Study of 3D cloud radiative effects using MODIS data

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Outline:

- MODIS data in I3RC project
- View-angle dependence of MODIS cloud optical thickness

MODIS data in I3RC project
(Intercomparison of 3D Radiative Codes)

I3RC goals:

- Comparison of 3D radiative transfer models
- Create benchmark 3D results
- Open source toolkit
- Educational web site

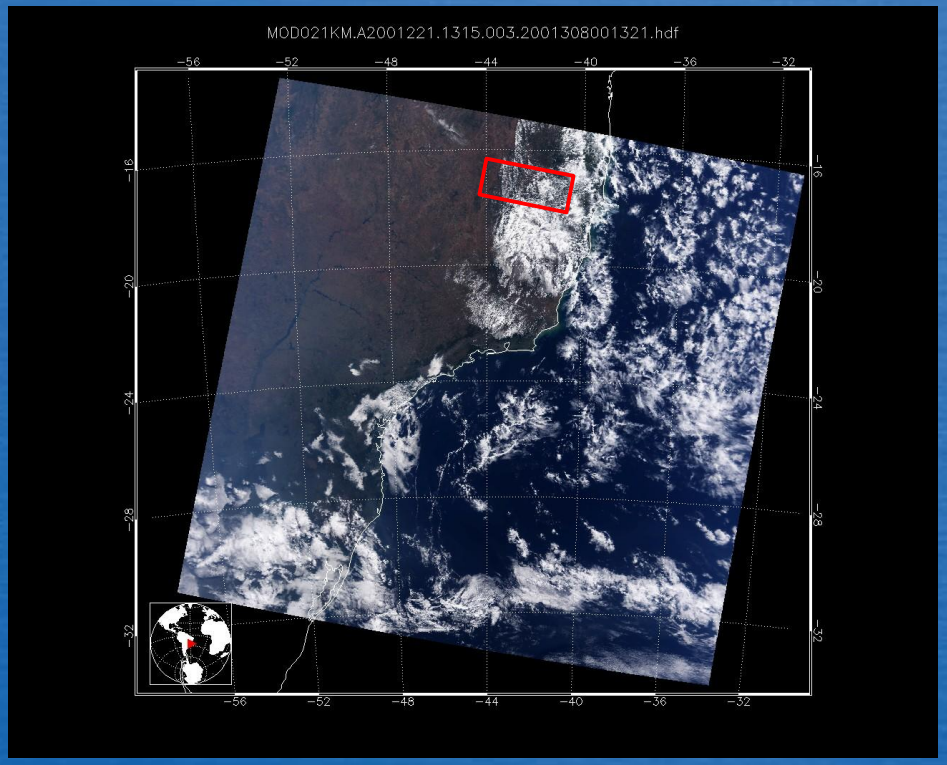
Phase III intercomparisons (October 2005):

- Lidar multiple scattering
- Cloud field observed by MODIS, MISR, ASTER

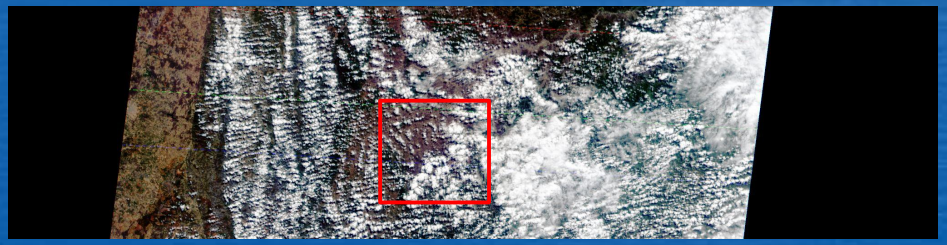
Test scene for I3RC Phase III

Biomass burning region in Brazil
(17° South, 42° West)
August 9, 2001, 10:15 AM local time
Solar zenith angle: 41°

