

# MODIS LAND PRODUCT



## MODIS land discipline team Collection 5 Workshop

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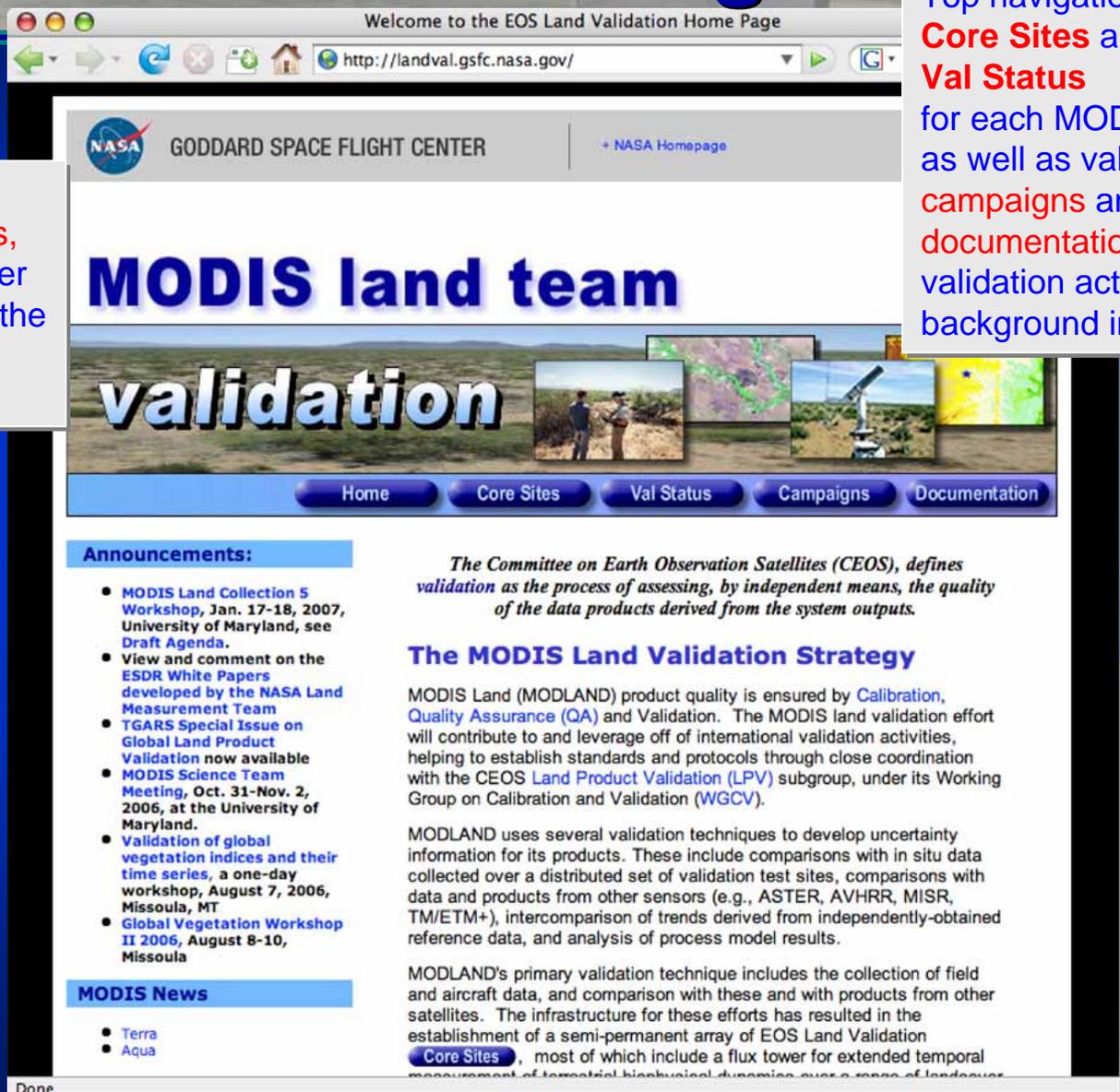
17 January 2007  
University of Maryland University College  
College Park, Maryland

# MODIS Validation Page

## Left Sidebar

Announcements, MODIS and other EOS news and the MODIS web organigram

Top navigation bar links to **Core Sites** and **Val Status** for each MODIS product as well as validation field campaigns and documentation of past validation activities and background information



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 Land Collection 5 Workshop, Jan. 17-18, 2007, University of Maryland, see Draft Agenda.**
- **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.**
- **Validation of global vegetation indices and their time series, a one-day workshop, August 7, 2006, Missoula, MT**
- **Global Vegetation Workshop II 2006, August 8-10, Missoula**

### MODIS News

- Terra
- Aqua

*The Committee on Earth Observation Satellites (CEOS), defines validation as the process of assessing, by independent means, the quality of the data products derived from the system outputs.*

