



Extending the use of satellite data sets and derived products in ecological models

Brad Reed and John Dwyer

LP-DAAC

USGS EROS





NASA EOS Data & Information System (EOSDIS)

GOALS:

Acquire, archive, manage, and distribute EOS data

TASKS:

Perform mission operations for instrument & spacecraft control

EMOS (EOS Mission Operations System)

Generate higher level standard data products

SIPS (Science Investigator-Led Processing System)

Archive and distribute data products

DAAC (Distributed Active Archive Centers)





TERRA: VITAL STATISTICS



MISSION: to observe and measure how Earth's atmosphere, cryosphere, lands, oceans, and life all interact

LAUNCH: December 18, 1999
Vandenberg AFB

ORBIT: Sun-synchronous
Near-Polar
705 km (438 mile)

EQUATOR CROSSING:
10:30 am descending

DESIGN LIFE: 6 years



AQUA: VITAL STATISTICS



MISSION: atmospheric temperature and humidity profiles, clouds, precipitation and radiative balance; terrestrial snow and sea ice; sea surface temperature and ocean productivity; soil moisture; and the improvement of numerical weather prediction

LAUNCH: May 4, 2002
Vandenberg AFB

ORBIT: Sun-synchronous
Near-Polar
705 km (438 mile)

EQUATOR CROSSING:
1:30 pm ascending

DESIGN LIFE: 6 years



MODIS INSTRUMENTATION: BROAD SPECTRAL COVERAGE

REFLECTIVE Bands

0.405 – 2.155 μm

VEGETATION INDICES

CHLOROPHYLL

LAND COVER

AEROSOL PROPERTIES

EMISSIVE Bands

3.660 – 14.385 μm

LAND, CLOUD, SEA
SURFACE

VOLCANIC/FIRE ACTIVITY

CLOUD PARAMETERS

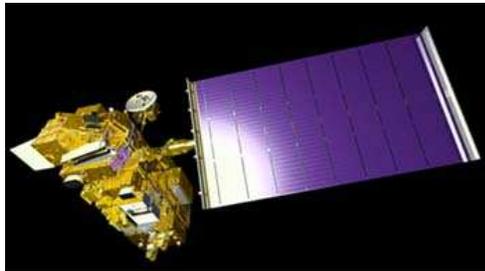
TROPOSPHERIC HUMIDITY

OZONE

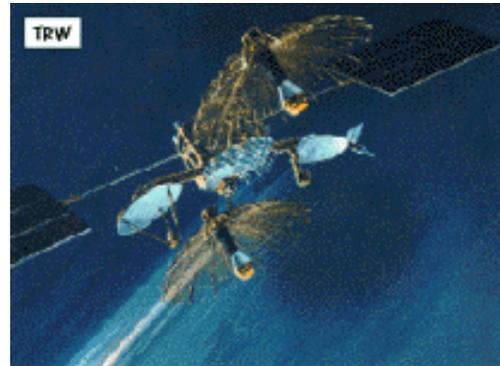




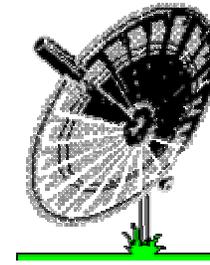
EOS: Data Chain (MODIS)



EOS SATELLITE



TDRSS



GROUND RECEPTION



The Goddard DAAC
*your link to Earth Observing System data
archived at the Goddard Space Flight Center*