MODIS granule



MISR block



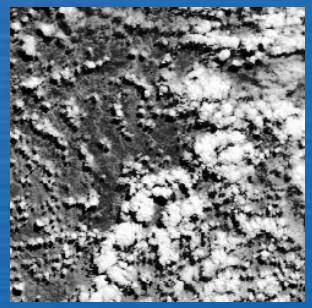
Test scene

ASTER

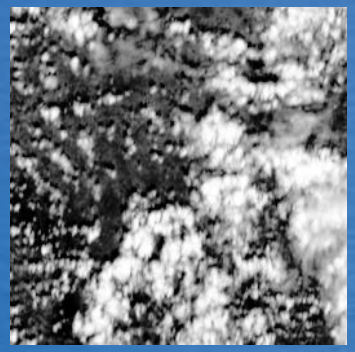
60 km

MODIS

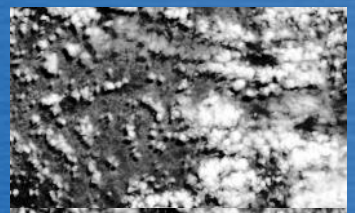
1 km resolution



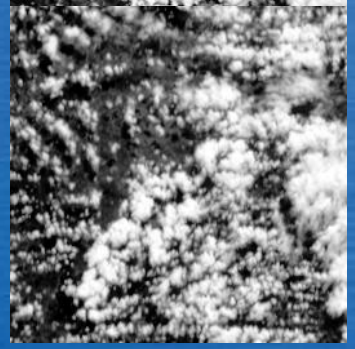
250 m resolution



CF (60º)



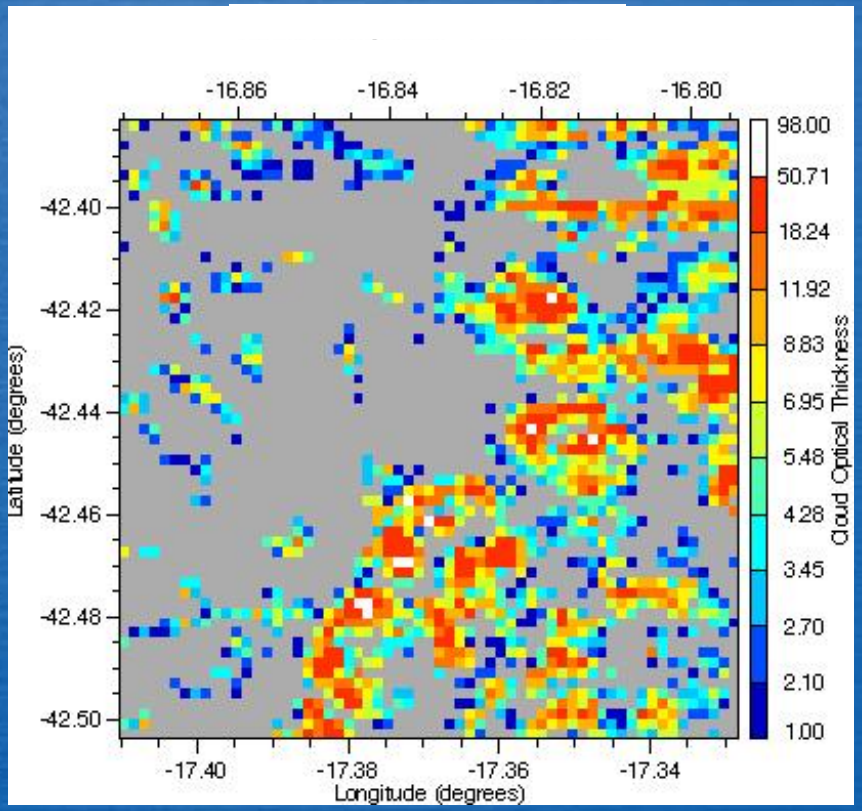
AN (0º)



