

MODIS Land Overview

**Chris Justice
and the
MODIS Land Team**

- Global Change ESE Land Science Drivers
- Instrument issues – post Day 306
- Product Availability
- QA
- Browse
- 250m System and Rapid Response Systems
- Validation
- Outstanding Issues
- Summary of Achievements

MODIS Land Products* / ESE Research Themes

- ***Energy Balance Product Suite***

- **Surface Reflectance**
- **Land Surface Temperature**
- **BRDF/Albedo**
- **Snow Cover**

Global Water Cycle and Energy Balance

- ***Vegetation Parameters Suite***

- **Vegetation Indices**
- **LAI/FPAR**
- **NPP/PSN**

Biology and Biogeochemistry of Ecosystems and the Global Carbon Cycle

- ***Land Cover Land Use Suite***

- **Land Cover**
- **Vegetation Cover Change**
- **Fire and Burned Area**

Land Cover and Land Use Change

Atmospheric Chemistry and Aerosols

Applications

Education

*Dependencies between products

USGCRP Strategic Planning

- **Emerging Fundamental Interdisciplinary Research Elements**
 - **Atmospheric Composition**
 - **Climate Variability and Change**
 - **Carbon Cycle**
 - **Water Cycle**
 - **Land Use and Land Cover Change**
 - **Terrestrial and Aquatic Ecosystem Resources**

NASA Systematic Measurements

- **MODIS critical part of NASA's systematic measurements – goal of providing science quality measurements and monitoring for earth system science and assessments**
- **Critical role in a 'multi-level monitoring system' with Landsat 7/ ASTER and Ikonos – land community is now well positioned to address science goals**
- **Challenge for NASA to transition systematic measurements to operational agencies –**
 - **For MODIS transition underway >NPP VIIRS>NPOESS**
 - **MODIS land algorithms provide a point of departure for a new generation of operational land products**
 - **some hard lessons learned re. instrument and data system**

Current Land Instrument Issues – post Day 305

- **Refining the Geolocation**
- **SWIR – sub-frame differences (5,6,7)**
 - Correction algorithm started 328
 - Need to evaluate algorithm
- **Mirror Side Effects**
- **Detector Striping – remaining noisy detectors (5, 21, 26)**
- **Evaluating Electronic Crosstalk**
- **Polarization thought to be small but needs evaluation -**
 - maybe an issue for Band 3
- **Calibration of Fire Band (21)**
 - calibration above 3.5% of full scale
 - sensor degradation

Production Highlights

- **Since August 2000, continuous and consistent production of the land products up to the monthlies in MODAPS with the exception of CMG products.**
- **Good working interface with the input data provider (GDAAC) with capabilities to reorder fairly easily any corrupted or lost data.**
- **Data for Validation Core sites subsets are being generated for all publicly released L3 land products.**
- **Currently L2/3 production is about 45 days behind current acquisition.**
- **Capability to schedule limited expedited L2 processing for validation campaigns (such as Safari 2000)**
- **A weekly production plan is posted on MODLAND production homepage.**
- **MODAPS daily production progress can be monitored through MODAPS Ops reports (<http://mtvs1.nascom.nasa.gov:8001/CM/Ops-Daily-Status.html>)**
- **GDAAC daily production progress can be monitored through the GDAAC inventory monitor at <http://g0ins02u.ecs.nasa.gov/DEV/cgi-bin/Monitors/Inventory>**

Land Products Summary Public Release

ESDT	Product	Release	Data Day	DAAC
MOD09	Surface Reflectance	8/4/00	6/9/00	EDC
MOD10	Snow	10/13/00	9/13/00	NSIDC
MOD11	Surface Temperature	9/1/00	6/25/00	EDC
MOD12	Land Cover	3/30/01*	6/1/00	EDC
MOD13	VI	8/4/00	6/9/00	EDC
MOD14	Fire	10/13/00	8/20/00	EDC
MOD15	LAI/FPAR	8/4/00	6/9/00	EDC
MOD17	NPP/PSN	2/2/01 *	10/30/00	EDC
MOD43	BRDF/Albedo	9/29/00	7/11/00	EDC
MOD44	Vegetation Cover Conversion	3/30/01*	2/28/01	EDC

* = expected

Complete information posted on the Web



Land Data Operational Product Evaluation

This web page is owned and maintained by the Land Data Operational Product Evaluation (LDOPE) facility.

