Atmospheric Correction around AERONET sites: Development of Global Land Validation Dataset

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Research Objective:

Development of Advanced Atmospheric Correction Algorithm for MODIS

Linked to:

Development of Validation Dataset of Surface Reflectance over Land

Challenges of SR Validation

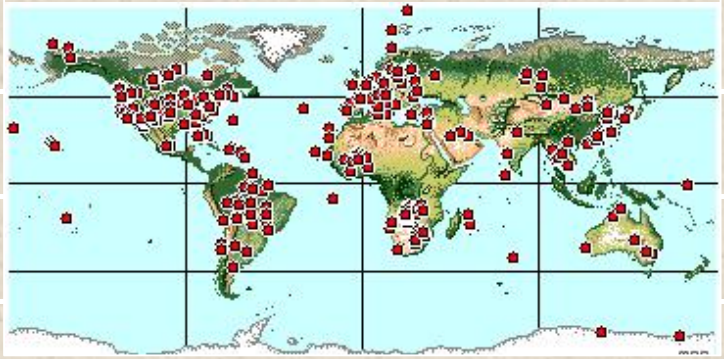
- Heterogeneous surface.
- Spatial resolution (1 km) *vs* scale of surface variation (20 m) (thousands of measurements).
- Spectral differences between ground-based and space-borne instruments.
- Ground-based measurements require atmospheric correction (complex experiments).

GSFC, October 5, 2000 (ETM+)

ASRVN - AERONET-based Surface Reflectance Validation Network

Main Functions

Daily Data Collection	Ancillary Data	Automatic AC
MODIS, MISR... (area ~ 32x32 km2)	AERONET aerosol and WV, NCEP ozone	(single validated RT, unified algorithm)



MISR
MODIS
ETM+
SeaWIFS
VIIRS

THEORETICAL BASIS

- 3D Radiative Transfer (Lyapustin & Knyazikhin, *Appl. Opt.*, 2001; 2002)
  - variable anisotropic surface;
  - arbitrary spatial resolution;
  - semi-analytical, accurate and fast due to parameterizations.
- Accurate Modeling of Gaseous Absorption
- Inversion with $MRPV_{MISR}$ and $LSRT_{MODIS}$ BRF Models

PRODUCTS

- BRF, Albedo (spectral & SW broadband)
- Surface Radiative Fluxes, PAR

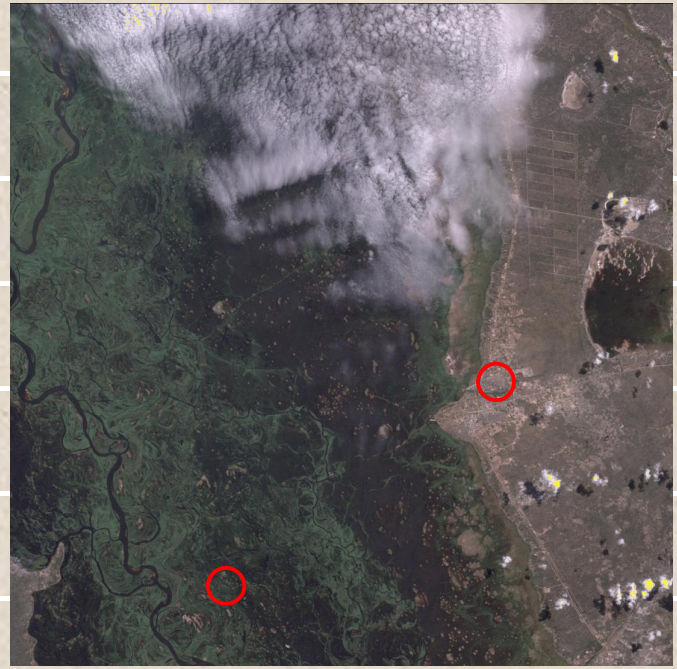
EXPECTED BENEFITS

- Validation of BRF & Albedo over Heterogeneous Surfaces
- MODIS-MISR Data Fusion
- Calibration Analysis
  - Vicarious calibration
  - Cross-calibration of different sensors
  - Detection of calibration trend based on a time series of surface reflectance.

