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Differences in penetration depth for MODIS and RSP/VIIRS spectral ice cloud effective particle size retrievals

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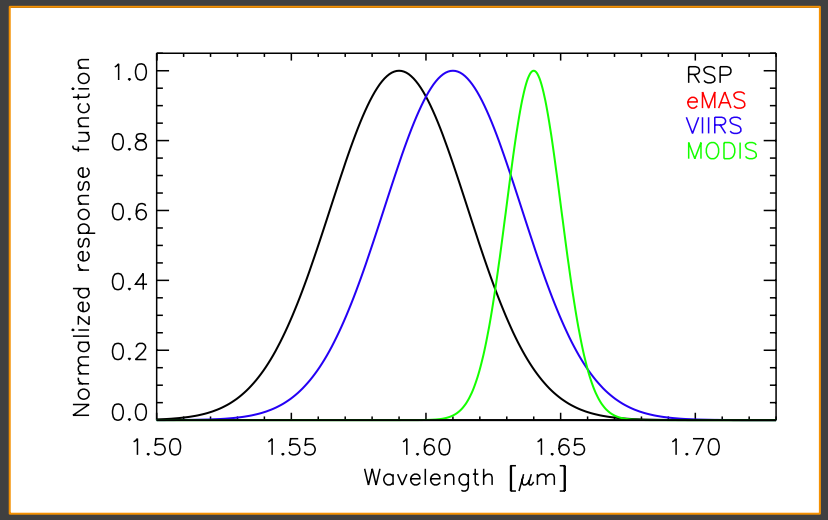
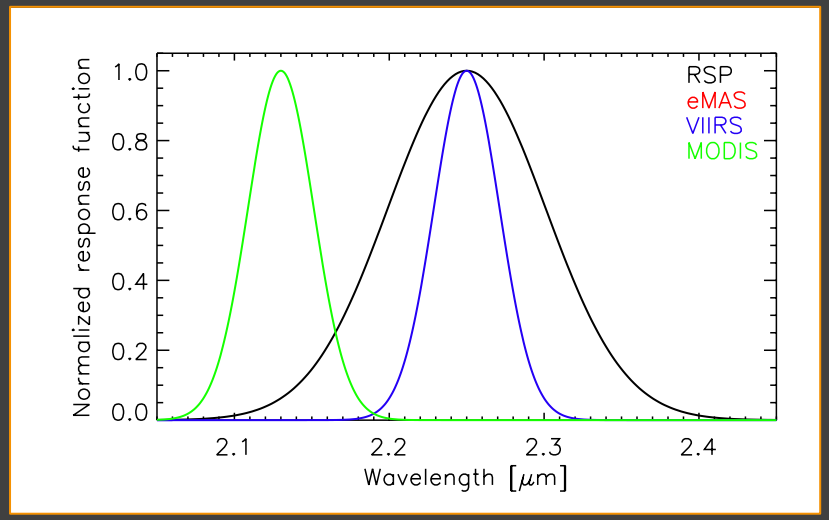
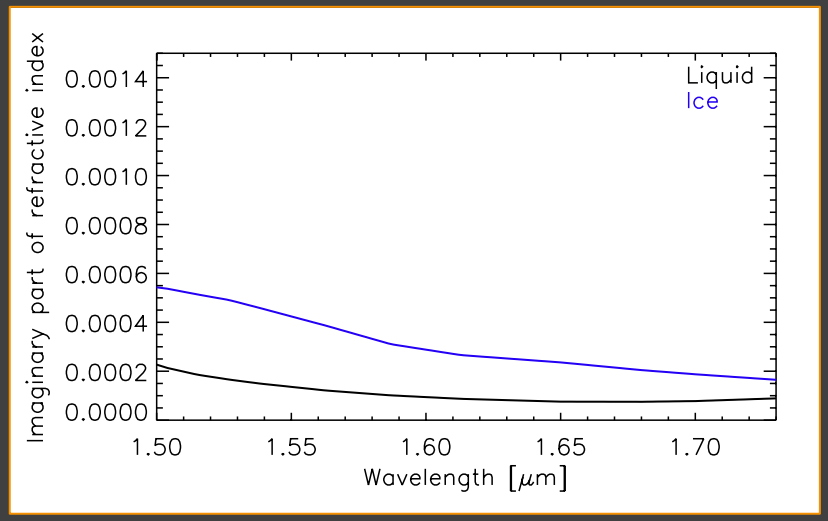
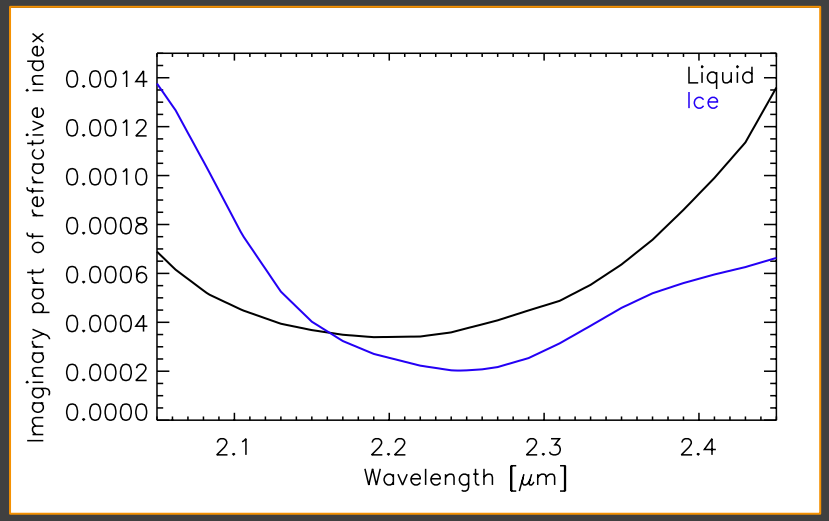
SWIR bands and absorption



