

Studying the Transition from Cloudy to Clear Skies Using the ARM Shortwave Spectrometer

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Background

- It is difficult to distinguish between cloudy and cloud free air in remote sensing observations.
- This problem has major climatic consequences, in particular on aerosol indirect effect studies, which demand a precise separation of clear and cloudy air (Charlson et al., 2006).
- The regions around clouds (often stretching out 10's of km) are neither precisely clear nor precisely cloudy. Koren et al. (2007) called them the 'twilight zone.'

ARM Shortwave Spectroradiometer

The SWS measures zenith sky spectral radiance from the near UV through near IR spectral range. It was deployed at the SGP Central facility on 4/27/06. Measurements are taken daily from 11:00-02:00 UTC.

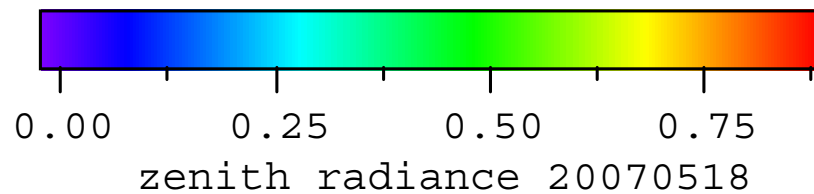
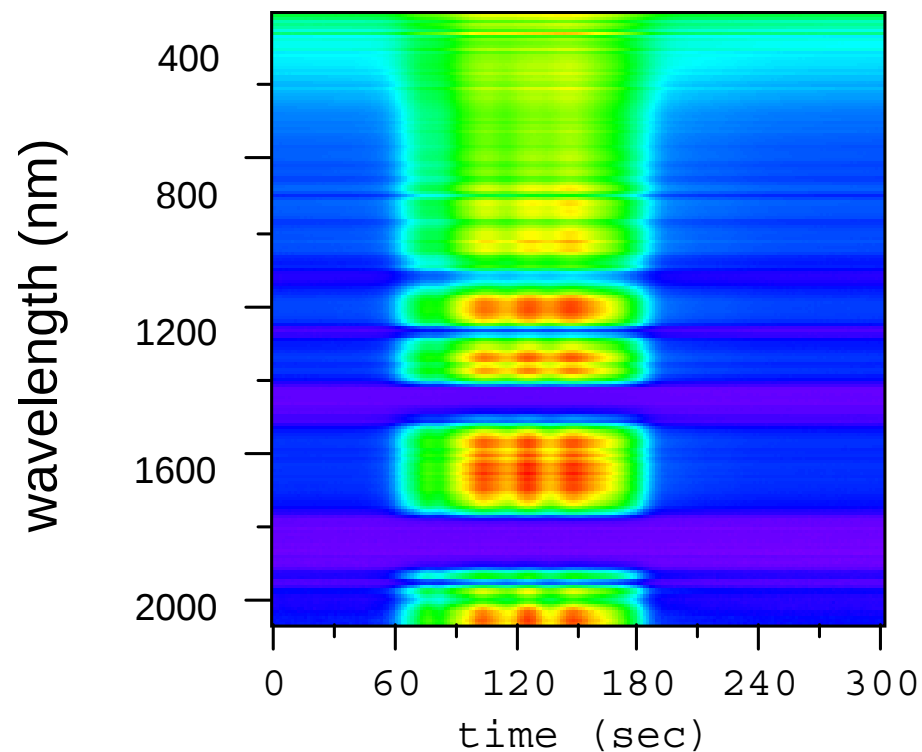
- Spectral Range: 380-2200nm
- Spectral Resolution
 - 380-970 nm: 8nm
 - 970-2200 nm: 12nm
- Spectral Sampling rate: 1 Hz
- Field of view: 1.4°
- 418 wavelengths
- Primary calibration tied to 30 in. integrating sphere at NASA Ames
- Weekly calibration with 12 inch integrating sphere

(from Pilewskie's presentation at the last ARM STM)



SZA=45°

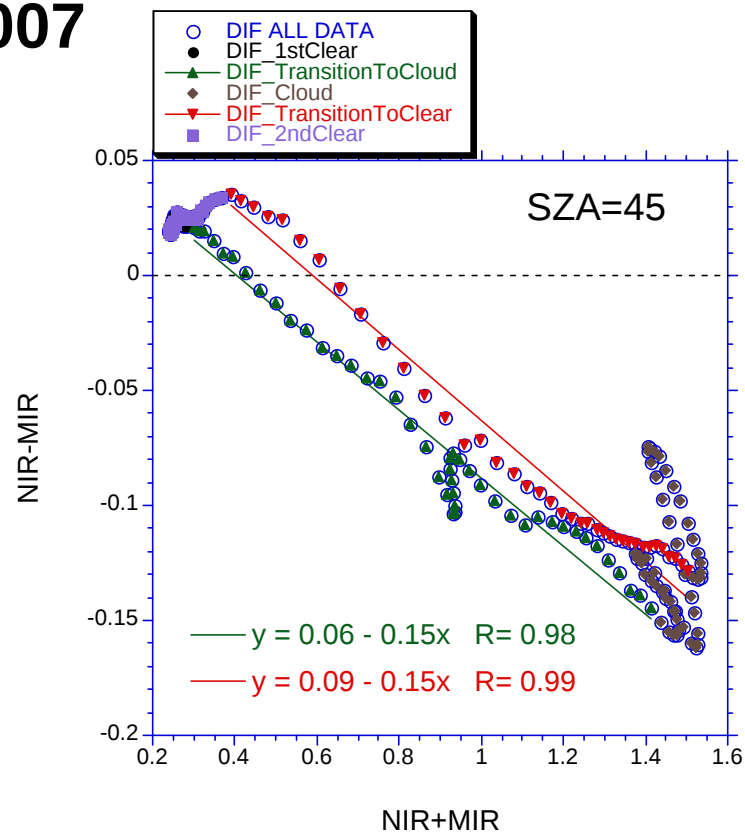
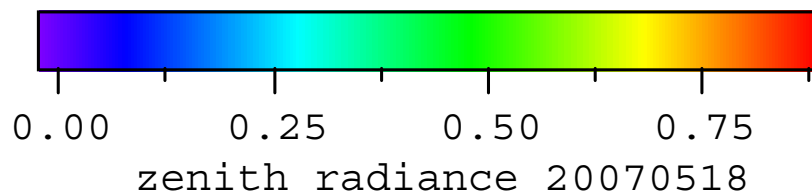
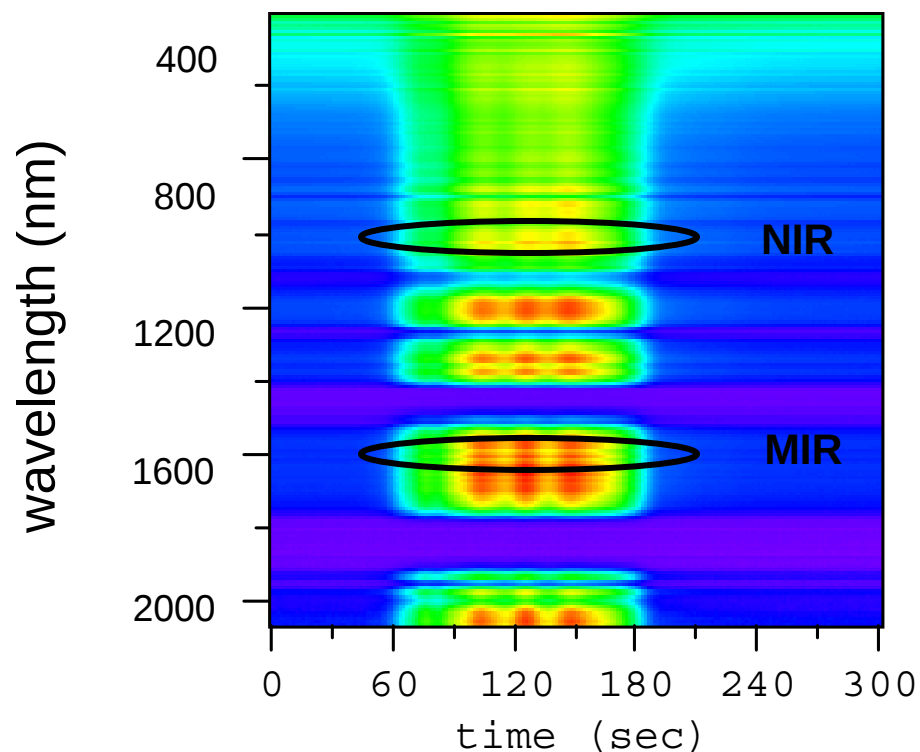
May 18, 2007





