

Improvement in the MISR aerosol product over land



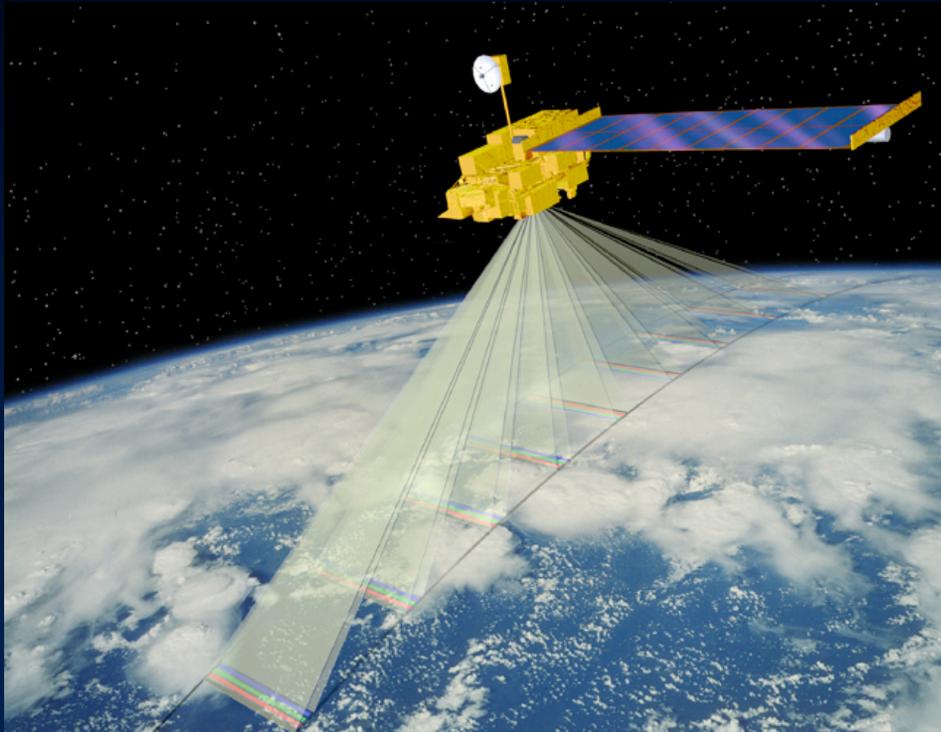
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MISR observing concept



9 pushbroom cameras

**9 view angles at Earth surface:
70.5° forward to 70.5° aftward**

**Multiple spectral bands at each angle:
446, 558, 672, 866 nm**

14-bit digitization

On-board calibration system

**Continuous pole-to-pole coverage
on orbit dayside**

400-km swath

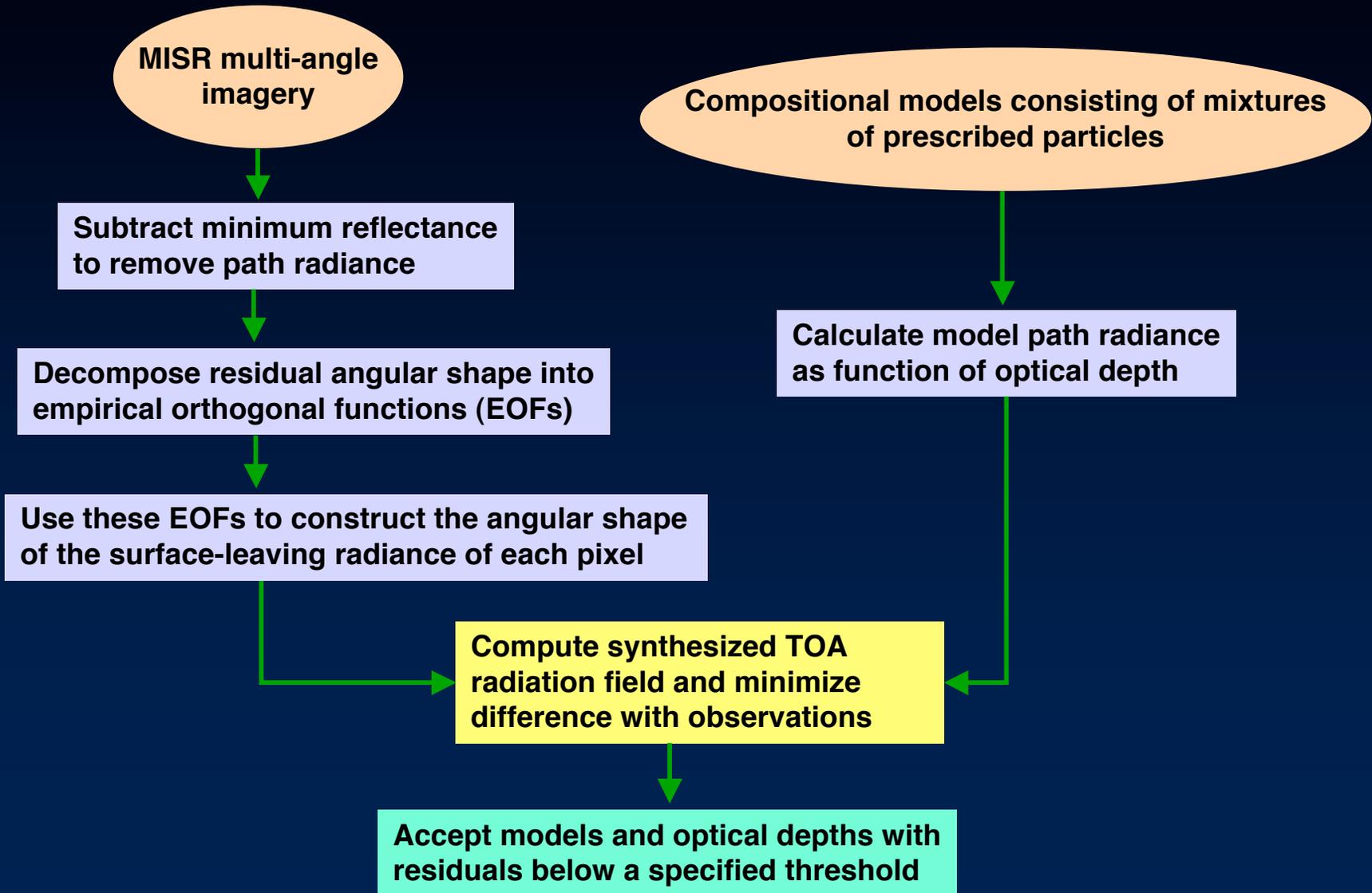
**Contiguous zonal coverage:
9 days at equator
2 days at poles**