Study Area:

1. Mongu (Zambia)
   (15º15'S, 23º09'E), H=1,104 m

2. GSFC (USA)
   (39º03'N, 76º88'W), H=50 m



March 19 | May 21 | June 22 | July 24 | August 25 | September 26 | October 28

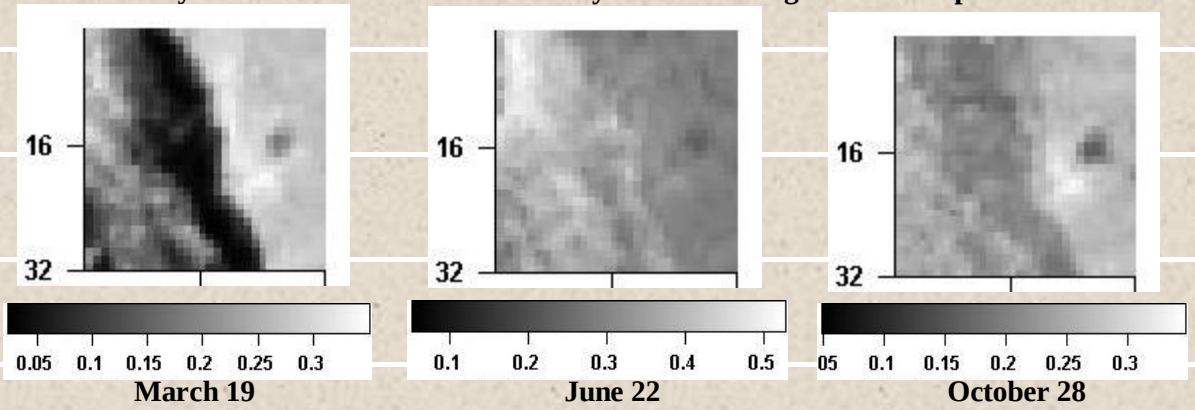
Albedo Time Series

(Mongu, 2003)

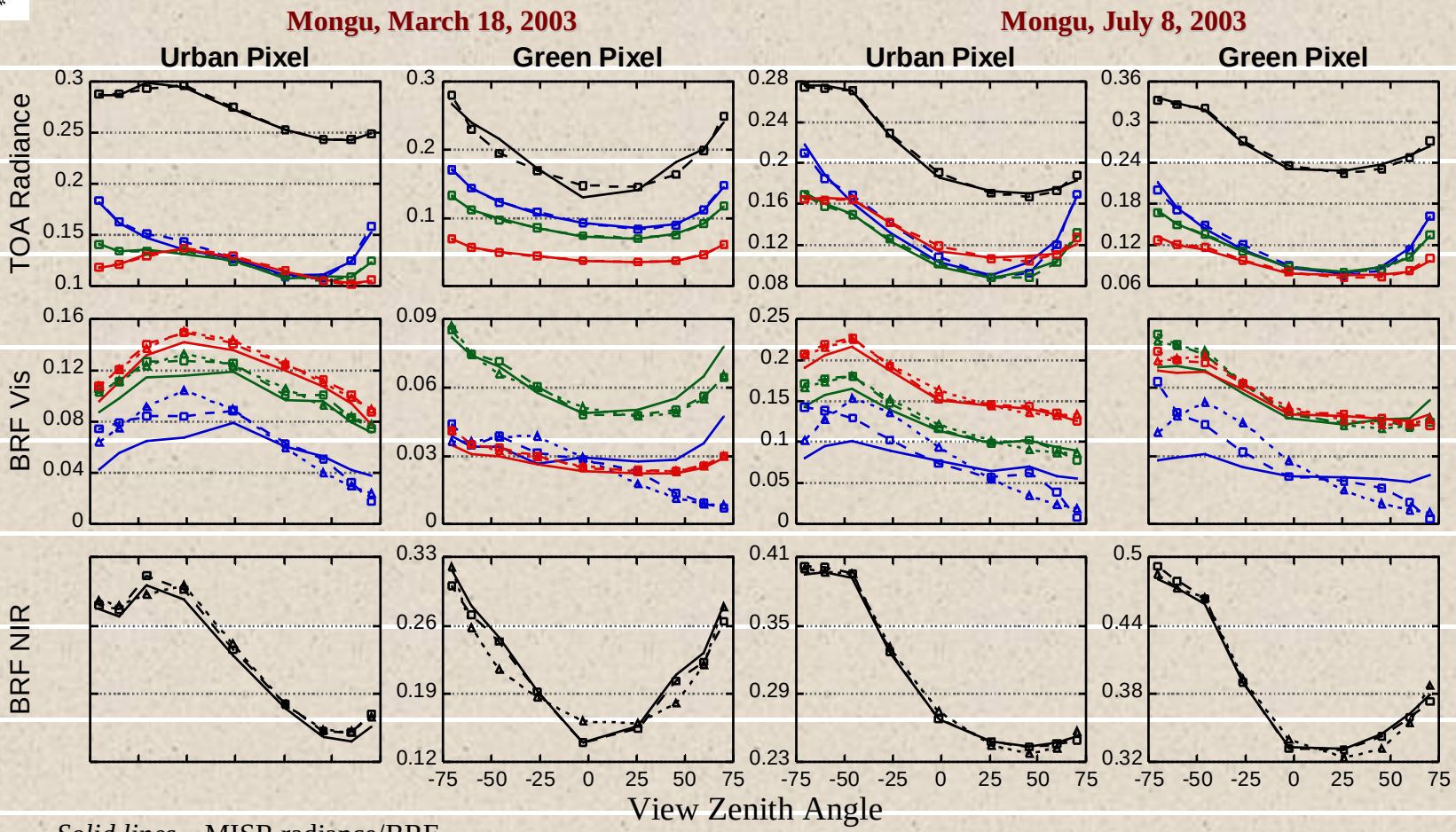
Vis. (RGB) and NIR (grey)

