Validation of OMPS LP ozone profile retrievals from NASA GSFC version 2.5 against correlative satellite measurements

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Key changes in version 2.5

- **Stray light correction for the VIS wavelengths;**
- **Sensor pointing errors [L. Moy et al., AMT 2017];**
- **New cloud height detection [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;
- Aerosol correction module is turned off

OMPS LP O_3 retrieval algorithm by [*Rault and Loughman, 2013*]

OMPS-LP v2.5 algorithm

- 3 UV pairs and 1 VIS triplet;
- Radiances are normalized at 55 km for UV and 40 km for VIS ranges;
- Include the explicit aerosol correction by using LP aerosol v1;
- Algorithm uses realistic a priori covariance matrices instead of Tikhanov regularization;

April-May 2017: Reprocessing LP data with the new 2.5 retrieval algorithm **DONE**

August 2017: Public release of the version 2.5 ozone profiles **DONE**

Sensor pointing corrections in version 2.5

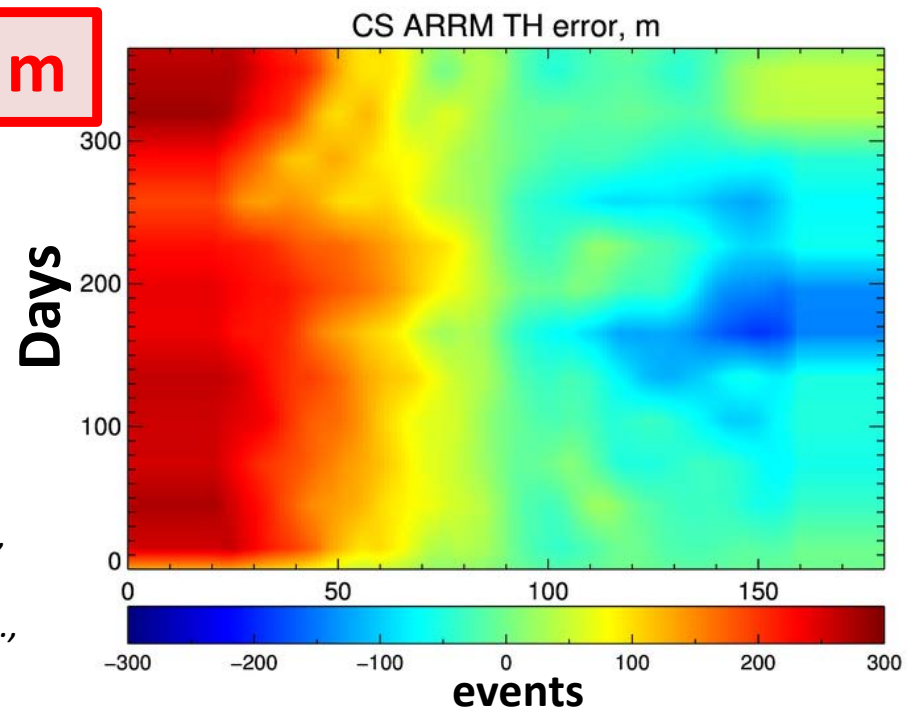
- ***Static corrections*** of 1.12/1.37/1.52 km for the left/center/right slits, correspondently;

- ***Time-dependent +0.1 km adjustments for all 3 slits*** on April 25, 2013 and on September 5, 2014 due to the spacecraft pitch and inclination adjustment maneuvers, respectively;

- ***Slit based, intra-orbital, seasonally varying TH*** corrections of ~0.3-0.4 km.