### The MODIS Land Validation Strategy

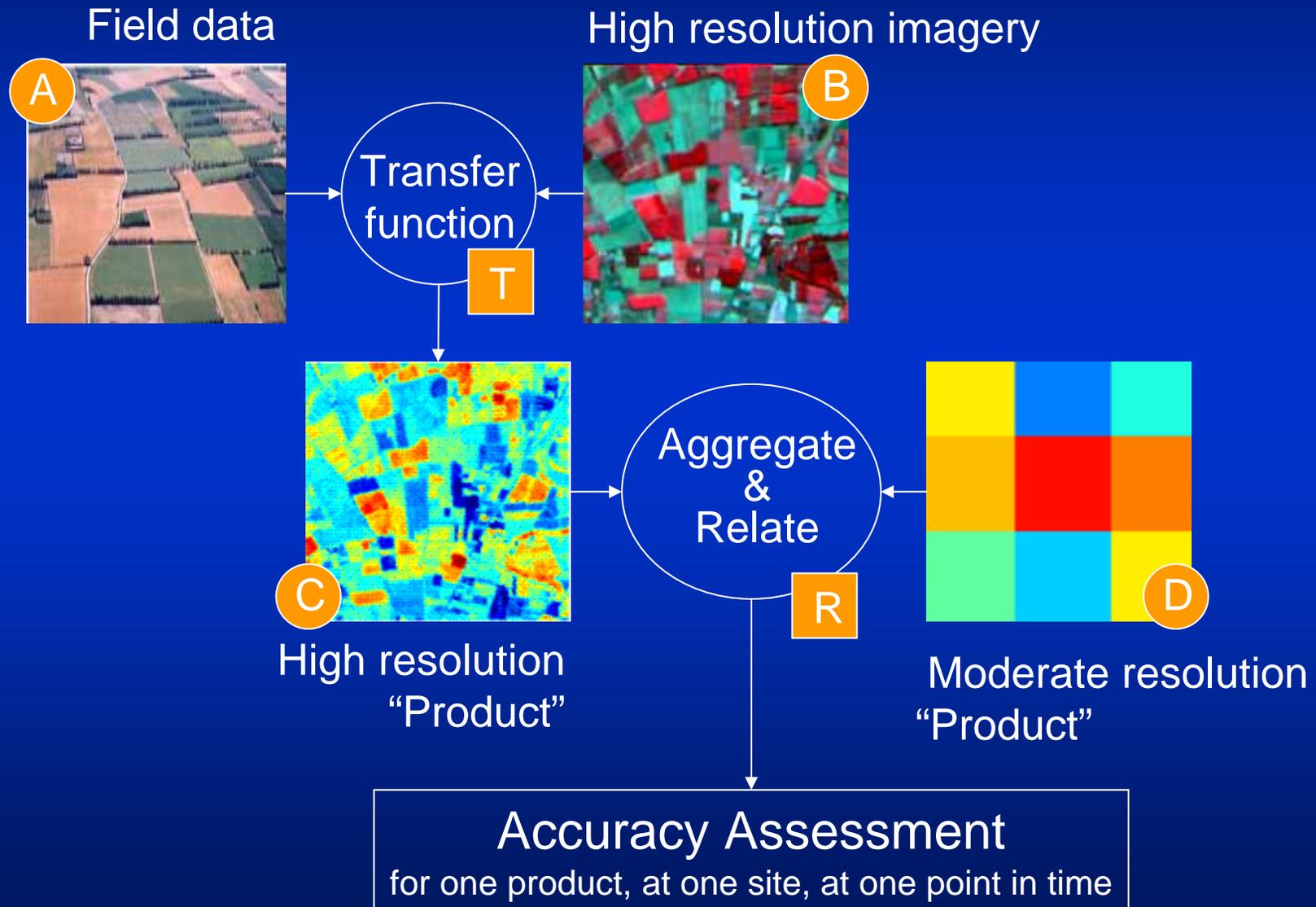
MODIS Land (MODLAND) product quality is ensured by Calibration, Quality Assurance (QA) and Validation. The MODIS land validation effort will contribute to and leverage off of international validation activities, helping to establish standards and protocols through close coordination with the CEOS Land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

web curator: Jaime Nickeson

# Validation Framework



# MODIS Validation Page

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## Core Site data

provides access to data and information categorized under the following groupings:

- Vital Statistics
- Satellite Data
- Field, tower and airborne data
- ancillary layers and background information
- Links to additional information

# EOS Land Validation Core Sites

EOS Validation Core Site Data	Site Names																														
	ARM CART	Barton Bendish	Bondville	BOREAS NSA	BOREAS SSA BERMS	H. J. Andrews LTER	Metolius/Cascades	Harvard Forest LTER	Howland	Jl-Paraná (Jaru - LBA)	Jornada LTER	Konza Prairie LTER	Kresnovorsk	Mandalgobi	Maricopa Ag. Center	Monpu (SAFARI 2000)	Walnut Gulch (San Pedro)	Sevilleta LTER	Shukuzza (SAFARI 2000)	Uardiy	USDA BARC	Virginia Coast Reserve	Walker Branch	Park Falls Branch	Barrow	Lake Tahoe	Chang Bui Shan	Mead	St. Petersburg	Lindenberg	Grand Morin
<b>Satellite Data</b>																															
MODIS 200x200km Subsets																															
MODIS 7x7km ASCII Subsets																															
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	5	1	1	1	2	3	5	2	2	3	3	1	1	4	1	5				
QuickBird		1										1											7								
ASTER	1	1	4	11	1	1	2	3	1	2	1	1	3	7	4	2	5	1	16	1	1	6	2	12	2	1	1	1	1	1	
Atmospherically Corrected ETM+		9			1	2	1	3				6	2	7	1	8	1	1	1	1											
EO-1																						1									
IRS AWIFS																						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
Global LC Test Sites (GLCTS)																															
GeoCover 1990's, 2000 TM, ETM+																										P	P	P	P	P	P
<b>Aircraft Data</b>																															
AirMISR																															
MODIS Quick Airborne Looks																															
AVIRIS																															
<b>Data Networks</b>																															
AERONET																															
FLUXNET																															
LTER/ILTER																															
VALERI																										P	P	P	P	P	P
CEOP (GEWEX)																															
BSRN																															
CRN (NOAA)																															
SPECNET																															