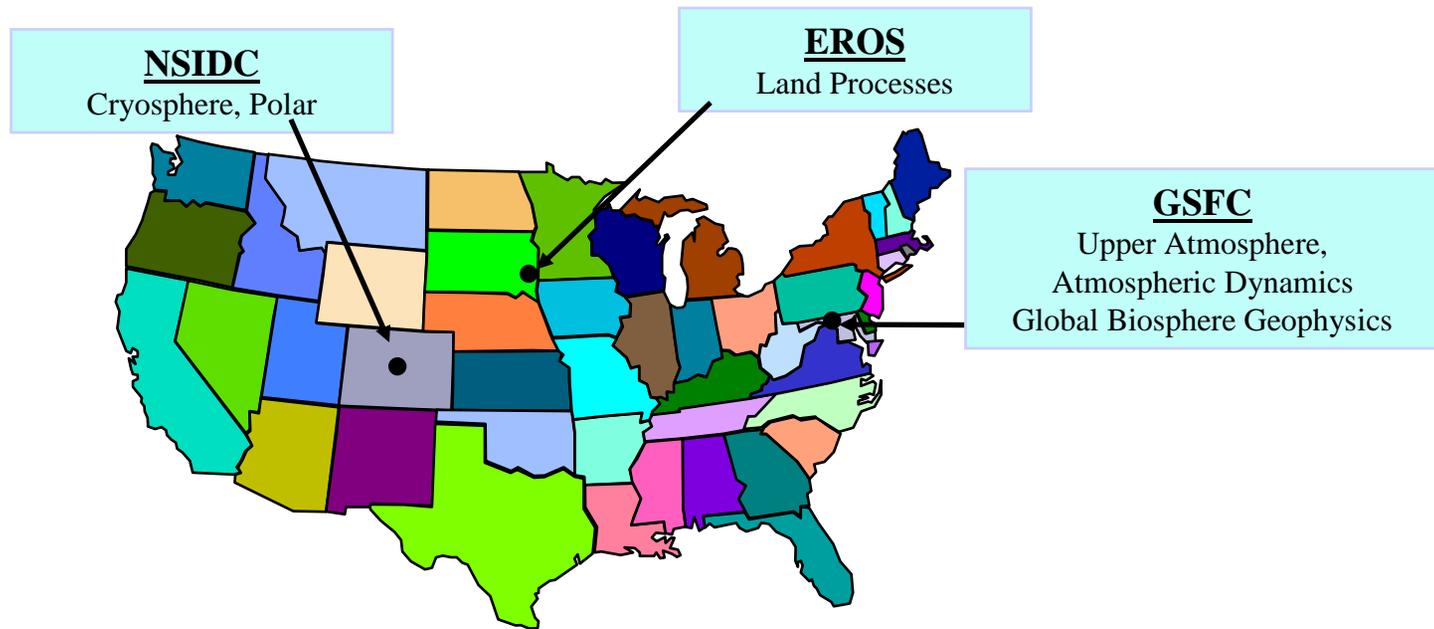
MODAPS





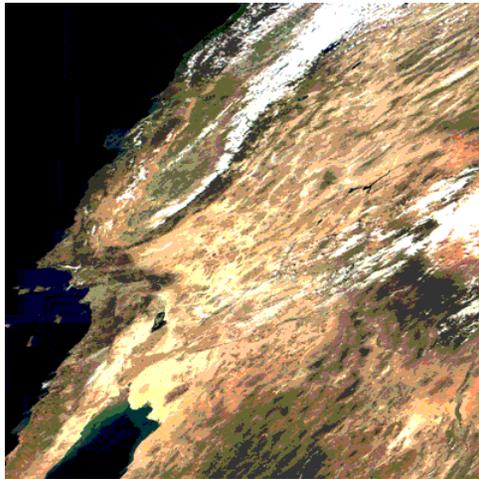
EOSDIS DAACs: MODIS

Distributed Active Archive Centers



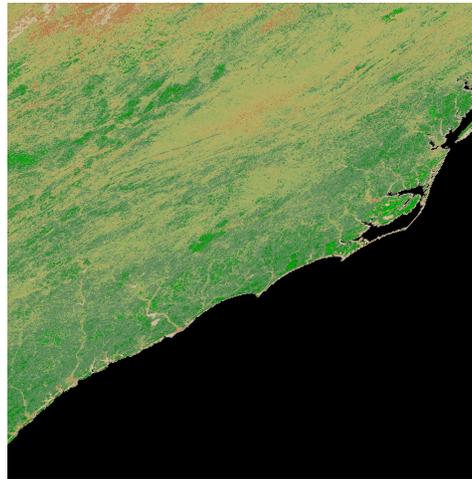


MODIS LAND DATA OVERVIEW



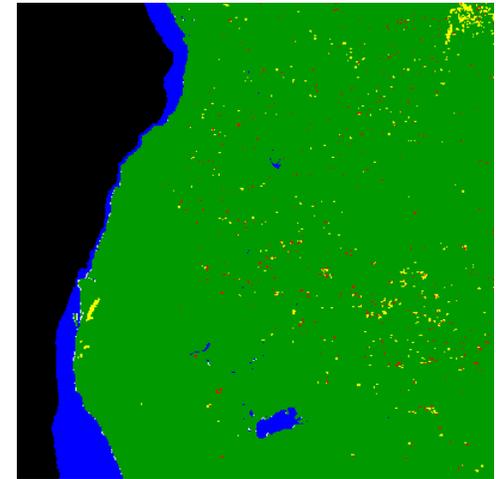
Radiation Budget

Surface Reflectance
BRDF/Albedo
Temperature/Emissivity



Ecosystem

Vegetation Index
LAI/FPAR
NPP



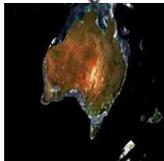
Land Cover

Thermal Anomalies/Fire
Land Cover
Land Cover Change





MODIS LAND DATA at LP DAAC: Data Characteristics



Temporal	1-, 8-, 16-, 32-day, monthly, quarterly, yearly
Spatial	250m, 500m, 1km, 0.05deg (~5.6 km at equator)
Level 2	Derived geophysical variables at the same resolution and location as Level 1 source data
Level 2G	Level 2 data mapped on uniform space-time grid scales
Level 3	Variables mapped on uniform space-time grid scales in derived spatial and/or temporal resolutions
Level 4	Model output or results from analyses of lower-level data.





MODIS DATA FORMAT: HDF-EOS

SDS MOD09A1	UNITS		SDS MOD09A1	UNITS
Band1 (620-670) nm	Reflectance		Day of the Year	Julian
Band2 (841-876 nm)	Reflectance		500m state flags	Bit Field
Band3 (459-479 nm)	Reflectance		Solar zenith	Degree
Band4 (545-565 nm)	Reflectance		View Zenith	Degree
Band5 (1230-1250 nm)	Reflectance		Relative Azimuth	Degree
Band6 (1628-1652 nm)	Reflectance		QC Flags	Bit Field
Band7 (2105-2155 nm)	Reflectance			



PRODUCT QUALITY

Bit encoded

“1001110100100111”

means something like:

produced, good quality

no atmospheric correction performed

aerosol quantity: low

no adjacency correction performed

no atmosphere BRDF correction performed

no mixed clouds

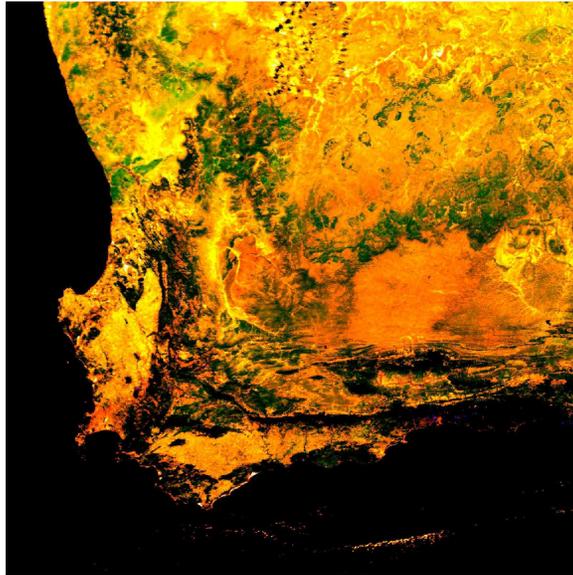
land

no possible snow/ice

no possible shadow

BRDF model based nadir equivalent VI





Versioning

Terra V004

Feb 24 2000 – present

Aqua V004

July 4 2002 – present

Version 5 Schedule – Beginning in October, 2005, will reprocess from Jan – Oct 2005, then July, 2002 through December, 2004, then remainder of collection.