275 m - 1.1 km sampling

**7 minutes to observe each scene
at all 9 angles**

Aerosol retrieval methodology over land

Applied to each 17.6-km area



New refinement: HDRF shape similarity pre-filter

**Assumes the surface hemispherical-directional reflectance factor (HDRF)
Can be decomposed as: $r(\lambda, \Theta) = r_0 * a(\lambda) * f(\Theta)$**

Then:

**$r(\lambda, \Theta) / [r(\lambda, \Theta)]_{\text{camera averaged}} = f(\Theta) / [f(\Theta)]_{\text{camera averaged}}$
i.e., normalized angular shape is band independent**

**$r(\lambda, \Theta) / [r(\lambda, \Theta)]_{\text{band averaged}} = a(\lambda) / [a(\lambda)]_{\text{band averaged}}$
i.e., normalized spectral shape is angle independent**

For a candidate aerosol mixture and optical depth, the surface HDRF is retrieved and the angular/spectral shape similarities are tested

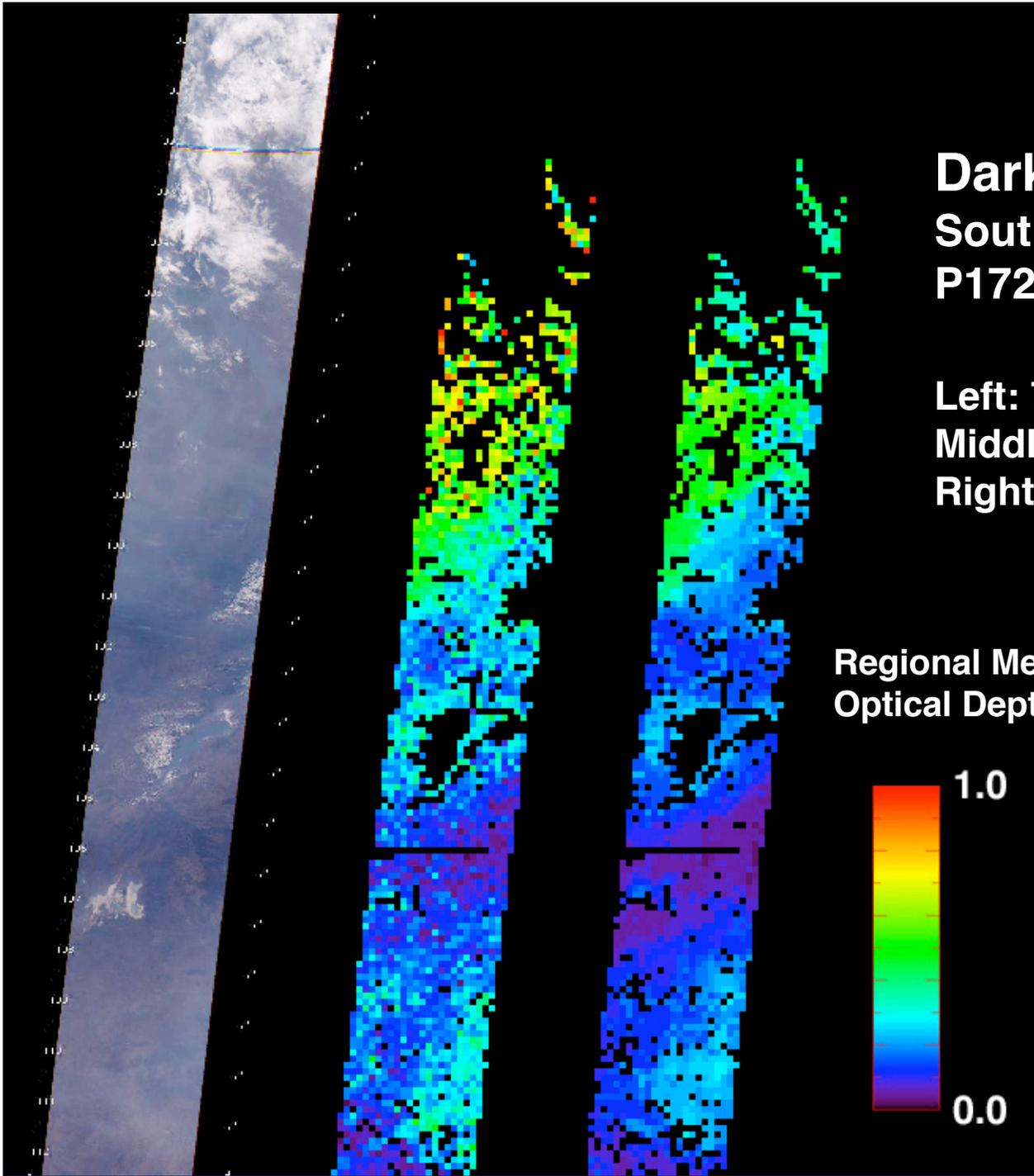
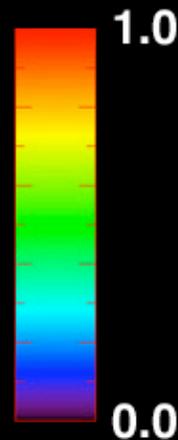
Only mixture-optical depth combinations for which the shape similarities meet specified thresholds are retained

The land aerosol retrieval algorithm is then applied to the surviving mixtures and optical depths

**Dark surface example
Southern Africa
P172, O3684, 27 August 2000**

**Left: 70°-aft browse image
Middle: HDRF pre-filter off
Right: HDRF pre-filter on**

**Regional Mean
Optical Depth**



Vicinity of Sua Pan
P172, O3684, Blocks 106-108
27 August 2000



HDRF pre-filter off



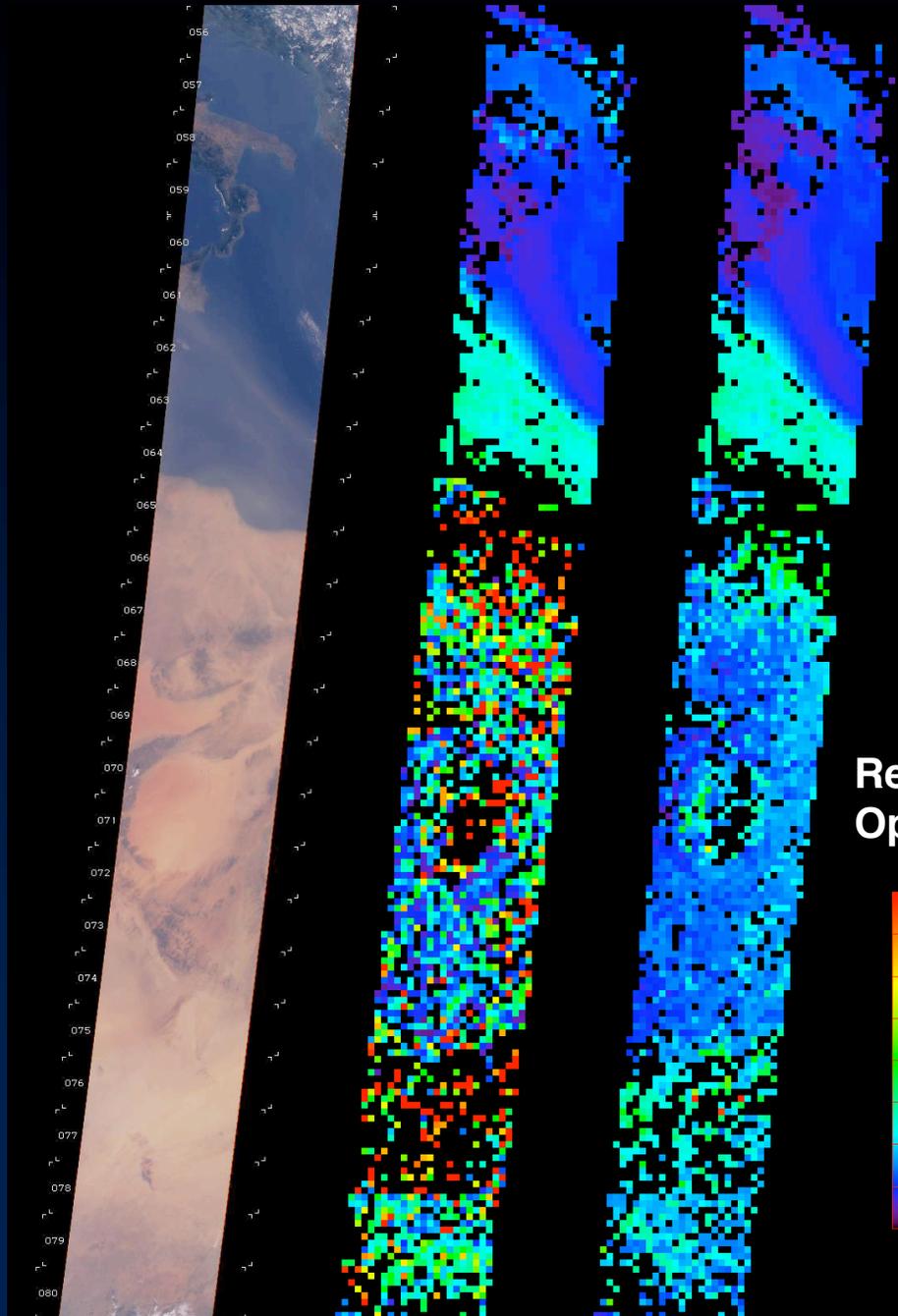
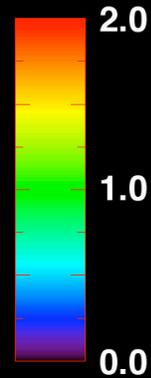
HDRF pre-filter on

