

# Land Product Validation

Jeffrey T. Morisette  
NASA Goddard Space Flight Center

Jaime Nickeson and Sebastien Garrigues.

MODIS/VIIRS Science Team Meeting  
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# Validation

- Validation science/results:
  - Moving Land products to stage 2 or 3
  - Validation/inter-comparison of MODIS/VIIRS
  - Seasonality or temporal products
  - Better define land product accuracy requirements
- Infrastructure:
  - What we need to keep/enhance/change
  - Complement IPO
  - Contribute and exploit CEOS Working Group on Cal/Val

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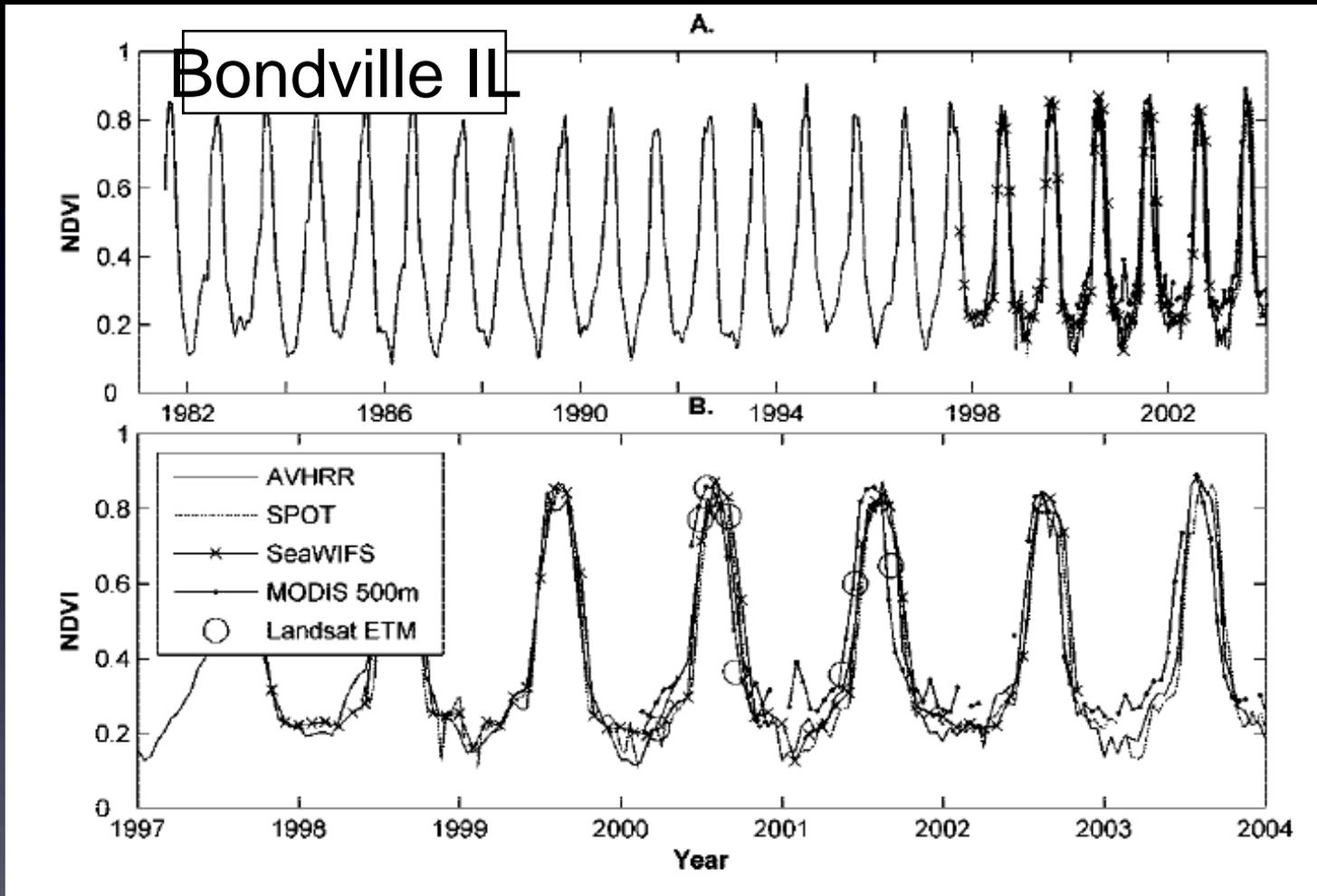
# Current Validation Stage

