Comparison of SCIAMACHY and OSIRIS aerosol products

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OUTLINE

I. Instruments
II. Aerosol extinction retrieval algorithms
III. Comparison of aerosol extinction
IV. PSD retrieval algorithms
V. Comparison of PSD parameters
VI. Conclusions
VII. What's next???

I. Instruments

INSTRUMENTS

Parameters	**SCIAMACHY - Limb**	**OSIRIS**	
Full name	**SC**anning **I**maging **A**bsorption spectro**M**eter for **A**tmospheric **CH**artograph**Y**	**O**ptical **S**pectrograph and **I**nfra**R**ed **I**maging **S**ystem	
Operating time	2002 – 2012	2001 – now	
Orbit	Sun-synchronous, 800 km	Sun-synchronous, 600 km	
Spectral range	214 – 2386 nm	**Opt. Spect.**	**IR Imager**
		274 – 810 nm	1260, 1270, 1530 nm
Spectral resolution	0.22 – 1.48 nm	1 nm	
Vertical range	-3 – 100 km	7 – 65 km	
Vertical sampling/resolution	3.3/2.5 km	2 /1 km	

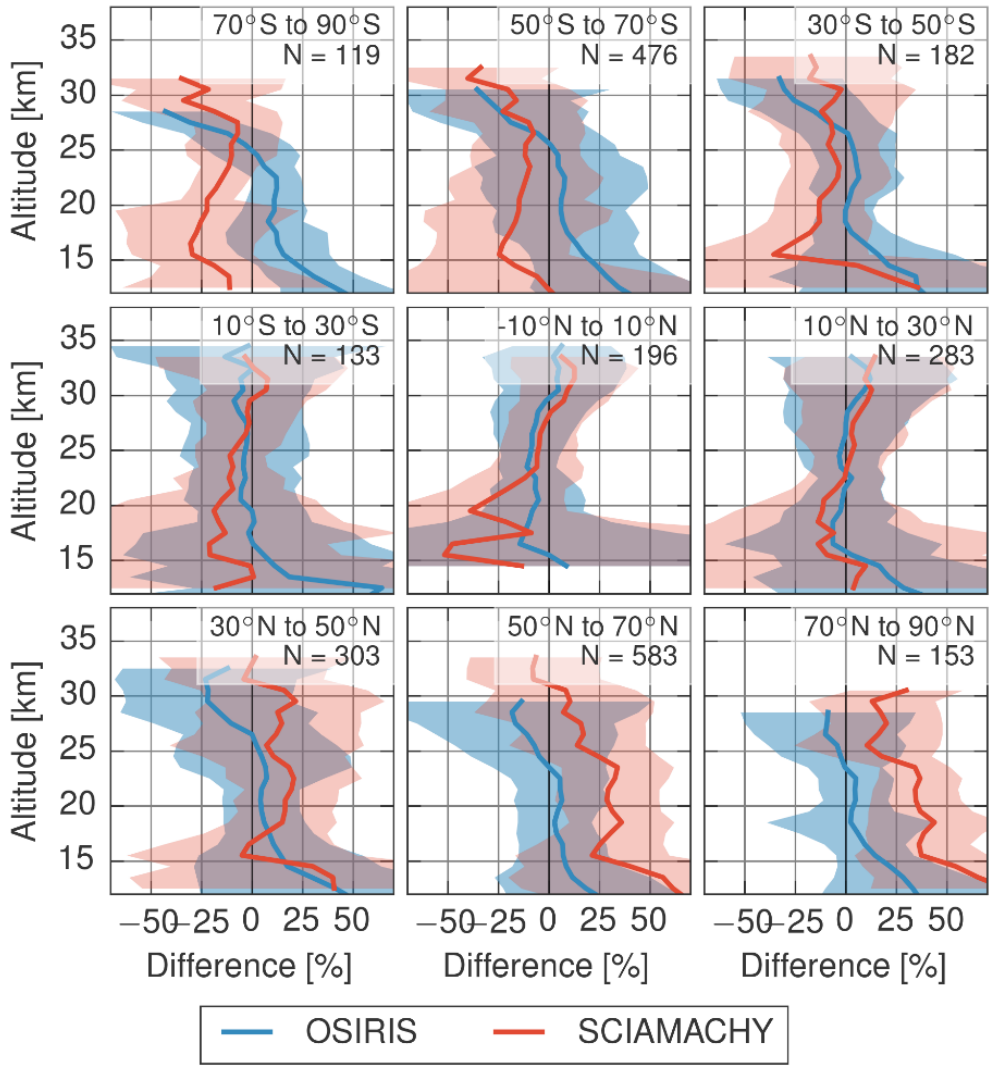
II. Aerosol extinction retrieval algorithms

AEROSOL EXTINCTION V1.4

	SCIAMACHY V1.4	OSIRIS V5.07
Wavelength normalization	No	470 nm
RTM	SCIATRAN	SaskTRAN
Wavelengths	750 nm	470 nm, 750 nm
PSD parameters	r_g=0.08µm , σ = 1.6 , $N_{SCIAMACHY}$	r_g=0.08µm , σ = 1.6, N_{OSIRIS}
Altitude grid	≈3.3 km	1 km
Reference spectrum	≈38 km	changing

III. Comparison of aerosol extinction

SCIAMACHY V1.4 VS OSIRIS V5.07



$$\left[\frac{\text{Inst} - \text{SAGE II}}{\text{SAGE II}}\right]$$

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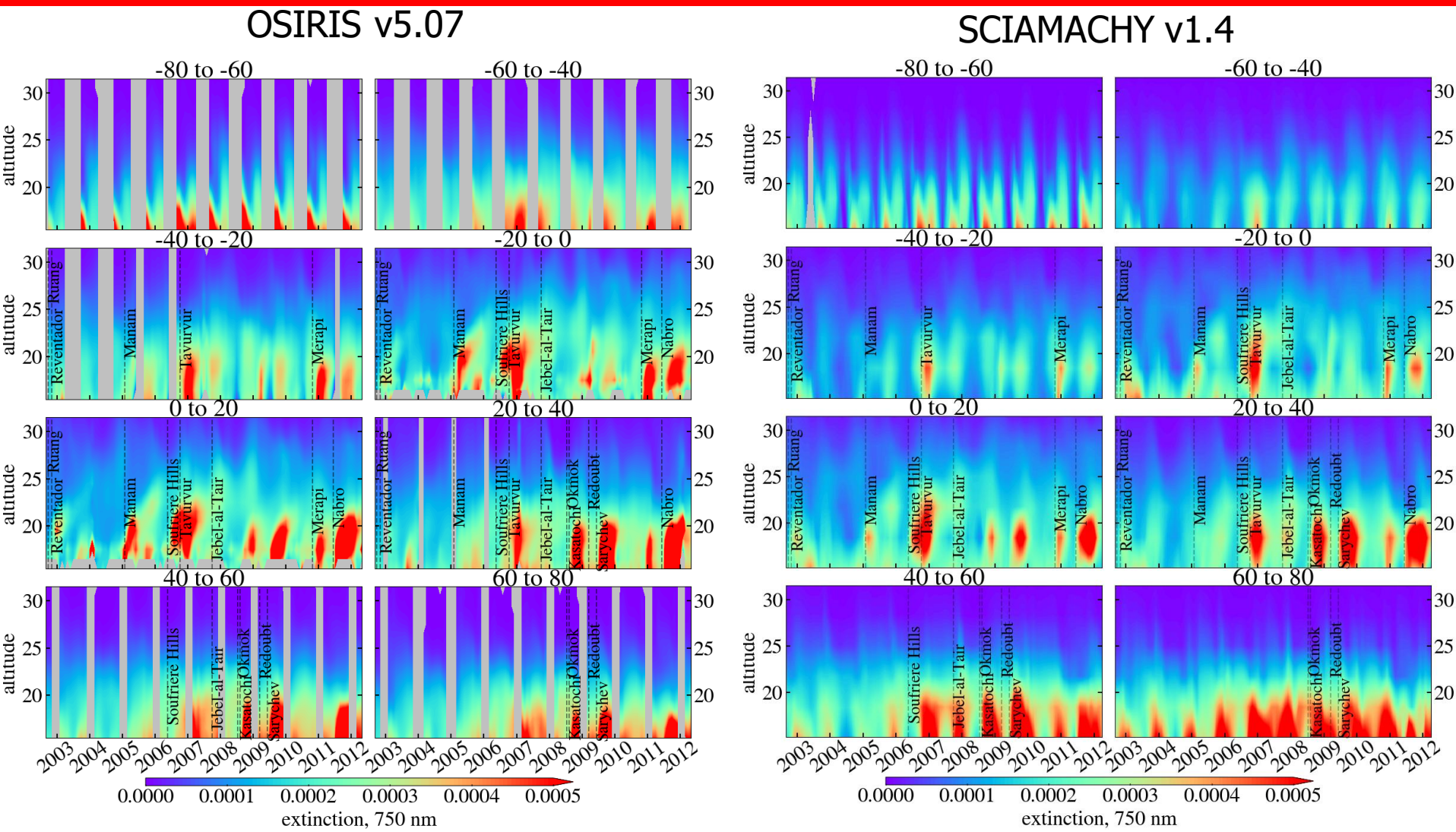
MONTHLY ZONAL MEANS CLIMATOLOGIES



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III. PSD retrieval algorithms

RETRIEVED QUANTITIES

Particle size distribution (PSD)

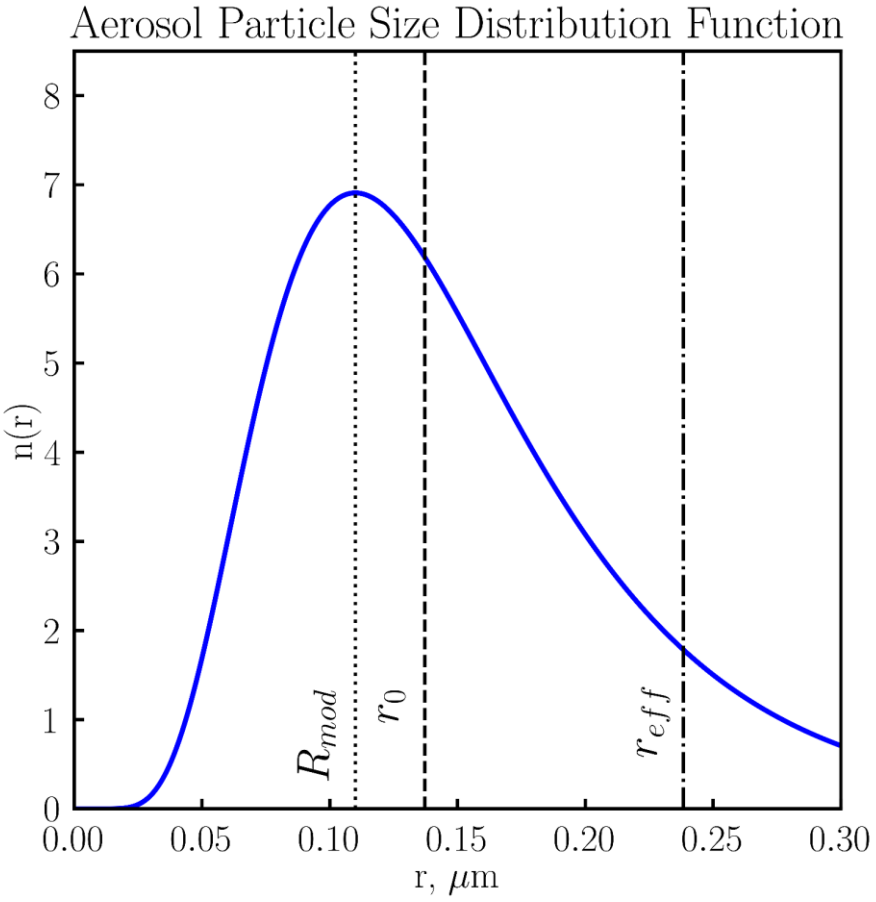
Assumed as lognormal

$$n(r) = \frac{N}{r(2\pi)^{\frac{1}{2}}\ln(\sigma)} \exp\left(\frac{-(\ln(\frac{r}{r_0}))^2}{2(\ln(\sigma))^2}\right)$$

N – particle number density

r_0 – ***MEDIAN*** radius

σ – distribution width (rel)



Mode radius: $R_{mod} = r_0 / e^{\ln \sigma^2}$

Width: $\exp(\ln(\sigma)^2 - 1) * \exp(2r_0 + \ln(\sigma)^2)$

Ångström exponent: $\alpha_{\lambda_1/\lambda_2} = -\frac{\log(extinction_{\lambda_1}/extinction_{\lambda_2})}{\log(\lambda_1/\lambda_2)}$

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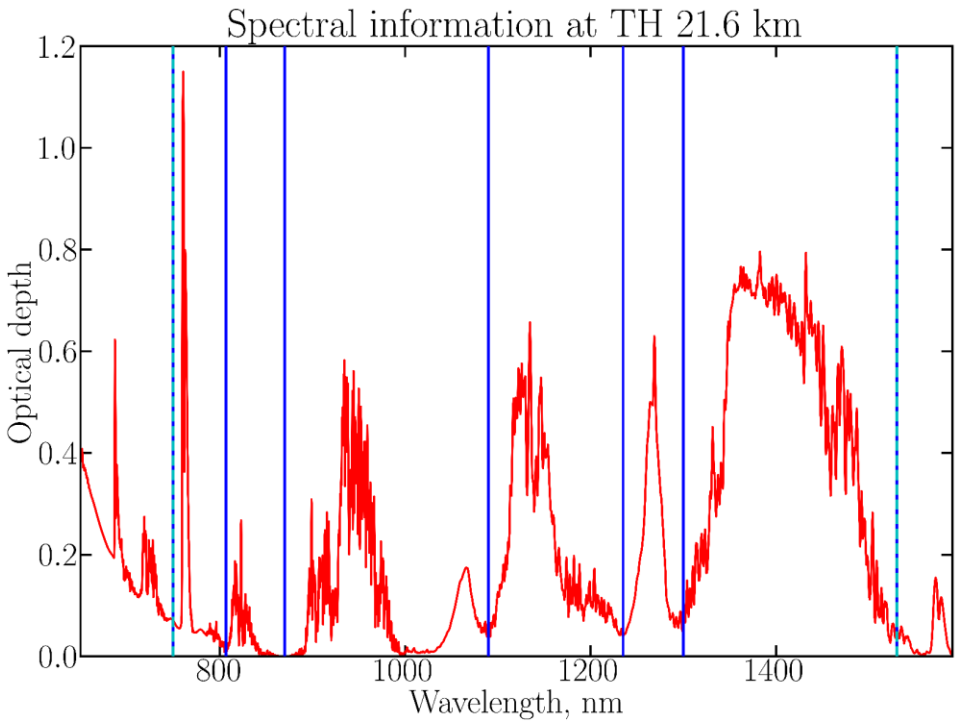
RETRIEVAL INFORMATION



Difference between the logarithms of the radiance without and with absorption by gaseous species (optical depth). Blue – selected wavelengths by SCIAMACHY, cyan – selected wavelengths by OSIRIS.

