Aura Tropospheric Ozone Columns Derived Using the TOR approach and Mapping Techniques

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Objectives

- Derive tropospheric column ozone (TCOs) using OMI and MLS data.
  - case I: using coincident measurements
  - case II: using mapped MLS values
- Validate the derived TCOs through comparisons against mid-latitude ozonesonde measurements

TOR method

Tropospheric ozone residual (TOR/TCO)

= total ozone (OMI) –

stratospheric column ozone (MLS)

TCO case I

Using coincident data

- MLS: on the same day and within ±1^{o} in latitude and ±8^{o} in longitude.

- OMI: clear sky OMI within an area of ±1.25^{o}× ±1.25^{o} (longitude by latitude).
  - clear sky (reflectivity ≤ 10%)
  - all possible scan angles

TCO case II

Using MLS mapped profiles

- MLS (215mb-700K) profiles are mapped to the designated time and locations using PV mapping.

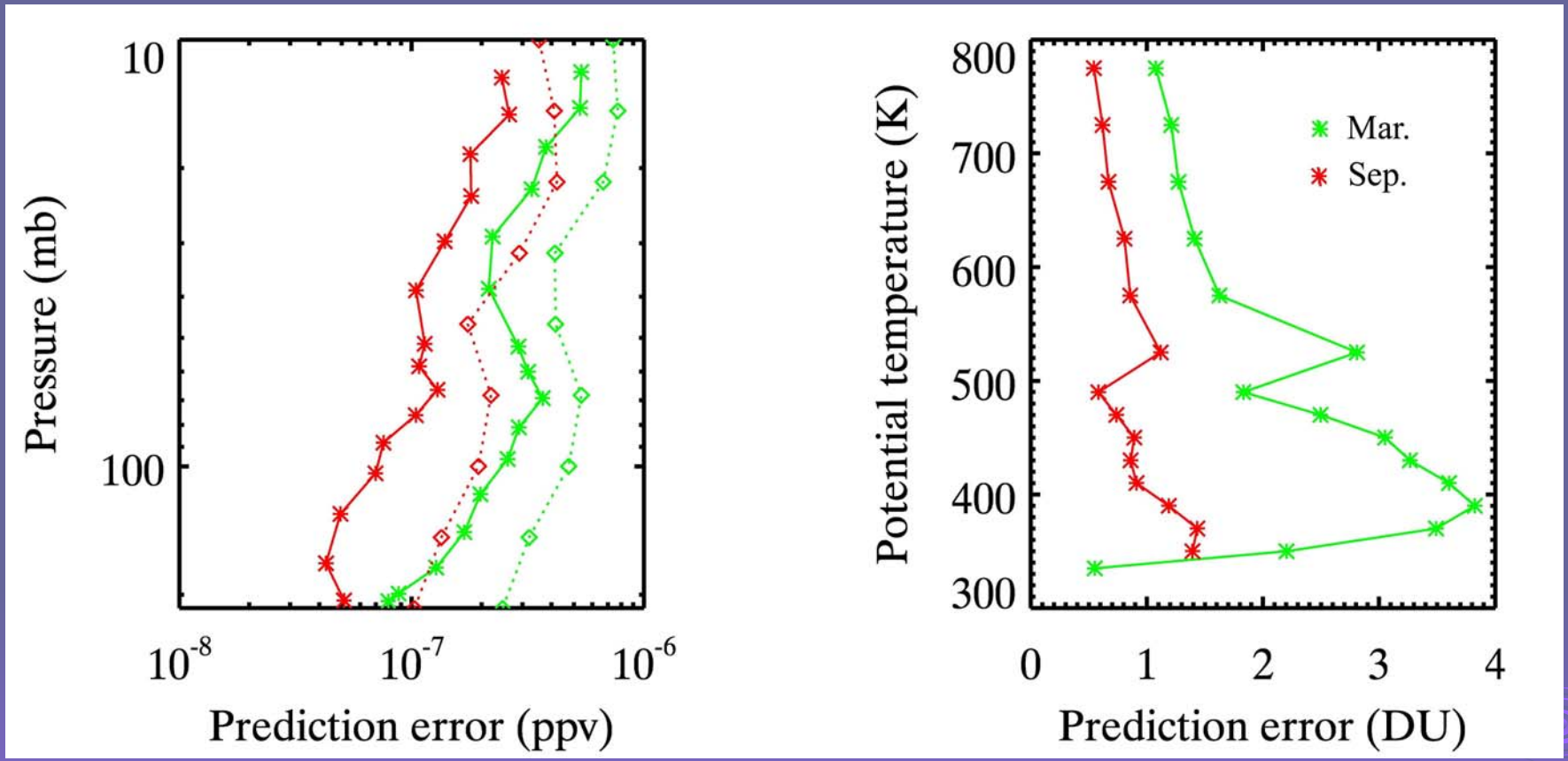
$$x = a + b * PV + c * Z$$

χ : ozone number density/mixing ratio.

