

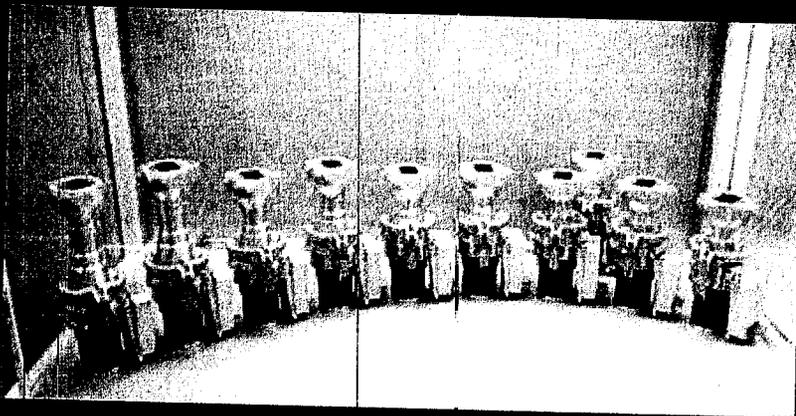
**Toronto**  
6 March 2000

# **Recent advances in aerosol retrievals from MISR**

**David J. Diner, J.V. Martonchik,  
R.A. Kahn, S.H. Pilorz, K.A. Crean**  
Jet Propulsion Laboratory,  
California Institute of Technology

**IGARSS'2002**  
Toronto, Ontario, Canada  
26 June 2002 |

# MISR characteristics



**9 CCD pushbroom cameras**

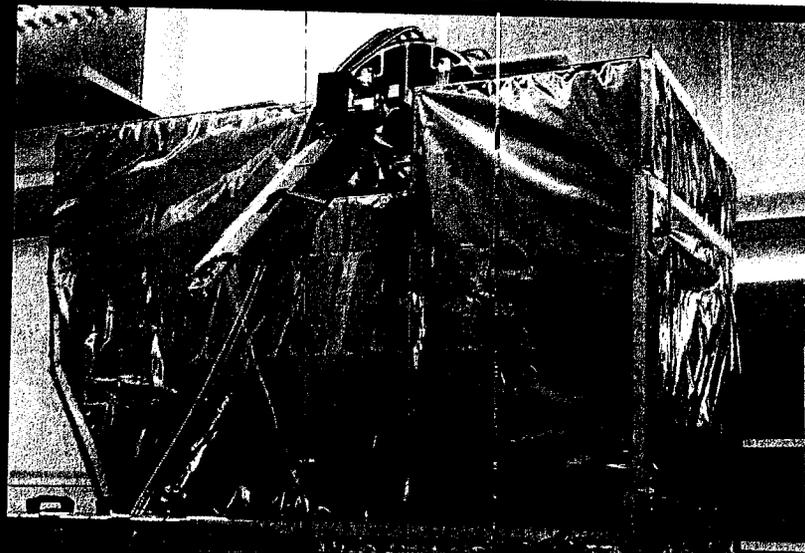
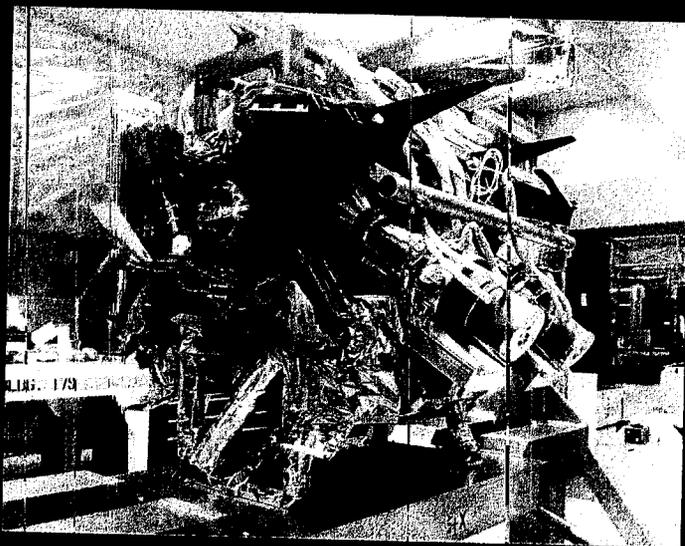
**9 view angles at Earth surface:  
70.5°, 60.0°, 45.6°, 26.1° forward  
nadir**

