

# Tropospheric ozone retrieval by using SCIAMACHY Limb-Nadir-Matching method



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## 1. Tropospheric ozone

Tropospheric ozone (O<sub>3</sub>) is a photochemically produced pollutant and a main component of summer smog. Exploiting alternating observations in limb and nadir modes, the Limb-Nadir Matching technique (LNM) is used to retrieve global distributions of the tropospheric ozone for the entire duration of the SCIAMACHY mission (Aug.2002-Apr.2012). Fig. 2 and Fig. 3 show the first version of tropospheric ozone retrieved by using SCIAMACHY LNM method. (F. Ebojje et al, 2013)

Fig. 1 limb nadir matching. Black indicates the limb pixels, gray is the nadir pixels.

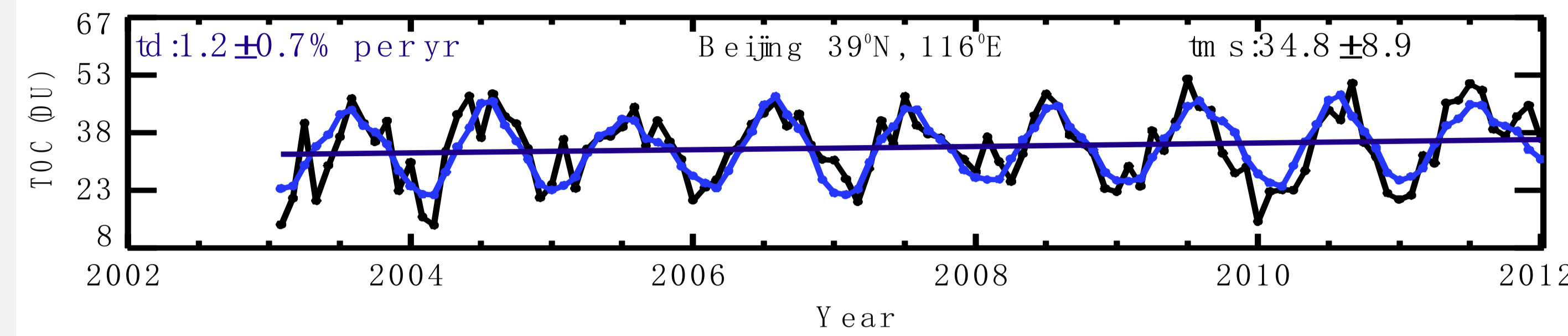
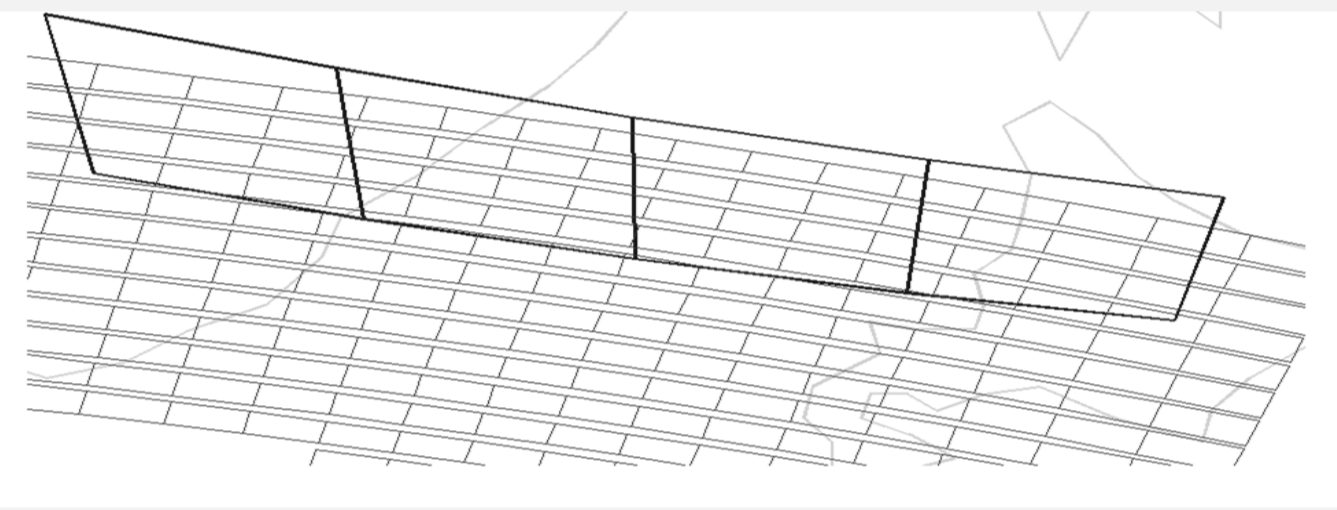