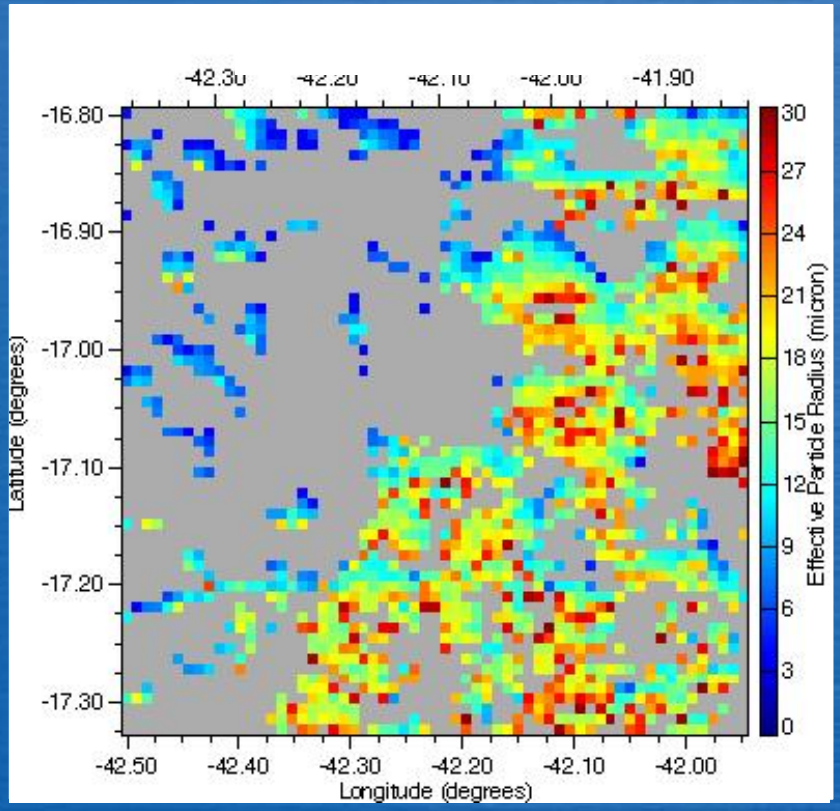
CA (60º)