Z : geopotential height.

a, b, & c : constants.

Mapping Prediction Error



*** Dash lines: std (½ (next_orbit + last_orbit) - current_orbit))**

Figure 1. Mean prediction errors of ozone mapping for 40°- 50°N in March (green lines) and September (red lines) 2005. The solid lines show mapping prediction errors. The dotted lines on the left panel represent standard deviations of the differences between MLS measurement profiles and the profiles averaged from measurements on the previous and succeeding orbits at the same latitude.

Tropopause -215mb (SAGE Mapping)

- In the regions between the tropopause and 215mb, SAGE II ozone mapping were used when tropopause is below 215mb.
- SAGE has good quality data down to tropopause, and Mapping is necessary because of the sparseness of the SAGE II data.

Tropopause -215mb (SAGE Mapping)

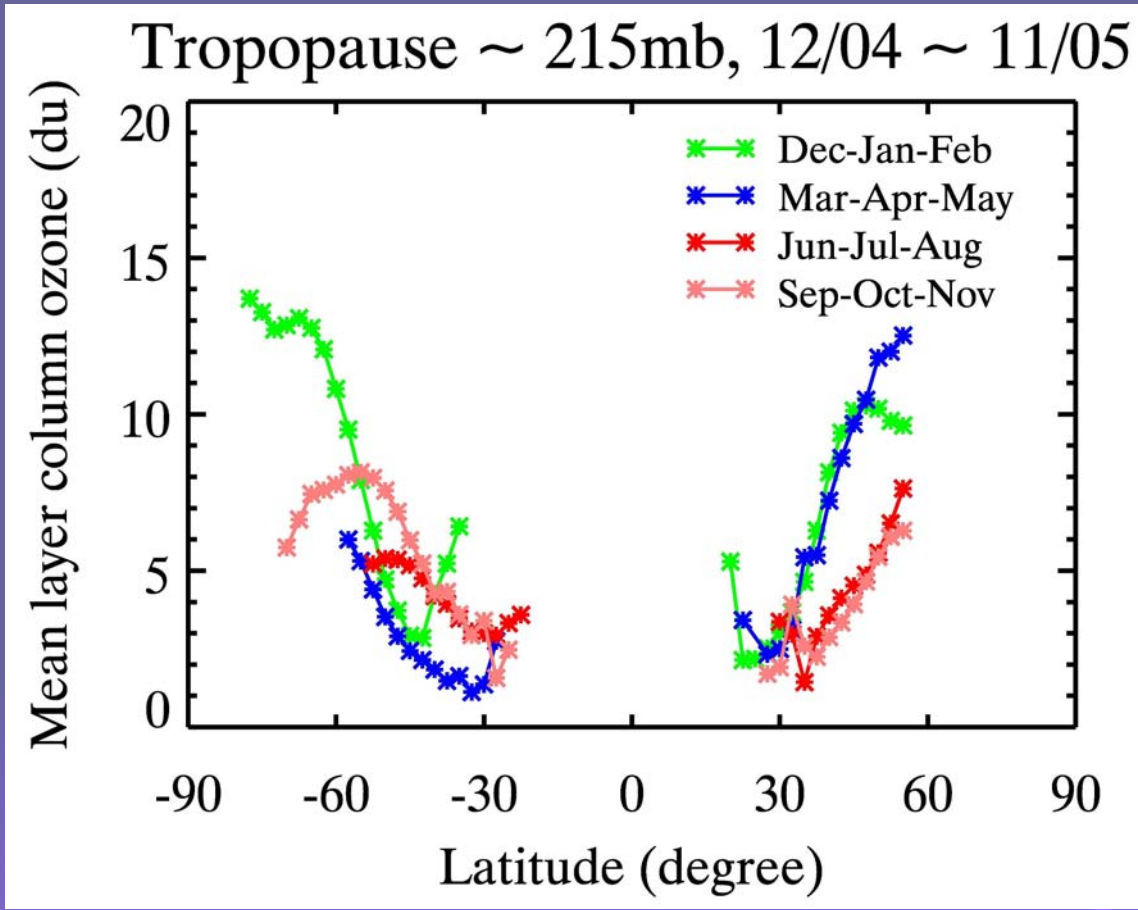


Figure 2: Seasonal mean column ozone between the tropopause and 215mb calculated by mapping SAGE II measurements. Only data with tropopause below 215mb were included in the calculations of the seasonal means.