from

MISR Collection 4 Data



Analysis of BRF

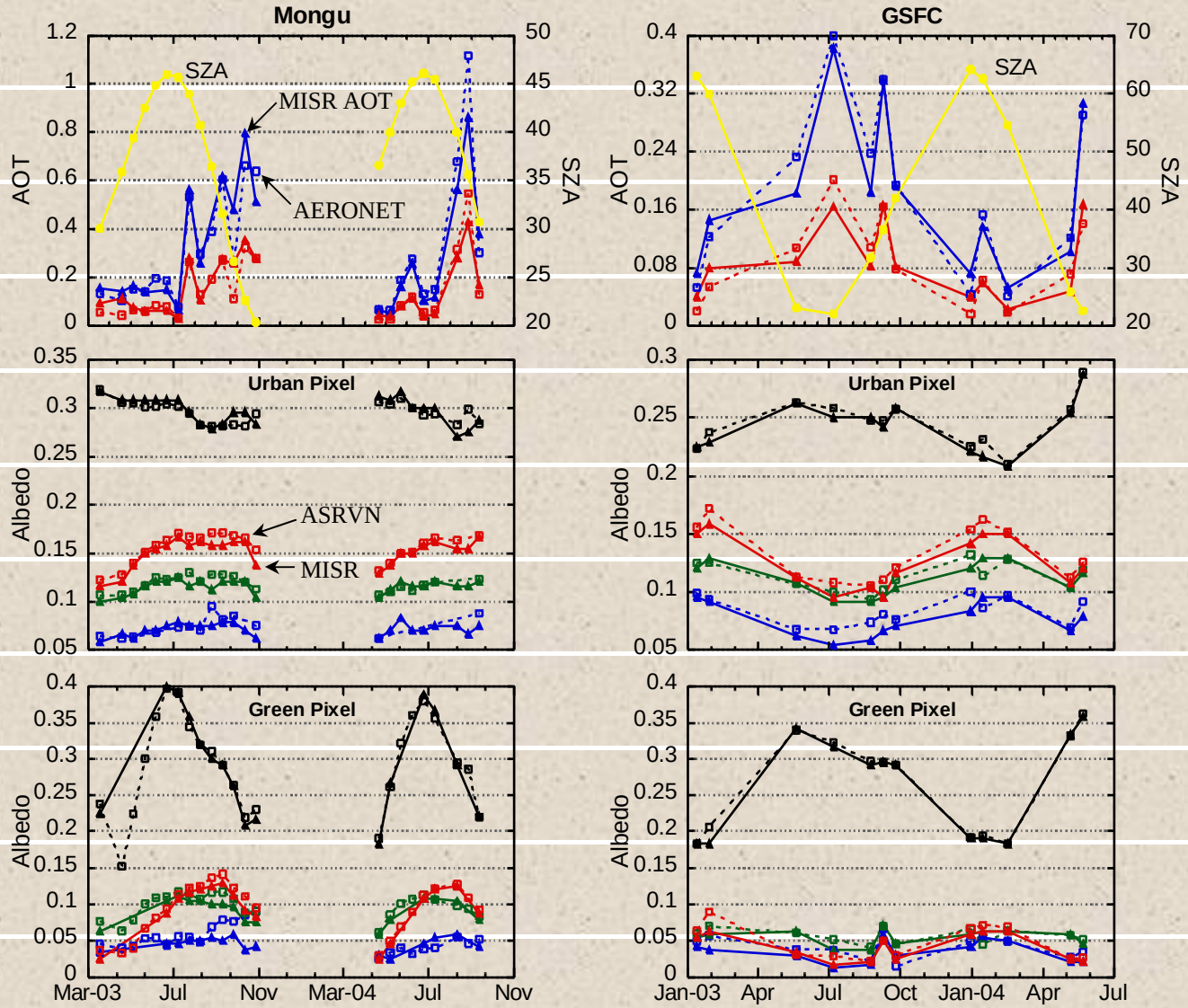


Solid lines – MISR radiance/BRF
Squares – ASRVN BRF (MRPV algorithm)
Triangles – model BRF calculated with the best-fit parameters (MRPV)