- [Quick Guide to MODLAND QA](#)
- [Product Specifications](#)
- [Product Interdependencies](#)
- [LDOPE QA Database](#)
- [Product Quality Documentation](#)
- [Known Issues](#)
- [MODAPS Production Links](#)
- [MODIS Web Organigram](#)
- [QA Personnel & Points of Contact](#)
- [Algorithm Theoretical Basis Documents](#)
- [Golden Tiles](#)
- [QA Tools](#)
- [Global Browse Images](#)
- [Platform, Calibration, Geolocation Links](#)

Updated 18 January 2001

Please direct questions or comments by email to David Roy droy@kratos.gsfc.nasa.gov

Responsible NASA official: Ed Masuoka

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providing a leadership
role in establishing
QA as an integral part
of the data system

documenting product
quality leading to
algorithm updates

addressing product
dependencies
and establishing time
series QA record

MODLAND Known Issues

The information listed on this site is for the express purpose of communication with the MODIS Land (MODLAND) Science Team and related parties.

A password is required to access this page. To obtain a username and password, please contact Robert Wolfe (robert.wolfe@gsfc.nasa.gov).

MODIS Land Products

- [Aggregation \(MODAGAGG, MODAGTEX\)](#)
- [L2G Pointer and Viewing Geometry \(MODPT*, MODMGGA*\)](#)
- [Surface Reflectance \(MOD09\)](#)
- [Snow \(MOD10\)](#)
- [Surface Temperature \(MOD11\)](#)
- [Land Cover \(MOD12\)](#)
- [Vegetation indices \(MOD13\)](#)
- [Thermal Anomalies \(MOD14\)](#)
- [FPAR/LAI \(MOD15\)](#)
- [PSN/NPP \(MOD17\)](#)
- [Sea Ice \(MOD29\)](#)
- [BRDF/Albedo \(MOD43\)](#)

Product Known Issues (problems) Web Site – description associated with each product - example of the problem given and its current status.

Related MODIS Products

- [Level 1B \(MOD02\)](#)
 - [Geolocation \(MOD03\)](#)
 - [Cloud mask \(MOD35\)](#)
 - [Land/SeaMask](#)
-

Detailed description

Color Key Case pending Case closed Case reopened QA note

Case #: DR_MOD43_01012 **Opening date:** 01/12/01 **Last update:** 01/12/01

Status: Note

MOD43 is not produced when there are insufficient observations to invert the BRDF model. The cloud mask has been found to [systematically label some desert transition regions as cloudy even when they are clear](#). MOD43 production is precluded in these regions. For example, the transition zone between grass savanna and desert shrubland across North Africa is seen to be all fill values in the mosaic image below.



MOD43B4.A2000305.h16v07.001.2001010133426.hdf MOD43B4.A2000305.h17v07.001.2001010135420.hdf
MOD43B4.A2000305.h18v07.001.2001010135906.hdf MOD43B4.A2000305.h19v07.001.2001010140948.hdf

SDS: Nadir_Reflectance

(True-color composite with fill values in white)