SCO (215mb – 700 K) / TCO time series

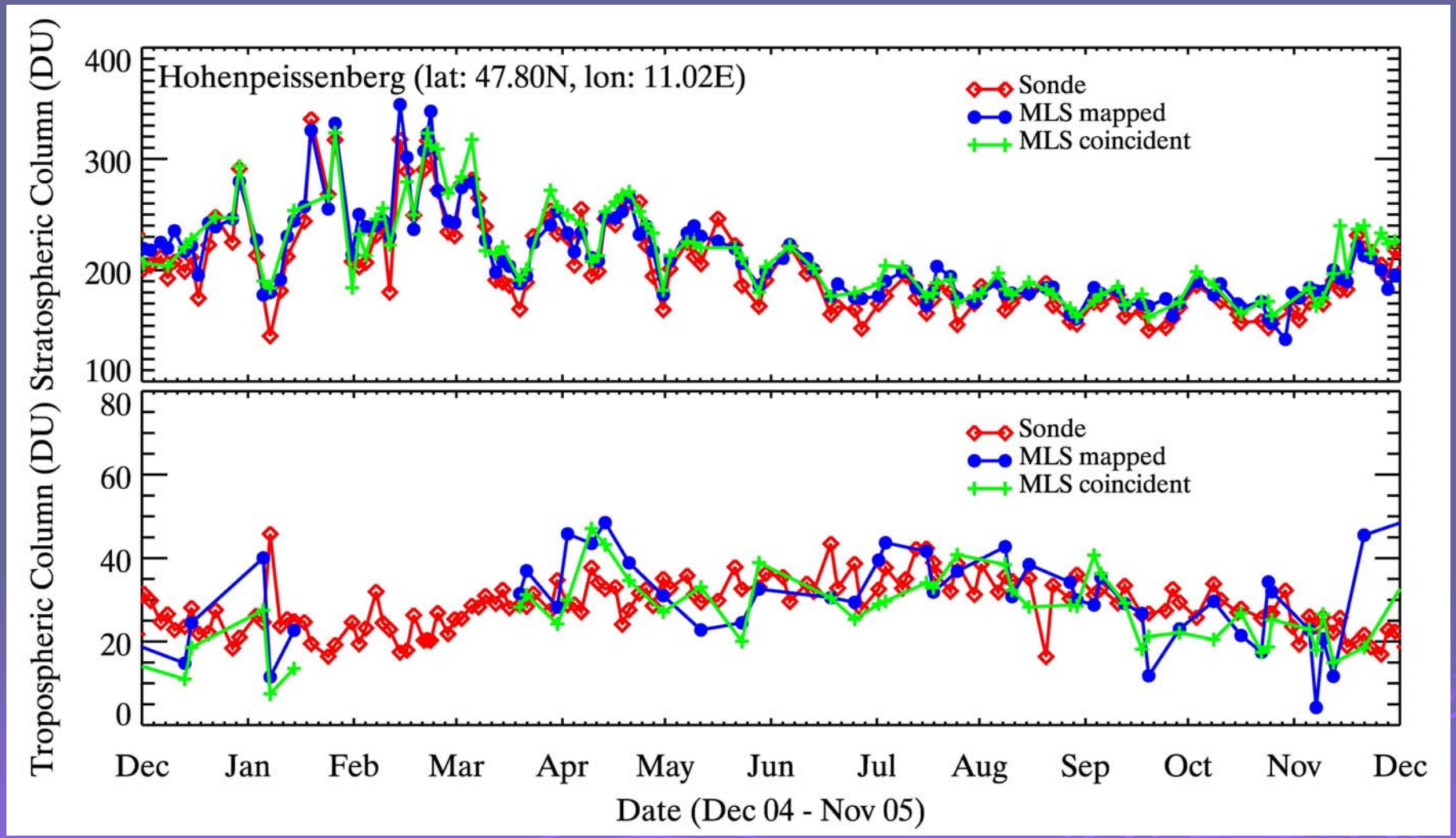


Figure 3. The comparisons of the time series of MLS/(SAGE II) stratospheric column ozone (215 mb/tropopause to 700 K) and resulting OMI derived tropospheric column ozone versus those from Hohenpeissenberg ozonesonde measurements.