Fig. 2 Tropospheric O<sub>3</sub> trend in Beijing.

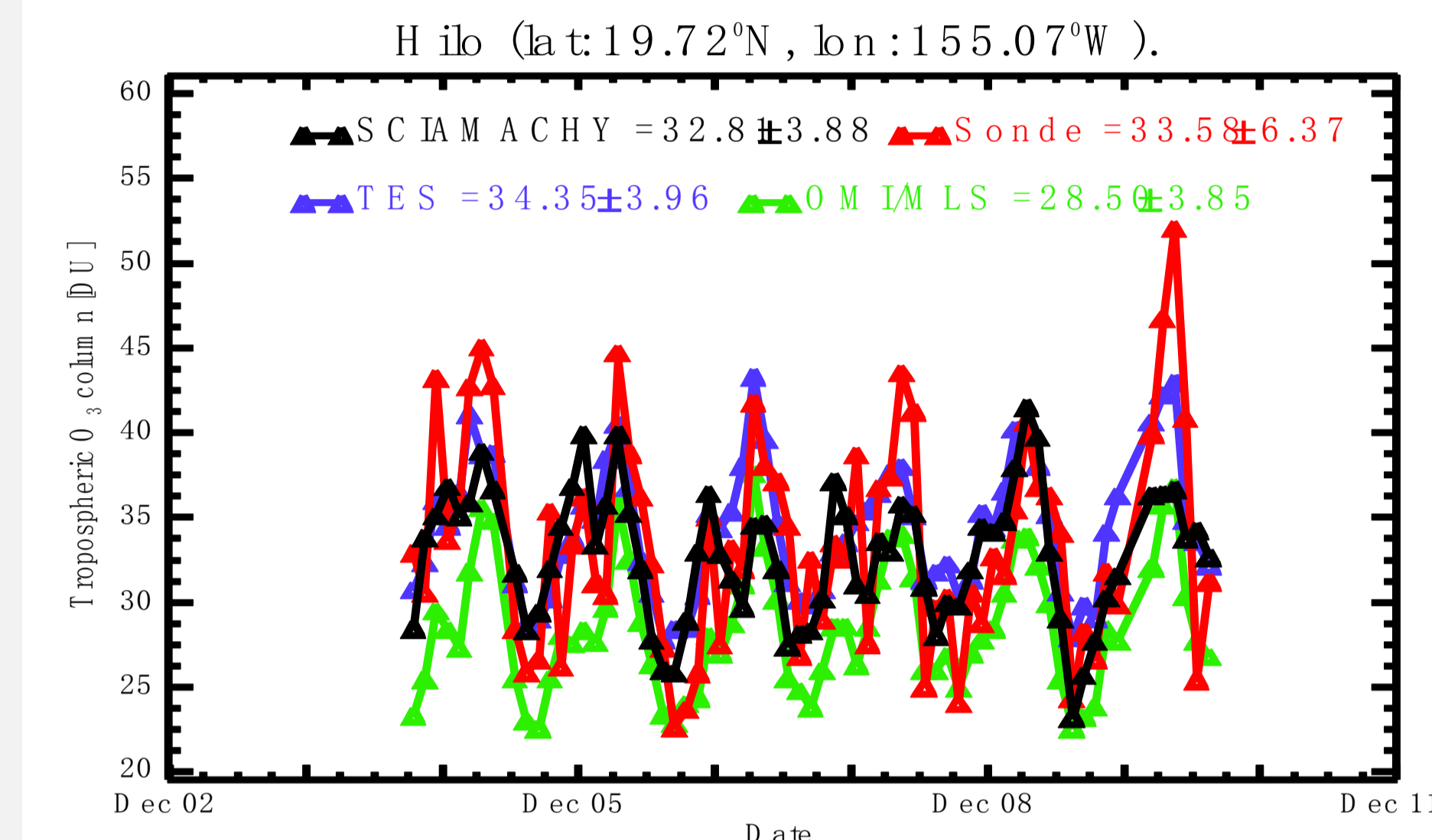
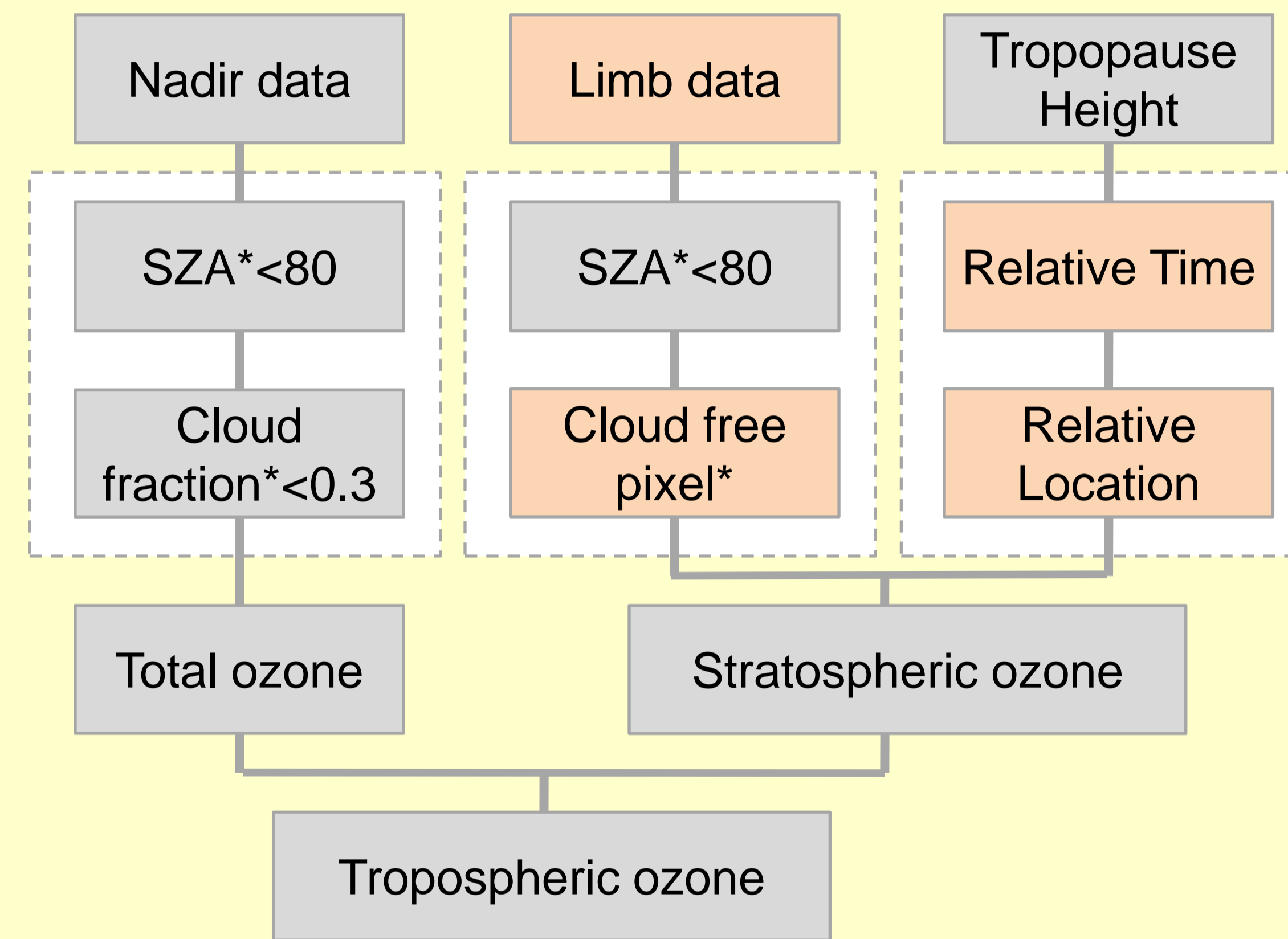


