Highlights of First Year of Data From the OMPS-Limb Instrument on Suomi/NPP Satellite

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Status

- L1/L2 data released on Oct, 1, 2012
  - Ozone from central slit only, no aerosols
  - Tangent heights of large aperture image was lowered by 1.35 km (no dynamic corrn).
- Issues with Release 1 Data
  - ~0.6 nm λ error @ 310 nm, varies with λ (contact matthew.deland@ssaihq.com for recent updates and impact on O_3 profile)
  - Small and large aperture (aka high gain/low gain) images do not match well.

Study presented in this talk is designed to plan future releases

Radiance Study Objectives

- Find causes of large radiance residuals from the L2 algorithm.
- Improve altitude registration methods.
- Isolate systematic errors in measured and calculated radiances.
- Evaluate accuracy of MLS and NCEP GPH profiles.
- Better understand information content of measurements.

Radiance Analysis Methodology

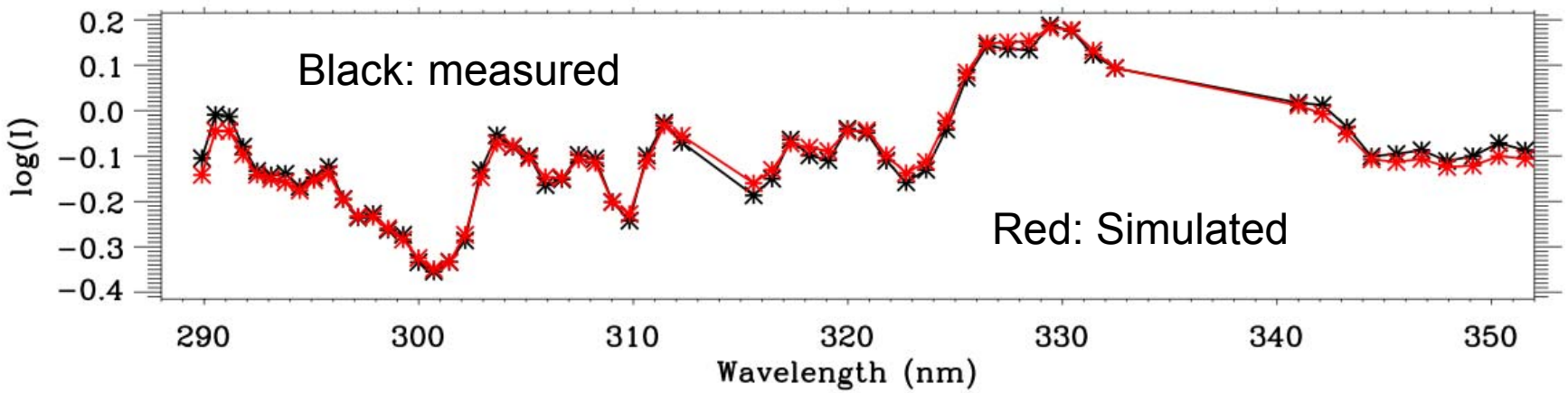
- Radiance Simulation
  - Bass & Paur cross-sections
  - Atlas SUSIM solar irradiance adj using OMPS data
  - Scalar radiative xfer code
  - MLS O_3, temp and GPH profiles
  - OMPS-NP reflectivity
  - NO_2 from climatology. No aerosols
- Data Analyzed
  - Ungridded, λ-corrected, UV (290-350 nm) radiances from large aperture (high gain) images only.
  - April, 2012 only

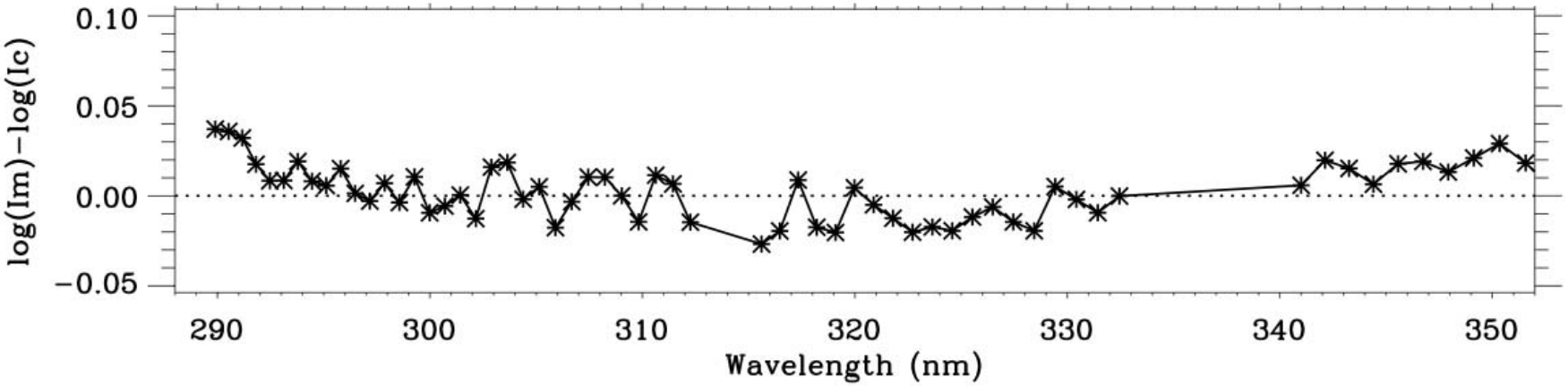
Large Radiance residuals
Primary Causes

- Wavelength error
- Error in solar irradiance spectrum assumed in calculating radiances in L2 S/W
  - No impact on O_3 profiles, since they are retrieved using altitude-normalized radiances, but produces residuals.
- T and GPH profiles in upper strat & mesosphere are not of high quality
  - Doesn't impact O_3 density vs alt profiles, but produces residuals, and impacts MR vs press profiles

Top 2 items will be fixed in next release. In future releases radiance residuals in UV may be used to improve NCEP T/GPH profiles.