- Stage 1
  - Albedo/BRDF
  - Fire
  - LAI/FPAR
  - Land cover
  - LST
  - Veg. Cont. Fields
- Stage 2
  - Snow cover / sea ice
  - Surface reflectance
  - Veg. Index
- Stage 3
  - NPP

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# MODIS/VIIRS overlap period

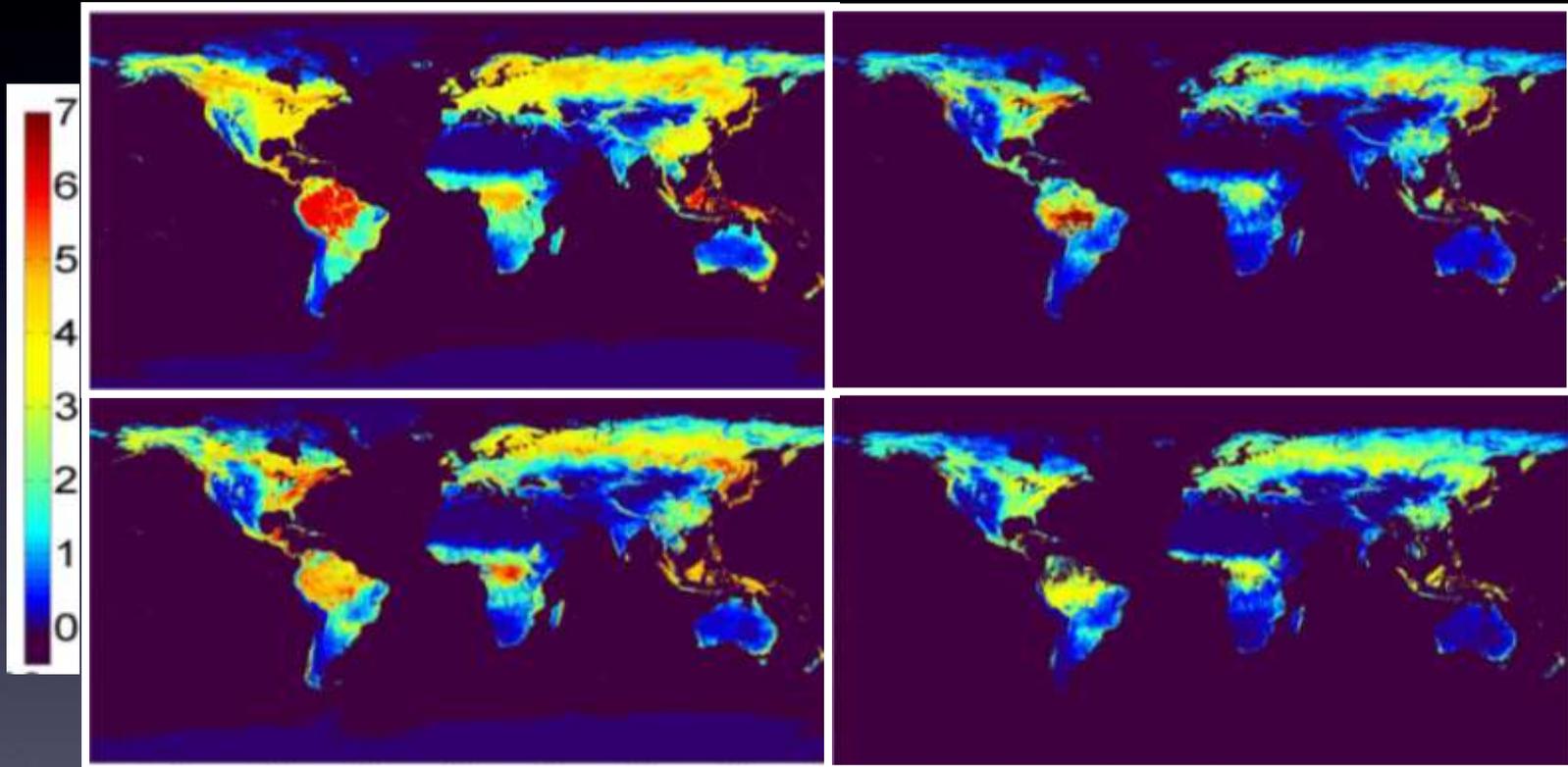


Brown, M. E. et al., 2006. Inter-Sensor Validation of long-term NDVI time series from AVHRR, SPOT-Vegetation, SeaWiFS, MODIS, and LandSAT ETM+, *IEEE TGARS*, 44(7)1787-1793.

# Example Inter-comparisons: Leaf Area Index

ECOCLIMAP

GLOBCARBON



MODIS