**70.5°, 60.0°, 45.6°, 26.1° backward**

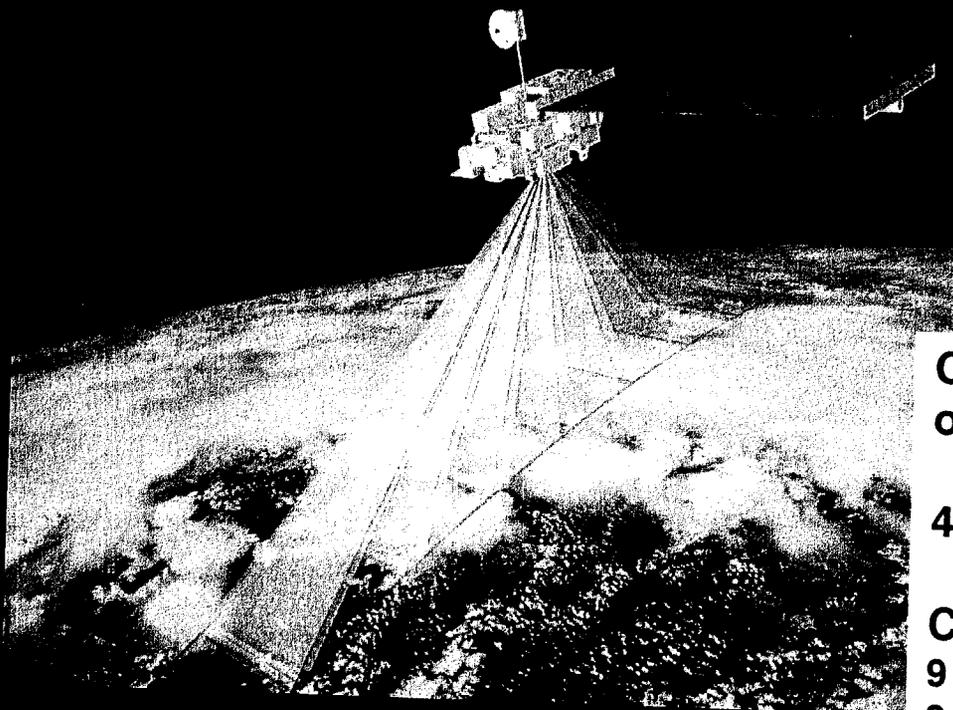
**4 spectral bands at each angle:  
446, 558, 672, 866 nm**

**14-bit digitization**

**On-board calibration system**



# Observational attributes



**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 water

MISR multi-angle  
imagery

Compositional models consisting of mixtures  
of prescribed particles

Surface glitter  
and whitecap  
model

Calculate model path radiance  
as function of optical depth

Minimize residuals between  
observations and modeled  
radiation field

Accept models and associated optical depths with  
residuals below a specified threshold

# Aerosol retrieval methodology over land

MISR multi-angle  
imagery

Compositional models consisting of mixtures  
of prescribed particles

Subtract minimum reflectance  
to remove path radiance

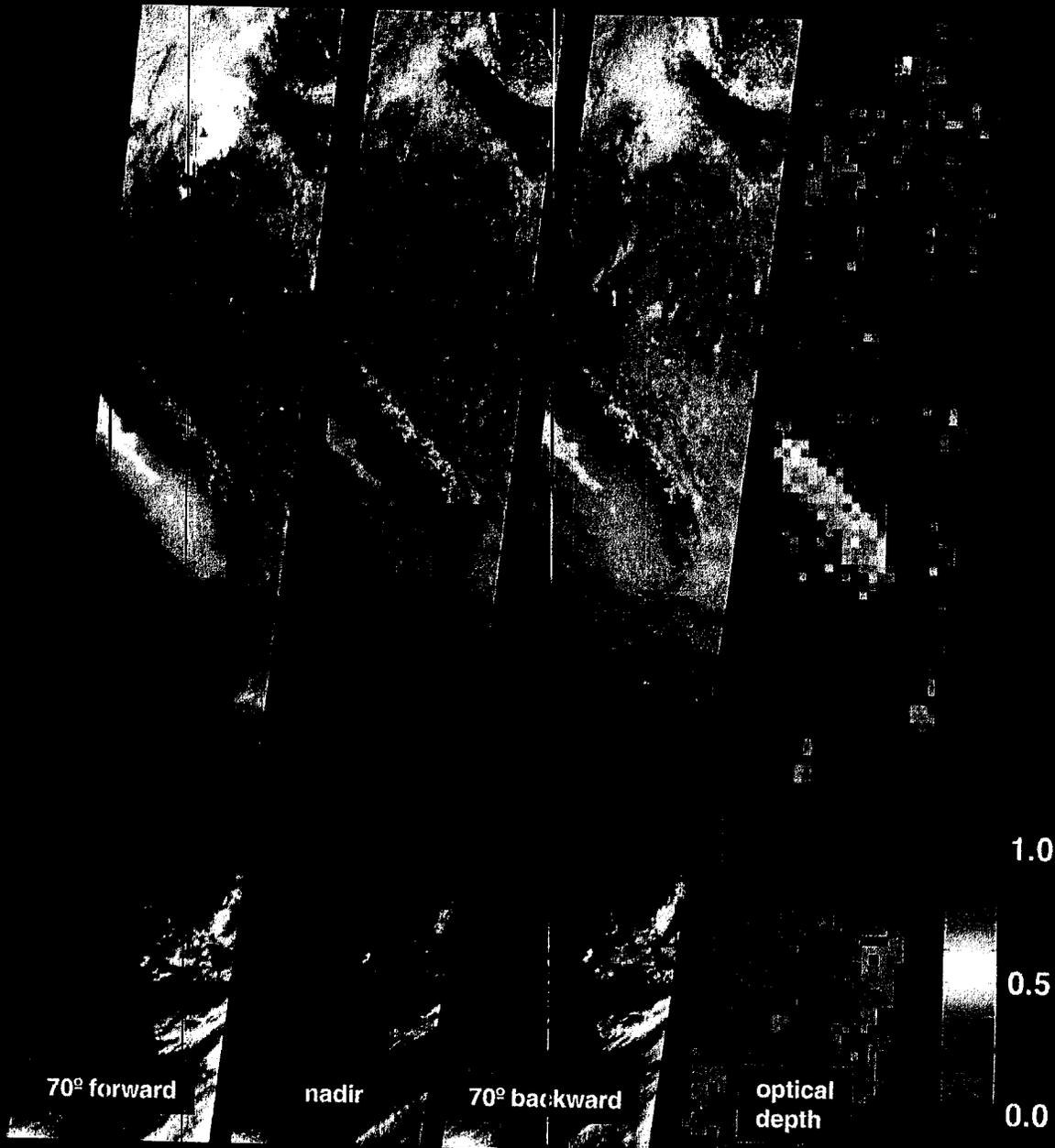
Calculate model path radiance  
as function of optical depth

