Tropospheric ozone derived from Suomi NPP OMPS satellite measurements

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Goal

Develop a daily global tropospheric ozone operational data product of high accuracy/precision for March 2012 – present from Suomi NPP OMPS nadir-mapper satellite measurements

Why Important?

- Important as a greenhouse gas and radiative forcing of the atmosphere

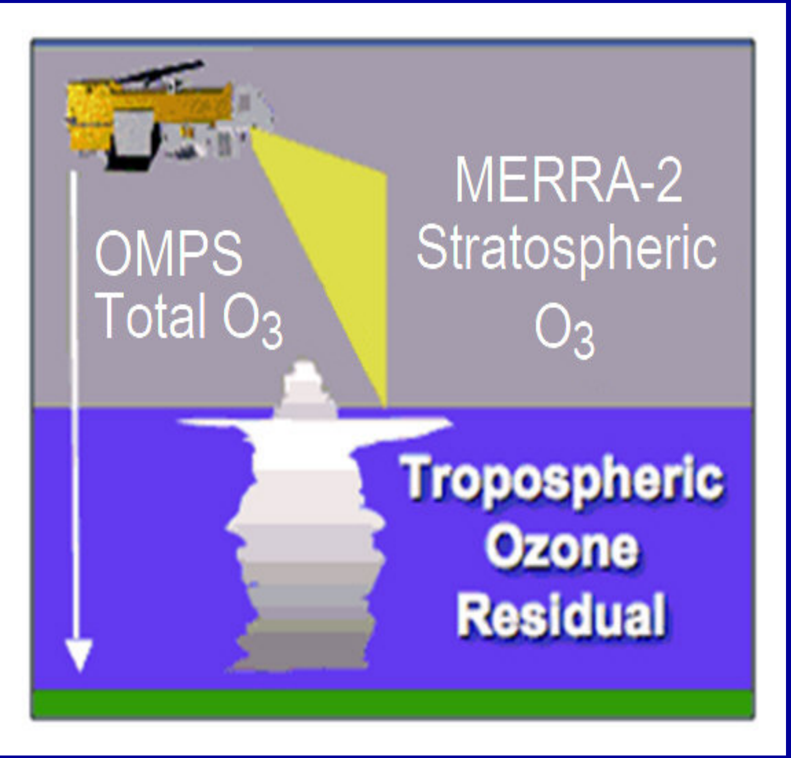
- Provides assessment of regional pollution, STE, and changes in global circulation from daily to decadal/trend timescales

- Can be used to aid in evaluation and development of global chemical transport models

Methodology to Derive Tropospheric Column Ozone

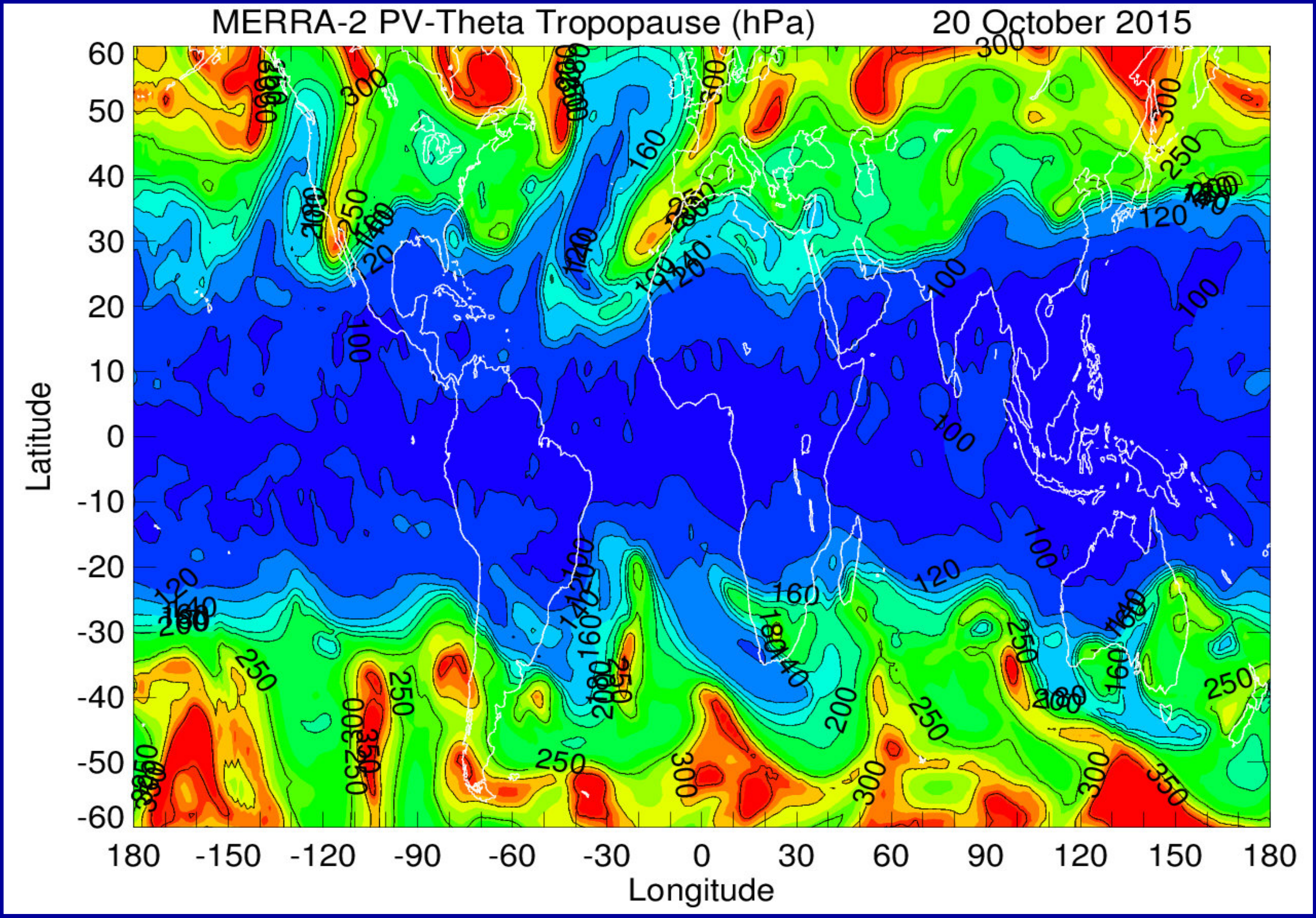
Tropospheric column ozone = OMPS nadir mapper total column ozone minus co-located MERRA-2 stratospheric column ozone (~1% column accuracy is necessary)

Tropopause pressure is derived from MERRA-2 potential vorticity (2.5 PVU) and potential temperature (380 K)