Timeliness

MODAPS forward processing is currently 5 days behind real time for Terra and Aqua

Original goal was to stay within 15 days of Level 1 production



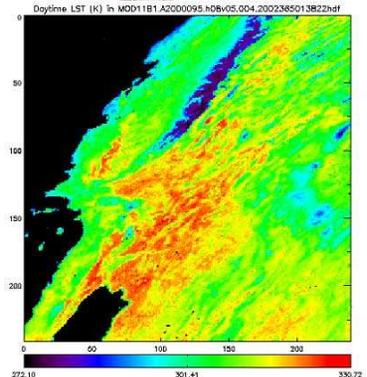
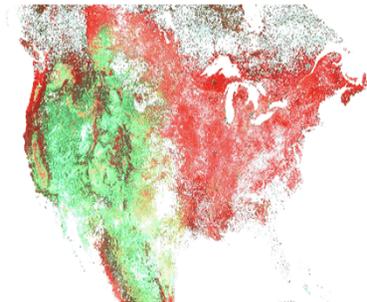
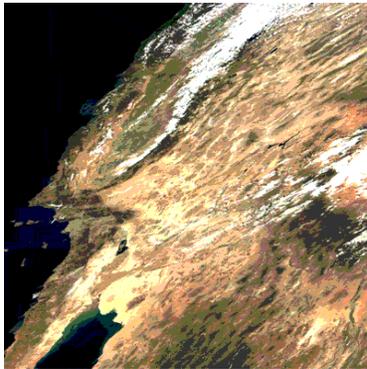


Radiation Budget Data Sets

Surface Reflectance

BRDF/Albedo

Temperature/Emissivity



09A1	Surface Reflectance 8-Day L3 Global 500m SIN Grid
09CMG	Surface Reflectance Daily L3 Global 0.05Deg CMG
09GHK	Surface Reflectance Daily L2G Global 500m SIN Grid
09GQK	Surface Reflectance Daily L2G Global 250m SIN Grid
09GST	Surface Reflectance Quality Daily L2G Global 1km SIN Grid
09Q1	Surface Reflectance 8-Day L3 Global 250m SIN Grid
43B1	BRDF/Albedo Model-1 16-Day L3 Global 1km SIN Grid
43B2	BRDF/Albedo Model-2 16-Day L3 Global 1km SIN Grid
43B3	Albedo 16-Day L3 Global 1km SIN Grid
43B4	Nadir BRDF-Adjusted Reflectance 16-Day L3 Global 1km SIN Grid
43C1	Albedo 16-Day L3 Global 0.05Deg CMG
43C2	BRDF/Albedo Parameters 16-Day L3 Global 0.05Deg CMG
43C3	Nadir BRDF-Adjusted Reflectance 16-Day L3 Global 0.05Deg CMG
11_L2	Land Surface Temperature/Emissivity 5-Min L2 Swath 1km
11A1	Land Surface Temperature/Emissivity Daily L3 Global 1km SIN Grid
11A2	Land Surface Temperature/Emissivity 8-Day L3 Global 1km SIN Grid
11B1	Land Surface Temperature/Emissivity Daily L3 Global 5km SIN Grid
11C1	Land Surface Temperature/Emissivity Daily L3 Global 0.05Deg CMG
11C2	Land Surface Temperature/Emissivity 8-Day L3 Global 0.05Deg CMG
11C3	Land Surface Temperature/Emissivity Monthly L3 Global 0.05Deg CMG



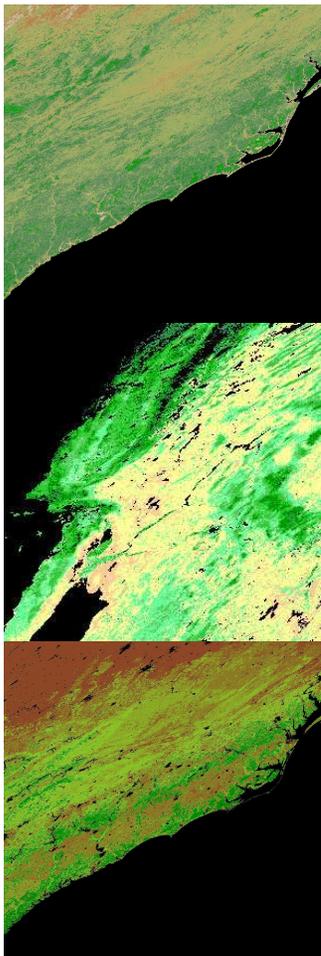


Ecosystem Data Sets

Vegetation Indices

LAI/FPAR

NPP/PSN



13A1	Vegetation Indices 16-Day L3 Global 500m SIN Grid
13A2	Vegetation Indices 16-Day L3 Global 1km SIN Grid
13Q1	Vegetation Indices 16-Day L3 Global 250m SIN Grid
15A2	LAI/FPAR 16-Day L3 Global 500m SIN Grid
17A2	Net Primary Production 8-Day L4 Global 1km SIN Grid
17A3	Net Primary Production Yearly L4 Global 1km SIN Grid