Calculate surface-leaving angular shape  
eigenvectors

Minimize residuals between  
observations and synthesized  
radiation field

Accept models and associated optical depths with  
residuals below a specified threshold

# Southern California and Western Nevada 3 January 2001



**Smoke from  
fires in  
Southern Mexico  
2 May 2002**



**nadir**

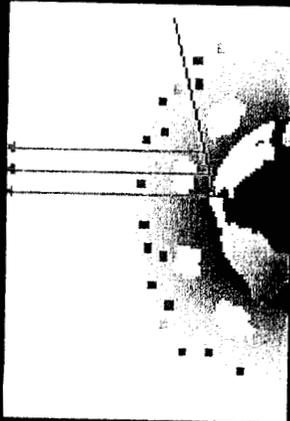
**70° backward**

**optical  
depth**

2.0  
1.5  
1.0  
0.5  
0.0

## Data product availability and maturity levels

MISR data are processed, archived, and publicly available at:



LANGLEY RESEARCH CENTER

**ATMOSPHERIC  
SCIENCES  
DATA CENTER**

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

Terra data products are given the following maturity classifications:

**Beta:** Minimally validated. Early release to enable users to gain familiarity with data formats and parameters. May contain significant errors.

**Provisional:** Partially validated. Improvements are continuing. Useful for exploratory and process studies.

**Validated:** Uncertainties are well defined, and suitable for systematic, long-term studies.

# Radiometric calibration



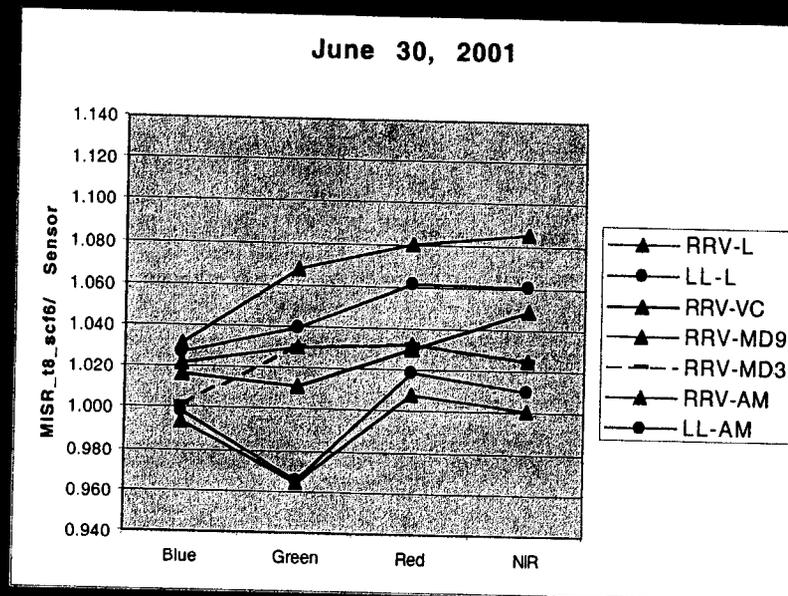
MISR image of Lunar Lake and Railroad Valley



AirMISR image of Railroad Valley target area

Accurate absolute, camera-relative, band-relative, and pixel-relative radiometric calibration are essential for MISR geophysical retrievals.

Currently we estimate a 1-3% systematic bias due to recently discovered scene context effects in the procedure for establishing the radiometric scale. This will be corrected in a future product upgrade.