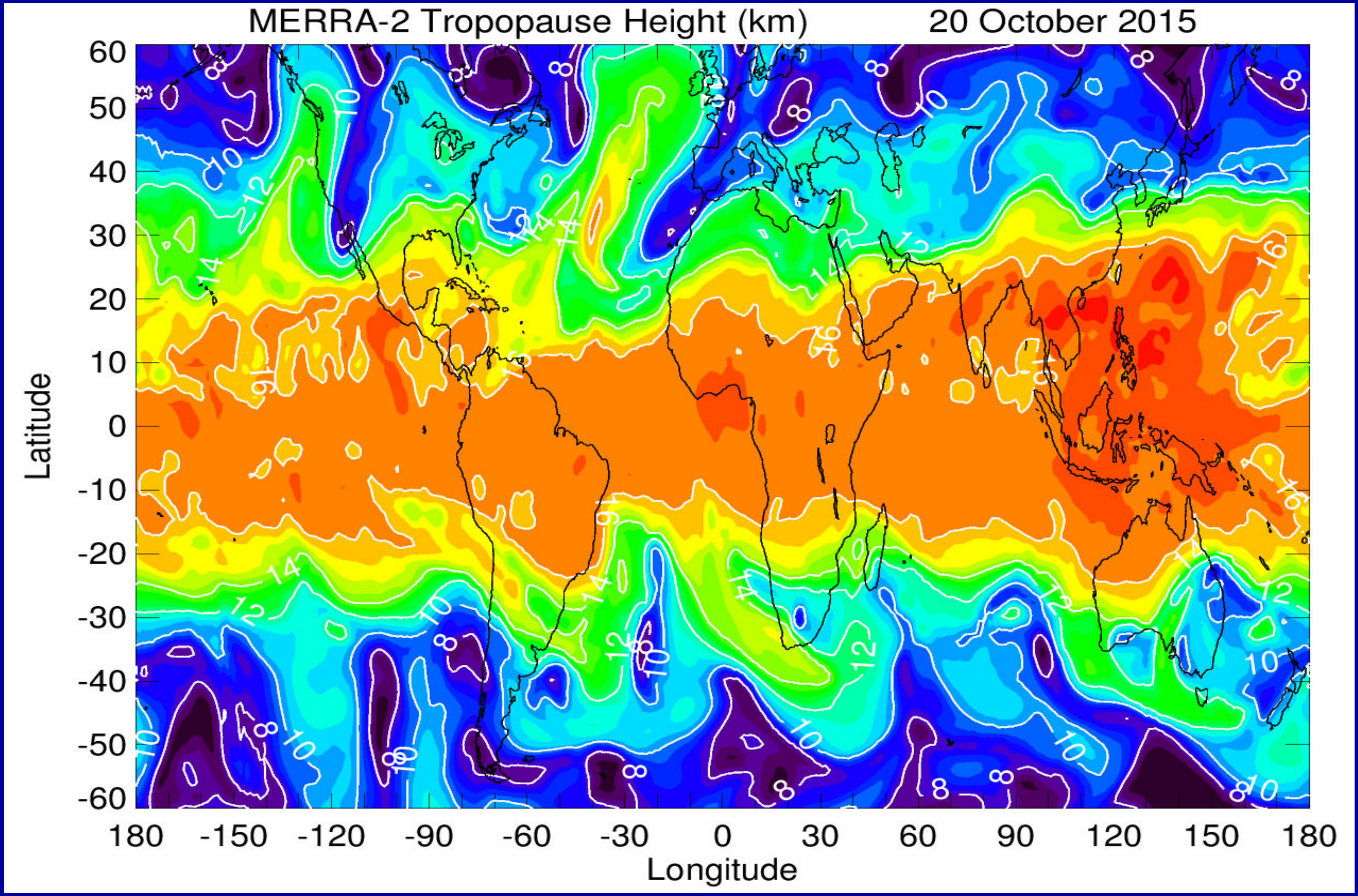
(Note: MERRA-2 is assimilated MLS ozone profiles)

Tropopause Pressure (hPa)



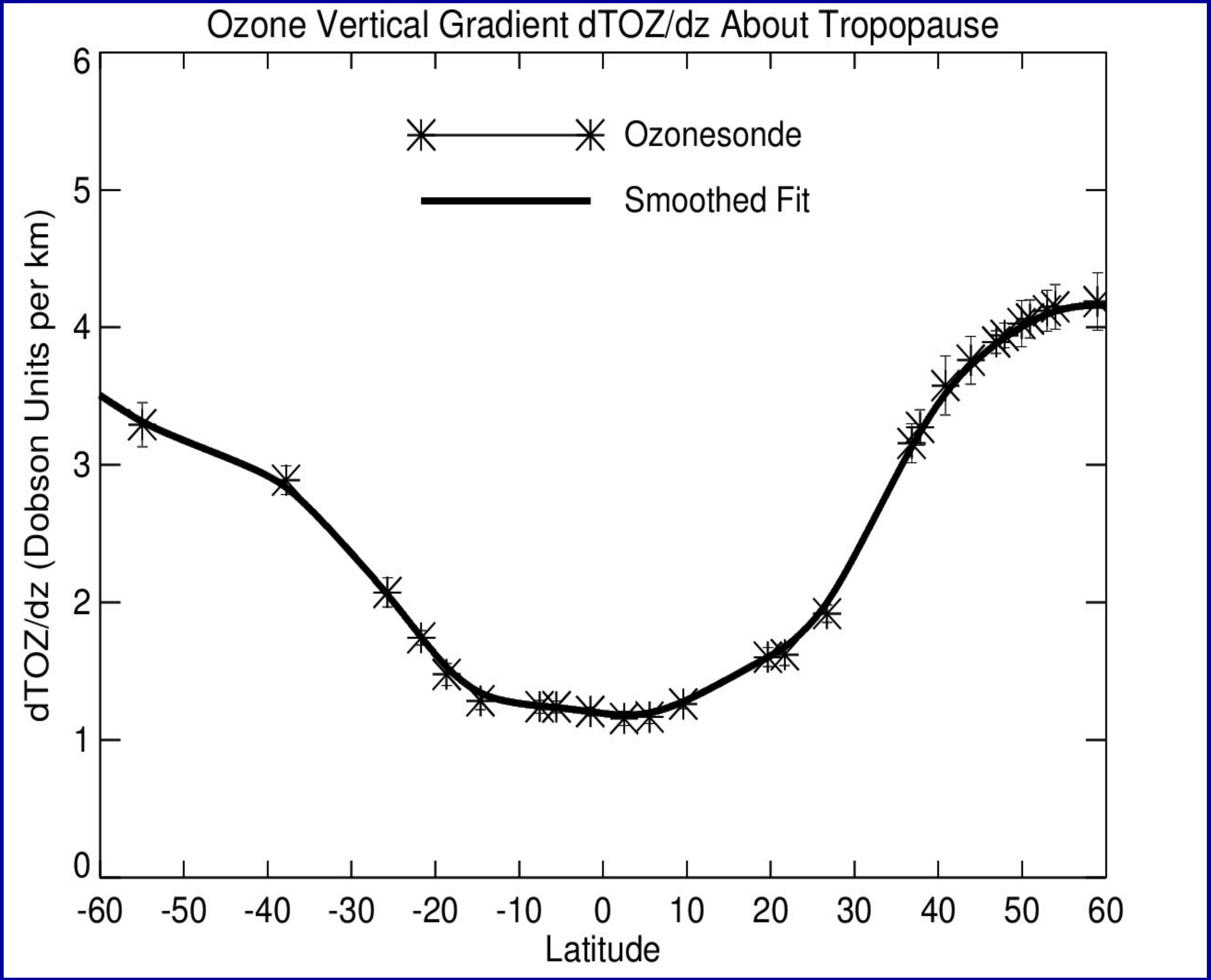
MERRA-2: Mapped to OMPS orbital footprint times