SCIAMACHY PSD V1.0:

- Sun-normalized radiances
- Wavelengths: 750, 807, 870, 1090, 1235, 1300, 1530
- Surface albedo is included in the retrieval (spectral), cloud free
- Fit: R_{mod}, $\ln(\sigma)^2$; fixed N
- Report: R_{mod}, σ , width

OSIRIS v6.0:

- Upper altitude normalization
- Wavelength: 750 and 1530 nm
- Albedo at 750 nm, coupled retrieval
- Fit: r_0, N; fixed $\sigma = 1.6$
- Report: $\alpha_{750/1530}$, $extinction_{750}$

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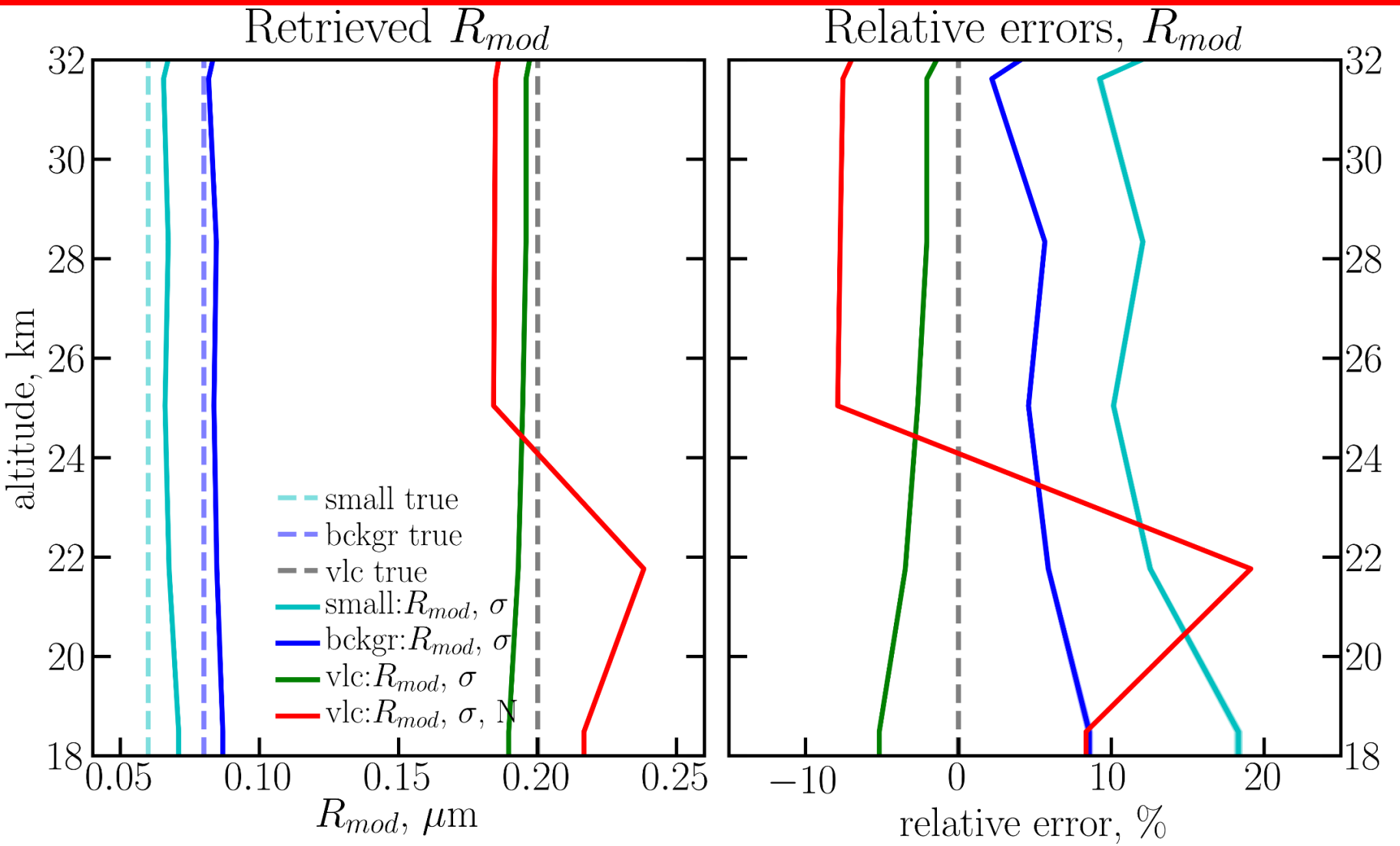
SYNTHETIC RETRIEVALS (R_{MOD})



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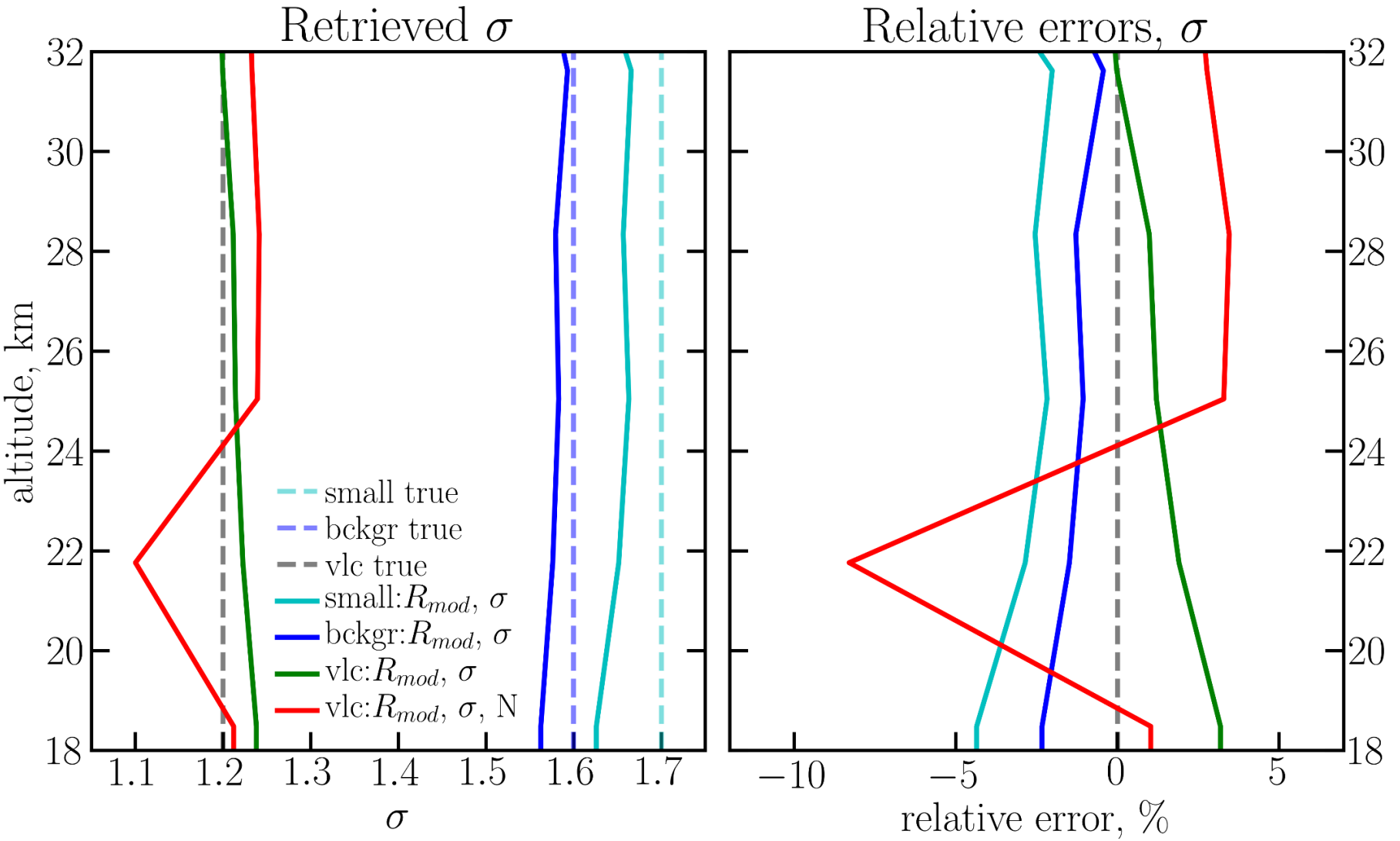
SYNTHETIC RETRIEVALS (SIGMA)



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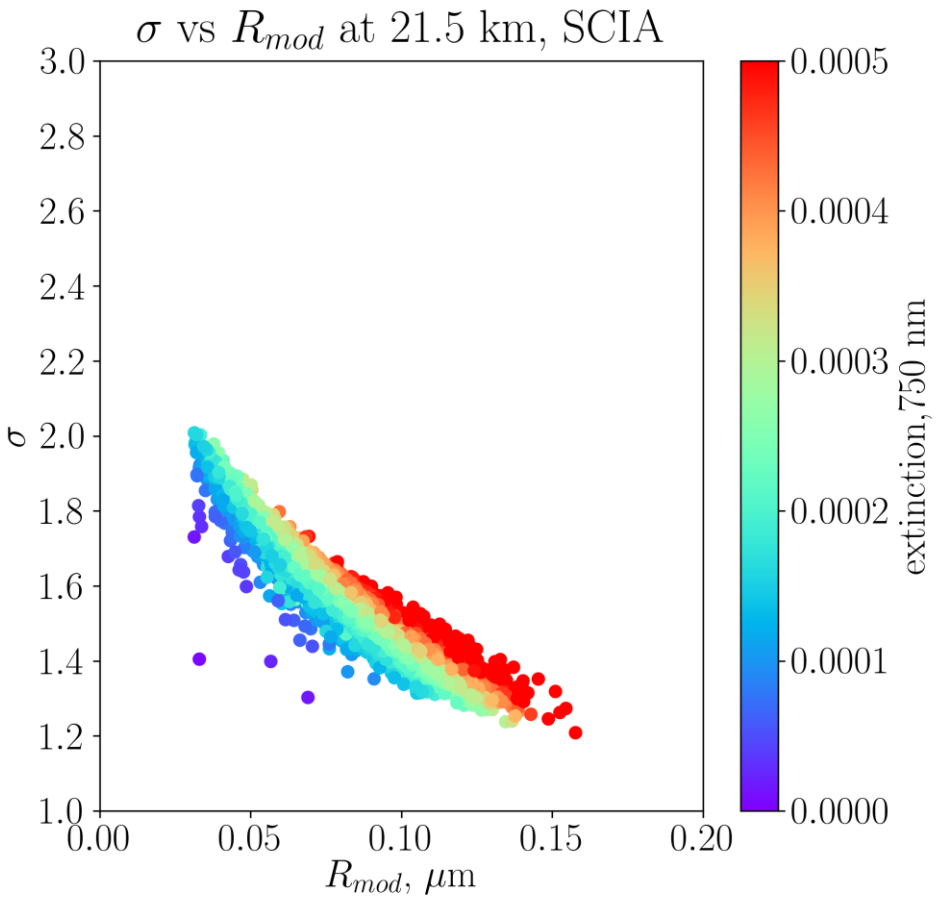
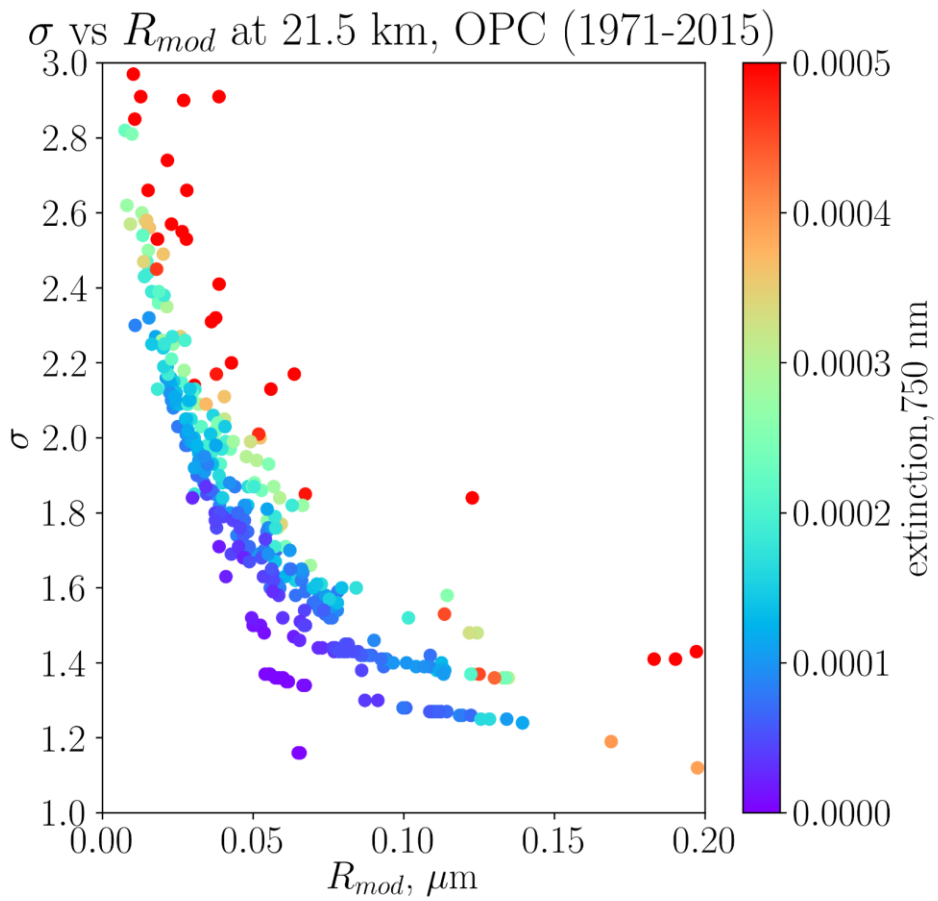
SCIAMACHY AND OPC





