropo.(O₃)



5. Summary and conclusions

➤ With excellent total ozone data (nadir data), stratospheric ozone (limb data) plays an important role in improving the retrieval accuracy of trop.O₃.

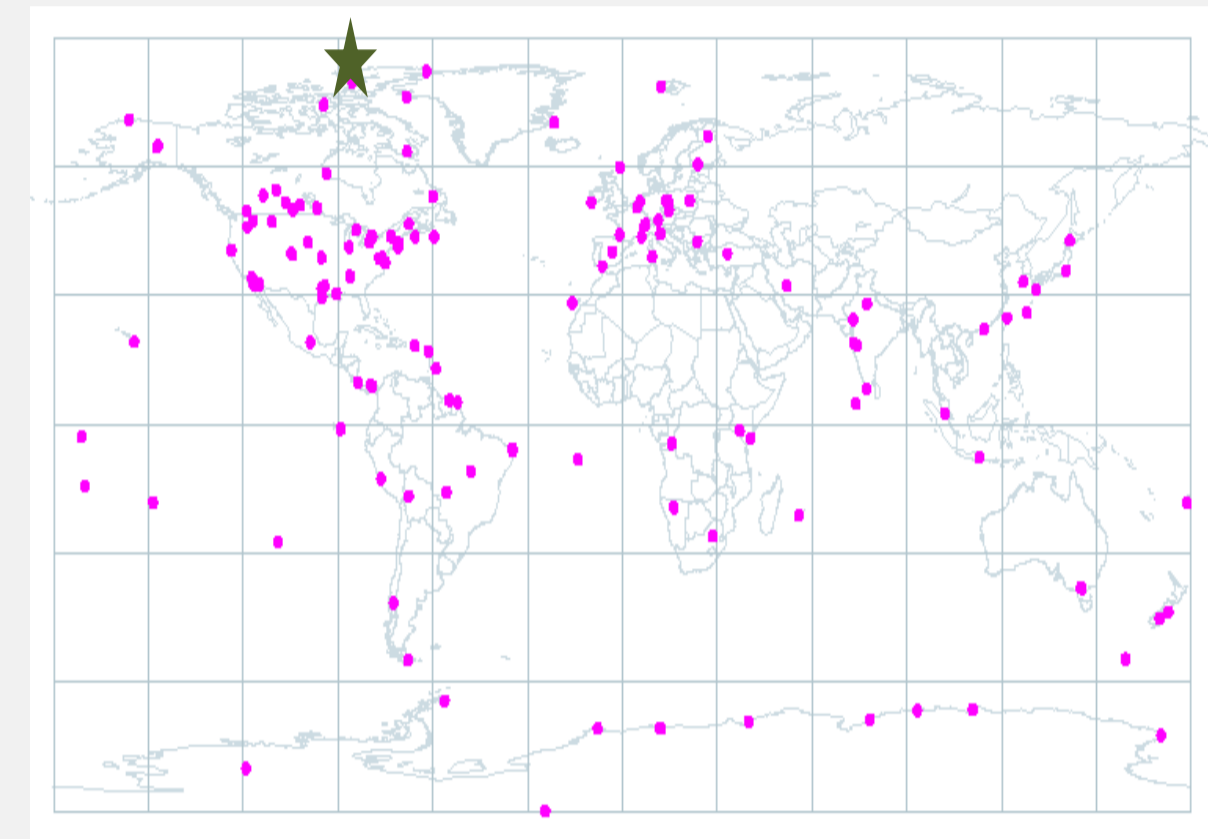
➤ Ozone limb data has been upgraded from V2.9 to V3.0 and sonde data of 60 WOUDC-stations have been used to validate ozone limb data. The results agree in both: the vertical profile and partial columns.

➤ As follows a decline of differences of about 2 ~ 18 DU in the amount of stratospheric ozone can be determined. There are substantial value improvements in high latitude regions and slight improvement at low latitudes.

➤ Trop.O₃ retrieval accuracy has been improved by 3 ~ 9 DU due to this work.