Tropopause Height (km)

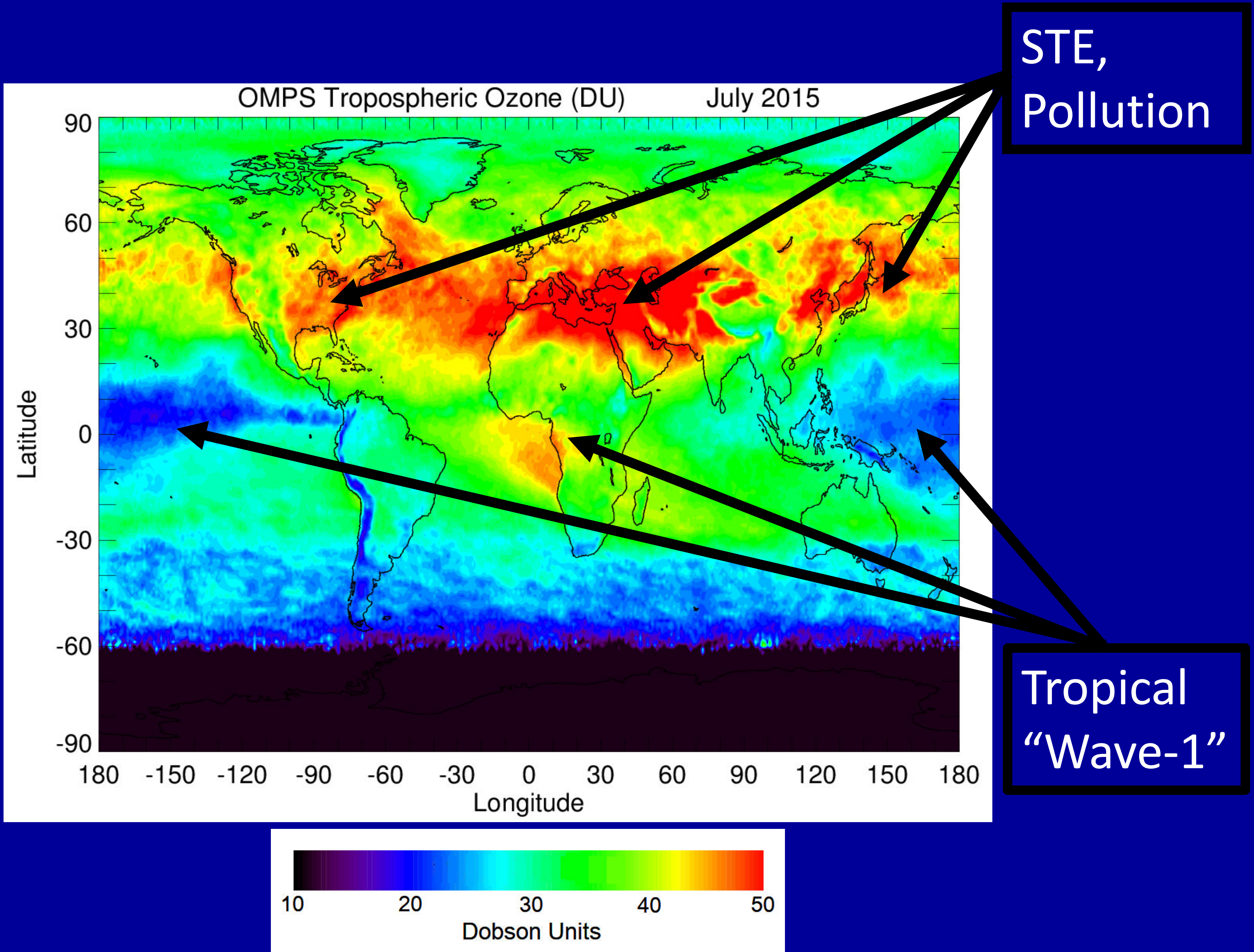


MERRA-2: Mapped to OMPS orbital footprint times

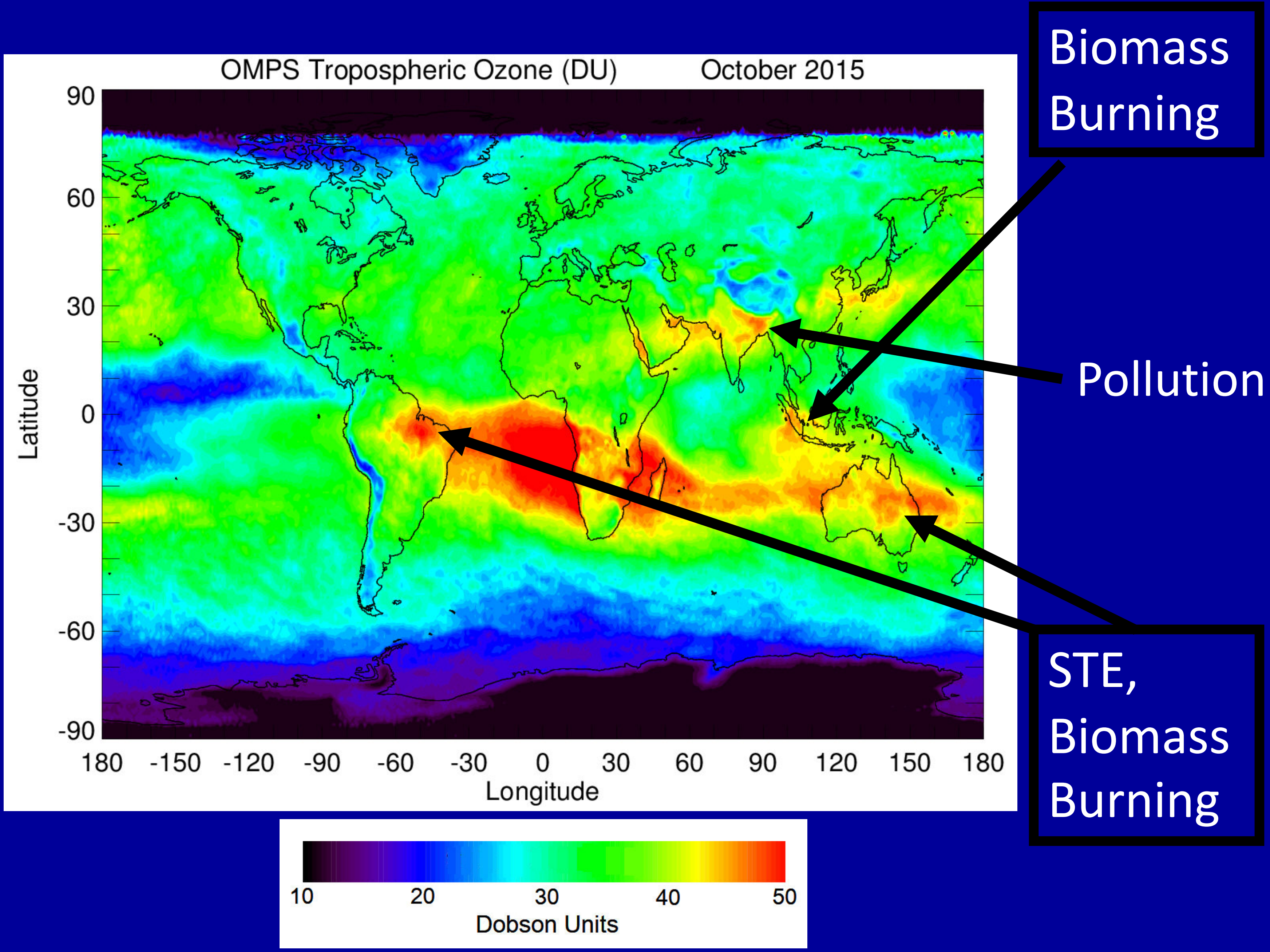
Error in Tropopause Pressure/Height is Not a Major Source of Error in Tropospheric Ozone