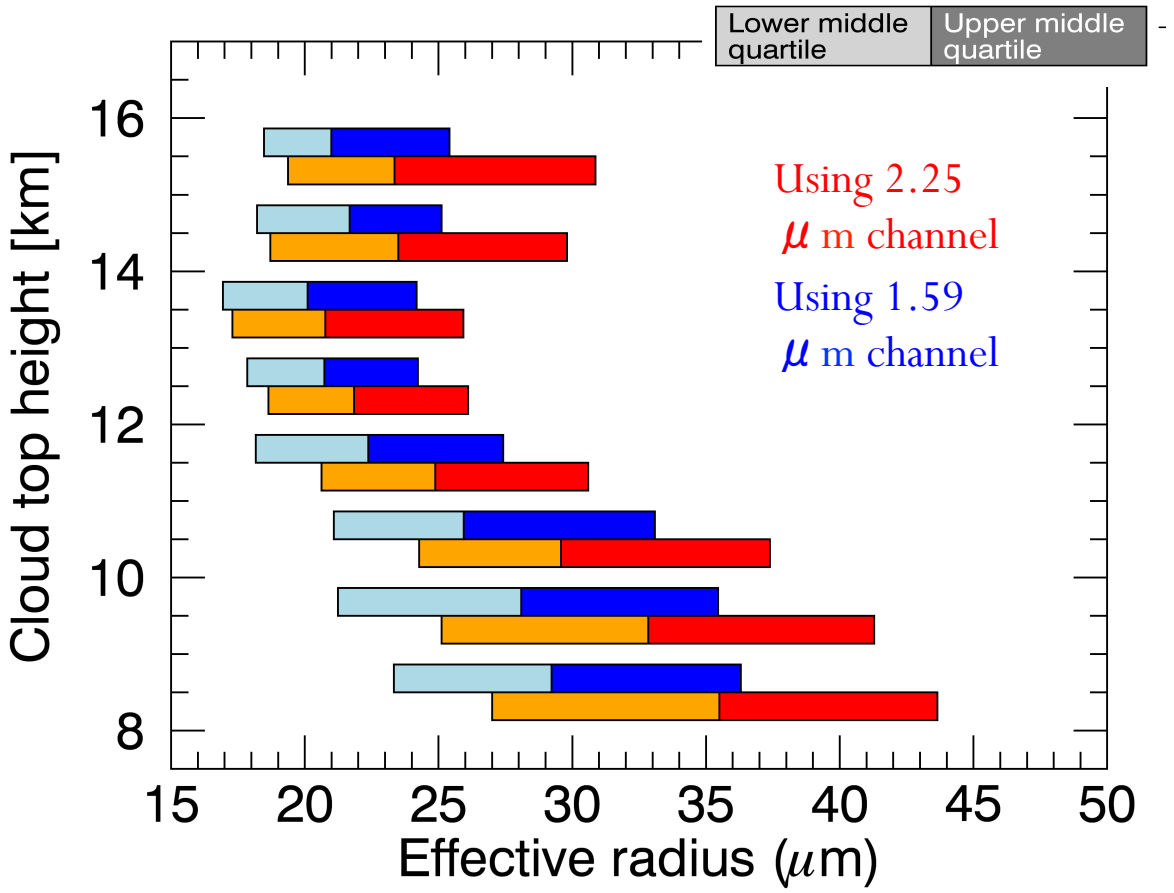






RSP data from the SEAC^{4}RS campaign

- Convective clouds only
- COT>5 only



