Unified non-Lambertian 3-D Retrieval and Validation of Land Surface Reflectance from MODIS

EOS SCIENCE NRA

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Accomplished Since 1998

Theoretical Basis Developed

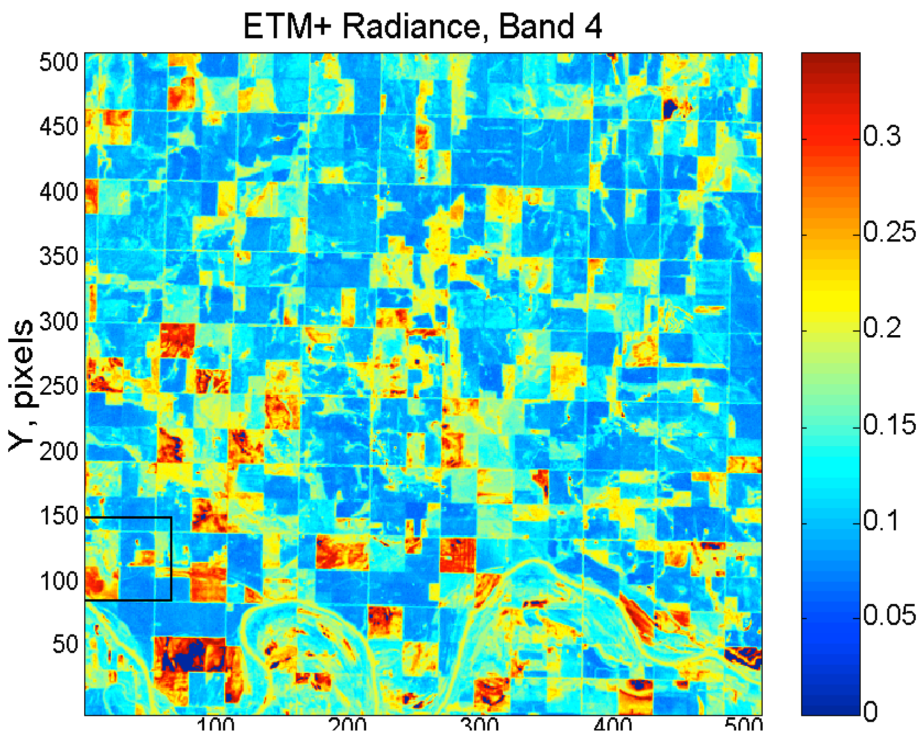
- 1D Radiative Transfer: Code SHARM-1D currently passing Goddard's Public Release Office.
  - ➢ Application: AC of Cloud Absorption Radiometer measurements during CLAMS.

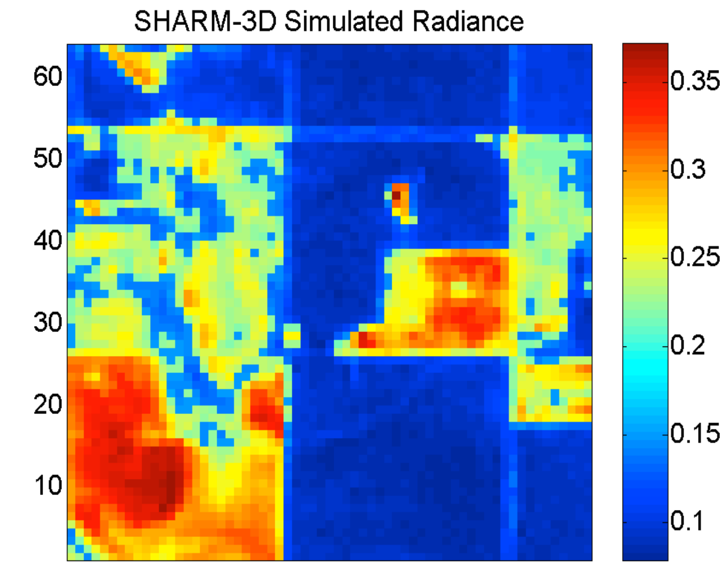
- 3D RT: Non-homogeneous surface, arbitrary BRDF. Accurate analytical theory for optimized AC.
  - ➢ ETM+: 3D aerosol retrievals and AC. (F. Hall, J. Masek, B. Middleton)

