



# Ozone profile products from the Suomi NPP OMPS Limb Profiler: overview of the quality of version 2.0 and a path for the updated version 2.5

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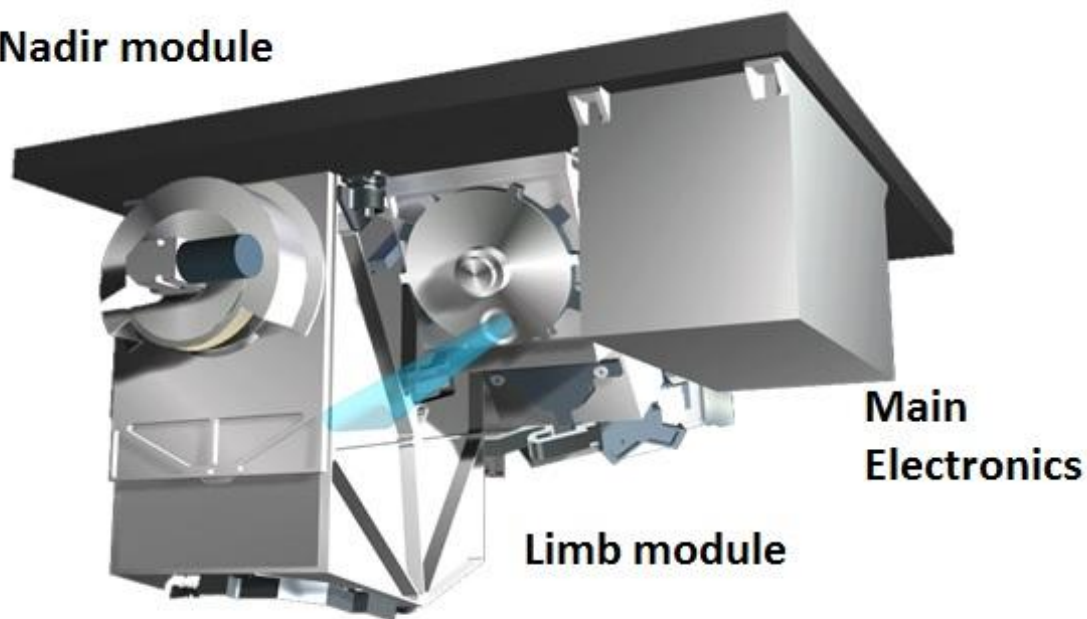


# Suomi NPP OMPS Limb Profiler



- LP measures limb scattered radiation in the wavelength range 290-1000 nm, with variable resolution (1-25 nm);
- LP has three slits separated horizontally by 4.25 (about 250 km) to expand the sensor cross-track coverage;
- Altitude range: 0-80 km with 1 km sampling and ~ 2 km vertical resolution;
- LP collects radiance spectrum simultaneously from all altitudes;
- LP makes about 160–180 measurements per orbit (~1° latitude sampling) with 14 orbits per day.

Nadir module



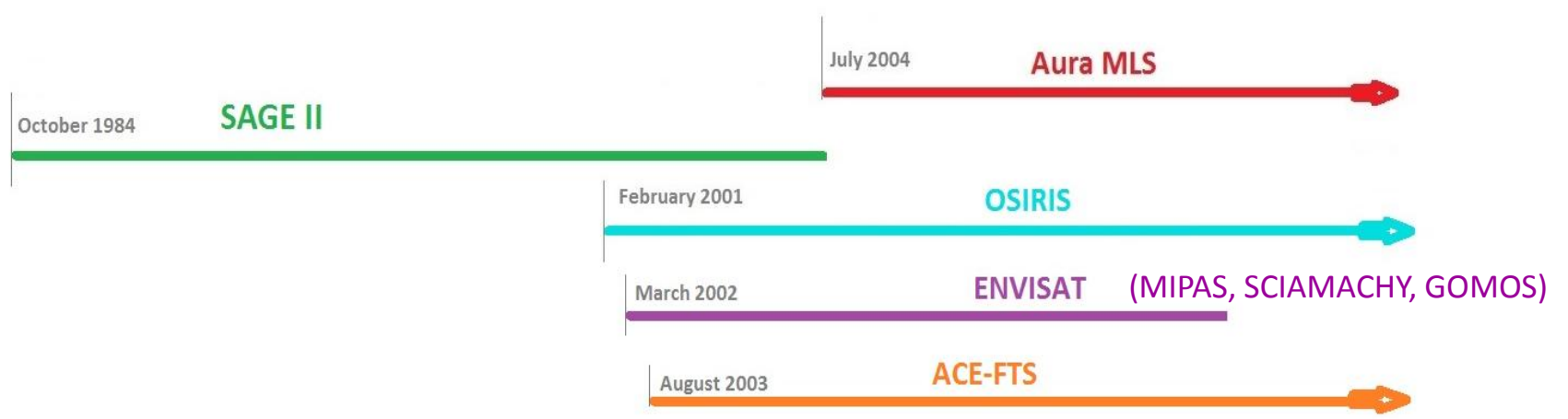
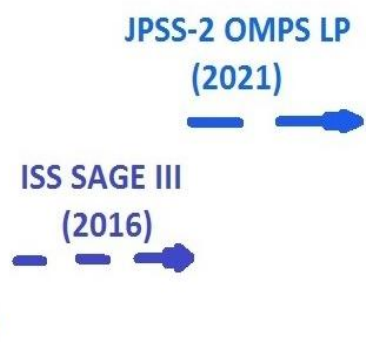
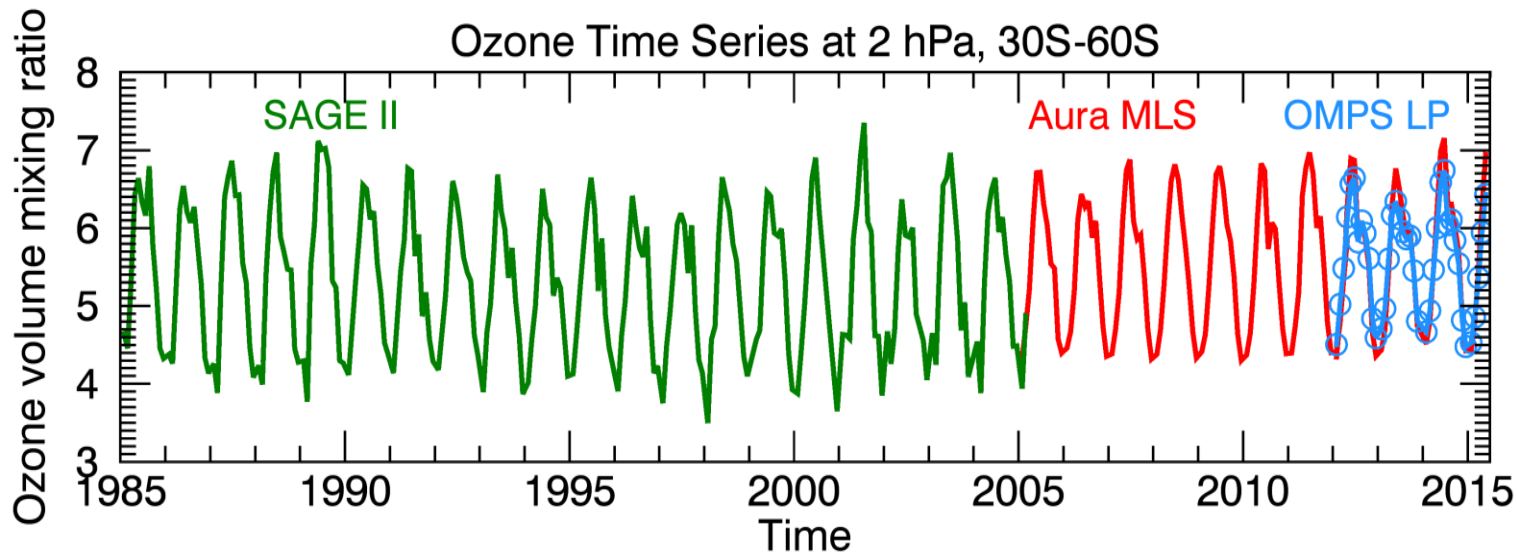
## OMPS LP ozone vertical profiles version 2.0