Retrieved 70°-aft HDRF

**Bright surface example
Northern Africa
P187, O13602, 9 July 2002**

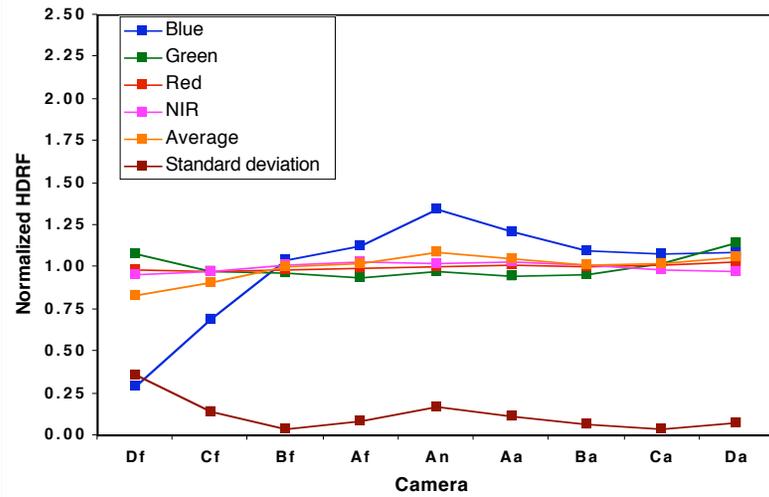
**Left: 70°-forward browse image
Middle: HDRF pre-filter off
Right: HDRF pre-filter on**