C. Bruegge, JPL / K. Thome, UofA

Ratio of MISR top-of-atmosphere radiances to  
 (L) Landsat preflight calibration  
 (VC) Vicarious calibration measurements (UofA data)  
 (MD) MODIS  
 (AM) AirMISR (green band calibration suspect)

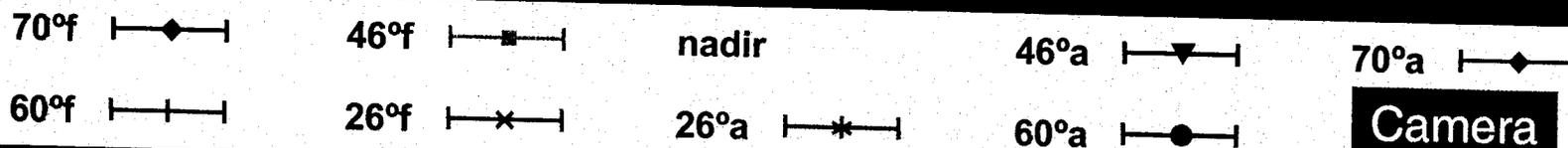
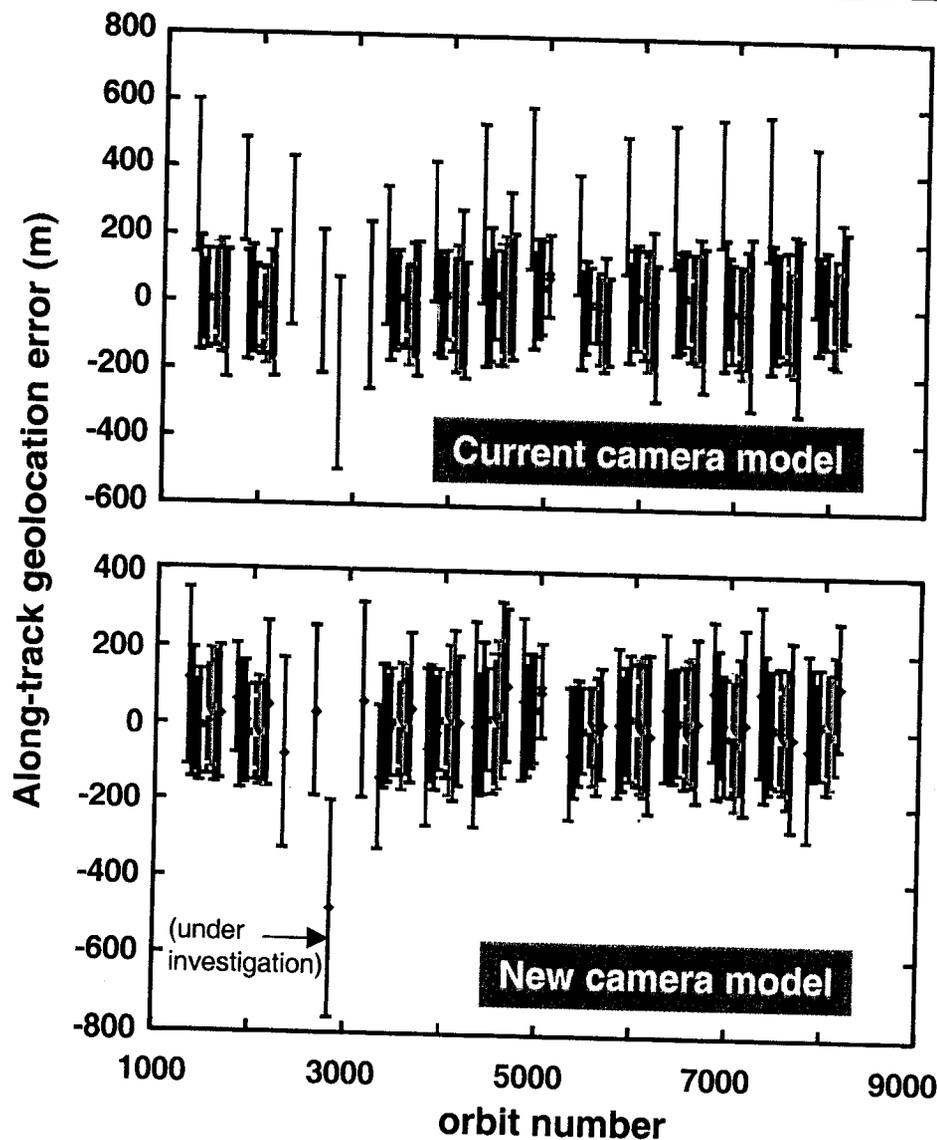
# Geometric calibration

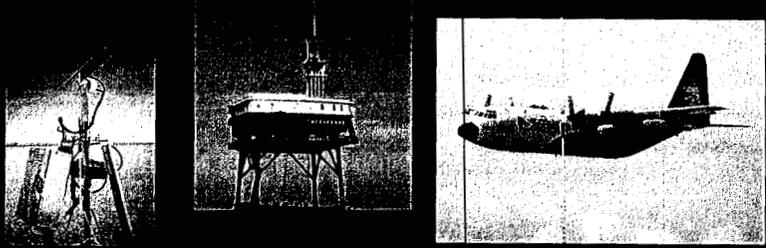
Accurate camera geolocation and camera-to-camera co-registration are essential for MISR geophysical retrievals.

Co-registration is particularly important for the oblique angles, which play a key role in stereoscopic height and wind retrievals.