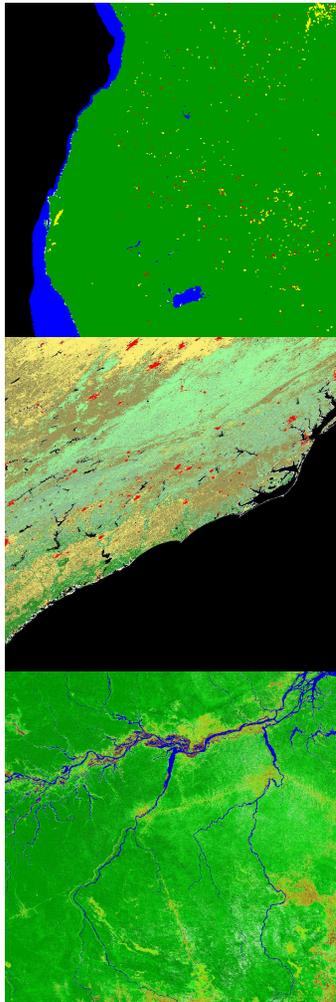


Land Cover Data Sets

Thermal Anomalies

Land Cover

Land Cover Change



science for a changing world

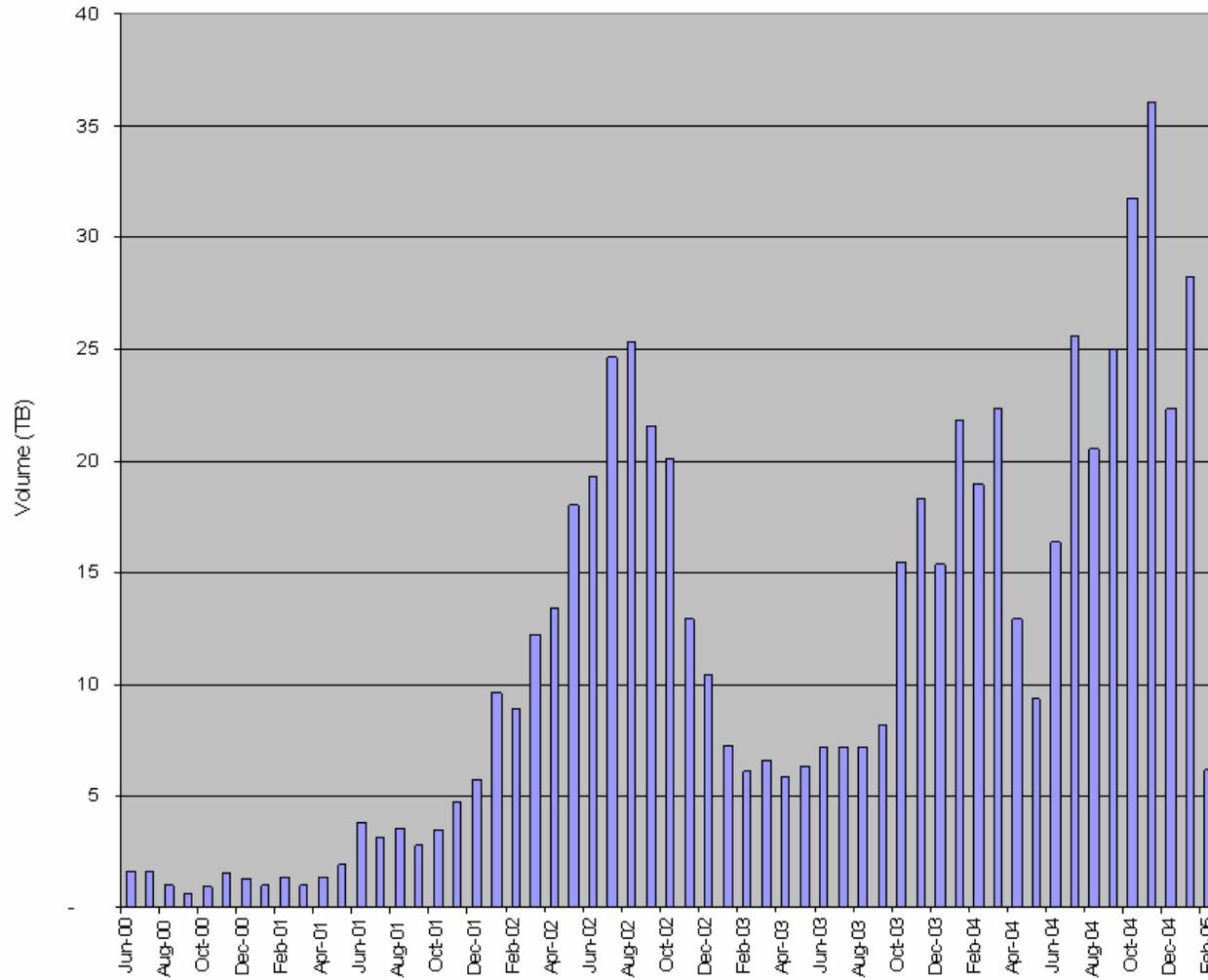
14	Thermal Anomalies/Fire 5-Min L2 Swath 1km
14A1	Thermal Anomalies/Fire Daily L3 Global 1km SIN Grid
14A2	Thermal Anomalies/Fire 8-Day L3 Global 1km SIN Grid
12C1	Land Cover Type 96-Day L3 Global 0.05Deg CMG
12Q1	Land Cover Type 96-Day L3 Global 1km ISIN Grid
44A	Vegetation Cover Conversion 32-Day L3 Global 250m ISIN Grid
44B	Vegetation Continuous Fields Yearly L4 Global 500m ISIN Grid