**Regional Mean
Optical Depth**

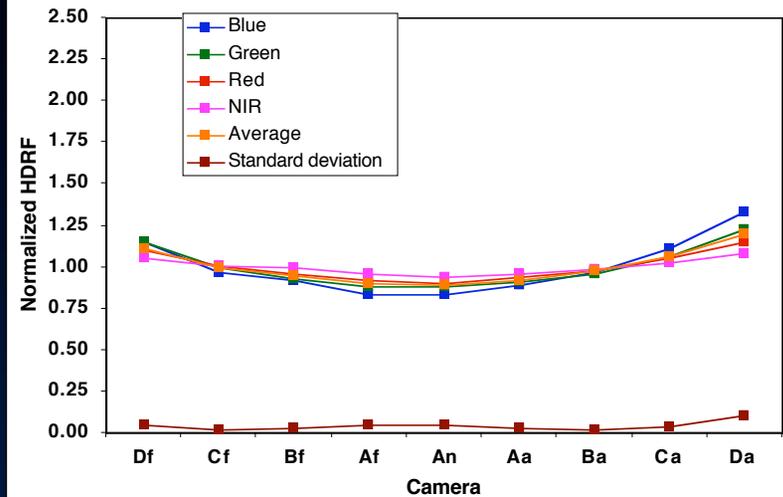


HDRF shape similarities as a function of optical depth

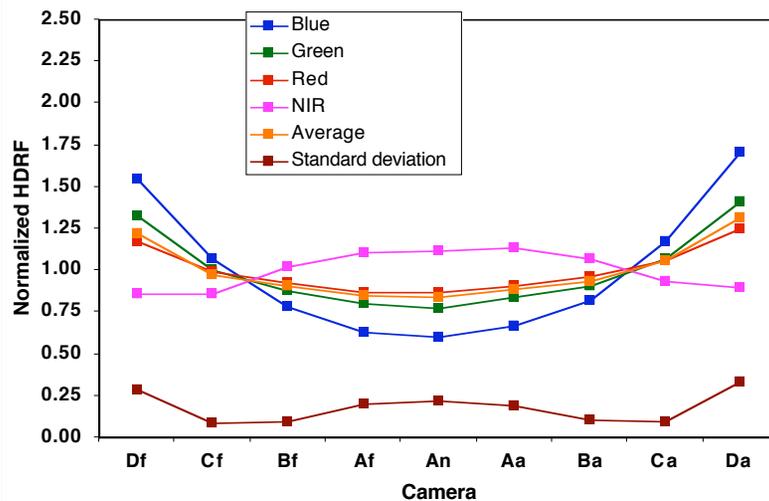
Desert, $\tau = 0.24$



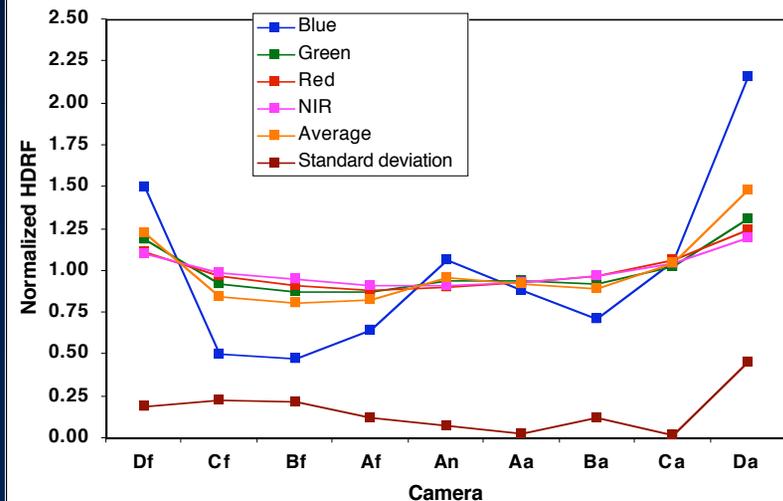
Desert, $\tau = 1.30$