“What a fantastic resource!”  
 Michael Hill  
 SDSU  
 looking at the combined MODIS and MISR data for structural parameters

Update forthcoming in AGU's "EOS Transactions"

# Validation Status (1 of 3)

Product "pick-list"

Welcome to the EOS Land Validation Home Page - Microsoft Internet Explorer

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Address http://landval.gsfc.nasa.gov/MODIS/

## MODIS land team validation

Home Core Sites Val Status Campaigns Documentation

**News:**

- [MODIS Vegetation workshop II](#), University of Montana, 17-19 August 2004
- [MODIS Land Data Operational Product Evaluation \(LDOPE\) software tools](#) now available to assist with the analysis and quality assessment of the MODIS Land products.
- [Call for Papers](#) - TGARS Special Issue on Global Land Product Validation
- Coordinated MODIS land validation activities will continue through the recently funded proposal: [Maintaining and Refining NASA's Land Product Validation Infrastructure](#)

**MODIS News**

- [Terra](#)
- [Aqua](#)

**Landsat 7 News**

- [Landsat ETM+ Dataset Transition](#)
- [Report following the Scan Line](#)

### MODLAND Val

MODLAND product quality assurance (QA) and Validation. The MODLAND team contribute to and leverage off of international validation standards and activities through close coordination with the Committee on Earth Observation Satellites (CEOS) [Land Product Validation](#) subgroup, under the Working Group on Calibration and Validation ([WGCV](#)).

MODLAND uses several validation techniques to develop uncertainty information on 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 airborne and spaceborne sensors (e.g., SeaWiFS, AVHRR, MISR, TM/ETM+, ASTER), inter-comparison of trends derived from independently obtained reference data and MODLAND products, and analysis of process model results (including EOS Interdisciplinary Science models) which are driven or constrained by MODLAND products.

MODLAND's primary validation technique includes the collection of and comparison with field and aircraft data, and comparison with data and 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](#) Mercury system. Results of all validation activities are conveyed to the end-user through both published literature and the Land Product [Val Status](#)

Documentation

Visible to middle infrared: first results

The accuracy of the of the signal - which

... resolution earth observation. Improved in and improved spectral band placement... developed in the development of improved... for global change research. Surface... used in developing several higher-order... on the heritage of the Advanced Very High... taking advantage of the new sensing... removal of water vapor and aerosol effects... products and the basis for a new generation... imagers. This paper summarizes the... accuracy, in comparison with other data... performance since launch. The MODIS surface... series data set for quantifying global

# Val Status (2 of 3)

## Accuracy Statement for each product

Welcome to the EDS Land Validation Home Page - Microsoft Internet Explorer

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Address <http://landval.gsfc.nasa.gov/>

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Home Core Sites

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Done Internet

EOS Validation Status for MODIS Surface Reflectance: MOD09

<http://landval.gsfc.nasa.gov/ProductStatus.php?ProductID=MOD09>

### MODIS land team validation

Home Core Sites Val Status Campaigns Documentation

#### Status for: Surface Reflectance (MOD09)

**General Accuracy Statement**

Validation at **stage 1** has been achieved for the surface reflectance product (MOD09). The accuracy of the MODIS operational surface reflectance product is better than .5% reflectance or 5% of the signal - which ever is greatest, with slight variation from band to band.

Product status updated: October 2003

**Supporting Studies:**

**Title:** Atmospheric correction of MODIS data in the visible to middle infrared: first results  
**Author:** Eric F. Vermote, Nazmi Z. El Saleous and Christopher O. Justice  
**Source:** Remote Sensing of Environment, 83: 97-111.  
[View Summary Results From This Document](#)

**Additional Validation and Product Quality**

[PI Maintained Validation Page](#)

#### Middle infrared: first results

Observation improved spectral band placement  
Equipment of improved range research  
Using several higher-order Advanced Very High Resolution Radiometer (AVHRR) and SeaWiFS algorithms, taking advantage of the new sensing capabilities of MODIS. Atmospheric correction by the removal of water vapor and aerosol effects provides improvements over previous coarse resolution products and the basis for a new time-series, which will extend through to the NPOESS generation imagers. This paper summarizes the first evaluation of the MODIS surface reflectance product accuracy, in comparison with other data products and in the context of the MODIS instrument performance since launch. The MODIS surface reflectance product will provide an important time-series data set for quantifying global environmental change.