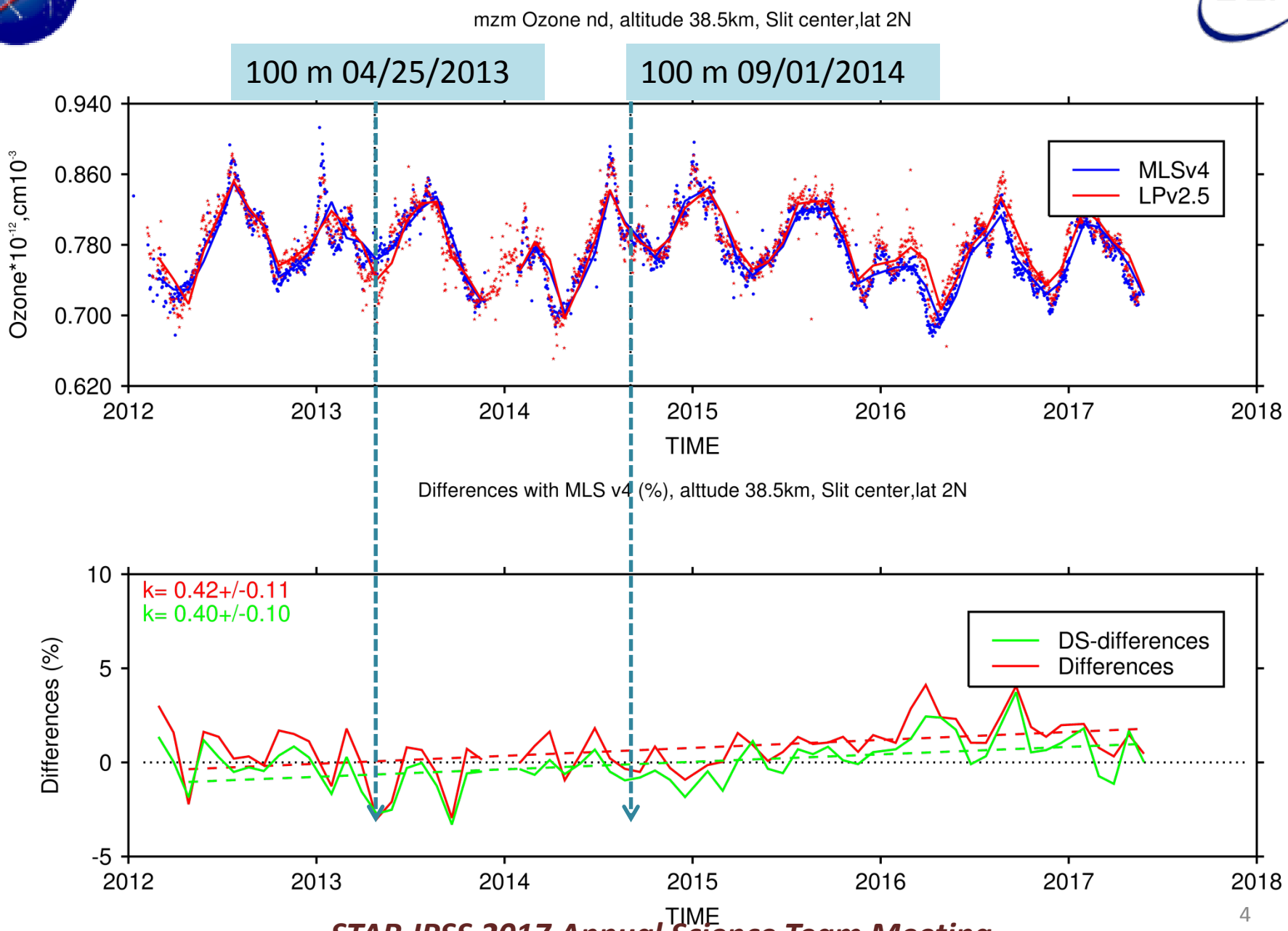
TH error, m	LEFT	CENTER	RIGHT
Version 2	0.58	1.18	1.75
Version 2.5	1.12	1.37	1.52

±200 m



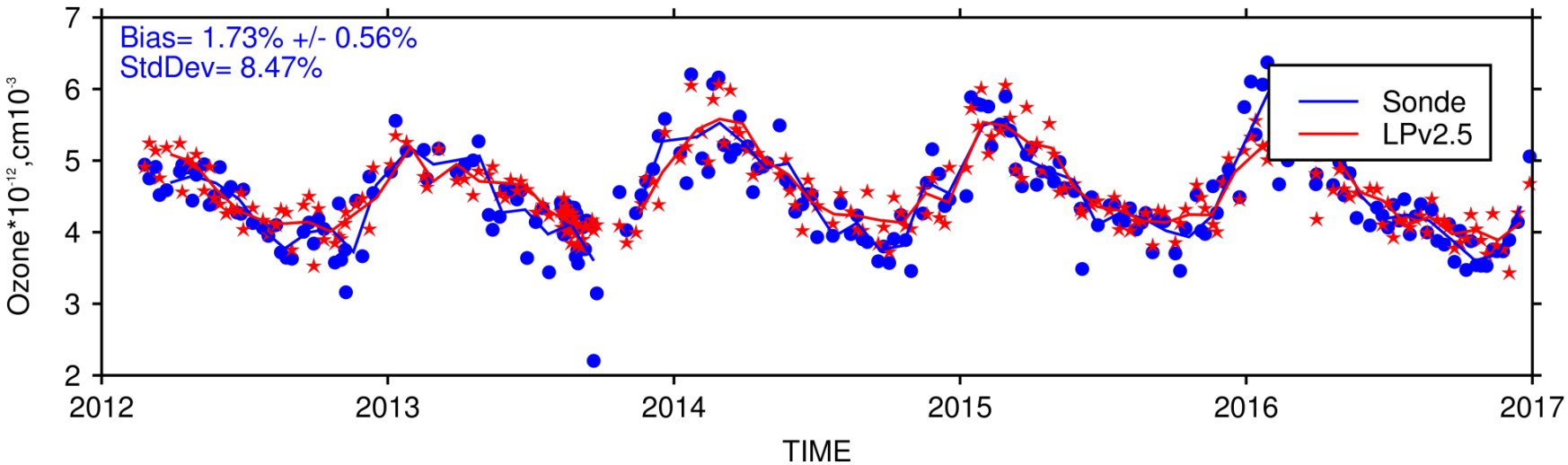
Moy, L., Bhartia, P. K., Jaross, G., Loughman, R., Kramarova, N., Chen, Z., Taha, G., Chen, G., and Xu, P.: Altitude registration of limb-scattered radiation, Atmos. Meas. Tech., 10, 167-178, doi:10.5194/amt-10-167-2017, 2017.