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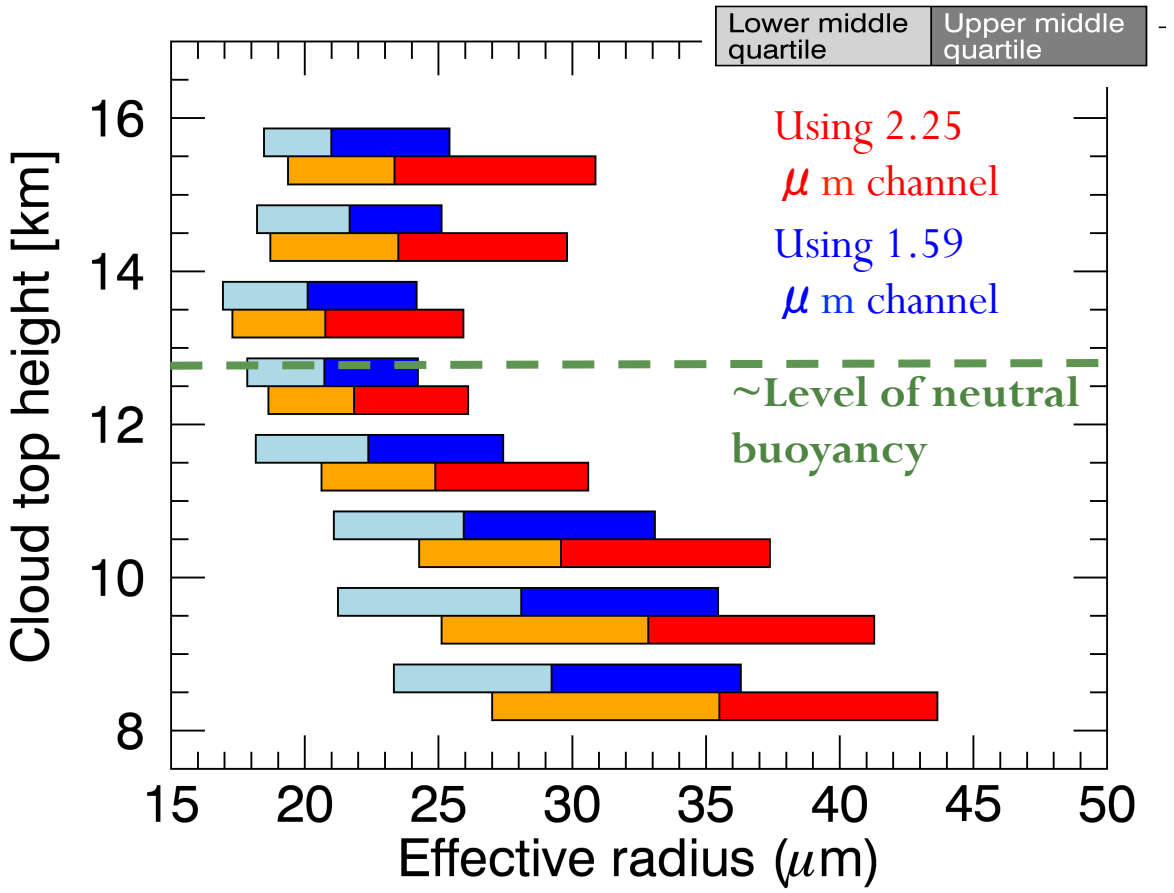
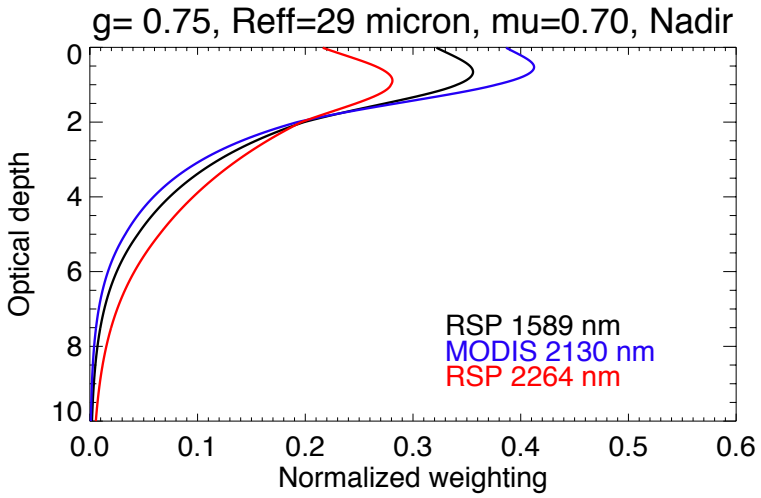
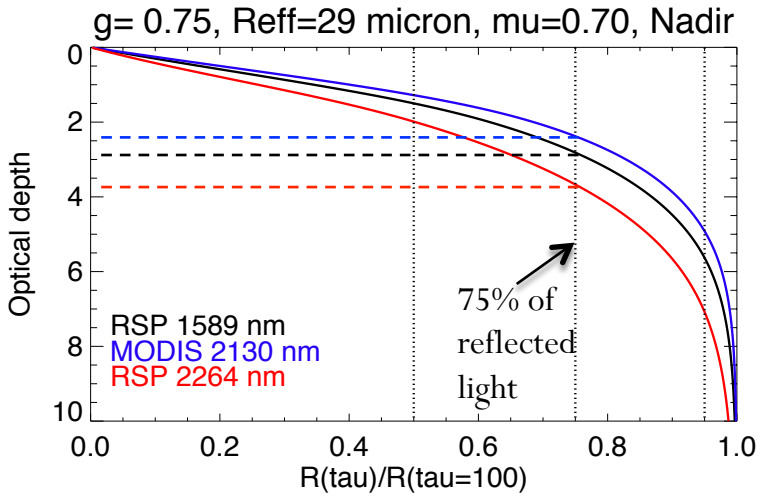