**Summary Figures and Tables**

**Figure 1:** The validation of the atmospheric correction has been done partially by applying to validate the aerosol optical thickness used in the correction algorithm by comparison to AERONET data as it is

Done Internet

# Val Status (3 of 3)

Welcome to the EDS Land Validation Home Page - Microsoft Internet Explorer

Address: <http://landval.gsfc.nasa.gov/MODIS/>

## MODIS land team validation

Home Core Sites

News:

- [MODIS Vegetation workshop II](#), University of Montana, 17-19 August 2004
- [Call for Papers - FGSR's special issue on Global Land Product Validation](#)
- [Overlaid MODIS land validation activities will continue throughout research to...](#)

Validation Infrastructure

MODIS News

- [Terra](#)
- [Aqua](#)

Landsat 7 News

- [Landsat ETR+ Dataset](#)
- [Transition](#)
- [Report Following the Scan Line](#)

Done Internet

EOS Land Validation core sites

Home Core Sites

### Status for: Surface Reflectance

General Accuracy Statement

Supporting Studies:

Additional Validation and Product Quality

Done Internet

EOS Validation Product News - MODIS - Microsoft Internet Explorer

Address: [http://landval.gsfc.nasa.gov/PROD/Results.php?ProdID=mosSR\\_valsp1](http://landval.gsfc.nasa.gov/PROD/Results.php?ProdID=mosSR_valsp1)

## MODIS land team validation

Home Core Sites Val Status Campaigns Documentation

Summary Results from:

### Atmospheric correction of MODIS data in the visible to middle infrared: first results

As they relate to the validation of MOD09

Authors: Eric F. Vermote, Nazim Z. El Saleous and Christopher O. Justice

Source: Remote Sensing of Environment, 92: 97-111

LINK to [Access Publication](#)

Abstract: The MODIS instrument provides major advances in moderate resolution earth observation. Improved spatial resolution for land observation at 250 and 500 m and improved spectral band placement provide new remote sensing opportunities. NASA has invested in the development of improved algorithms for MODIS, which will provide new data sets for global change research. Surface reflectance is one of the key products from MODIS and is used in developing several higher-order land products. The surface reflectance algorithm builds on the heritage of the Advanced Very High Resolution Radiometer (AVHRR) and SeaWiFS algorithms, taking advantage of the new sensing capabilities of MODIS. Atmospheric correction by the removal of water vapor and aerosol effects provides improvements over previous coarse resolution products and the basis for a new time-series, which will extend through to the NPOESS generation imagers. This paper summarizes the first evaluation of the MODIS surface reflectance product accuracy, in comparison with other data products and in the context of the MODIS instrument performance since launch. The MODIS surface reflectance product will provide an important time-series data set for quantifying global environmental change.

Summary Figures and Tables

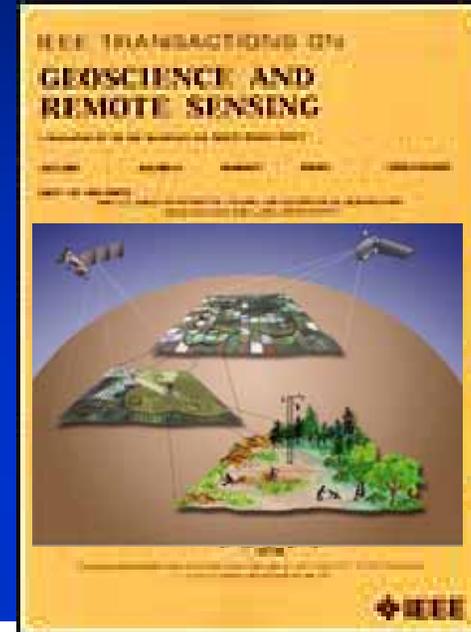
Figure 1: The validation of the atmospheric correction has been done partially by attempting to validate the aerosol optical thickness used in the correction algorithm by comparison to AERONET data as it is

Done Internet

**Support material for each Accuracy Statement - updated by product PI and validation community** →

# LPV “Special Issue” of IEEE TGRS

- Special Issue: describing the state of the art research on both protocol and results for validation and accuracy assessment of global land products  
(Morisette, Baret, and Liang guest editors)
- Three “framework” papers  
19 “validation results” and  
four “user response” papers - an attempt to solicit “user feedback”.



	2004												2005					2006						
	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	N	D	J	F	M
<b>Announcement</b>																								
<b>Validation papers</b>				submissions						reviews				revisions			review		final/profs					
<b>User perspective papers</b>							submissions							reviews			revisions			final/profs				
<b>Publication date</b>																				March 2006 ->				

July 2006

Morisette, J.T., F. Baret, S. Liang, 2006. Special issue on Global Land Product Validation, *IEEE TGARS* 44(7) 1695-1697.