3. Improvement of limb data

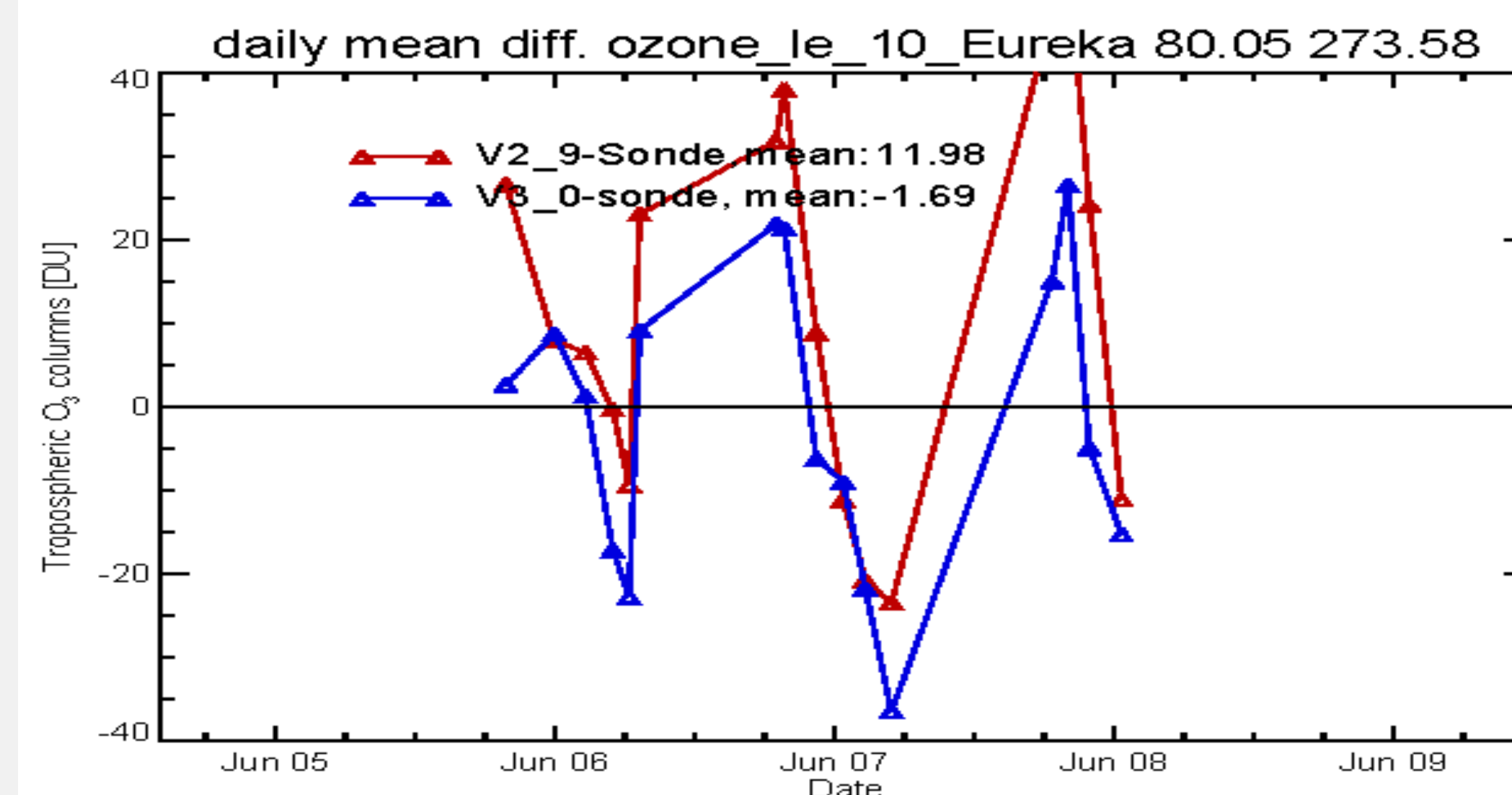
When switching from the old V2.9 to the new V3.0, the reference of retrieval changed from upper tangent height to extraterrestrial solar spectrum. Therefore retrieval method also changed from triplet to DOAS polynomial. Moreover, we added aerosol information retrieved from SCIAMACHY measurement [Ernst et al., 2012] as well.



The WOUDC ozone sonde data from 60 stations were used to evaluate both V2.9 and V3.0. 'Eureka' which is chosen as an example is marked as star.

Follow images present comparison in vertical structure and partial columns* time series in station 'Eureka'. V3.0 demonstrates consistency in different altitude layers and partial columns, as well as the trop.O₃ retrieval result.