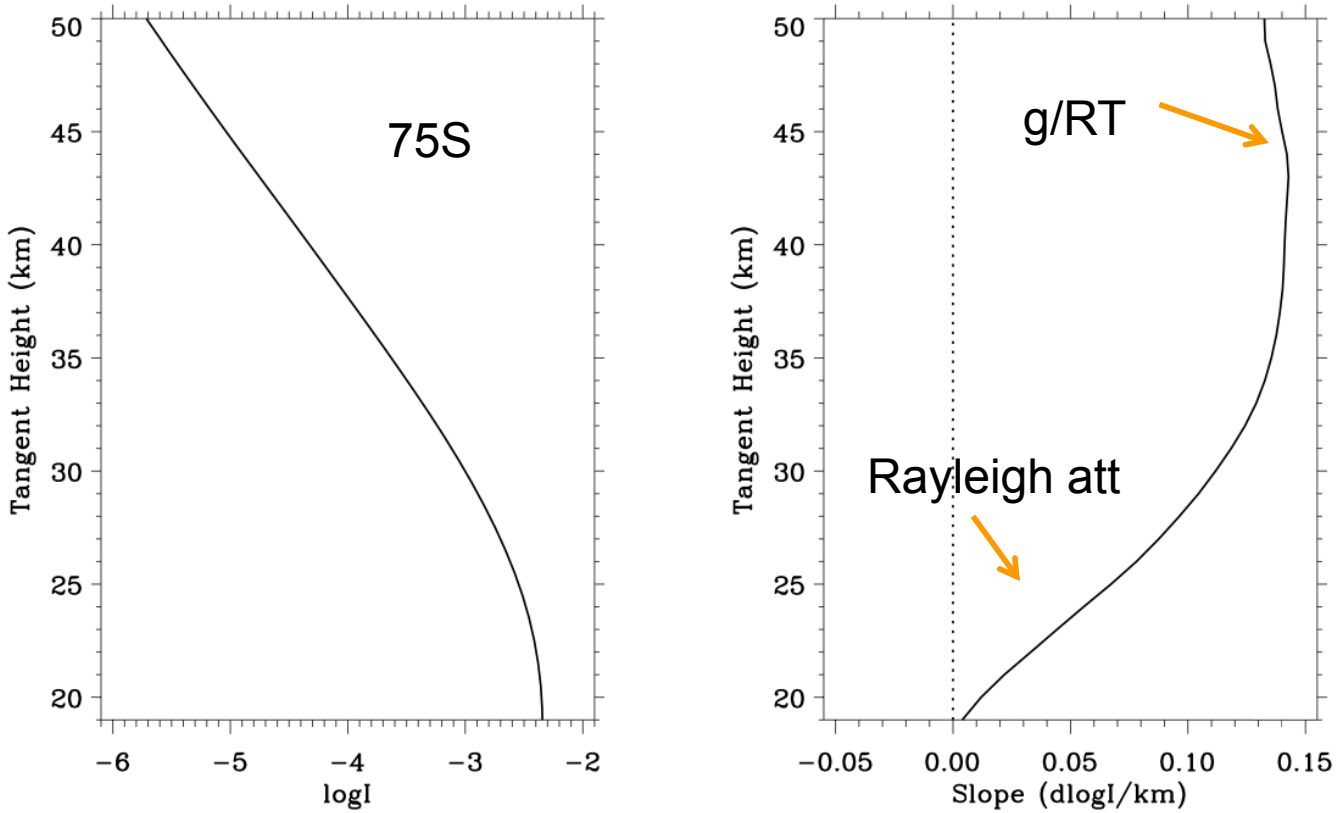
Meas/Calc Rad Comp 75S, 59.5 km





Altitude Reg. using 350 nm Radiances

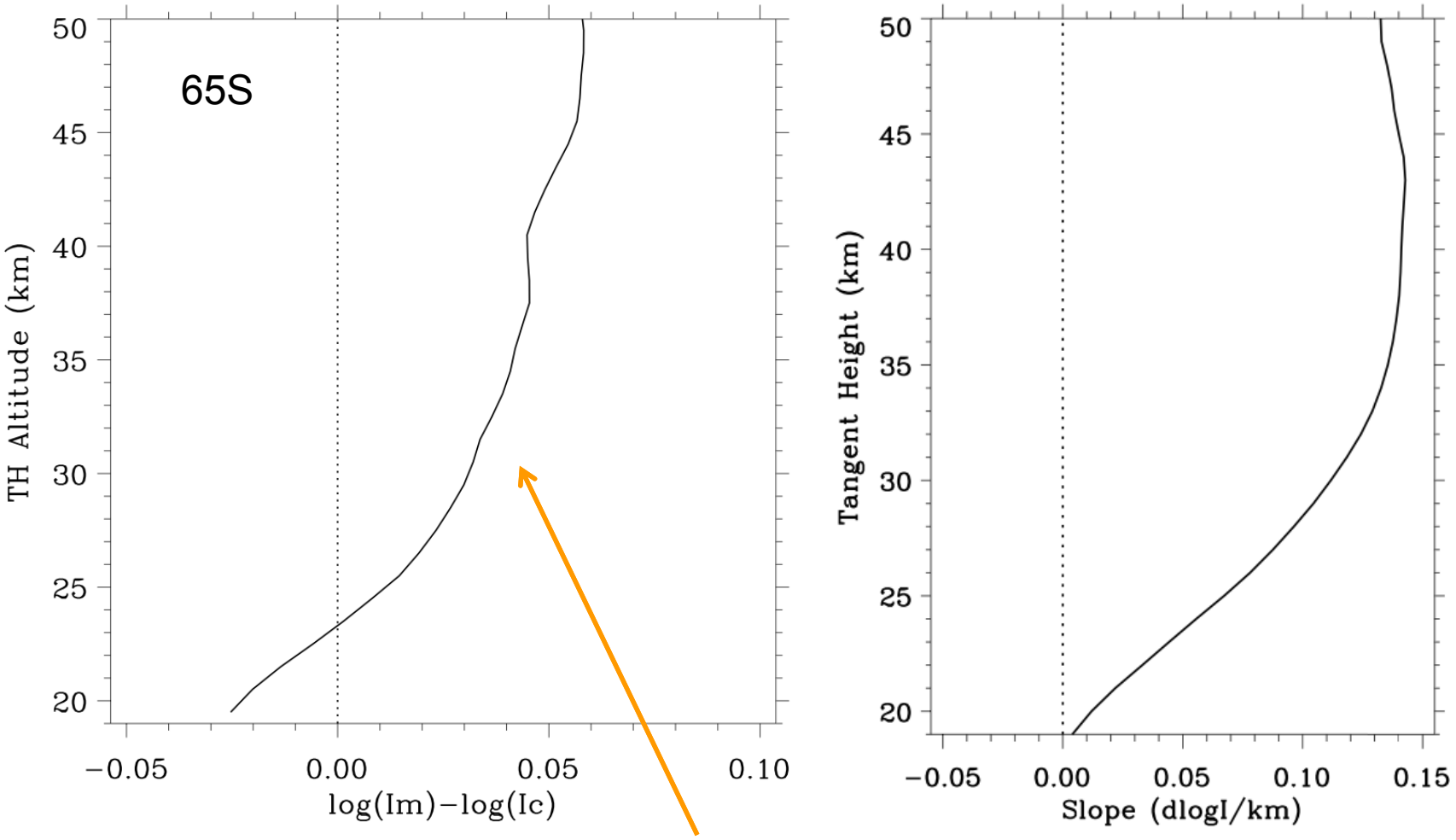
(The “RSAS” method, proposed in 1993)



- 30/20 km radiance ratio varies by ~10%/km.
- Not affected by calibration and reflectivity but affected by scene inhomogeneity along LOS, and strat aerosols.
- Technique works best in S. Polar regions.

350 nm meas-calc log of radiance vs. TH

Zonal Mean, April 2, 2012



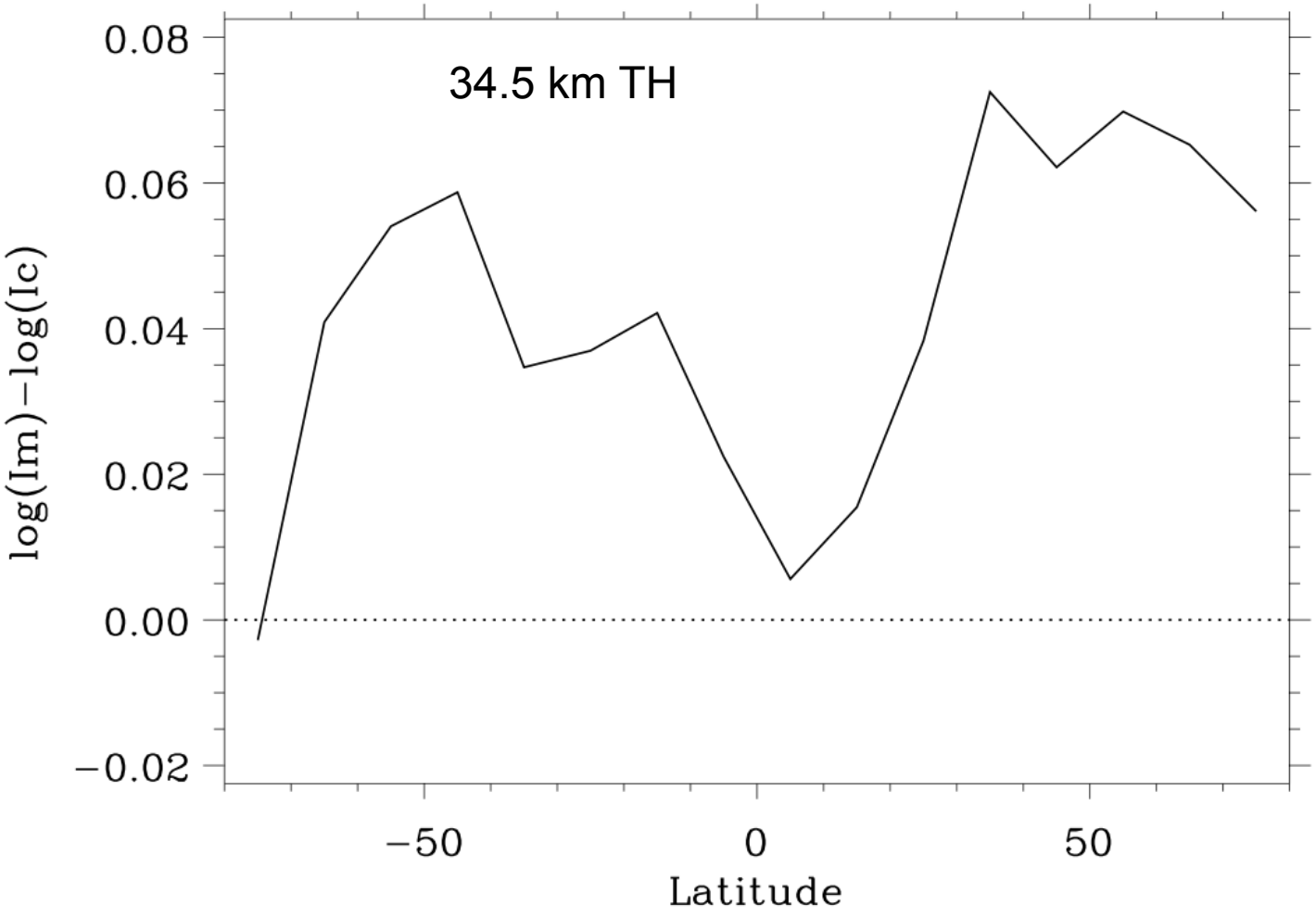
~300m OMPS TH error or MLS GPH error?

