Radiative transfer simulation for EPIC/DSCOVR: Application to cloud and ocean color remote sensing

Meng Gao, Peng-Wang Zhai

JCET, Department of Physics, UMBC

Yuekui Yang

NASA/GSFC

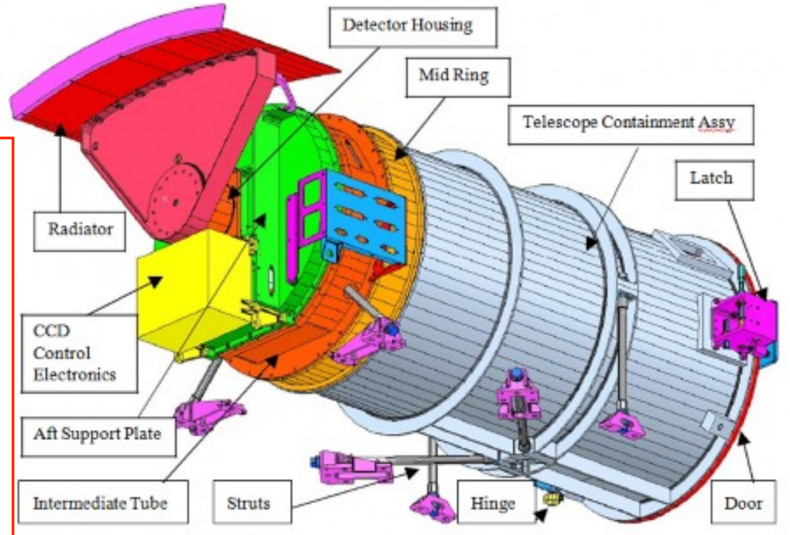
Yongxiang Hu

NASA/LaRC

EPIC (Earth Polychromatic Imaging Camera) @ DSCOVR

EPIC Wavelengths and main data products

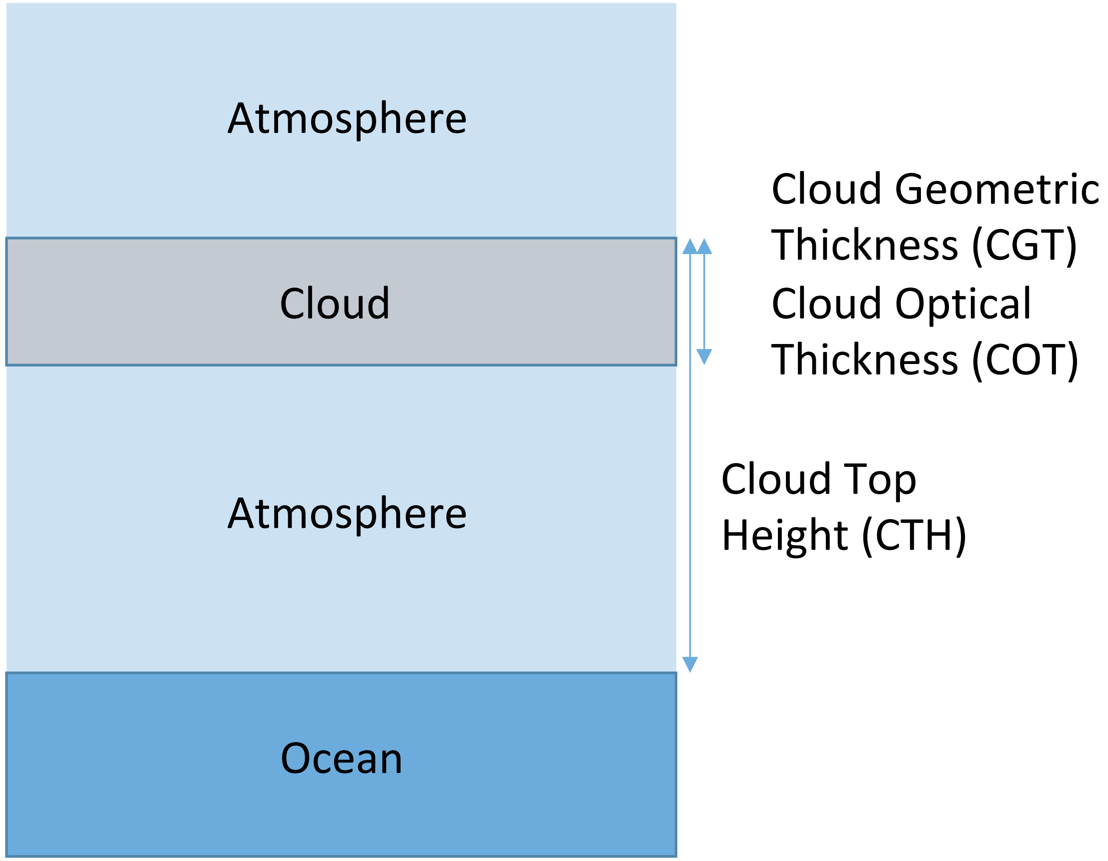
Wavelength(nm)		Full Width (nm)	Primary Application
317.5 ± 0.1		1 ± 0.2	Ozone, SO_2
325 ± 0.1		2 ± 0.2	Ozone
340 ± 0.3		3 ± 0.6	Ozone, Aerosols
388 ± 0.3		3 ± 0.6	Aerosols, Clouds
443 ± 1		3 ± 0.6	Aerosols, Clouds
551 ± 1		3 ± 0.6	Aerosols
680 ± 0.2		3 ± 0.6	Aerosols, Vegetation
687.75 ± 0.2	O2 B	0.8 ± 0.2	Aerosols, Vegetation, Clouds
764 ± 0.2	O2 A	1 ± 0.2	Cloud Height
779.5 ± 0.3		2 ± 0.4	Clouds, Vegetation