CYCLOPES

Garrigues, et al., (in press). Validation and Intercomparison of Global Leaf Area Index Products Derived From Remote Sensing Data, *JGR*.

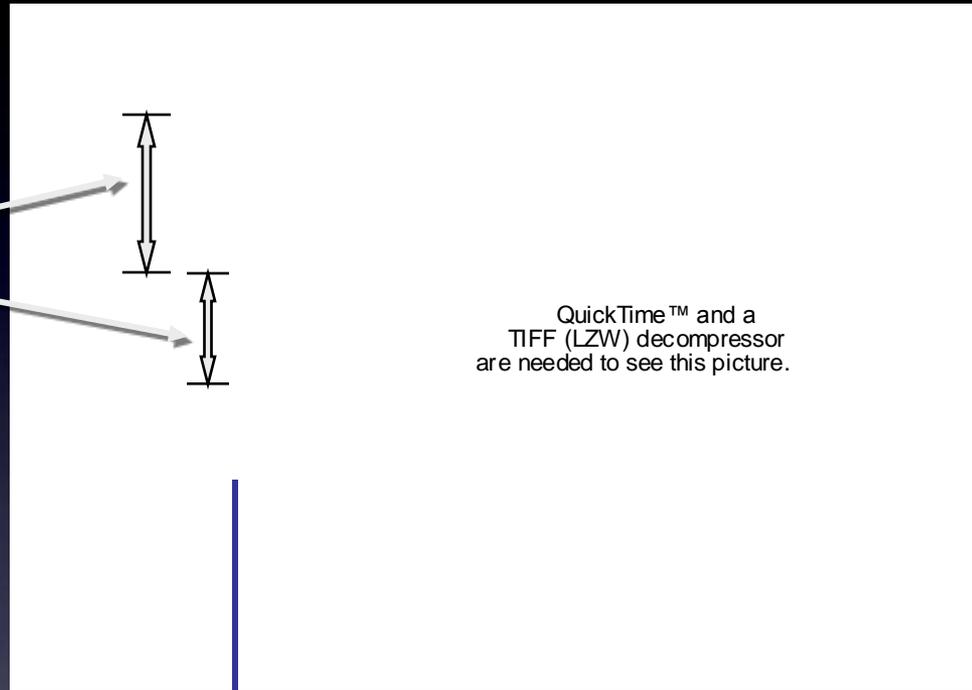
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# Considering the temporal component

Current validation activities address the accuracy of a specific parameter at one or more points in time.

VI



QuickTime™ and a  
TIFF (LZW) decompressor  
are needed to see this picture.

time

Validation of phenological parameters requires quantifying the uncertainty in the time domain.