Land Processes Distributed Active Archive Center



MODIS Distribution from the LP DAAC: Volume



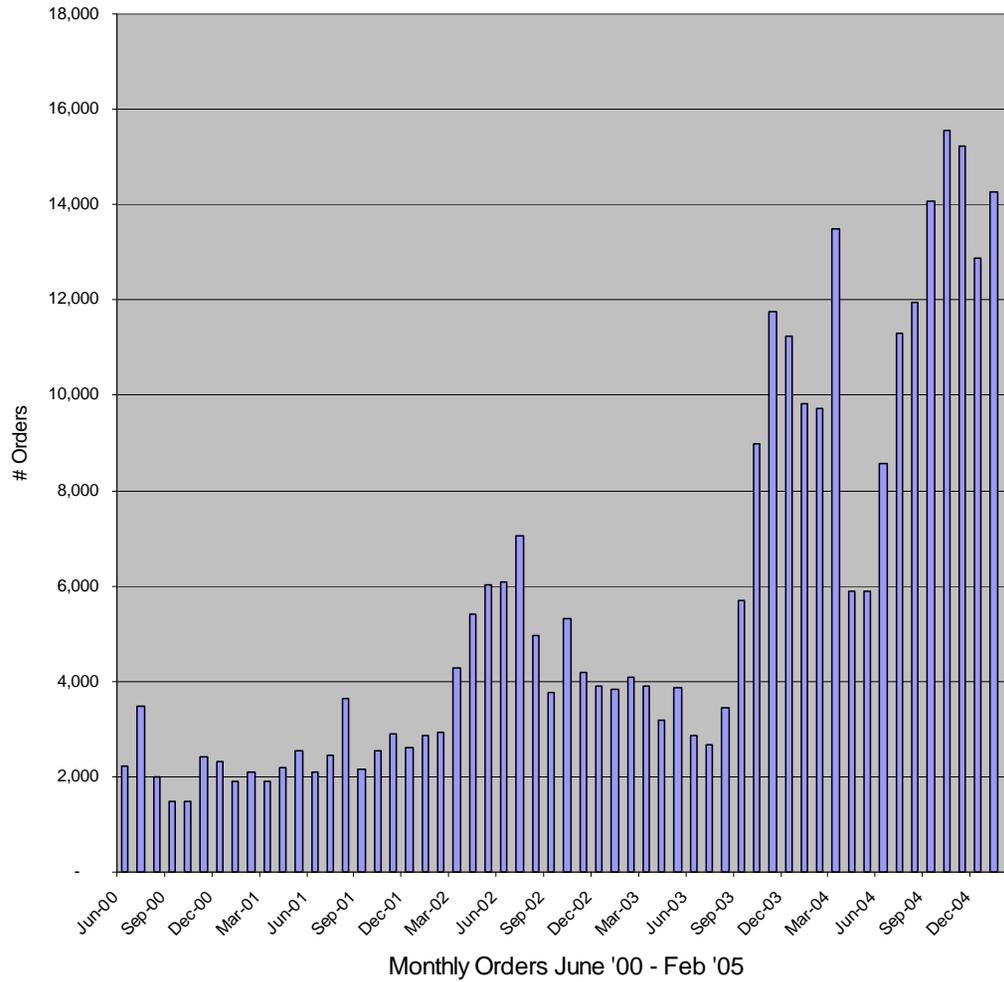
Monthly Distribution June '00 - Feb '05



Land Processes Distributed Active Archive Center



Orders for MODIS Land Products Requested from the LP DAAC





Extending the use of EOS Data: Data Delivery

- Current ECS Archive Architecture and Technology
- Overview of the new ECS Data Pool Architecture
- LP DAAC Data Pool Data Holdings & Access:
 - FTP Site (anonymous ftp)
 - Web Client
- Seamless Server





‘Standard’ ECS Architecture

- Client/Server architecture with a near-line data archive on tape
 - Inventory (metadata) is stored in a relational database
 - Datasets (granules) are stored on STK 9940 tapes (3 - STK Silo's)
 - Servers are utilized to satisfy inventory searches and accept orders for products
 - Client application(s) are used to place searches and orders (EDG)
 - Products (granules) are then delivered asynchronously to the user
- User experience is very traditional:
 - End users browse inventory via Client searches (EDG is single tool)
 - End users identify granules of potential interest / applicability
 - End users “order” granules via Client order requests to Servers
 - After an “unacceptable” amount of time the end user receives a product either on media or is notified where to “pull” granules from
- End Result is that the User is “Isolated” from the data





ECS Data Pool Architecture

- Data Pools are an additional subset “inventory” of science data (granule, browse, metadata) that reside in a separate inventory database, with their physical files resident on local storage area network (SAN = 44TB) (On-line model).
 - NASA intent is to grow the on-line to be a “working copy” of the most popular data
- Data pool granules are populated at insert time in the primary ECS archive (a function of ingest)
- Dataset “Collections” belong to “Groups” and are configured for “X” days of persistence and are automatically removed at expiration (rolling archive concept)
- Data Pool Web client(s) and/or ftp site access are used to navigate contents, browse, access and download data products.





Data Pool Users

- Data Pool User Experience is basically an on-line model:
 - End users browse & navigate directory structures to ascertain holdings (ftp-site) including machine access (can script a daily pull of new granules).
 - End users have option of using simple web client to “search” against inventory and drill down to holdings
 - End users identify granules of potential interest / applicability (browse and metadata files are resident on-line)
 - End users can download data files or open them with a COTS application
- End Result is that the User can find data holdings on-line, use it (without an order), and come back later for more updates...
 - Supports increased electronic distribution (no charging)
 - Reduce the need to pull from near-line archive (trade silo drives for disk)
 - Reduce the need for media orders (and \$ cost)





LP DAAC Data Pool Data Collection

- ASTER
 - Version 3 L1B Registered Radiance at the Sensor (AST_L1B) granules over **the United States and its territories only**
 - Temporal extent: March 2000 to Present
 - **No charge** for ASTER L1B data downloaded from the Data Pool
- MODIS Aqua & Terra
 - Temporal Extent: Date varies according to data type
 - MODIS daily data are available for up to 4 days. MODIS composite data are available for up to 1 year.





Access to Data Pool

- Basically two methods of accessing data pool data
- Anonymous FTP Site
- “Simple” Web Client(s) (intent is to navigate & browse data holdings)
 - ECS has delivered a “generic” client for all DAACs
 - LP DAAC MODIS Data Pool Client will roll out soon
- Public Access:
<http://lpdaac.usgs.gov/datapool/datapool.asp>



LP DAAC Data Pool Interface

DataPool @ LP DAAC

- About Data Pool
- Data Types
- Data Pool Help
- Release Notes
- Glossary
- EOS Data Gateway

[Reformat, Reproject & Subset](#)
[8mm Distribution To Cease](#)

Welcome to the Data Pool at the Land Processes Distributed Active Archive Center (LP DAAC). The Data Pool is an online archive that provides FTP access to selected LP DAAC data products. ASTER Data Pool coverage includes the United States and Territories. MODIS coverage is global. For these Terra and Aqua sensors, there are several [data types available at no charge through the Data Pool](#). MODIS daily products are retained for 4 days, all others for 12 months. There is no scheduled removal cycle for ASTER products.

A simple 'drill-down' web interface is used to quickly locate data of interest. Metadata and most browse data can be viewed directly in your browser. Data granules can be downloaded via ftp. If you are new to the Data Pool, please read Data Pool [Help](#) and [Release Notes](#) to get a quick overview of the 'drill-down' interface. Note that the contents of the Data Pool will not always match the contents of the EOS Data Gateway. If the desired data is not found in the Data Pool archives, try searching the [EOS Data Gateway](#) (EDG). Missing granules cannot be inserted into the Data Pool archive.

- SEARCH Data Pool
- FTP Aster
- FTP MODIS Aqua
- FTP MODIS Terra
- FTP MODIS Combined

Please note that scheduled downtime occurs every Wednesday from 7 a.m. to 11 a.m. Central time.