https://epic.gsfc.nasa.gov/epic

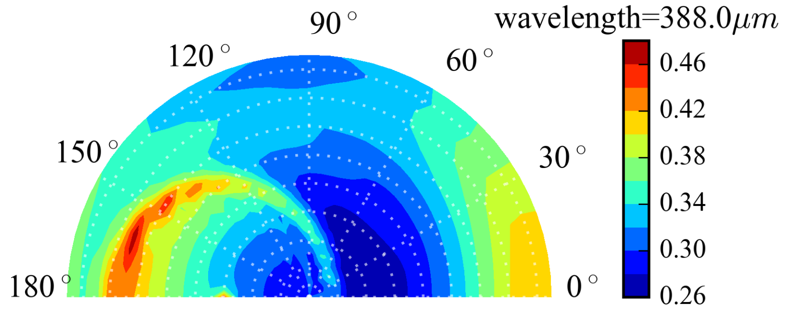
Atmospheric model for EPIC cloud simulation

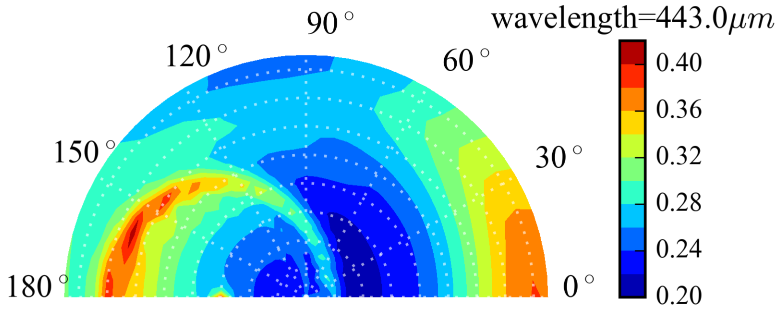
- $BRDF = \pi I / (\mu_0 F_0)$
- SOS Radiative transfer model: Zhai et al., (2009, 2010).
- Gas absorption :
  - H2O, CO2, CH4, O2, OZONE, NO2
- Wavelength(*μm*):
  0.388, 0.443, 0.551, 0.68, 0.68775, 0.764, 0.7795.