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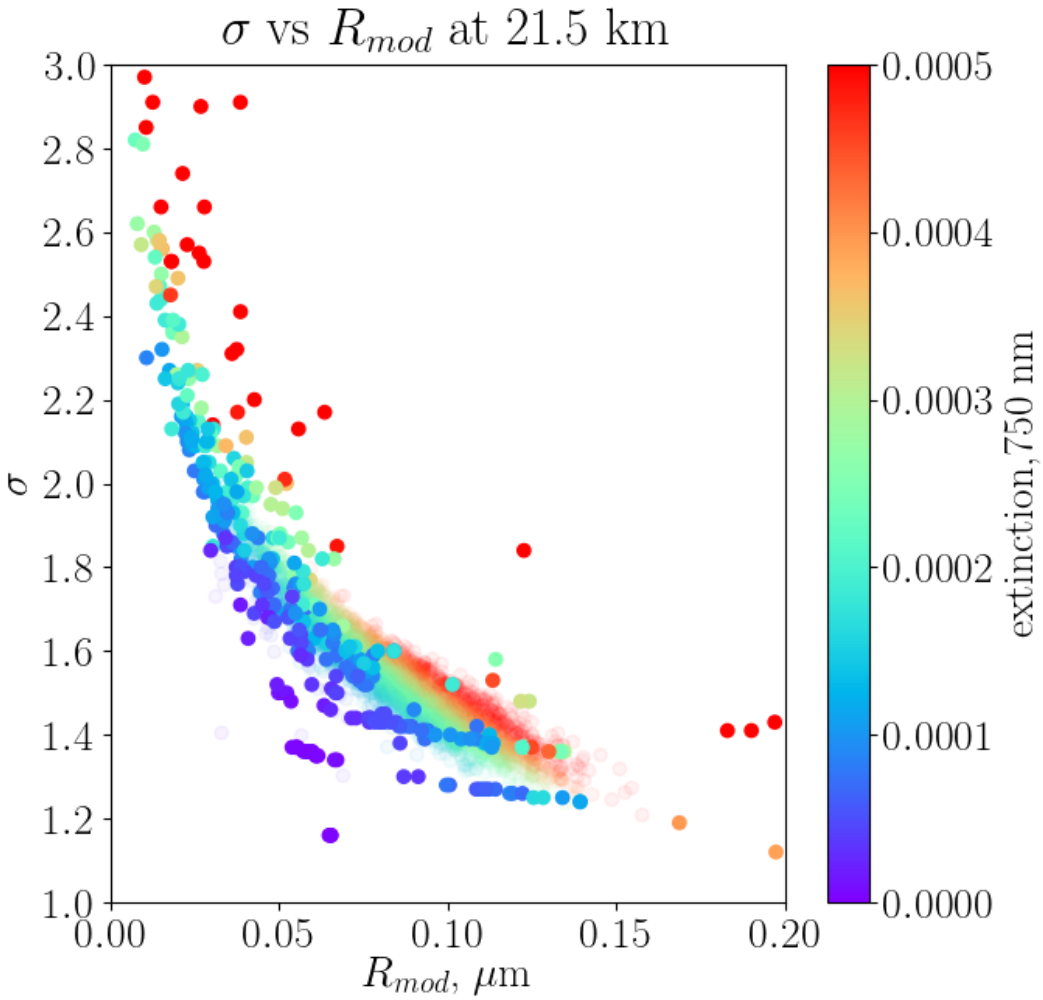
SCIAMACHY AND OPC



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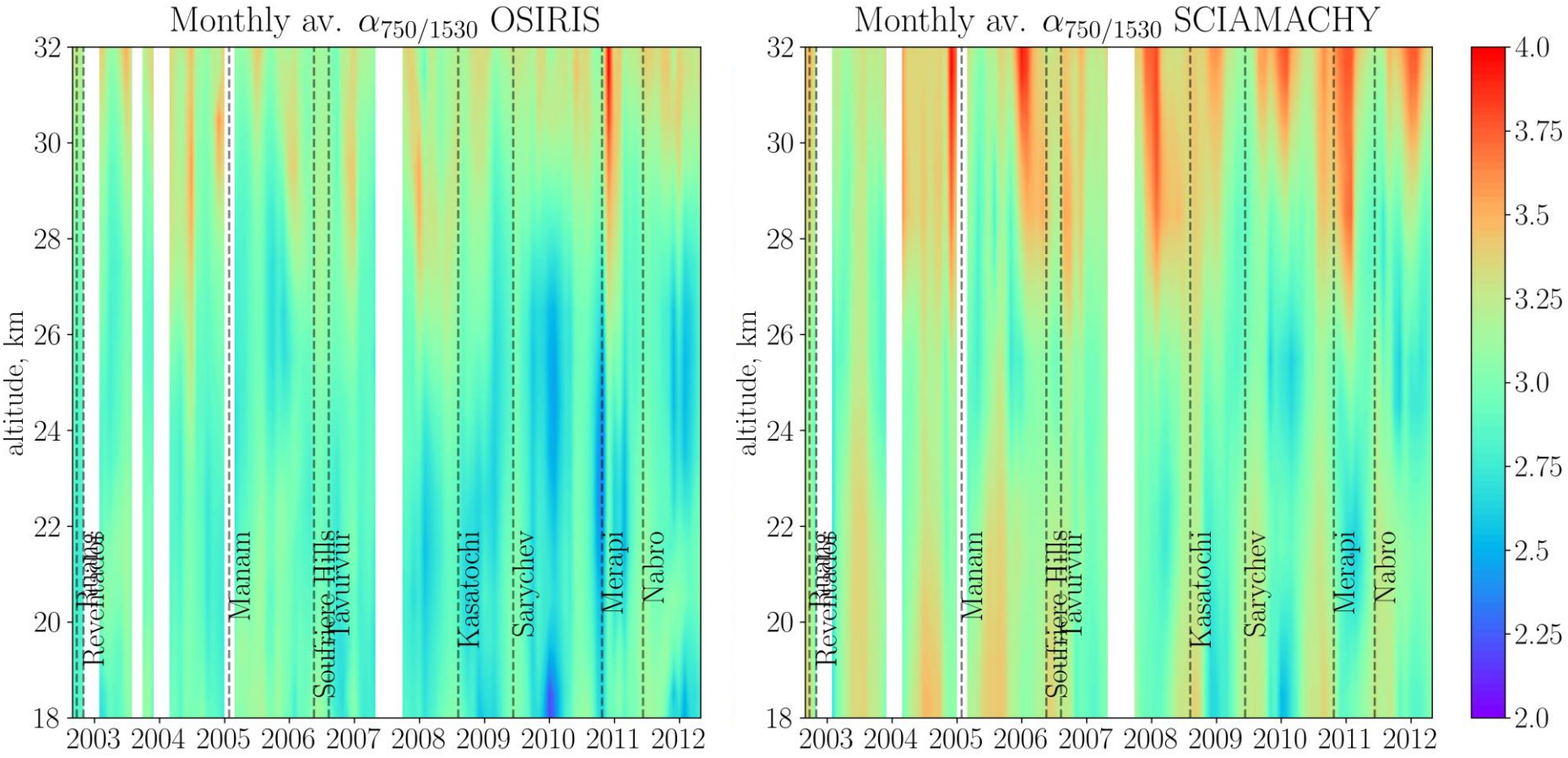
III. Comparison of PSD parameters

ANGSTROM EXPONENT COMPARISON



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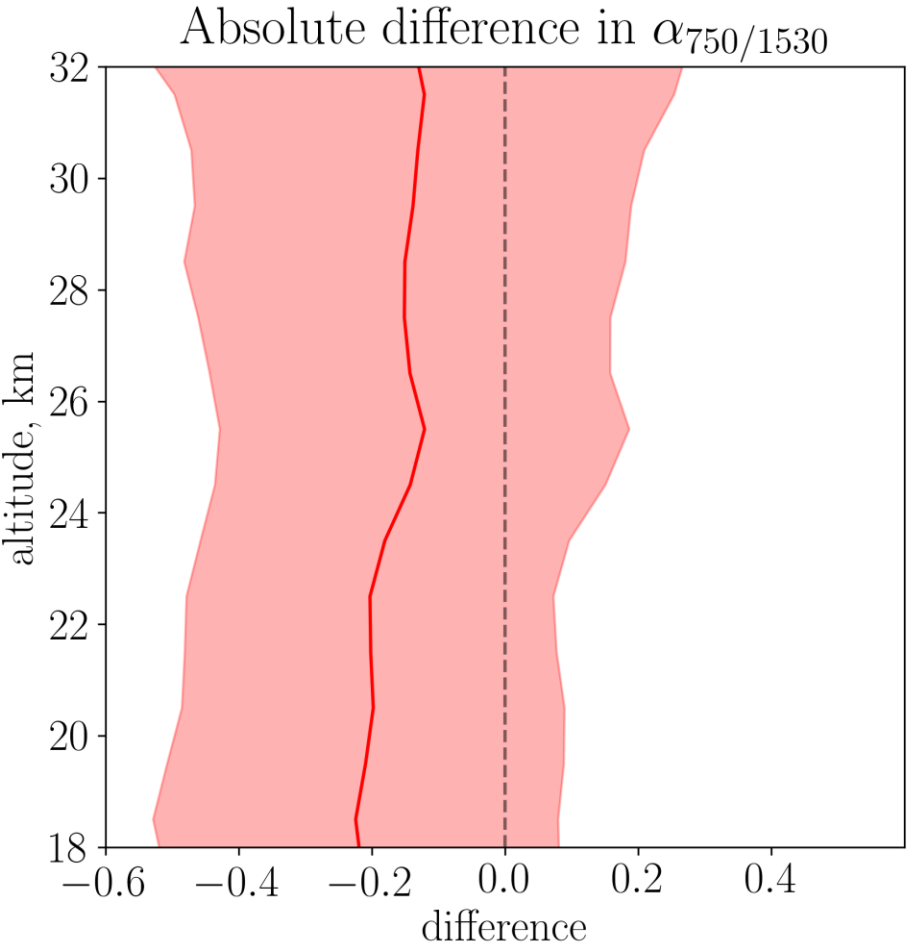
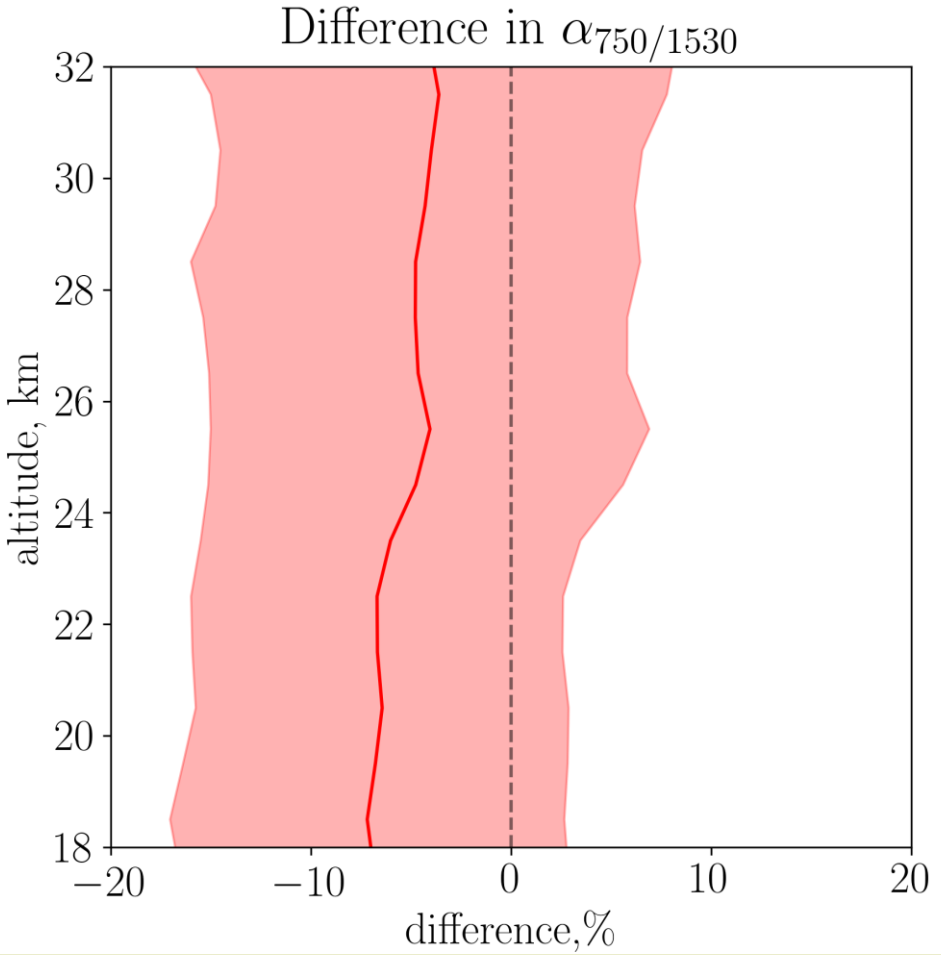
ANGSTROM EXPONENT COMPARISON