Occurrence: TBD

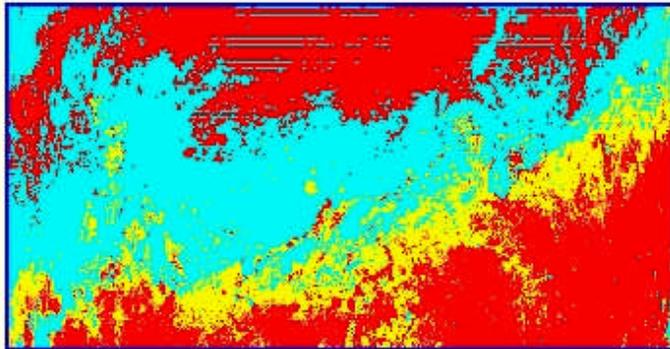
PGE: 2.2.9

Case #: DR_MOD35_01011 Opening date: 01/11/01 Last update: 01/12/01

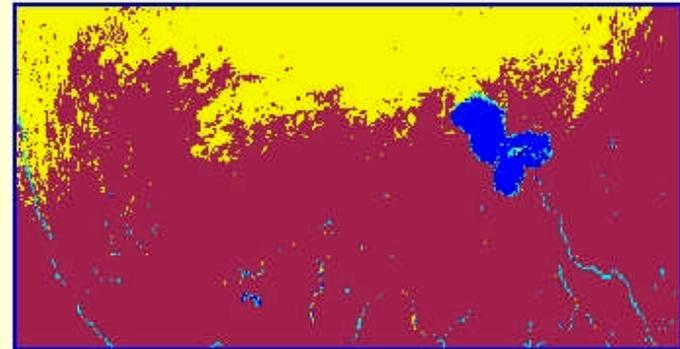
Status: Pending

Clouds are often falsely labelled over transition zones between desert and non-desert. This is most likely because of MOD35 PGE threshold sensitivity in these areas and because of errors in the static desert mask read by the MOD35 PGE.

For example, the transition zone between grass savanna and desert shrubland across North Africa is systematically incorrectly labelled as cloudy. This is illustrated for a whole MODIS swath below.



MOD35_L2.A2000329.1005.002.2000351163659.hdf
1km Cloud Flag from SDS 'Cloud_Mask'
(Cyan: cloudy, Yellow: 66% clear, Coral: 95% clear, Red: 99% clear)



MOD35_L2.A2000329.1005.002.2000351163659.hdf
SDS: 1km Processing flags bits 6-7
(Maroon = Land, Yellow = Desert, Blue = Water, Cyan = Coastal)

Note The [striping problem](#) is clearly evident and Lake Chad is also falsely labelled as cloudy.



MOD09.A2000329.1005.002.2001008225501.hdf
SDS: Surface Reflectance (Red: band 1, Green: band 4, Blue: band3).

Similar cloud detection sensitivity to the desert mask is seen elsewhere. For example, the images below show unreliable cloud detection over the Kalahari Desert region in Southern Africa.

Example of Web Posted Science Quality Flag Updates

MOD09A1 - *Prior to day 2000257*

ScienceQualityFlag: Suspect

ScienceQualityFlagExplanation: Early product assessment is on going. Users are advised to use caution applying these data to project-applications. Input L1B and cloud mask products are still being refined.

MOD09A1 - *Day 2000257 - 2000264*

ScienceQualityFlag: Failed

ScienceQualityFlagExplanation: Missing input L2G pixels (obs. cov. threshold implementation problem).

Note: 11 tiles made in this period over southern Africa with production date 2000297 were reprocessed and have the same quality as MOD09A1 prior to day 2000257.

PGE Versions

- **Products are being refined and patches are being made to code and products based on QA results**
- **The PGE (Product Generation Executive) version is embedded in the product metadata and is readily available to the user.**
- **Version of input data is not included in the product metadata.**
- **The land production homepage contains tables summarizing the change history of land and some upstream PGEs. The tables can either display the overall change history since the nadir door was opened or gives more details for a time period of interest.(<http://modland.nascom.nasa.gov/prod/>)**

MODLAND BROWSE

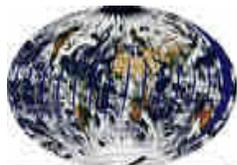
- **MODLAND** makes available global browse images for most of its products and for the L1B radiance
- Browse images are available from the MODLAND homepage. (<http://modland.nascom.nasa.gov/browse/>)
- Browse images are updated automatically ever 6 hours.
- Default browse resolution is 40 km. A 20 km browse is also available. Started to make available 5 km resolution images.