Special Collection: Seamless Server

Support AVHRR – MODIS Vegetation
Index intercomparisons

- Build simultaneous composites (AVHRR 16-day composites corresponding to MODIS schedule)
- Build MODIS data set corresponding to USGS conterminous US AVHRR (projection, extent, etc.)
- Make data available via Seamless Server





MODIS/Terra Vegetation Indices 16-Day L3 Global 1km SIN Grid - MOD13A2

Select Band	Select Year	Select Julian Date
NDVI	2002	None
Update Display		

LP DAAC MOD13A2

(MODIS/Terra Vegetation Indices 16-Day L3 Global 1km SIN Grid)

The MOD13A2 product is a MODIS Level 3 16-day composite of Vegetation Indices at 1km resolution. This product uses, as input, MODIS Terra surface reflectances, corrected for molecular scattering, ozone absorption, and aerosols. Two vegetation index (VI) algorithms are produced globally for land. One is the standard normalized difference vegetation index (NDVI), which is referred to as the "continuity index" to the existing NOAA-AVHRR derived NDVI. The other is an 'enhanced vegetation' index with improved sensitivity into high biomass regions and improved vegetation monitoring through a de-coupling of the canopy background signal and a reduction in atmosphere influences. The two VIs compliment each other in global vegetation studies and improve upon the extraction of canopy biophysical parameters. A new compositing scheme that reduces angular, sun-target-sensor variations is also utilized. The gridded vegetation

Scale Information



Layers

- Display Download
- Places (Names)
- Layer Extent
- Structures
- Transportation
- Boundaries
- Hydrography
 - National Atlas Stream
 - National Atlas Water Bodies
- Orthoimagery
- Land Cover
 - NASA_LPDAAC_MOD13A2_004
 - NLCD 1992 Transparency on NED Shaded Relief
 - NLCD 2001 Land Cover
 - NLCD 2001 Canopy
 - NLCD 2001 Impervious Surface
- Elevation

Seamless Data Distribution Delivery - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address <http://gisdata.usgs.net/Website/Seamless/viewer.php>

USGS
Seamless Data Distribution [Back to Main Page](#)

Zoom

+

-

XY

Query

i

Tools

Hand

Print

Documents

Map

Downloads

Download

Scale Information

Out In

Scale ~ 1:69,826,710

Layers

Display Download

- ▶ Places (Names)
- ▶ Layer Extent
- ▶ Structures
- ▶ Transportation
- ▶ Boundaries
- ▼ Hydrography
 - National Atlas Stream
 - National Atlas Water Bodies
- ▶ Orthoimagery
- ▼ Land Cover
 - NASA_LPDAAC_MODIS 004 NDVI 2002 161
 - NLCD 1992 Transparent on NED Shaded Relief
 - NLCD 2001 Land Cover
 - NLCD 2001 Canopy
 - NLCD 2001 Impervious Surface
- ▶ Elevation

U.S. Department of the Interior | U.S. Geological Survey | EROS Data Center
URL: <http://Website/Seamless/disclaimer.php> | Last Update: April 16, 2004 || Maintainer: [Comments and Suggestions](#) | [Disclaimer](#)

Map: -97.87 , 36.11 -- Image: 502 , 258 -- ScaleFactor: 0.16308864265927977

Start | Microsoft Active... | 2 Novell Group... | John L Dwyer - I... | Microsoft PowerP... | 2 Internet Ex... | 9:46 AM

Seamless Data Distribution Delivery - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address <http://gisdata.usgs.net/Website/Seamless/viewer.php>

USGS
Seamless Data Distribution [Back to Main Page](#)

Zoom

Query

Tools

Documents

Downloads

Scale ~ 1:8,685,762

Layers

Display Download

- Places (Names)
- Layer Extent
- Structures
- Transportation
 - ESRI Interstate La
 - ESRI Interstates
- Boundaries
- Hydrography
 - National Atlas Stre
 - National Atlas Wat Bodies
- Orthoimagery
- Land Cover
 - NASA_LPDAAC_MC 004 NDVI 2002 16
 - NLCD 1992 Transp on NED Shaded Re
 - NLCD 2001 Land C
 - NLCD 2001 Canopy
 - NLCD 2001 Imperv Surface
- Elevation

Click and drag to select area to download or order. The color of the box indicates how the data can be delivered:
Green: Selection can be downloaded or ordered on media.
Red: Selection can be ordered on media only.

U.S. Department of the Interior | U.S. Geological Survey | EROS Data Center
 URL: <http://Website/Seamless/disclaimer.php> | Last Update: April 16, 2004 || Maintainer: [Comments and Suggestions](#) | [Disclaimer](#)

Map: -100.18 , 38.99 -- Image: 480 , 139 -- ScaleFactor: 0.02028663603810596

Start | Microsoft Active... | 2 Novell Group... | John L Dwyer - I... | Microsoft PowerP... | 3 Internet Ex... | 9:54 AM

DDS Request Options Page

Order Options:

Output Coordinate System: Native

Requested Product(s):	Data Format:	Archive Format:	Metadata Format:	Year:	Instances:	Components:
<input type="checkbox"/> Landsat Mosaic	Not selected.					
<input type="checkbox"/> Bureau of Land Management Orthoimagery	Not selected.					
<input checked="" type="checkbox"/> NASA LPDAAC MOD13A2	GeoTIFF ArcGRID GeoTIFF BIL	ZIP	HTML	2000	Julian Date 049	<input checked="" type="checkbox"/> 1. NDVI Image File <input type="checkbox"/> 2. EVI Image File <input type="checkbox"/> 3. Blue Reflectance Image File <input type="checkbox"/> 4. Red Reflectance Image File <input type="checkbox"/> 5. NIR Reflectance Image File <input type="checkbox"/> 6. MIR Reflectance Image File <input type="checkbox"/> 7. EVI QA Data <input type="checkbox"/> 8. NDVI QA Data <input type="checkbox"/> 9. Average Sun Zenith Angle <input type="checkbox"/> 10. Average View