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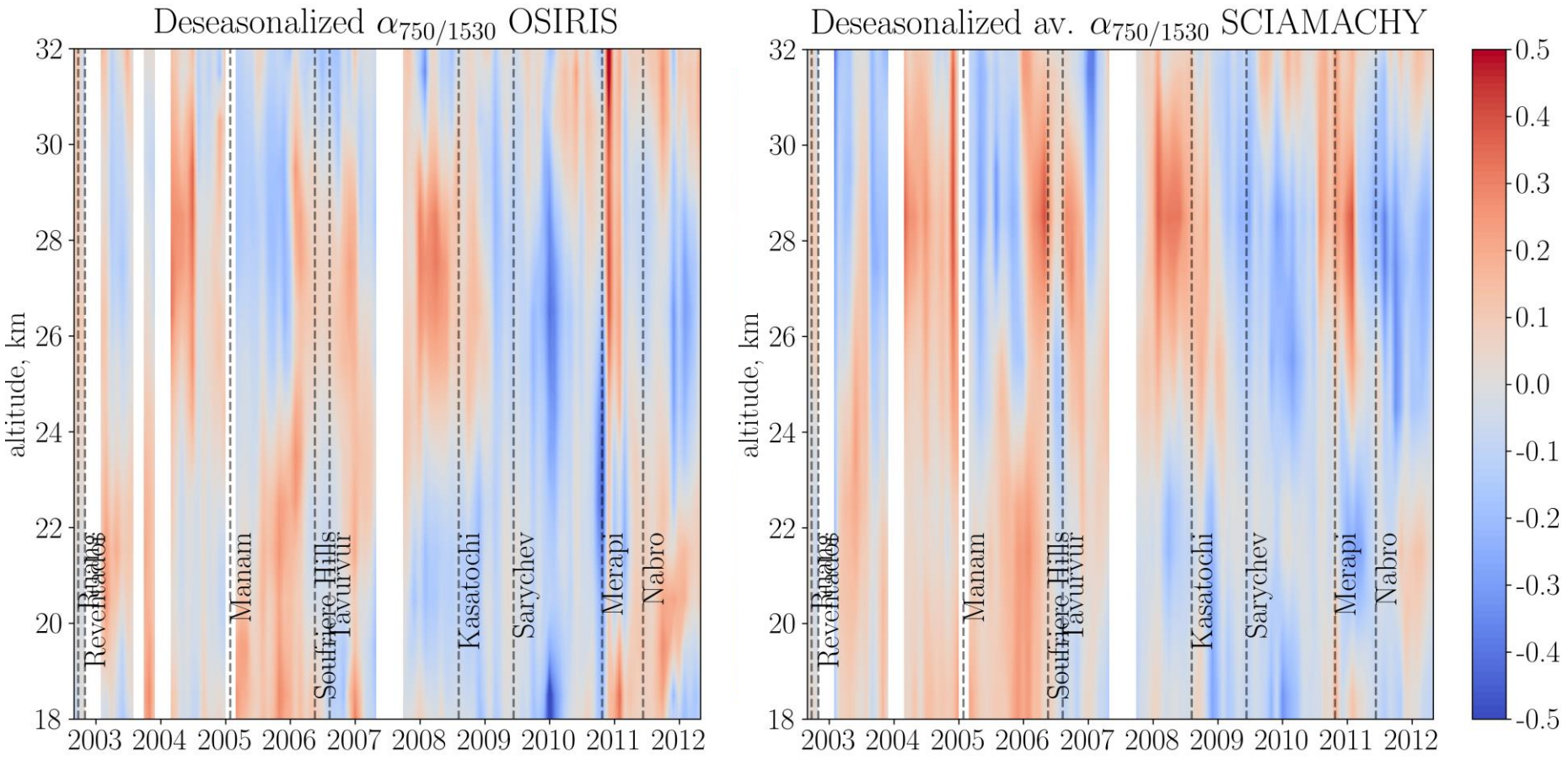
ANGSTROM EXPONENT COMPARISON



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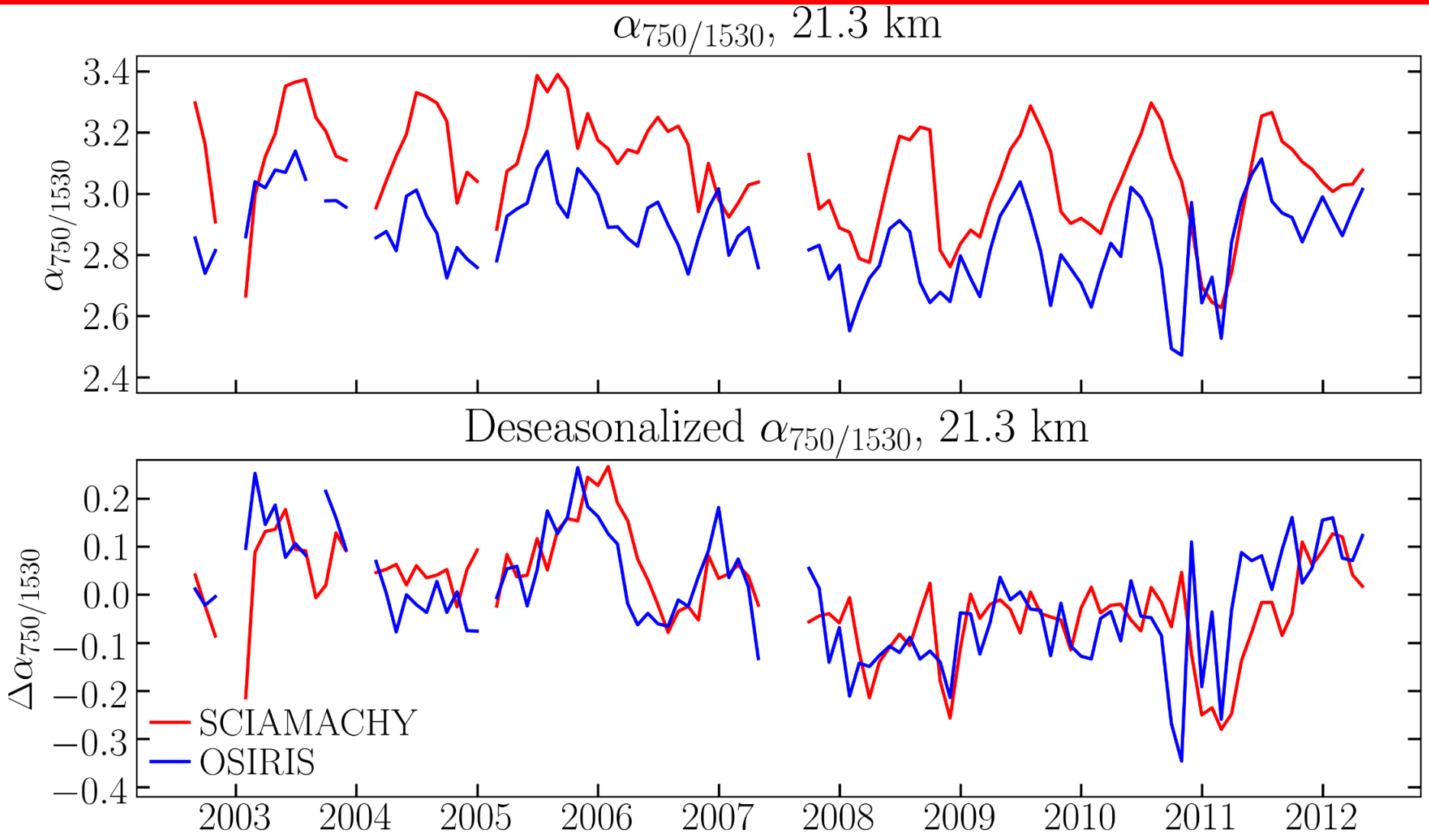
ANGSTROM EXPONENT COMPARISON



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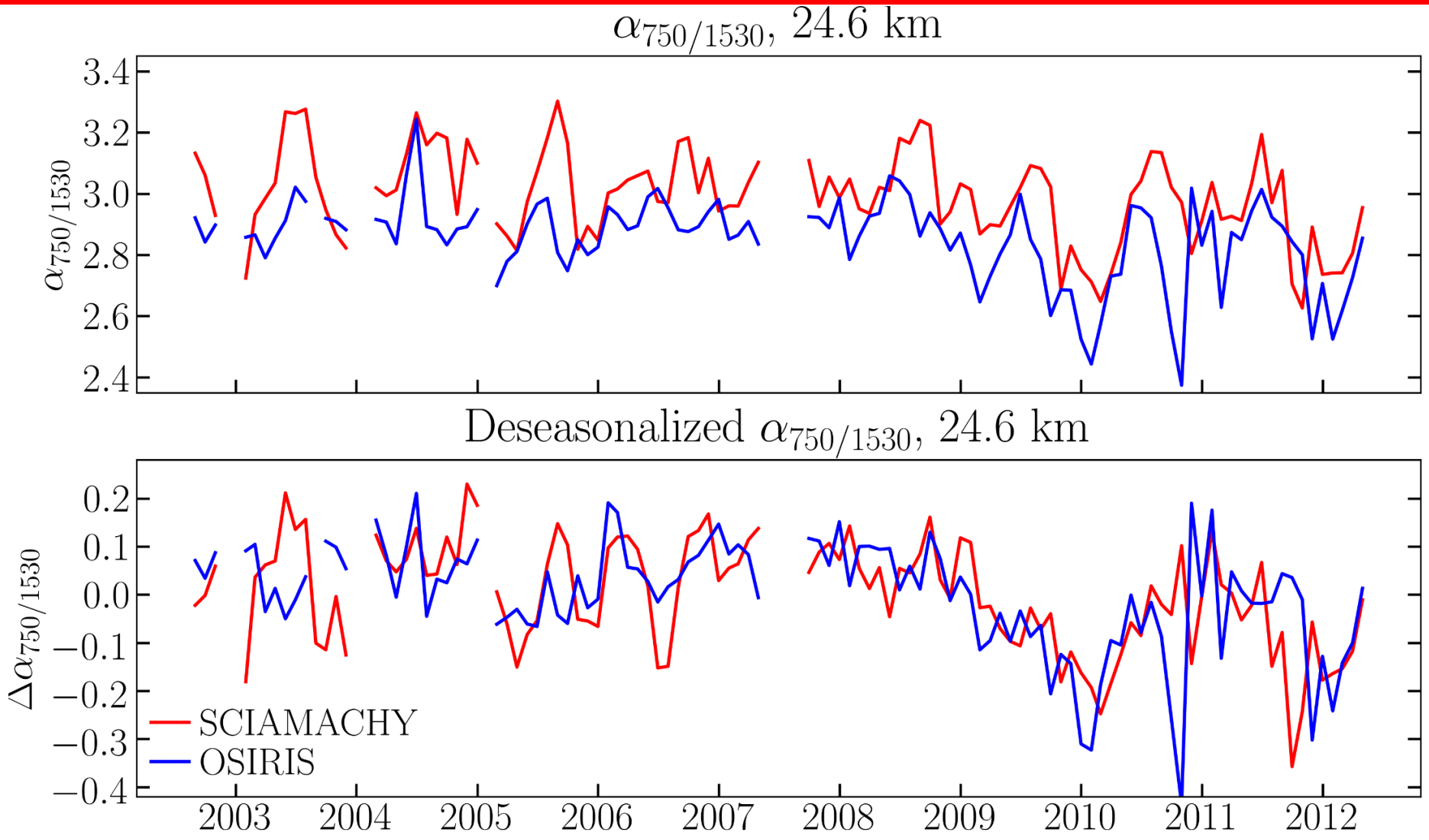
ANGSTROM EXPONENT COMPARISON



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VI. Conclusions

SUMMARY

- Agreement between OSIRIS, SCIAMACHY and SAGE II aerosol extinction profiles is generally good, particularly in the tropics, with larger biases at higher latitudes
- Good agreement of OSIRIS v5.07 and SCIAMACHY V1.4 extinction climatologies
- Good agreement of the Angström exponents between SCIAMACHY and OSIRIS (difference within 10 %)

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Acknowledgements USask: this work was supported by the Natural Sciences and Engineering Research Council (Canada) the CSA, ESA, DAAD.
Data: the SAGE data were obtained from the NASA Langley Research Center EOSDIS Distributed Active Archive Center.
Many thanks to Terry Deshler for the balloons OPCs data.