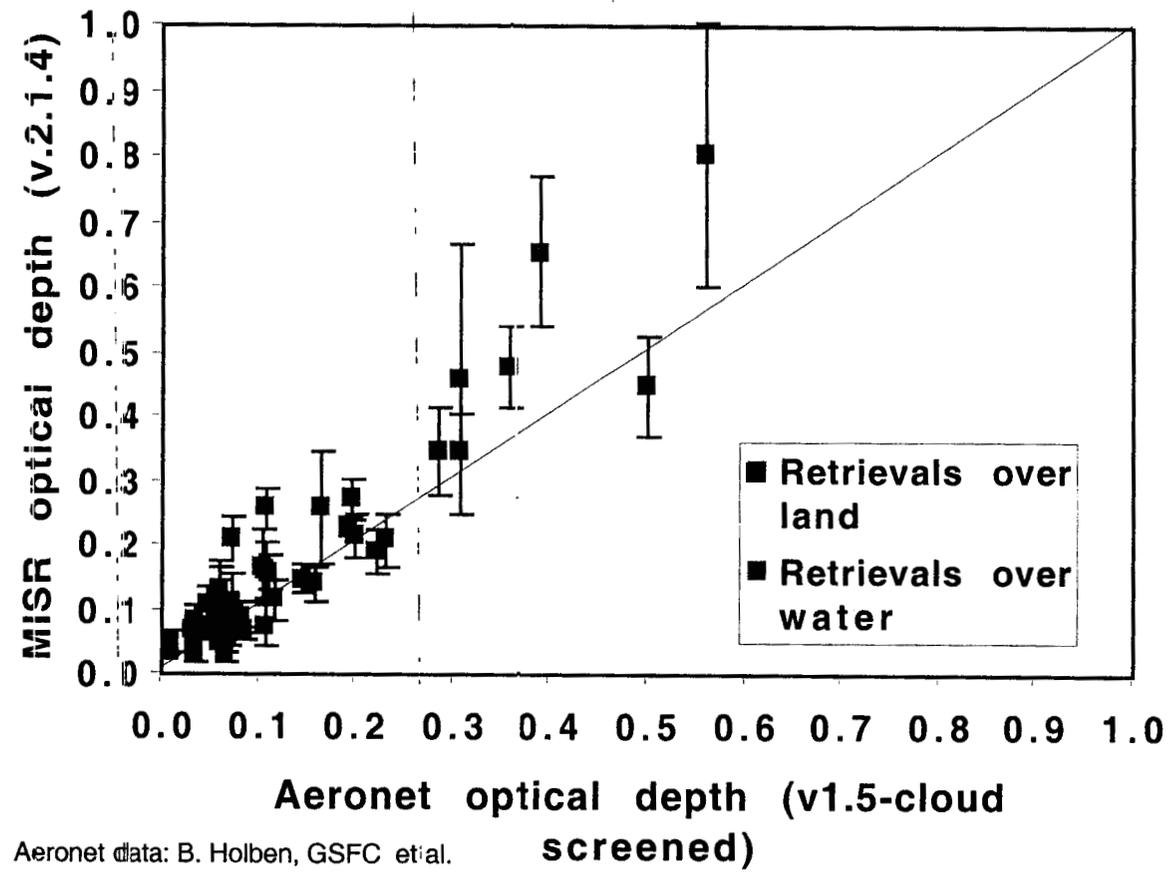
A systematic error has been present in the Da (70° aft) camera, and a new camera model has recently been developed to correct this bias.

V. Jovanovic / M. Smyth, JPL





MISR aerosol validation is based upon intensive field campaigns involving in-situ, ground-based, and aircraft observations, plus long-term, statistical comparisons with AERONET