1. *MISR retrieves correct BRF shape.*
2. *MISR BRF is less anisotropic than the ASRVN BRF in the Vis.*

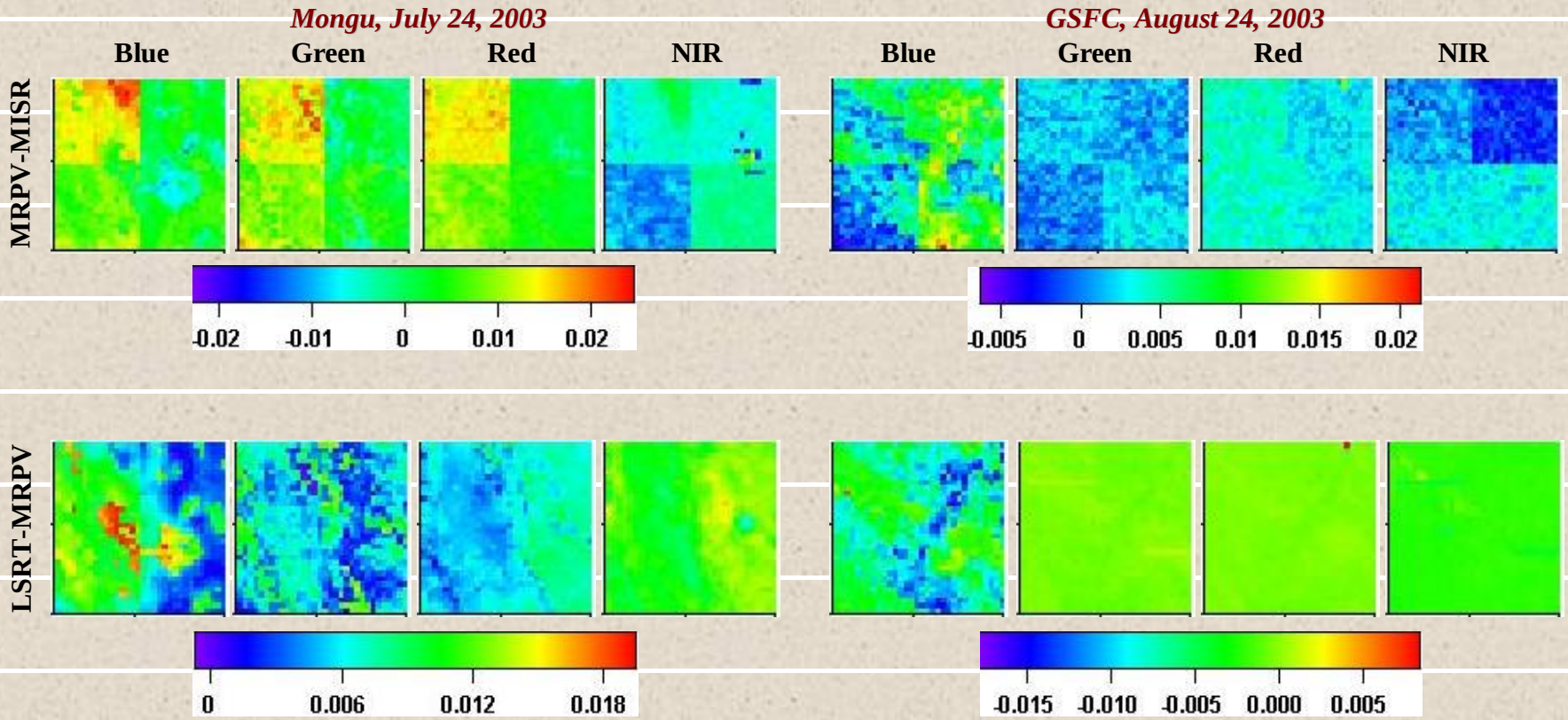
(analysis: *in IEEE TGARS Special Issue on Land Product Validation)*