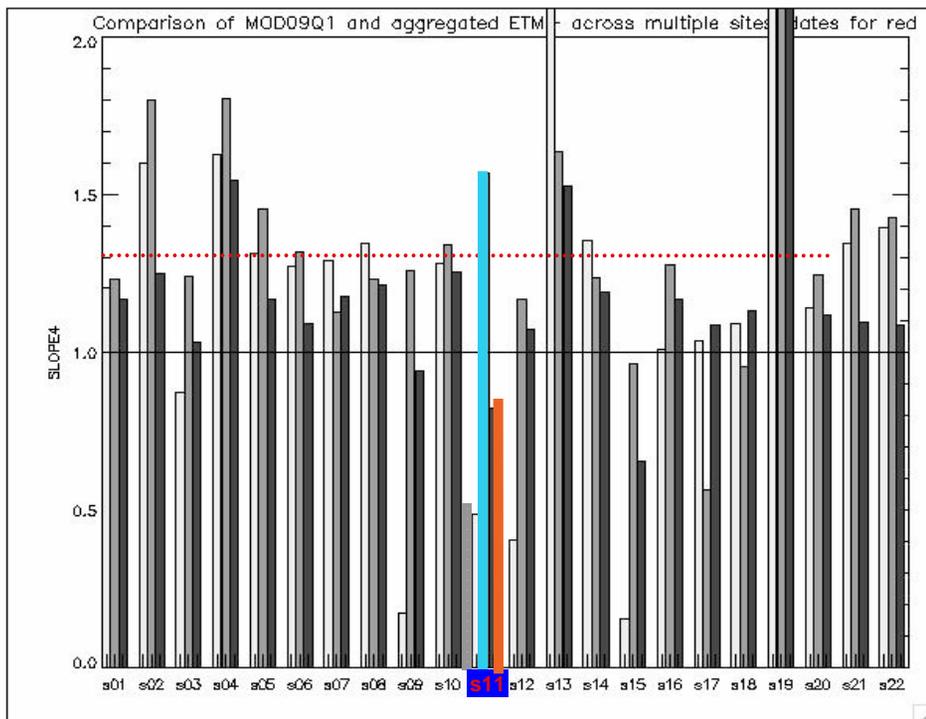
# MODIS/CEOS validation “hierarchy”

- **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.

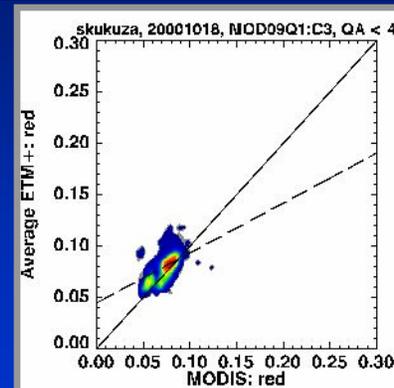
# “Axis-swapping”

## Evaluating MODIS Products from Collections 3, 4 and 5 Comparisons with Coincident ETM+ Data

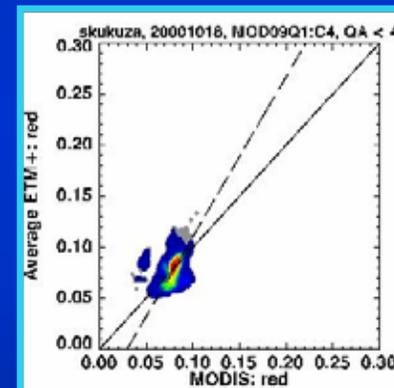
Product: MOD09Q1\_ETM with a QA threshold of 4  
Parameter: Fitted slope



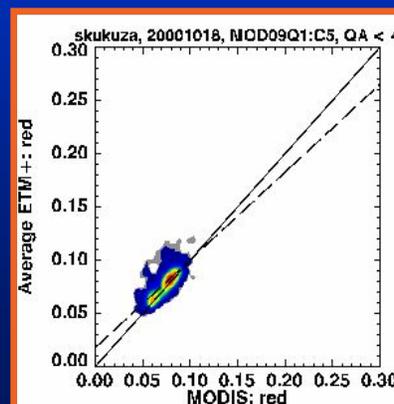
- |                                   |                            |
|-----------------------------------|----------------------------|
| s01 - Ji-Parana, 11 Aug 2001      | s12 - Skukuza, 28 Apr 2001 |
| s02 - Bondvill, 15 May 2001       | s13 - Skukuza, 18 Aug 2001 |
| s03 - Harvard, 5 Sep 2001         | s14 - Skukuza, 3 Sep 2001  |
| s04 - Harvard, 28 Jul 2001        | s15 - Tapajos, 30 Jul 2001 |
| s05 - Konza, 9 May 2001           | s16 - Usdaars, 3 Nov 2000  |
| s06 - Konza, 13 Aug 2001          | s17 - Usdaars, 22 Jan 2001 |
| s07 - Mongu, 31 Jul 2000          | s18 - Usdaars, 7 Feb 2001  |
| s08 - Mongu, 1 Sep 2000           | s19 - Usdaars, 23 Feb 2001 |
| s09 - Parkfall, 25 Sep 2001       | s20 - Usdaars, 28 Apr 2001 |
| s10 - Skukuza, 31 Aug 2000        | s21 - Usdaars, 2 Aug 2001  |
| <b>s11 - Skukuza, 18 Oct 2000</b> | s22 - Walkerbr, 1 Oct 2001 |



collection 3



collection 4



collection 5

# http:landval.gsfc.nasa.gov/LPVS

Matches WGCV page layout and graphic

Welcome to the Land Product Validation Subgroup - Microsoft Internet Explorer

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**CEOS WORKING GROUP ON CALIBRATION & VALIDATION**  
**Land Product Validation Subgroup**