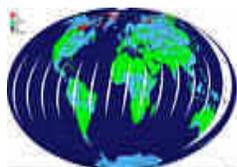
MODIS Land Products: Browse (Day: 9/29/00)



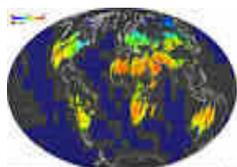
**TOA Visible Radiance
MOD02**



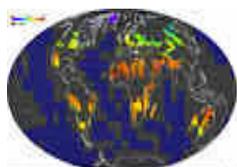
**Surface Reflectance
Daily MOD09**



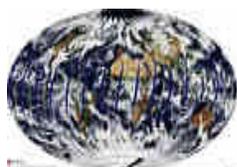
**Snow Cover
Daily MOD10 L2**



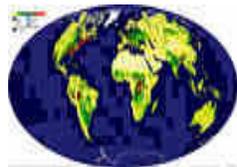
**Surface Temp (Day)
Daily MOD11**



**Surface Temp (N)
Daily MOD11**



**Active Fire /Surface
Reflectance Daily
MOD14 w. MOD 09**



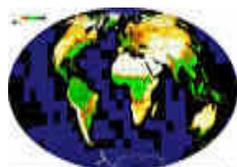
**Leaf Area Index
Daily MOD15A1**



**Fractional PAR
Daily MOD15A1**



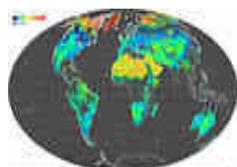
**8-day Land Surface
Reflectance MOD09A1**



