OMPS LP Altitude Registration Methodology and Key Results

OMPS Science Team Meeting
July 29, 2015

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Outline of Talk:

Methodology

- Slit edge method- provides only internal errors
- RSAS- provides total error but only over Antarctica
- 305 nm remainders- provides errors relative to RSAS – gives variations with time and latitude

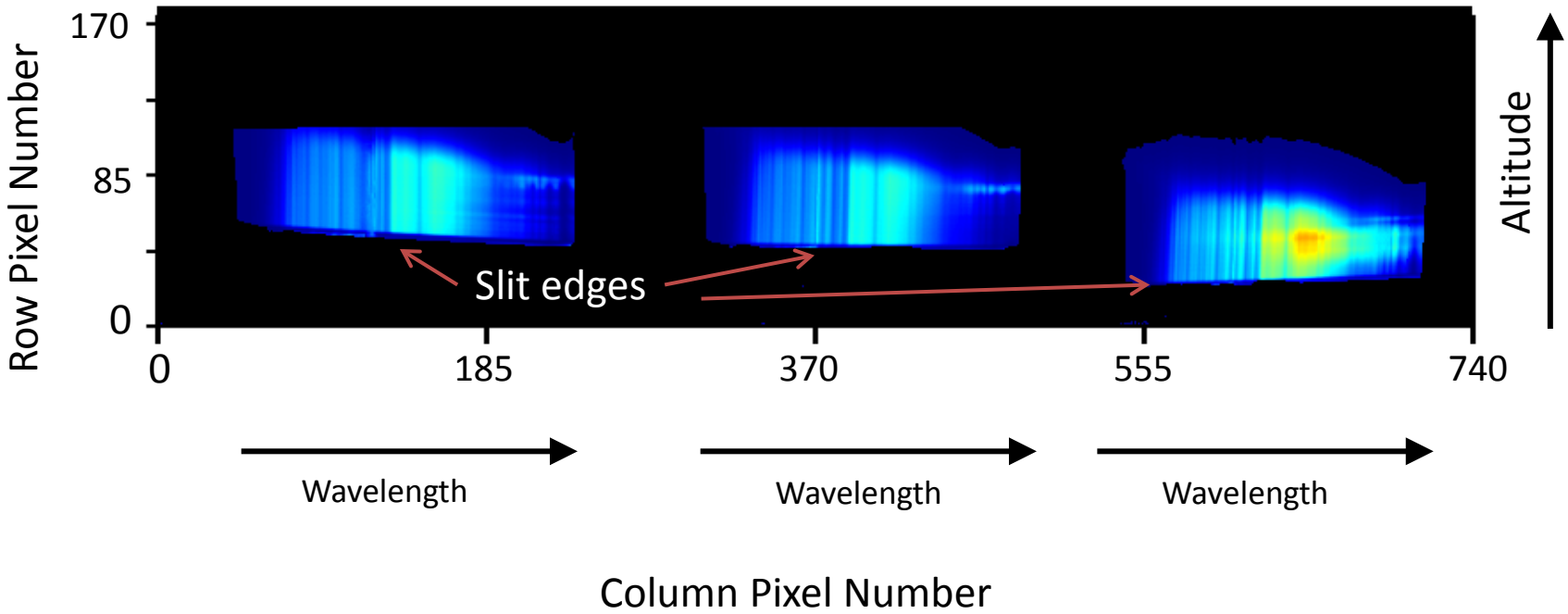
Results

OMPS LP ozone with and without TH correction compared with MLS, ACE, Lidar

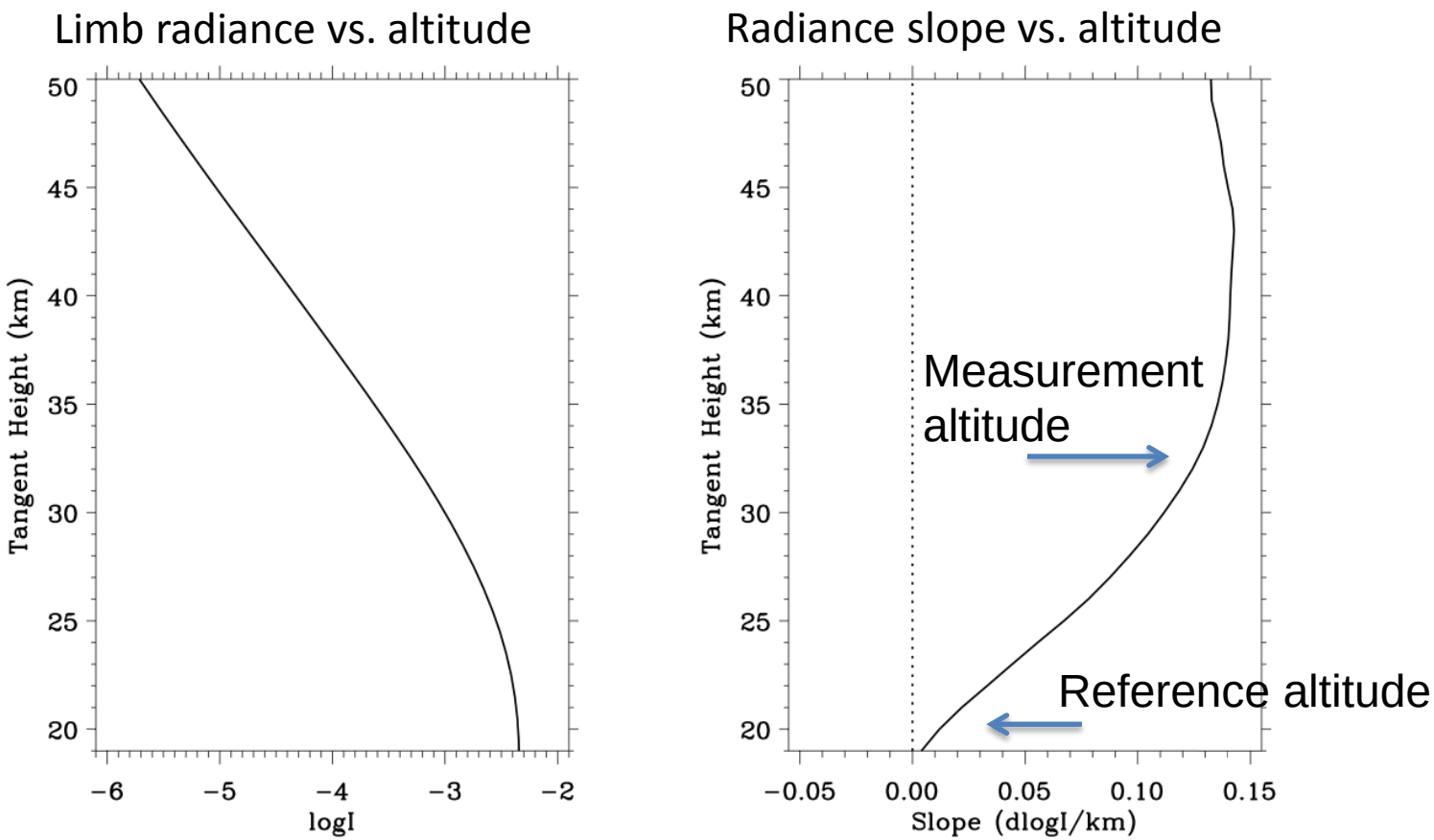
Summary

OMPS LP CCD high gain earth viewing radiance images for the 3 slits.

Slit edge method: location changes indicate **internal errors**.
A 1 pixel shift corresponds to a 965 m TH shift.



RSAS method uses 350 nm Radiances at 32 and 20 km



- 32 km radiance varies by ~12%/km
- 20 km radiance is ~1% / km

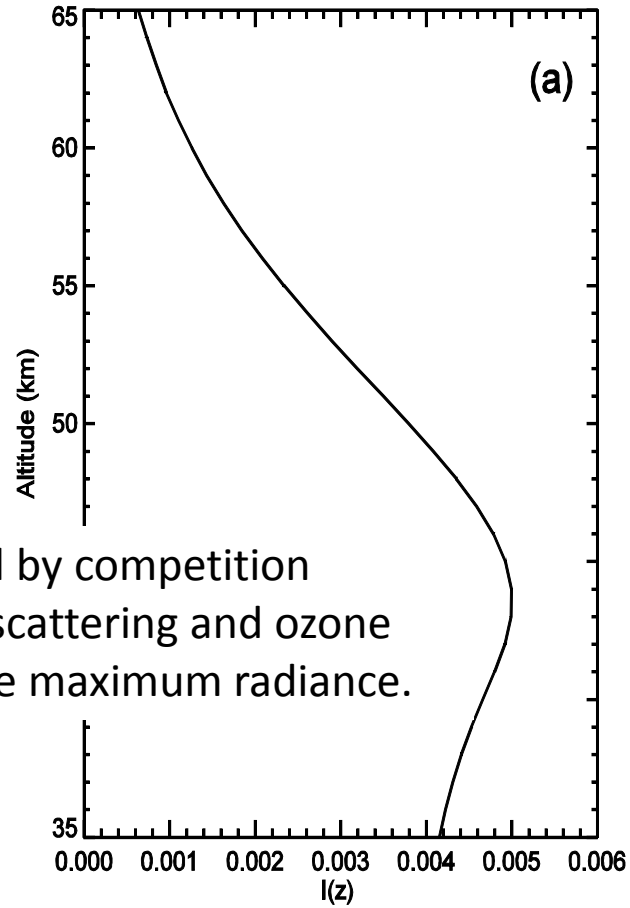
} *Use of ratio reduces influence of calibration errors*

- Compare measured and calculated radiance ratios
- Affected by stratospheric aerosols.