Ozone Time Series

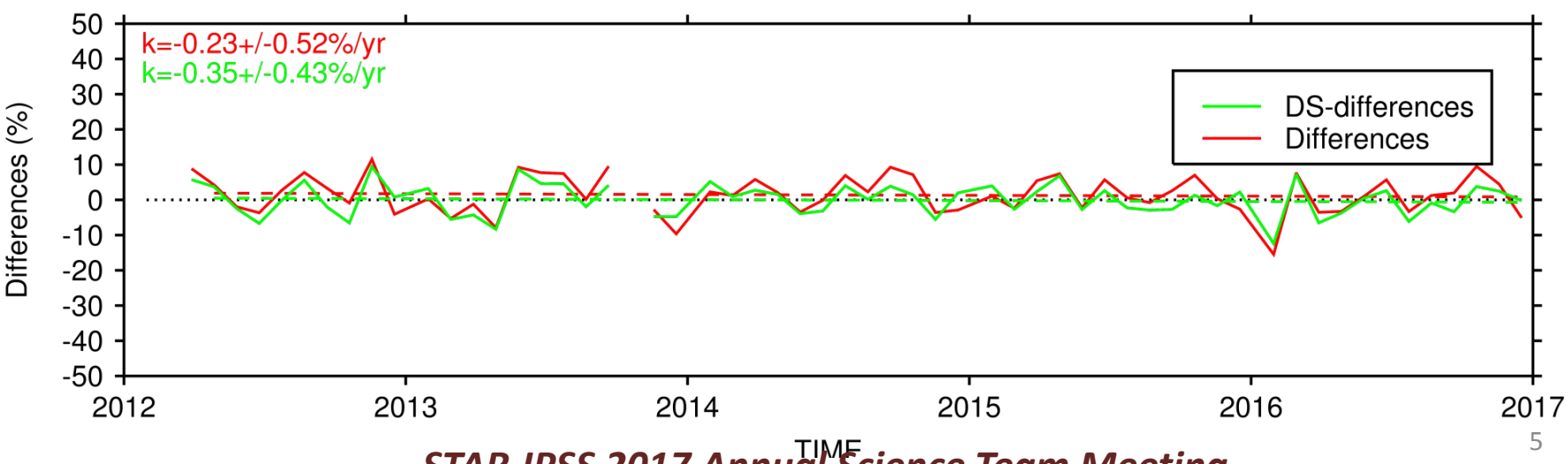


Ozone Time Series

Ozone nd, altitude 22.5km, Slit center, boulder, [39N,105W]

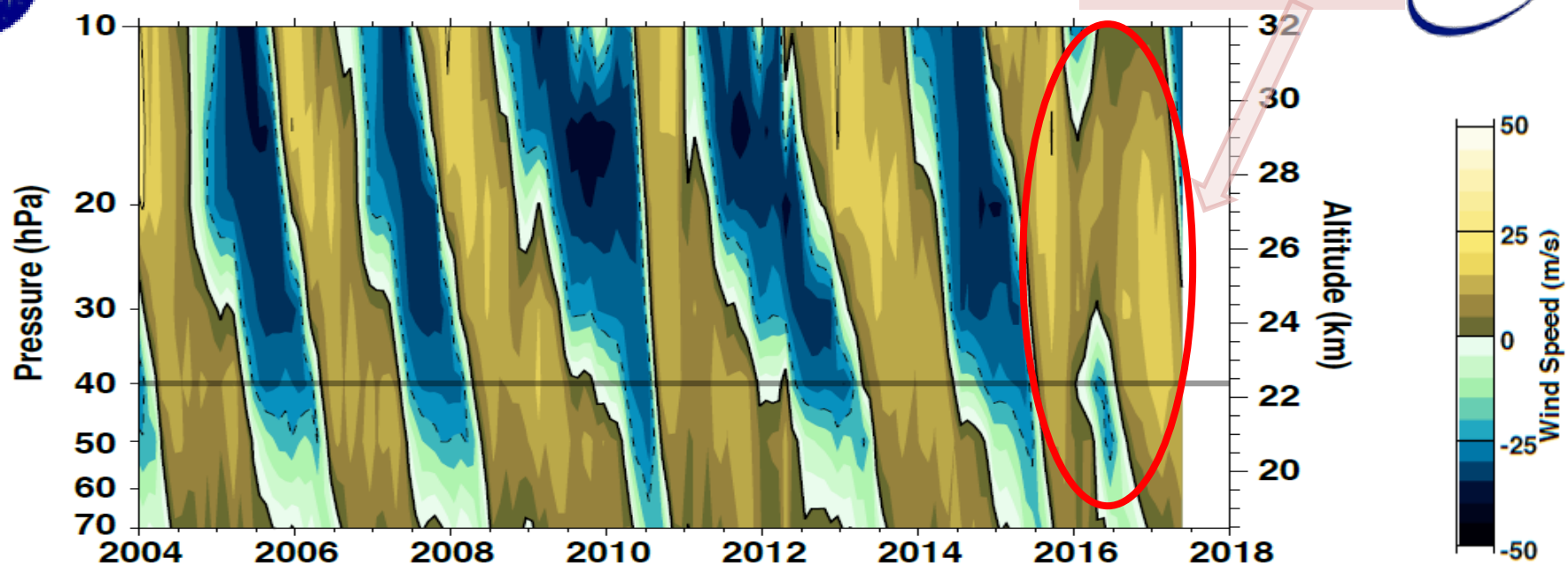


Differences with Sonde (%), altitude 22.5km, boulder, [39N,105W]