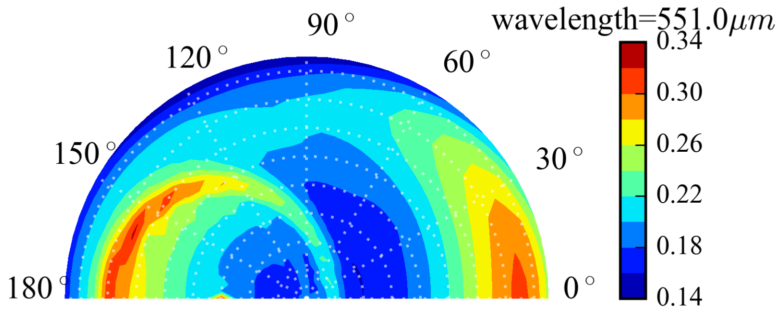


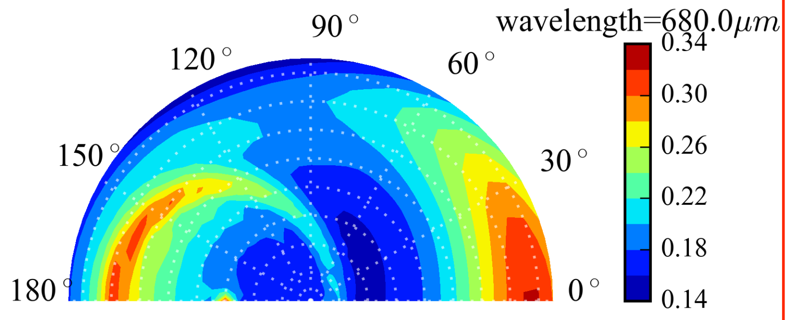
BRDF (Cloudy)