SA=45°

May 18, 2007

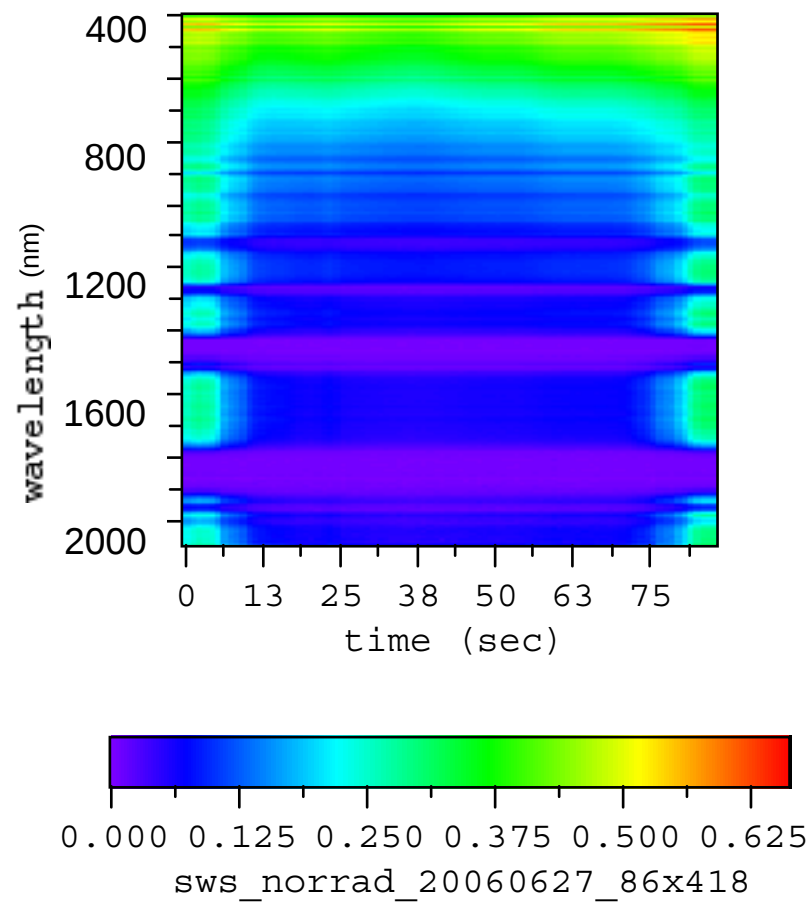


0.87 μm (NIR) and 1.6 μm (MIR)



SZA=14°

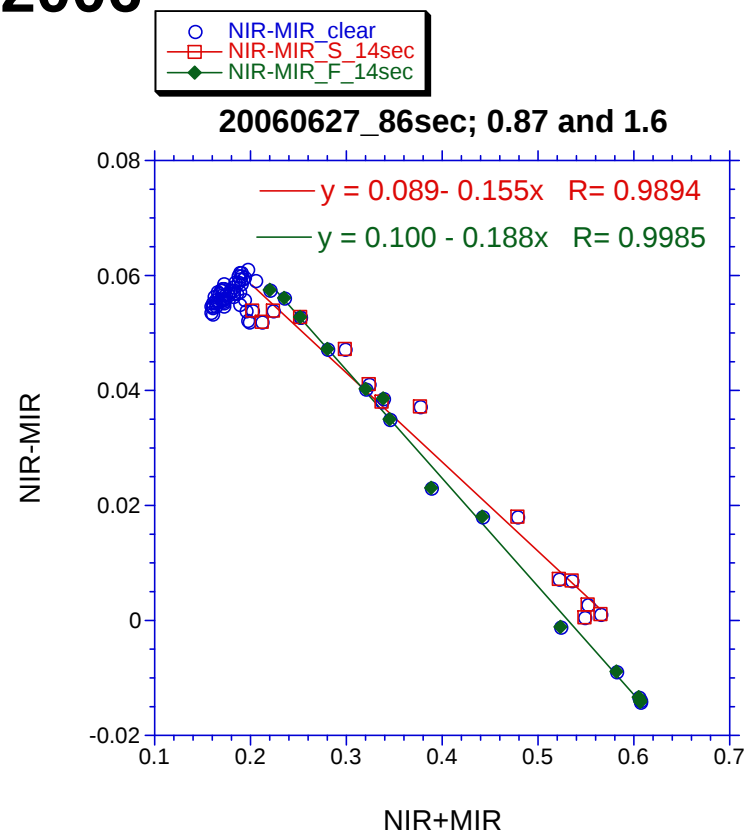
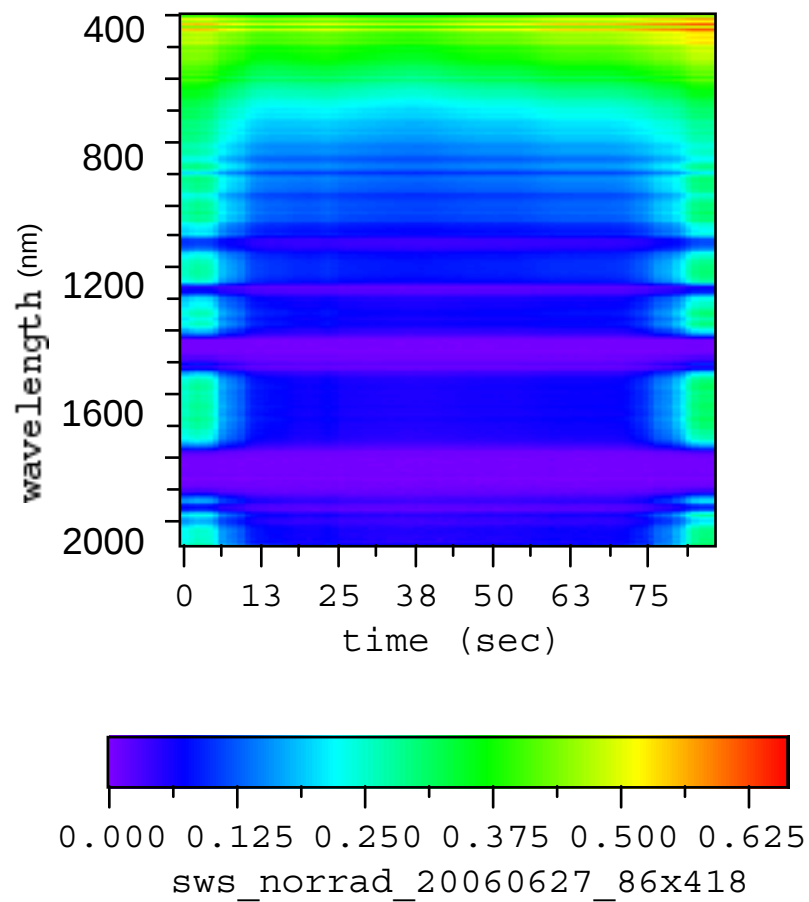
June 27, 2006