MLS GPH uncertainties

Z*	Region	Resolution Vert. × Horiz. / km	Precision[a] / meters	Modeled bias uncertainty / m	Observed bias uncertainty / m	Comments
	<0.001 hPa	—	—	—	—	Unsuitable for scientif c use
	0.001 hPa	10–13 × 220	±110	700±150	−450	
	0.01 hPa	8–12 × 185	±85	600±100	−100	
64 km	0.1 hPa	6 × 165	±60	500±150	0	
48 km	1 hPa	7 × 165	±45	300±100	100	
32 km	10 hPa	4.3 × 165	±35	200±100	100	
16 km	100 hPa	5.2 × 165	±30	150±100	150	
	261 hPa	5.3 × 170	±35	100±150	150	
	1000 – 316 hPa	—	—	—	—	Unsuitable for scientif c use

The MLS team believes that they have 200-300m “bias” in GPH in 1-10hPa region. Is this what OMPS is seeing?

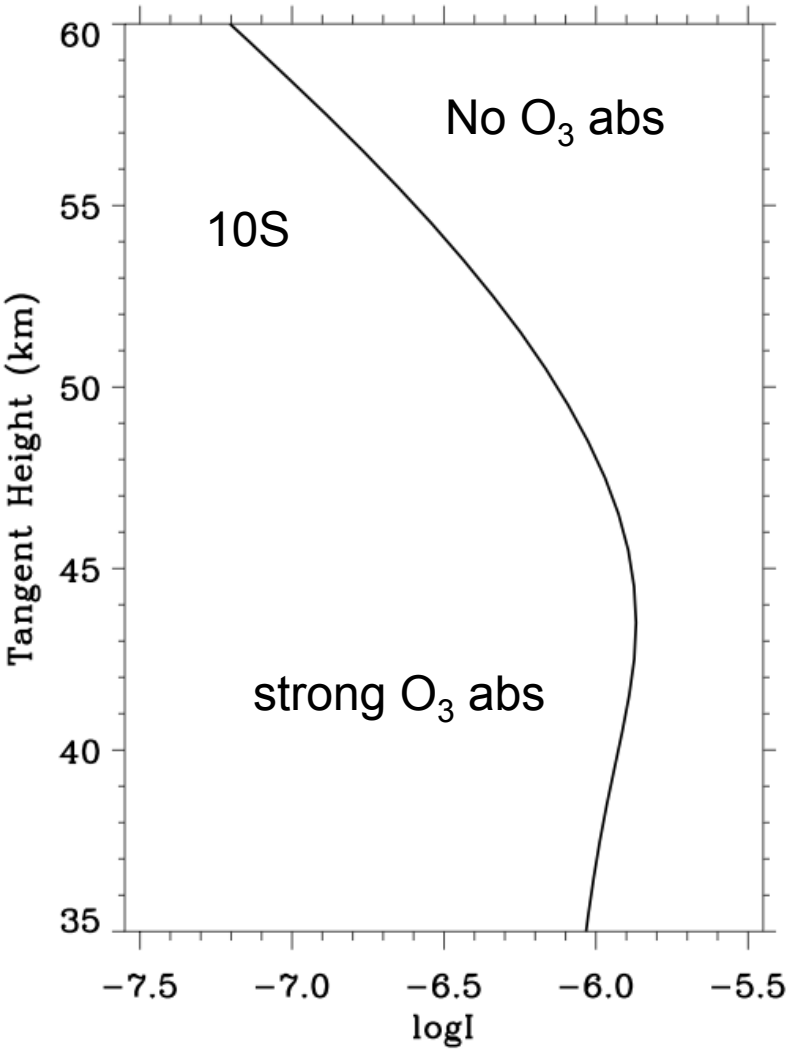
350 nm Meas-Calc ZM vs Lat

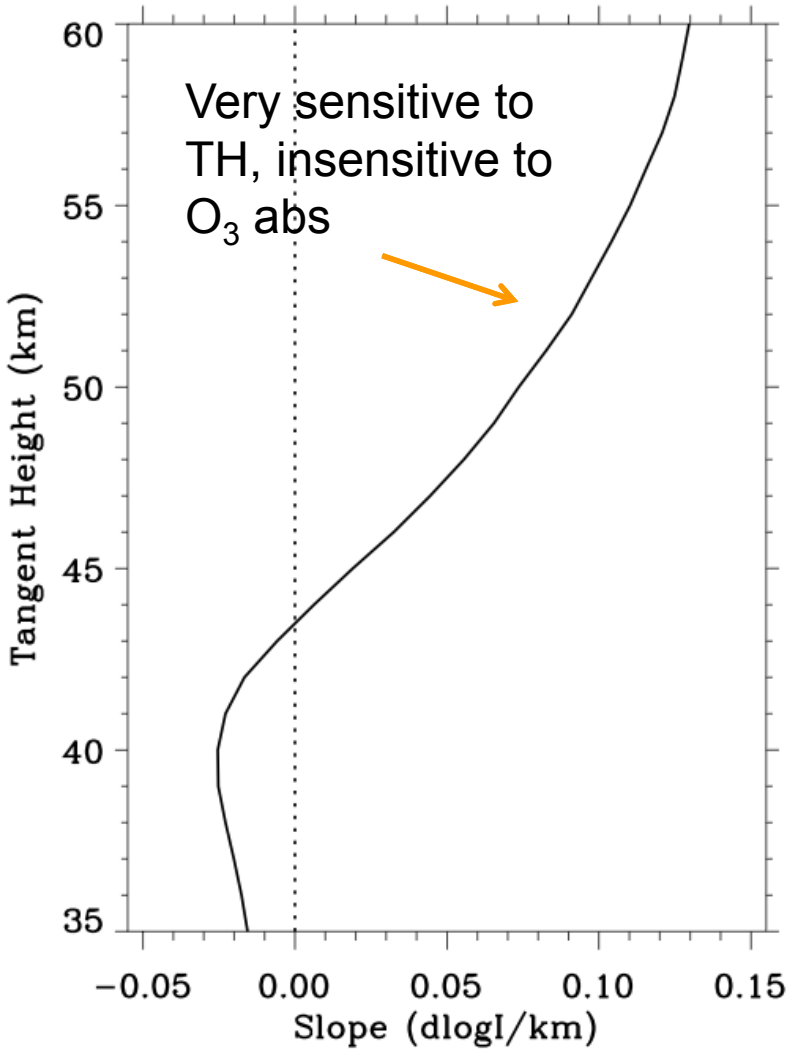


Lat variations are partly due to the use of scalar RTM

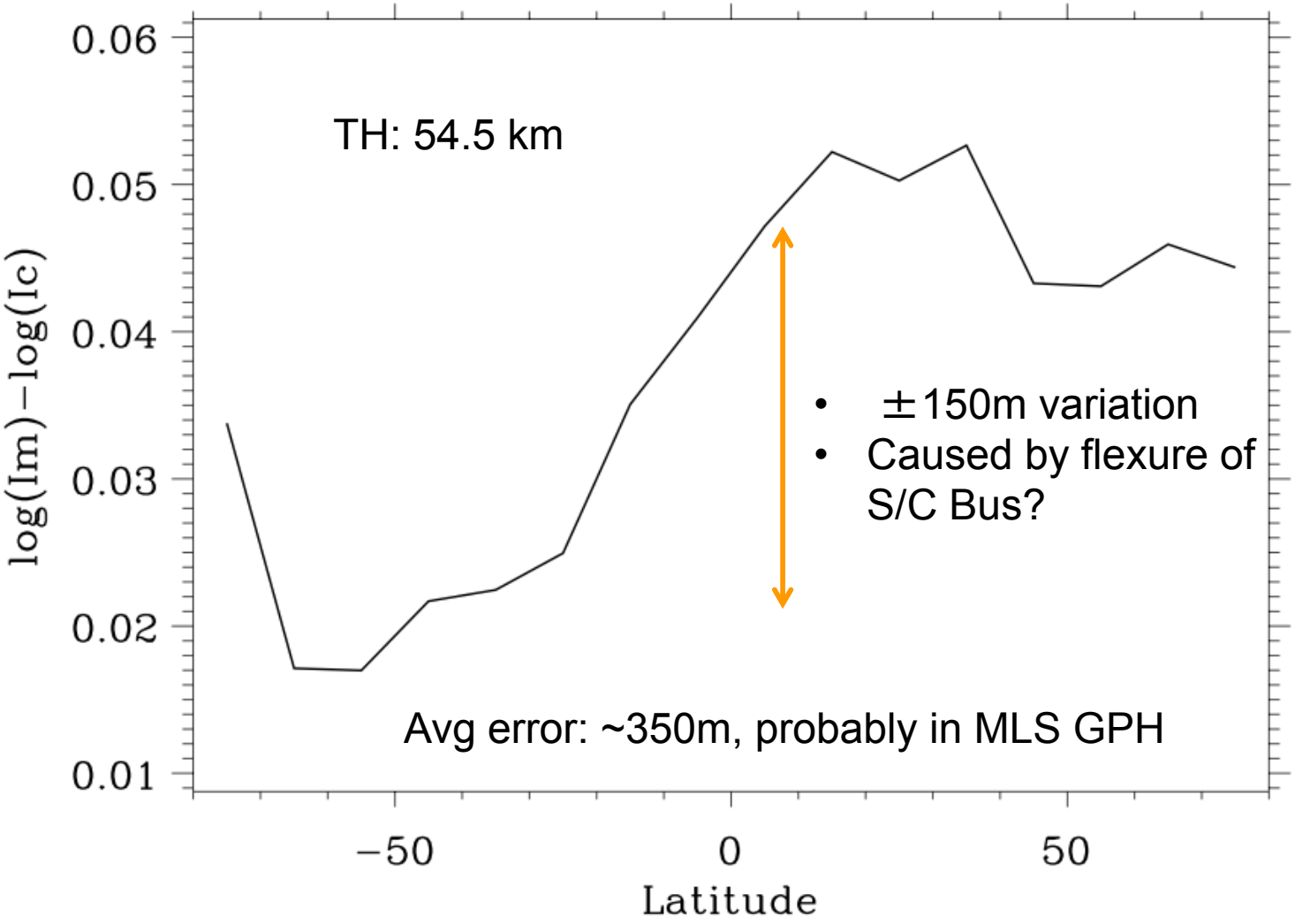
Alt Registration using 305 nm

305 nm not affected by reflectivity & scalar/vector diif

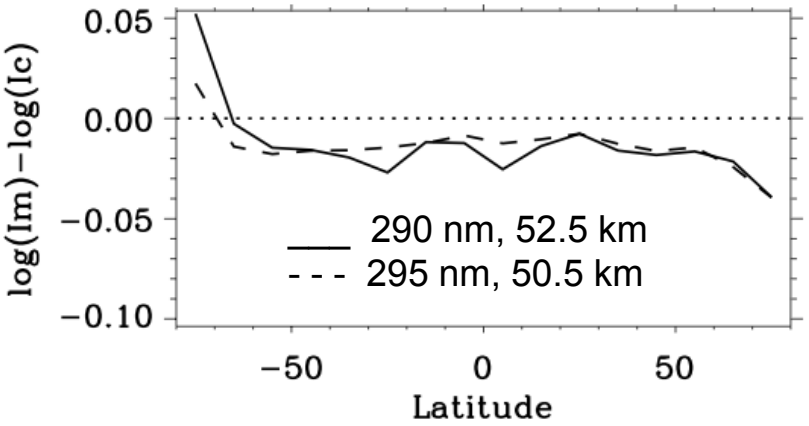


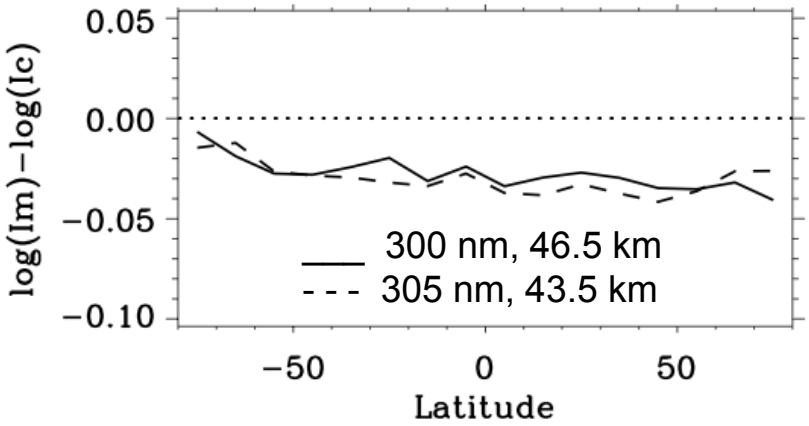


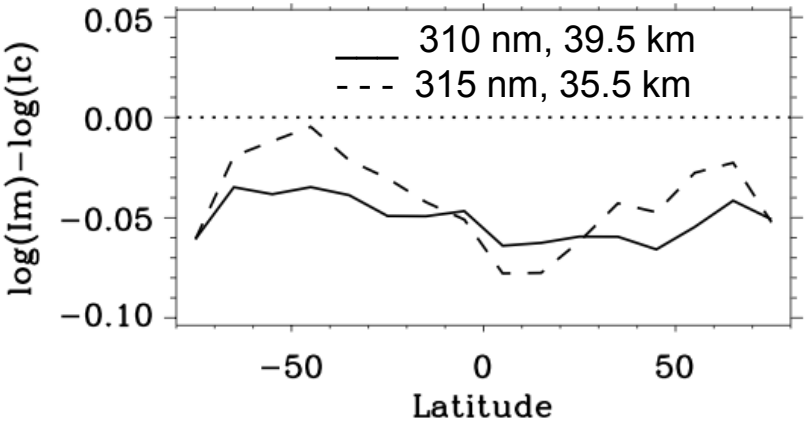
305 nm meas-calc ZM vs lat

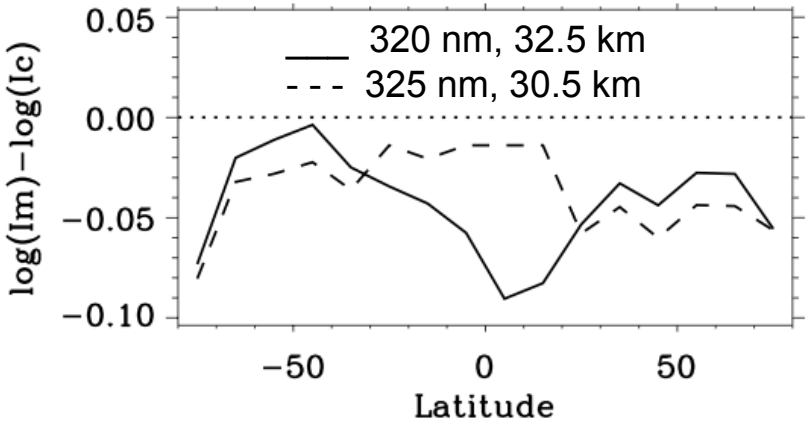