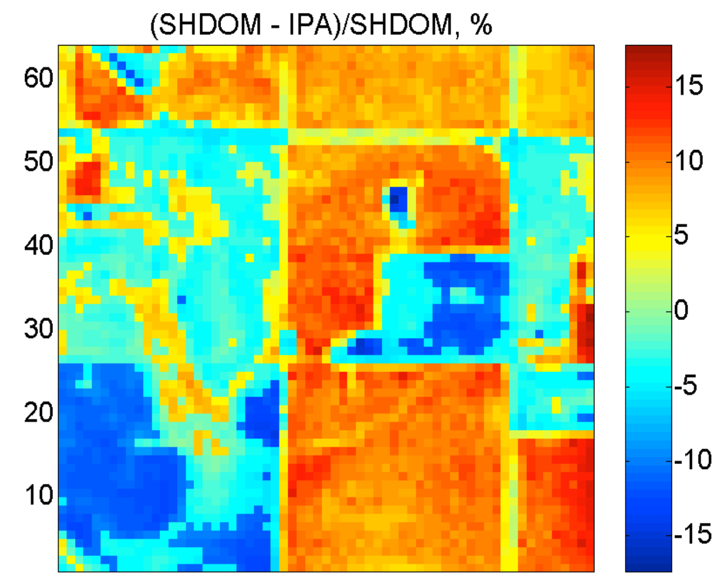
- Non-Grey RT: Absorption based on HITRAN-2000. Fast IPC method for RT with arbitrary spectral resolution.
  - ➢ Collaboration with AERONET: water vapor, carbon dioxide (B. Holben, A. Smirnov, M. Sorokine …).

3D Effects: Are They Important?