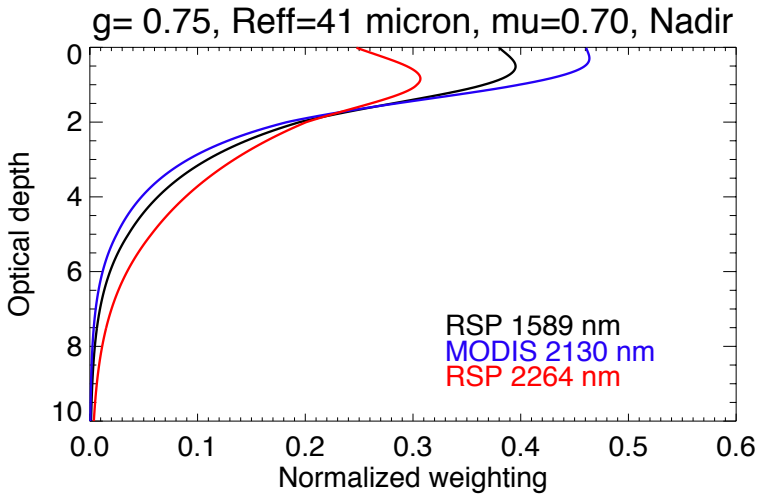
Vertical weighting functions

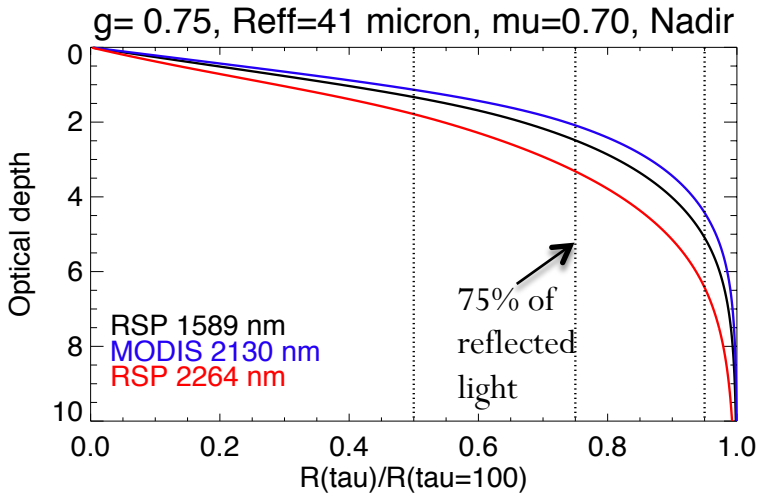




- Defined as in Platnick (2000)
- Homogeneous layers

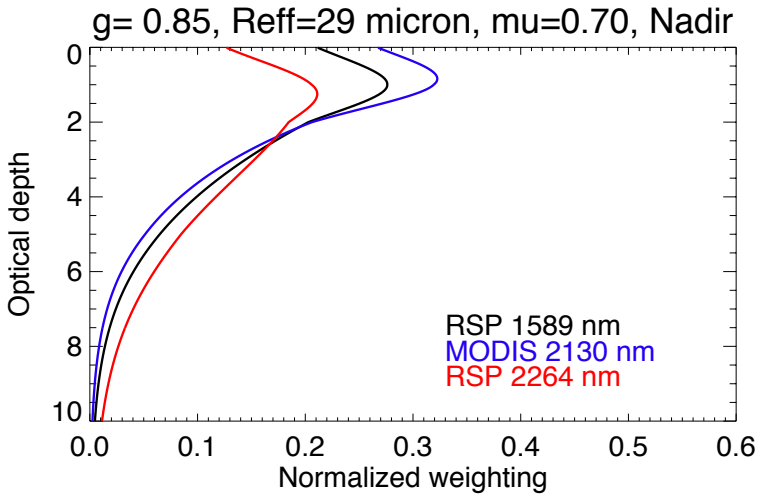
Vertical weighting functions: Larger particle size

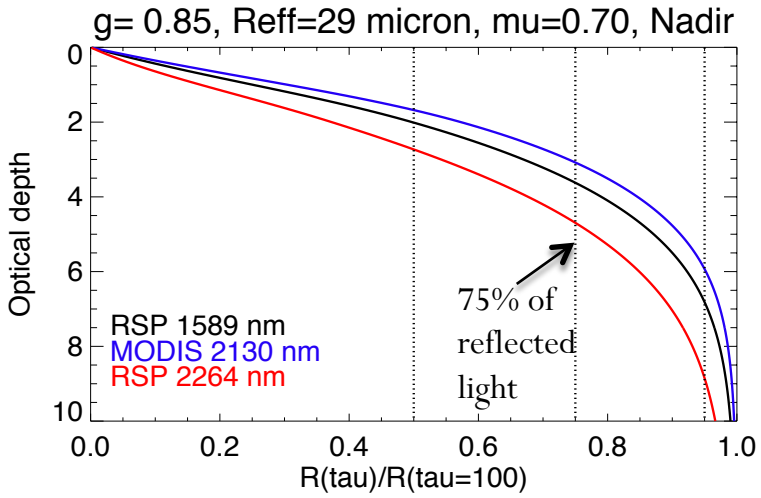




- Defined as in Platnick (2000)
- Homogeneous layers

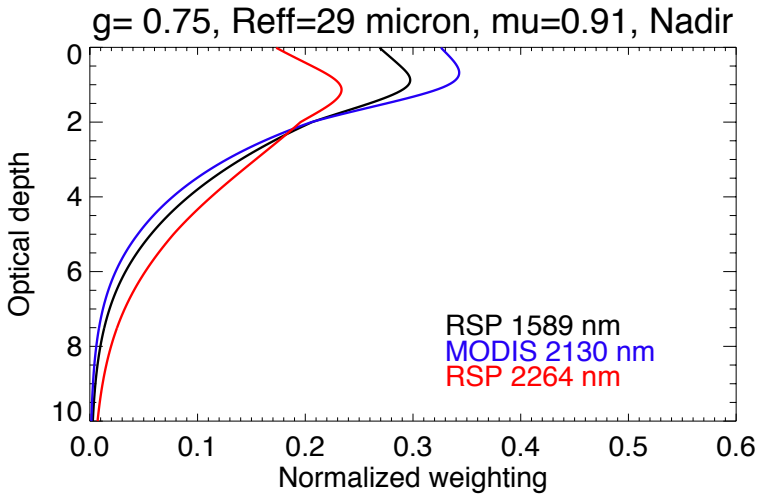
Vertical weighting functions: Larger asymmetry parameter