Comparison of ZM at alt of max O_3 abs



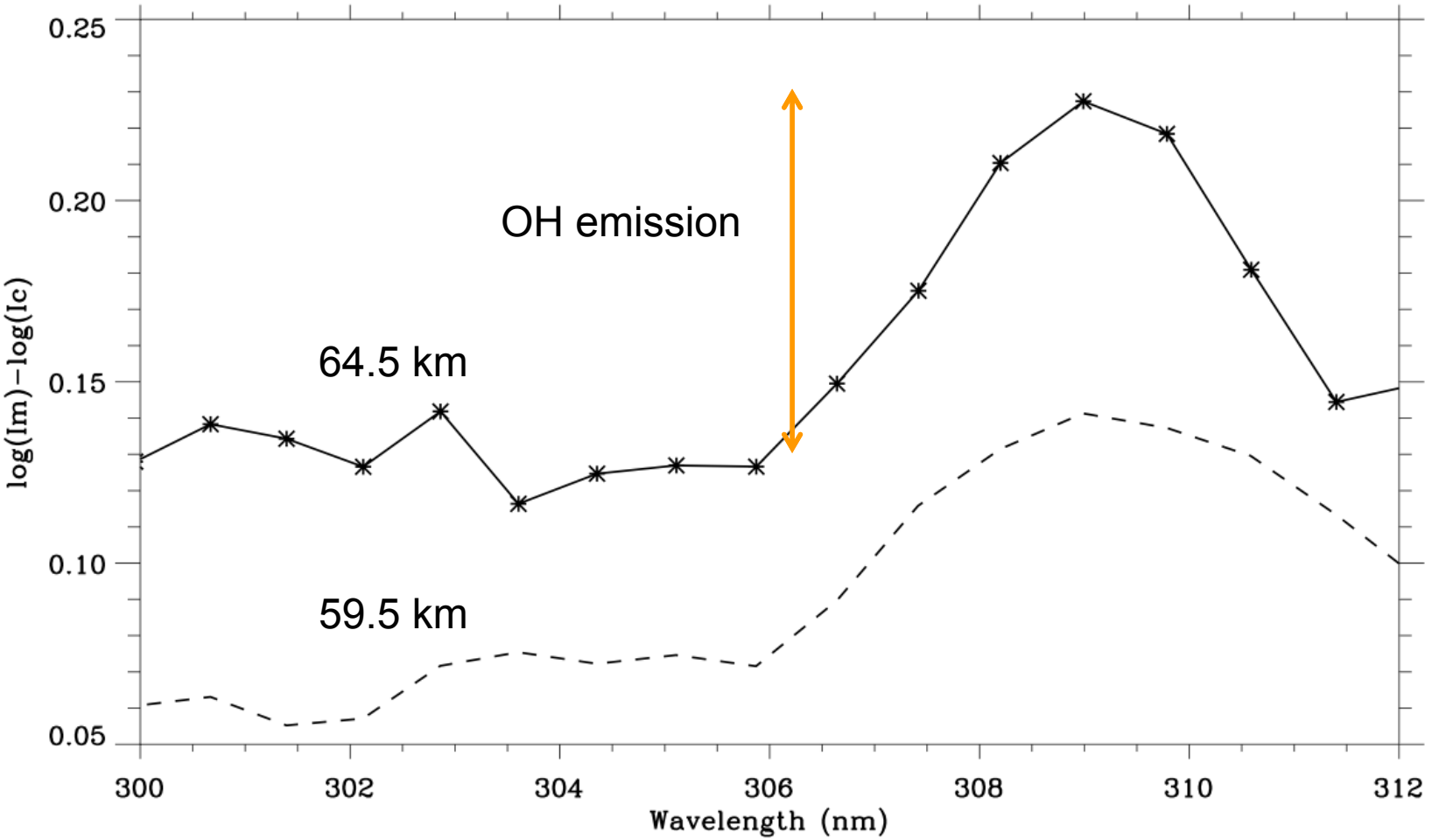






Difference is partly due to MLS GPH error. Also scalar code error.

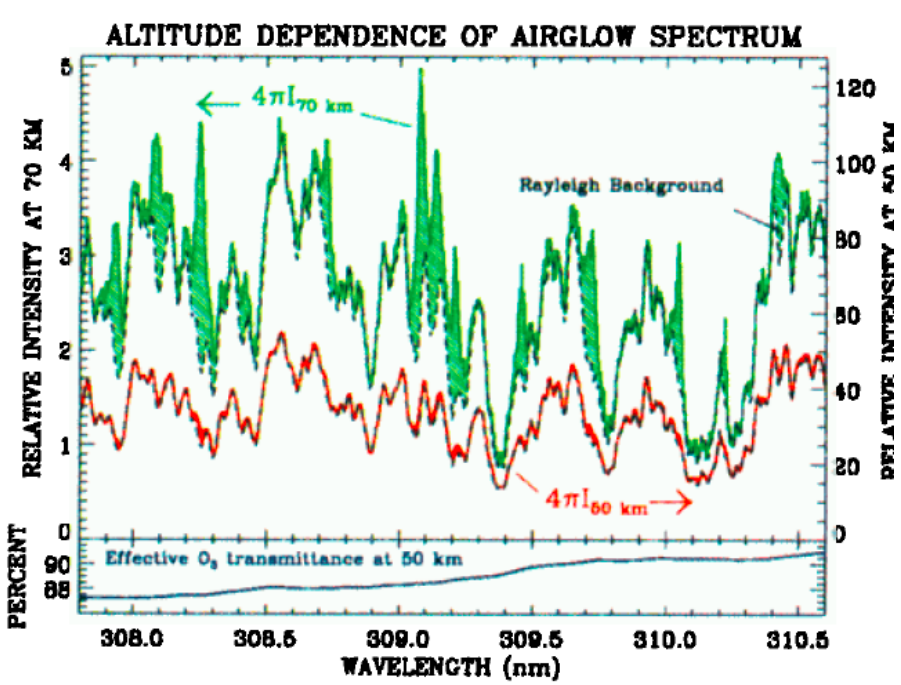
OH Emission Signal

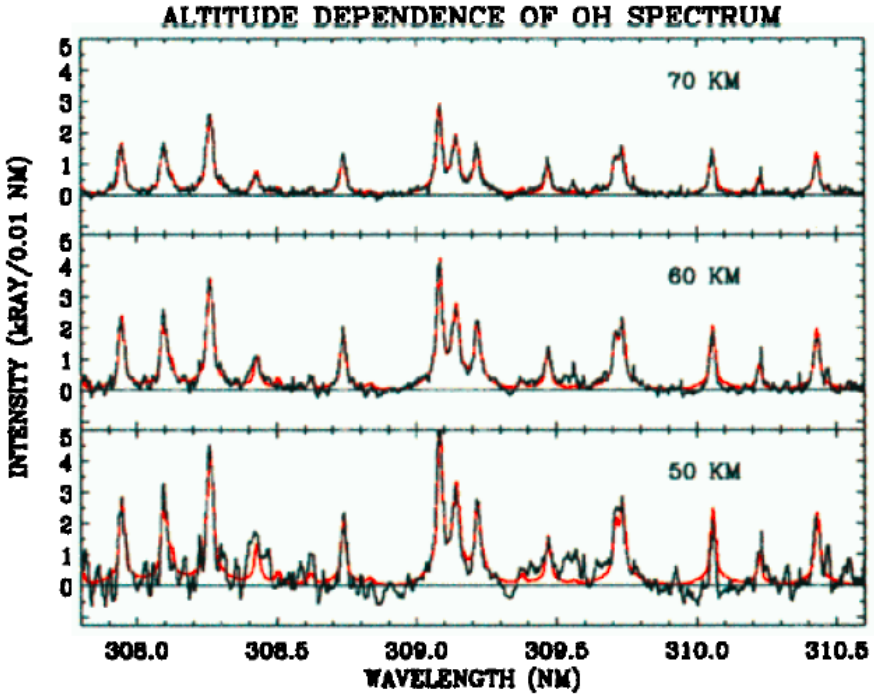


GEOPHYSICAL RESEARCH LETTERS, VOL. 23, NO. 16, PAGES 2093-2096, AUGUST 1, 1996

Satellite measurements of hydroxyl in the mesosphere

Robert R. Conway[1], Michael H. Stevens[1], Joel G. Cardon[2],
Scott E. Zasadil[2], Charles M. Brown[1], Jeff S. Morrill[1], and George H. Mount[3]