CGT:3km
COT: 3.055
CTH:12.5
Solar zenith: 30 Degree

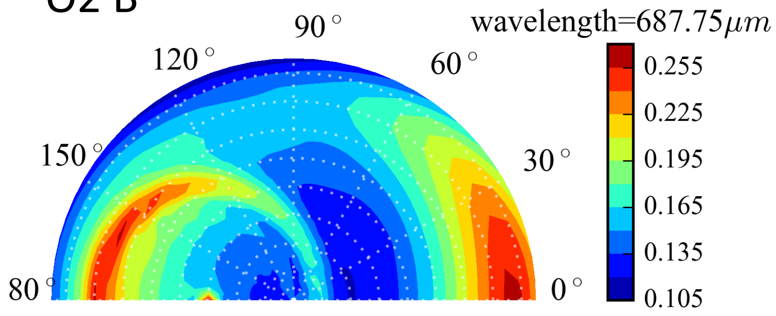






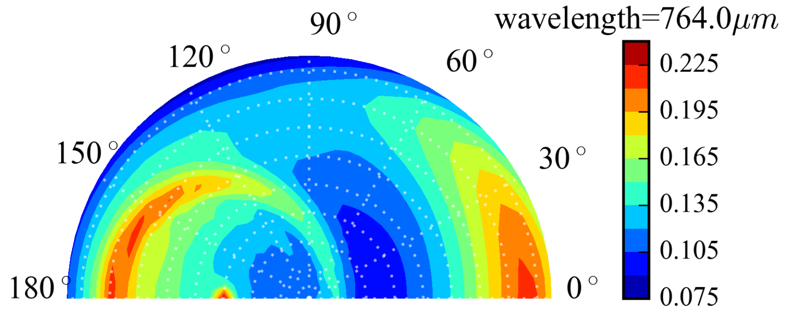


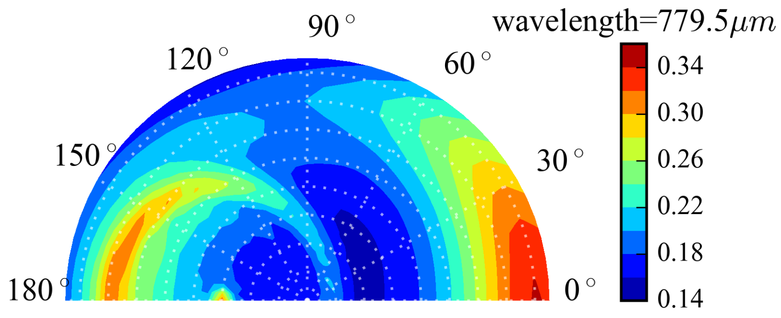
O2 B



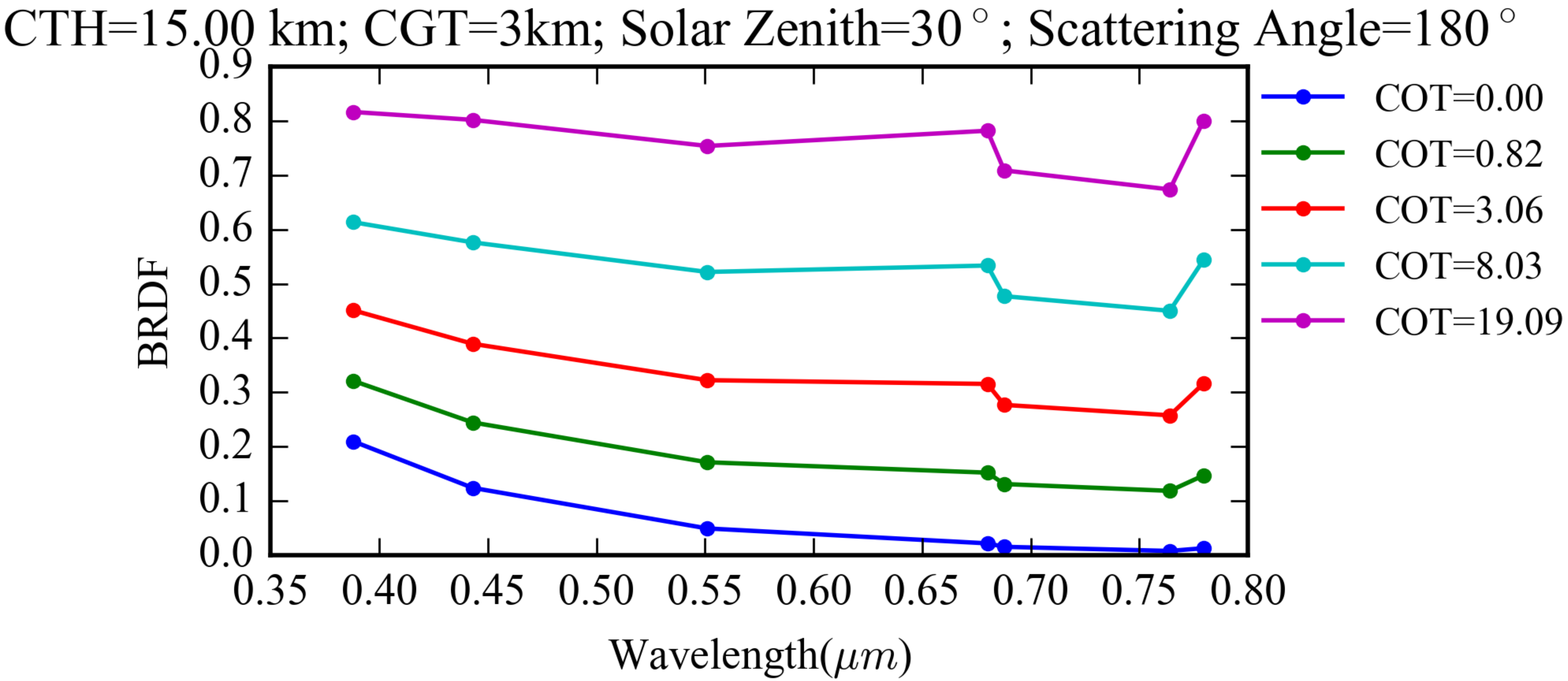
Viewing angles(18x37)
Zenith: 0-85, every 5 degrees
Azimuth: 0-180, every 5 degrees