MODIS cloud products

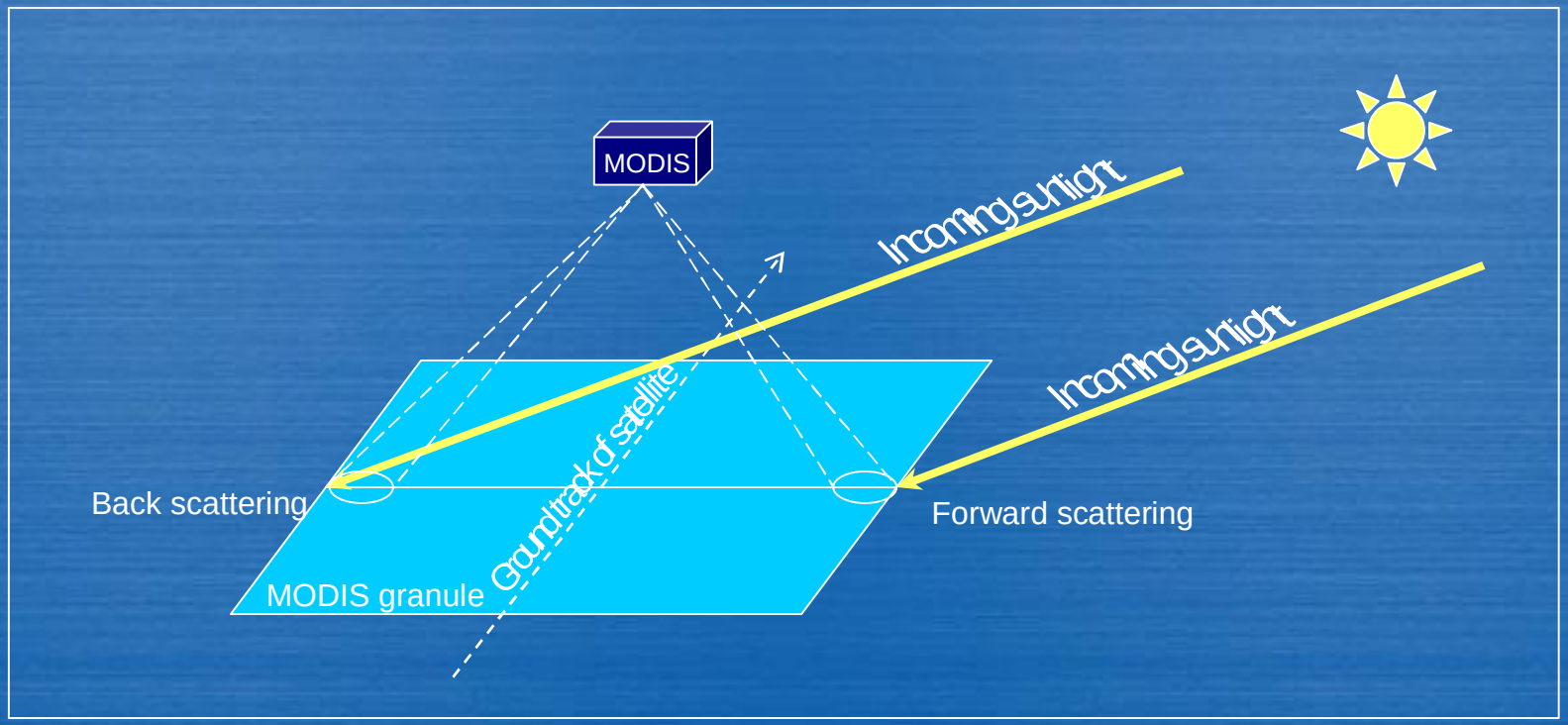
Cloud optical thickness



Droplet effective radius



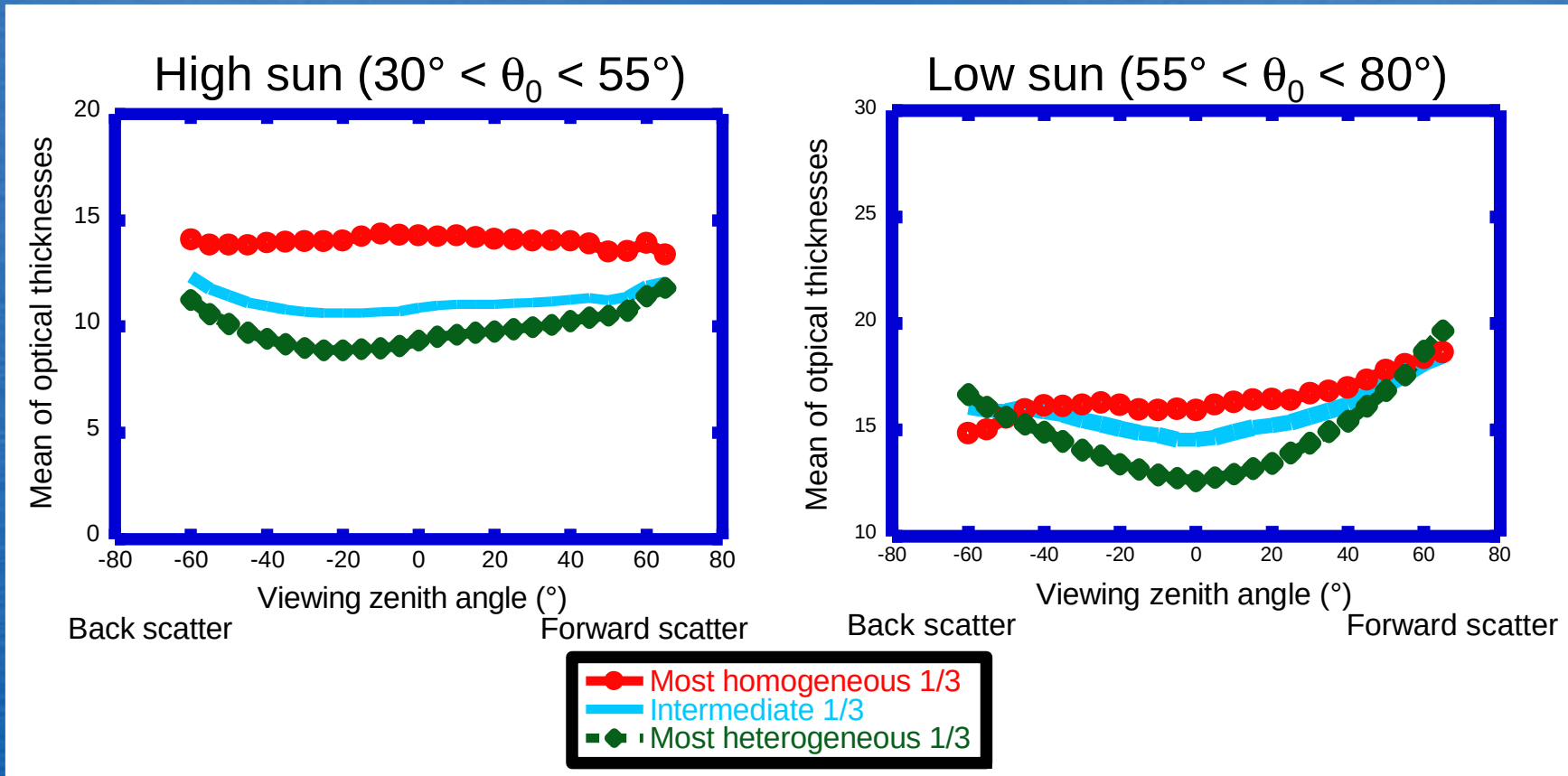
View-angle dependence of MODIS cloud optical thickness



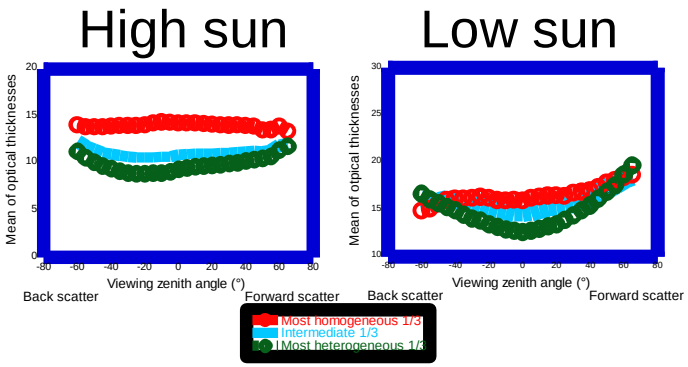
Data

- Virtually all daytime granules for 6 months (Aug. 2004-Jan. 2005)
- About 7% of scan lines
- 11 μm BT and cloud products at 1 km resolution
- High-confidence retrievals
- Liquid cloud phase