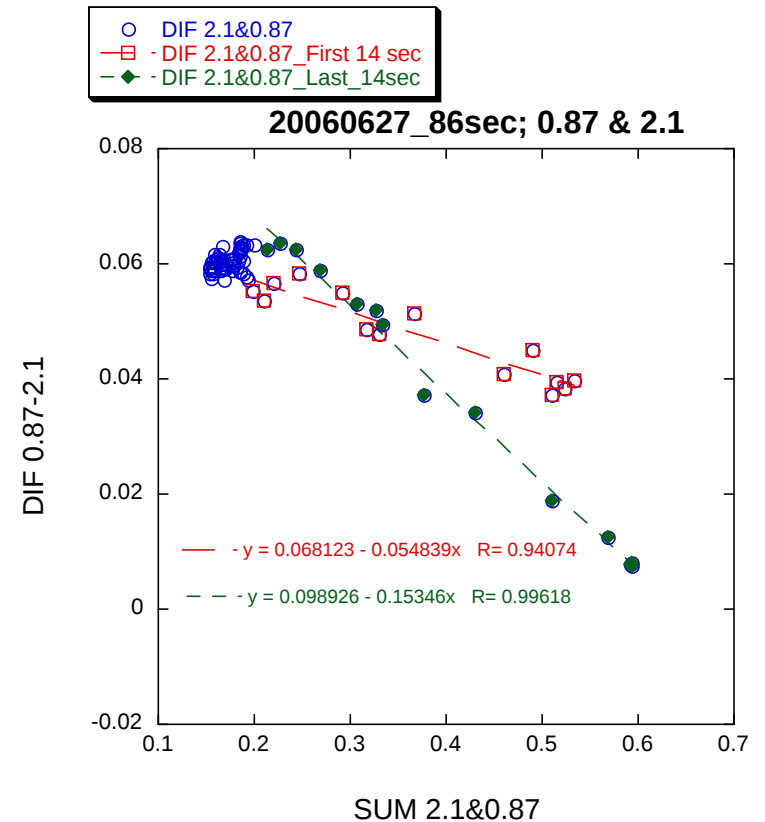
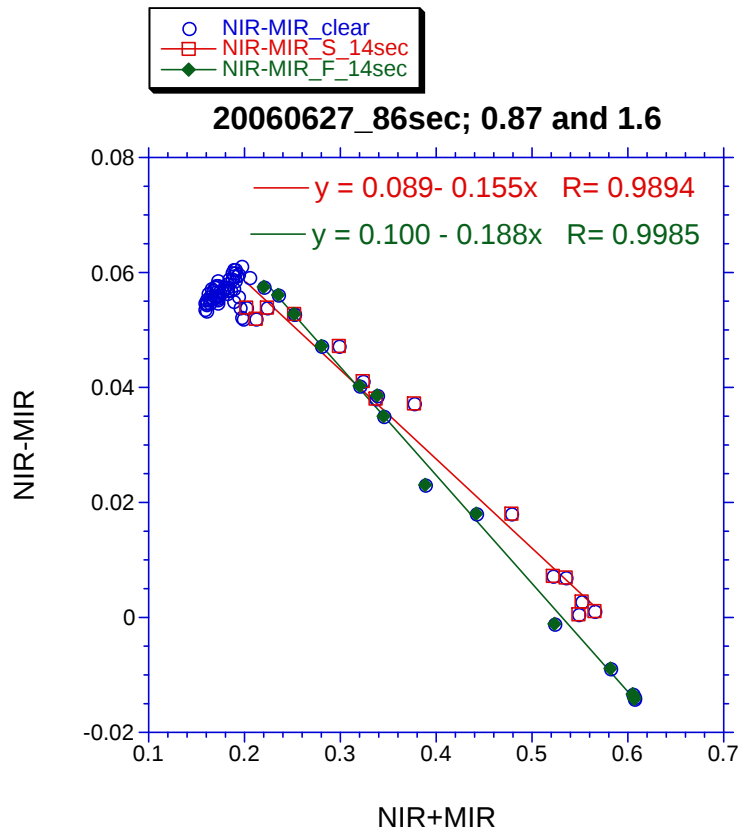
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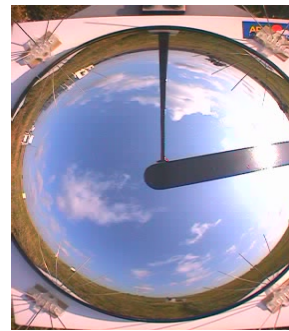
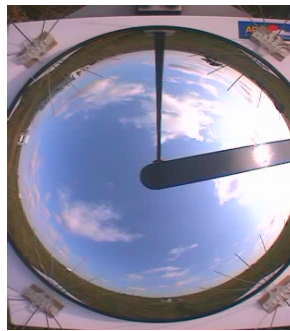
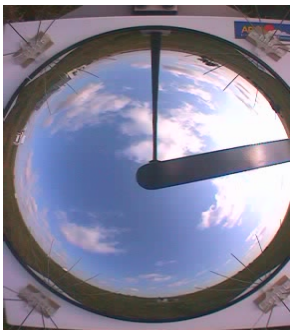
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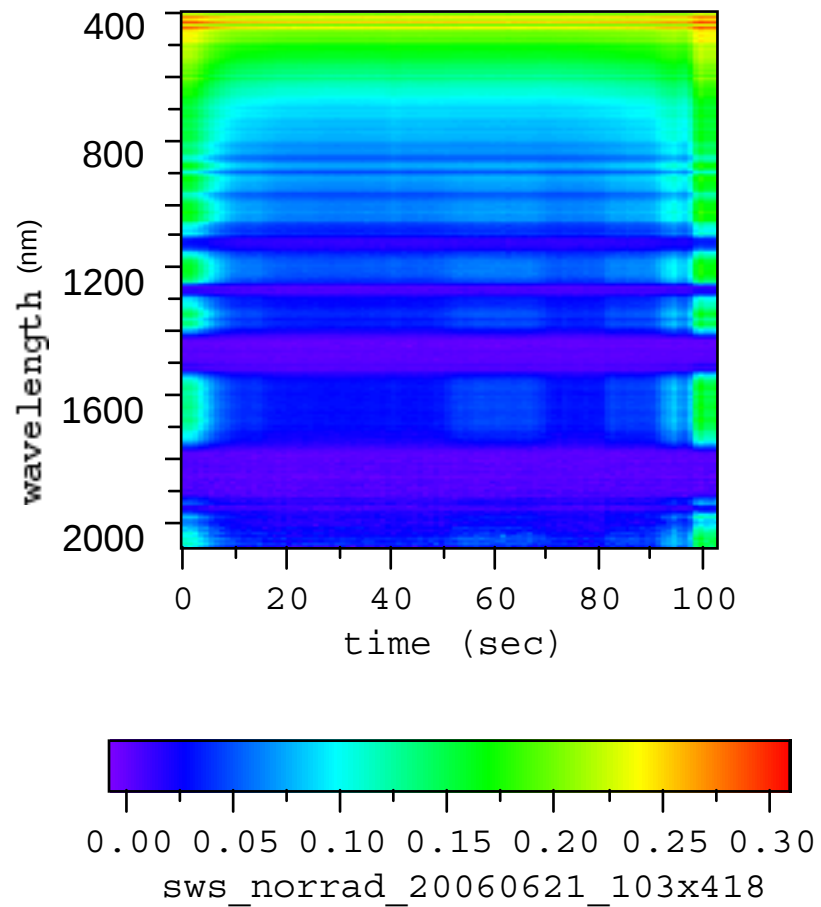
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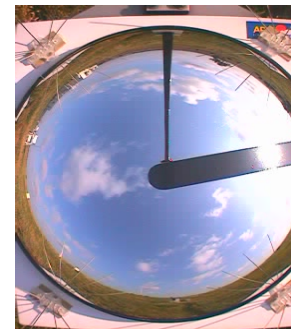
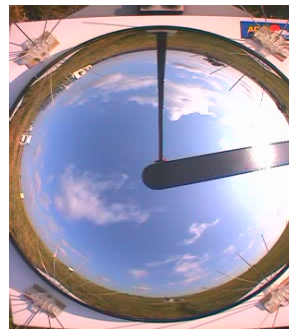
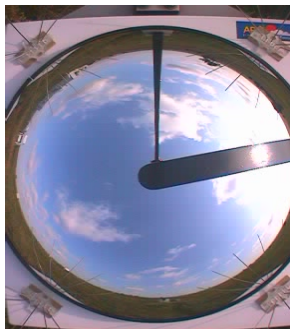
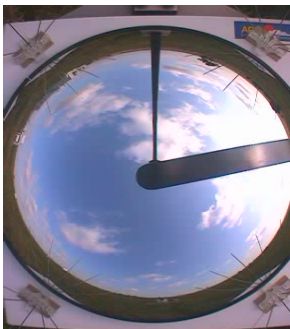