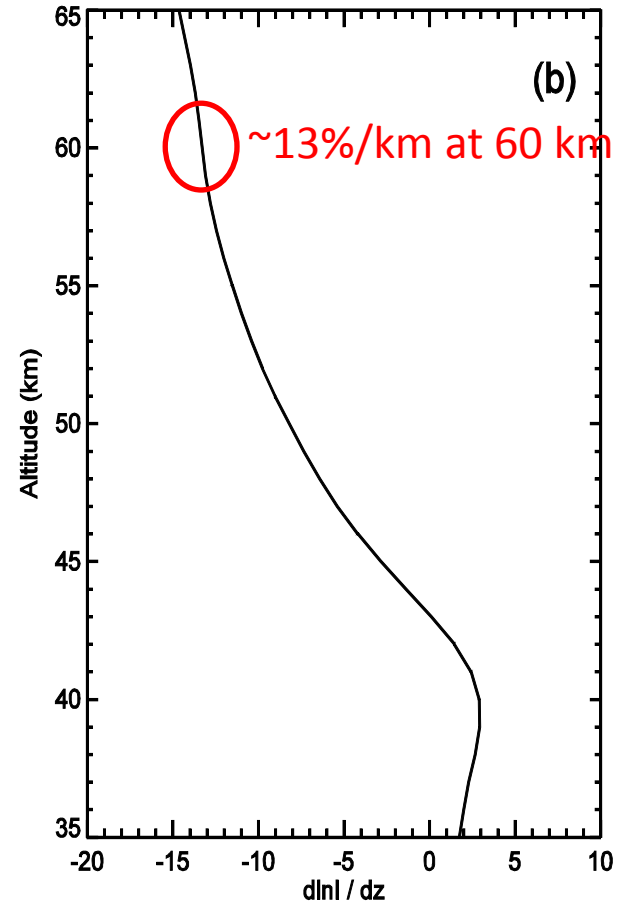
New Method: 305 nm Residuals at 60 km

* above 55 km the sensitivity is nearly constant in height (~13%/km)
* constrained above by stray light
* constrained below by less sensitivity, ozone absorption, aerosols

Calculated 305nm Radiances assuming no aerosols.



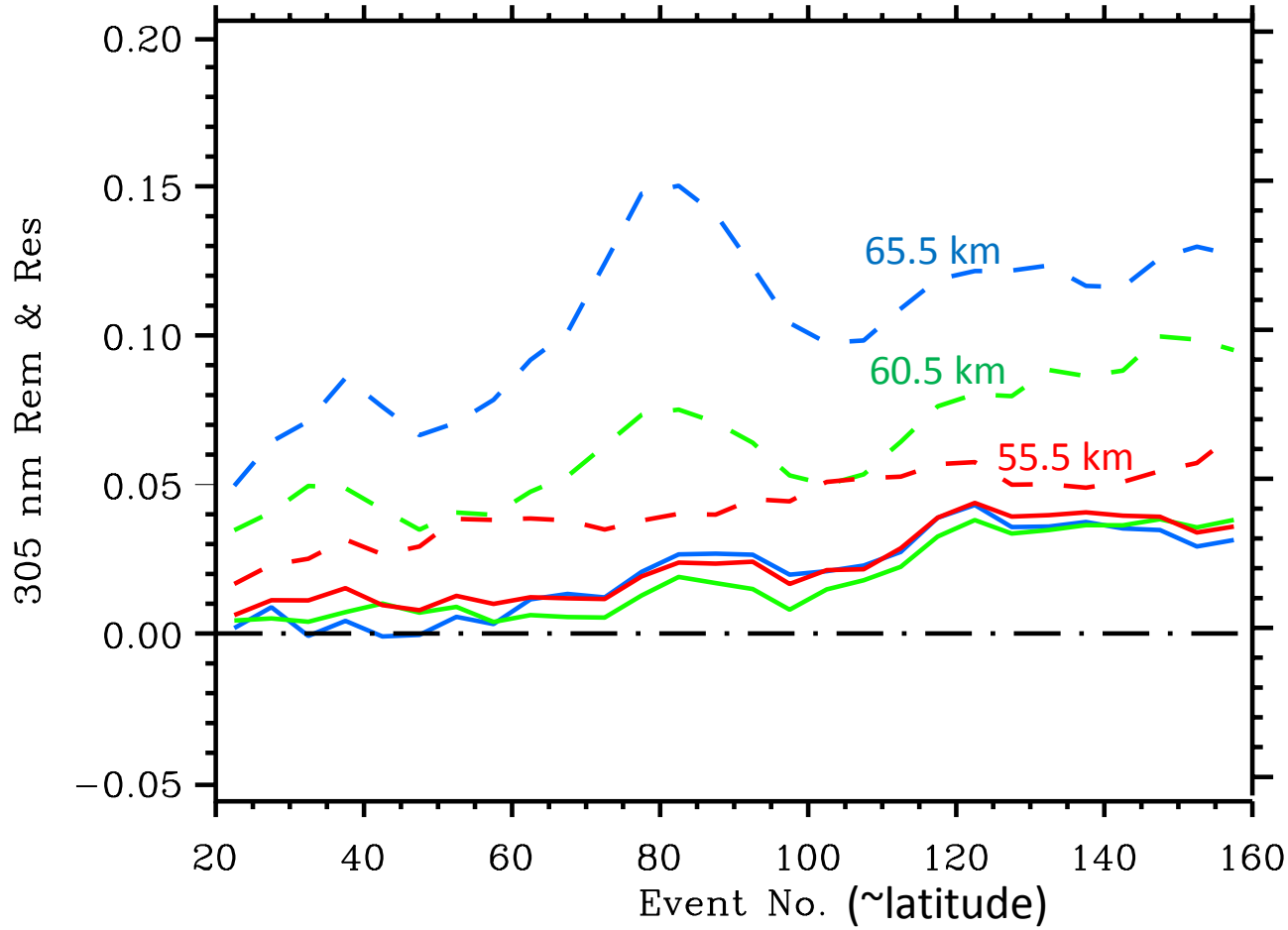
Gradient dln Ic / dz



The slope is caused by competition between Rayleigh scattering and ozone absorption near the maximum radiance.

Typical orbit of 305 nm residuals (dashed lines) and remainder values (solid lines).
The additional terms removes some errors from calibration, stray light, GPH assumptions.

$$Remainder = Res(305nm, 60km) - [Res(350nm, 60km) - Res(350nm, 40km)]$$



latitudinal dependence in the residual is greatly reduced in the remainders at all altitudes