# Validation

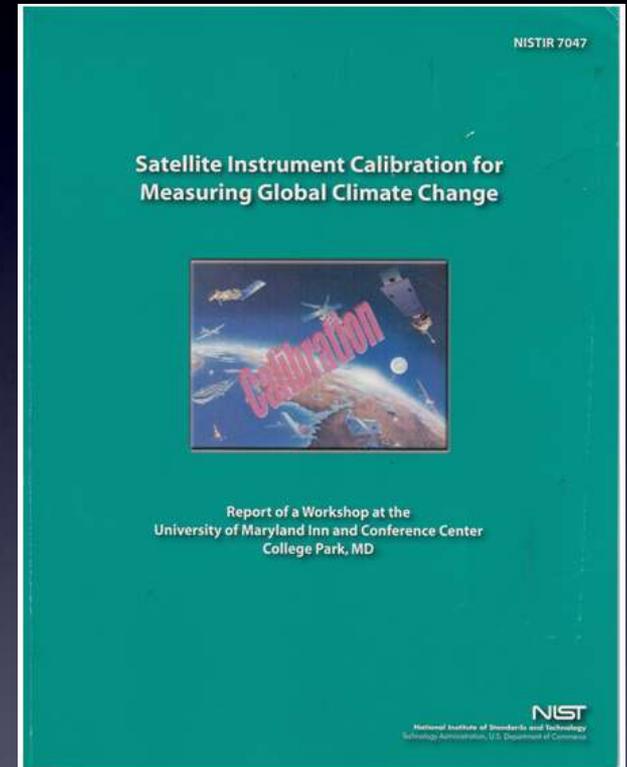
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# Future: There is still a need to define land product accuracy requirements

The land validation community could build on the experience of the calibration community.



*Achieving Satellite  
Instrument Calibration for  
climate Change  
May 16-18, 2006*



Ohring, G., J. et al. (2007), Achieving Satellite Instrument Calibration for Climate Change, *Eos Trans. AGU*, 88(11), 136

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# EOS Validation Core Site Data

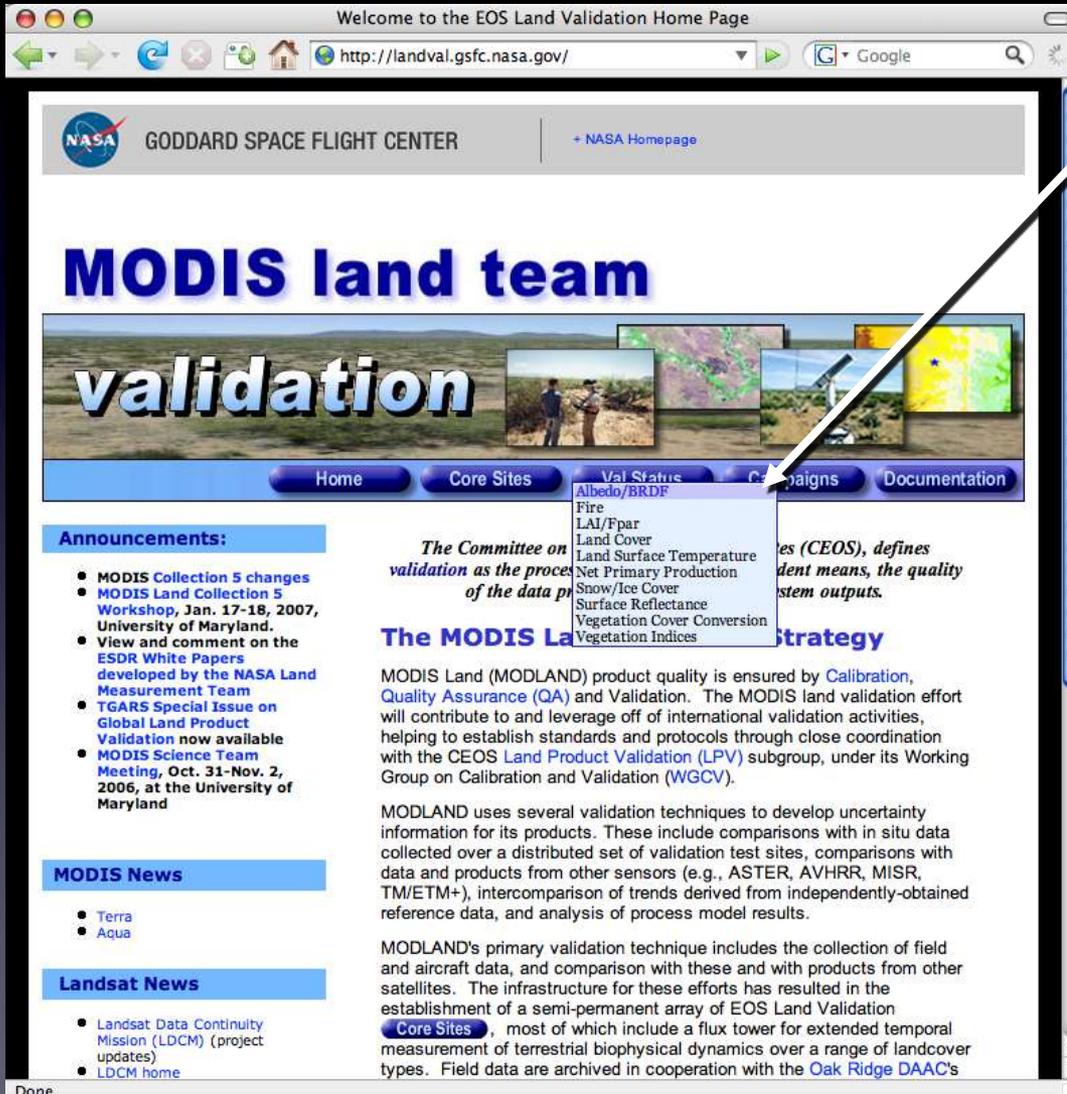
- ARM CART
- Barton Bendish
- Bondville
- BOREAS NSA
- BOREAS SSA BERMS
- H. J. Andrews LTER
- Metolius/Cascades
- Harvard Forest
- Howland
- JJ-Paraná
- Jornada (Jaru - LBA)
- Konza LTER
- Krasnoyarsk
- Mandalgobi
- Maricopa Ag. Center
- Mongu (SAFARI 2000)
- Walnut Gulch (San Pedro)
- Sevilleta LTER
- Skukuza (SAFARI 2000)
- Lardry
- USDA BARC
- Virginia Coast Reserve
- Walker Branch
- Park Falls LTER
- Barrow
- Lake Tahoe
- Chang Bai Shan
- Mead
- St. Petersburg
- Lindenbergl
- Grand Morin
- Sky Oaks