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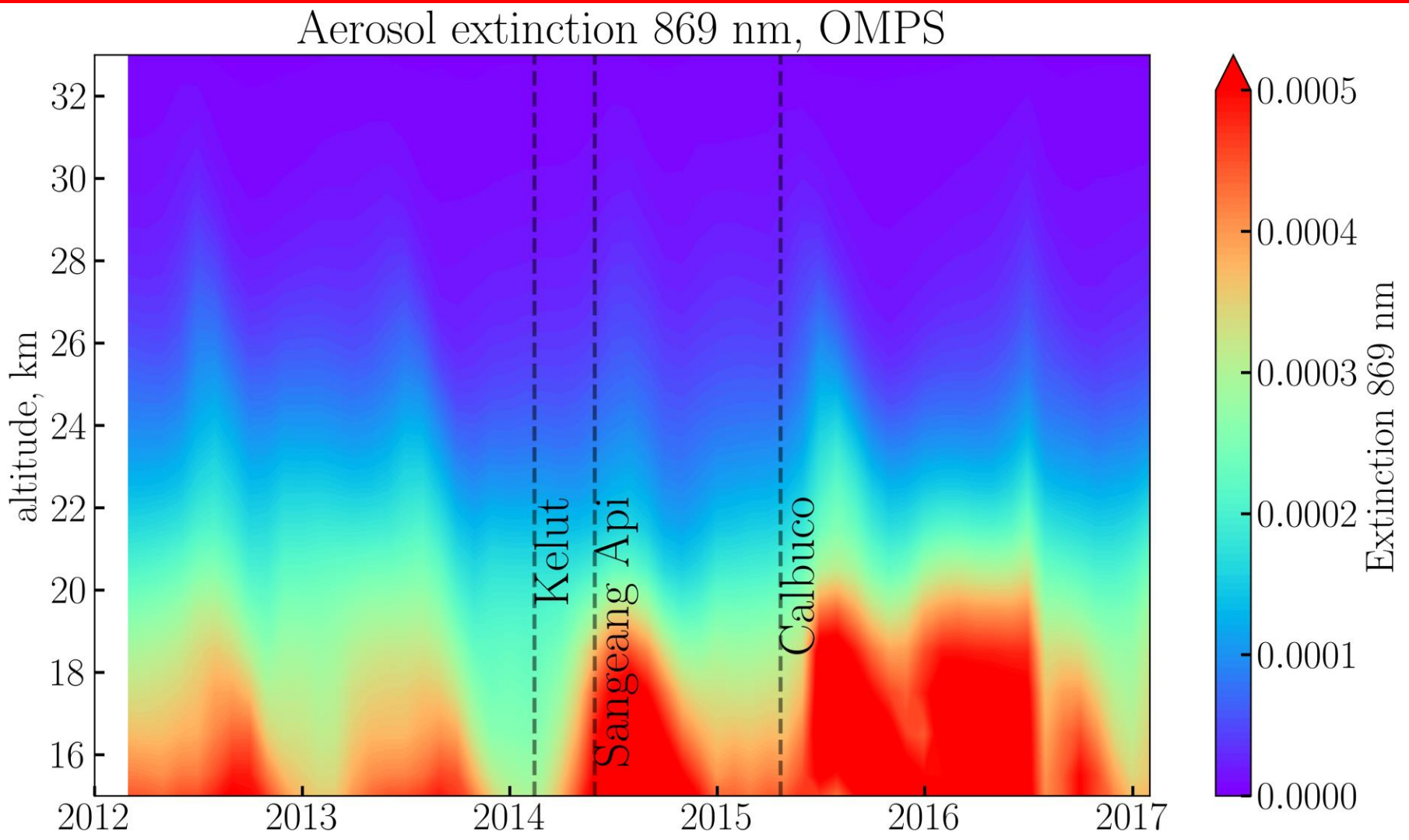
VII. What's next?

OMPS EXTINCTION



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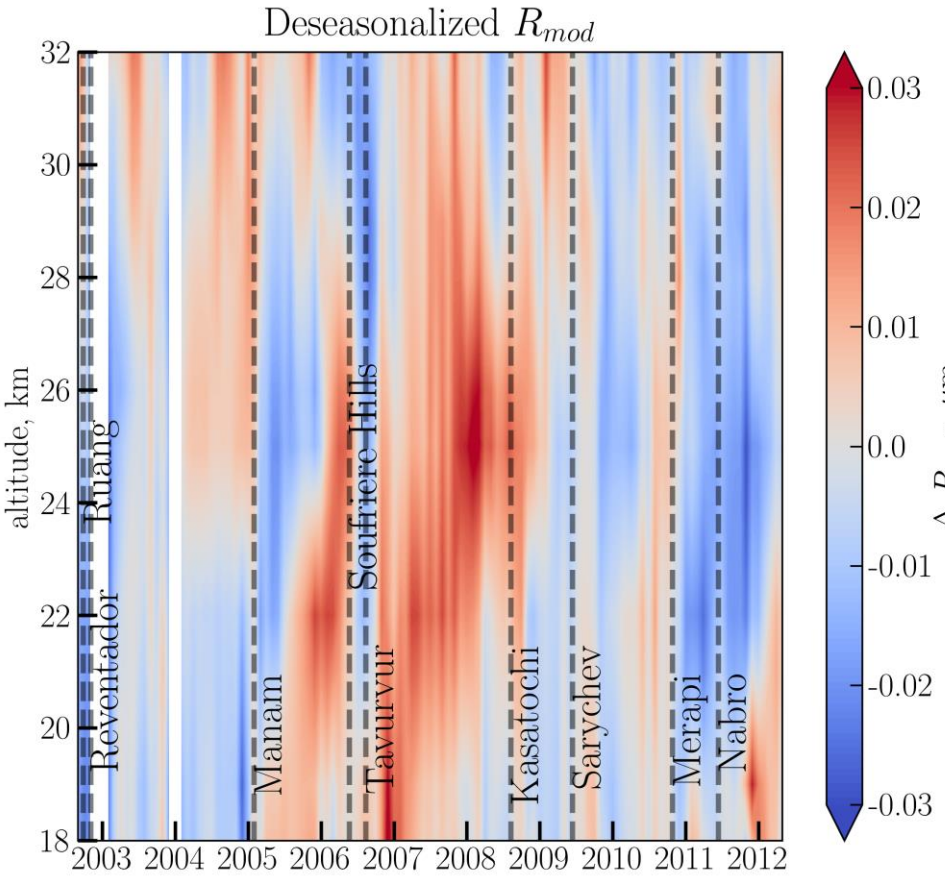
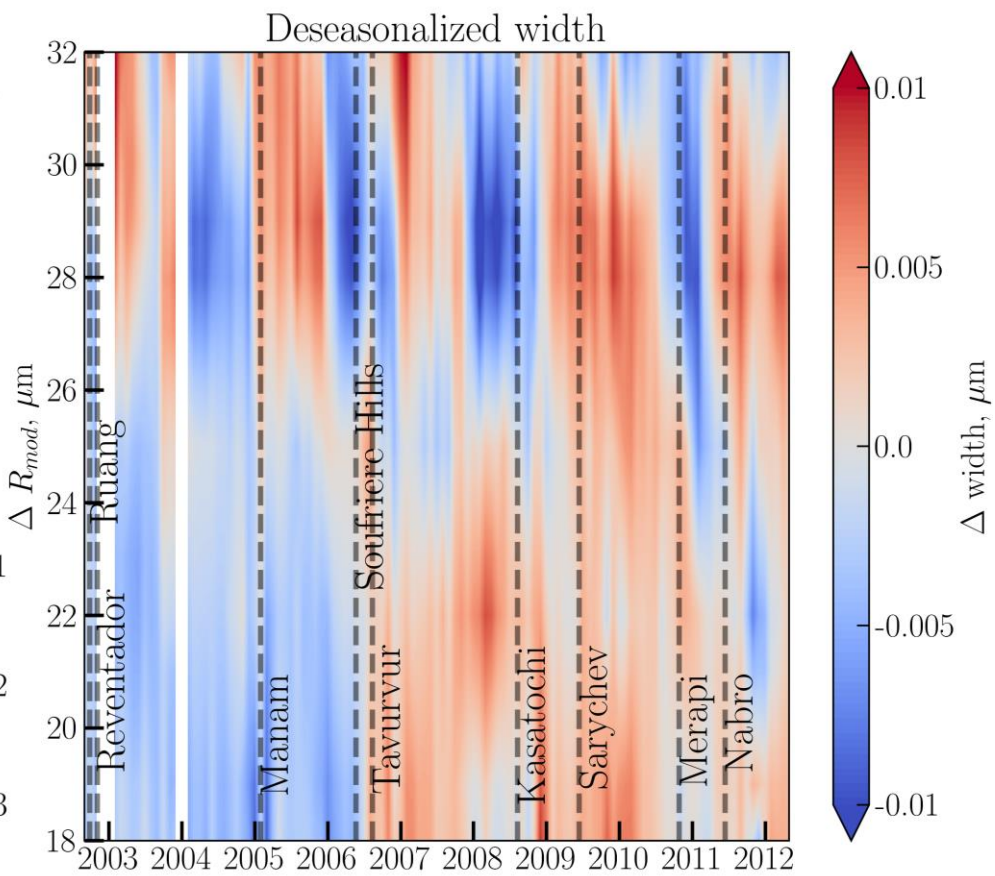
Extra