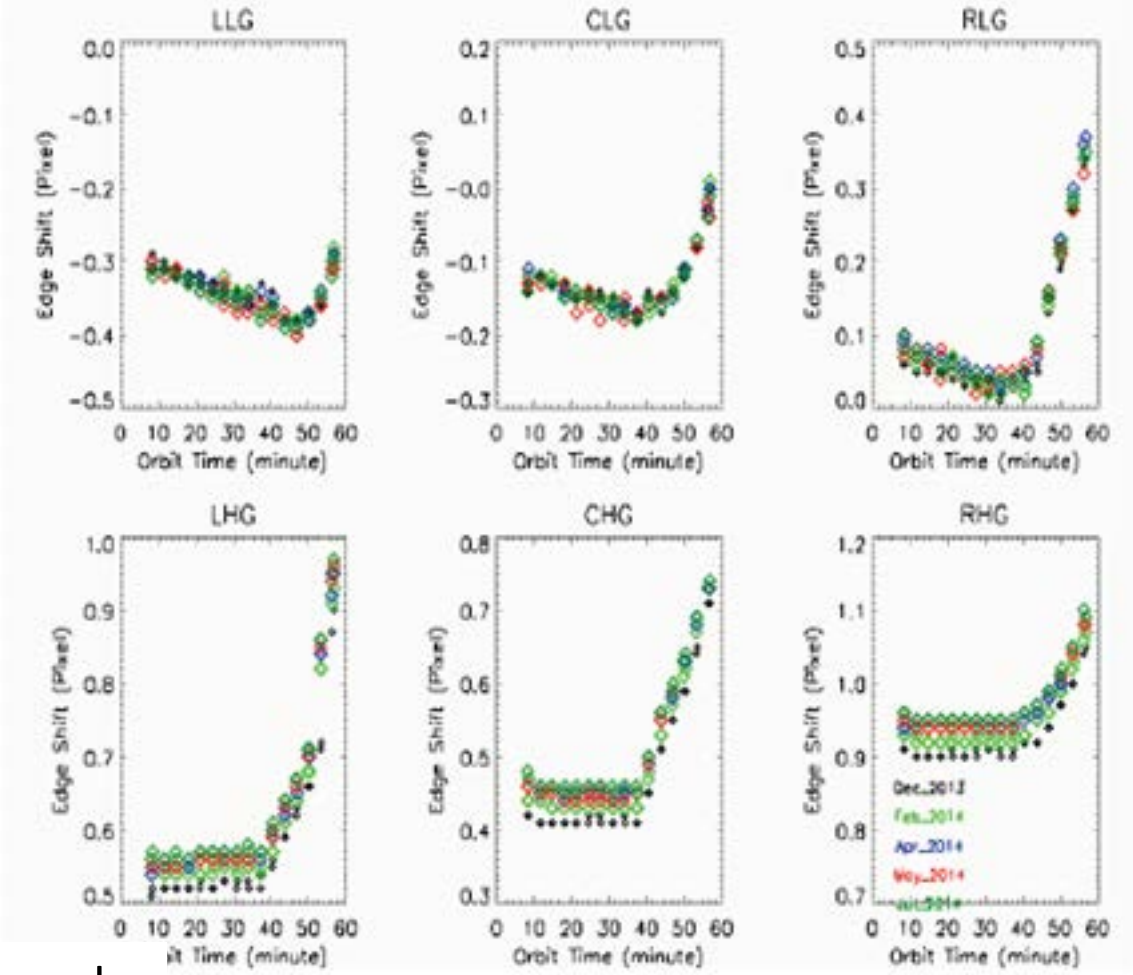
RESULTS: RSAS

- Shortly after launch a significant pointing error found
- RSAS results include internal and external errors

RSAS results in km

	Left	Center Slit	Right
Low Gain	1.0	1.4	1.7
High Gain	1.8	1.9	2.5

RESULTS: Slit edge



Slit Edge Offset, Internal errors only

	L	C	R
Low Gain	-0.30	-0.10	0.10
High Gain	0.55	0.45	0.95

Slit edge results for each of three slits/ 2 gains

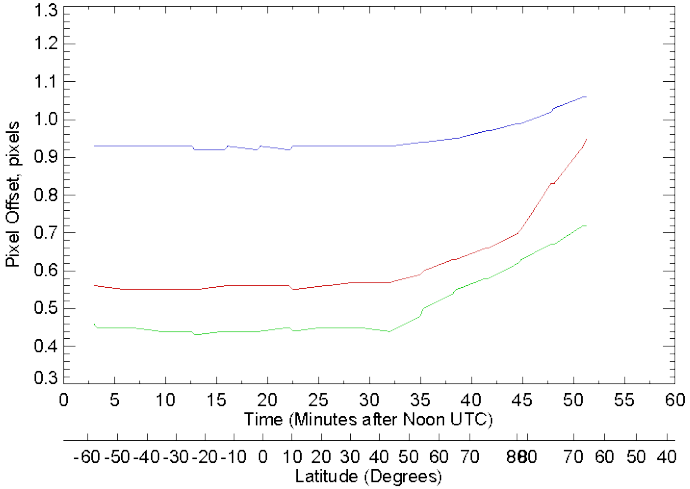
RSAS results (external,internal errors)

	Left	Center	Right
Low Gain	1.0	1.4	1.7
High Gain	1.8	1.9	2.5

Slit Edge results (internal errors)

	L	C	R
Low Gain	-0.30	-0.10	0.10
High Gain	0.55	0.45	0.95

Slit Edge results - orbital dependence



external errors = RSAS results - Slit Edge offsets

	Left	Center	Right
Low Gain	1.3	1.5	1.6
High Gain	1.2	1.4	1.5

Offset + thermal orbital corrections applied to V2.
Next slides evaluate errors <u>after</u> these corrections was applied

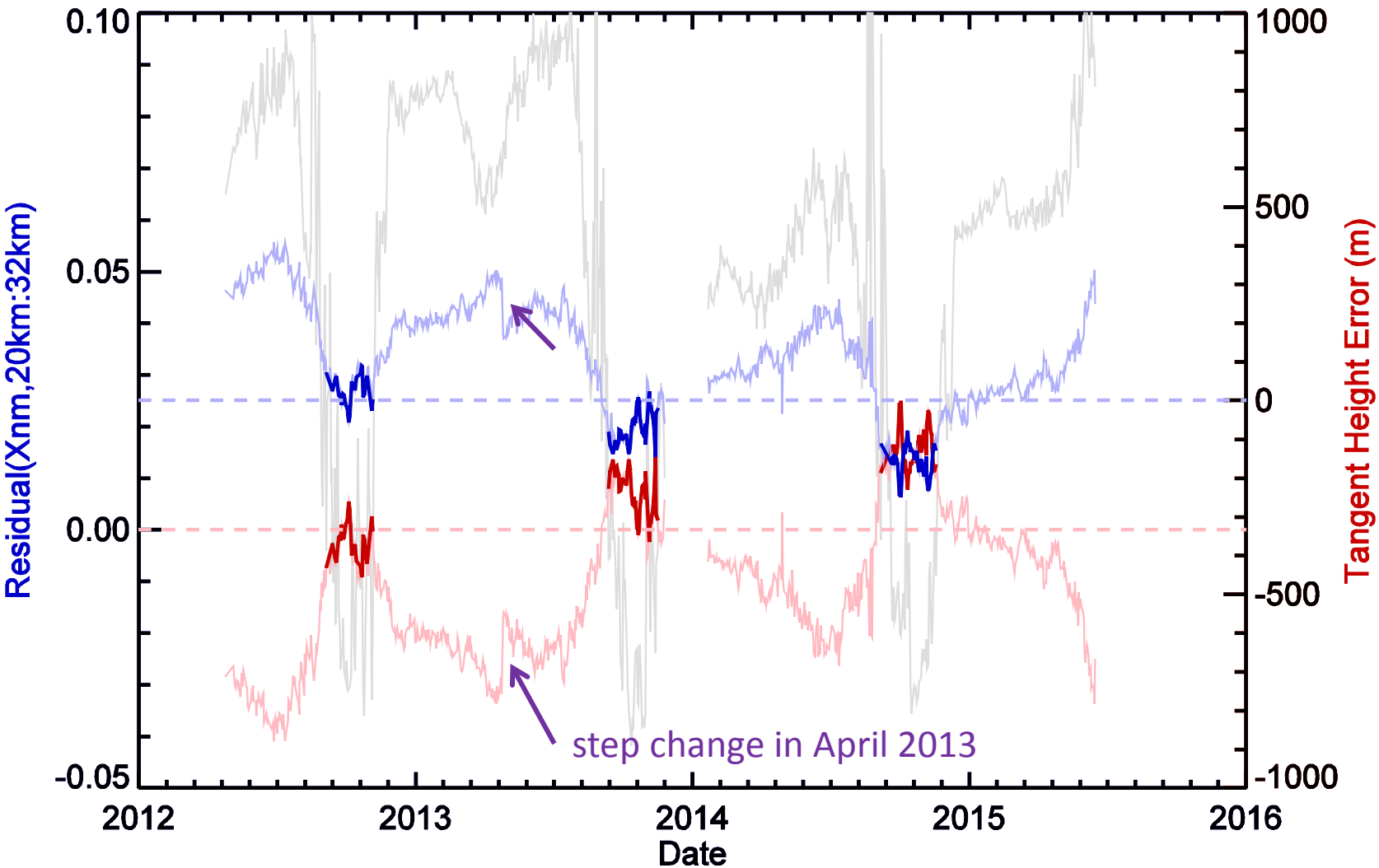
Updated RSAS: time series from measurements closest to the South Pole.

On 28 April 2013, the SNPP spacecraft began using two star trackers in its attitude solution.