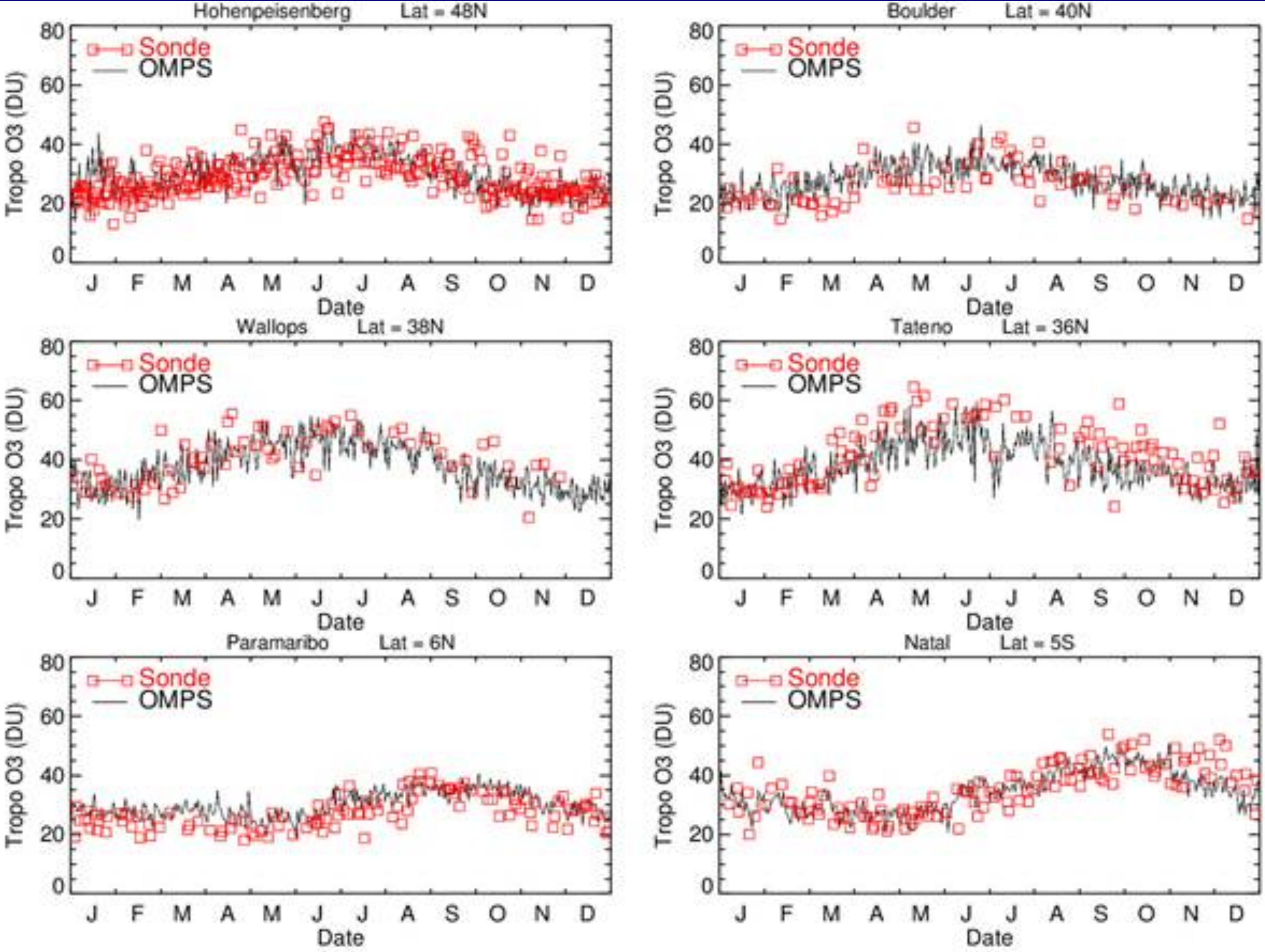
Approximate error in tropospheric column ozone due to a ±1 km error in tropopause height



OMPS Tropospheric Ozone (DU) July 2015
90
60
30
0
-30
-60
-90
Latitude
180 -150 -120 -90 -60 -30 0 30 60 90 120 150 180
Longitude
10 20 30 40 50
Dobson Units
STE, Pollution
Tropical "Wave-1"


OMPS Tropospheric Ozone (DU)
October 2015
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-150
-120
-90
-60
-30
0
30
60
90
120
150
180
10
20
30
40
50
Dobson Units
Biomass Burning
Pollution
STE, Biomass Burning

2015-2018 annual cycle



List of Potential Errors to Consider in Deriving Daily Maps of Tropospheric Ozone

- Errors due to snow/ice
- Errors due to clouds
- Errors due to aerosols
- Reduced sensitivity of measuring ozone in the lower troposphere
- Errors in applied tropopause pressure

Conclusions

- Analyses shows OMPS/MERRA-2 tropospheric ozone to be a viable daily product with near global coverage (outside polar night regions) for March 2012 – present

- Regional errors in OMPS/MERRA-2 tropospheric ozone appear to be OMPS difficulty in detecting BL ozone (One possible solution is to adjust OMPS total ozone using the GMI model simulation of BL ozone)