**16-day Enhanced Vegetation
Index MOD13A2**



**16-Day Nadir BRDF-Adj
Reflectance MOD43B4**

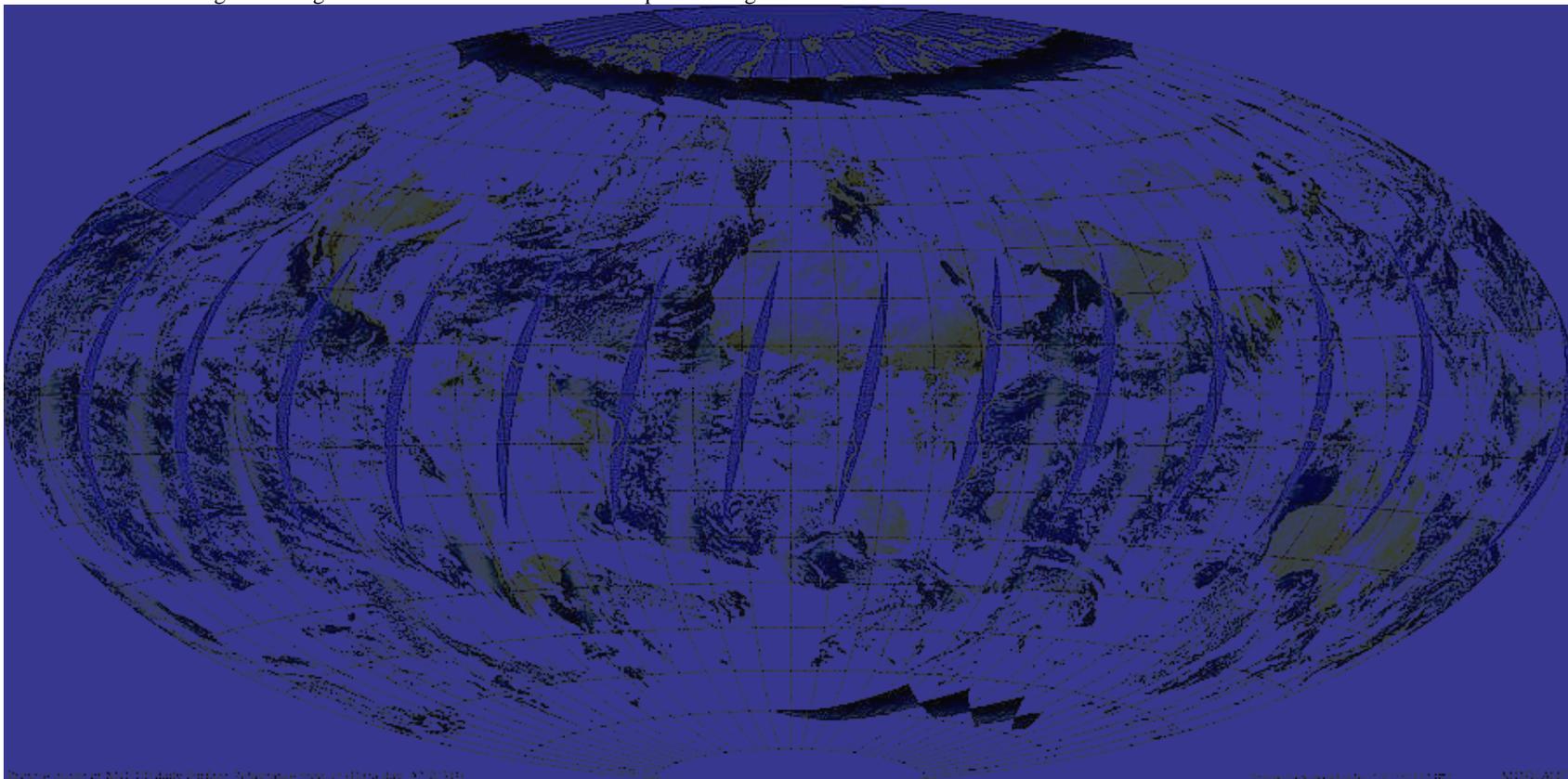


**16-day Shortwave Broad-
band White-Sky Albedo
MOD43B3**

Land Global Browse Availability

ESDT	Product	Start Data Day	
		20km/40km	5km
=====	=====	=====	=====
MOD02	L1B TOA radiance	055	090
MOD09	L2/L3 Surface reflectance	055/057	060/145
MOD10	Snow Cover	055	257
MOD11	Land Surface Temperature	055	256
MOD13	16-day VI	177	177
MOD14	Fire	055	297
MOD15	LAI/FPAR	257	257
MOD29	Sea Ice	055	289
MOD43	BRDF	257	257

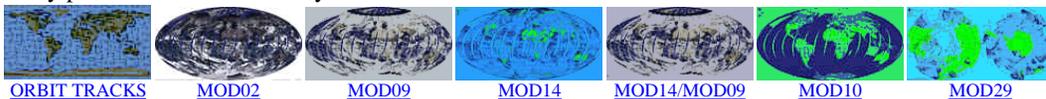
Click to an area in the global image to raise a 5km-resolution close-up of this region



Navigation controls including a left arrow, a "1 day" button, two globe thumbnails labeled "20km" and "5km", another "1 day" button with a right arrow, a "Submit" button, a text input field containing "200033", and a "Date" label.

[Main Global Browse](#)
[Page](#)
(multi-product layout)

Daily products available for day 2000/334:



Also available: [8-day](#) and [16-day](#) products

Example Browse Page



Land 250m Project



Rationale	Methodology	Products	Get Data	Links
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First MODIS 250m Coverage Available

The **MODIS Land 250m Project** is supported by the NASA Earth Science Information Partners Program as a partial solution to the EOS programmatic restraint of 50% production volume in the first year from MODIS PI processing of Level 2 and 3 data. Currently, 250m production is only supported for 10% of the land surface.



the first coverage of the MODIS 250m

Surface Reflectance product for the US is now available for the two 8-day periods beginning June 9th (2000161) and June 17th (2000169). [Click here](#) to find and download MODIS 250m data. For other available MODIS products go to the [EDC DAAC](#). The map to the right illustrates the initial coverage region (click [image for larger version](#)).
More News Items

- [Chesapeake Bay early image](#)
- [First engineering images produced on MODIS 250m system](#)
- [Terra Launches Successfully](#)