Satellite Data																																											
MODIS 200x200km Subsets																													C5	C5	C5	C5	C5	C5									
MODIS 7x7km ASCII Subsets																																		C5	C5	C5	C5	C5	C5				
ETM+	2	6	15	5	1	4	16	1	1	5	10	3	1		11	1	8	13	2	1	11	5	1	4	4	4																	
IKONOS	1	1	1	4	1	3	2	7	1	2	4	4	1	1	1	2	3	5	2	2	3	3	1	1	4	1	5																
ASTER	1	1	1	1	1	1	2			3	1	2	1		1	3	7	4	2	5	1		16	1	1	4	2	12	1	1	1	1	1	1	1								
Atmospherically Corrected ETM+			9			1	2			1		3			6		2	7	1		8	1	1	1	1																		
AVHRR NDVI subsets																																			P	P	P	P	P	P			
SPOT-VEG NDVI subsets																																				P	P	P	P	P	P		
Digital Elevation Data																																											
MISR subsets																																				P	P	P	P	P	P		
Quickbird			P																																								
Global LC Test Sites (GLCTS)																																											
GeoCover 1990's, 2000 TM, ETM+																																					P	P	P	P	P	P	
Aircraft Data																																											
AirMISR																																											
MODIS Quick Airborne Looks																																											
AVIRIS																																											
Data Networks																																											
AERONET																																											
FLUXNET																																											
LTER/ILTER																																											
VALERI																																						P	P	P	P	P	P
CEOP (GEWEX)																																											
BSRN																																											
SPECNET																																											

Data Location and Code Legend	
<span style="background-color: #90EE90; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	LP DAAC
<span style="background-color: #FFA500; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	ORNL DAAC
<span style="background-color: #ADD8E6; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	GSFC
<span style="background-color: #FFB6C1; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	Langley DAAC
<span style="background-color: #FFFF00; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	Univ. of Arizona
<span style="background-color: #8B4513; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	JPL
<span style="background-color: #0000FF; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span>	Active Network
C5	To be Subset with MODIS Collection 5
P	Pending data extraction
#	Number of Acquisitions Available for Site

Nickeson, J., J. Morissette, J. Privette, C. Justice, D. Wickland, 2007. Coordinating Earth Observing System Land Validation, *EOS Transactions*, 88(7)81-82.