- O<sub>3</sub> profiles are independently retrieved from UV and VIS spectral ranges;
- 43 UV pairs and 17 VIS triplets;
- measurements are normalized at 65 km for UV and 45 km for VIS ranges;
- Optimal Estimation technique + Tikhonov regularization;
- The aerosol correction module is turned off.

[D. Rault and R. Loughman, 2013]

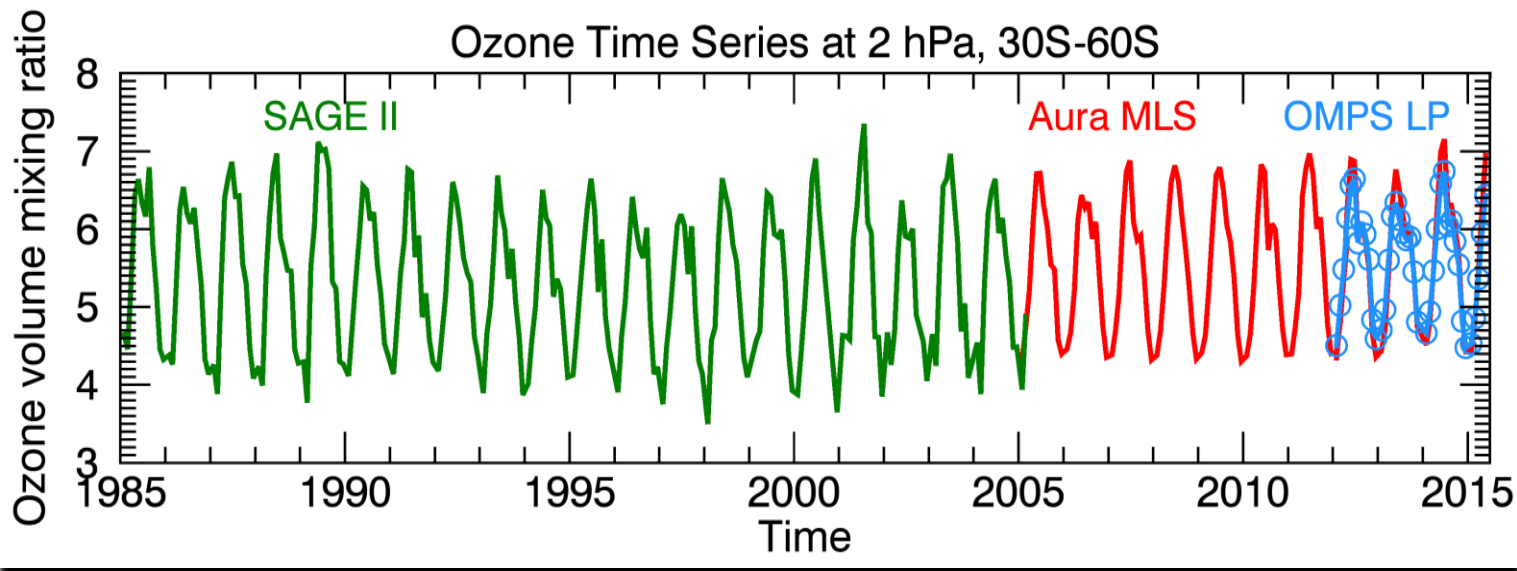


# Continuation of the ozone climate record





# Continuation of the ozone climate record



**Stability of LP measurements: altitude (or tangent height) registration error** is the main source of uncertainties in limb measurements. In addition to the star tracker readings, two methods for the altitude registration - RSAS and ARRM – have been tested and applied. By combining these two methods we can detect the tangent height **with  $\pm 200$  m uncertainties**. The ARRM method detected a 100m shift in altitude registration in April 2013, later confirmed by the star tracker system. This 100m shift in April 2013 will be corrected in the version 2.5 processing of Level 1 data.