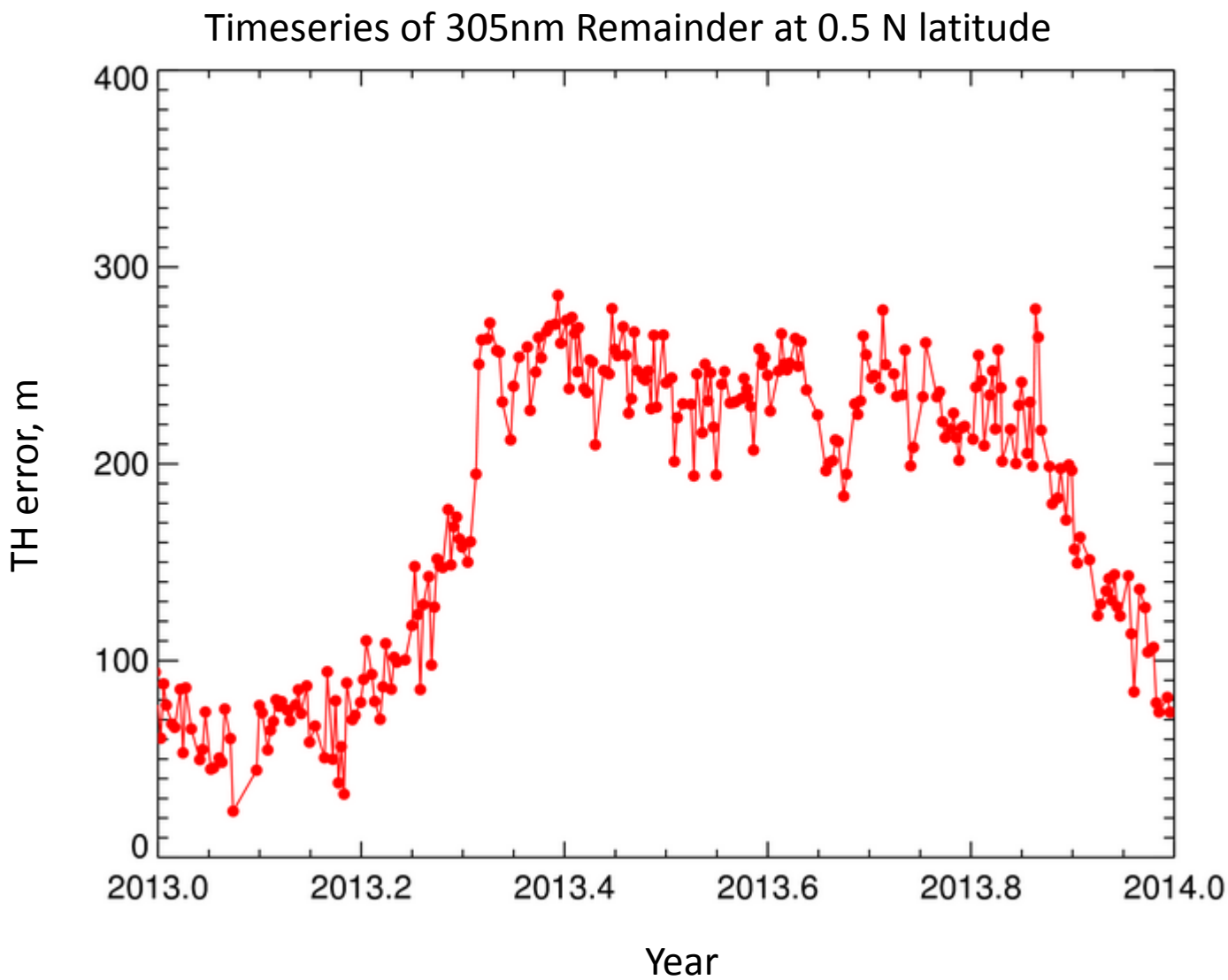
6 arcsec ~= TH change of ~100m

TH error - Sept/Oct results are the least contaminated by aerosols

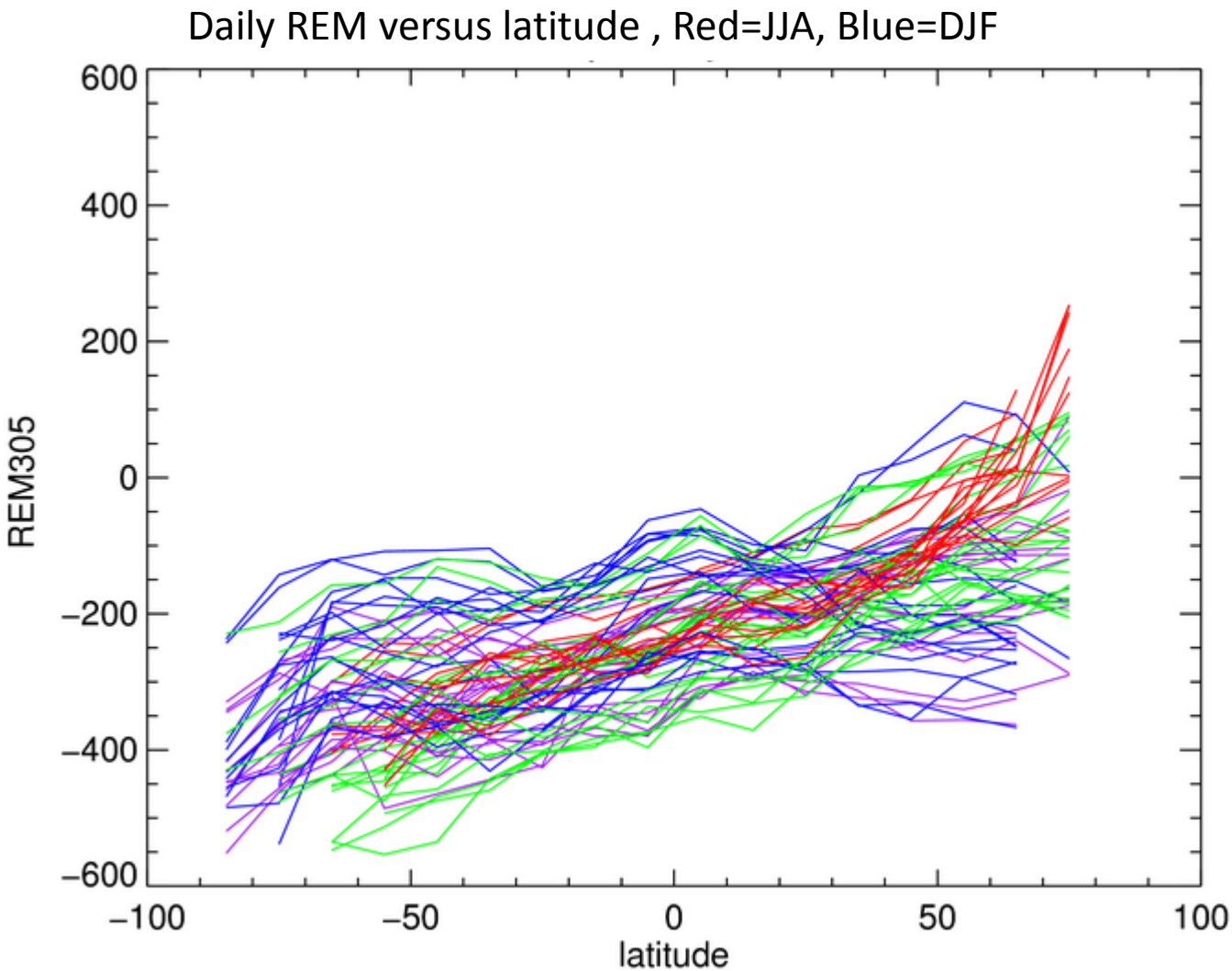
Grey- 675nm residuals to measure aerosol