# Maintain land product accuracy statements



Welcome to the EOS Land Validation Home Page  
http://landval.gsfc.nasa.gov/

NASA GODDARD SPACE FLIGHT CENTER + NASA Homepage

## MODIS land team validation

Home Core Sites Val Status Campaigns Documentation

**Announcements:**

- MODIS Collection 5 changes
- MODIS Land Collection 5 Workshop, Jan. 17-18, 2007, University of Maryland.
- View and comment on the ESDR White Papers developed by the NASA Land Measurement Team
- TGARS Special Issue on Global Land Product Validation now available
- MODIS Science Team Meeting, Oct. 31-Nov. 2, 2006, at the University of Maryland

**MODIS News**

- Terra
- Aqua

**Landsat News**

- Landsat Data Continuity Mission (LDCM) (project updates)
- LDCM home

The Committee on validation as the process of the data products (CEOS), defines validation means, the quality of the system outputs.

### The MODIS Land Product Validation Strategy

MODIS Land (MODLAND) product quality is ensured by Calibration, Quality Assurance (QA) and Validation. The MODIS land validation effort will contribute to and leverage off of international validation activities, helping to establish standards and protocols through close coordination with the CEOS Land Product Validation (LPV) subgroup, under its Working Group on Calibration and Validation (WGCV).

MODLAND uses several validation techniques to develop uncertainty information for its products. These include comparisons with in situ data collected over a distributed set of validation test sites, comparisons with data and products from other sensors (e.g., ASTER, AVHRR, MISR, TM/ETM+), intercomparison of trends derived from independently-obtained reference data, and analysis of process model results.

MODLAND's primary validation technique includes the collection of field and aircraft data, and comparison with these and with products from other satellites. The infrastructure for these efforts has resulted in the establishment of a semi-permanent array of EOS Land Validation **Core Sites**, most of which include a flux tower for extended temporal measurement of terrestrial biophysical dynamics over a range of landcover types. Field data are archived in cooperation with the Oak Ridge DAAC's

Product "pick-list"



Albedo/BRDF  
Fire  
LAI/Fpar  
Land Cover  
Land Surface Temperature  
Net Primary Production  
Snow/Ice Cover  
Surface Reflectance  
Vegetation Cover Conversion  
Vegetation Indices

MOD43. The accuracy of the high quality studied thus far and even those albedo

found in the May-June 2004 issue of the

and Albedo Retrievals Using Combined

Yufang Jin  
June 2006 1555

ground measurements and values derived from

7-5317



ice albedo product using region on the Tibetan Plateau

Ma, Zhian Sun, and Wenhua Jiang  
2004

roradiometer (MODIS) global land : studies. We evaluate the accuracy any 2001 to July 2003) of ground in (32.30 deg N, 84.06 deg E, 4420 m) consists of semidesert or desert soil. field measurements shows that the accuracy requirement of 0.02. There is a 10% difference between the ground-measured albedo, with a 0.036.