III. Retrieved trop.O₃ comparison

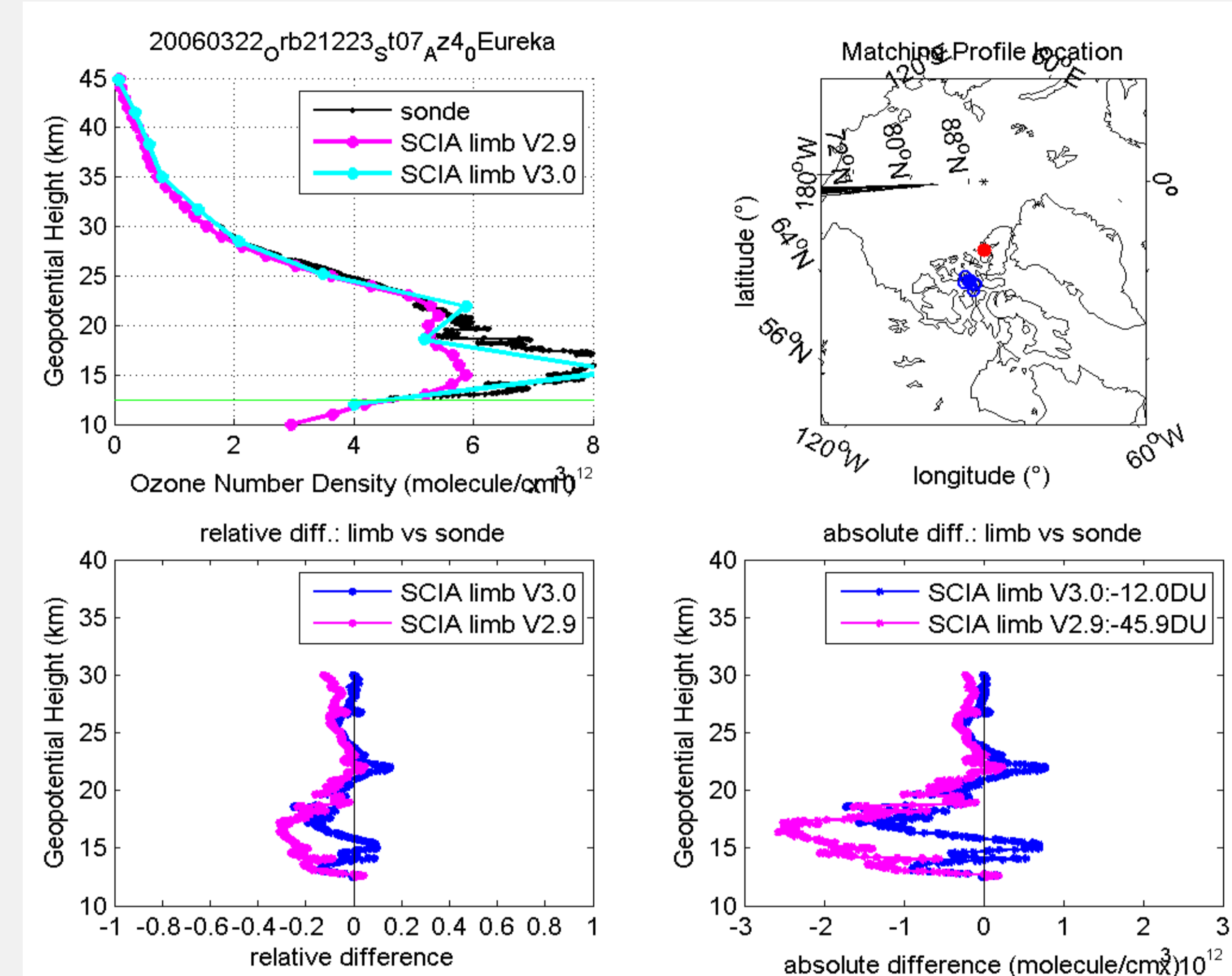


As a preliminary test, 10 km was chosen as tropopause height. Retrieved trop.O₃ was compared with ozone sonde data. Available data reduced as a result of limb-nadir data matching in cloud-free condition.

6. Selected references

- Sierk, B., Richter, et al. (2006). "Retrieval and Monitoring of Atmospheric Trace Gas Concentrations in Nadir and Limb Geometry using the Space-Borne SCIAMACHY Instrument", Environmental Monitoring and Assessment, DOI: 10.1007/s10661-005-9049-9.
- M. Coldewey-Egbers, M. Weber, et al. (2005). "Total ozone retrieval from GOME UV spectral data using the weighting function doas approach". Atmospheric Chemistry and Physics, 5(4):1015-1025.
- Sonkaew, T., V. V. Rozanov, et al. (2009). "Cloud sensitivity studies for stratospheric and lower mesospheric ozone profile retrievals from measurements of limb-scattered solar radiation". Atmospheric Measurement Techniques, 2(2):653-678
- F. Ernst, C. von Savigny et al. (2012). "Global stratospheric aerosol extinction profile retrievals from SCIAMACHY limb-scatter observations". Atmos. Meas. Tech. Discuss., 5, 5993-6035.