June 21, 2006

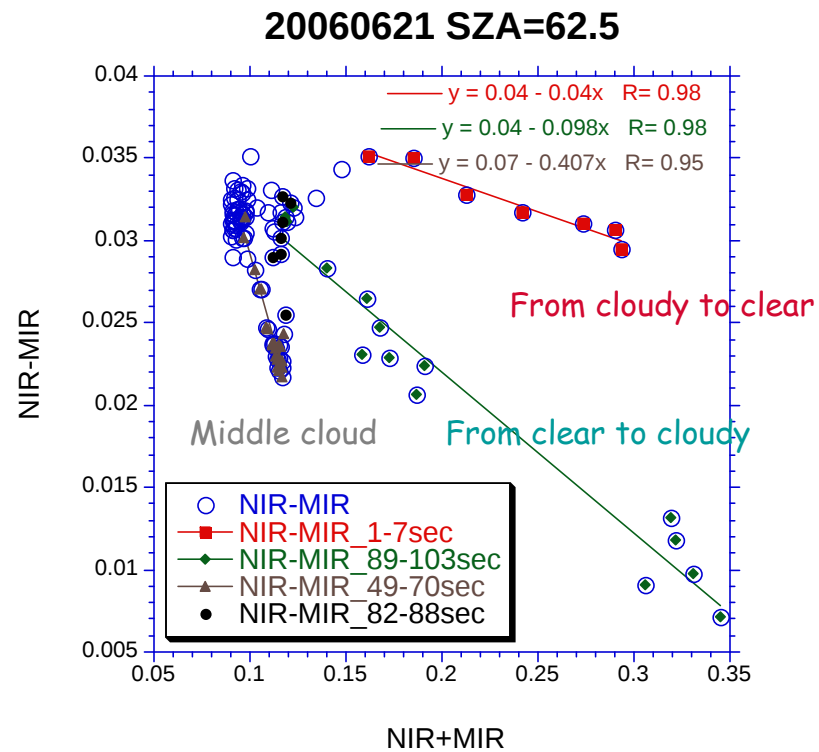
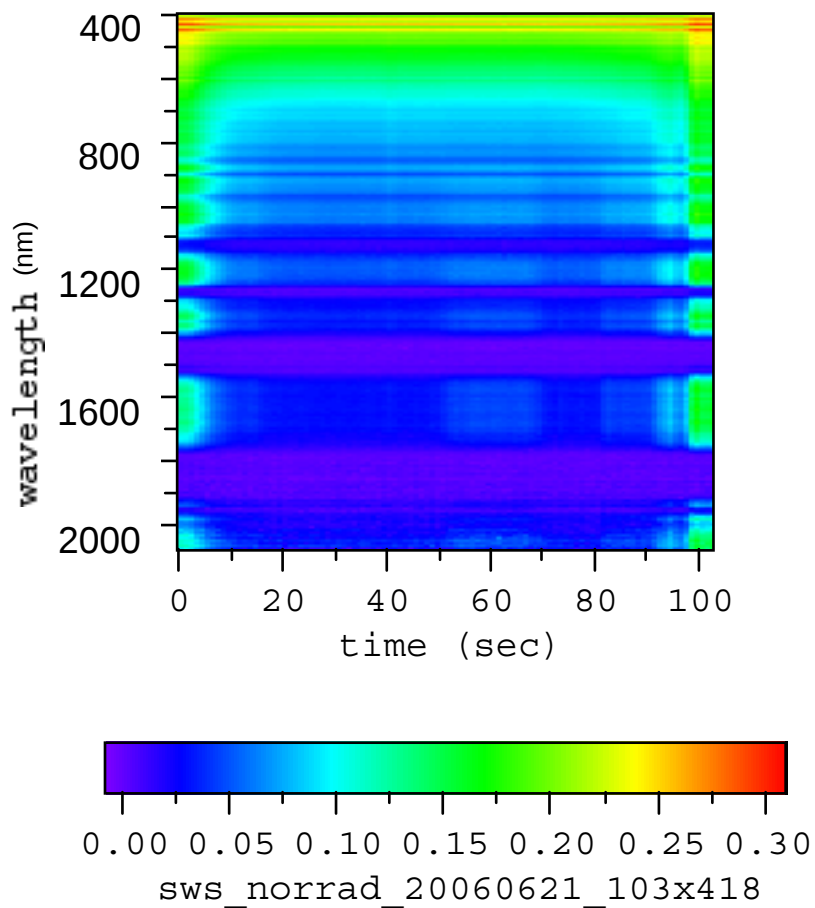
SZA=62.5°

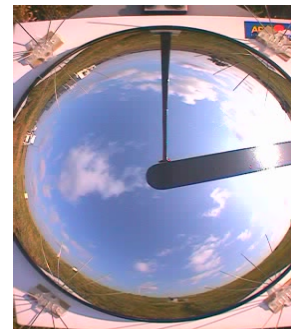
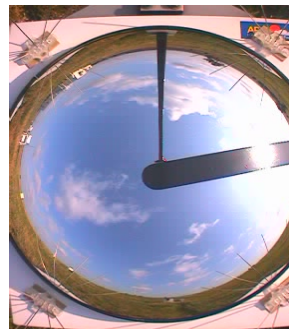
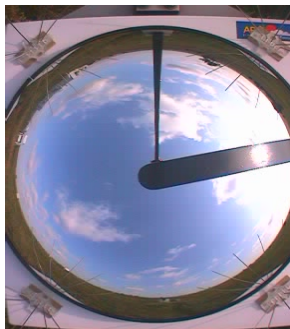
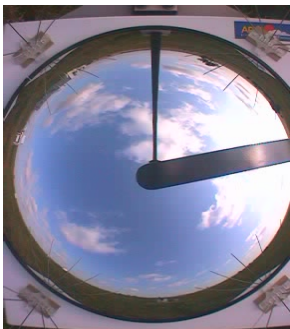