O2 A

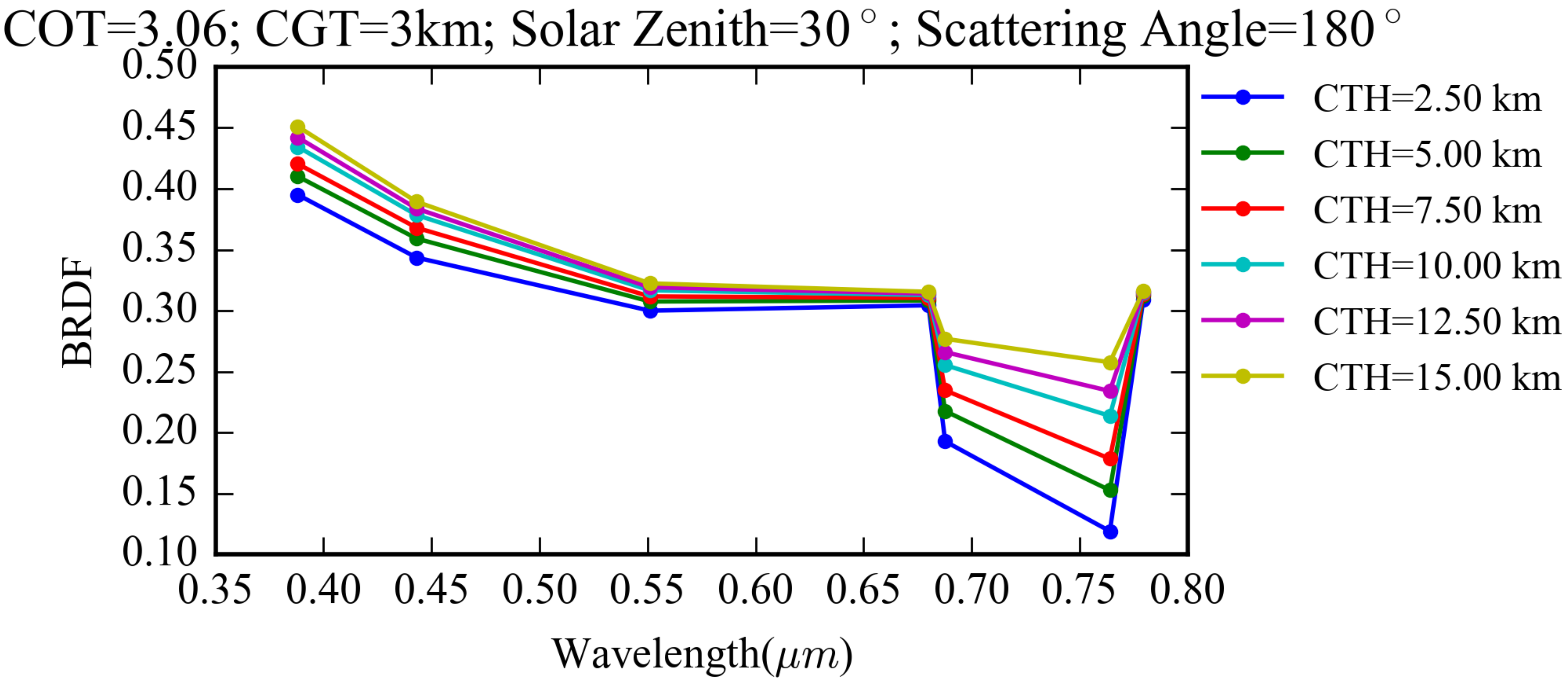




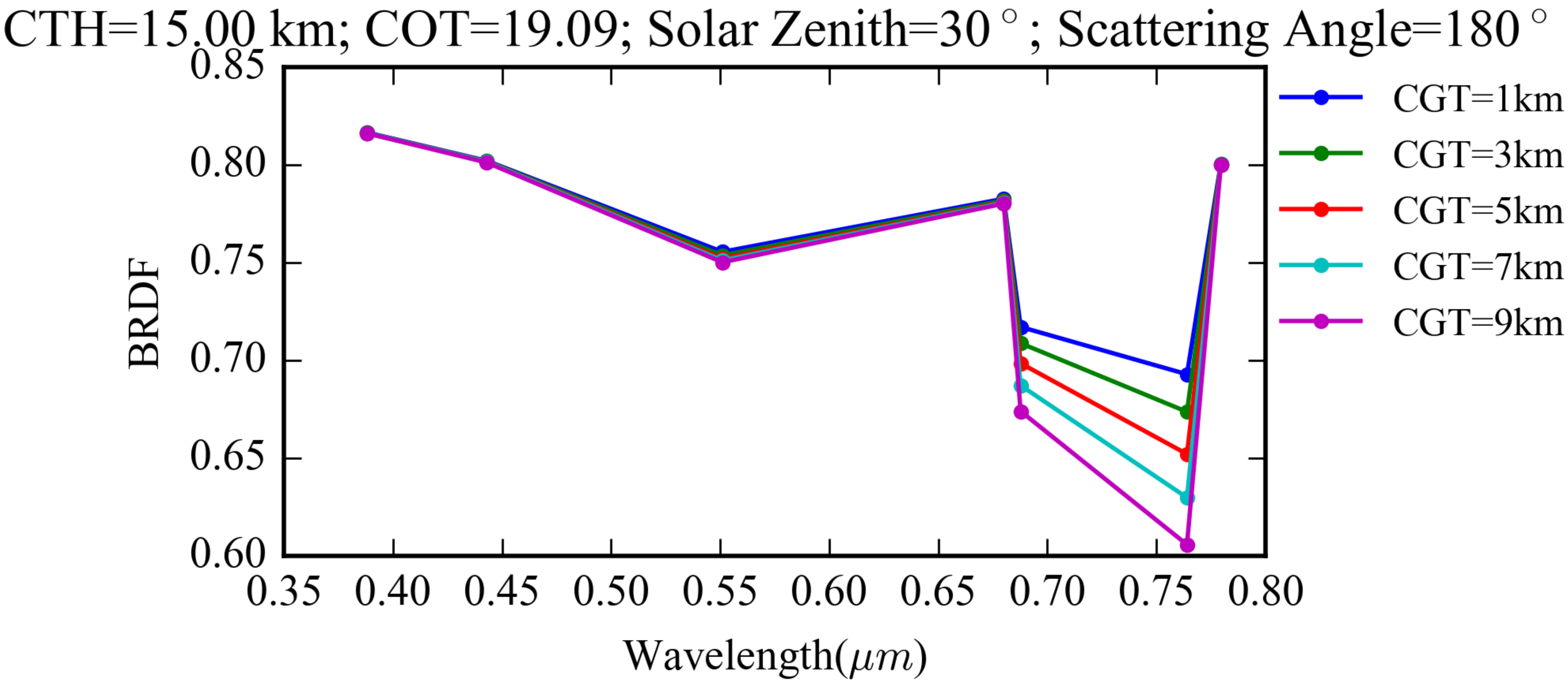
BRDF vs Cloud Optical Thickness (COT)