RETRIEVED PARAMETERS





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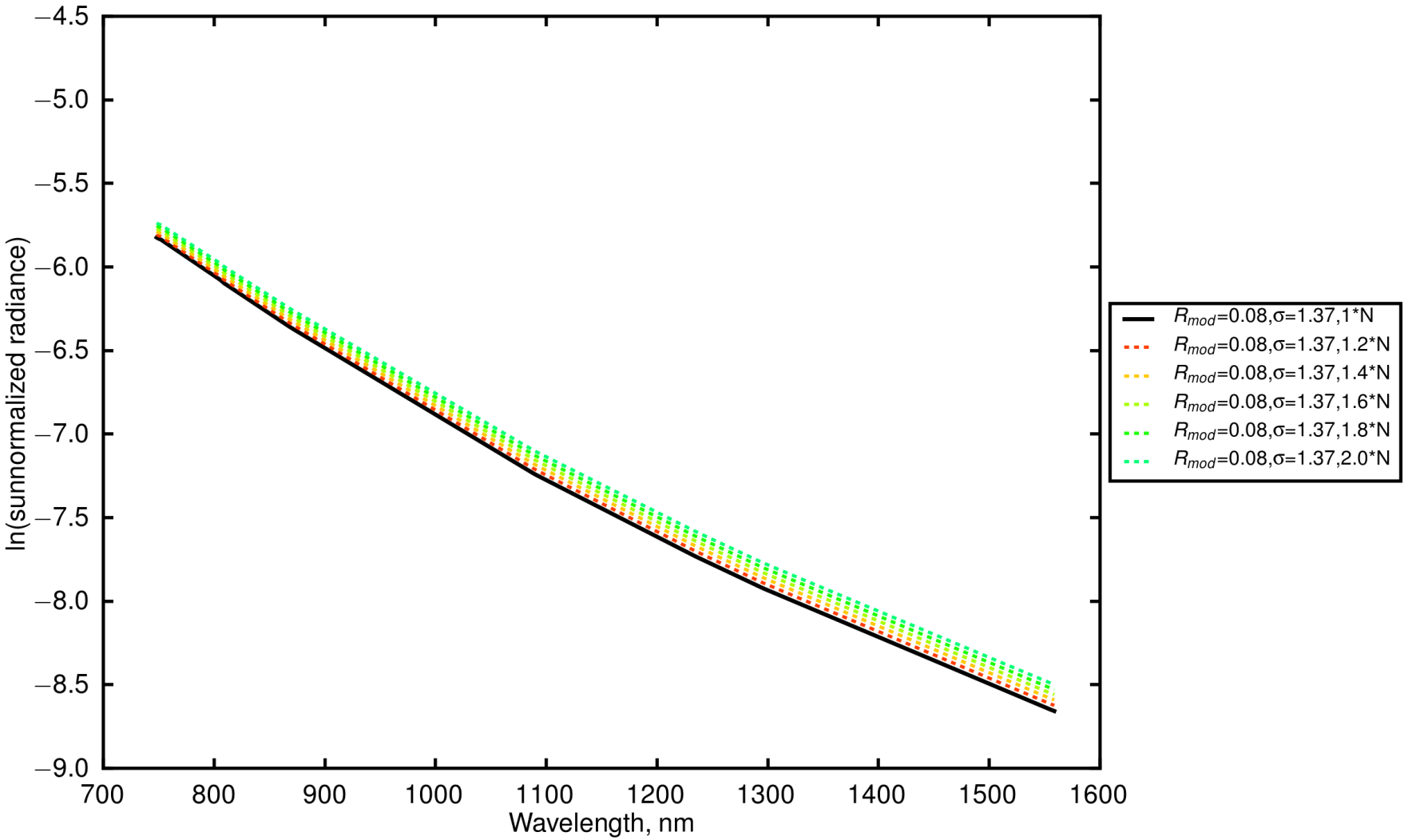
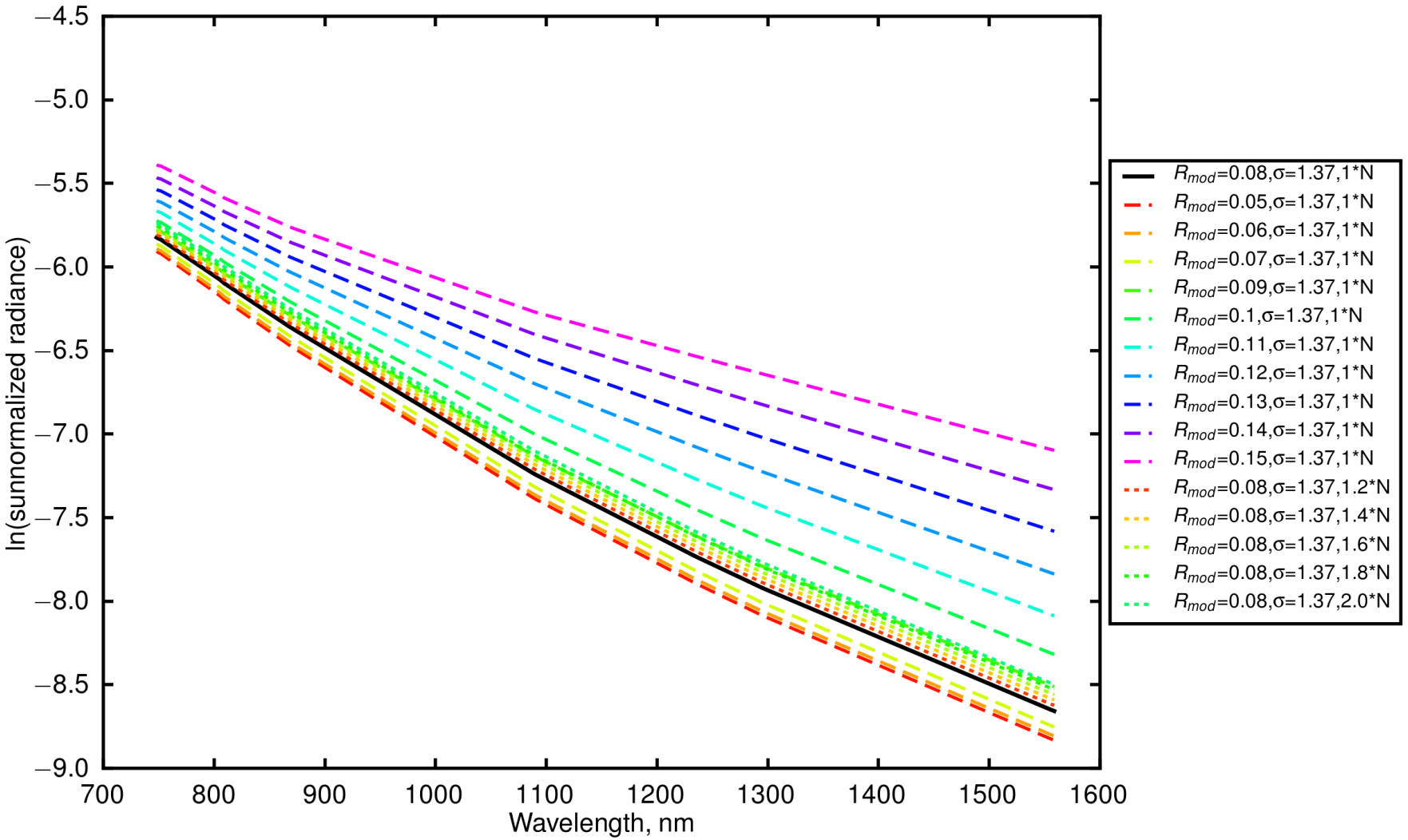
MODELED INTENSITIES WITH DIFFERENT PSD



MODELED INTENSITIES WITH DIFFERENT PSD



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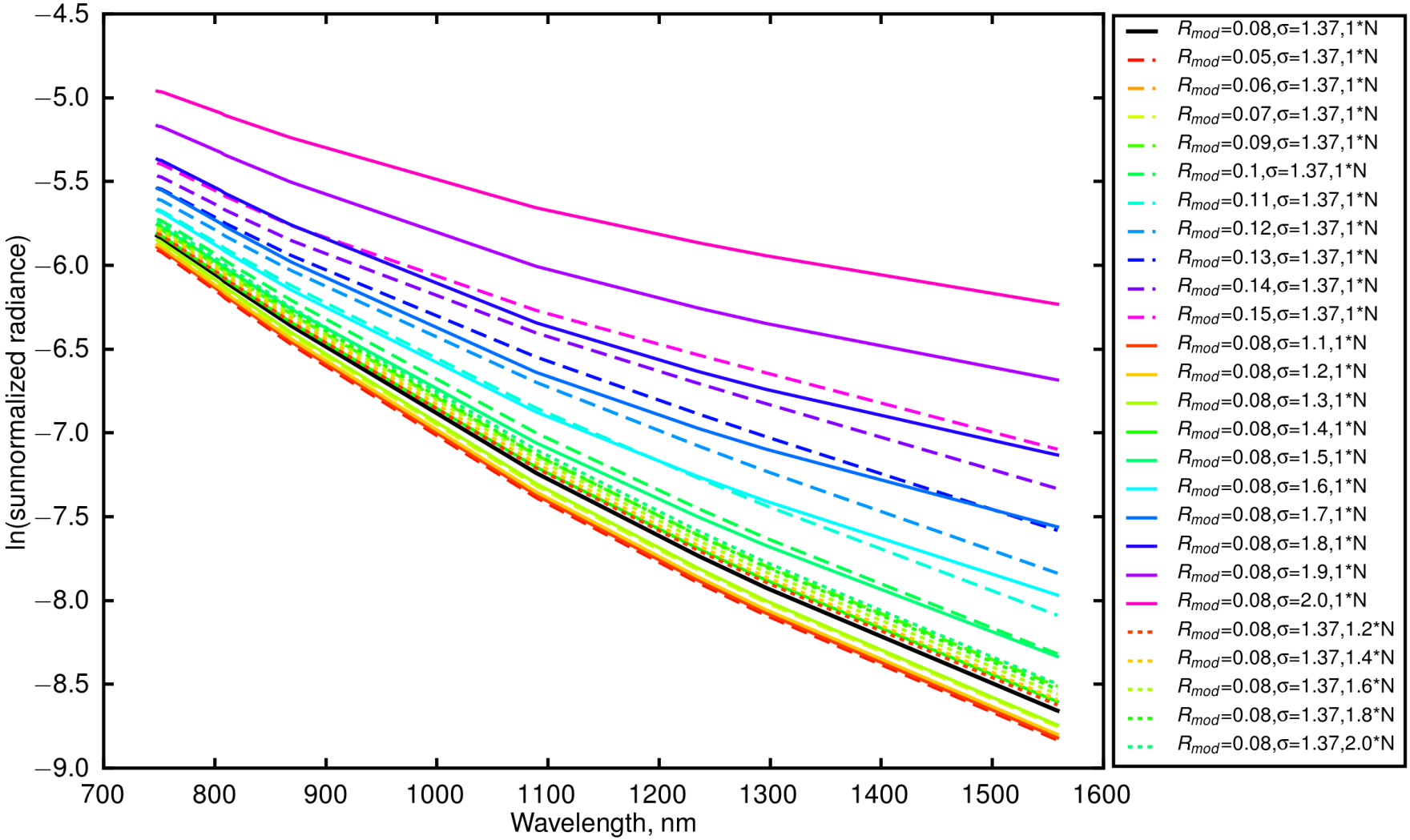
MODELED INTENSITIES WITH DIFFERENT PSD



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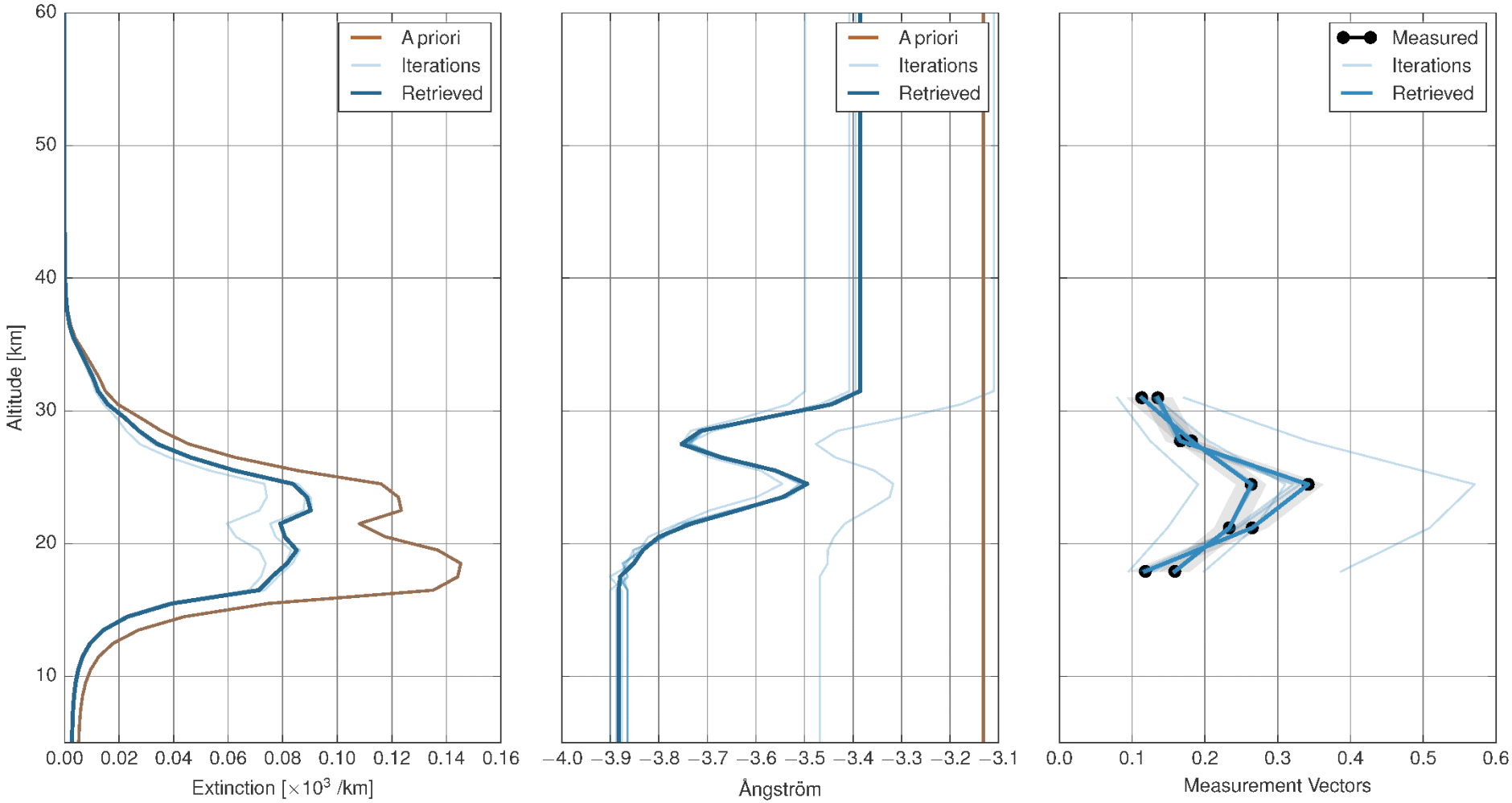
SCIAMACHY ON SASKTRAN