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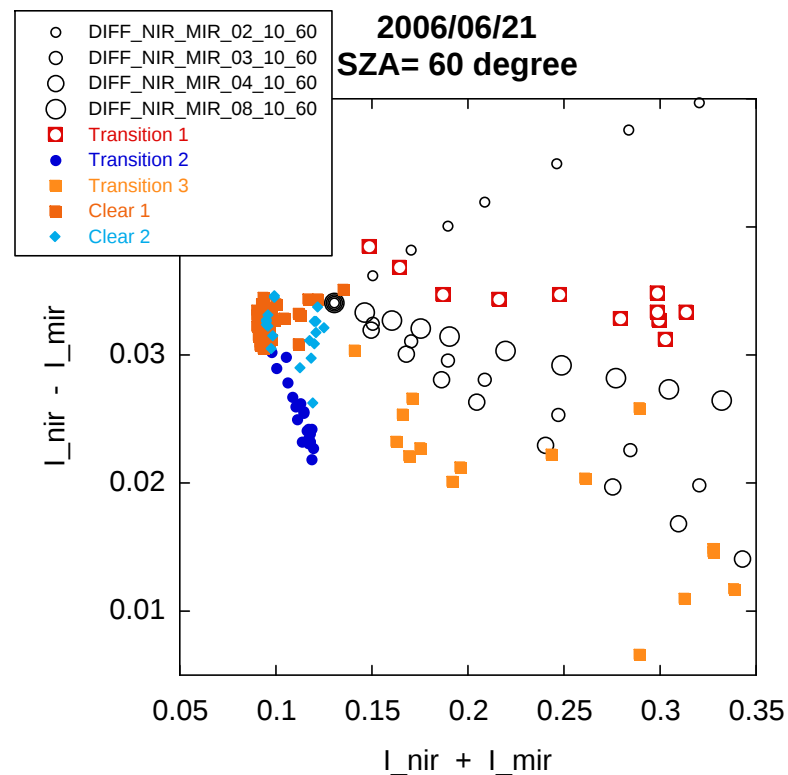
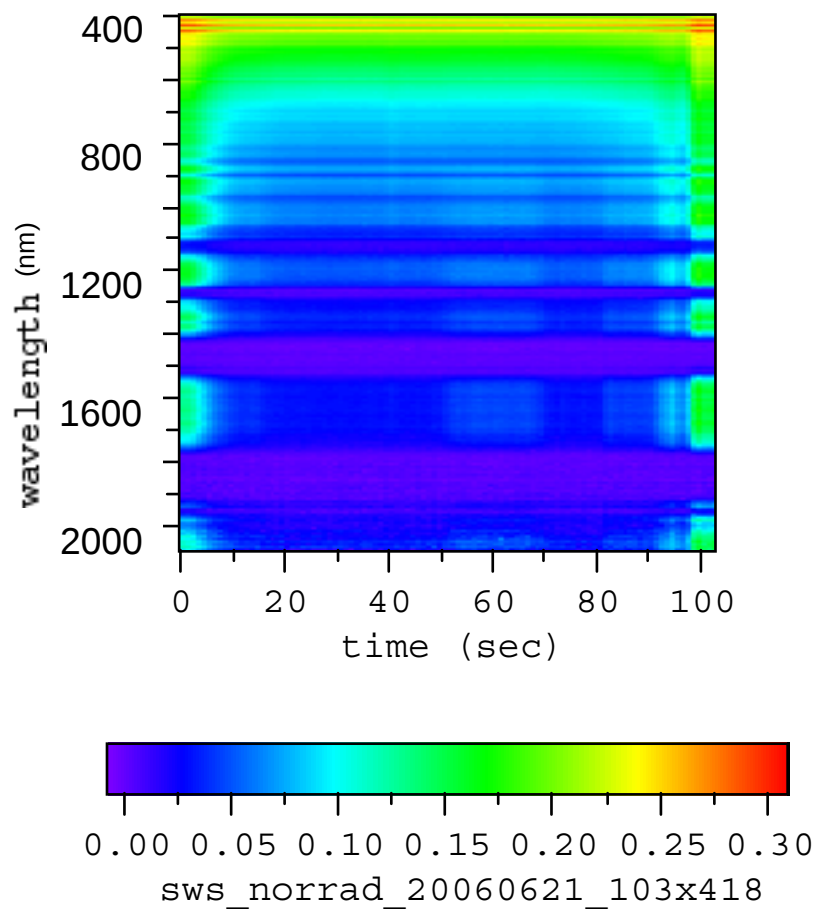
SZA=62.5°