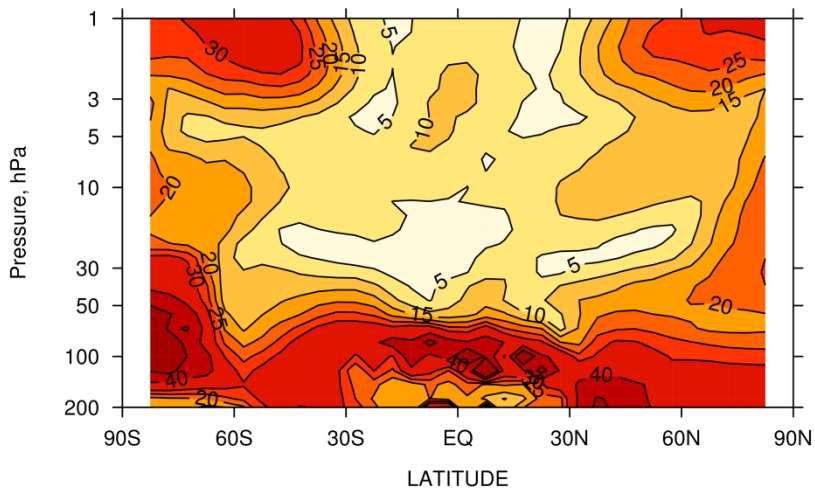
[Moy et al., *Atmos. Meas. Tech. Discuss.*, doi:10.5194/amt-2016-103, 2016]



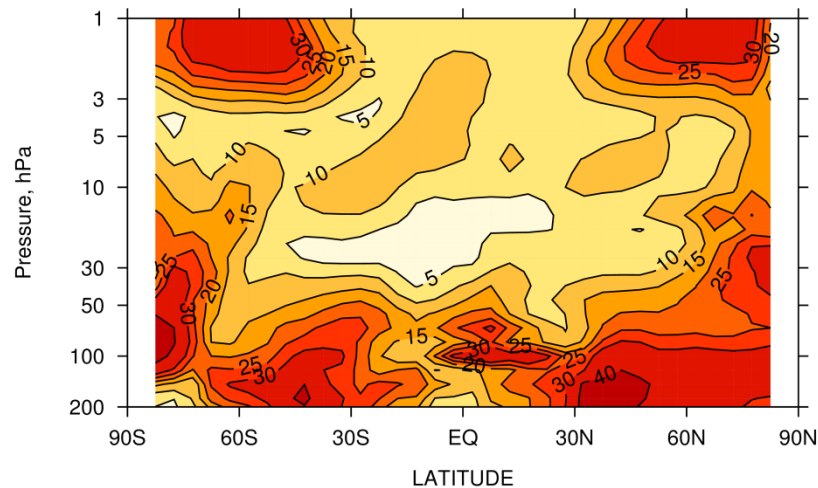
# Ozone seasonal cycle: Aura MLS, MIPAS and OMPS LP



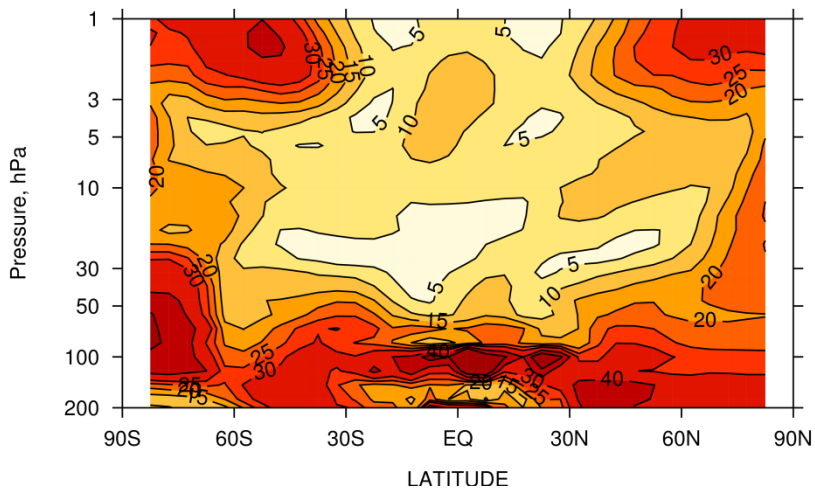
Amplitude of the Seasonal cycle MIPAS, nd(%)



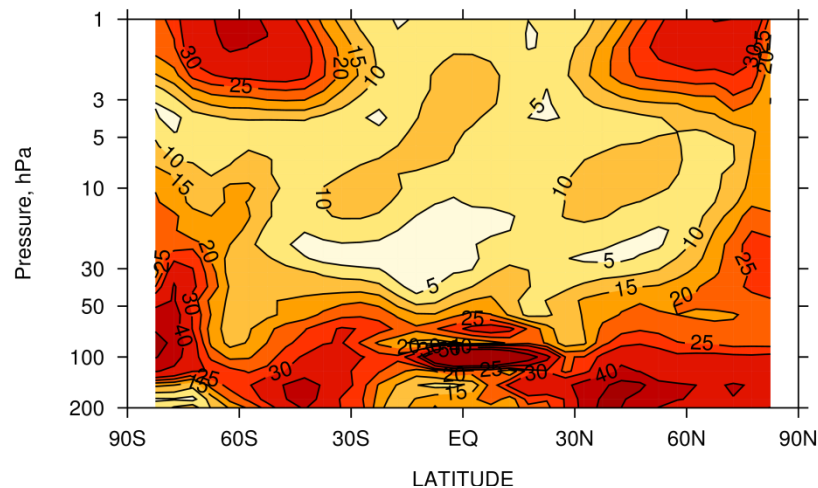
Amplitude of the Seasonal cycle LP, nd(%)



Amplitude of the Seasonal cycle MLS, nd(%)



Amplitude of the Seasonal cycle MLS, nd(%)