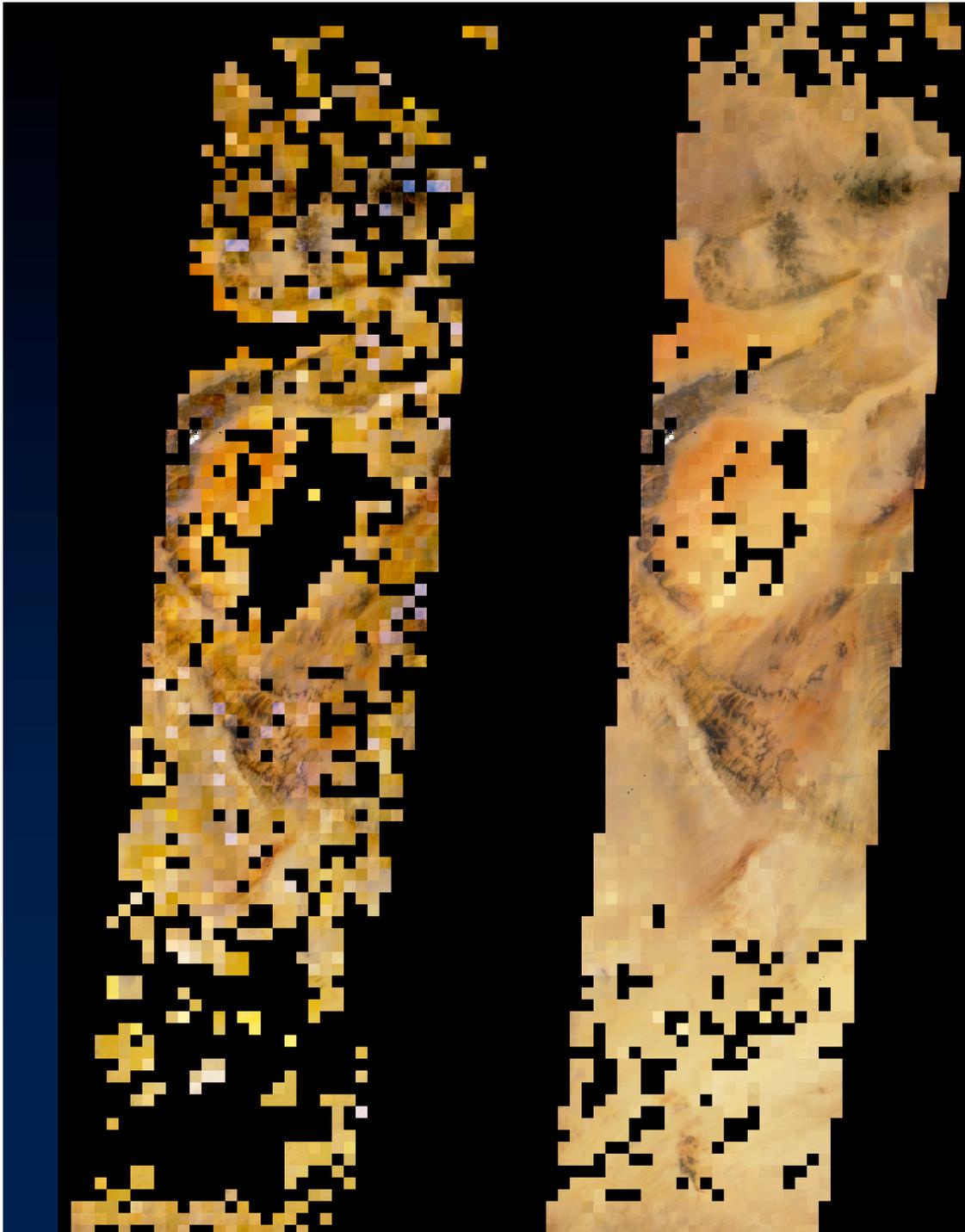


Desert, $\tau = 2.30$



Desert, $\tau = 2.90$



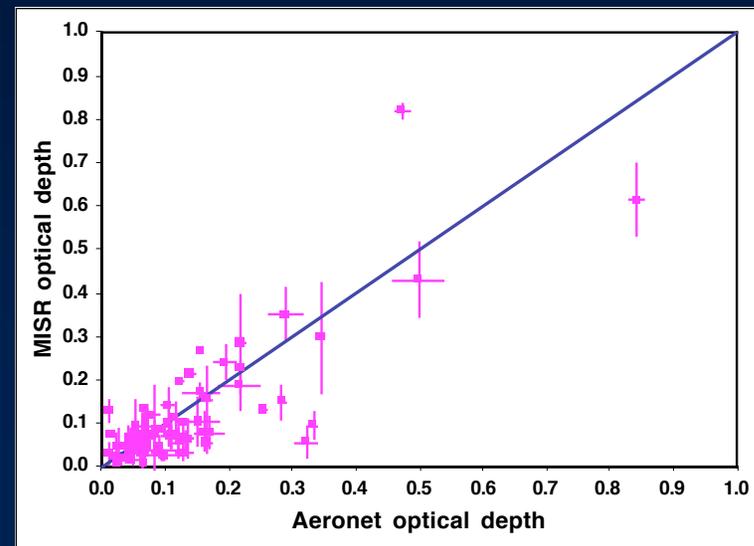
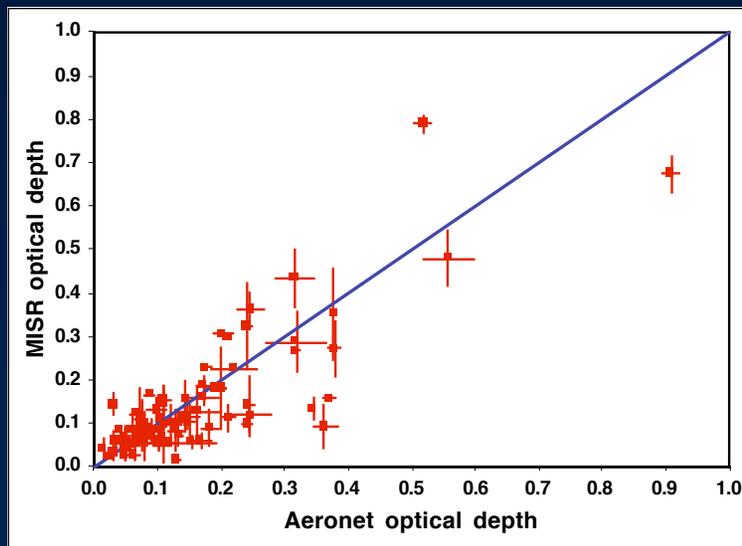
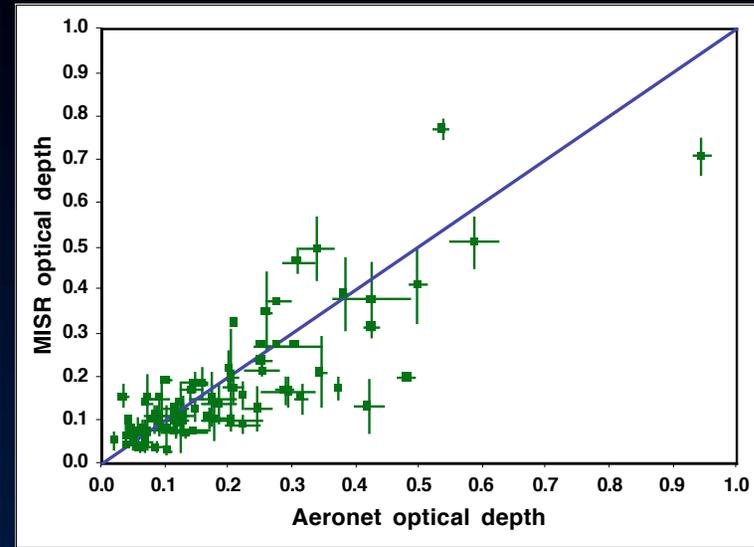
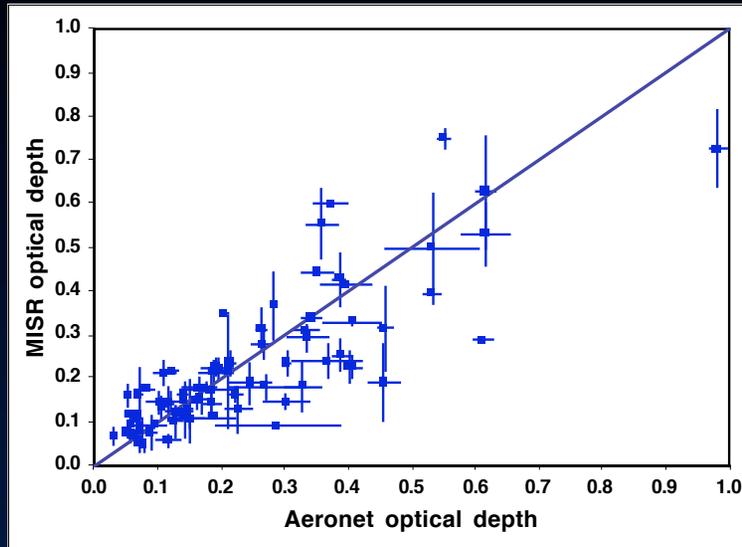