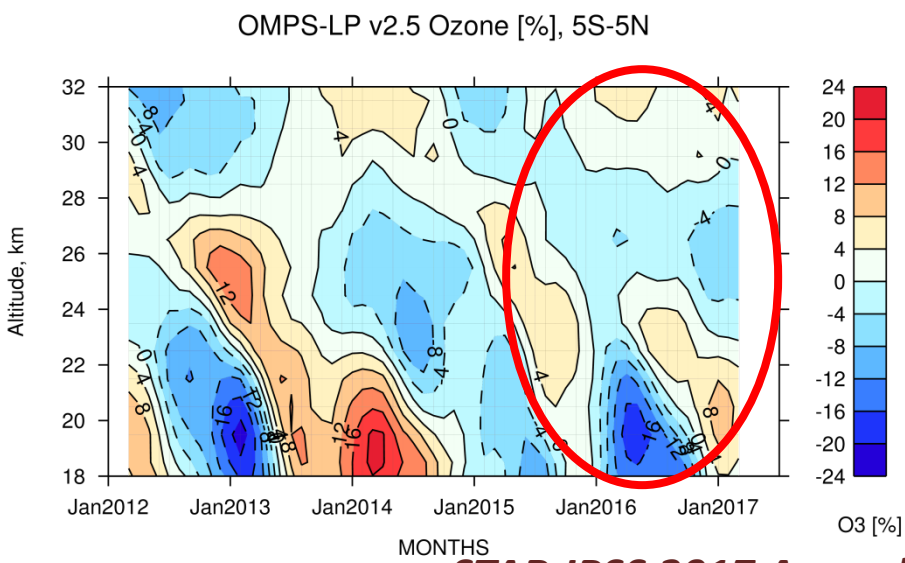


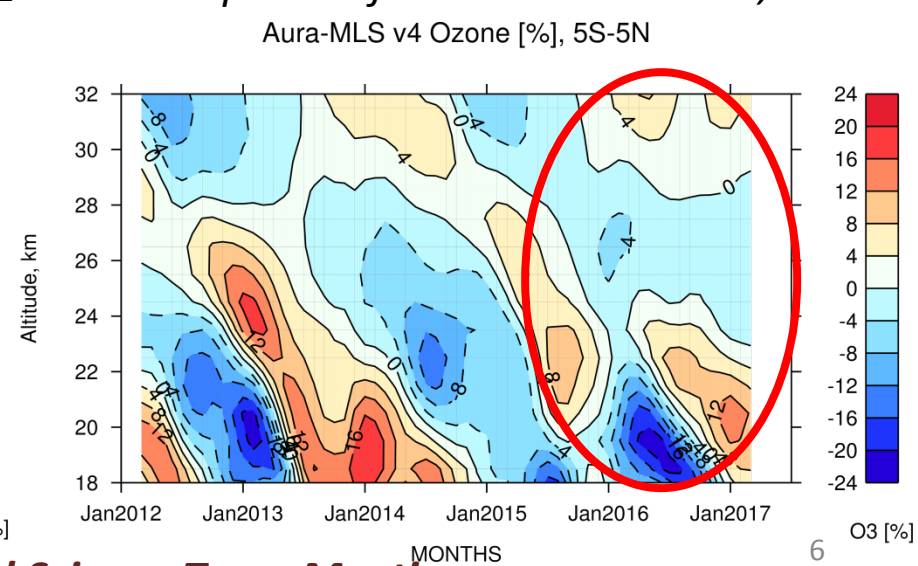
Disrupted QBO

Disrupted 2015-2016 QBO

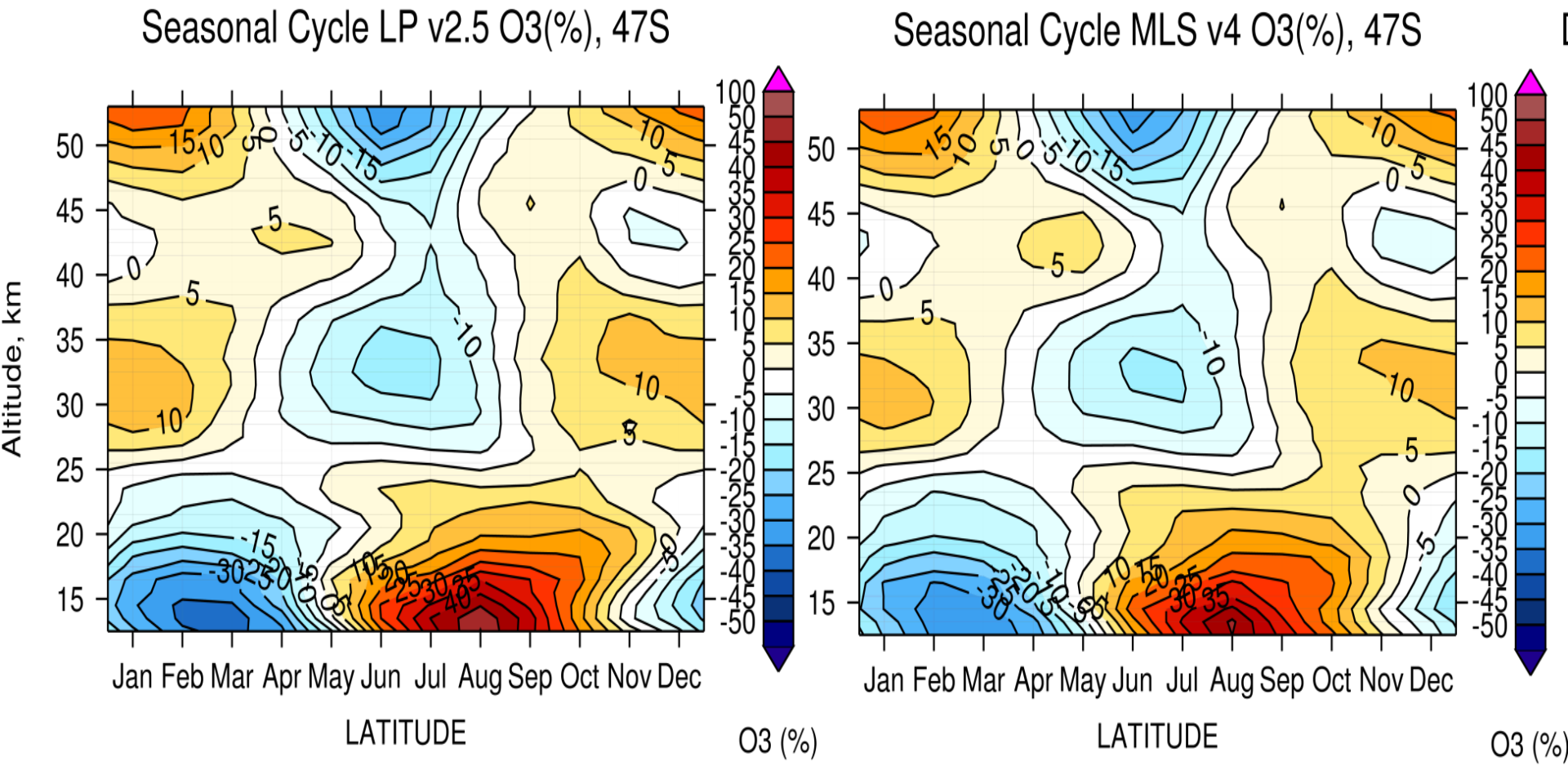


Updated from Newman et al., 2016





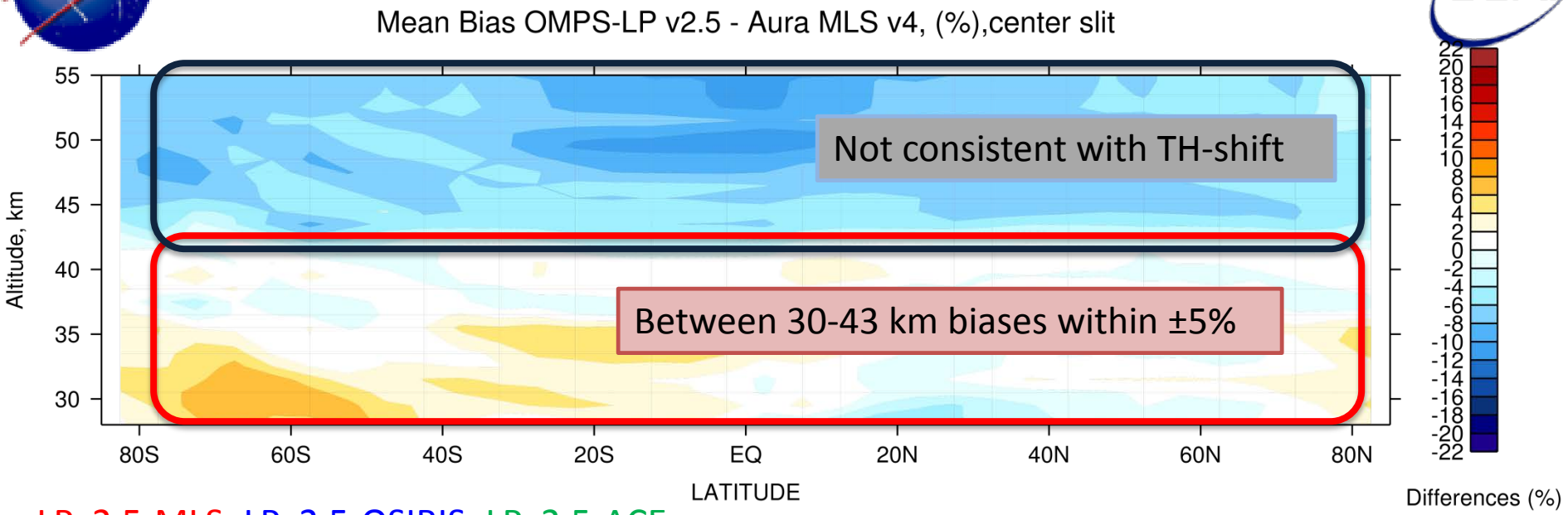
Ozone Seasonal Cycle