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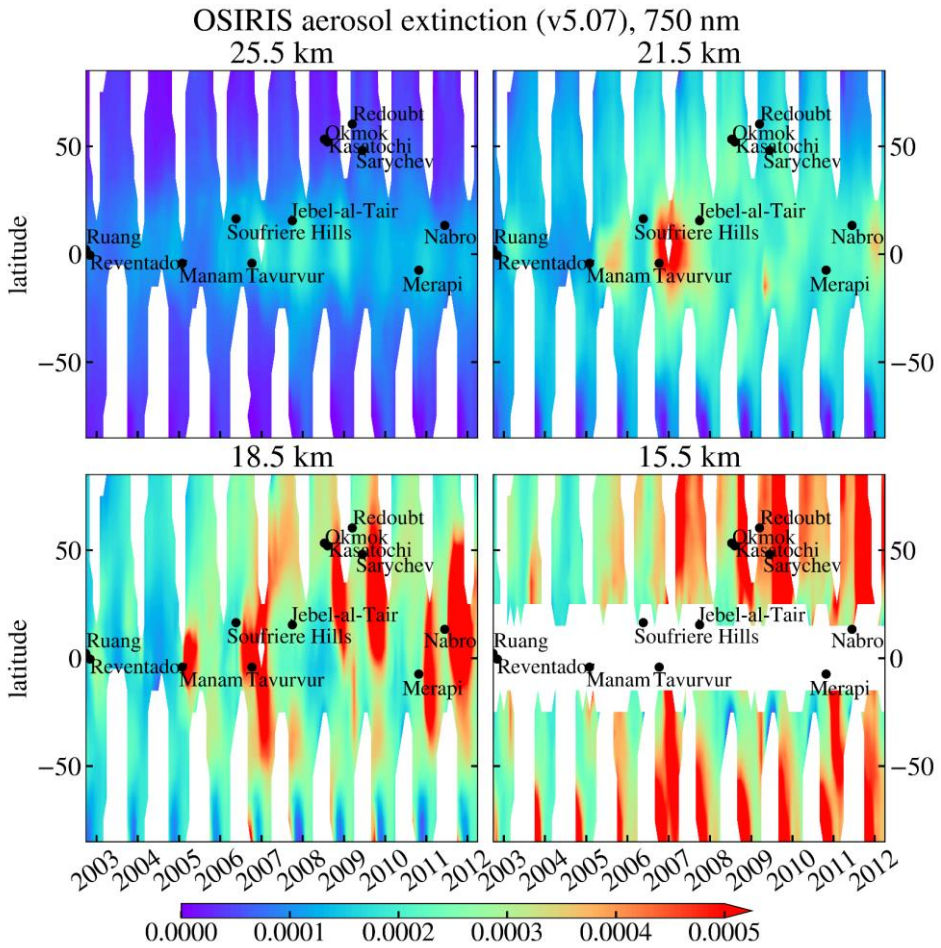
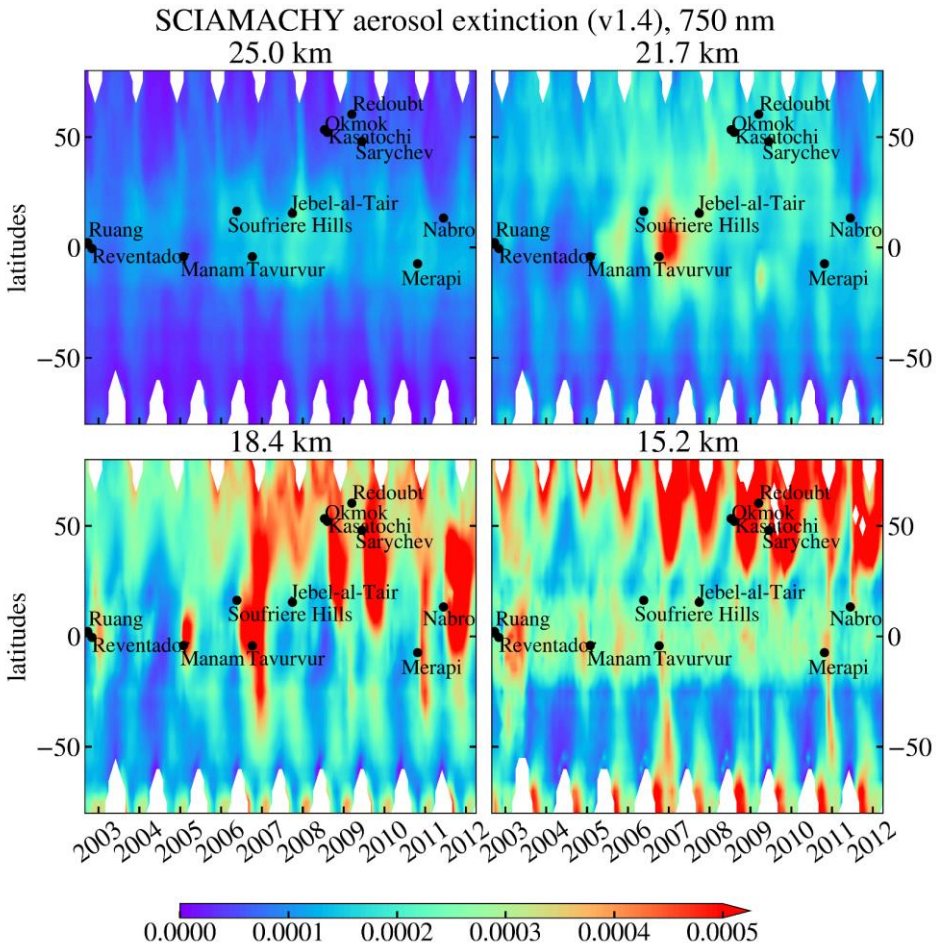
CLIMATOLOGIES COMPARISON

OSIRIS v5.07

SCIAMACHY v1.4





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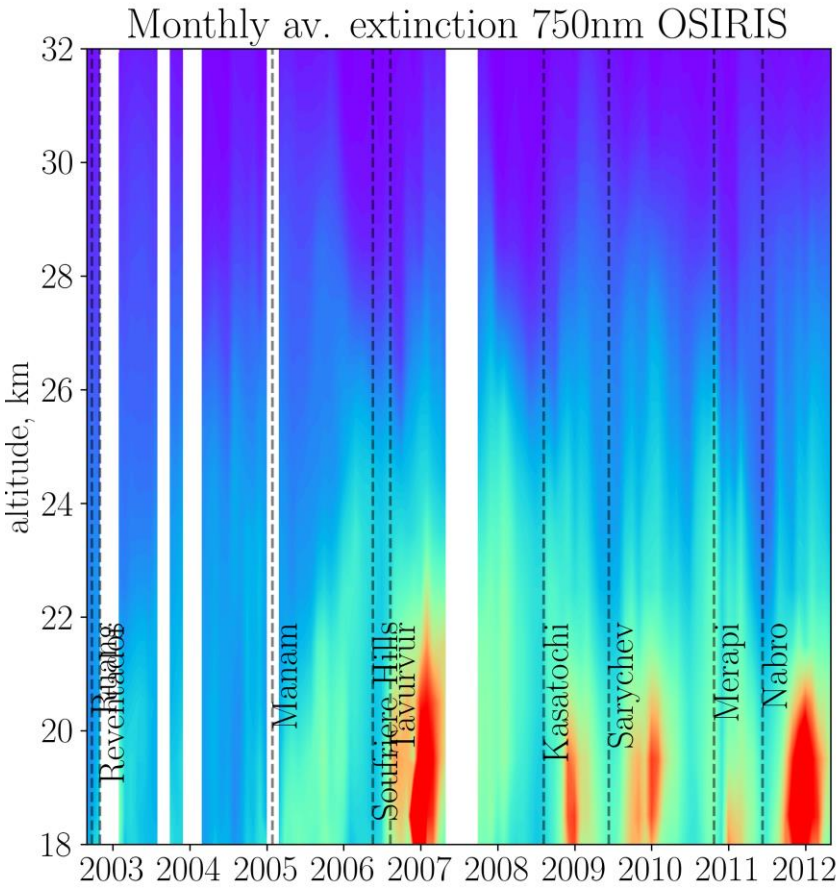
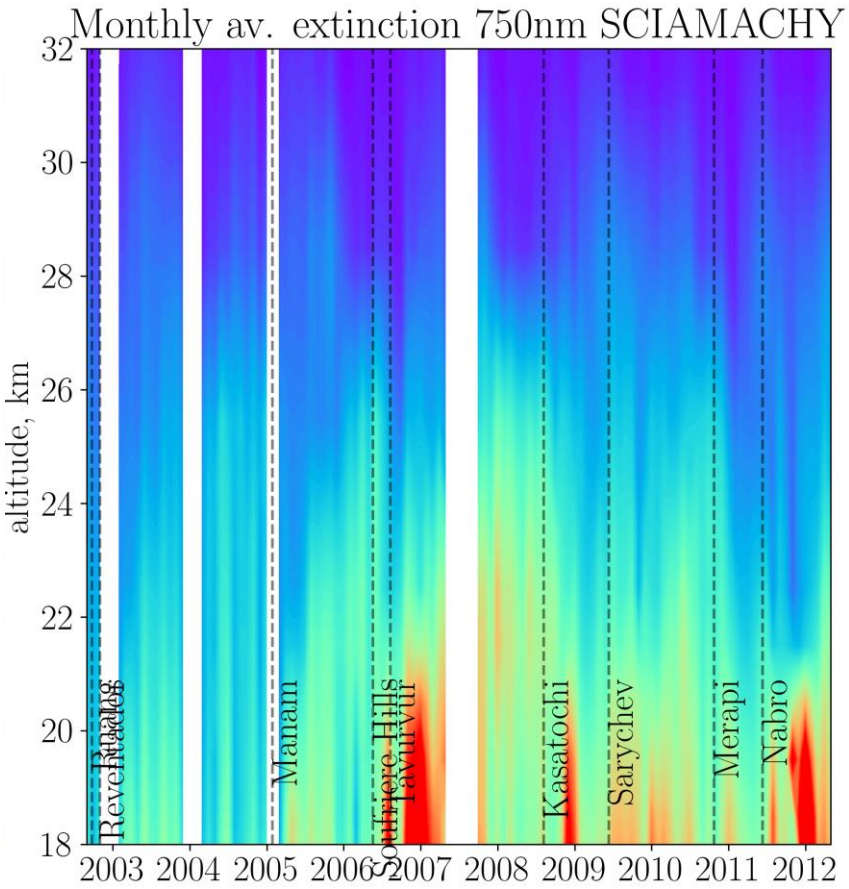
EXTINCTION COMPARISON





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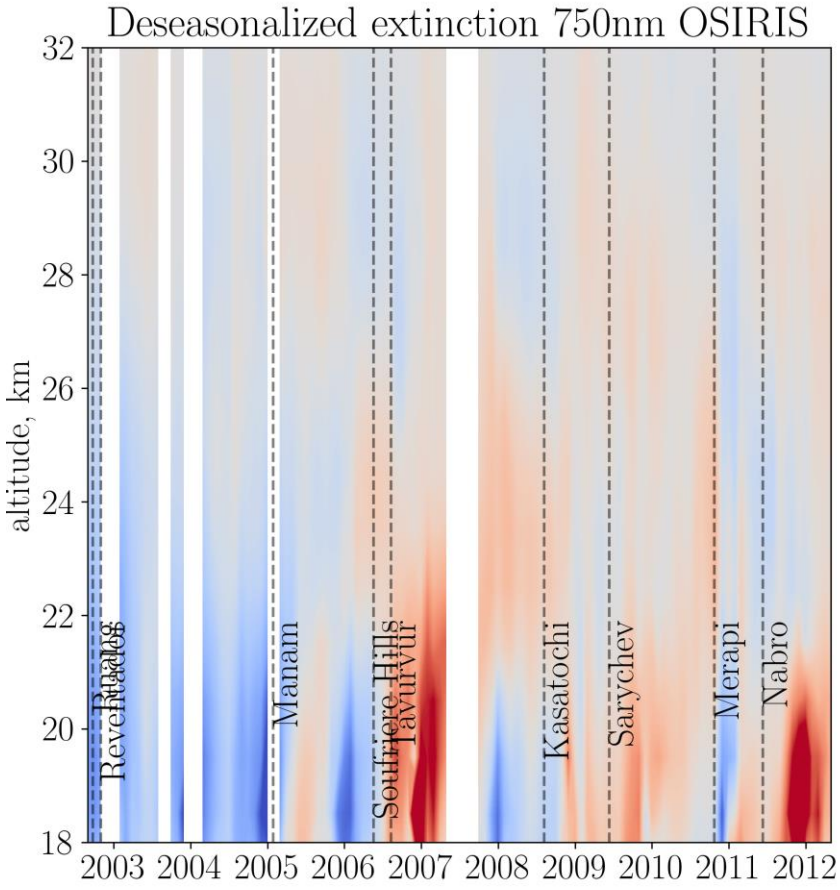