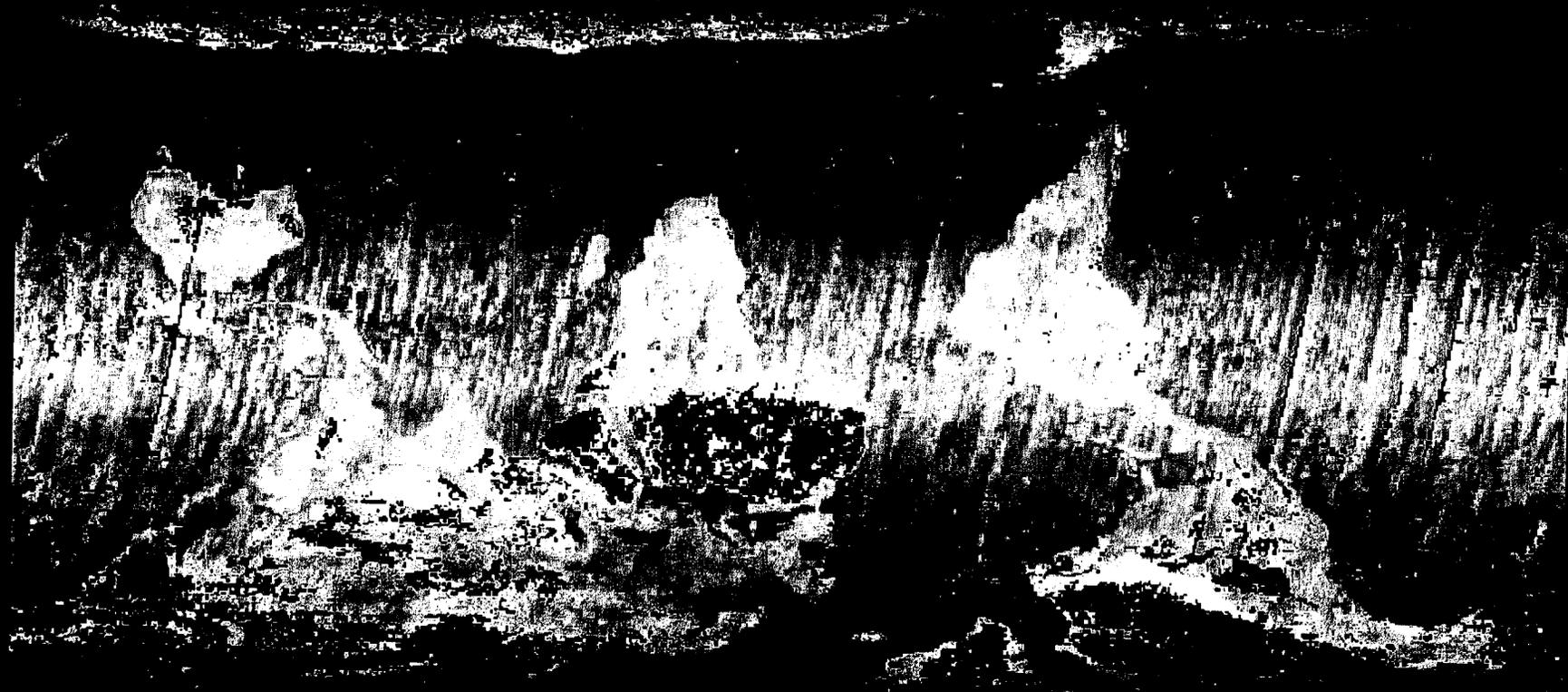


Globally distributed Aeronet data from September 2001 - November 2001



Global radiance map, nadir camera  
March 2002

Global radiance map, nadir camera  
Cloud screened using radiometric threshold cloud mask  
March 2002



## **Aerosol retrieval software versions**

**V2.1.4 (beta product, operational since September 2001)**

- 63 aerosol mixtures, maximum Angstrom exponent 1.5**
- glint avoidance to 30° from specular angle**
- partial cloud screening**

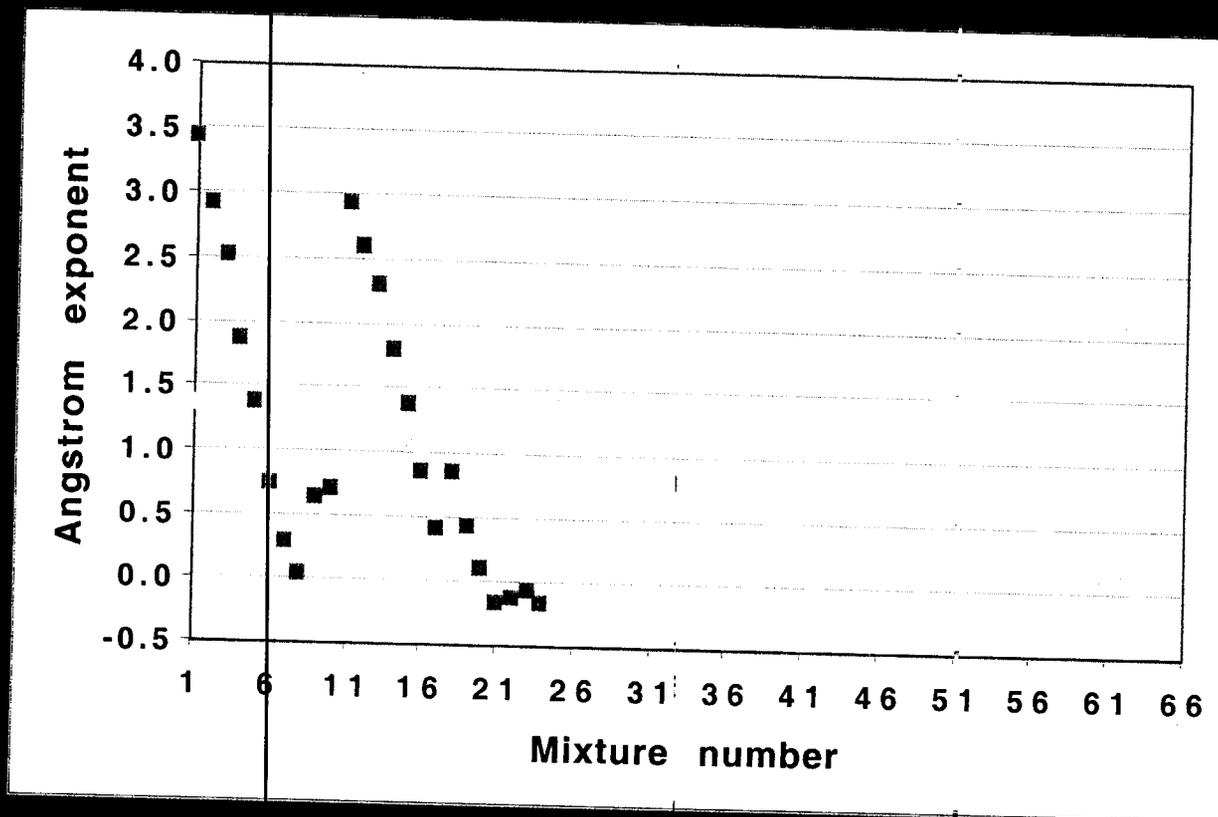
**V2.2 (beta product, operational since April 2002)**