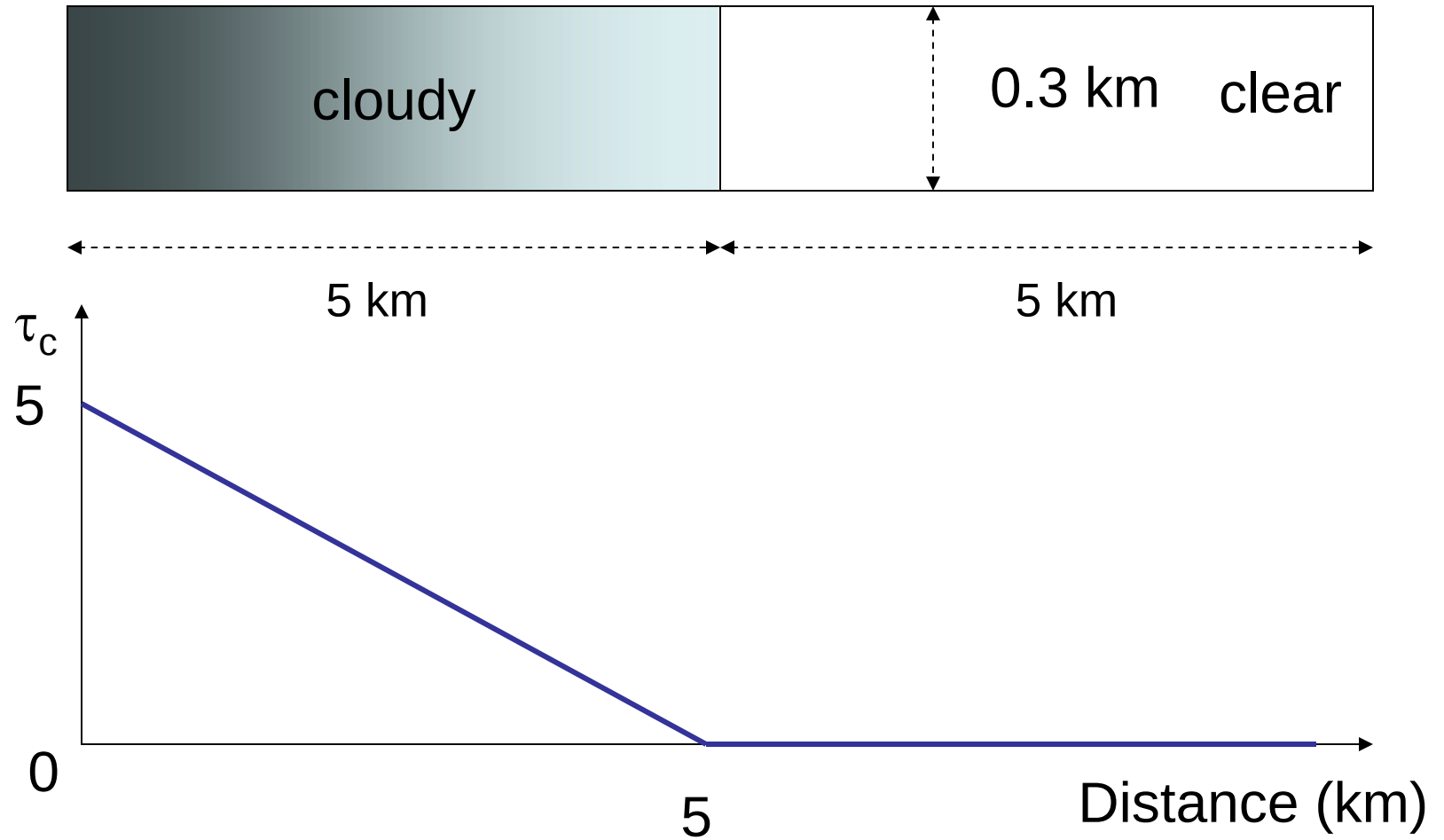


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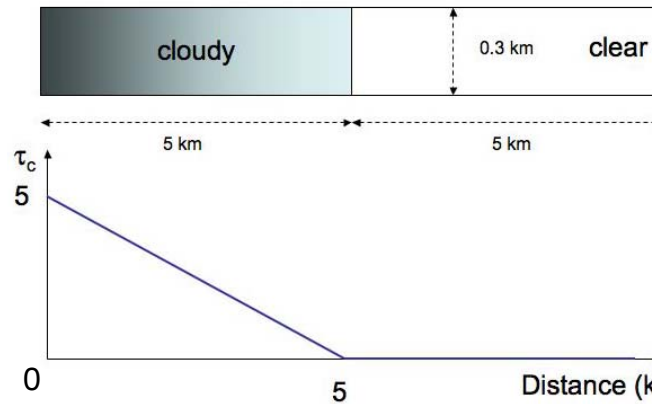
SZA=62.5°



