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


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**Abstract.** We have developed an atmospheric correction algorithm to retrieve the surface BRF and albedo from MISR measurements for small areas around AERONET sunphotometer sites, using AERONET aerosol and column water vapor information. Our goal is to develop an indirect validation method for global surface reflectance products over heterogeneous land. Our algorithm makes independent retrievals with both the Li Sparse – Ross Thick kernel BRF model and the modified Rahman-Pinty-Verstraete BRF model used in the MODIS and MISR land algorithms, respectively. In this study, we report the first results of processing MISR Collection 4 data for 2003-2004 for two sites, Mongu, Zambia, and Greenbelt, Maryland (USA). We found that MISR generally provides accurate retrievals of BRF and albedo in both clear and hazy atmospheric conditions, correctly reproducing the parameter time series and spatial distribution. We also found that the MISR BRF on average is less anisotropic than actual BRF in the visible bands. The difference is greatest in the blue band, but decreases with increasing wavelength such that it is negligible in the near-IR band. Our initial results suggest that the MISR surface albedo is on average lower than the actual albedo by about 0.005 in the green and red bands.


**Research Objective**

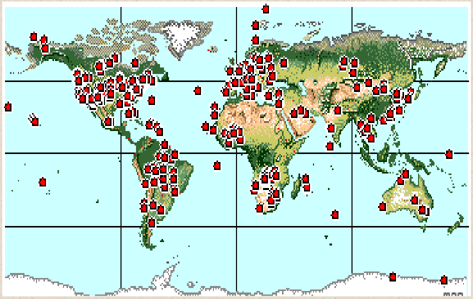
*Development of Advanced Atmospheric Correction Algorithm for MODIS*

**Linked to**

*Development of Validation Dataset of Surface Reflectance over Land*

**Main Functions**

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



- MISR
  - MODIS
    - ETM+
      - SeaWIFS
        - VIIRS

### 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 pace-borne instruments.
- Ground-based measurements require atmospheric correction (complex experiments).

### 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 Fluxes, PAR

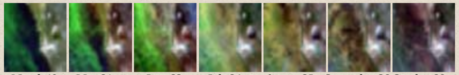
### EXPECTED BENEFITS

- 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.

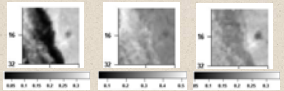
### Study Area

1. Mongu (Zambia) *(15°15'S, 23°09'E), H=1,104 m*
2. GSFC (USA) *(39°03'N, 76°88'W), H=50 m*

### Albedo Time Series *(Mongu, 2003, Vis. (RGB) and NIR (grey) from MISR Collection 4 Data)*

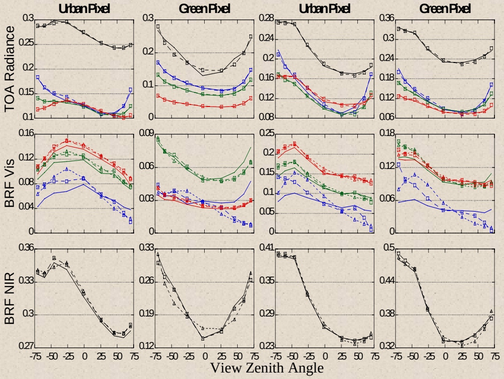


March 19 · May 21 · June 22 · July 24 · August 25 · September 26 · October 28



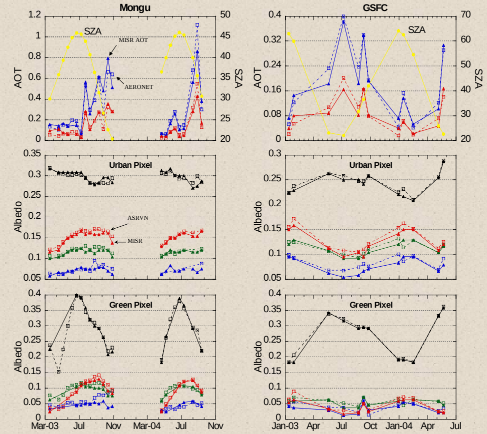
March 19 · June 22 · October 28

### Analysis of BRF

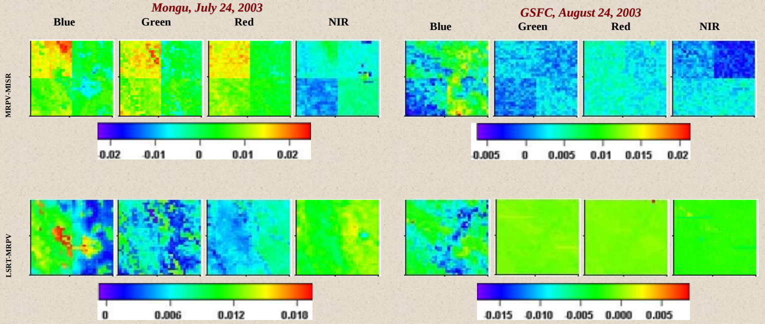



*Solid lines* – MISR radiance/BRF
*Squares* – ASRVN BRF (MRPV algorithm)
*Triangles* – model BRF calculated with the best-fit parameters (MRPV)

### Analysis of Albedo




### Analysis of Albedo Spatial Distribution




### 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 $\Delta q$ is spatially homogeneous but site-dependent (function of aerosol absorption).*