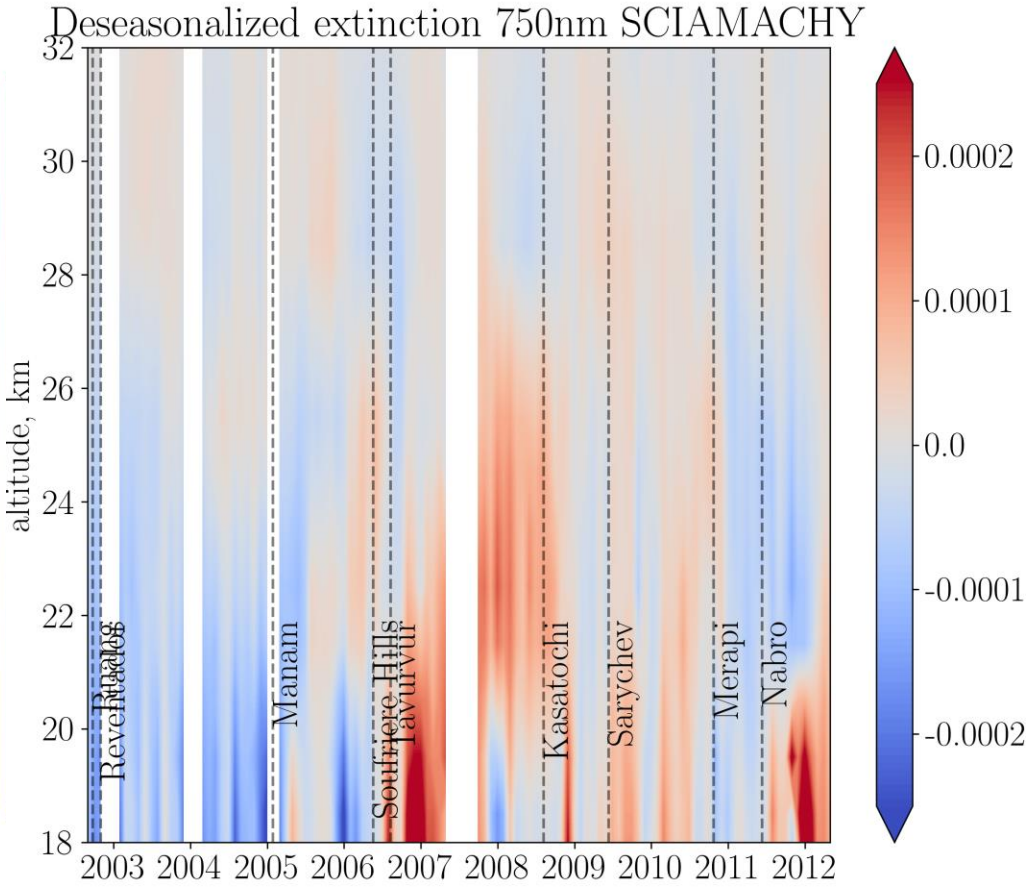

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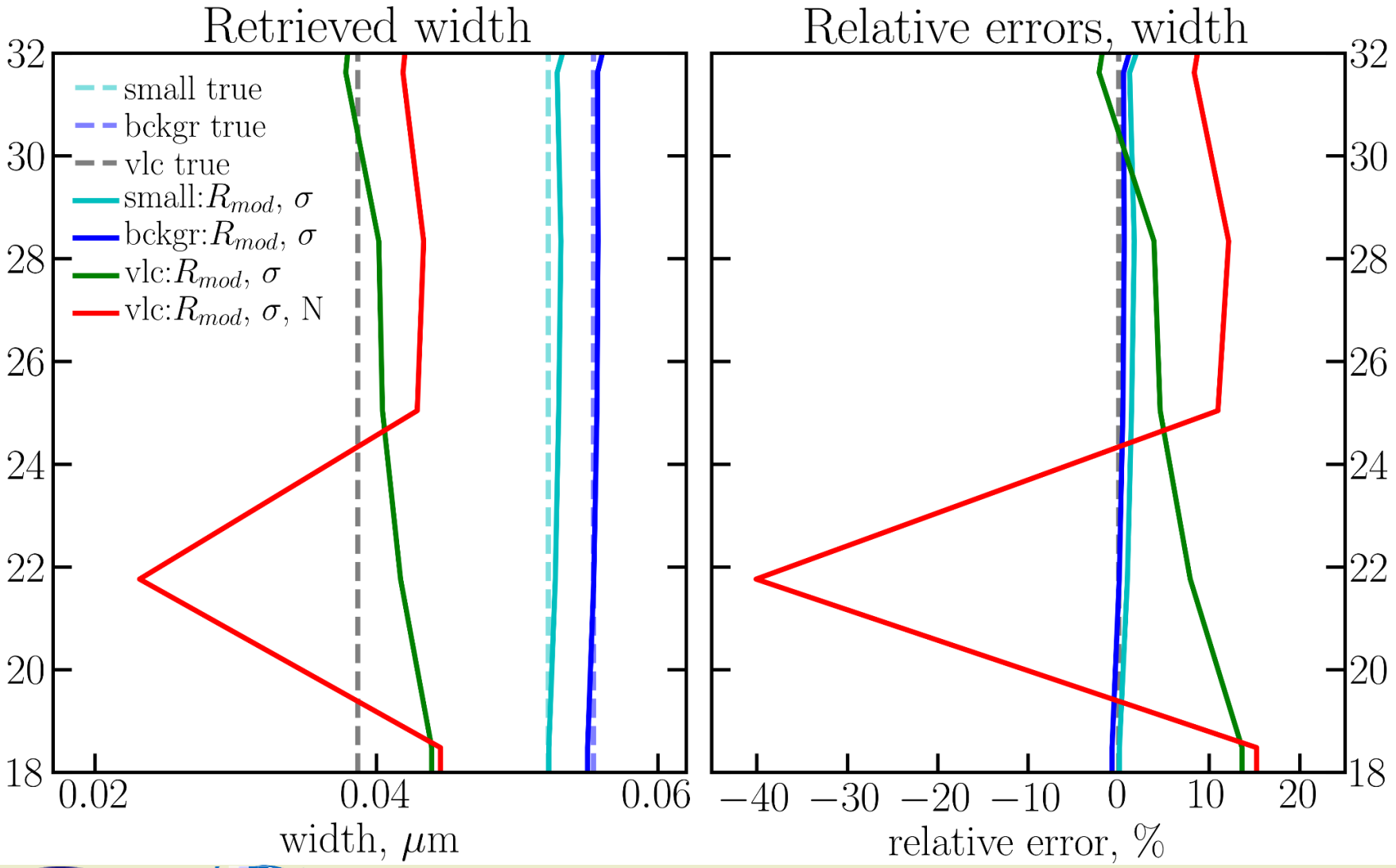
SYNTHETIC RETRIEVALS (WIDTH)



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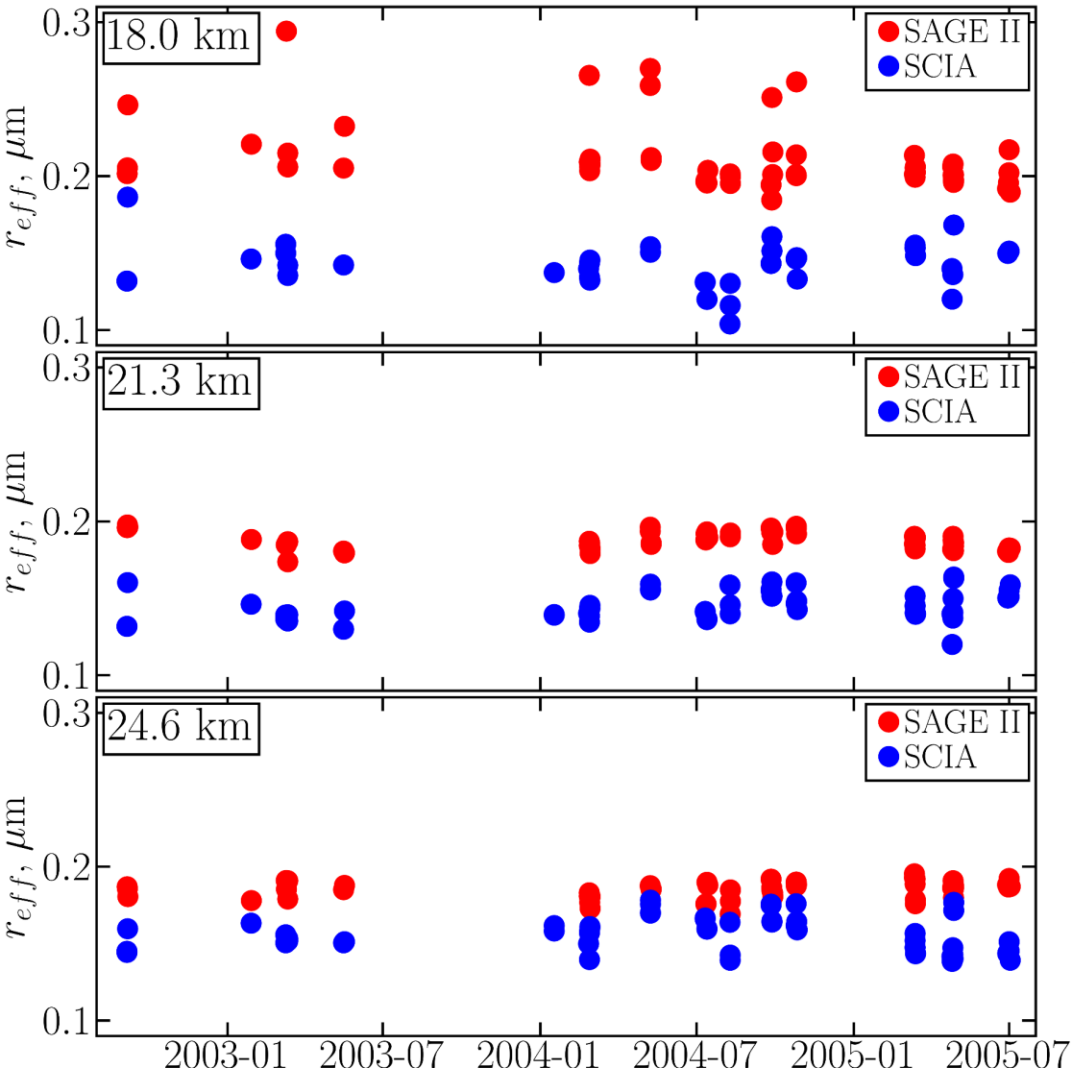
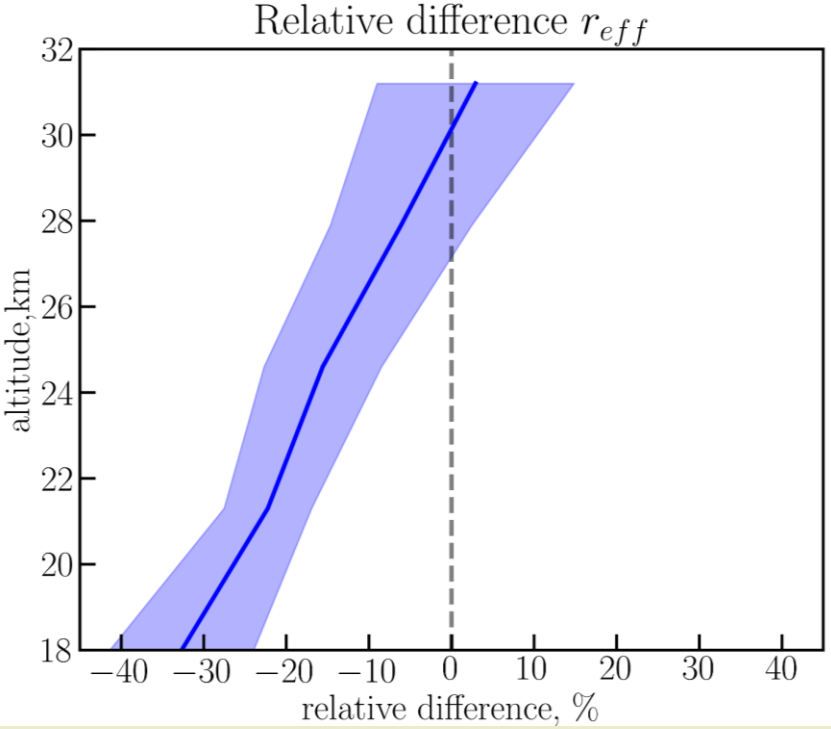
SAGE II COMPARISON



- August 2002 – August 2005
- ±5° latitude, ±10° longitude, ±24 hours (38 cases)
- Effective radii comparison

$$r_{eff} = r_0 * \exp(5 \ln(\sigma)^2 / 2)$$



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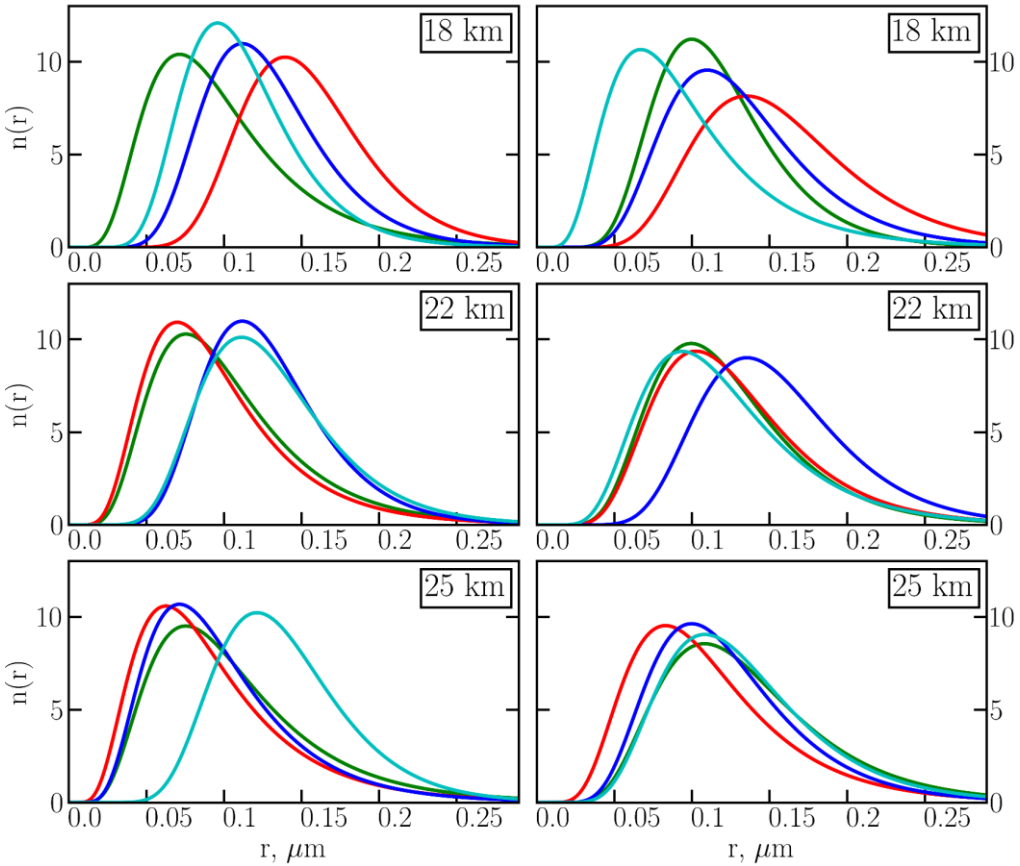
SERIES



24 January 2005
✱eruption: Manam(28 Jan. 2005)
30 March 2005
09 August 2005
31 March 2006

22 April 2006
✱eruption: Tavurvur(11 Aug. 2006)
06 September 2007
05 April 2007
31 November 2007

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