Analysis of Albedo



1. *MISR correctly reproduces the time series of albedo.*
2. *MISR albedo is on average lower by about 0.005 in the green and red bands.*

Analysis of Albedo Spatial Distribution



1. *MISR correctly reproduces spatial distribution of albedo.*
2. *An albedo mosaic may develop due to MISR aerosol retrievals at 17.6 km resolution.*
3. *ASRVN albedo does not have model-dependent distortions from the variable land cover.*

Summary of Results (*local* analysis)

MISR

1. *MISR BRF and albedo products are generally accurate in both clear and hazy atmospheric conditions.*
2. *MISR correctly reproduces the time series and spatial distribution of albedo.*
3. *MISR BRF on average is less anisotropic than actual BRF in the visible bands.*

   The difference is greatest in the blue band, decreases with wavelength, and it is negligible in the near-IR band. This discrepancy most likely originates in 1) MISR aerosol retrieval algorithm over heterogeneous land, which tends to select an aerosol model that benefits the spectrally invariant shapes of surface BRF; 2) MISR surface HDRF retrieval algorithm where the iteration loop that removes the diffuse atmospheric transmittance is currently turned off.
4. *Our initial results suggest that the MISR surface albedo is on average lower than the ASRVN albedo by about 0.005 in the green and red bands.*

BRF Model (LSRT vs MRPV)

1. *MRPV model fits BRF shapes slightly better than LSRT model, except in the blue band.*
2. *The AC algorithm based on LSRT model is much faster and more robust (due to linearity).*
3. *The albedos from the two models are generally similar, with the average difference $\Delta q \leq 0.005$. The difference Δq is spatially homogeneous but site-dependent (function of aerosol absorption).*

What is Next …

MISR

- *ASRVN is receiving and processing operational MISR collection 5 data (0.5 Yr in 2000, and since Dec. 2004) for all AERONET stations (166). We plan to carry on MISR validation analysis on the regional and then global scales.*
- *The web-interface with data analysis tools is under development.*

ETM+

- *The ASRVN_ETM+ processing algorithm is being finalized (1 month).*
- *ASRVN_ ETM+ products will become available this summer.*

MODIS

- *Cooperating with Goddard Earth Sciences Data & Information Services Center (G. Leptouch, D. Ouzounov) to produce MODIS Collection 5 subsetted and aggregated data for ASRVN.*
- *Operational ASRVN_ MODIS products will become available this fall.*