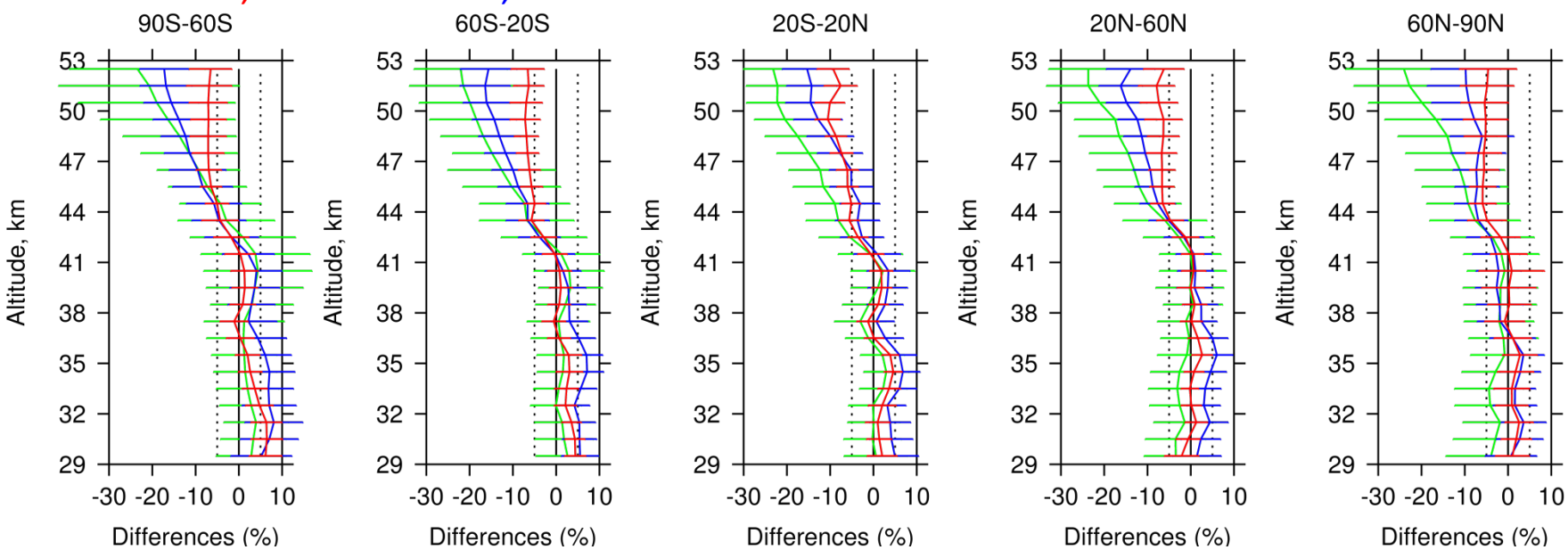
Overview of uncertainties in OMPS LP O3 retrievals [%]

Altitude [km]	Vertical res. [km]	Precision	TH error ±200 m	Drift in TH ~80m RSAS [%/yr]	Syst. error in measure ments	Backgrou nd aerosol effect
<15km	~2.0-6.0	~10-50	~5-10	~0.4-0.8	±3	??10-60
20 km	~1.6-2.8	6-10	~10	~0.8	±3	5
25 km	~1.7-2.2	5-8	~0	~0	±3	-
30 km	~1.8-2.8	6-9	~2	~0.16	±3	~<1
35 km	~2.2-3.0	7-10	~5	~0.4	±3	n/a
40 km	~1.6-2.0	6-8	~5	~0.4	±3	n/a
45 km	~1.5-1.8	6-7	~5	~0.4	±3	n/a
50 km	~2.2-3.0	8-12	~5	~0.4	±3	n/a