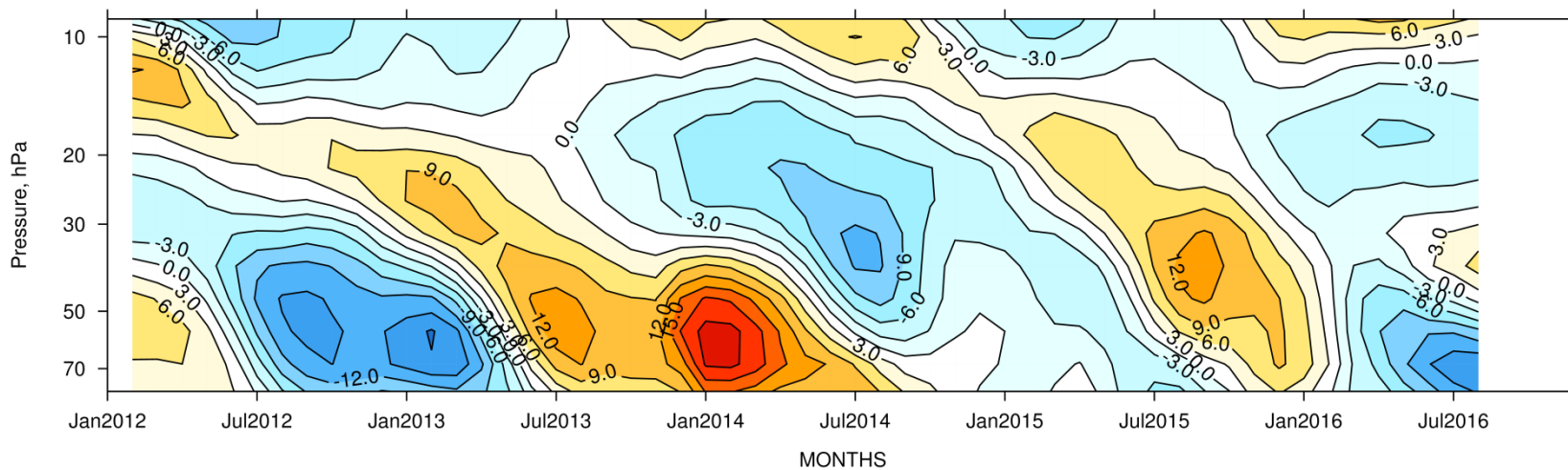




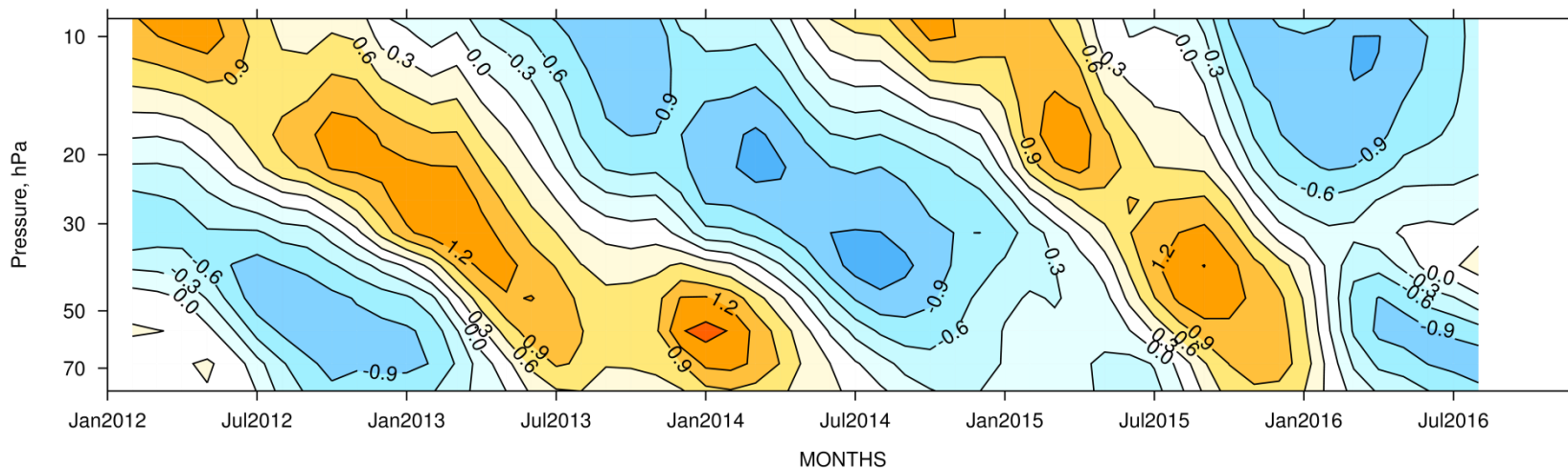
# Quasi-Biennial Oscillation in the equatorial stratosphere