Home Landcover Biophysical Fire/Burn Surface Rad

**Subscribe!**  
LPV subgroup topclassing lists:  
Subscribe: [v]  
Unsubscribe: [v]  
List: [v]

**Announcing...**  
Collaborates the LPV special issue in 2008  
Transactions on Geoscience and Remote Sensing

**Organization:**  
LPV is a subgroup of the Working Group on Calibration and Validation

**WGCV**  
WGCV is a standing Working Group of the Committee on Earth Observing Satellites

**Mission**  
To foster quantitative validation of higher-level global land products derived from remote sensing data and to relay results so they are relevant to users

**Background**  
The subgroup on Land Product Validation (LPV) is one of six subgroups of the Working Group on Calibration and Validation (WGCV), which itself is one of two standing working groups within the Committee on Earth Observing Satellites (CEOS, see also CEOS structure). The six WGCV subgroups are:

- Infrared and Visible Optical Sensors (IVOS)
- Atmospheric Chemistry (AC)
- Microwave Sensors (MS)
- Synthetic Aperture Radar (SAR)
- Terrain Mapping (TM)
- Land Product Validation (LPV)

The Land Product Validation subgroup arose out of the recognition in the late nineties that standardized approaches to global product validation were essential for wide acceptance and use of proposed global land products. Several programs at the time were aimed at global monitoring of Earth processes, many with plans to distribute higher level data products. A common approach to validation would encourage widespread use of validation data, and thus help us to move toward standardized approaches to global product validation. With the high cost of in-situ data collection, the potential benefits from international cooperation are considerable and obvious.

Previous requests for assistance from the original International Global Observing Strategy (IGOS) pilot projects and two subsequent ad hoc meetings of the WGCV identified a clear need for improved international collaboration concerning the validation of land products derived from Earth observing satellites. A new subgroup within the WGCV was proposed to the CEOS Plenary in Stockholm at the end of 1999, receiving full support. The LPV was officially adopted as a subgroup at the WGCV-17 meeting in October of 2000.

The LPV subgroup activities are divided up into four themes that compliment the research agenda of the Global Observations of Forest and Land Cover Dynamics (GOFCCGOLD) program, namely biophysical products, fire/burn scar detection, and land cover mapping. In addition to the GOFCCGOLD themes, the LPV subgroup includes an Albedo/Surface Radiation thematic group. Working with GOFCCGOLD, who seek the common goal of coordinated validation of fire products by standardized protocols, LPV aims for similar coordination for all land products.

link to 2004  
**CEOS Calendar**

Pull-down menu for main topical areas:

- Land cover
- Biophysical
- Fire/Burn
- Surface Radiation

Each pull-down lists:

- Background
- Producers \*
- Meetings
- Case studies
- Intercomparisons

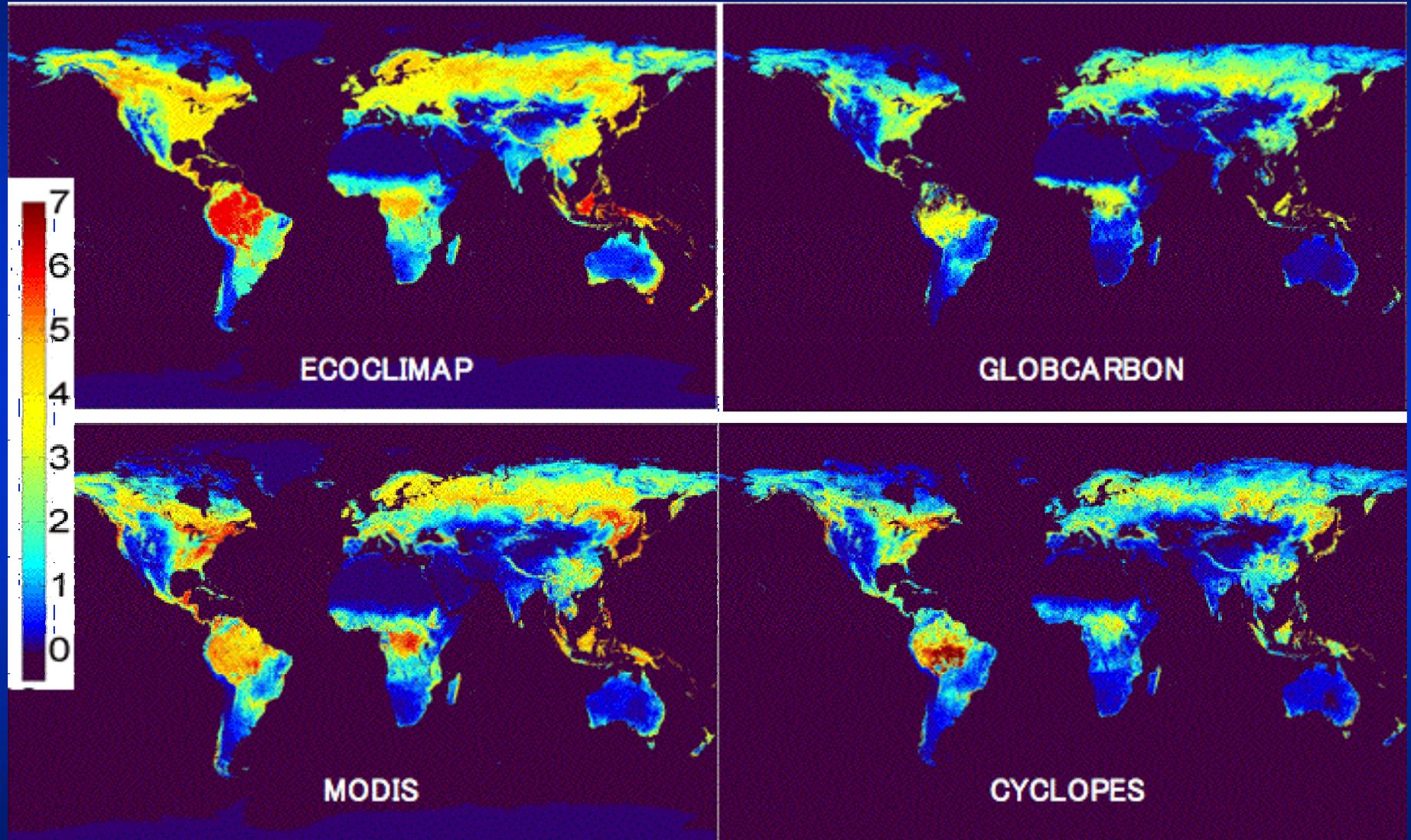
\* input needed

Quick links to:

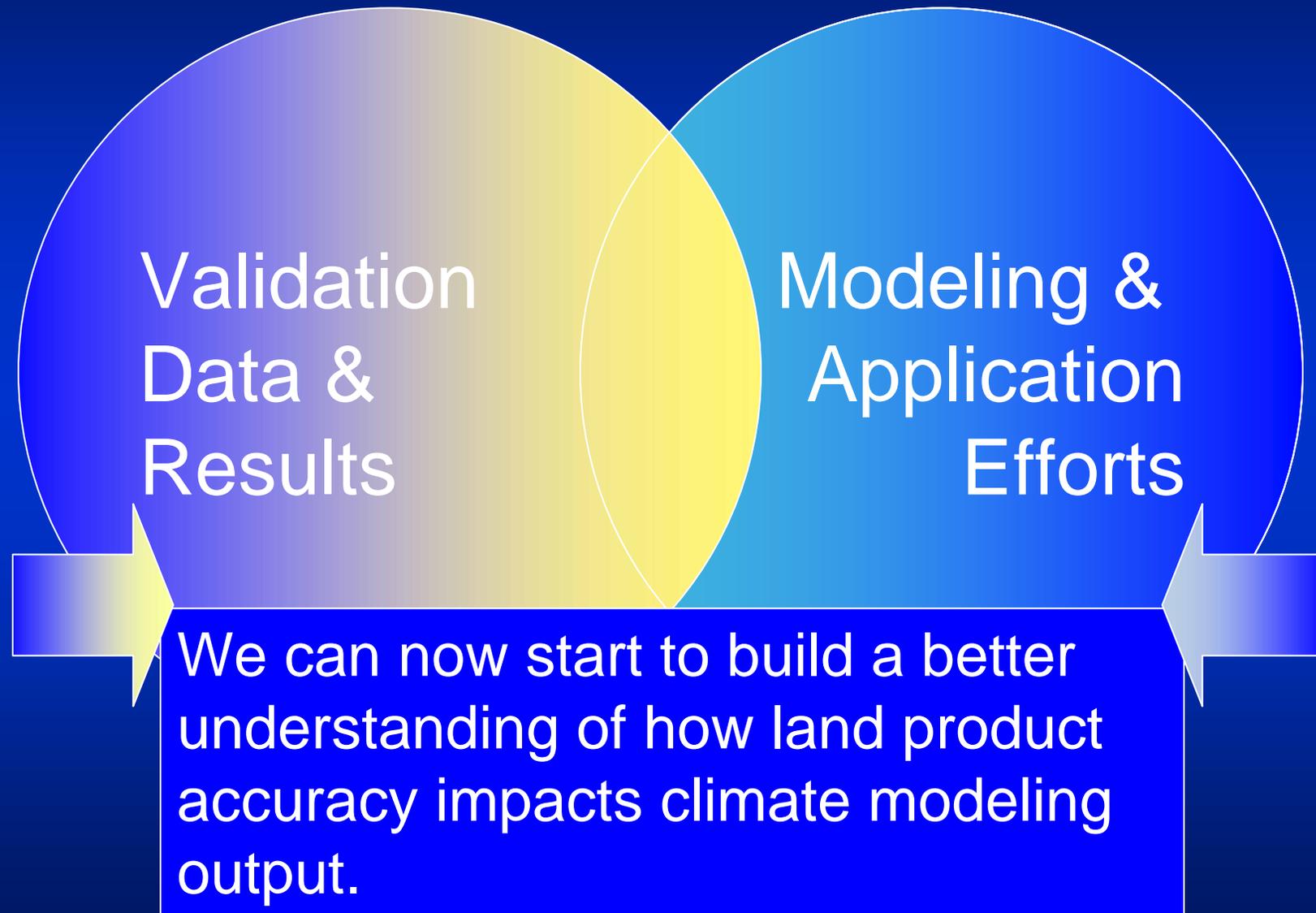
- Listserves
- Announcements
- WGCV
- CEOS and
- CEOS calendar