Scale ~ 1:8,685,762

Layers

- Display Download
- Places (Names)
- Layer Extent
- Structures
- Transportation
 - ESRI Interstate L
 - ESRI Interstates
- Boundaries
- Hydrography
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 - National Atlas W Bodies
- Orthoimagery
- Land Cover
 - NASA_LPDAAC_M 004 NDVI 2002 1
 - NLCD 1992 Trans on NED Shaded P
 - NLCD 2001 Land
 - NLCD 2001 Canop
 - NLCD 2001 Imper Surface
- Elevation

Internet



Data Delivery Services

- Data Subscriptions
 - email notification upon data ingest
 - ftp push capability
- Machine to Machine gateway
 - for large orders





Tools for extending the use of MODIS data

MODIS Reprojection Tool (MRT)

LDOPE Tool

MODExtract





MRT Capabilities

- Reprojects MODIS products in SIN using the Generalized Cartographic Transformation Package (GCTP)
- Output projections
 - Geographic
 - Hammer
 - Mollweide
 - Sinusoidal
 - UTM
 - Transverse Mercator
 - Integerized Sinusoidal
 - Goode's Interrupted Homolosine
 - Lambert Azimuthal
 - Lambert Conformal Conic
 - Polar Stereographic





MRT Capabilities

- Data subsetting
 - Any subset of SDSs may be selected
- Spatial subsetting
 - Subset by input lat/long or line/sample, or output projection coordinates
- Mosaicking
 - Geographically connects adjacent tiles
- Resampling
 - nearest neighbor
 - bilinear interpolation
 - cubic convolution
- File format conversion
- Datum conversion





MRT Capabilities

- Datum conversions
 - NAD 27, NAD 83, WGS 66, WGS 72, WGS 84
- File formats
 - Input – HDF-EOS and flat binary
 - Output – HDF-EOS, GeoTIFF, and flat binary with header record





MRT Capabilities

- Platforms and Operating Systems
 - Windows 95/98/2000
 - Windows XP
 - Linux
 - Sun/Solaris
 - SGI/IRIX
- GUI or Command-line interface
- Requires Java 1.2 or higher





MRT Availability

- Download from
<http://edc.usgs.gov/programs/sddm/modisdist/index.shtml>
- Register as a user
- Download all code for appropriate platform
- Download User Guide and Release Notes
- Unzip archive file
- Run install script
(for PCs this will modify ModisTool.bat and the autoexec.bat with appropriate directory paths)





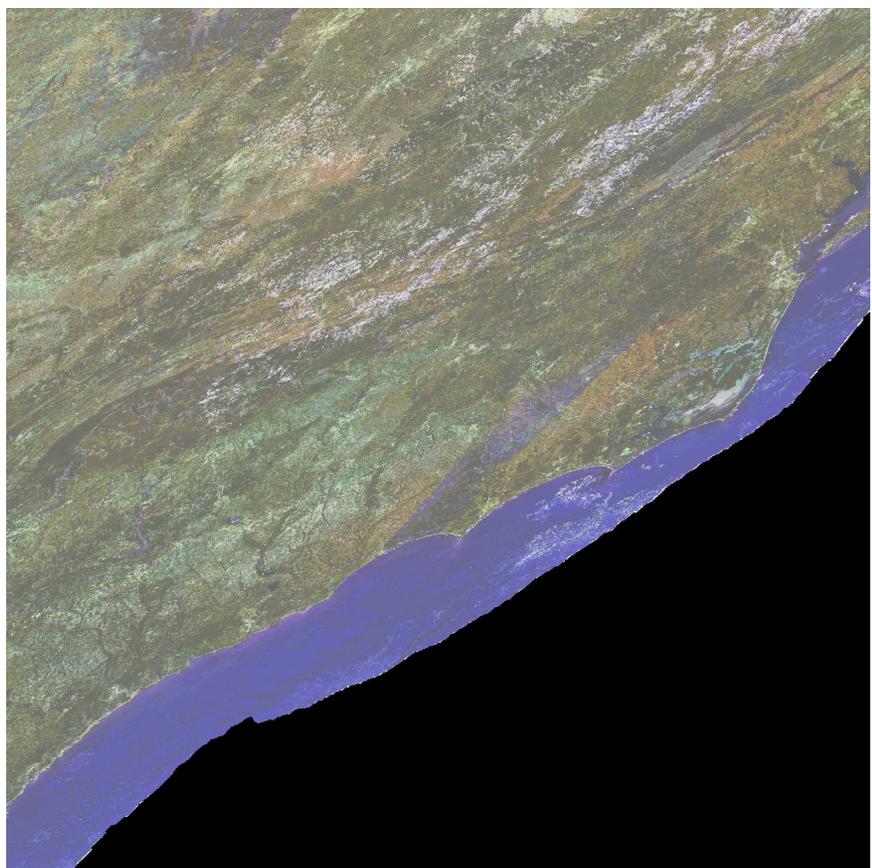
MRT Execution

- GUI mode
 - MS_DOS or Unix prompt >ModisTool
 - the resample.log file (in /bin directory) tracks all messages and errors from MRT
- Command-line mode
 - Designed for script/batch file processing
 - MS_DOS or Unix prompt >resample
 - ✓ parameter filename required
 - ✓ user specified parameters such as I/O options, resampling method, projection, subsetting, pixel size, logfile name