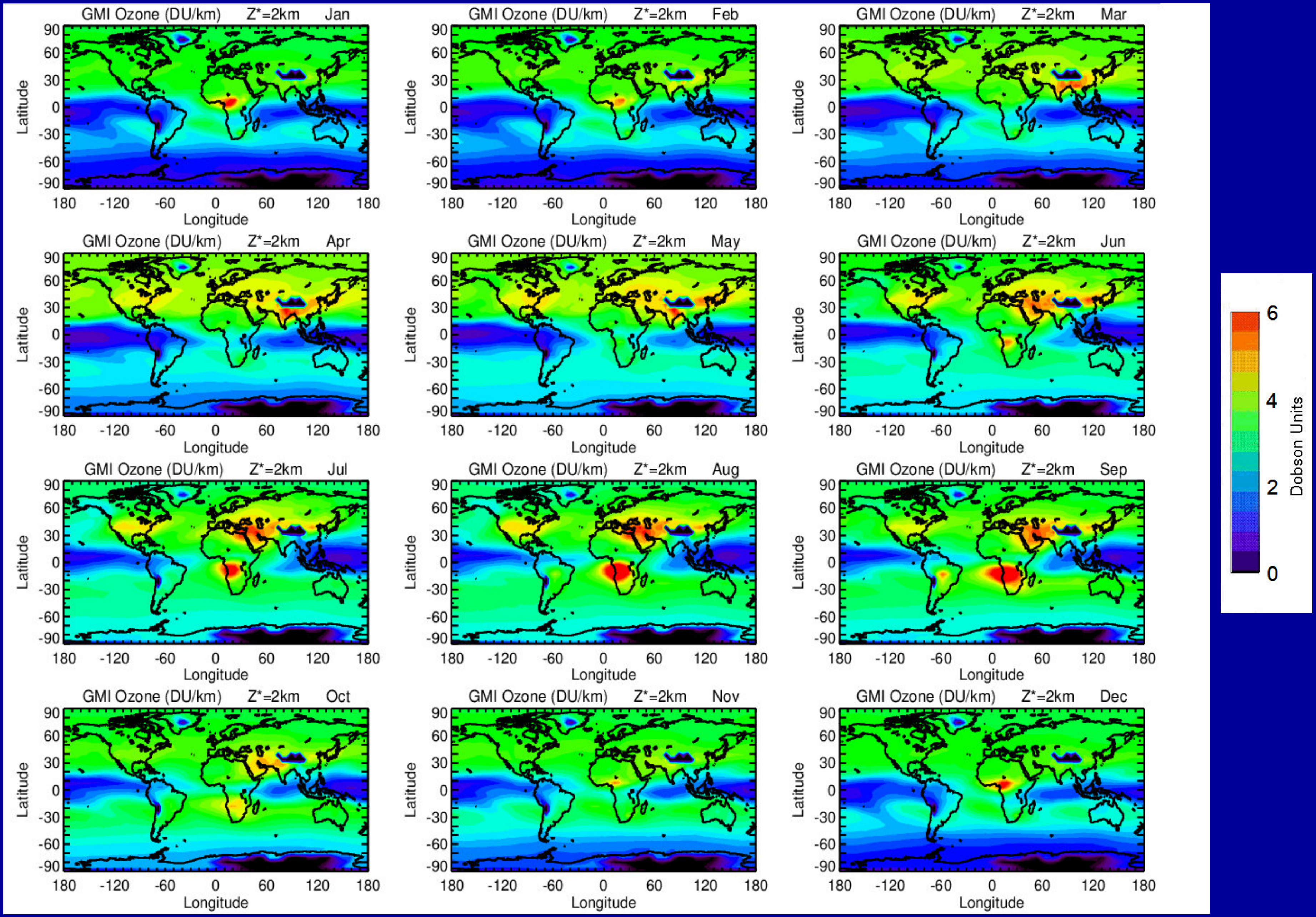
- Tropopause definition is not a large source of error

- Comparisons to ozonesondes show similar signal & noise

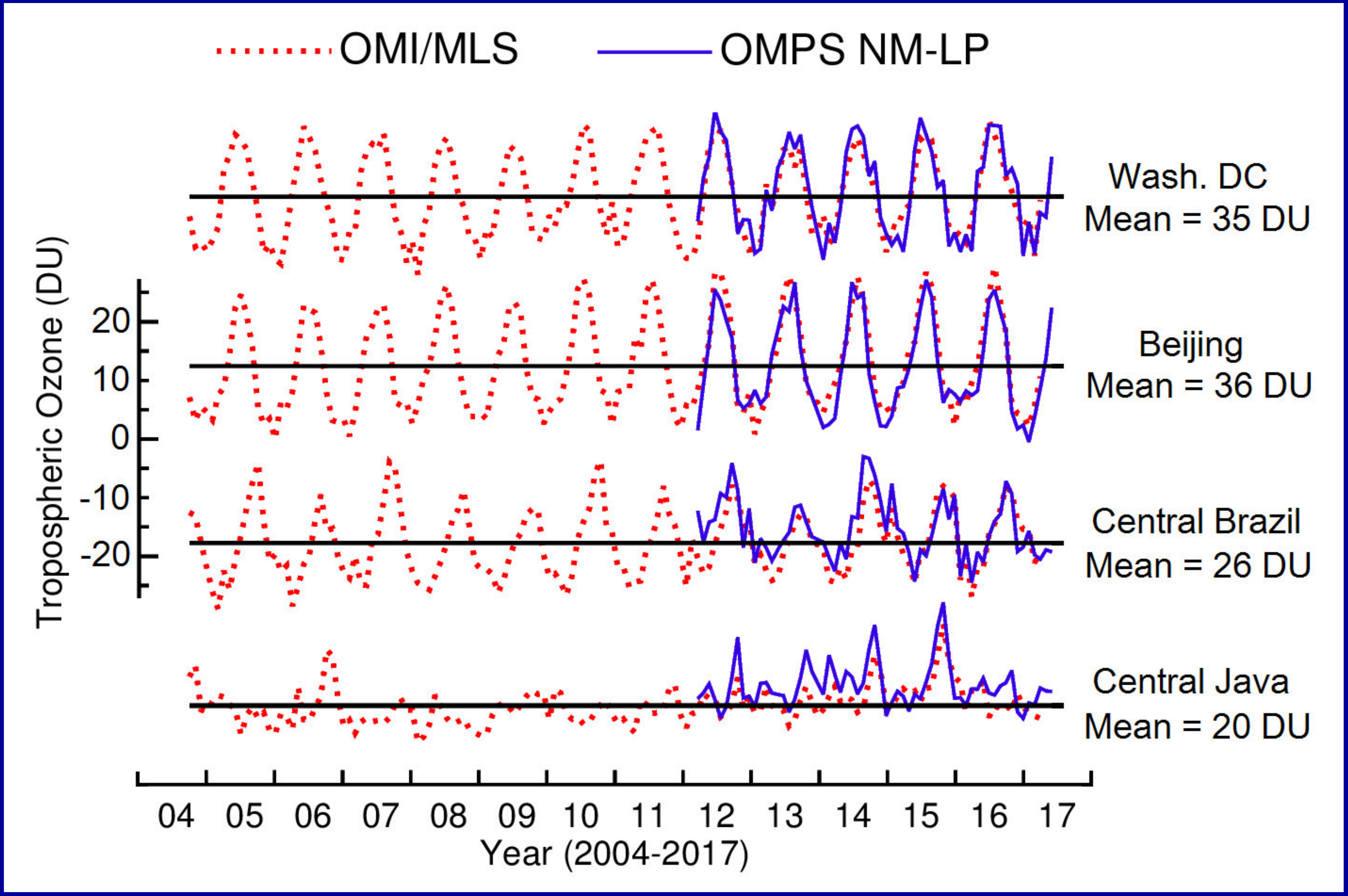
- OMPS/MERRA-2 will continue the record of OMI/MLS and TOMS/Cloud slicing tropospheric ozone for 1979 – present