web curator: Jaime Nickeson

# LAI Intercomparison

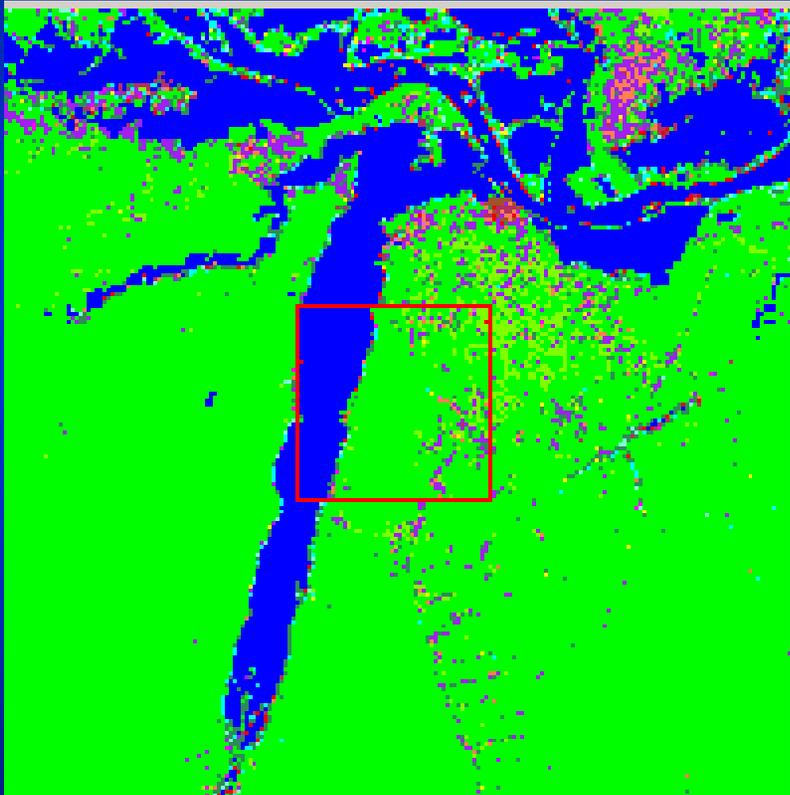


# Future Directions

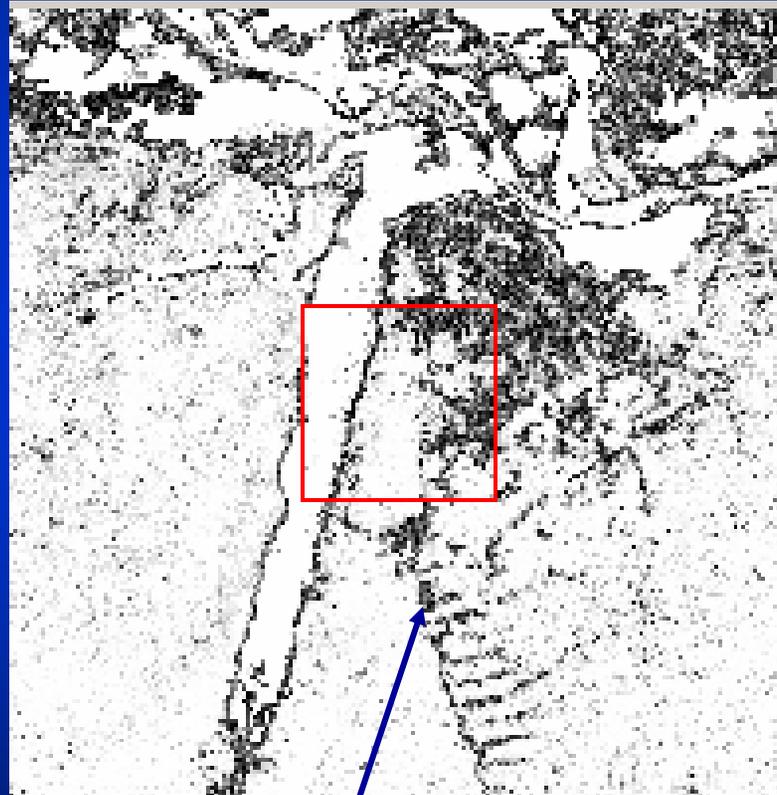


# Accuracy/Confidence Layers

MODIS land cover  
(collection 4)



Associated Confidence layer  
(lighter = more confidence)



Note lower confidence in deforestation areas

MODIS Land cover product (MOD12Q1)

# Thank you



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301-614-5498  
[jeff.morisette@nasa.gov](mailto:jeff.morisette@nasa.gov)