TCO differences (compared with ozonesonde)

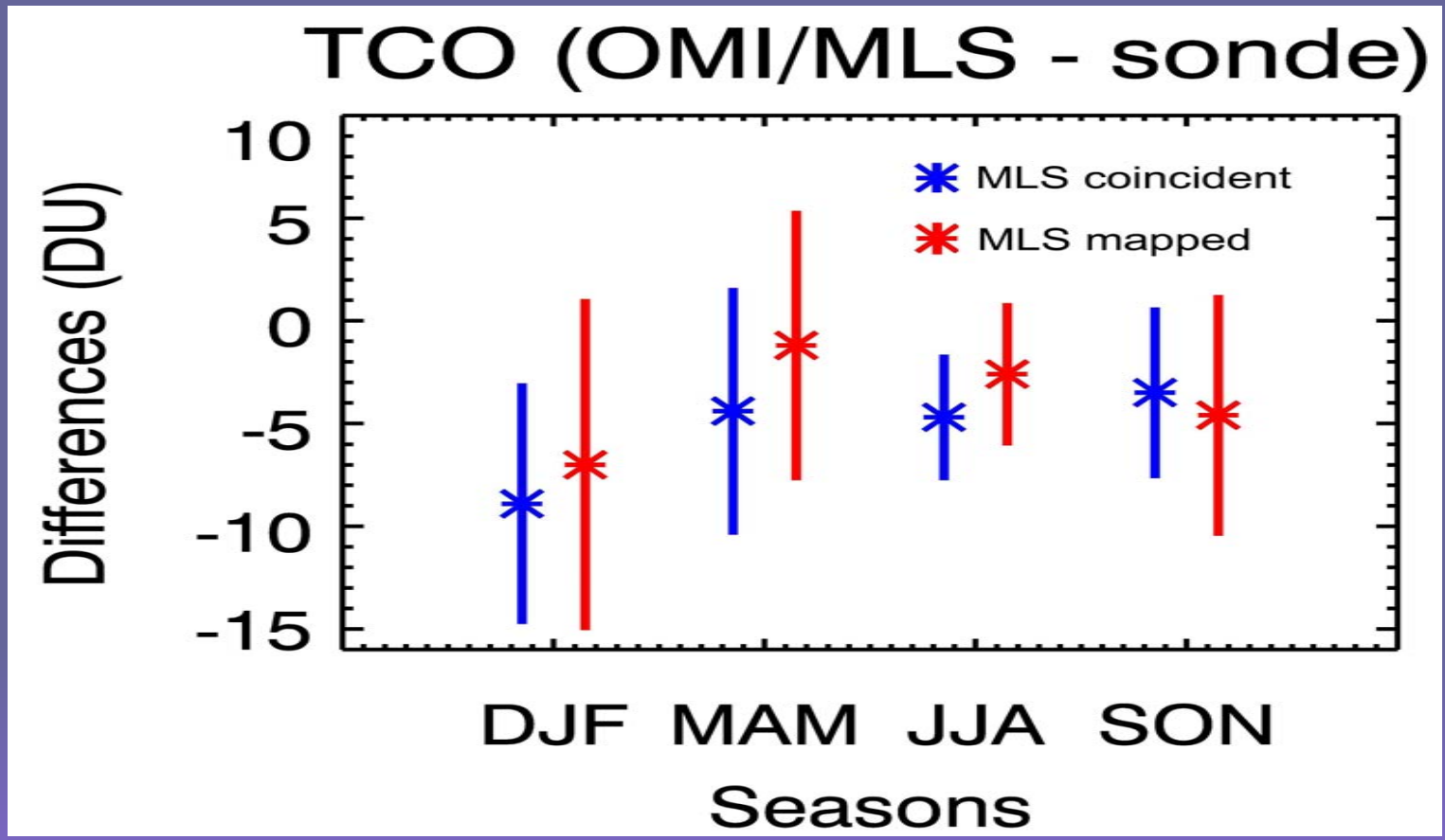


Figure 4: Tropospheric column ozone calculated from clear sky OMI and mapped/coincident MLS/(SAGEII) measurements versus similar columns at 8 ozonesonde stations locating between 35^{o}-60^{o}N for the period of August, 04 to Nov, 2005.