mzm ozone deseasonalized, OMPS LP (%), 5S-5N



mzm MERRA T deseasonalized (%), 5S-5N

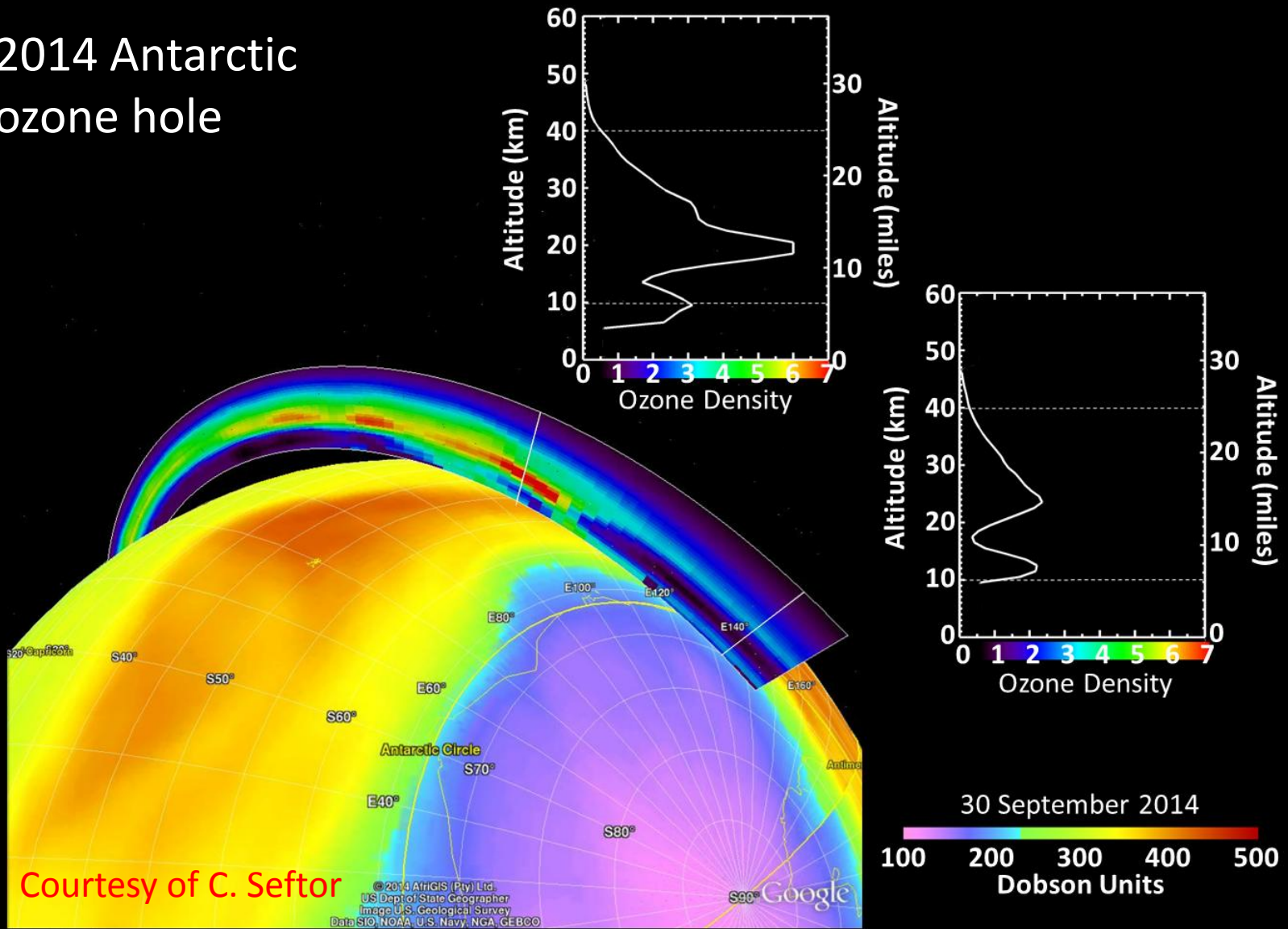




# Antarctic ozone measurements with OMPS: synergy between nadir and limb modules



## 2014 Antarctic ozone hole



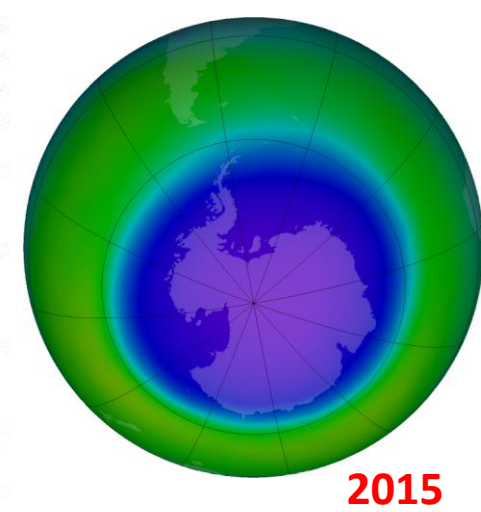
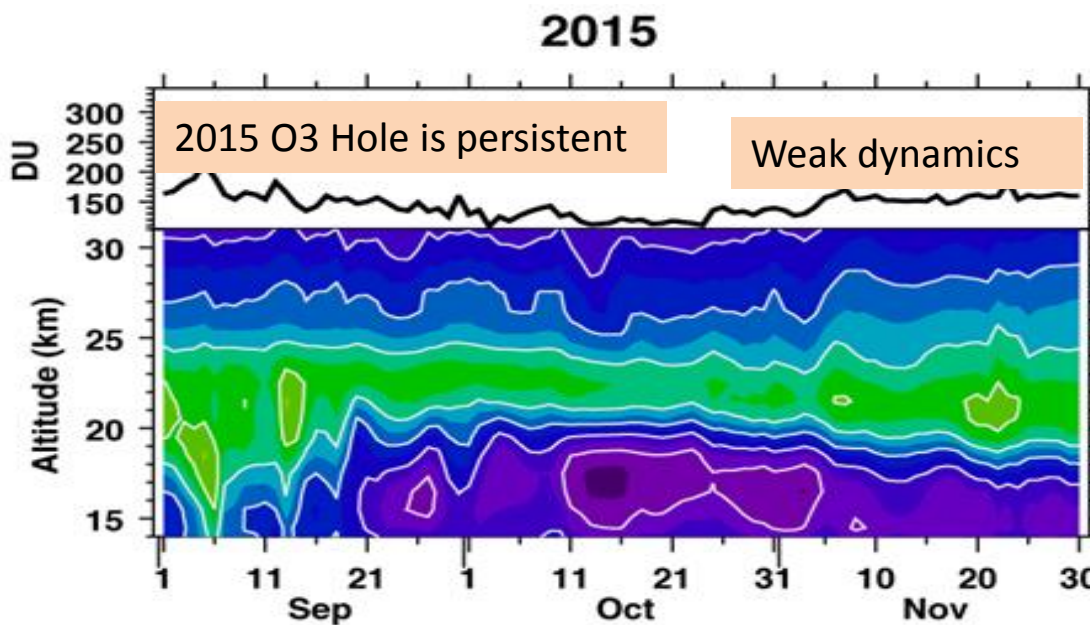
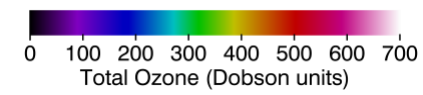
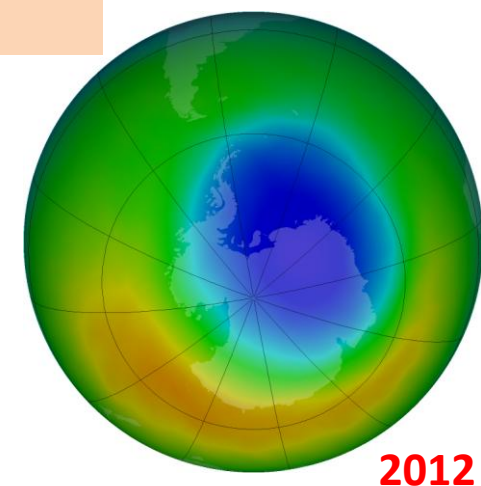
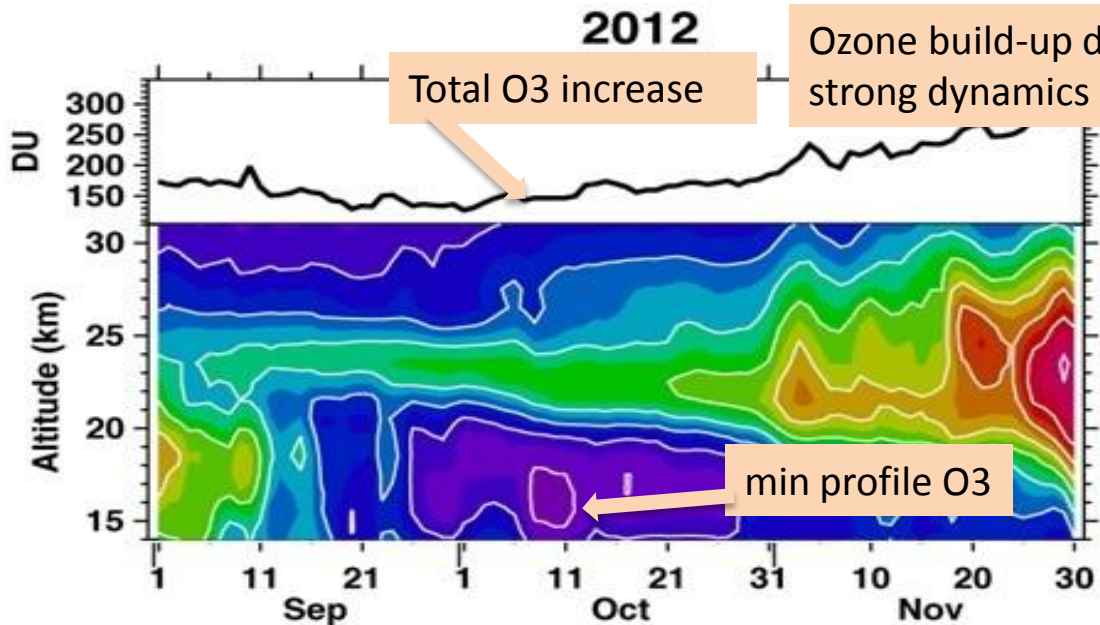
Courtesy of C. Seftor