- 24 aerosol mixtures, maximum Angstrom exponent 3.5**
- glint avoidance to 40° from specular angle**
- improved cloud screening using radiometric and stereoscopic cloud masks from other MISR products**

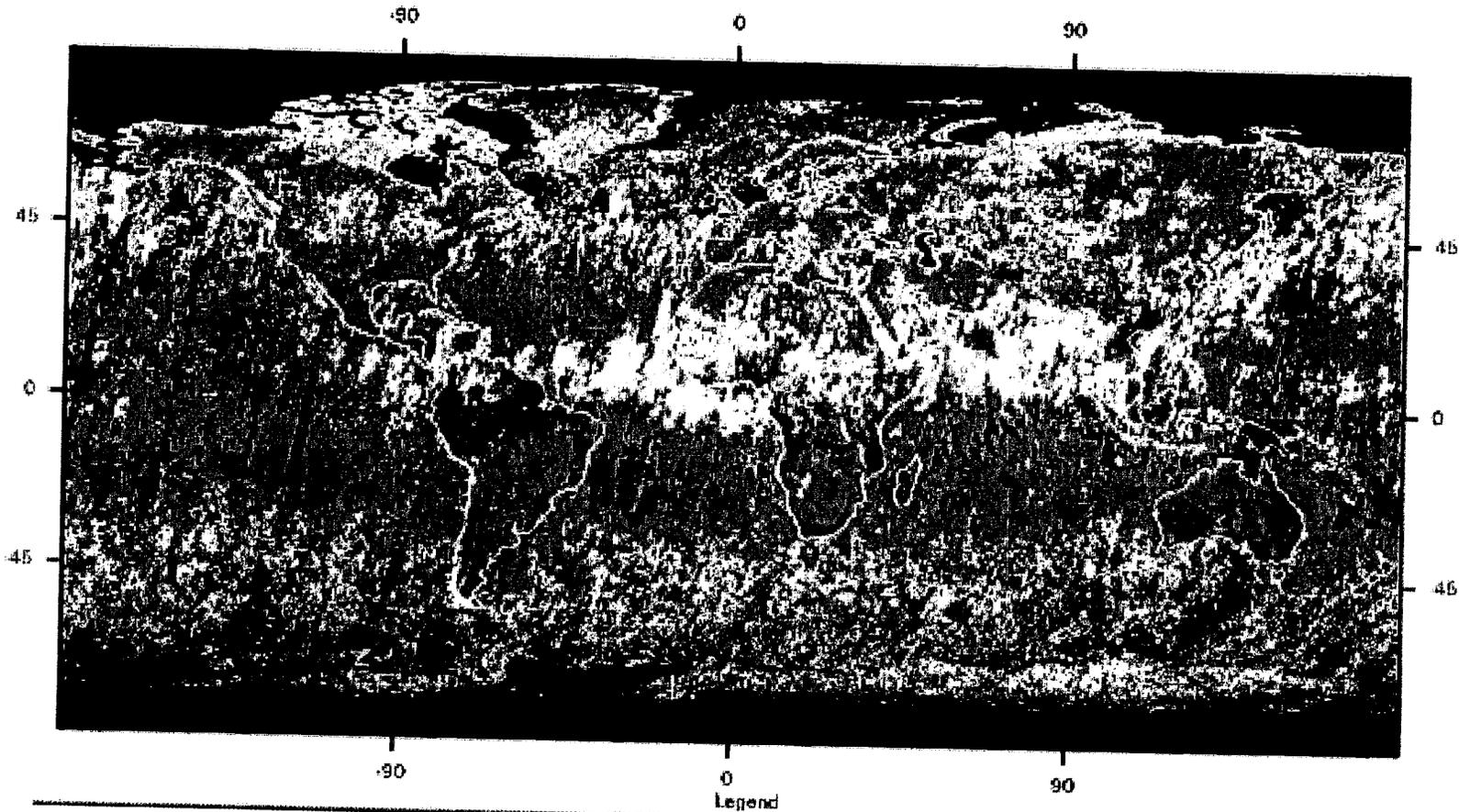
**V2.2i2 (to become operational this summer)**

- image correlation requirement from angle to angle over land**
- optical depth retrieval consistency from band to band, over land**