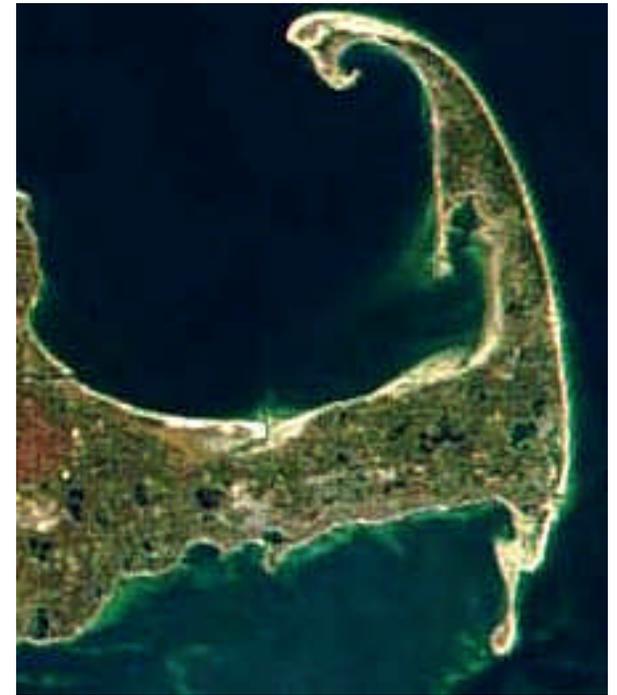


MODIS 250m Products Website

Developed/Maintained by John Owens, University of Maryland (jowens@hermes.geog.umd.edu)
Authorized by Christopher Justice, MODIS Land Discipline Leader

250m Production and Distribution System

Web Based System Developed in response to limited processing capacity
Supported by NASA ESIPS Project



- 10% coverage
- Surface Reflectance
- Vegetation Index
- feeds VCC at UMd ESIP
- Transition back to MODAPS after 1 year

250m System Status

- **First data made available on August 4 for 8-day period starting June 9 (day 2000/161).**
- **Initial production limited to L3 SR and North America data set (from 20N to 60N), then extended to Southern Africa**
- **Production stabilized after data day 2000/257 (Sept. 13)**
- **Production transitioned to MODAPS in early November for L2G and in early January for L3**
- **10% production of L3 SR and L3 VI starting data day 2000/289 (Oct. 15)**
- **Data distributed by the 250m distribution system, eventually shipped to EDC DAAC in year II**
- **Production in the 250m system in the next few months will fill data gaps**

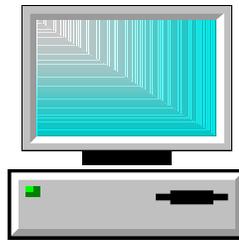
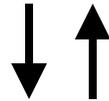
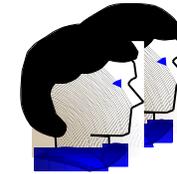
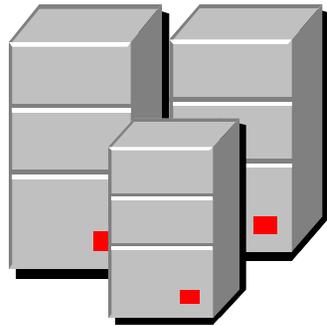
250m Production at UMD

GLCF ESIP:

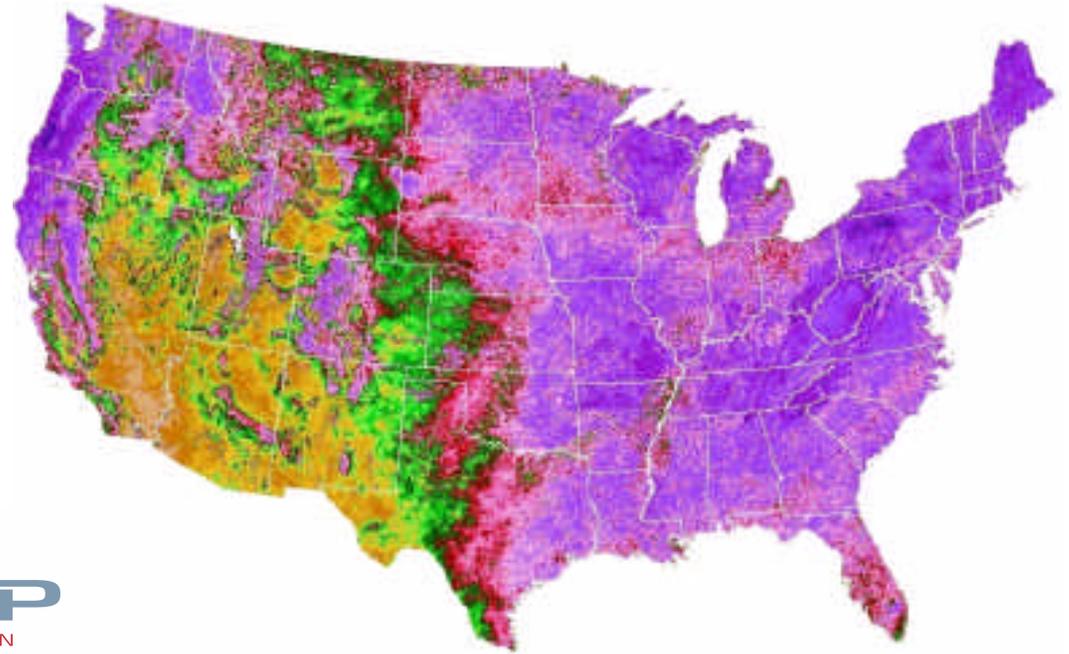
Produce 16-day U.S. VI in regional sub-sets and user friendly data formats; produce early VCC

Distribute to
User Community
<http://glcf.umiacs.umd.edu>

Ingest
Daily Data
from
MODAPS



QA at SCF



Fire - Rapid Response System (Under Development)

- **Based on experience from Montana fires – work around to support fire management**
- **Need for near real time response for MODIS (15 - 45 day gap)**
 - **extract sample imagery from MODIS global data stream**
 - **ground stations**
- **250m Surface Reflectance / Active Fire**
- **System under development will build upon**
 - **NOAA bent pipe – operational feed for forecasting**
 - **Streamlined SCF processing - no toolkits, stand-alone code**
 - **250m Web access to data / GIS integration**
- **Planned links to community sites – e.g. Earth Observatory (PR, Outreach) Hawaii Thermal Alert, UN Fire Monitoring Center, USFS Fire monitoring**