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US Dept of State Geographer  
Image U.S. Geological Survey  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google



# Look inside the ozone hole with OMPS



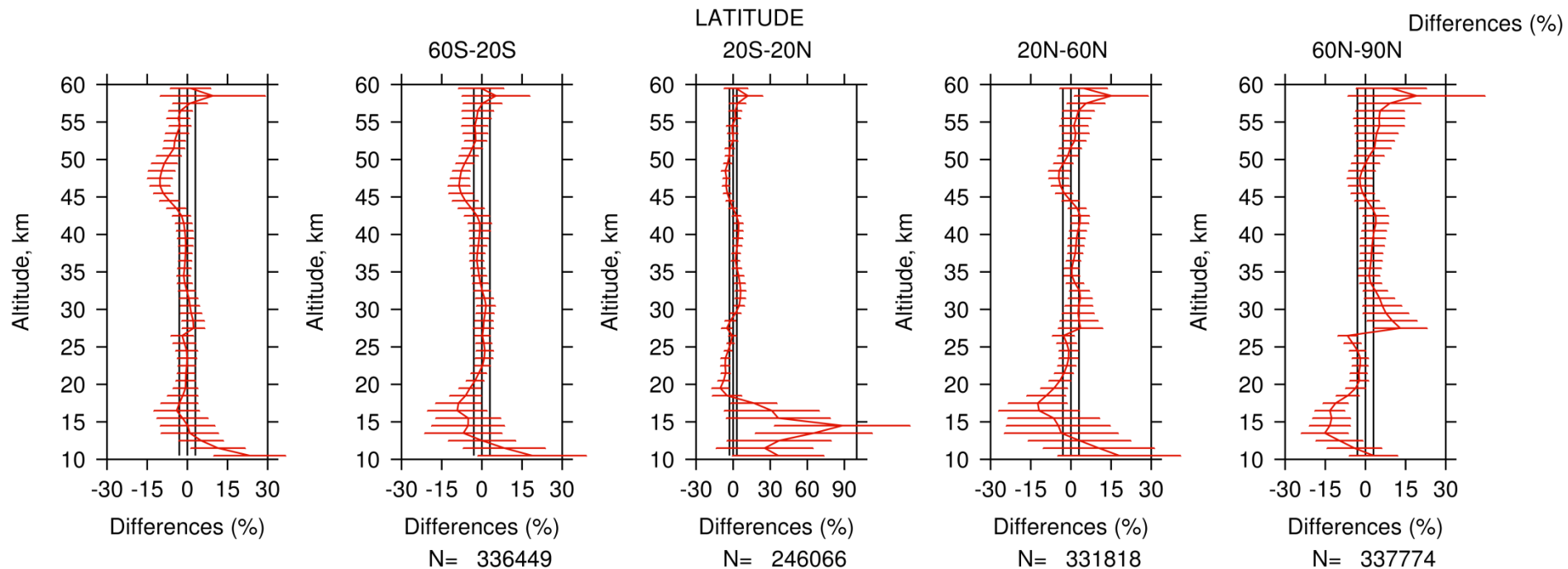
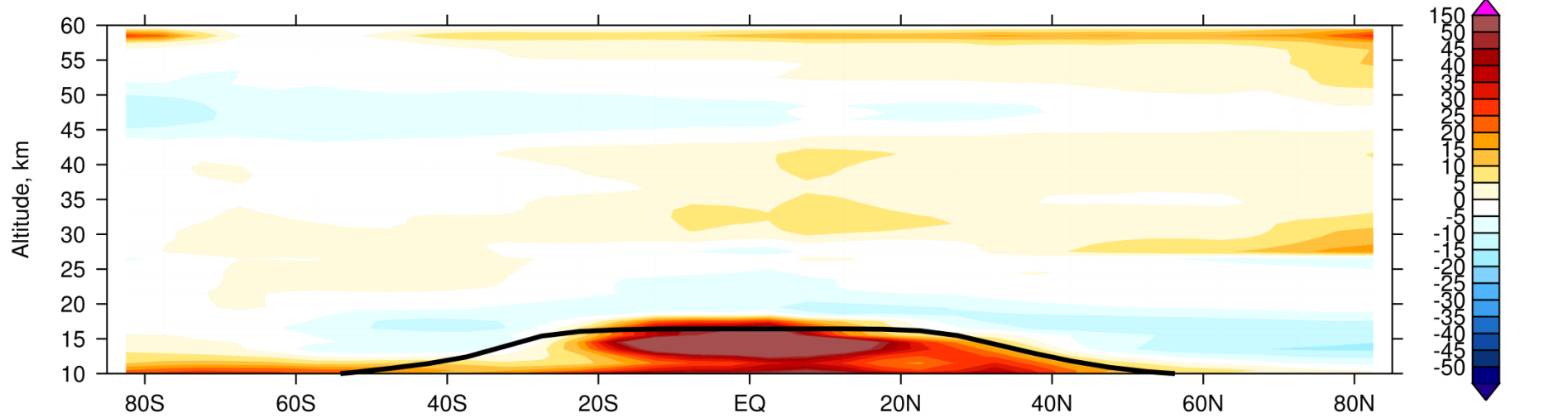