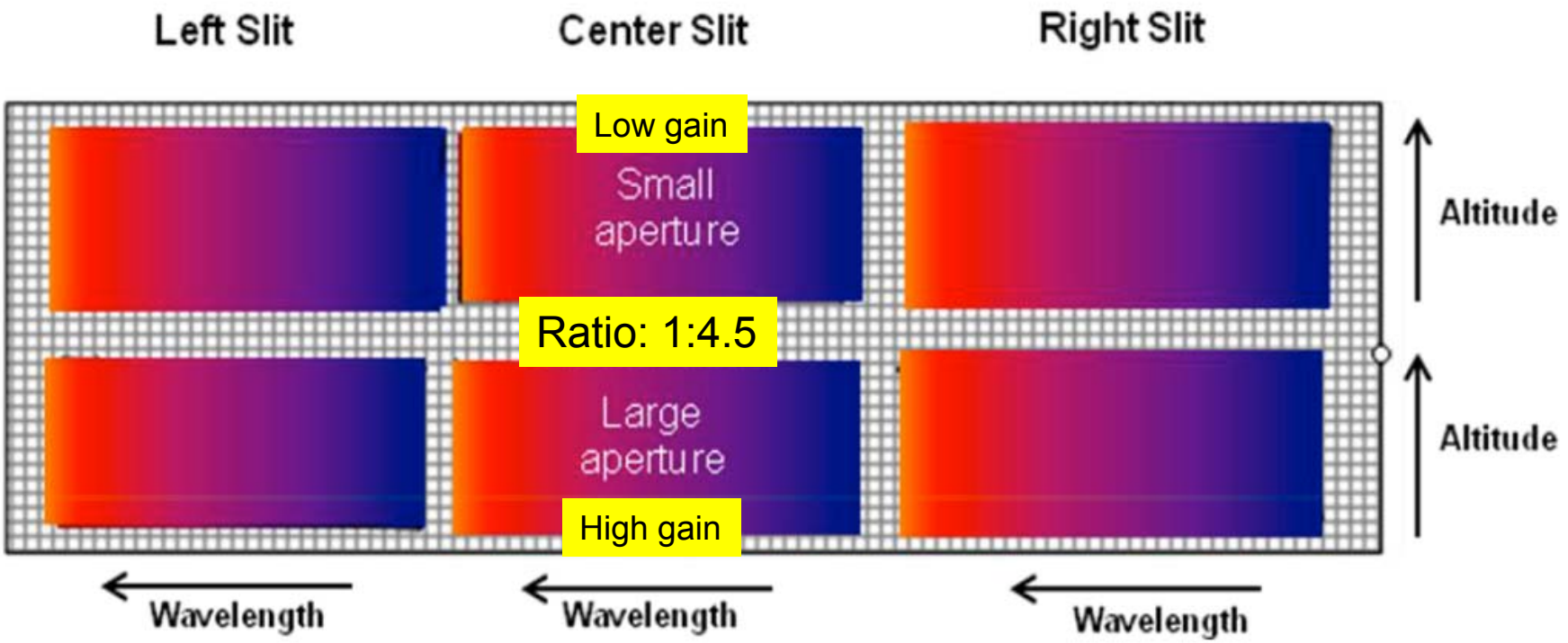


Conclusions & Future Plans

- With correct λs measured and calculated sun-normalized radiances agree well.
- Remaining differences are at least partly due to MLS GPH error
  - Error in T/GPH affect MLS density vs alt profiles but not their MR vs press profiles, vice-versa for OMPS.
- Release 2 plans (release date: Oct 1, 2013)
  - L1: Better λs, will not mix small and large aperture data, no further TH corrn.
  - L2: increase vertical smoothing, remove OH λs, provide aerosol profiles, O_3 from central slit only.

BACKUP SLIDES

LP Focal Plan Schematic



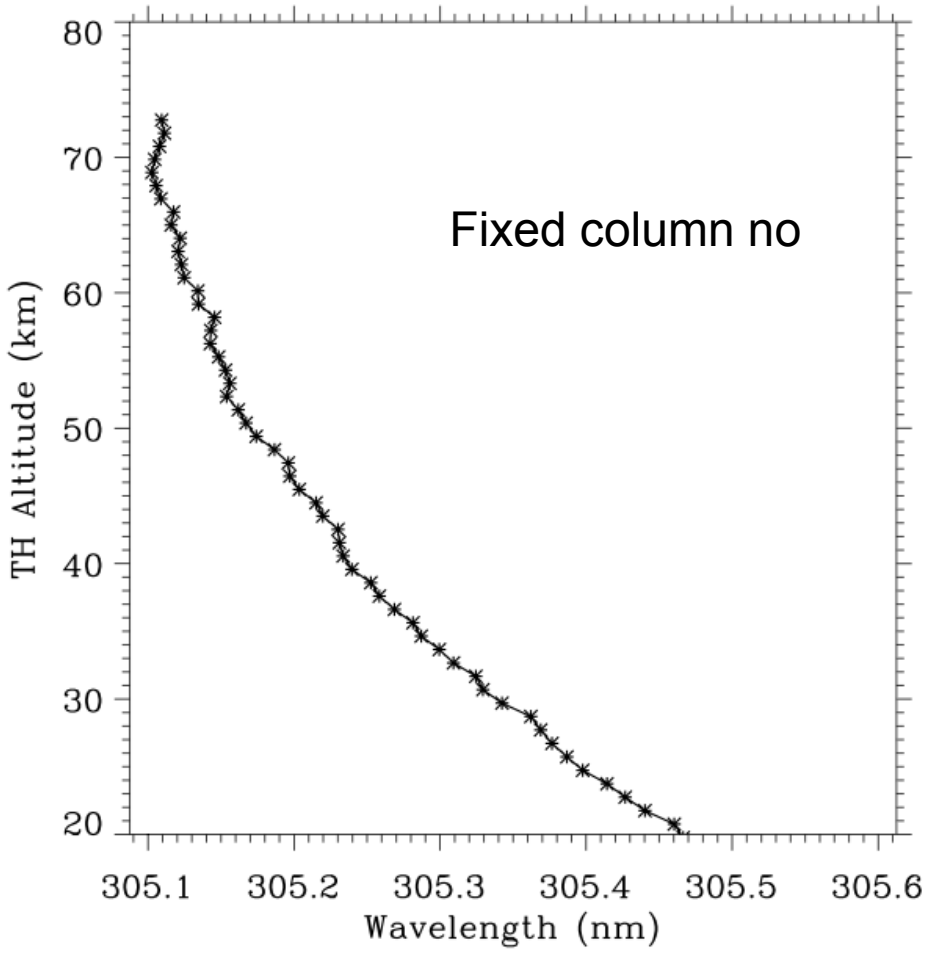
Two interleaved exposures in 1:31 ratio

Designed for sequencing HG Long/LG long/HG Short/LG short: 1: 4.5: 7: 4.5
Total dynamic range gain: x140