BRDF vs Cloud Top Height (CTH)

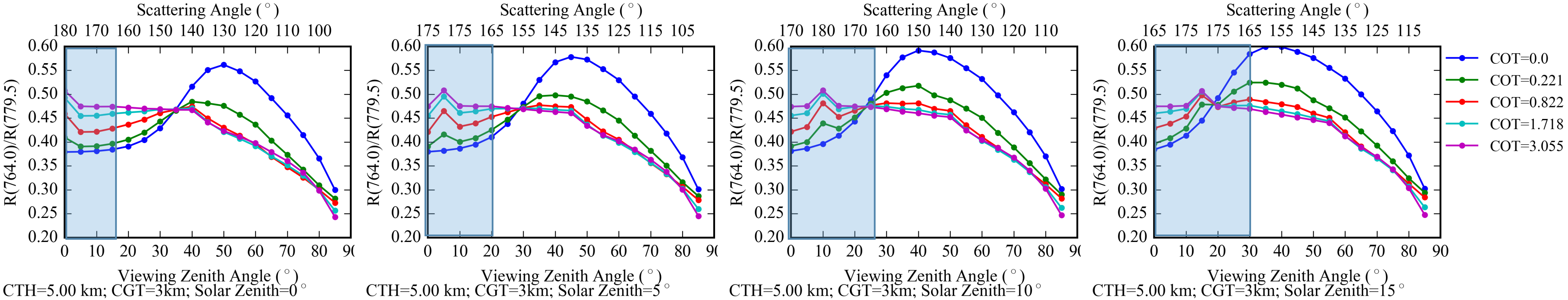


BRDF vs Cloud Geometric Thickness (CGT)

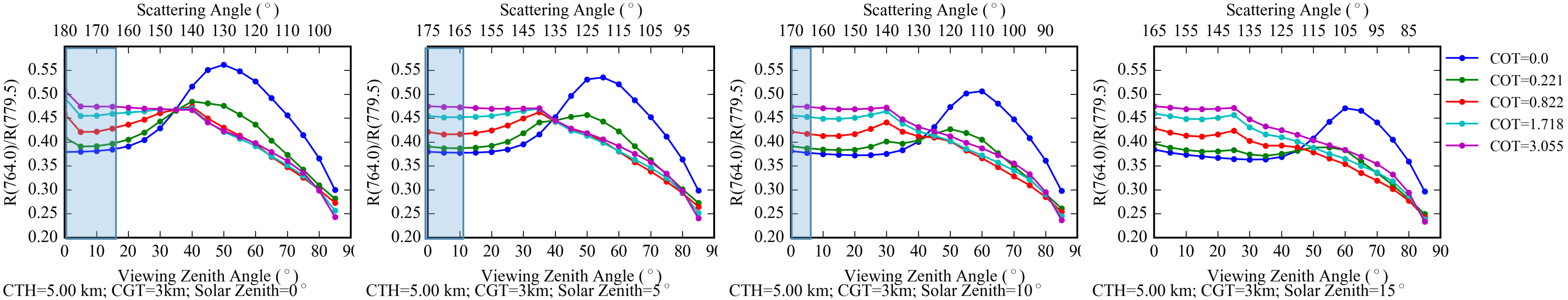


Band Ratio: R(764)/R(780)