Example 1. TOA Radiance

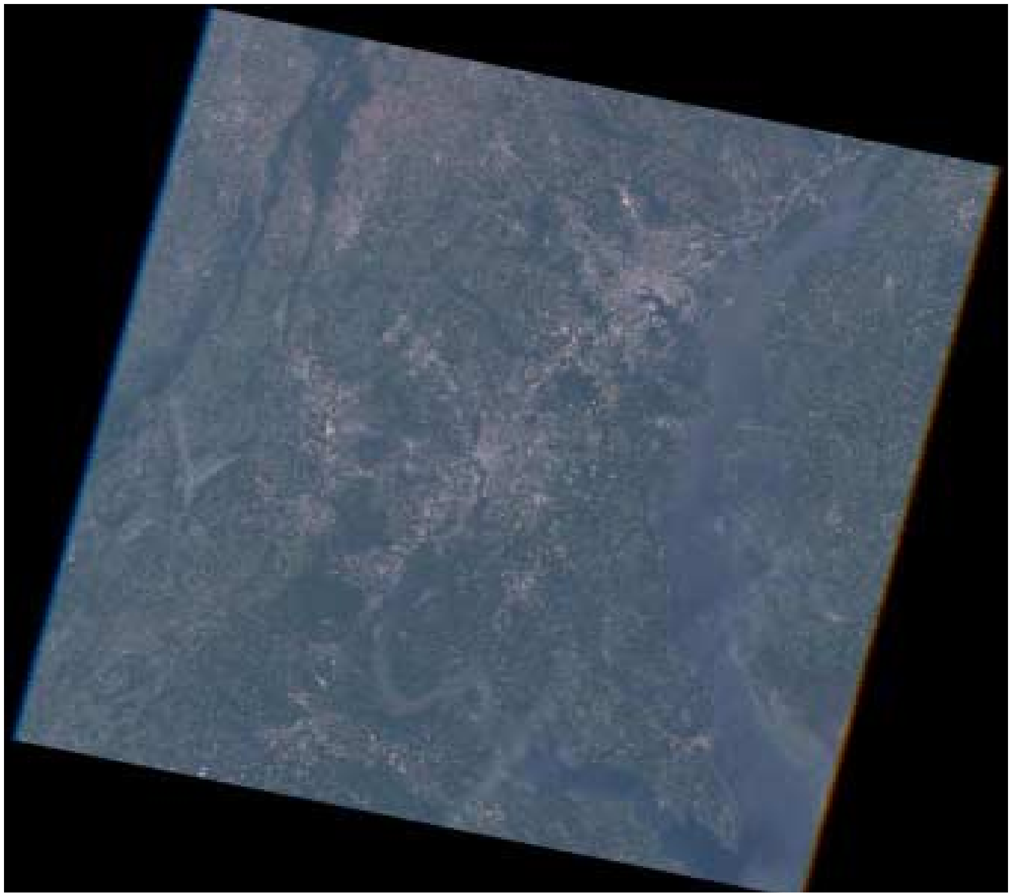




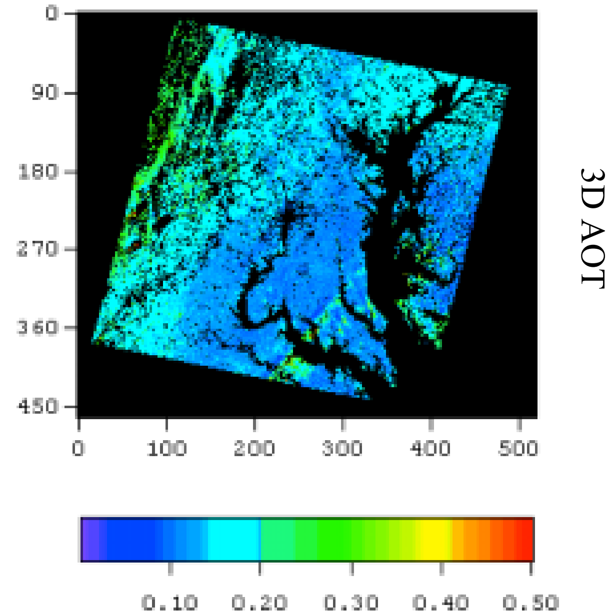


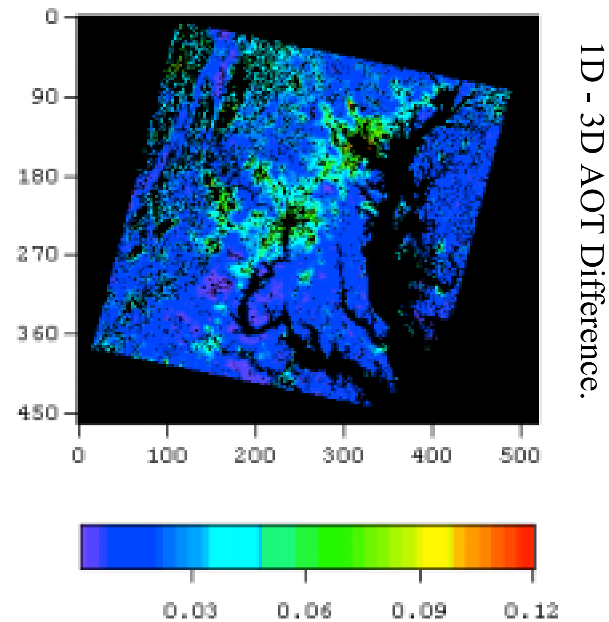
3D Effects: Are They Important? (cont'd)

Example 2. Aerosol Retrievals, 3D vs 1D



The RGB color composite of the ETM+ image of the Chesapeake Bay region acquired August 2, 2001.





Approach To MODIS AC
(straightforward and rigorous)

Over Dark Vegetated Surfaces

1. Retrieve aerosol over DDV based on 3D theory with simultaneous selection of aerosol model.

2. Derive surface BRDF/albedo from accumulated multi-day TOA reflectance

Over Bright Surfaces

A classical dilemma of one measurement and two unknowns, i.e., surface reflectance and AOT.

The introduction of two assumptions:

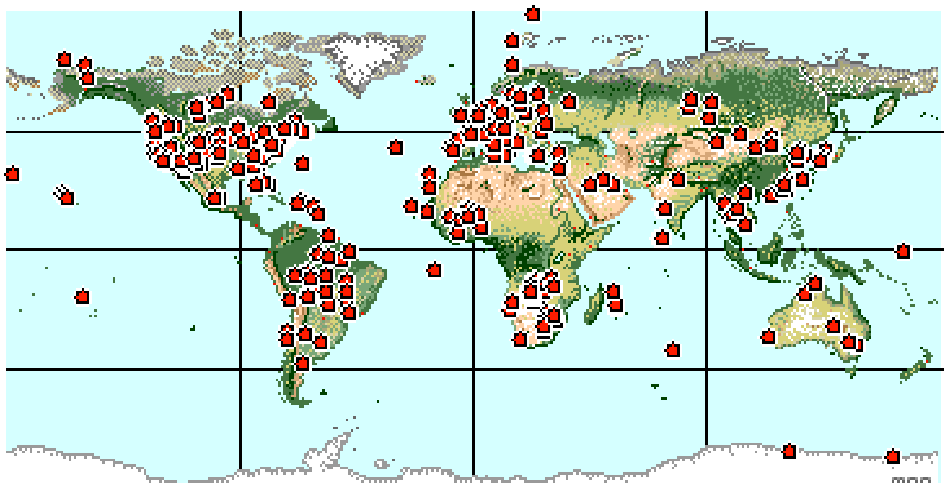
- the scale of aerosol variability is larger than 3-5 km, and
- surface reflectance does not change over several consecutive days,

renders a closed system of equations that can be solved for AOT on different days, along with surface reflectance.

A-SRVN - AERONET-based Surface Reflectance Validation Network

Main Functions

- **Daily Data Collection**
  MODIS, MISR ...
  (area ~ 16x16 km2)
- **Ancillary Data**
  AERONET aerosol and WV, NCEP ozone
- **Automatic AC**
  (single validated RT, unified algorithm)



PROGRESS

- Developed Design of A-SRVN.
- Finalizing AC Algorithms for MODIS and MISR.
- Have an Agreement on Operational MODIS Data Transmission from MODAPS to a dedicated workstation (N. Saleos, R. Wolfe, J. Morisette).

PRODUCTS

BRDF

1. Point-wise in Observation Angles
2. Best-fit MRPV (MISR)
3. Best-fit Kernel (MODIS)

Albedo

1. Spectral
2. Shortwave Broadband (SB)
3. Spectral and SB Fluxes, PAR

Spectral Regression (for AOT retrieval)

1. 2.1 _m → blue & red

EXPECTED BENEFITS

1. Validation of surface albedo/BRDF
2. Development of global surface climatology for aerosol retrievals
3. Way to MODIS – MISR data fusion

Calibration Analysis

4. Vicarious calibration
5. Cross-calibration of different sensors
6. Detection of calibration trend based on a time series of surface reflectance