Optical distortions in HG Image

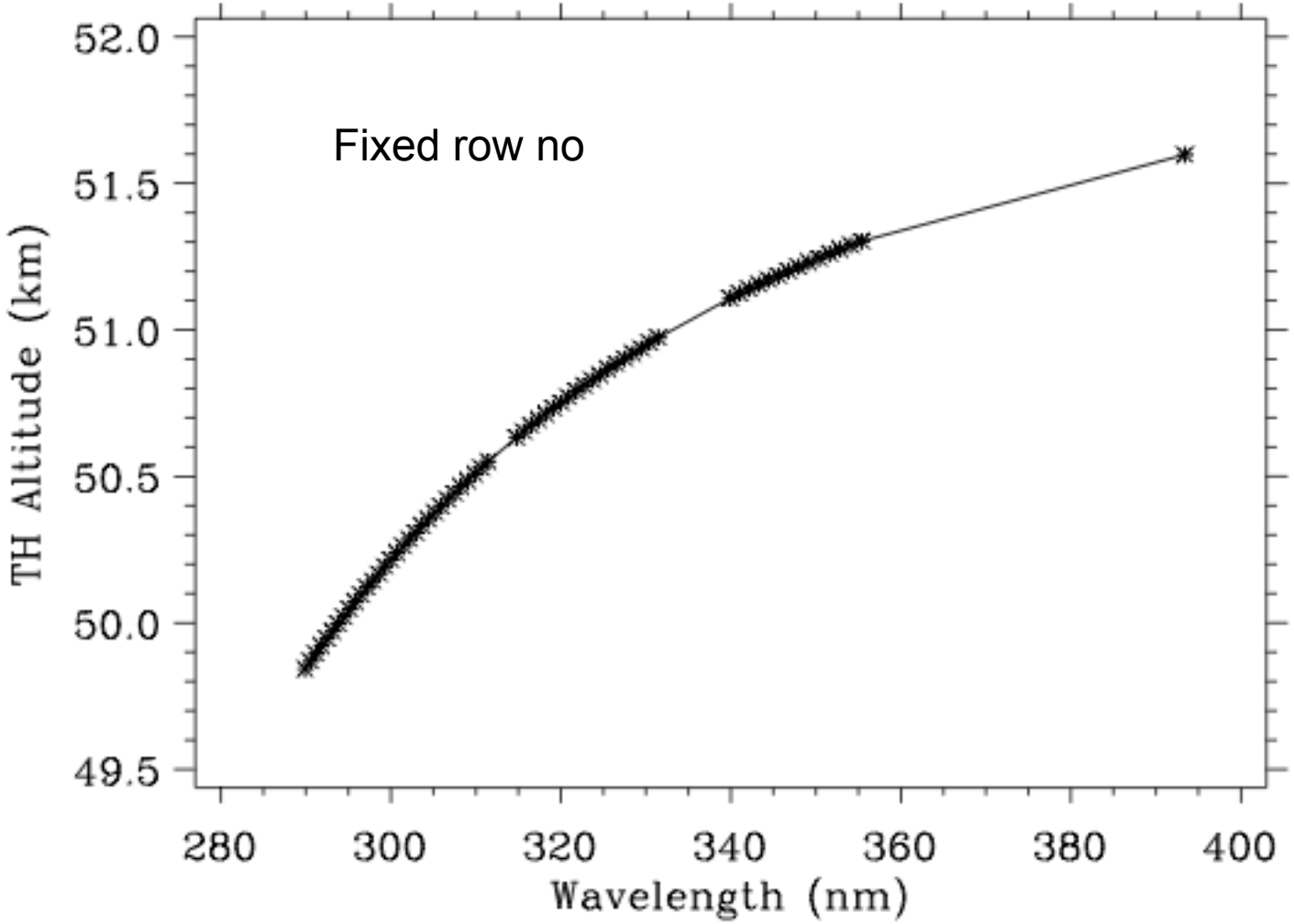
Variation of wavelength with TH

- λ variation is smaller than instrument bandpass, but still needs to be corrected.
- λ variation is 4 times worse for LG image.