Backscattering side: Viewing Azimuth=180

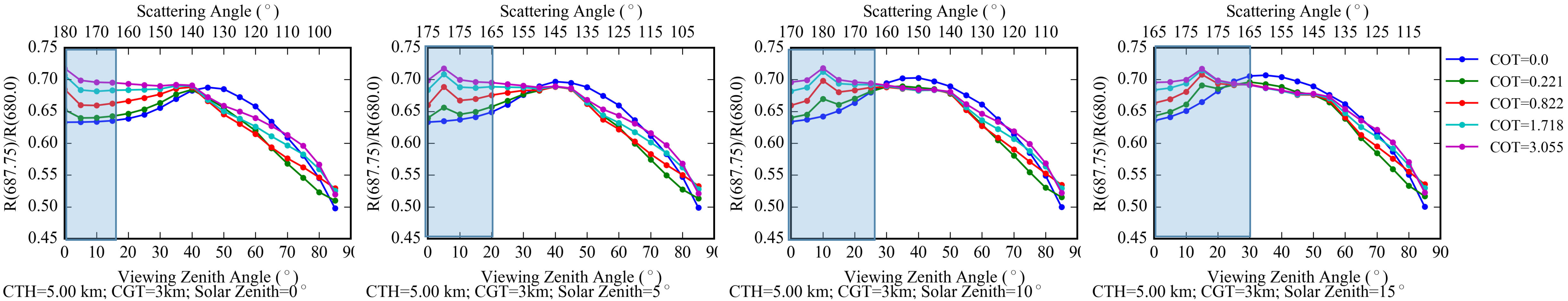


Glint side: Viewing Azimuth=0

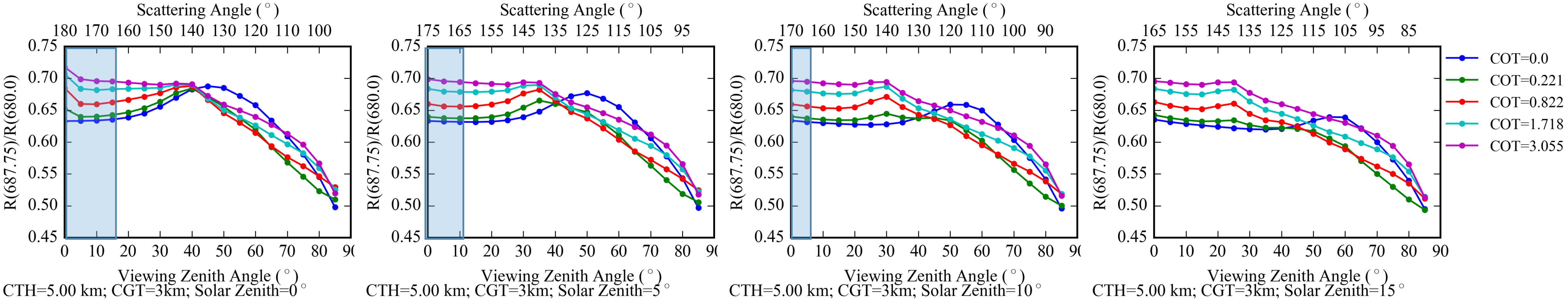


Band Ratio: R(688)/R(680)

Backscattering side: Viewing Azimuth=180



Glint side: Viewing Azimuth=0



Summary

- We have built a radiative transfer simulator for EPIC/DSCOVR, which accounts for multiple scattering by clouds, aerosols, molecules, ocean surface, subsurface, etc..
- Gas absorption is fully coupled with multiple scattering simulation so that oxygen A and B bands are accurately represented.
- Sensitivity study is performed to study the dependence of the EPIC observation on water cloud properties, which are valuable in terms of glint and cloud masking, and water cloud property retrieval.
- We have demonstrated that EPIC images can be used for algal bloom detection, which provides an important tool for algal physiology research.
- Future study includes the incorporation of the radiative transfer results in the retrievals of cloud products and ocean color.