305 nm Remainder Results – confirms the star tracker change on April 28, 2013



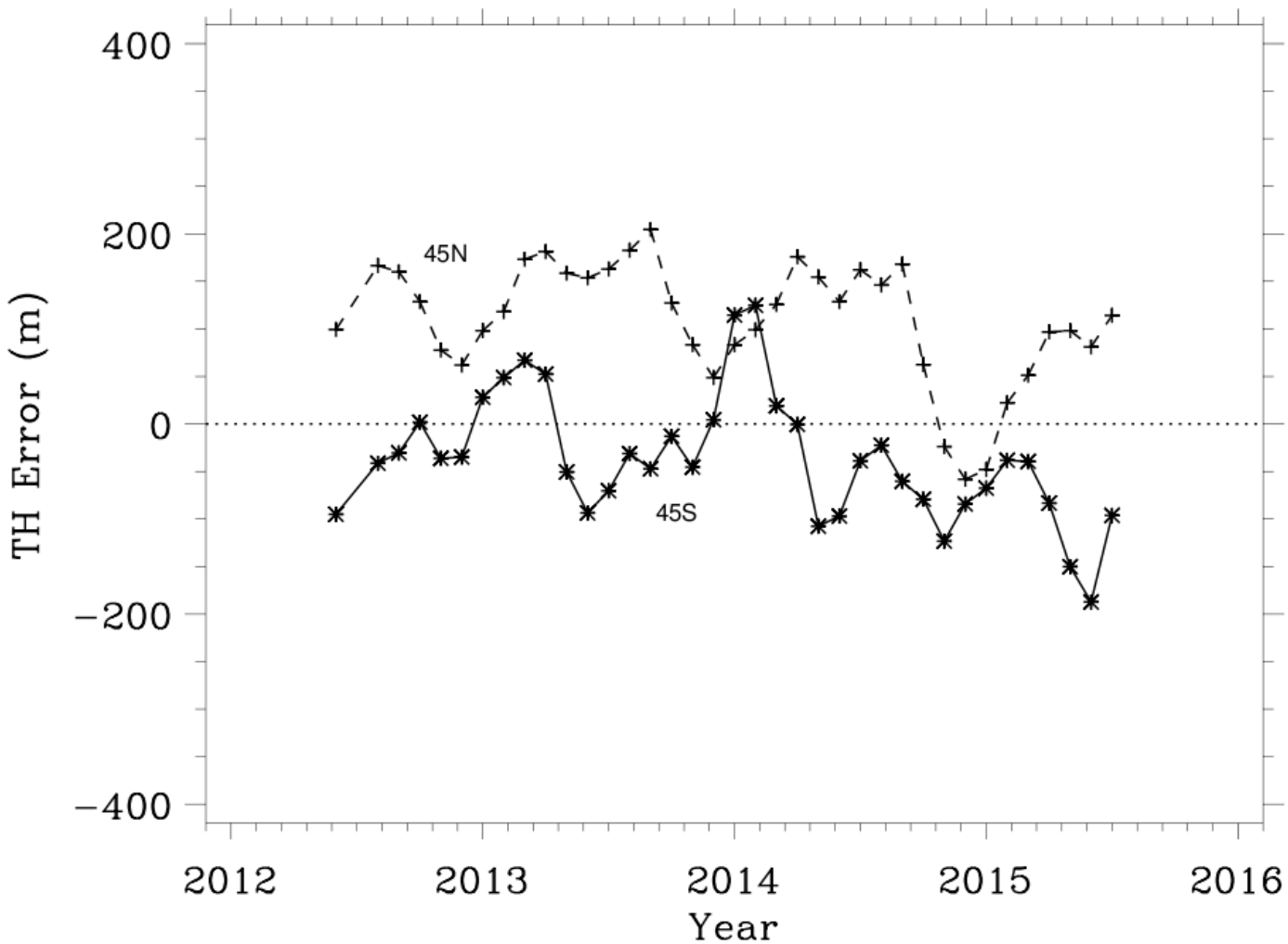
305 nm Remainder Results v latitude



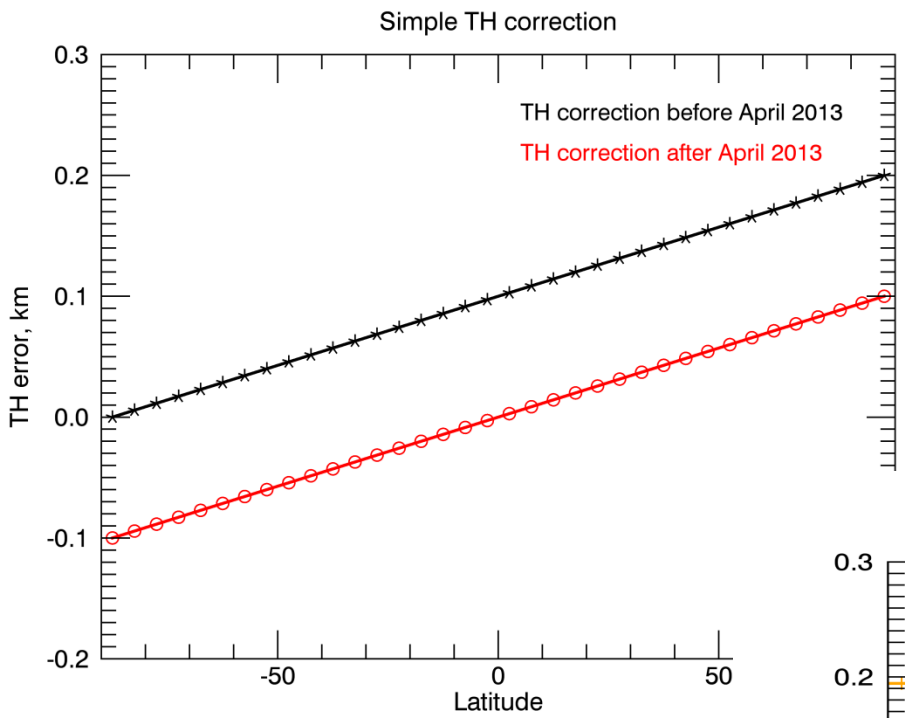
305nm remainder results at 45S and 45N

While the latitude dependence appears to be due to variation in TH error with latitude, we do not yet know if the time dependence is caused by error in GMAO GPH (near 3 hPa) or LP TH error or some combination of the two.

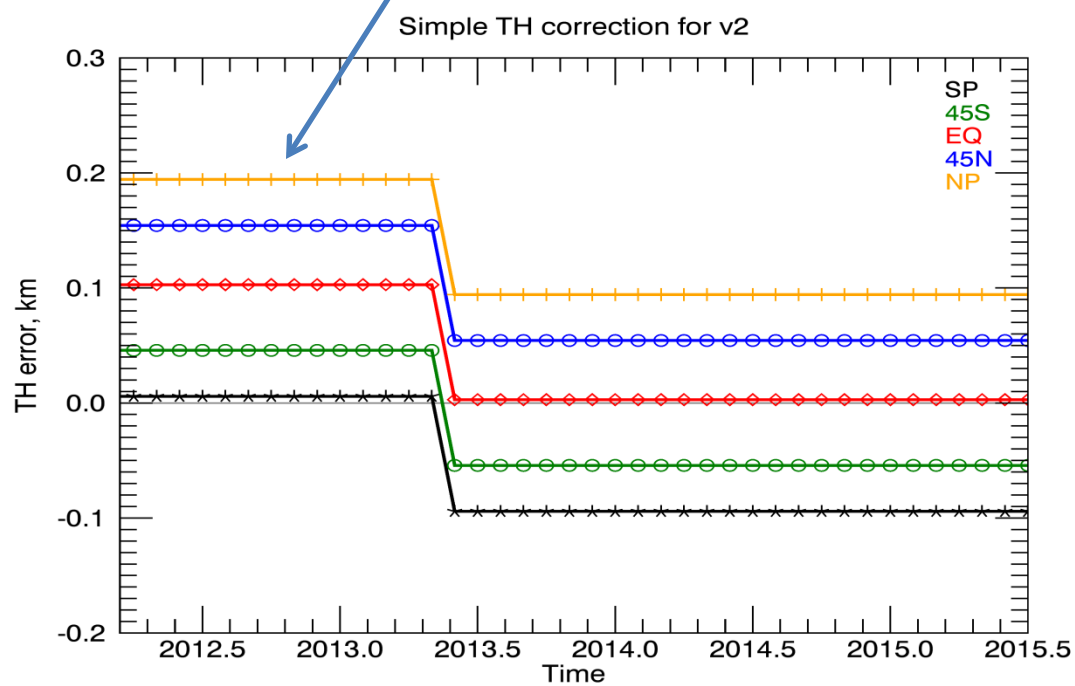
It will take more work to figure this out, given that the errors are quite small (+/- 150 m).