Fig. 3 Tropospheric O<sub>3</sub> time series from SCIAMACHY, OMI/MLS, TES and ozone sonde data at Hilo.

## 3. Latest results

In this section the limb data has been upgraded from V2.9 to V3.0. Tropospheric ozone in the tropical region has a 0-15 DU increase by using limb V3.0 data.

### SCIAMACHY LNM method



\*SZA: solar zenith angle  
\*Cloud fraction: cloud coverage ratio in a pixel  
\*Cloud free: the relative cloud top height is lower than the tropopause height

#### Advantage:

SCIAMACHY observes the same air mass within 7 minutes first in the limb and then in the nadir viewing modes.

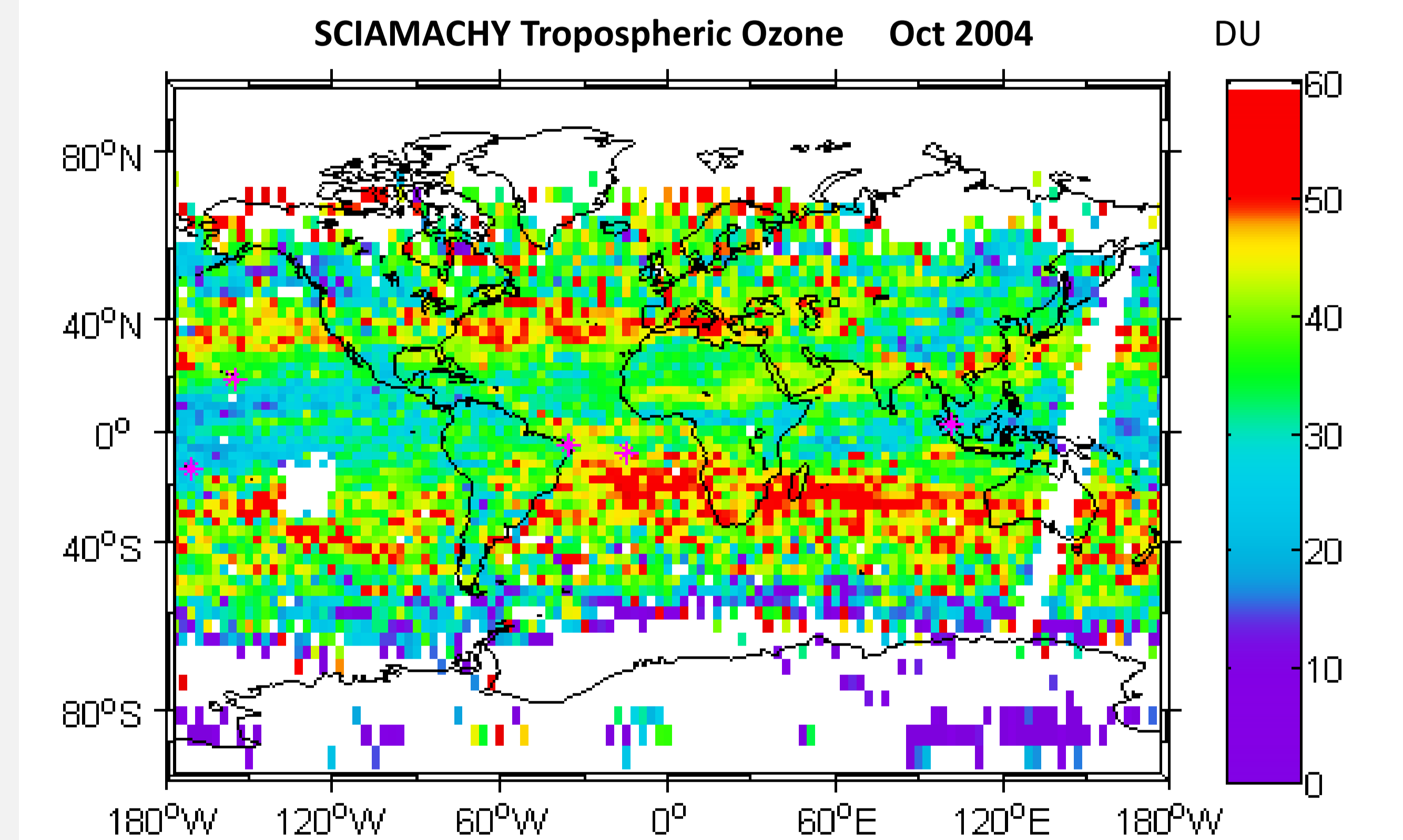
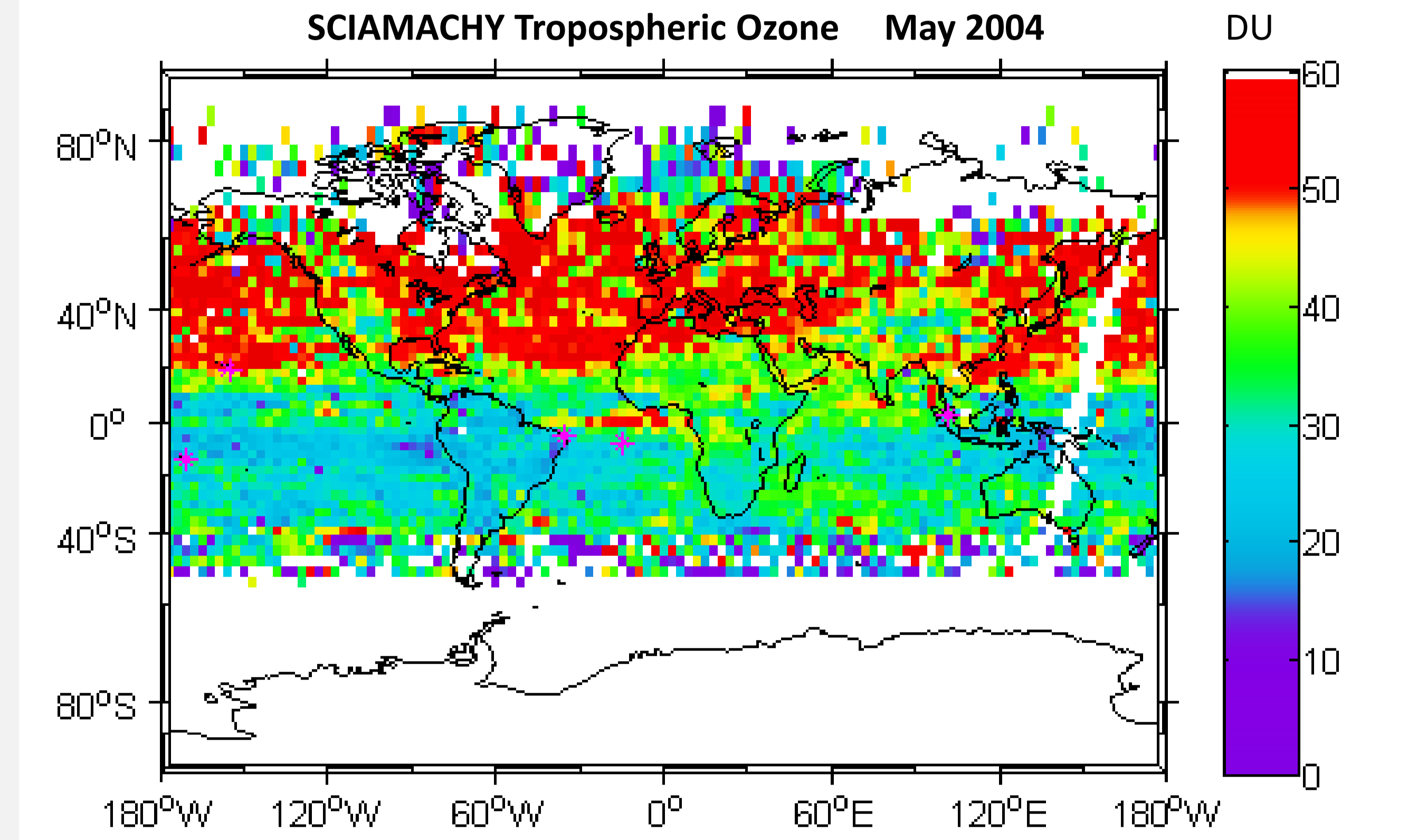
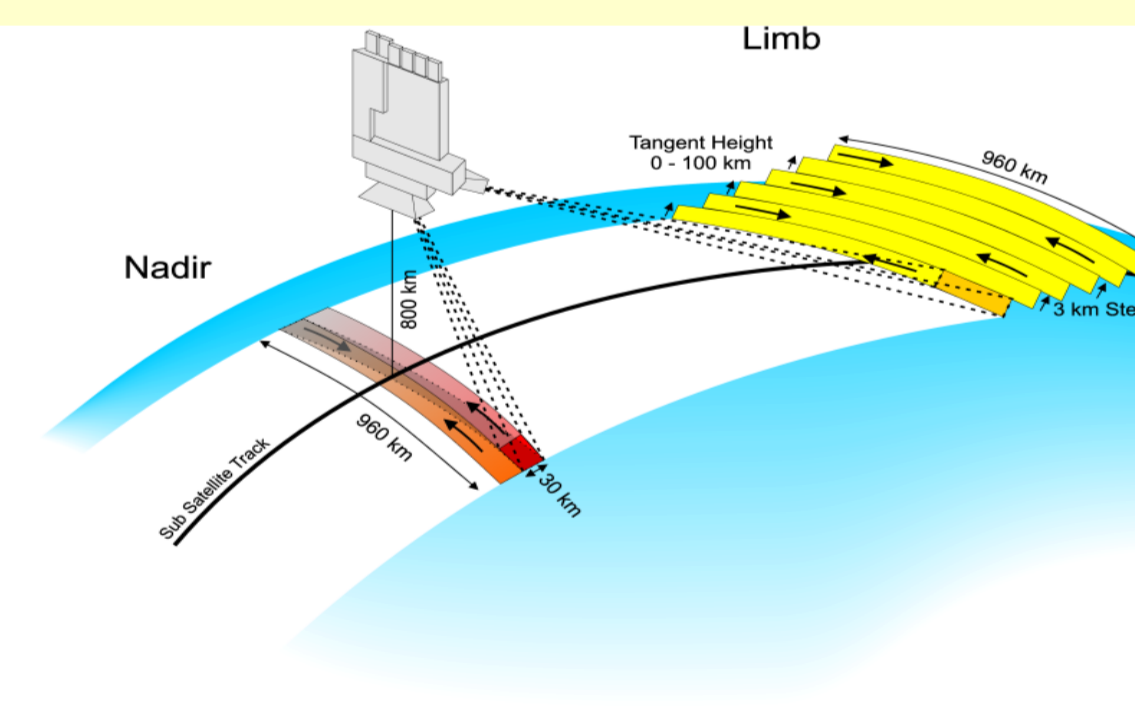