Extra Slides

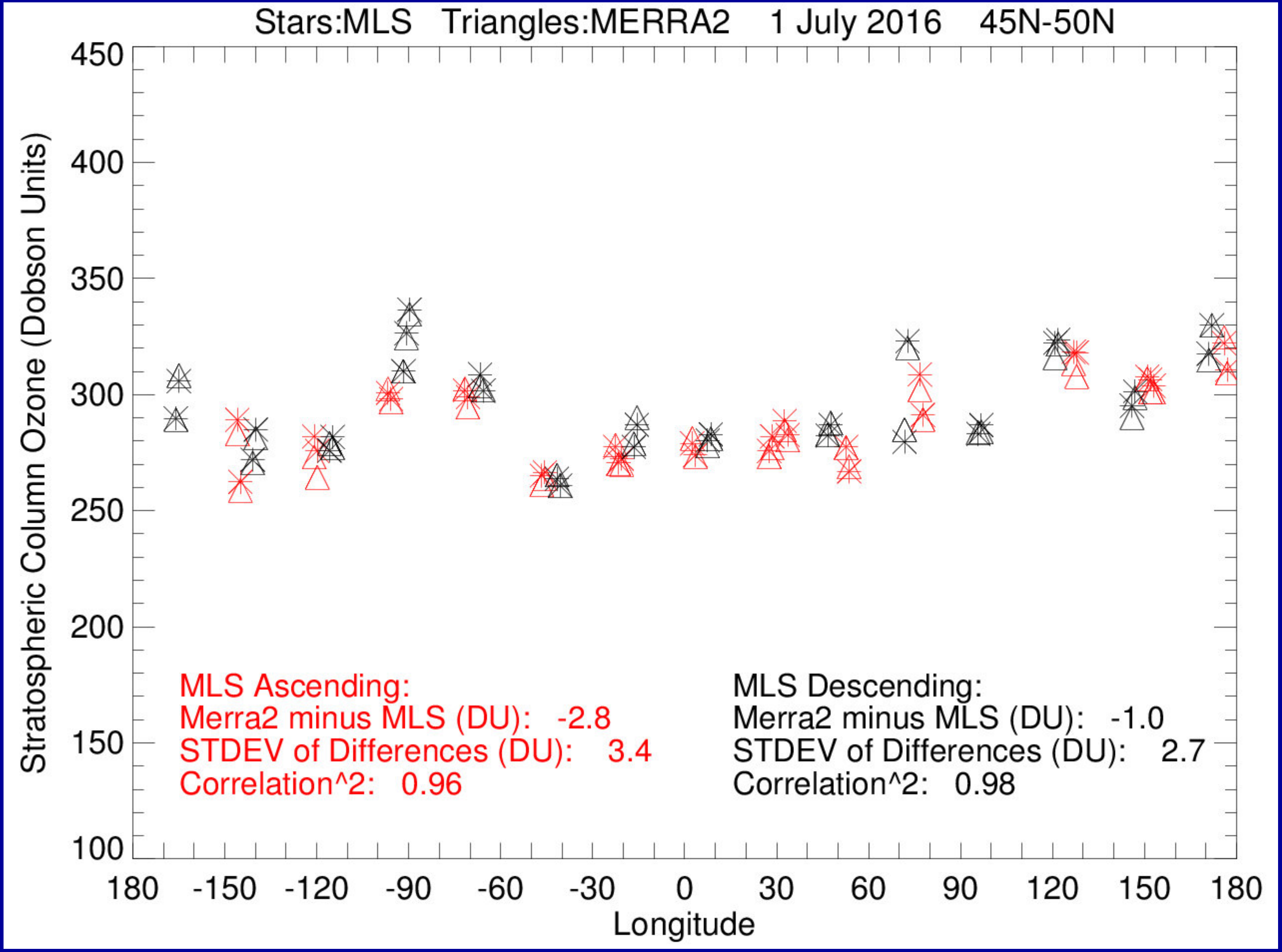
MERRA-2 GMI Tropospheric Ozone Climatology (Z=2km)



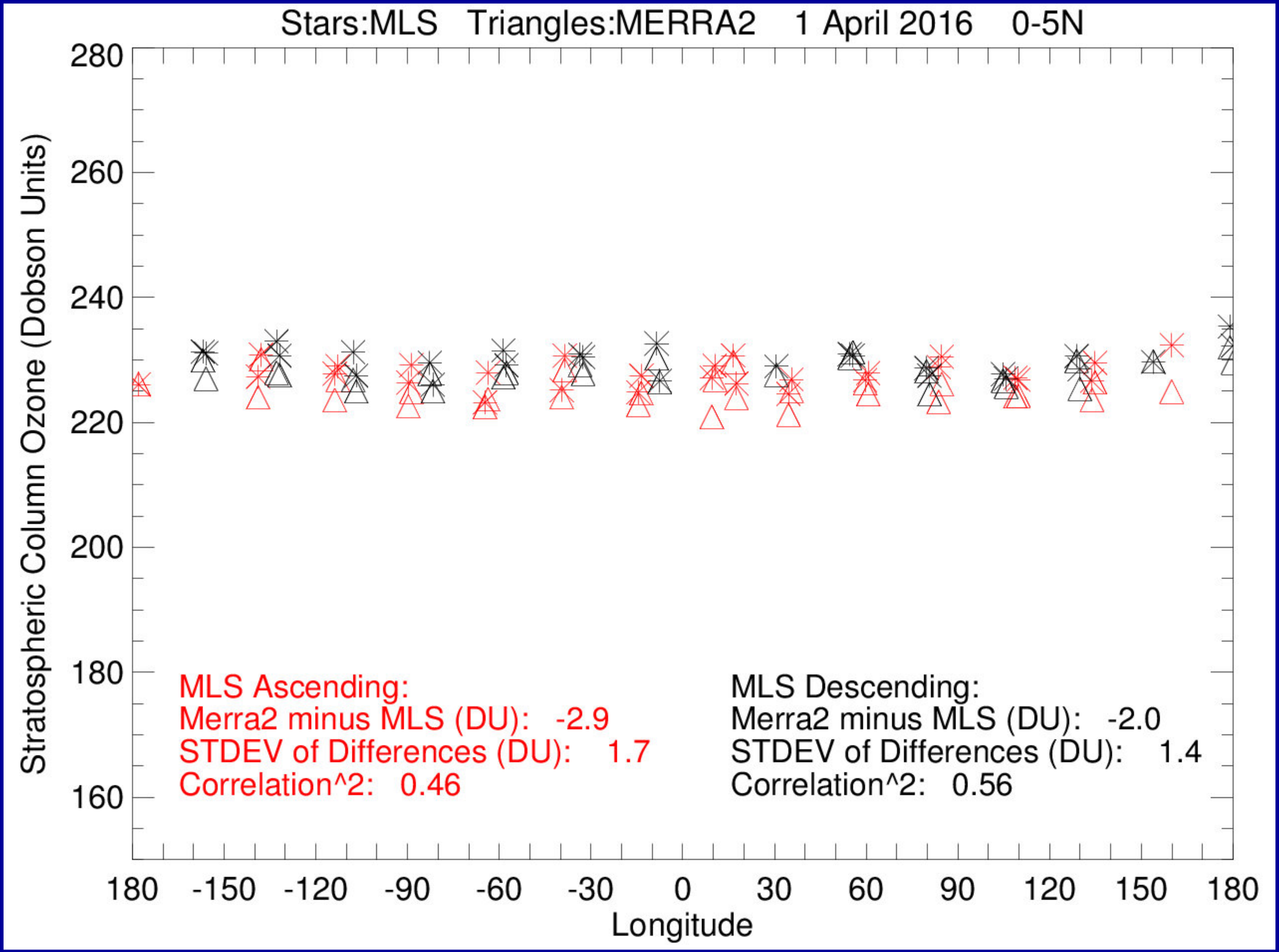
OMPS will continue the OMI/MLS record of tropospheric ozone that starts October 2004