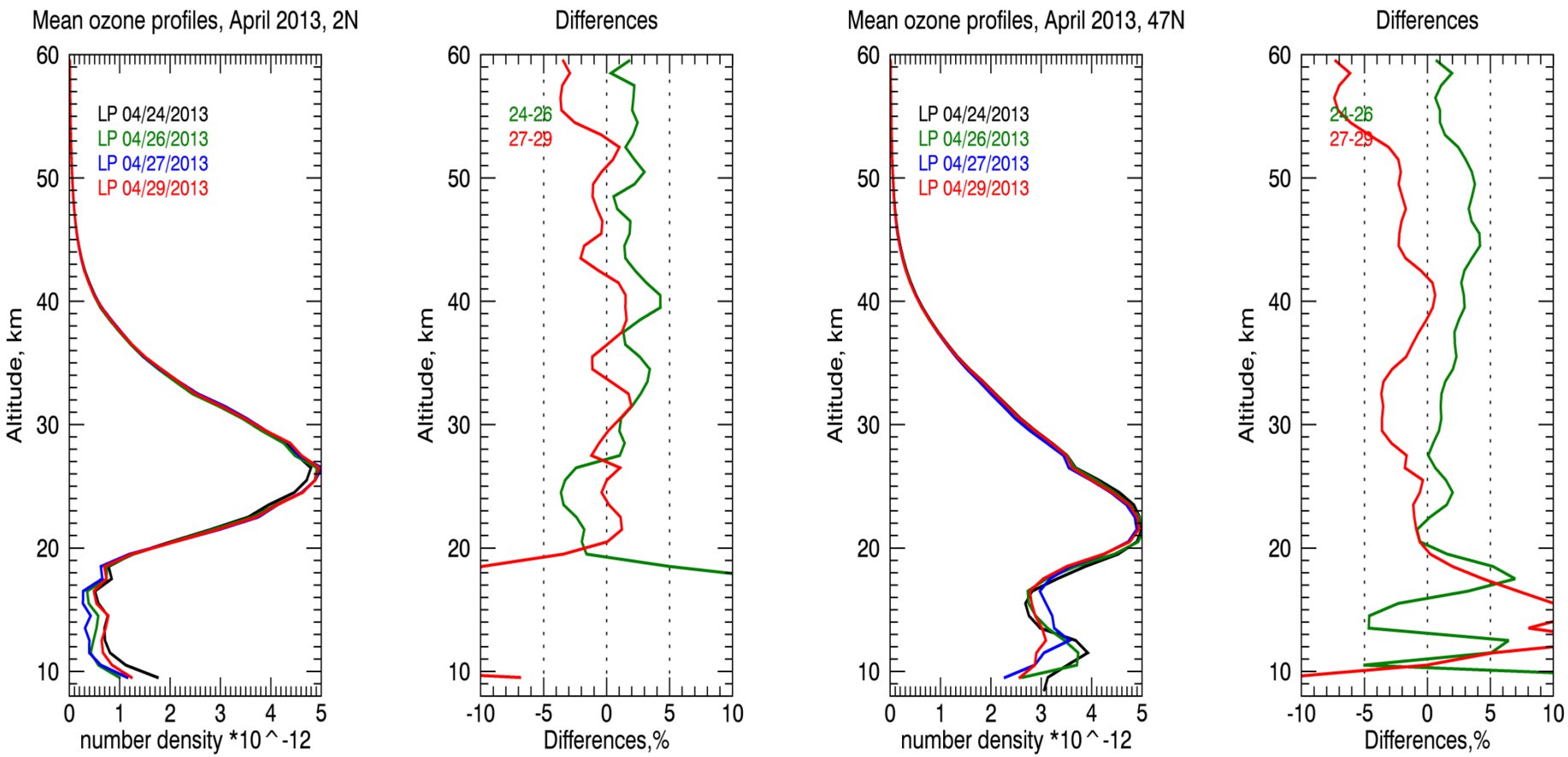
Simple TH correction



Largest TH change for equatorial (100m) and northern latitudes (150-200m) occurs in period from April 2012-April 2013