Fig. 6 Latest tropospheric ozone retrieved from SCIAMACHY LNM method.

## 2. Refine limb data and matching technique

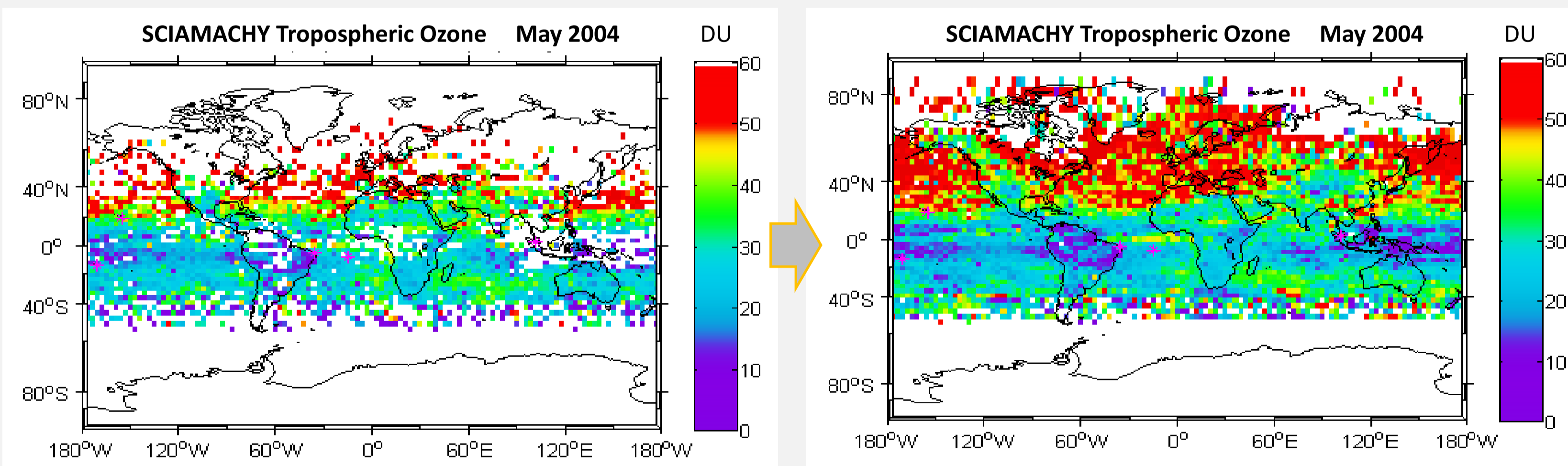
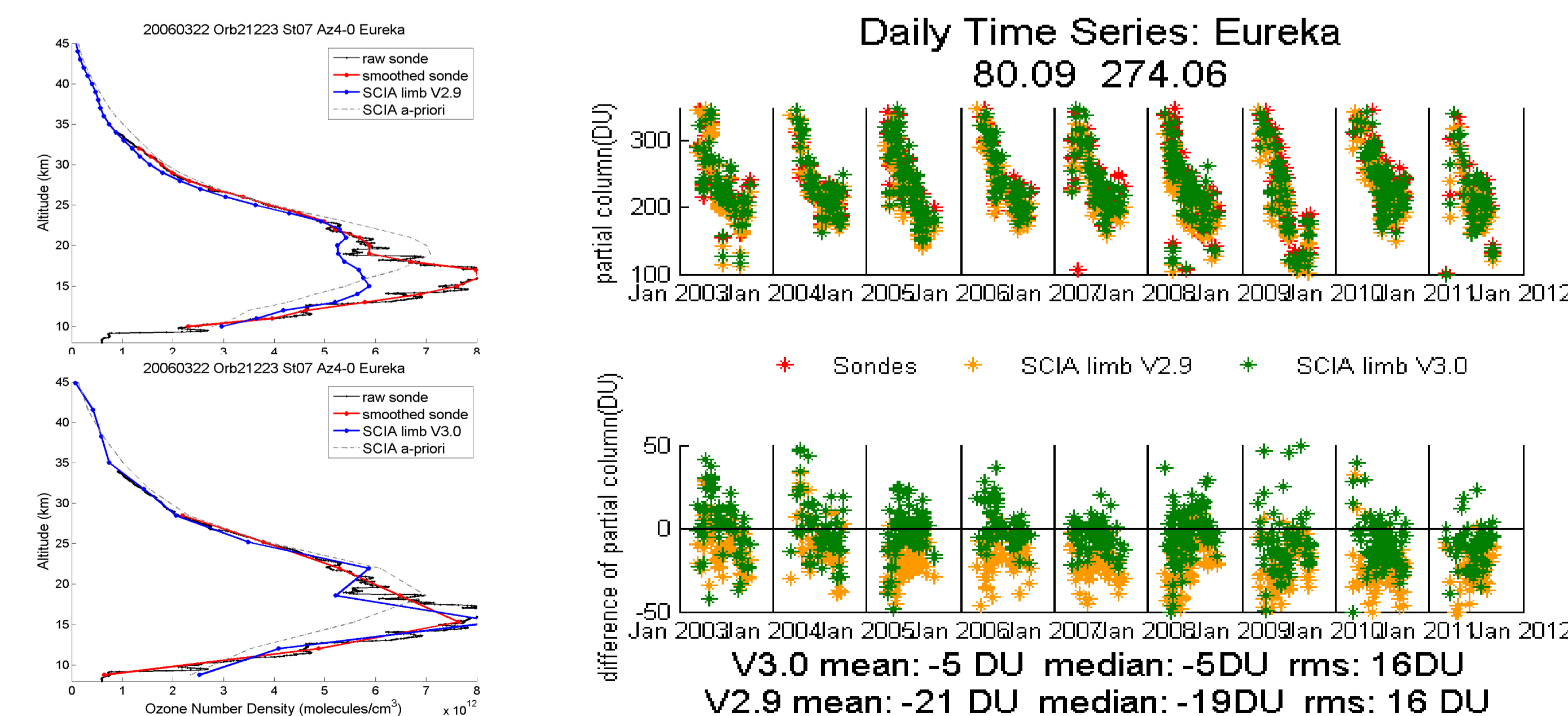