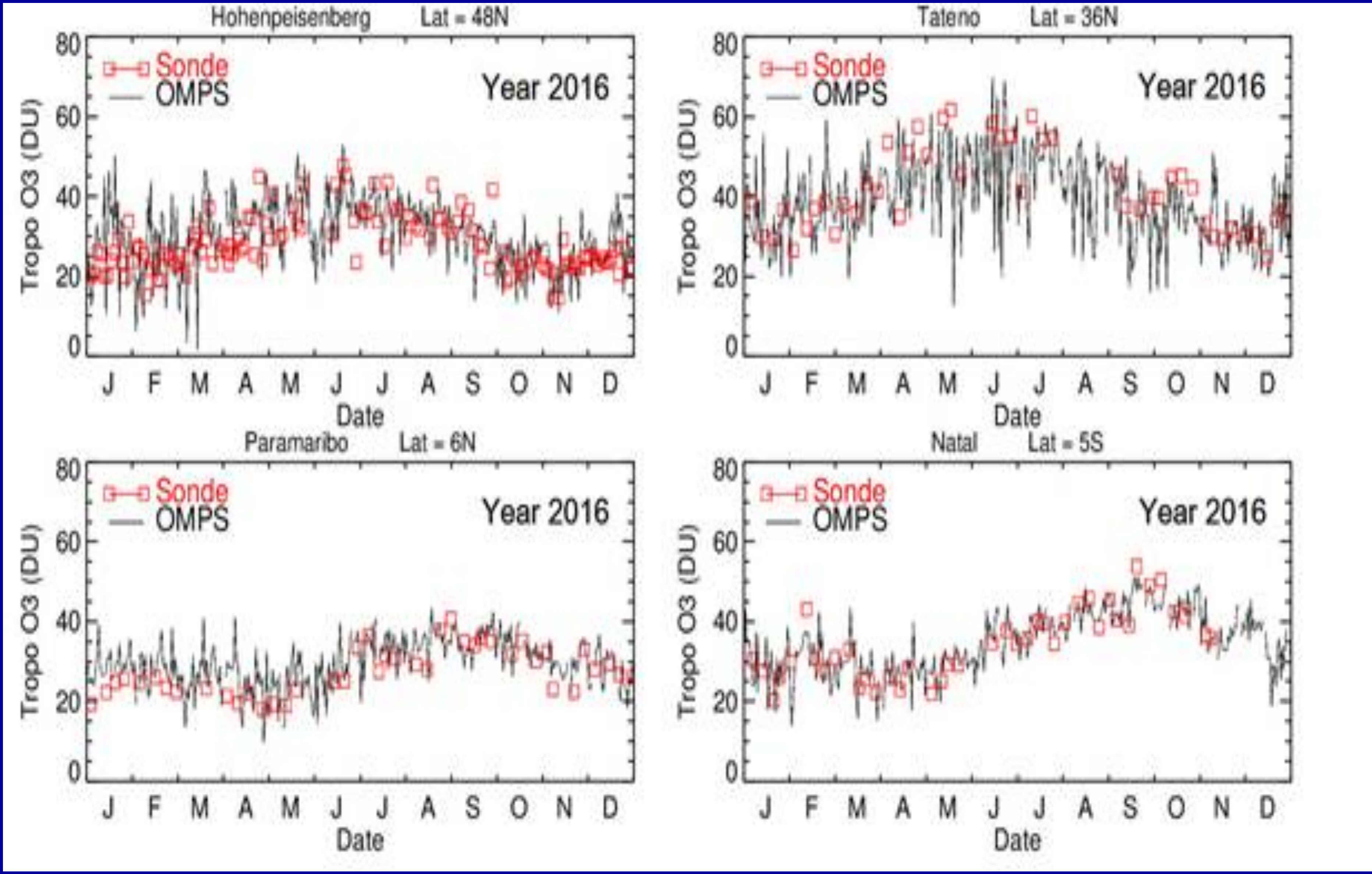
MLS SCO (stars) versus MERRA-2 SCO (triangles)