Northern Africa
P187, O13602, 9 July 2002
Blocks 66-78

70°-forward HDRF
Left: HDRF pre-filter off
Right: HDRF pre-filter on

MISR vs. AERONET optical depths

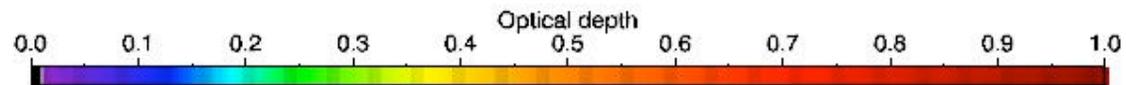
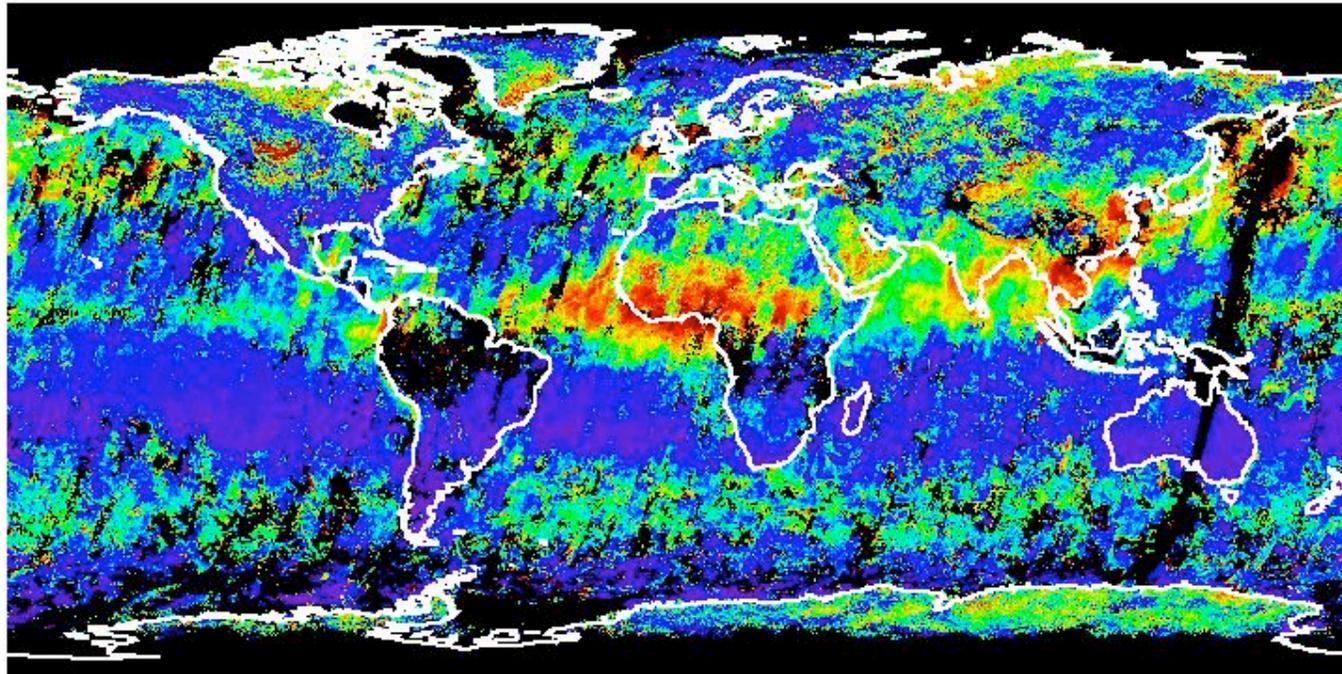
51 globally distributed sites, March 2002