# Quality assessment of OMPS LP v2



Mean Bias OMPS-LP v2 - Aura MLS v4, (%)

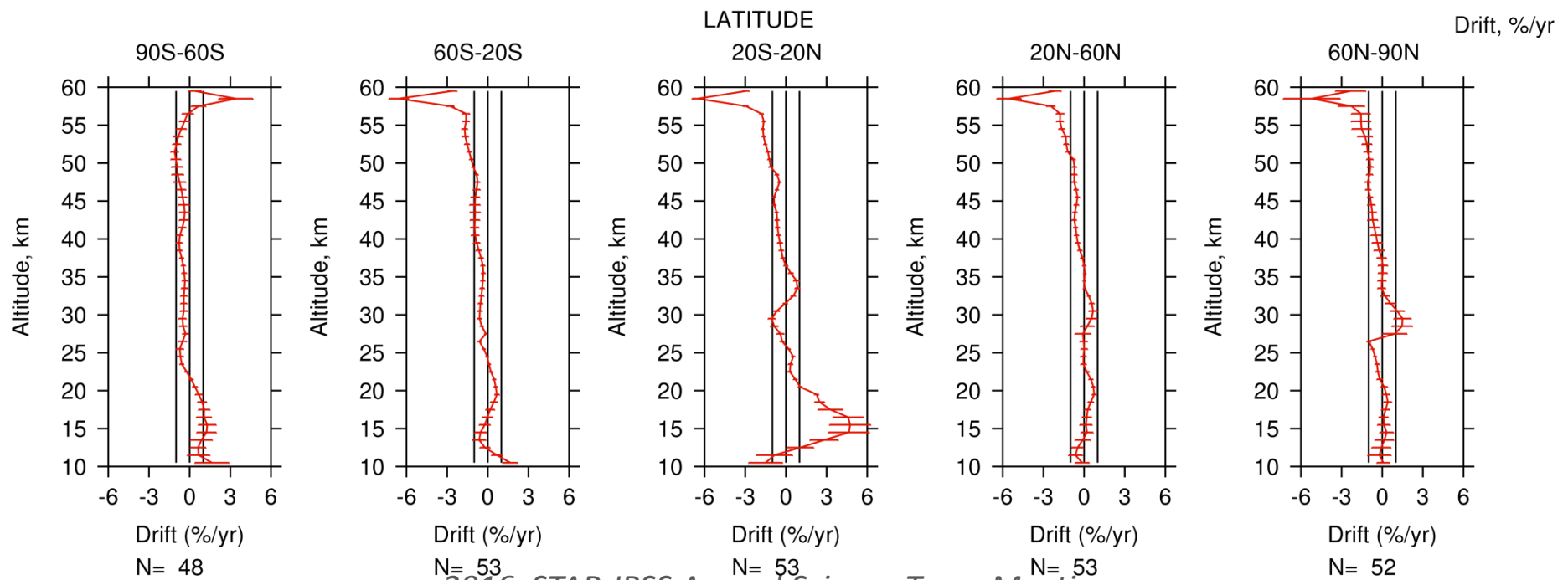
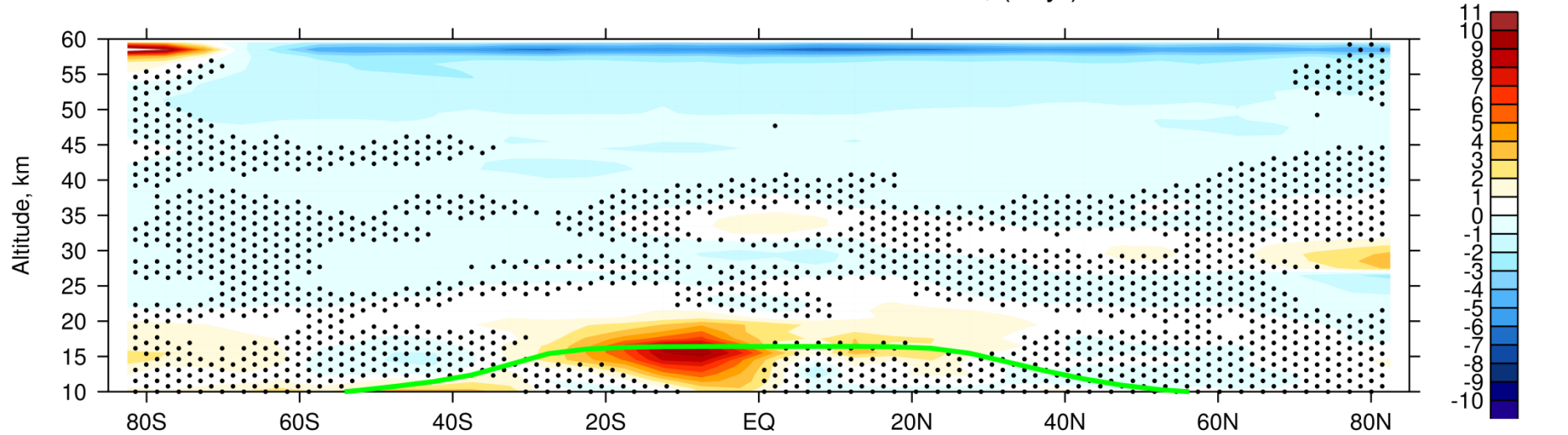




# Quality assessment of OMPS LP v2



Relative drift OMPS-LP v2 - Aura MLS v4, (%/yr)





# A path toward the version 2.5



- The stray light correction for the VIS wavelengths will be implemented in version 2.5;
- A 100 m shift in the altitude registration detected in April 2013 will be corrected;
- TH shifts between 3 slits will be removed (expect better agreement between slits);
- A new cloud height detection algorithm will be integrated in version 2.5 [Chen et al., AMT, 2016].