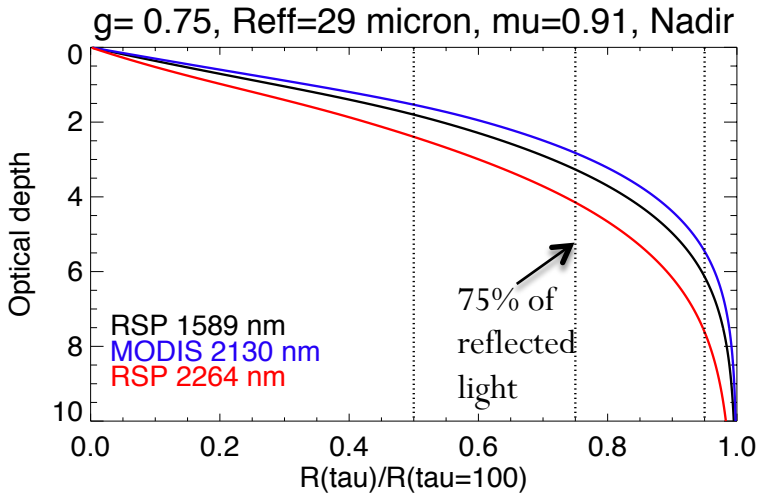




- Defined as in Platnick (2000)
- Homogeneous layers

Vertical weighting functions: Higher sun

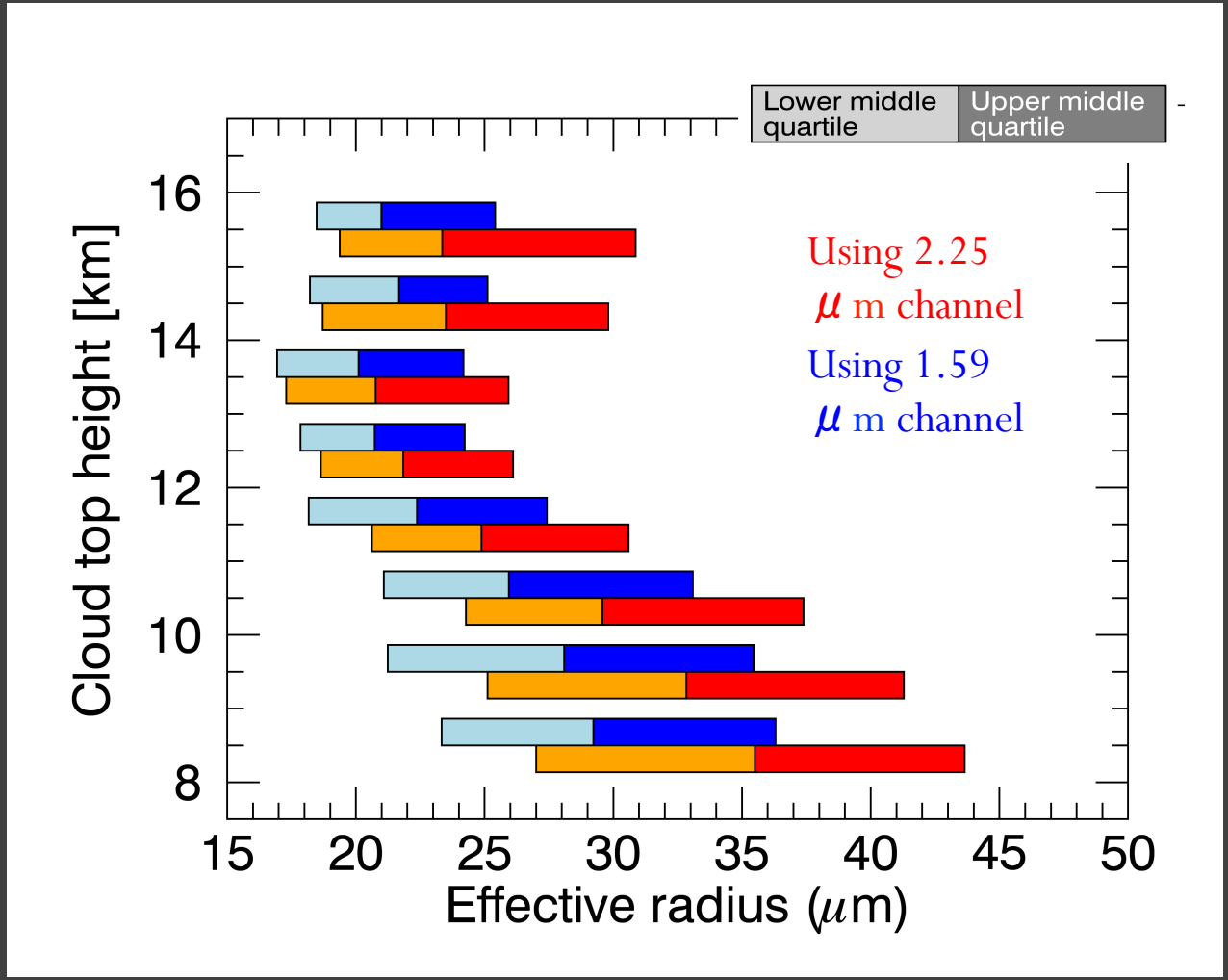




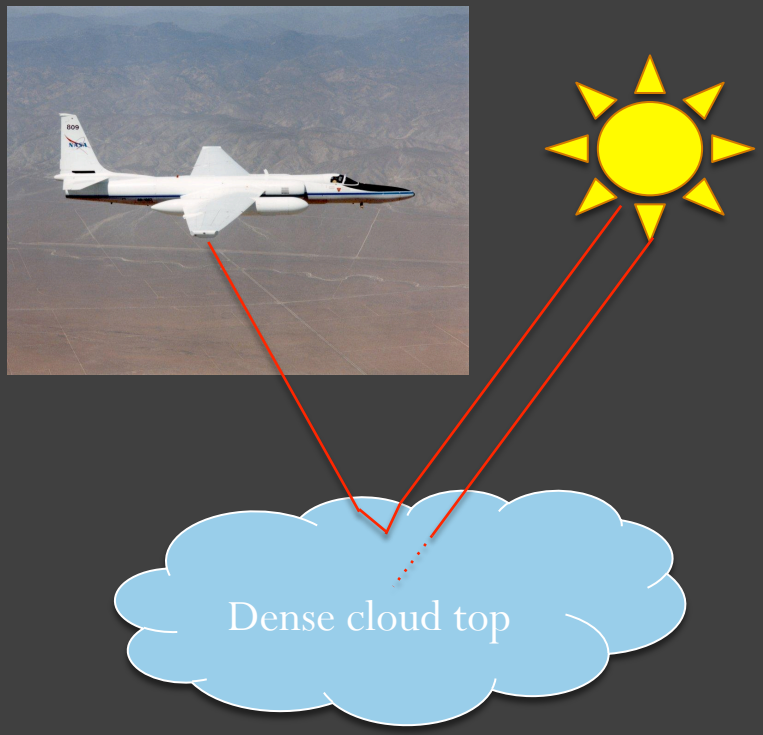