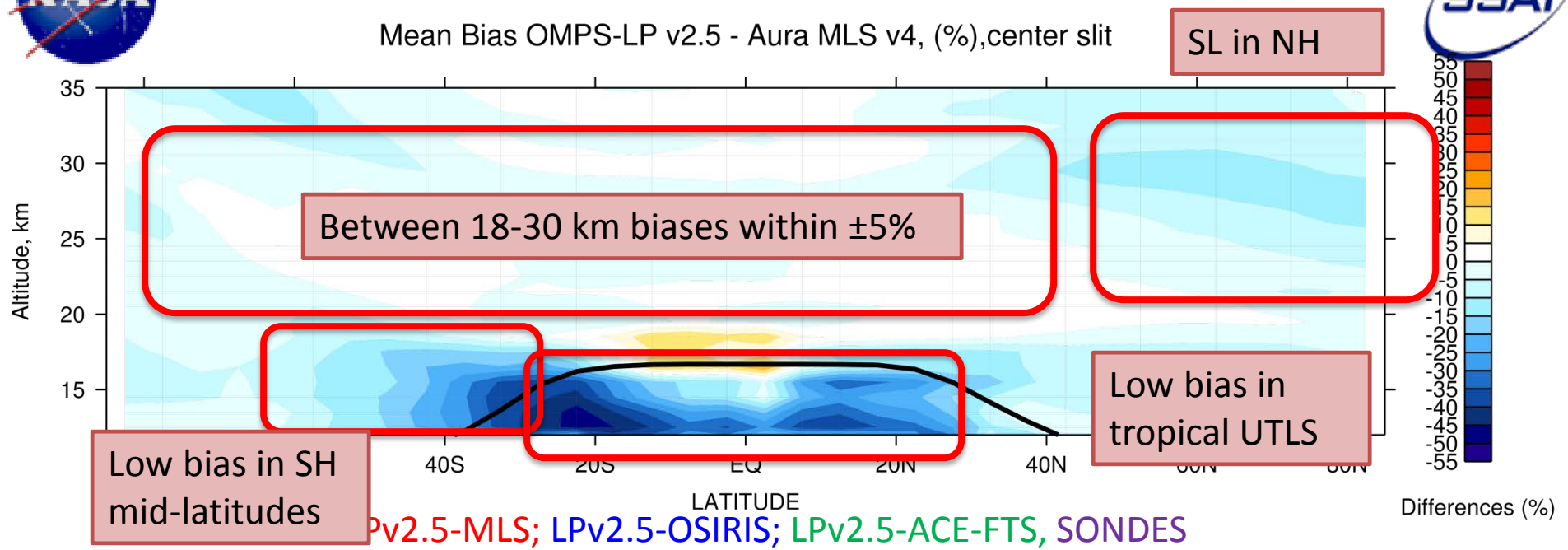
Mean Biases UV

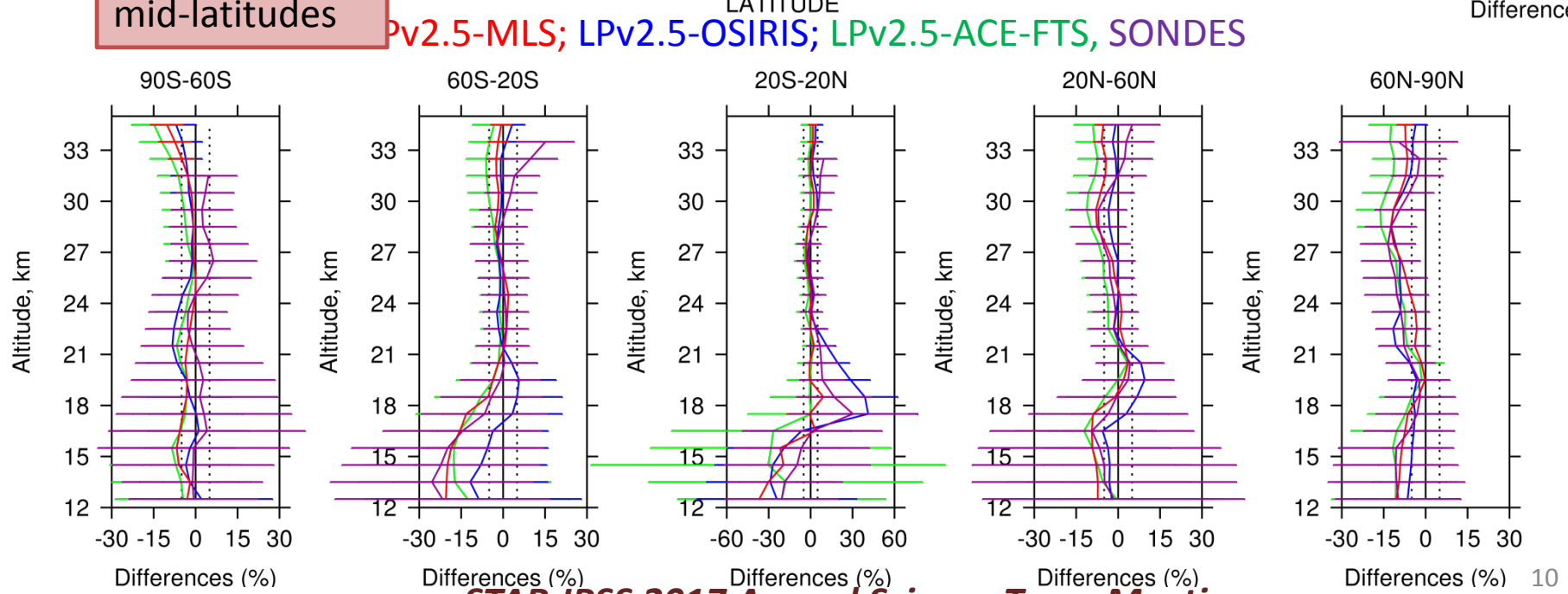


LPv2.5-MLS; LPv2.5-OSIRIS; LPv2.5-ACE

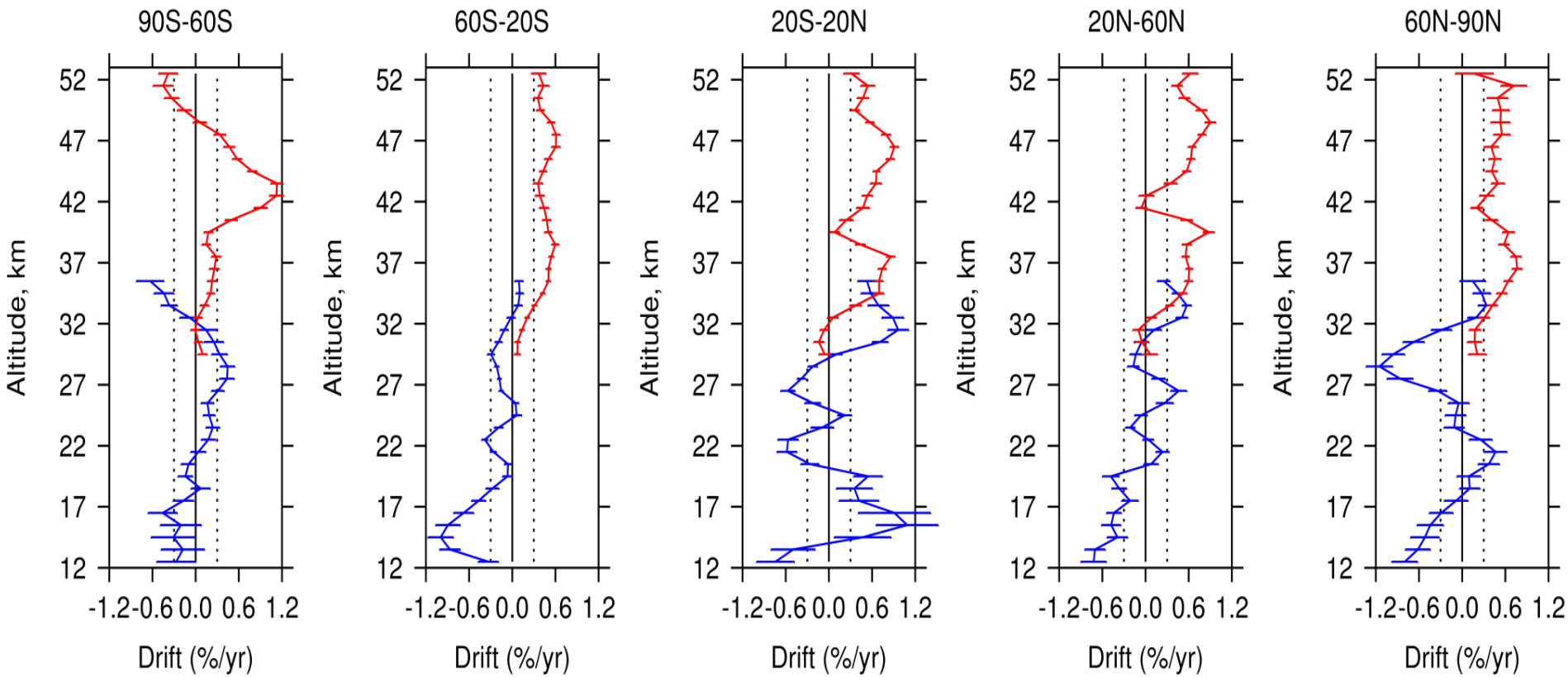


Mean Biases VIS





Relative drift against Aura MLS



UV LPv2.5, **VIS LPv2.5**

Conclusions

Systematic errors in LP version 2.5 (internal analysis):

- ✓ absolute sensor pointing error ±200 m (~5% above 35 km);
- ✓ quasi-random measurement errors (±3% everywhere);
- ✓ background aerosol (expected to be small after the explicit corrections in v2.5);
- ✓ drift in sensor pointing ~80m over 5 years (~0.4%/yr).

Comparisons with correlative satellite measurements:

OMPS LP v2.5 UV:

- within ±5% with Aura MLS, ACE-FTS and OSIRIS between 30-42 km;
- above 43 km bias of -6% – -12%, within quoted uncertainties for LP/MLS;

OMPS LP v2.5 VIS:

- within ±5% between 20 and 30 km, except for high NH latitudes where differences are larger due to instrumental errors;
- ~-15% differences in the SH mid-latitudes (20S-60S) below 18 km;
- ~-30% differences in the tropical UTLS;

Absolute TH registration: comparisons with correlative satellite instruments did not reveal patterns in O3 biases consistent with the TH shift.

Drift in TH registration: drift in O3 relative to MLS and OMPS NP ~0.5%/yr (or 2.5% over 5 years) at altitudes above 35 km. The pattern is consistent with the detected 80-meter drift in TH.