# Comparison of aerosol mixtures in v2.1.4 and v2.2



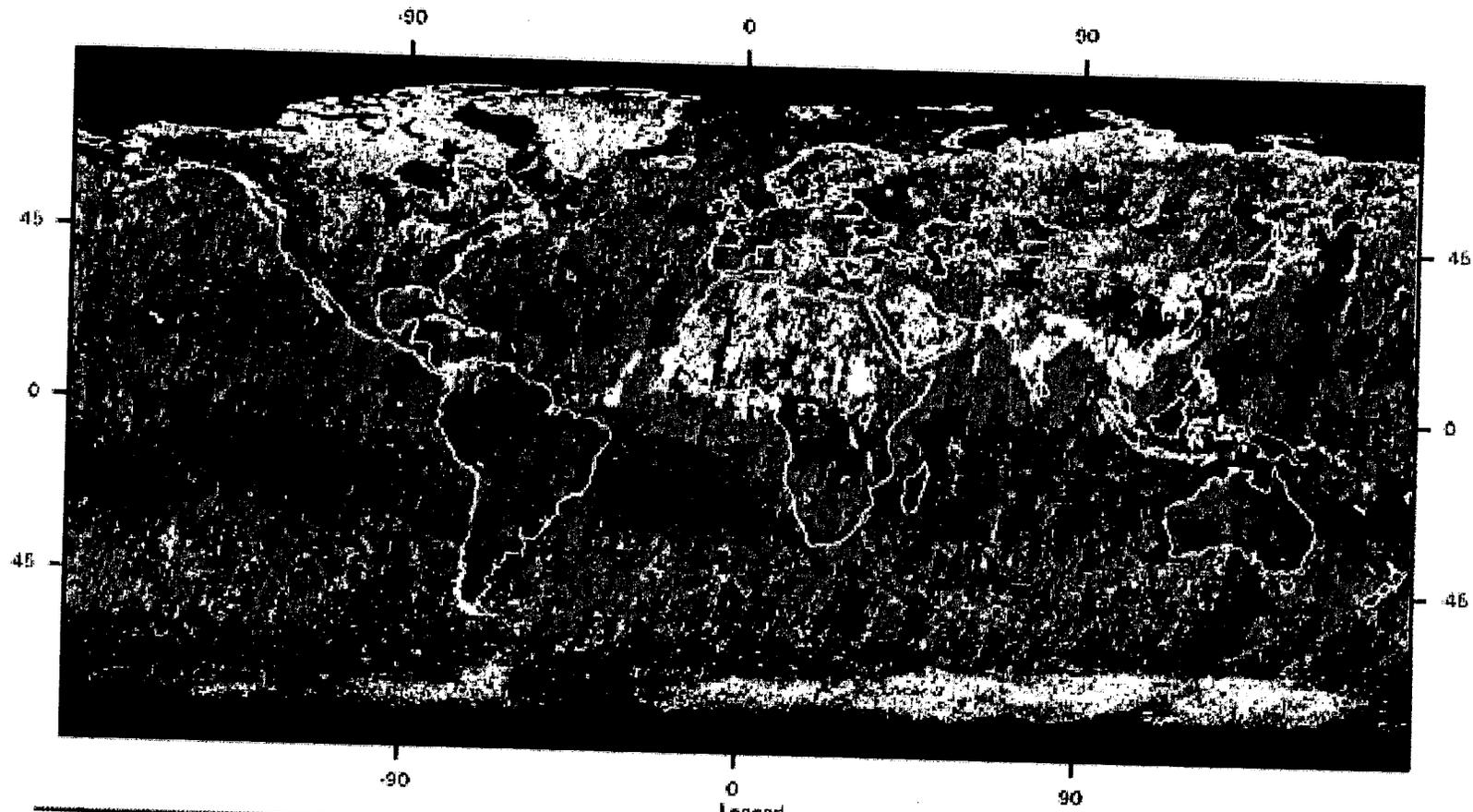
# Optical Depth March 2002 V2.1.4



Legend

0.05	0.25	0.45	0.65	0.85	1.05	1.25	1.45	1.65	1.85
0.1	0.3	0.5	0.7	0.9	1.1	1.3	1.5	1.7	1.9
0.15	0.35	0.66	0.75	0.95	1.15	1.35	1.55	1.75	1.95
0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	

# Optical Depth March 2002 V2.2



Legend

| Opt Dep |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 0.05    | 0.25    | 0.45    | 0.65    | 0.85    | 1.05    | 1.25    | 1.45    | 1.65    | 1.85    |         |
| 0.1     | 0.3     | 0.5     | 0.7     | 0.9     | 1.1     | 1.3     | 1.5     | 1.7     | 1.9     |         |
| 0.15    | 0.35    | 0.55    | 0.75    | 0.95    | 1.15    | 1.35    | 1.55    | 1.75    | 1.95    |         |
| 0.2     | 0.4     | 0.6     | 0.8     | 1       | 1.2     | 1.4     | 1.6     | 1.8     |         |         |



**MISR**



*Multi-angle Imaging SpectroRadiometer*

MISR aerosol data products (beta quality) are available  
through the Langley Atmospheric Sciences Data Center DAAC  
<http://eosweb.larc.nasa.gov>

More information about MISR  
<http://www-misr.jpl.nasa.gov>