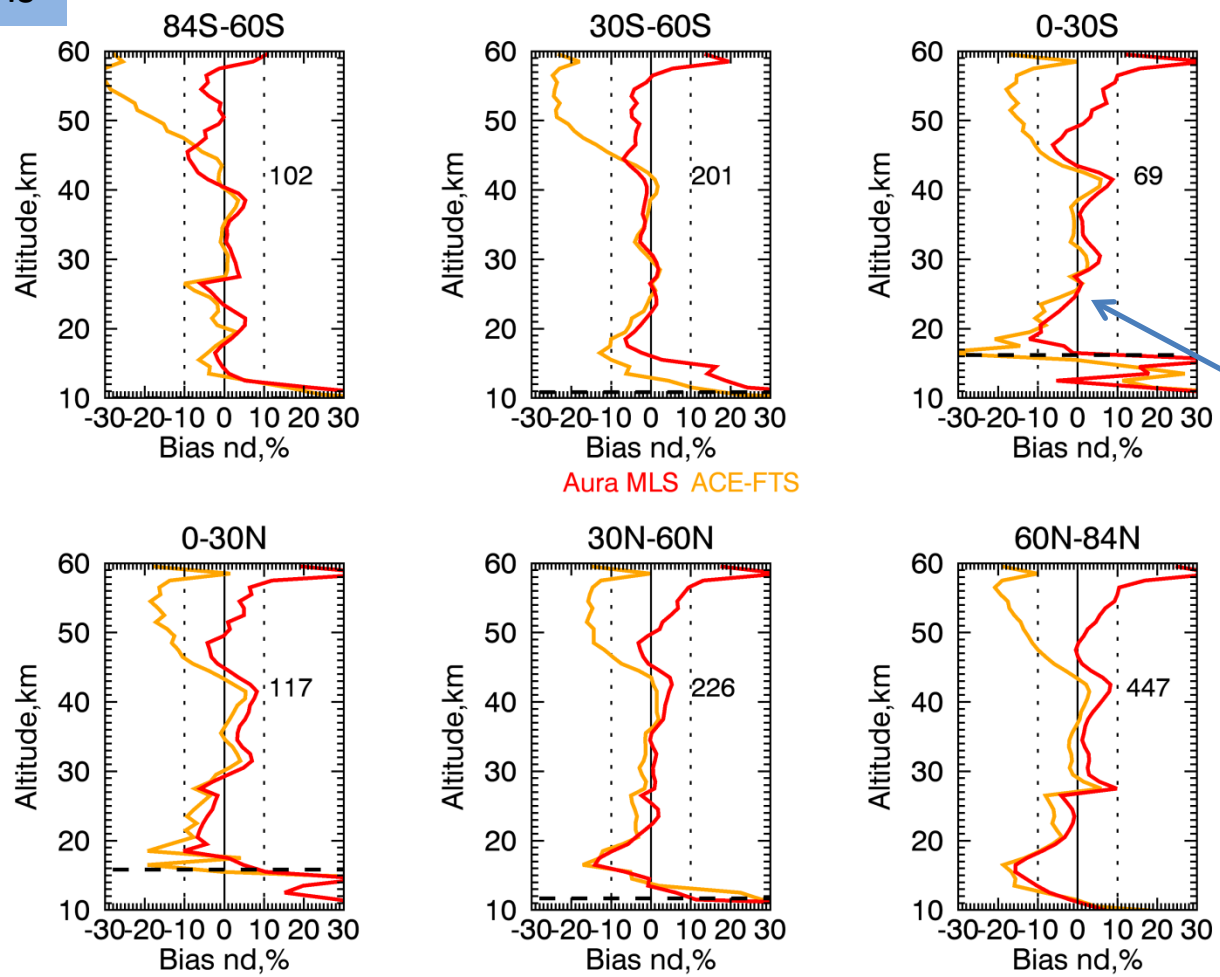


Comparison before and after April 2013 step change



Biases between LP and MLS/ACE 2012

No TH corrections



Note this slope in biases: indication of TH error

Biases between LP and MLS/ACE 2012

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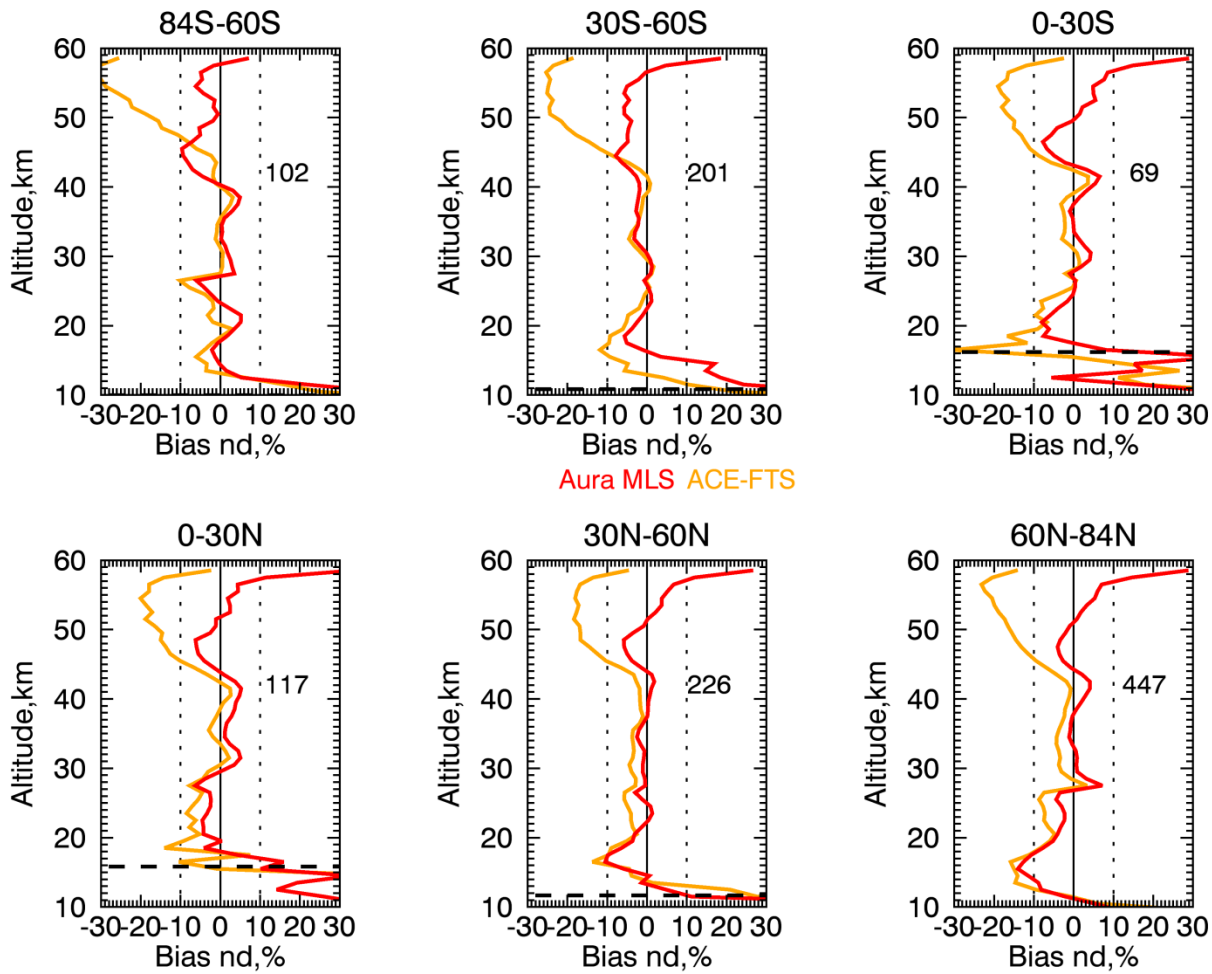
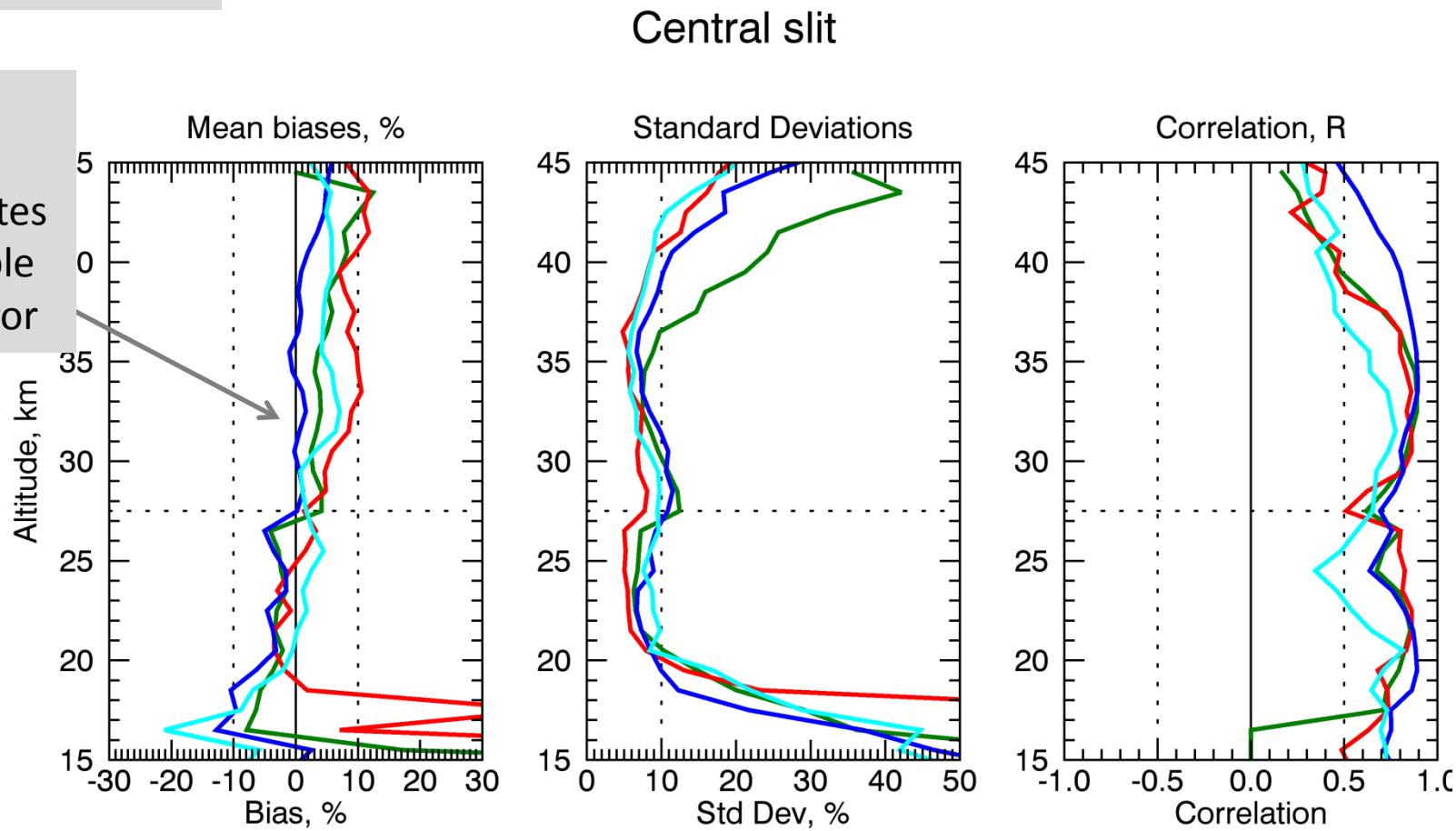


Visible improvement (slope decreases) everywhere between 60S and 82N

OMPS LP v2 against lidar

No TH correction

This slope indicates possible TH error



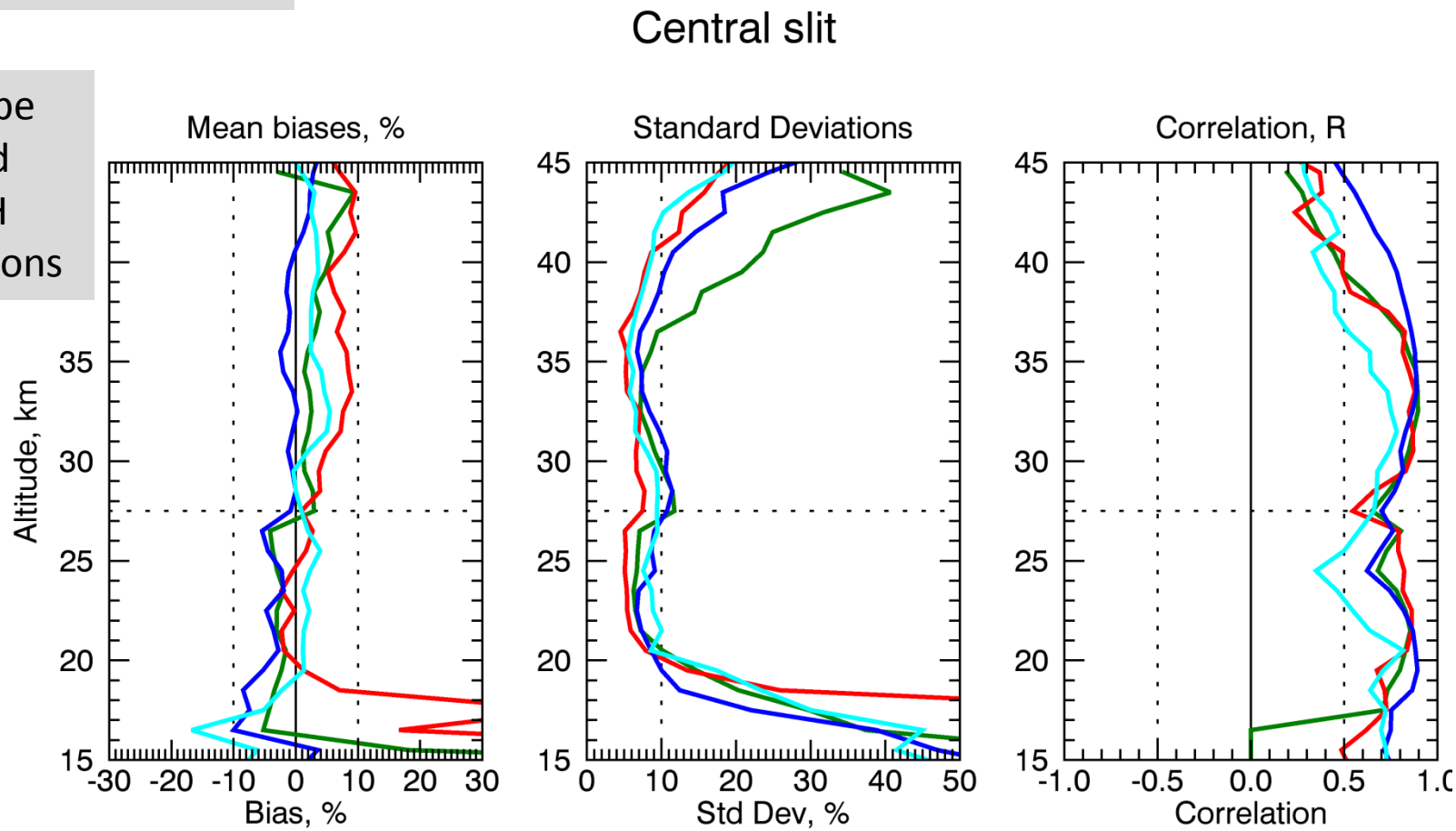
OHP 297 MLO 122 HOH 169 TBL 81

OHP - Haute Provence [44N, 6E], time period Apr2012- March 2014
MLO -Mauna Loa [20N, 156W], Apr2012- Aug 2013
HOH- Hohenpeissenberg [48N, 11E] Apr2012- March 2014
TBL -Table Mountain [35N,118W] Apr 2012 - Aug 2013