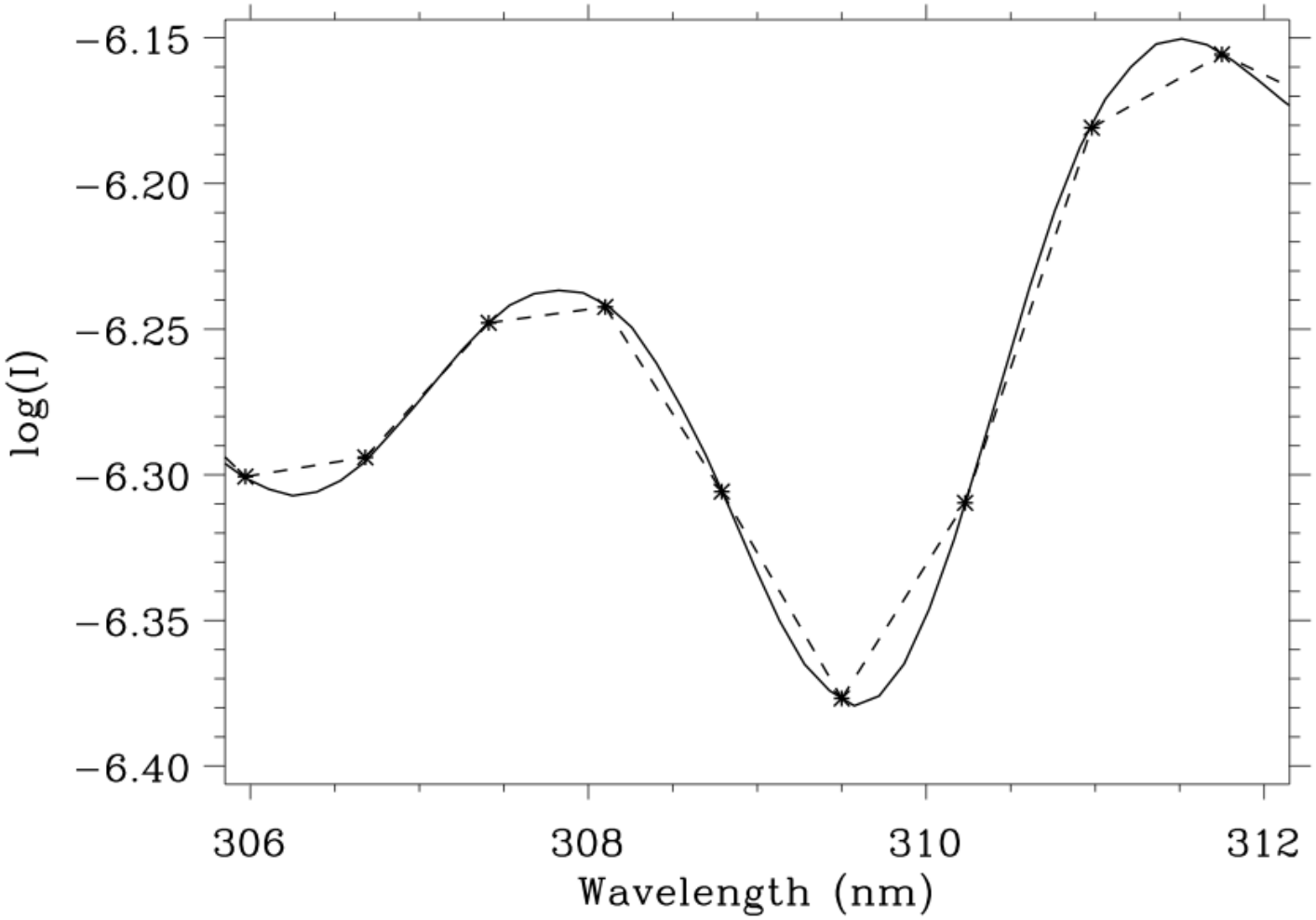
Optical distortions in HG Image

Variation of TH with wavelength



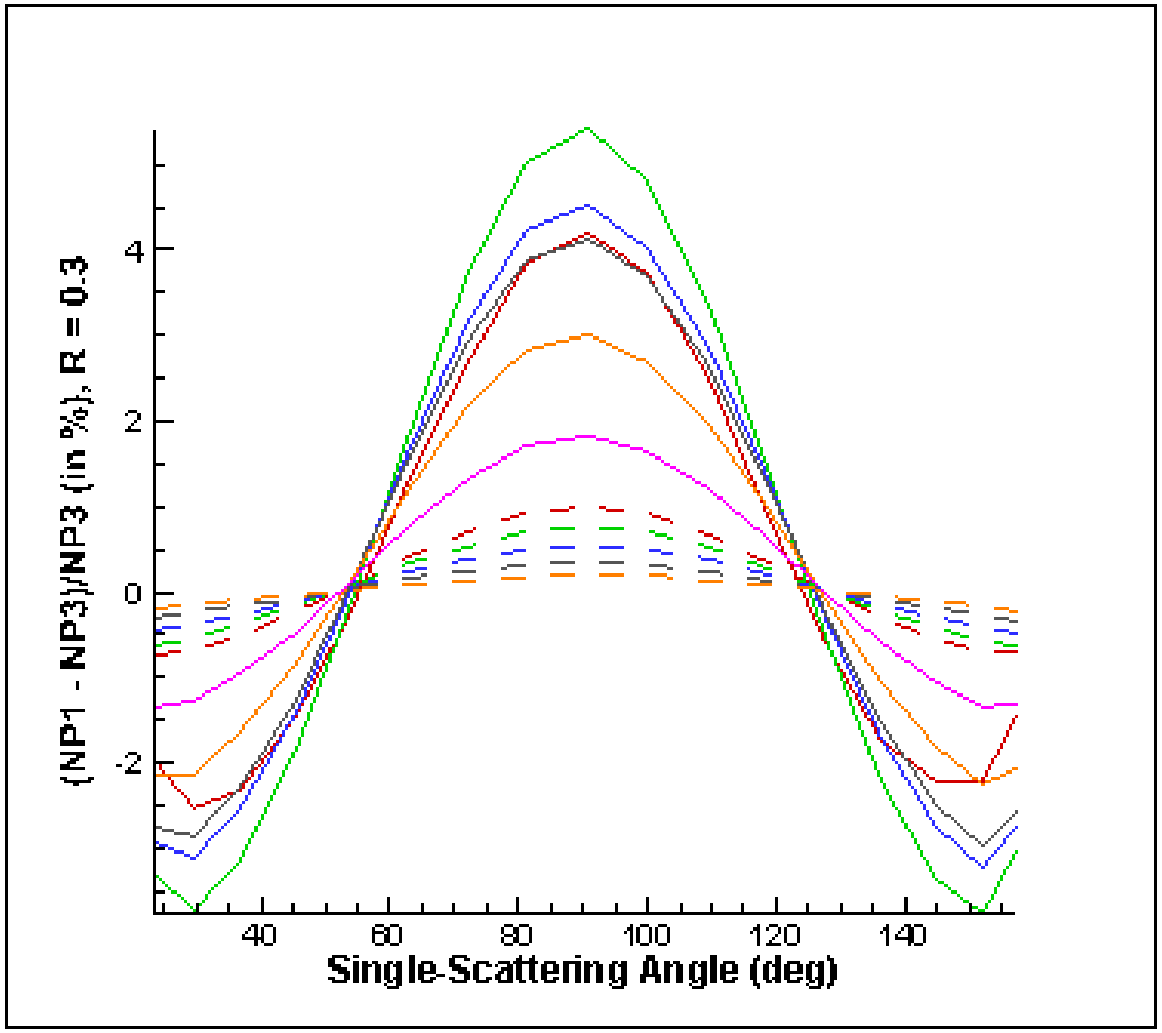
Wavelength Under-sampling

Radiances convolved with OMPS bandpass



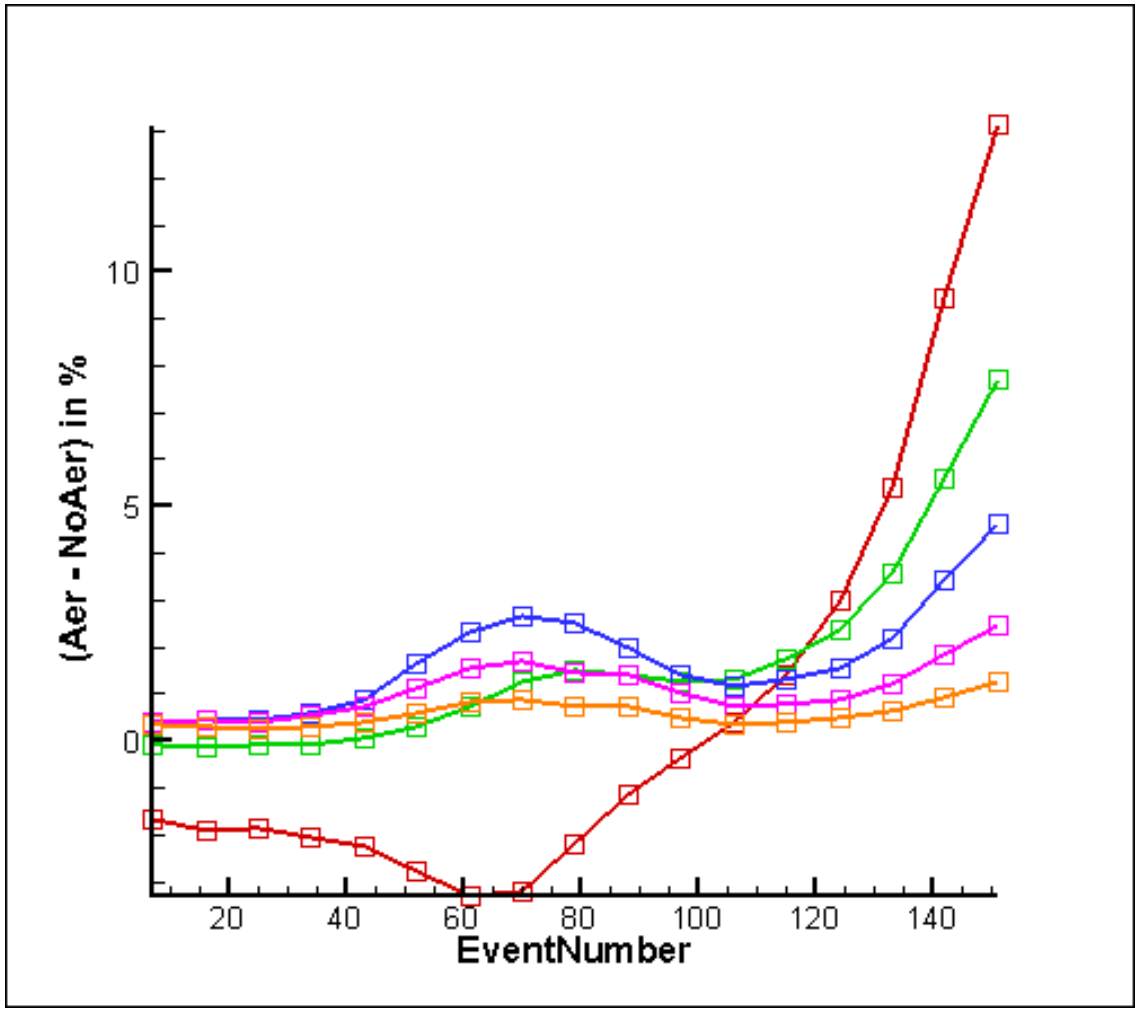
Without under-sampling corrn interpolation error can be as large as 3%

Scalar radiance error at TH = 40 km, R = 0.3



Error is shown for λ = 325, 345, 385, 400, 449, 521 nm (solid lines) and 602, 676, 756, 869, 1020 nm (dashed line)

% change in 350 nm radiance due to aerosols



% change shown for TH = 20, 25, 30, 35, 40 km

Surface reflectivity = 0

λ = 350 nm