- Defined as in Platnick (2000)
- Homogeneous layers

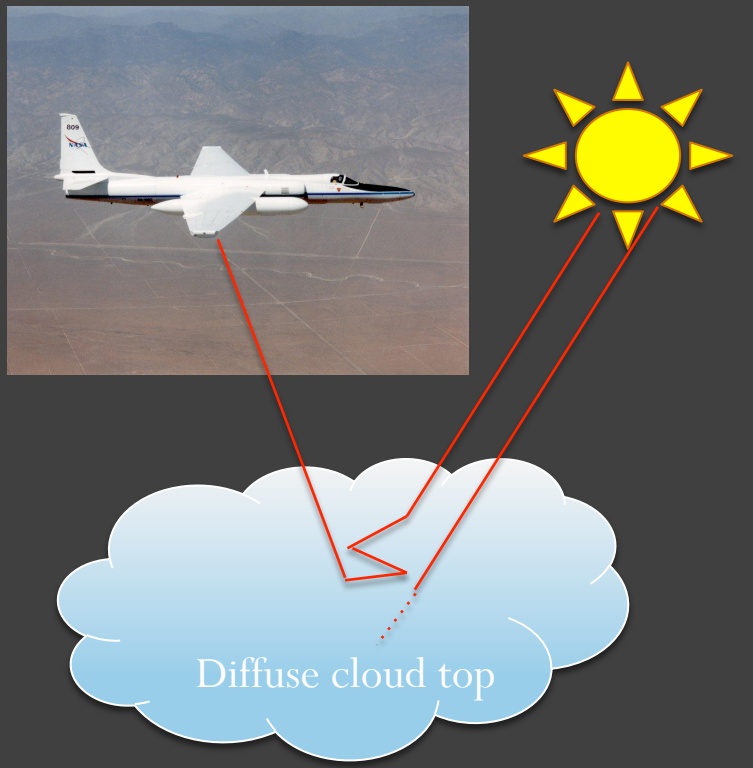
RSP data from the SEAC^{4}RS campaign

- Convective clouds only
- COT>5 only
- 2.25 micron channel sees (optically) deeper into cloud