MODIS land team

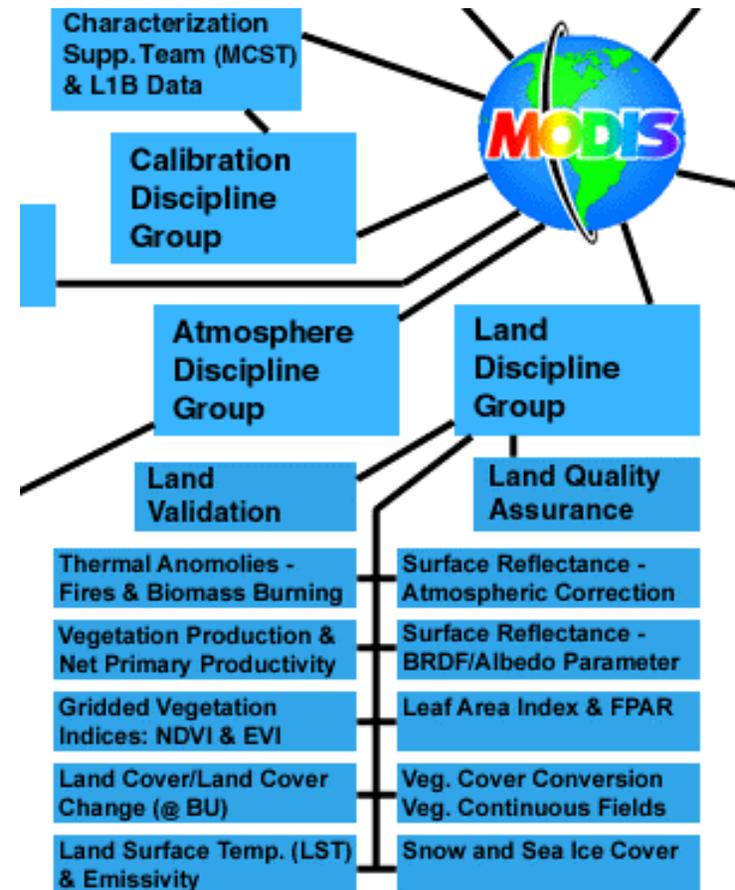


<http://modis.gsfc.nasa.gov/MODIS/LAND/VAL/>

- Land validation coordination
- Validation plans
- User guides
- MODIS/EOS Land Core Sites
- Data coordination – w. ORNL
- High resolution acquisition (L7, Aster, Ikonos w. CDB)
- Other Correlative data e.g SeaWiFs
- Validation Campaign support SAFARI 2k. LBA
- International Validation Program Representation – CEOS
Land Product Validation

MODLAND Outreach

- **Significant increase in Web information**
- **Web sites for each product**
- **Educational outreach**
 - MODIS Snow Middle School Video , curriculum
- **Starting to get requests for help from the science community**
- **Interactions with the Federation**
- **Initial interactions with applications community – on new product capabilities e.g. RESACS, USFS, UNFAO, USDA**
- **Concerted effort to present results at community conferences e.g. AGU, IGARSS**
- **Science Publication (RSE Spec Edition 2001**



subset of MODIS
mall map

Land Group Outstanding Issues and Concerns

- **MODIS Cloud Mask** needs refinement for land product use
- **Team recompetition recommendations**
 - capitalizing on investments made
 - maintain current and enhance capabilities
 - not enough processing capacity for current products
- **Data processing resources**
 - process all the land products full resolution – SWGD ‘00 requirements
 - exploring efficiencies
- **Reprocessing resources**
 - writing V3 code for reprocessing
 - urgent need for subset validation reprocessing
 - rate is critical - need to reprocess 1 year in 4 months
- **Validation**
 - MODIS data needed for validation campaigns in ‘00
 - global products largely unvalidated
 - scope of the initial global product validation is large
 - land group needs to step up validation effort

Land Group Outstanding Issues and Concerns

- **Distribution resources**
 - Need to manage and meet community expectations
 - Flexible Subset ordering at DAACs
- **Data analysis tools** – reprojection, multiple-instrument integration, GIS interface
 - current working projection is giving us problems - reprojection
 - tools not there to enable the science community to use the data
 - handholding needed by the science team for the user community
- **DAAC User Services and Outreach**
 - Need a closer working relationship with land team – creative solutions needed to meet growing information demands
 - Review roles / responsibilities versus current capabilities
- **Applications potential of MODIS considerable**
 - Need to develop an informed interaction with the applications community re. the MODLAND products

Land Group Outstanding Issues and Concerns

- **Direct Broadcast** - requests coming into the team
 - shareware for land code highly desirable - help standardization
- **MODIS as part of an observing strategy**
 - Planned interaction with other Terra instruments – combined data products proposed
 - ASTER data coming on line – validation and scaling issues
 - Landsat continuity
- **MODIS Applications**
 - role of the team
 - how to strengthen this aspect
- **MODIS and VIIRS**
 - availability of information
 - lessons learned – instruments/algorithms/data systems

Summary of Achievements

- **Next Generation Land Science Products**
 - improved products (e.g. SR, Fire, LAI/FPAR, Land Cover, NPP)
 - new capabilities (e.g. LST, BRDF, EVI, VCC)
- **Land Products available within 1 yr from launch**
 - dedicated to getting the data out to the community (ASAP)
- **Data Systems Development (MODAPS /250m /Rapid Response/GLCF)**
- **LDOPE QA system – new paradigm, community leadership role**
- **Land Product Validation – new paradigm, community leadership role**
 - Test sites – focus for data collection – community
 - Modland/Fluxnet – 100 plus towers, integration with in-situ
 - Measurement Protocols e.g. Big Foot
 - Validation data management distribution
 - Campaigns – SAFARI, LBA
 - CEOS WG Cal Val – Land Product Validation Subgroup
- **Pathfinding for NPOESS/NPP VIIRS (lessons learned)**
 - Instrument design / characterization / specifications
 - Data system
 - Algorithms / products
- **International cooperation – e.g. MODLAND w. GLI, Polder, Vegetation**