SCO (215mb – 700 K) / TCO differences

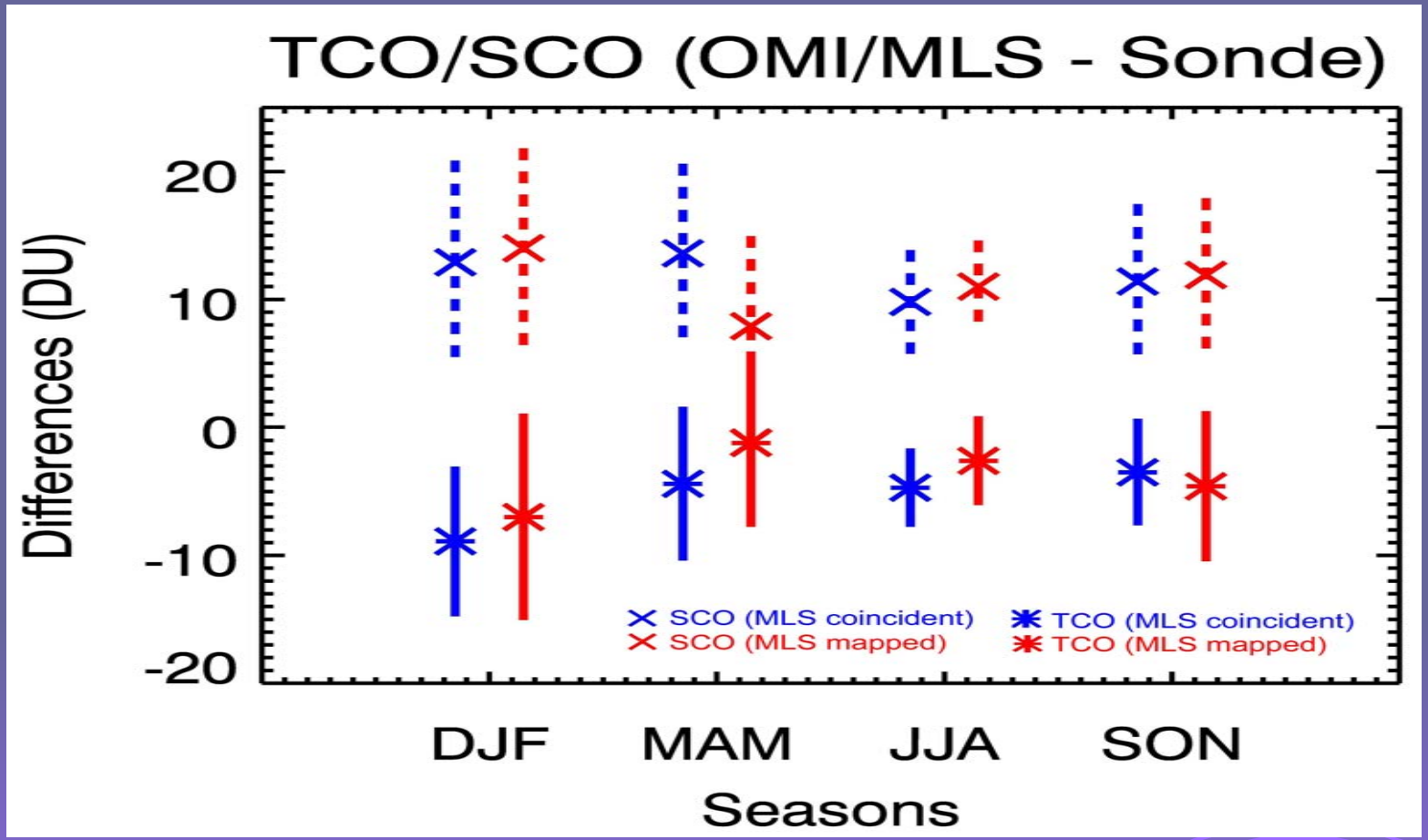


Figure 5: Tropospheric column ozone and stratospheric column ozones (215mb -700K) calculated from clear sky OMI and mapped/coincident MLS/(SAGEII) measurements versus similar columns at 8 ozonesonde stations locating between 35°-60°N.

Summary

- **The derived tropospheric columns are, in the mean, 1-9 DU, depending on season, smaller than ozonesonde column measurements. These differences are associated with MLS differences in lower stratospheric columns from 215 mb to 700K (potential temperature) which are approximately 11 DU larger than the corresponding ozonesonde columns.**

- **The first bullet suggest a calibration offset of approximately 1% between MLS and OMI measurements (MLS higher).**

- **PV mapping of MLS columns, on the averaging over 4^{o} of longitude, only reduces the standard deviations of the differences on a few occasions during winter/spring; however a substantial improvement is produced by mapping when an orbit of data is missing.**