Optical depth -> physical depth

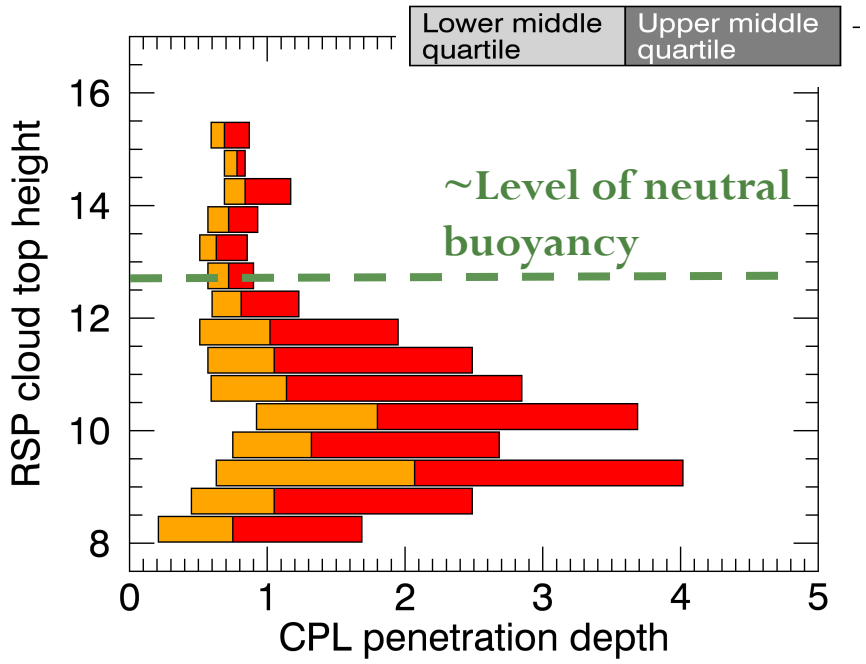


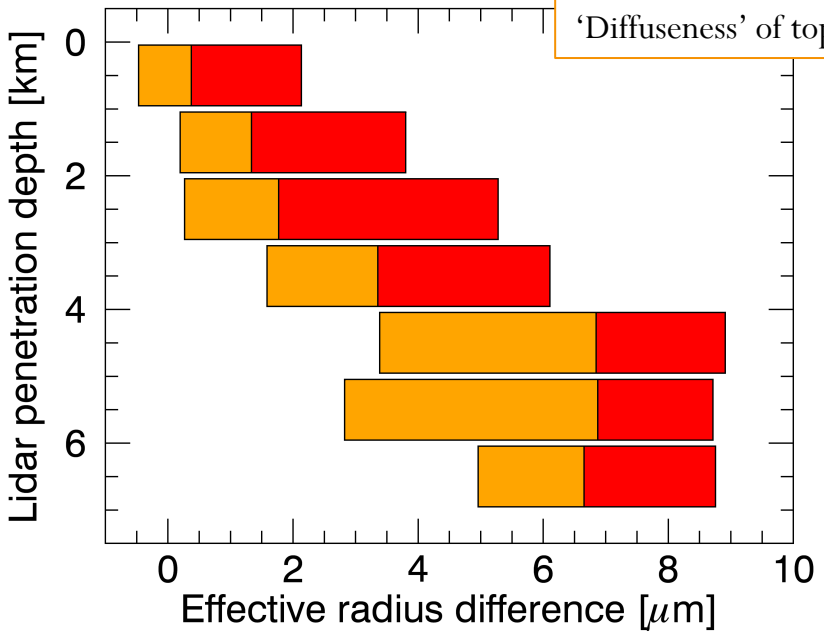


Probing cloud top ‘diffuseness’ with lidar

Lidar Penetration depth:
H(τ =0.1)-H(τ =3)