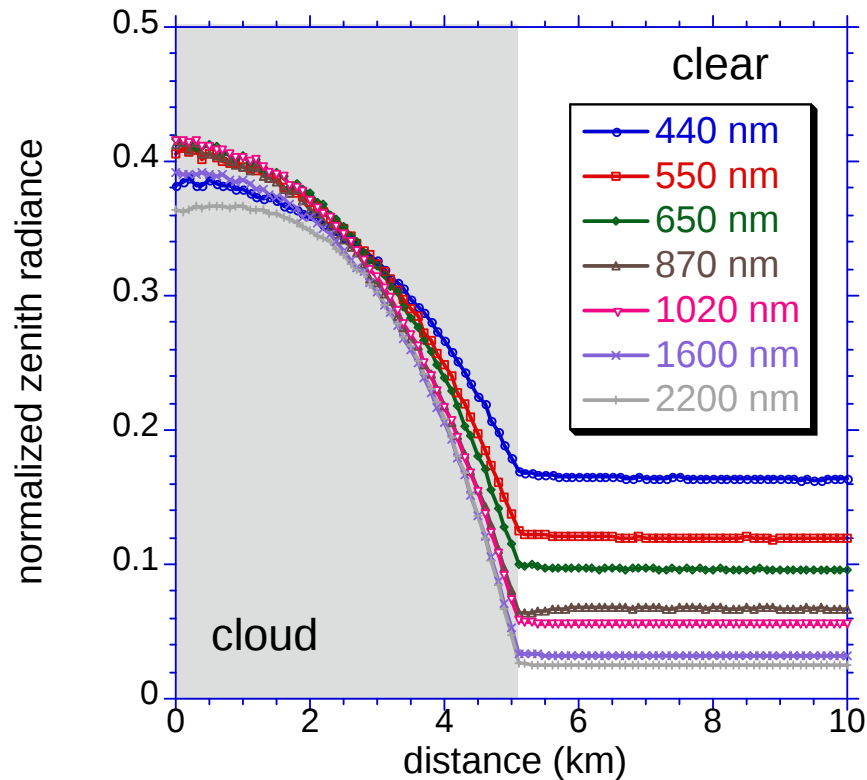
A simple 3D RT experiment



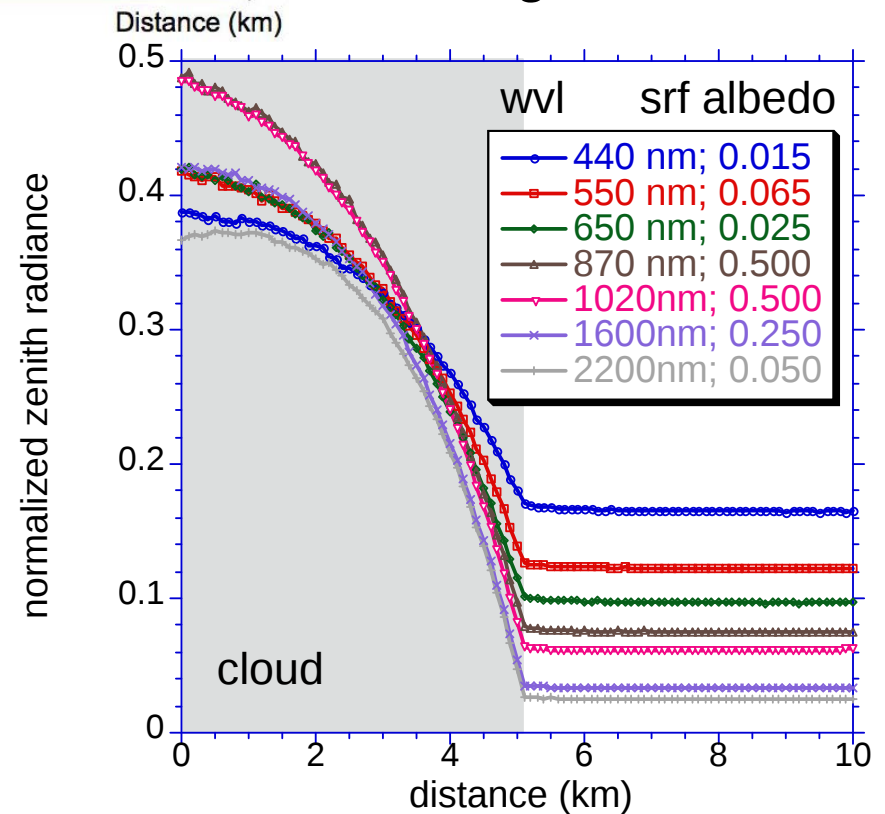
A simple 3D RT experiment



black surface



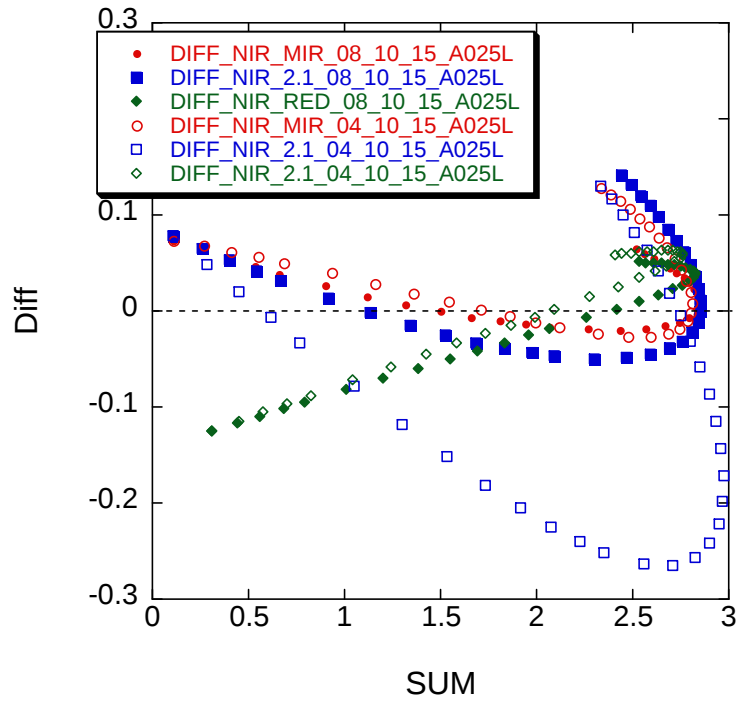
vegetated surface



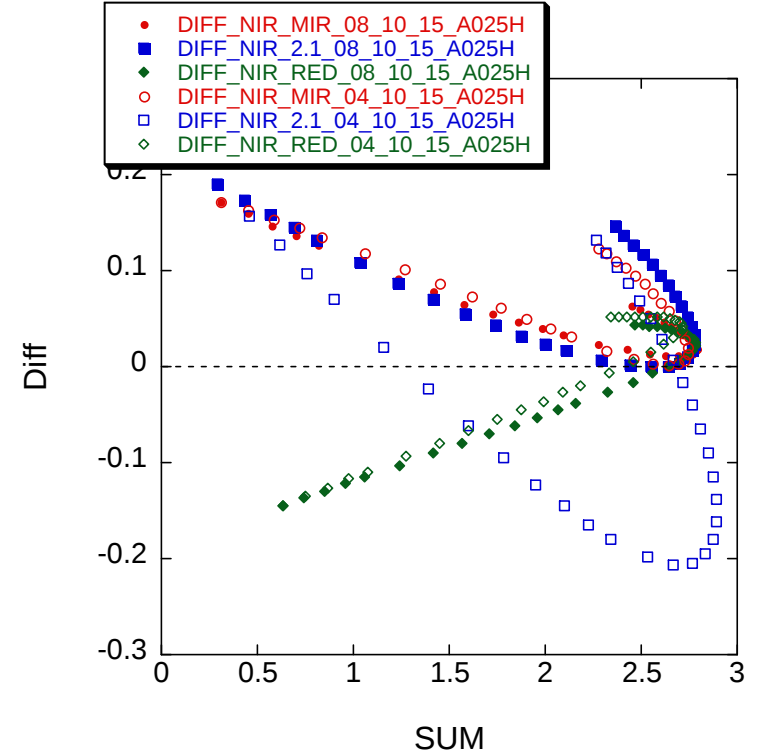
DISORT calculations

SZA=15

Low Aerosol, SZA=15

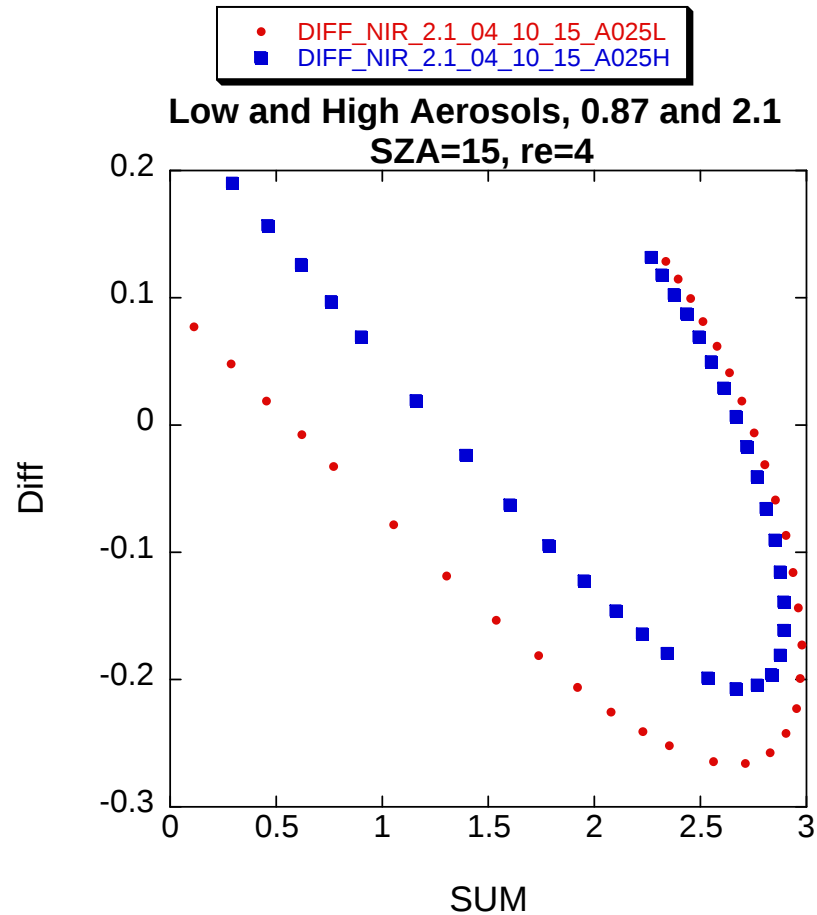


High Aerosol, SZA=15



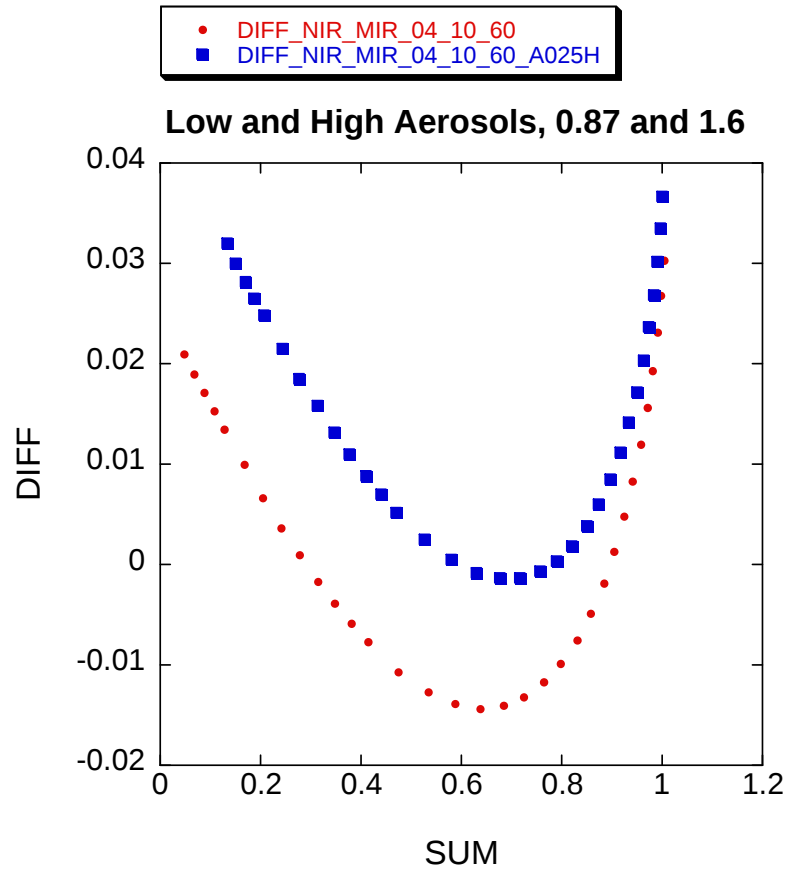
DISORT calculations

SZA=15



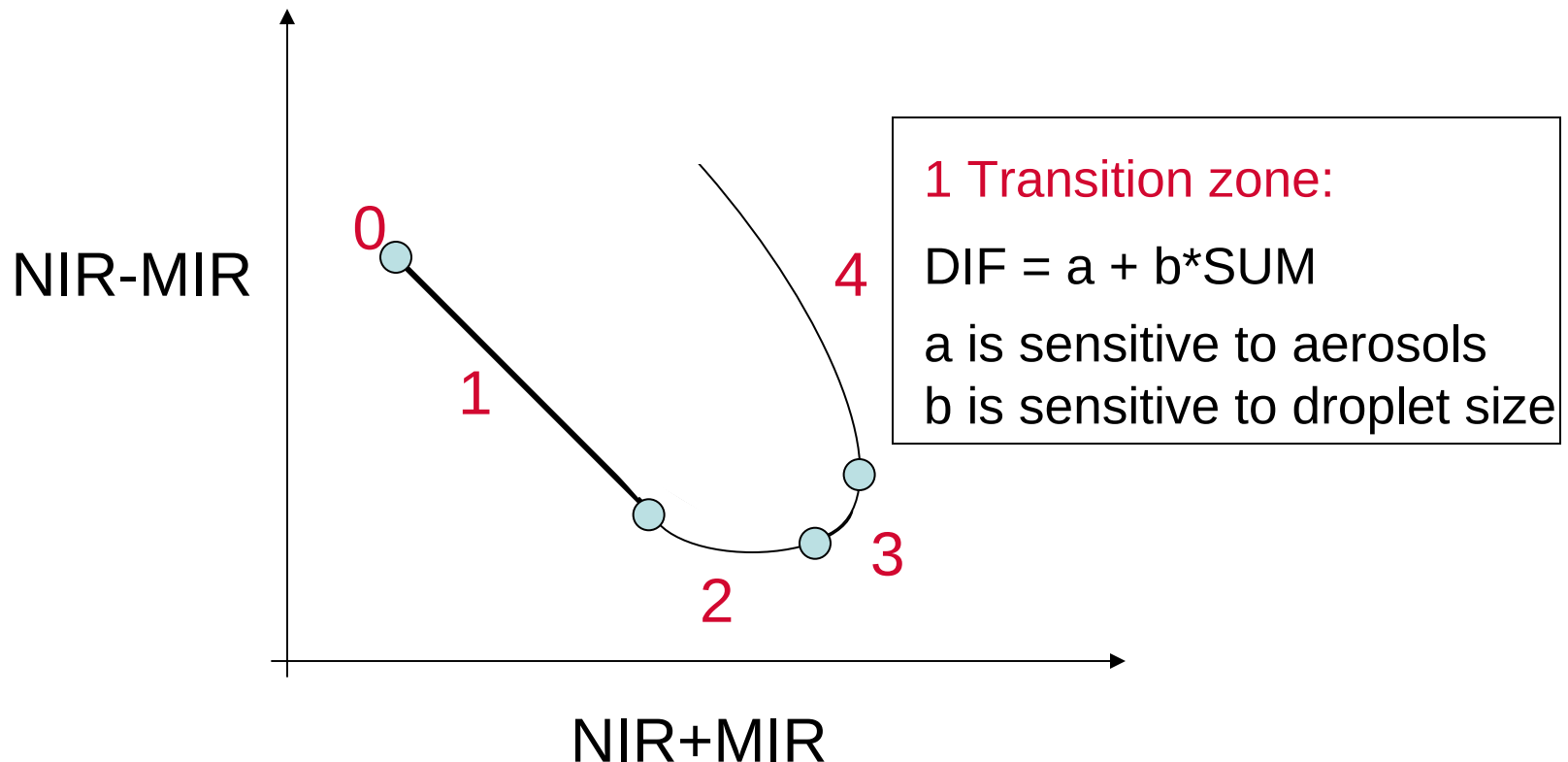
DISORT calculations

SZA=60