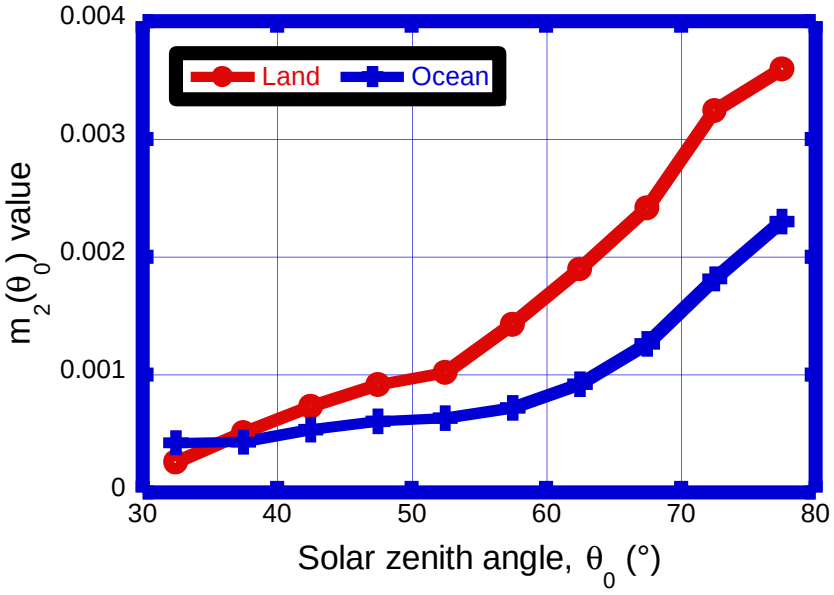
Clouds over ocean



Dependence on solar zenith angle



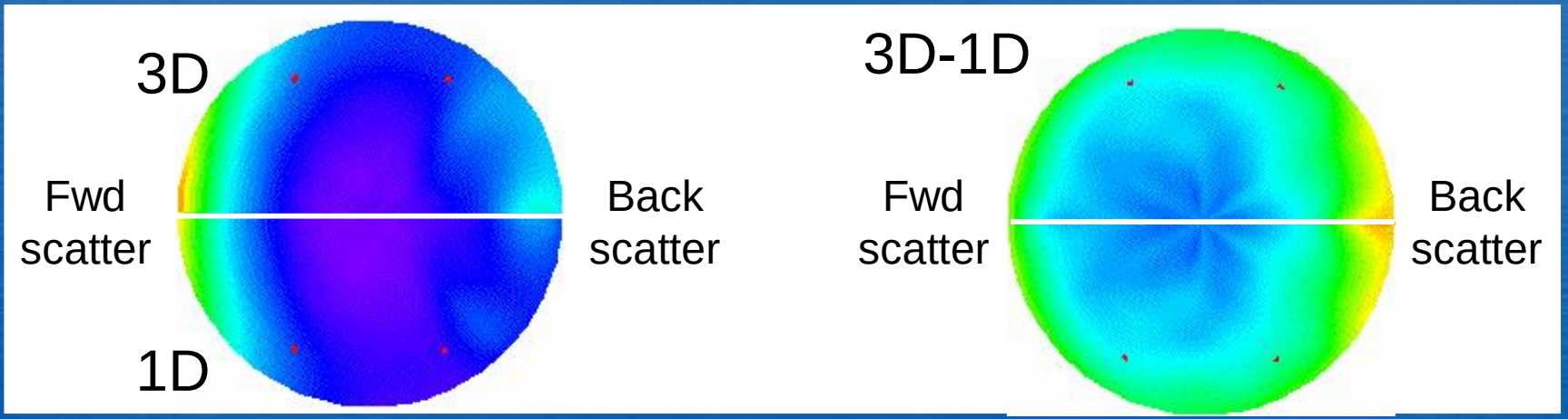
$$f(\theta,\theta_0) = m_0(\theta_0) + m_1(\theta_0)\cdot\theta + m_2(\theta_0)\cdot\theta^2$$



Possible causes of behavior seen for heterogeneous clouds

Considered:
- Daily cycle
- Latitude-dependence
- Solar elevation
- Cloud altitude
- Gaseous absorption
- Aerosol effects
- Surface effects

Most likely cause:
- Radiative effects of cloud heterogeneity



Summary

- MODIS data are used for setting up test cases in phase III of I3RC project.

- 3D cloud structure influences the view-angle dependence of MODIS cloud optical depths; its influence on cloud droplet size is much smaller.

- View-angle dependence is used to assess radiative effects cloud inhomogeneity and its climatology.

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