Data plotted are matchups where MISR and AERONET had coincident retrievals

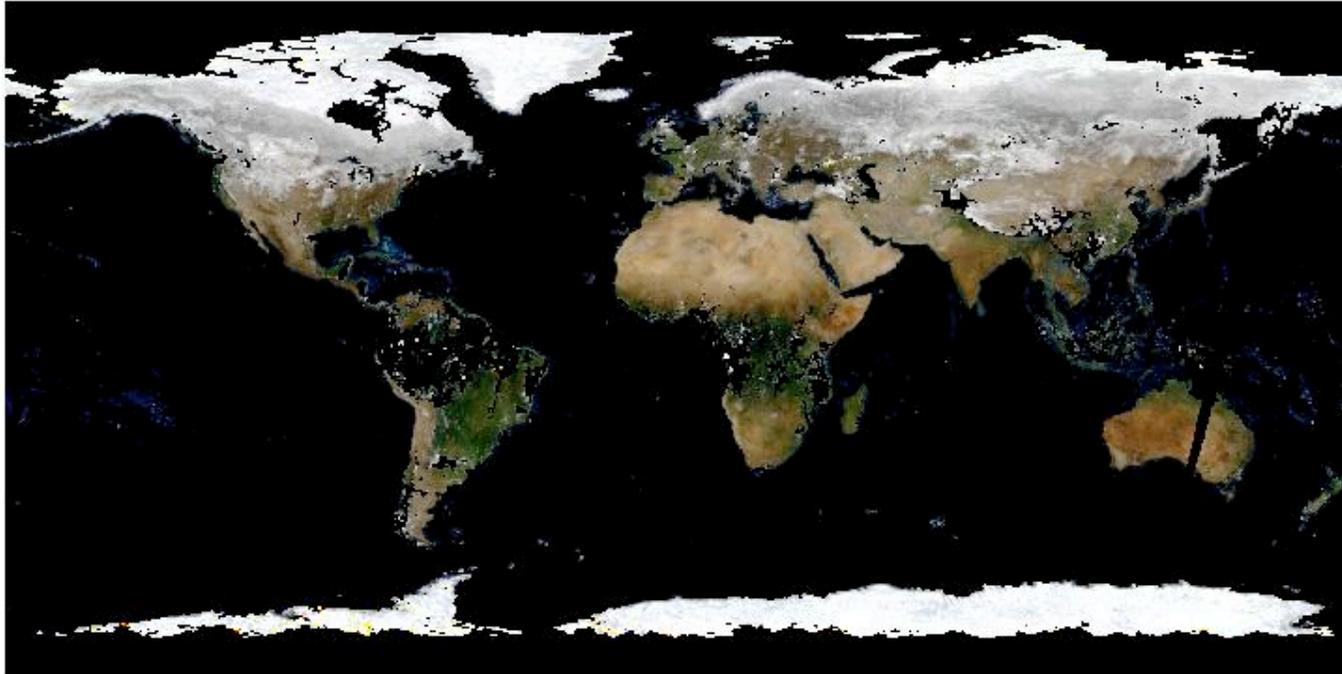
MISR global aerosol optical depth March 2002

Optical depth March 2002 F01_0005



MISR directional hemispherical reflectance March 2002

DHR March 2002 F01_0005 (Natural color, Histogram equalized)



Conclusions



The new pre-filter has significantly reduced the aerosol retrieval blunder rate and results in an improved quality surface product

The empirical orthogonal function algorithm and the HDRF angular shape pre-filter have no single-angle analogs

Multi-angle remote sensing provides unique ways of retrieving aerosol properties over land, including bright deserts which are major source regions

MISR data products and tools are publicly available through the NASA Langley Atmospheric Sciences Data Center

<http://eosweb.larc.nasa.gov>

For more information about MISR:

<http://www-misr.jpl.nasa.gov>