OMPS LP v2 against lidar

Simple TH correction

The slope reduced after TH corrections



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Summary of TH error results:

Large offset in TH (~1.5km) found soon after launch by the RSAS technique that have been ascribed to pitch and roll errors in s/c attitude. (in Version 2)

Thermal shifts in LP focal plane are latitude dependent found by Slit Edge method. (in Version 2)

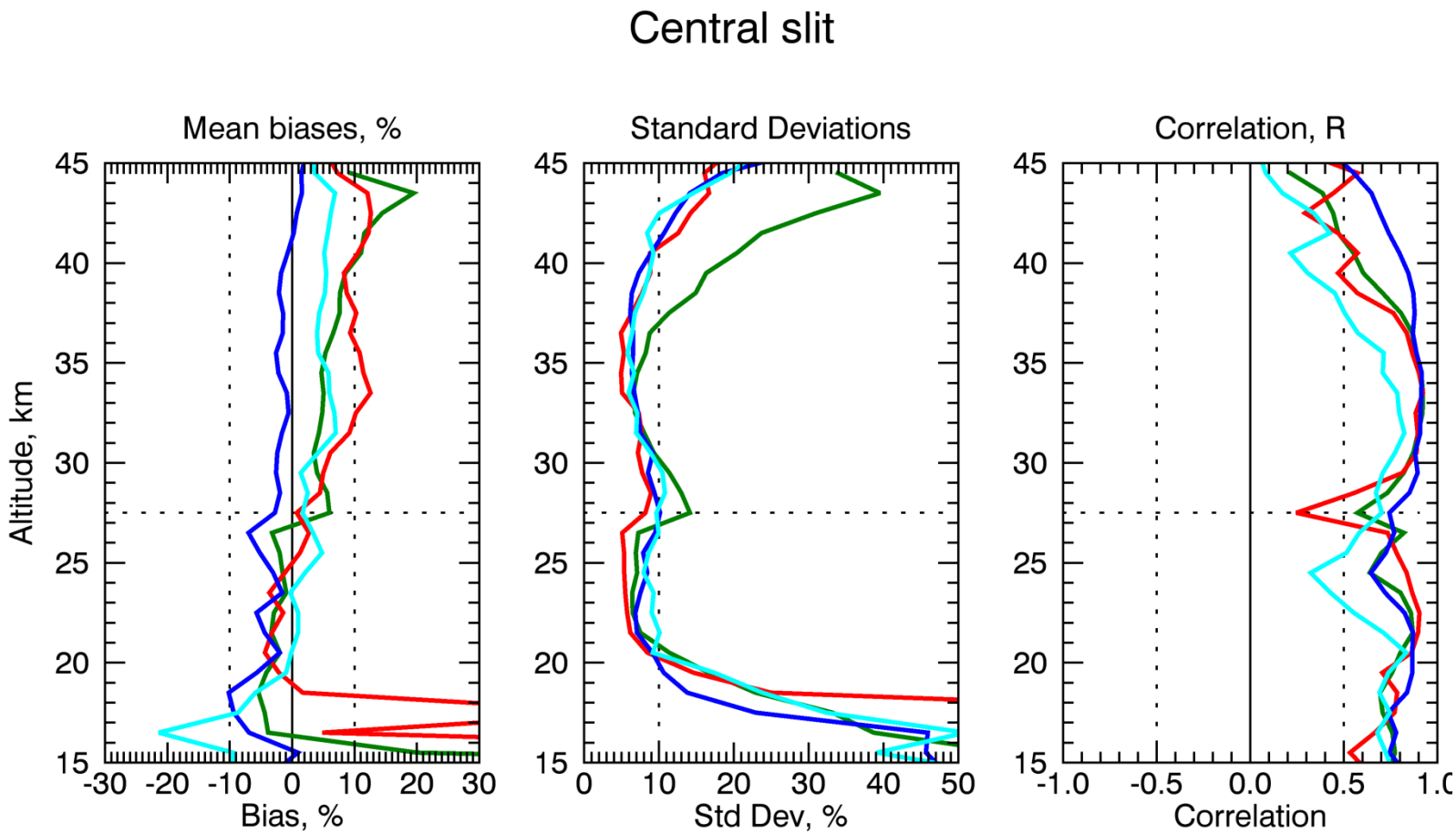
305 nm Remainder method found a 100 m shift in s/c attitude when the second star tracker was turned on April 28, 2013.

Indication of +200/300 m TH error varying in latitude based on 305 nm remainders but is not always present.

Evidence of seasonal variation in either TH error or in GMAO pressure based on 305 nm remainders. Both errors affect LP ozone mixing ratio, so one cannot separate between the two by LP/MLS comparison. (further investigation needed)

OMPS LP v2 against lidars

No TH correction,
Apr 2012-Mar 2013



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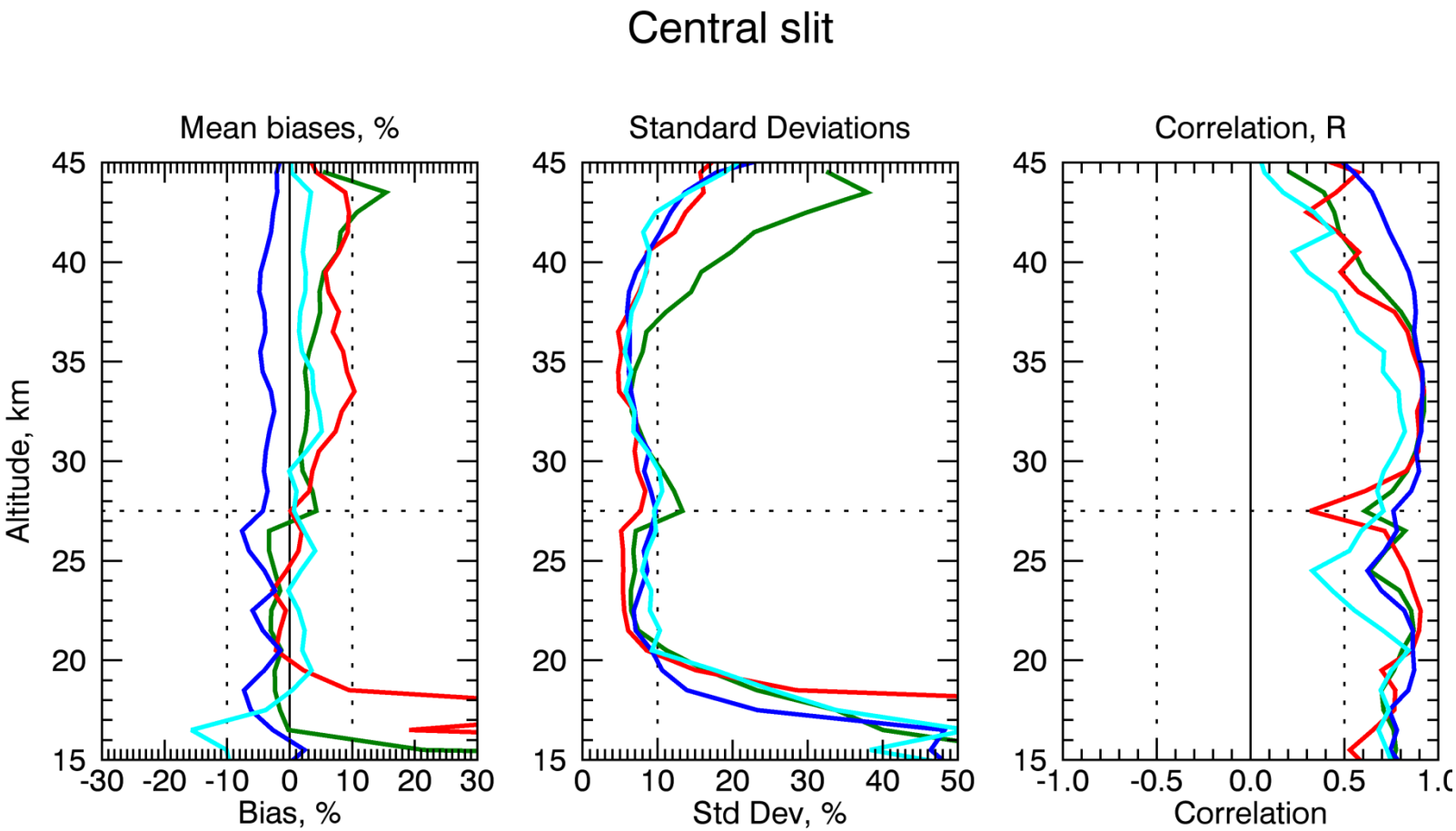
OMPS LP v2 against lidars

Simple TH correction,
Apr 2012- Mar 2013



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