Difference between SWIR band retrievals depends on 'diffuseness' of top

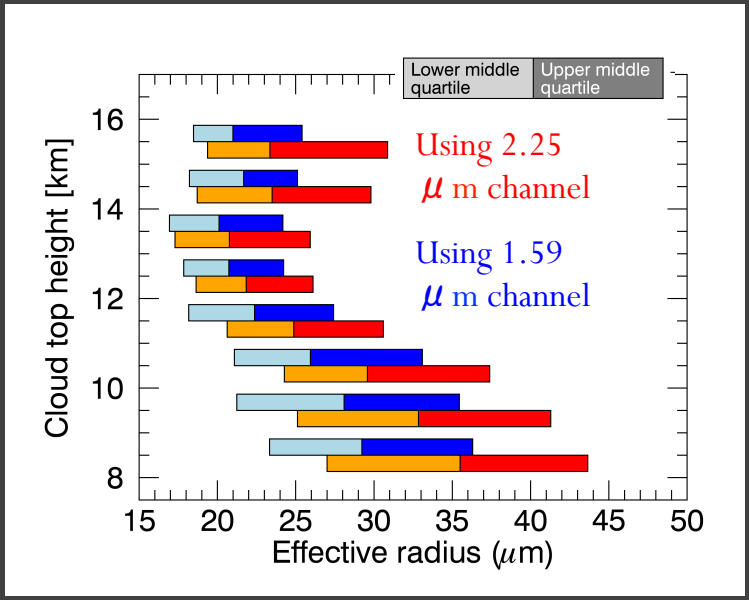


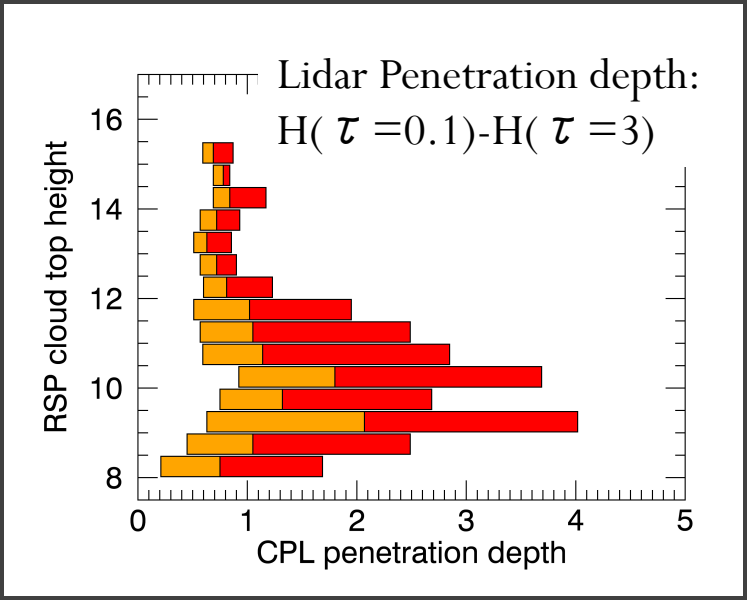


Difference in size from two channels increases with 'Diffuseness' of top

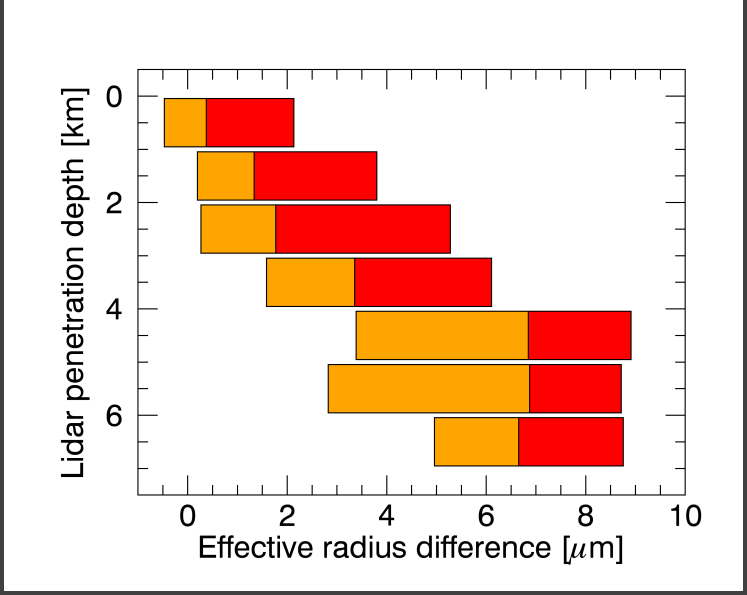
Lidar Penetration depth:
$H(\tau = 0.1) - H(\tau = 3)$

Difference between SWIR band retrievals





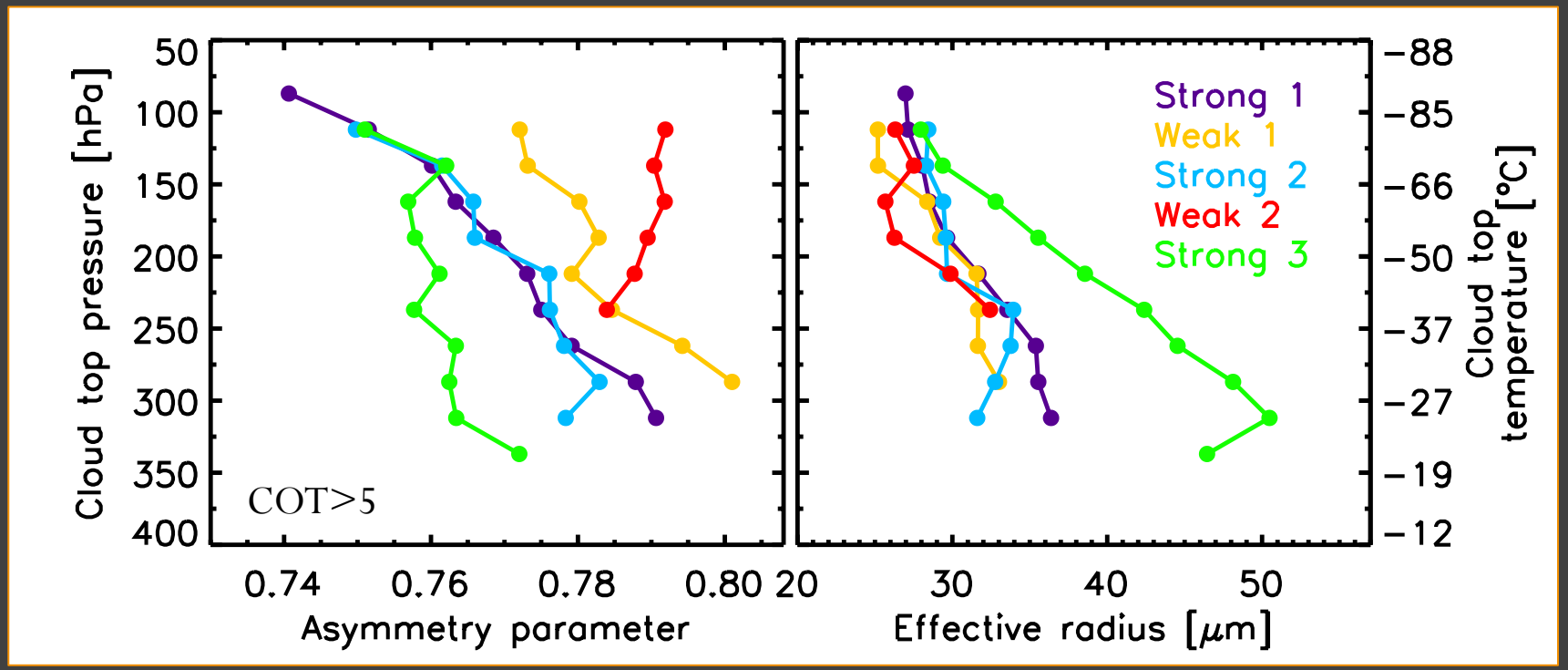
- Difference between SWIR band retrievals depends on 'diffuseness' of top



MODIS+POLDER retrievals at TWP

- Vertical variation of effective radius and asymmetry parameter varies

From van Diedenhoven et al., JGR, 2014



Conclusions

- MODIS vs VIIRS will depend on cloud top structure.
- MODIS vs VIIRS will depend on g (higher in warm clouds)
- MODIS vs VIIRS will depend on geometry
- Smallest differences expected for dense, cold convective cloud tops clouds near LNB

Suggestion

- Use two (or more) SWIR bands to retrieve
  - Effective radius at specific level (e.g., OD=1)
  - Linear slope of effective radius w.r.t. optical depth

- Benefits:
  - Comparison between sensors more straightforward
  - Easier to use for model evaluation
  - Paring with lidar allows estimate of slope w.r.t. to physical height/temperature
  - Can also be applied to liquid clouds?

SWIR bands and absorption