Fig. 4 tropospheric ozone before and after refined matching technique.

Fig. 5 Comparison of ozone from SCIAMACHY and from ozone sonde at station Eureka (80.09° N, 85.94° W) in vertical profiles and partial columns.

The processes marked orange in the centre diagram are the improved retrieval processes after the first reported version. Fig. 4 shows the tropospheric ozone results before and after all the improved processes (limb data optimizing excluded). Data coverage has increased with a more precise TPH (tropopause height).

Insufficient sensitivity in the high latitudes lower stratosphere has been identified in the current limb ozone retrieval (V2.9) leading to a significant overestimation of the tropospheric ozone at high latitudes. The issue has been resolved by optimizing the SCIAMACHY limb ozone retrieval algorithm (V3.0) (Jia et al, in preparation).



## 4. Outlook

Since 90% of ozone is located in the stratosphere, the usage of LNM technique requires very high accuracy of the input limb, nadir and tropopause height data. The yellow columns on the left side indicate the challenges for the coming research:

1. A systematic retrieval offset is found around 35 km, this lead to maximum 8 DU uncertainty (low panels on the right side).
2. The quality of limb data below 15 km needs to be analyzed. The influence of it can be observed in station Lauder.
3. The influence from the data column below cloud (so called ghost column) need to be investigated.
4. The patterns around Gulf of Aden and Sahara desert et al. on the right upper panel may suggest retrieval been influenced by albedo and cloud.