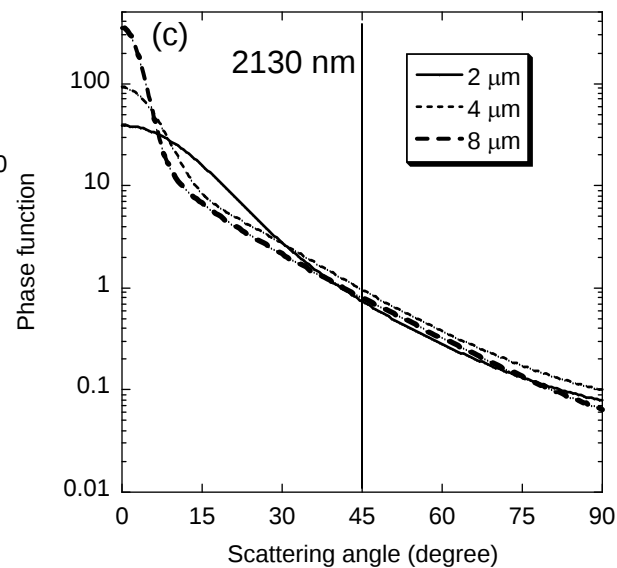
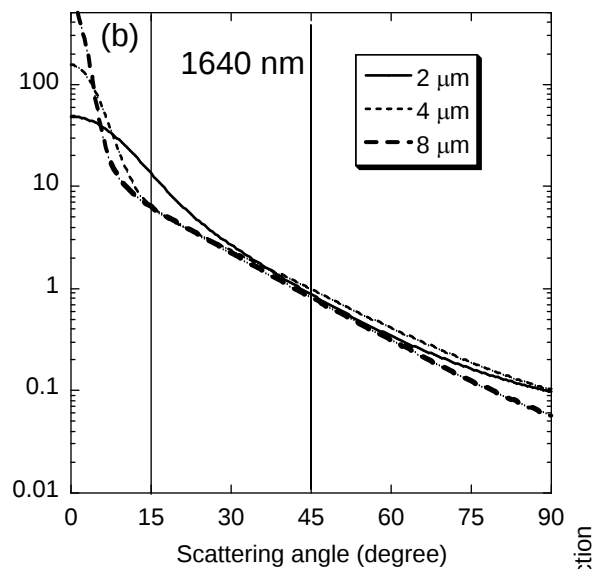
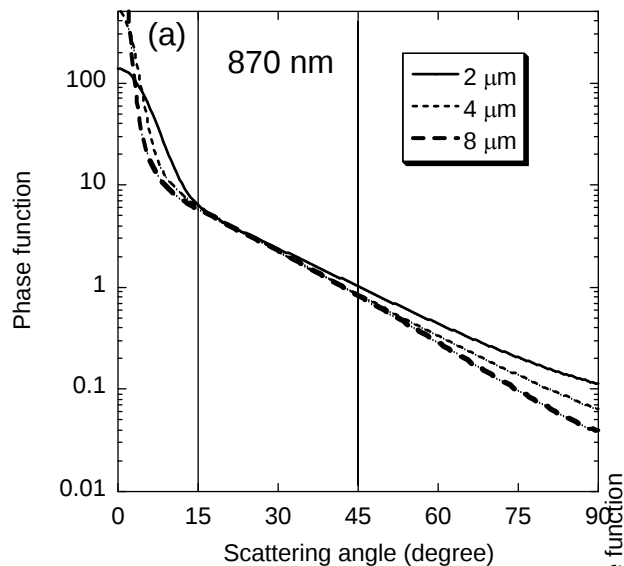


Schematics

- 0: Cloud-free (Rayleigh + aerosol)
- 1: Transition to cloud: single scat. domin. (Rayleigh + aerosol + very thin clouds)
- 2: In-cloud multiple scattering important (aerosol + very thin clouds)
- 3: In-cloud multiple scattering + Surface-cloud interaction (thin clouds + surface)
- 4: Multiple scattering + Surface-cloud interaction (thicker clouds (less T) + surface)



Mie Phase function



Mie Phase function