as observed from AWS and derived

daily albedos  
ground  
MODIS

# Accuracy statement for each product



The screenshot shows a web browser window with the URL <http://landval.gsfc.nasa.gov/ProductStatus.php?P>. The page title is "EOS Validation Status for MODIS BRDF/Albedo: M\*D43". The main heading is "MODIS land team validation". Below the heading is a navigation menu with buttons for "Home", "Core Sites", "Val Status", "Campaigns", and "Documentation". The page content is titled "Status for: BRDF/Albedo (M\*D43)" and features a section titled "General Accuracy Statement" highlighted in yellow. The text in this section states: "Validation at stage 1 has been achieved for the surface reflectance product (MCD43). The accuracy of the high quality MODIS operational albedos is well less than 5% albedo at the validation sites studied thus far and even those albedo values with low quality flags have been found to be within 10% of field data. Further work on albedo validation is planned. A summary of these plans can be found in the May-June 2004 issue of the Earth Observer. Product status updated: October 2004 (modified January 2007) Product version: Collection 4". Below this is a section titled "Supporting Studies:" also highlighted in yellow, which lists two studies with their titles, authors, and sources. The first study is "Validation of the MODIS Bidirectional Reflectance Distribution Function and Albedo Retrievals Using Combined Observations From the Aqua and Terra Platforms" by Jonathan G. Salomon, Crystal B. Schaaf, Alan H. Strahler, Feng Gao, and Yufang Jin, published in IEEE Transactions on Geoscience and Remote Sensing, Vol. 44, No. 6, June 2006, pages 1555. The second study is "Comparison of MODIS broadband albedo over an agricultural site with ground measurements and values derived from Earth observation data at a range of spatial scales" by M. Disney, P. Lewis, G. Thackrah, T. Quaife, and M. Barnesley, published in Int. J. Remote Sensing, 10 December, 2004, vol. 25, no. 23, pp. 5297-5317. The page also includes a "Done" button at the bottom left and a "View Summary Results From This Document" link for each study.

**MODIS land team**  
**validation**

Home Core Sites Val Status Campaigns Documentation

**Status for: BRDF/Albedo (M\*D43)**

**General Accuracy Statement**

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[View Summary Results From This Document](#)

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[View Summary Results From This Document](#)

Done

Support material for  
each accuracy statement

- updated by  
product producer *and*  
the validation  
community.



A screenshot of a web browser displaying a NASA website. The browser's address bar shows the URL 'http://landval.gsfc.nasa.gov/Results.php?TitleID=...'. The page title is 'MODIS land team validation'. Below the title is a banner image with the word 'validation' in large, bold letters. Underneath the banner are navigation buttons for 'Home', 'Core Sites', 'Val Status', 'Campaigns', and 'Documentation'. The main content area features a section titled 'Summary Results from:' followed by the text 'Validation of the MODIS global land surface albedo product using ground measurements in a semidesert region on the Tibetan Plateau'. Below this is a sub-section 'As they relate to the validation of MOD43' with author names and a source citation. An 'Abstract' section follows, describing the evaluation of the MODIS albedo product. At the bottom, there is a section for 'Summary Figures and Tables' with a caption for 'Figure 1: Temporal series of shortwave albedo at local solar noon as observed from AWS and derived from MODIS in (a) 2001, (b) 2002 (partial), and (c) 2003.' A legend for the figure is visible, showing symbols for 'daily albedo', 'ground', and 'MODIS'. The browser's status bar at the bottom indicates 'Done'.

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# Integration with IPO

- Participated in NOAA Asheville meeting (Feb. '08)
- Participate in NPP cal/val peer review (5/21/08)
- We could consider a NASA addendum to the NPP cal/val plan?

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# QA4E



A QUALITY ASSURANCE  
FRAMEWORK FOR  
EARTH OBSERVATION

- Data Quality,
- Data Policy *and*
- Communication & Education.



This QA4EO framework strategy, being completed and endorsed by CEOS for GEO task DA-06-02, will be recommended for integration and use throughout the GEO community.

Work is underway to optimise an implementation strategy for endorsement at CEOS plenary in November 2008, and its potential evolution to meet any additional specific needs of data providers, for example those related to *in situ* measurements.



# Terminology: the CEOS Validation Hierarchy

Stage 1 Validation: Product accuracy has been estimated using a small number of independent measurements obtained from **selected locations and time periods** and ground-truth/field program efforts.

Stage 2 Validation: Product accuracy has been assessed over a **widely distributed set of locations and time periods** via several ground-truth and validation efforts.

Stage 3 Validation: Product accuracy has been assessed, and the uncertainties in the product well-established via independent measurements made in a **systematic and statistically robust way that represents global conditions**.