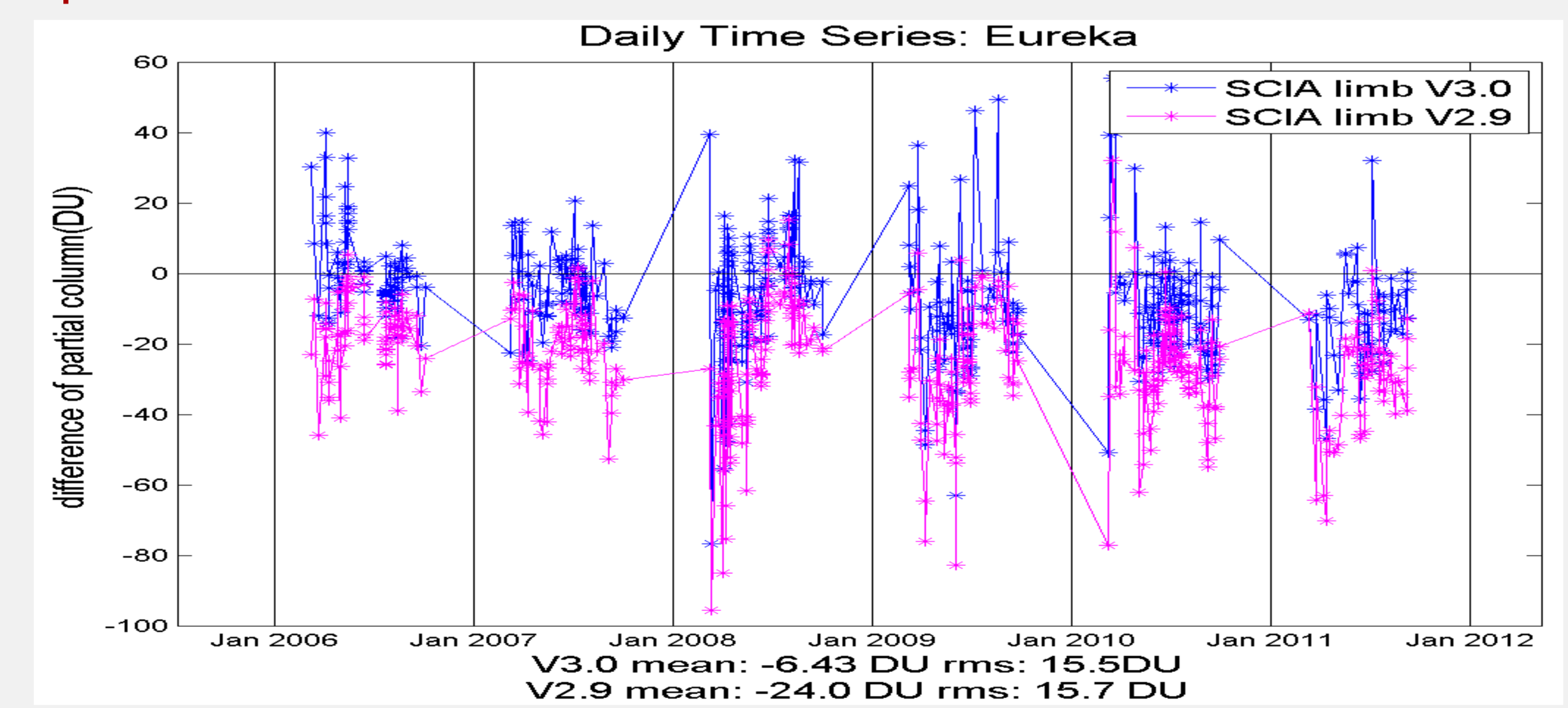
I. Vertical structure comparison



Only cloud-free layers are used in the comparison. Cloud-top height is shown as a green line in left upper image.
➤ Upper left: ozone number density comparison;
➤ Upper right: location of the data. Red point is sonde station, blue square is SCIA state.
➤ Lower left: relative difference, (SCIA-sonde)/sonde.
➤ Lower right: absolute difference, SCIA-sonde

II. Partial column comparison

- Right figure shows time series of the differences of partial column
- *Partial column criterion:
1) The altitude range from 15 km to 30 km was selected considering the uncertainty of both satellite and sonde data.
2) The difference of partial column is SCIA minus Sonde.



7. Acknowledgements

- SCIAMACHY data have been retrieved by IUP
- WOUDC data have been provided by Environment Canada <http://www.woudc.org/>
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