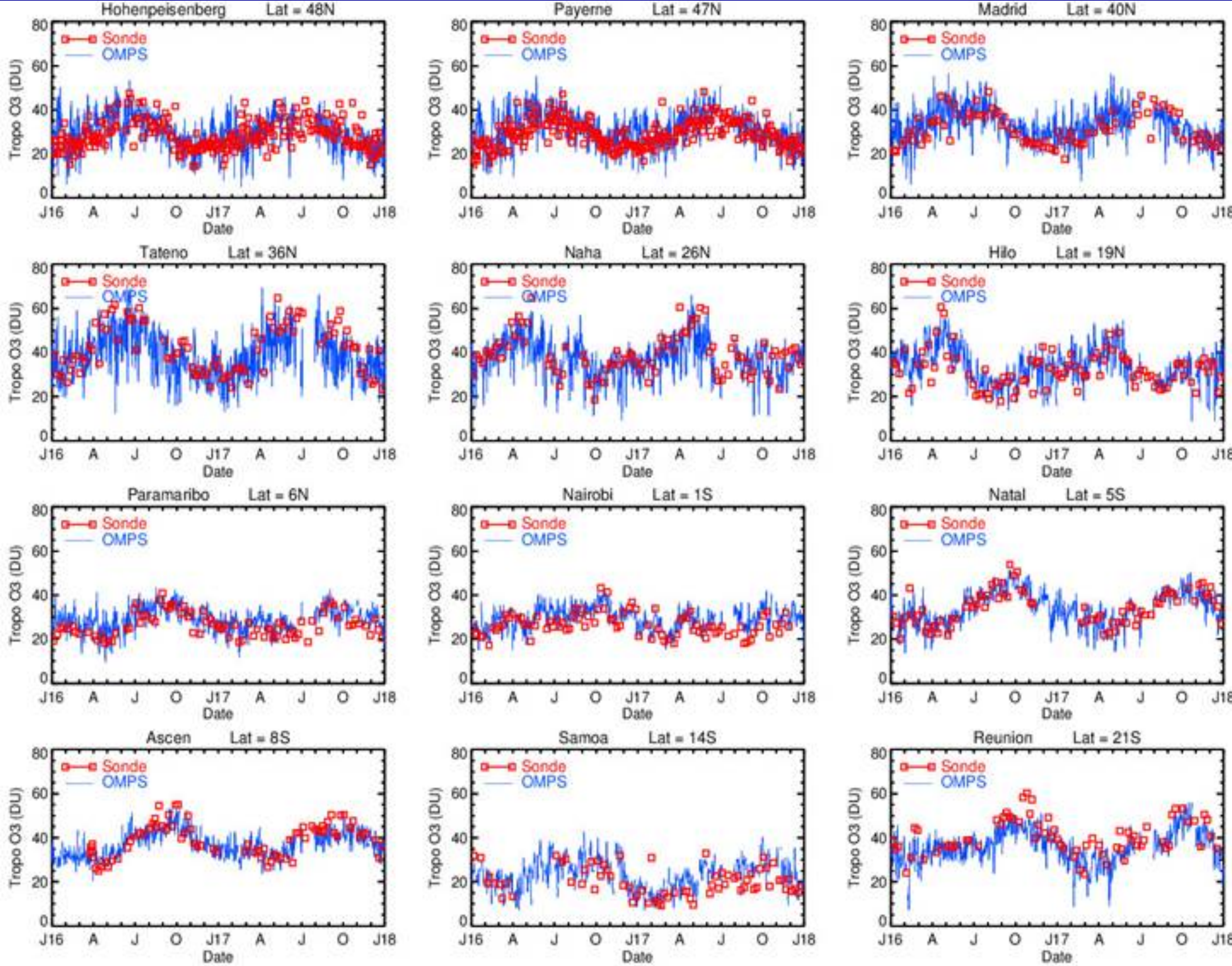


MLS SCO (stars) versus MERRA-2 SCO (triangles)



Some validation using ozonesondes




Hohenpeisenberg Lat = 48N
Payerne Lat = 47N
Madrid Lat = 40N
Tateno Lat = 36N
Naha Lat = 26N
Hilo Lat = 19N
Paramaribo Lat = 6N
Nairobi Lat = 1S
Natal Lat = 5S
Ascen Lat = 8S
Samoa Lat = 14S
Reunion Lat = 21S
Sonde
OMPS
Tropo O3 (DU)
0
20
40
60
80
J16
A
J
O
J17
A
J
O
J18
Date

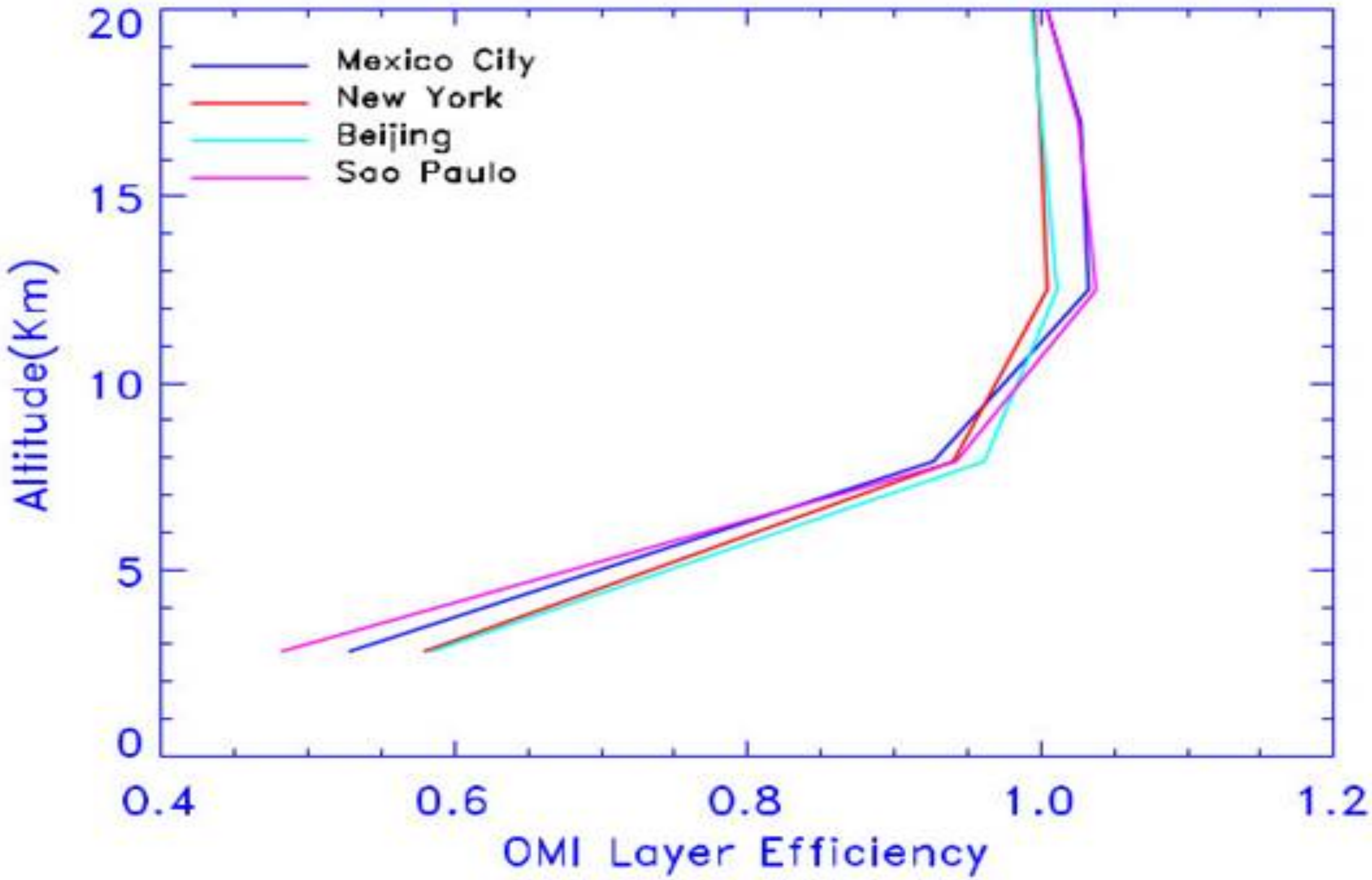


Fig. 5. Layer efficiency profiles near New York (July 2005), Beijing (August 2005), Sao Paulo (October 2005) and Mexico City outflow plume (February 2005) from the OMI level 2 data for reflectivity less than 0.3.