## OMPS-LP v2 algorithm

- 43 UV pairs and 17 VIS triplets;
- radiances are normalized at 65 km for UV and 45 km for VIS ranges;
- The aerosol correction module is turned off



## OMPS-LP v2.5 algorithm

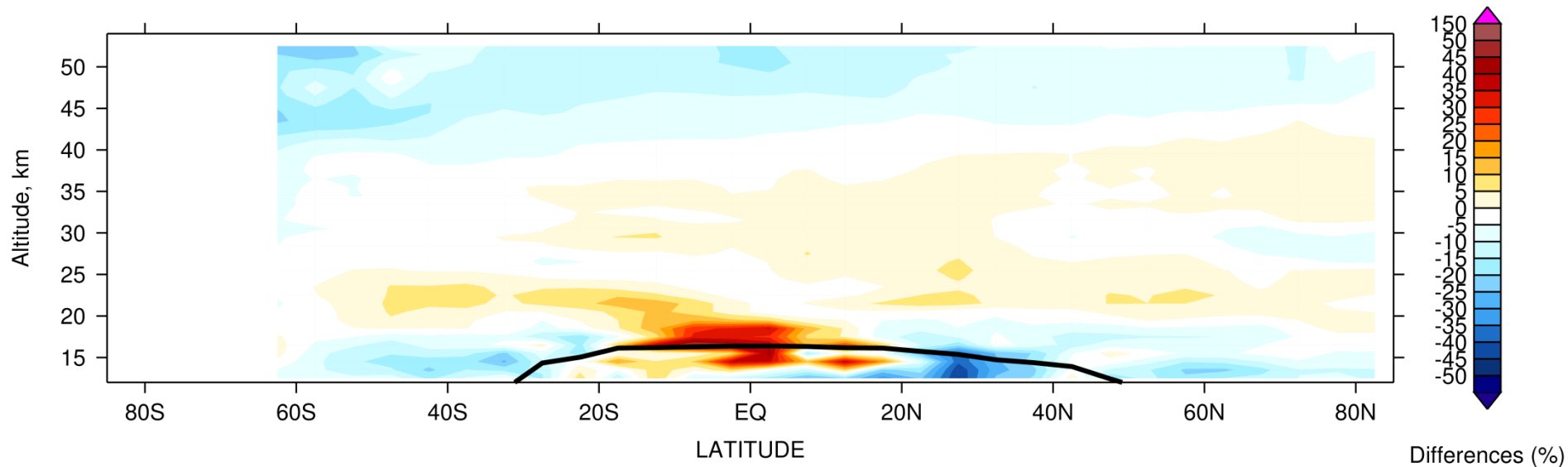
- 3 UV pairs and 1 VIS triplets;
- radiances are normalized at 55 km for UV and 40 km for VIS ranges;
- Include the explicit aerosol correction by using LP aerosol v1



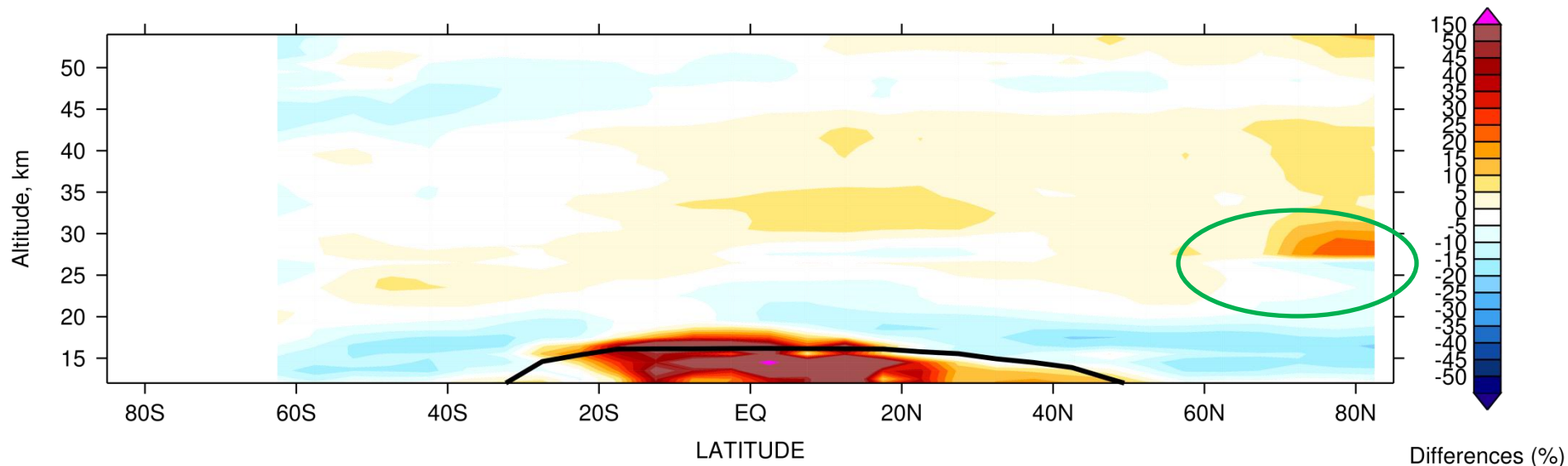
# Version 2.5



Mean Bias OMPS-LP v2.5 Center - Aura MLS v4, August 2015, (%)



Mean Bias OMPS-LP v2 Center - Aura MLS v4, August 2015, (%)





# Future plans

- Account for horizontal inhomogeneity (2D effects) along the line of sight :
  - ✓ 1. Near-term: apply the horizontal contribution function of the measurement vector to the retrieved profiles;
  - ✓ 2. Long-term: collaborate with GMAO in assimilating cloud and aerosol corrected LP radiances using 2D RT model.
- Temperature profiles in the mesosphere and upper stratosphere can be retrieved from the LP measurements.