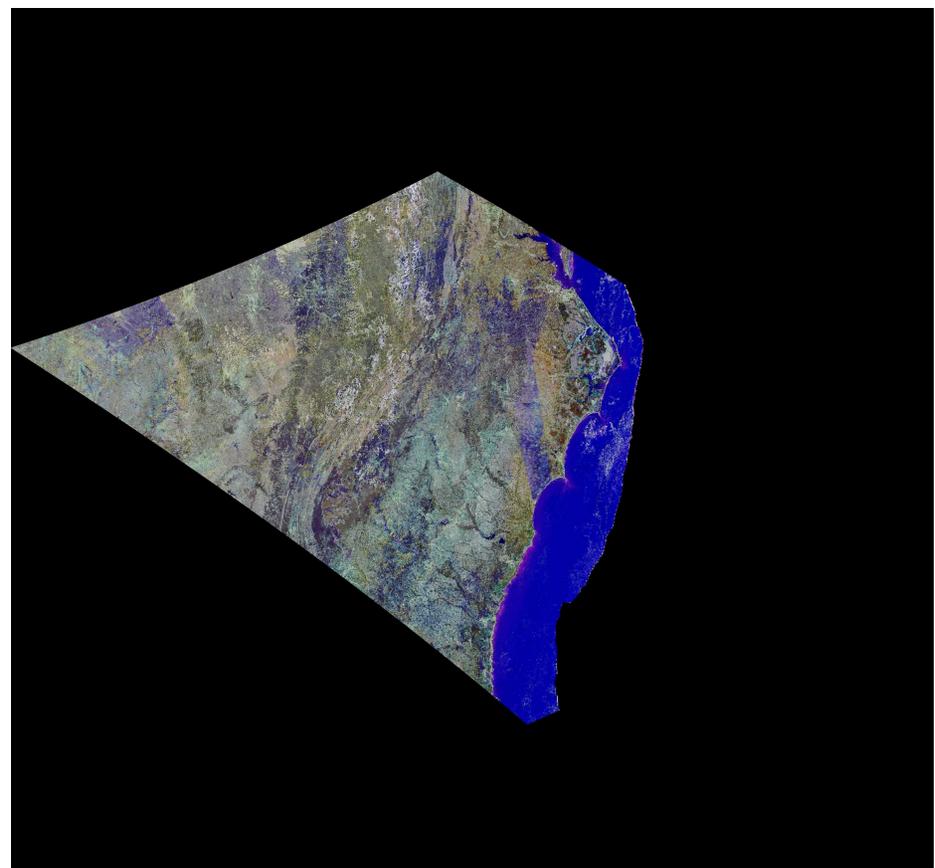




Integerized Sinusoidal



Lambert Azimuthal



Source

Input Files

D:\Dwyer\data\MODIS\Problems\MOD09A1.
D:\Dwyer\data\MODIS\Problems\MOD09A1.
D:\Dwyer\data\MODIS\Problems\MOD09A1.
D:\Dwyer\data\MODIS\Problems\MOD09A1.

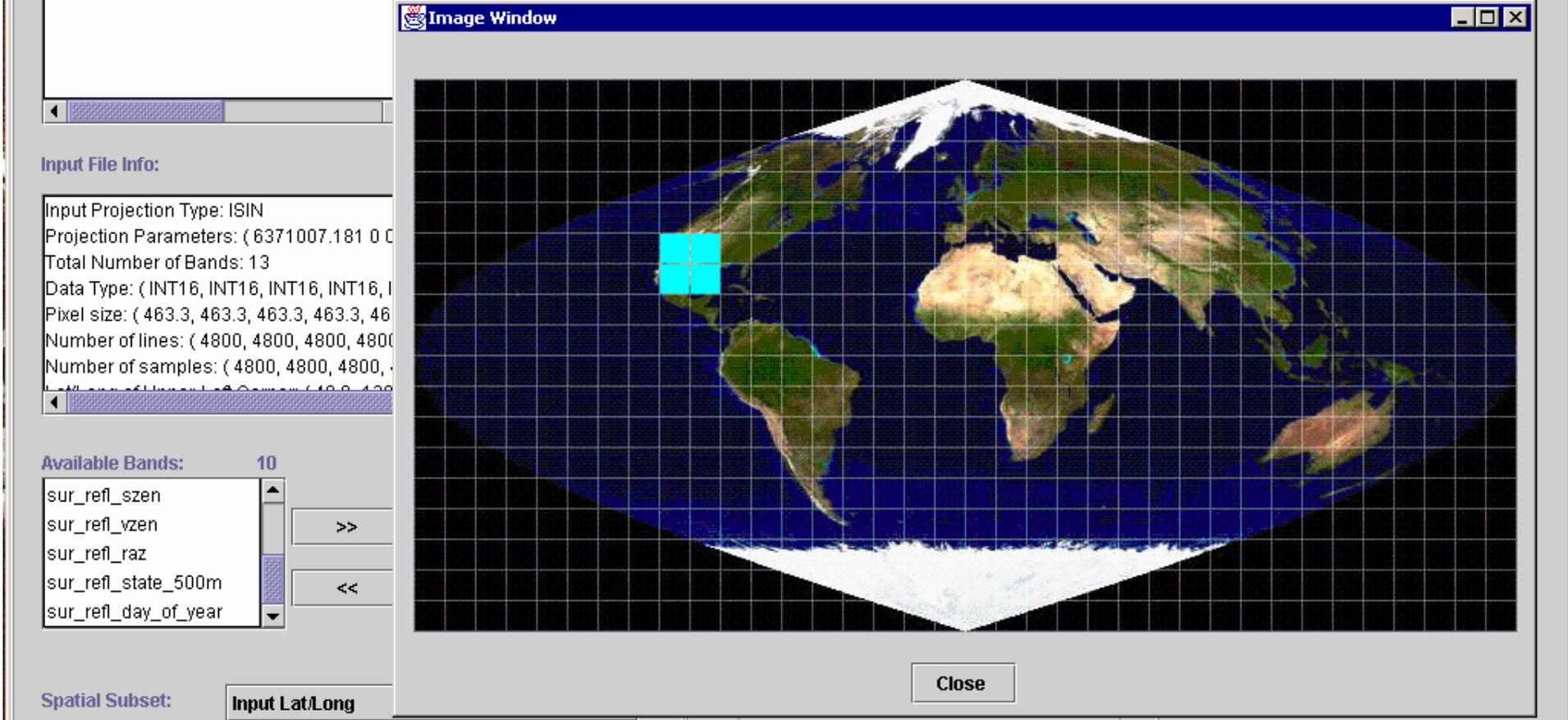
Open Input File ...

Destination

Specify Output File ...

Output File

D:\Dwyer\data\MODIS\Problems\Western_US.tif



Input File Info:

Input Projection Type: ISIN
Projection Parameters: (6371007.181 0 0
Total Number of Bands: 13
Data Type: (INT16, INT16, INT16, INT16, I
Pixel size: (463.3, 463.3, 463.3, 463.3, 46
Number of lines: (4800, 4800, 4800, 4800
Number of samples: (4800, 4800, 4800, .
Left Edge of Image in X Coords (480.0, 480

Available Bands: 10

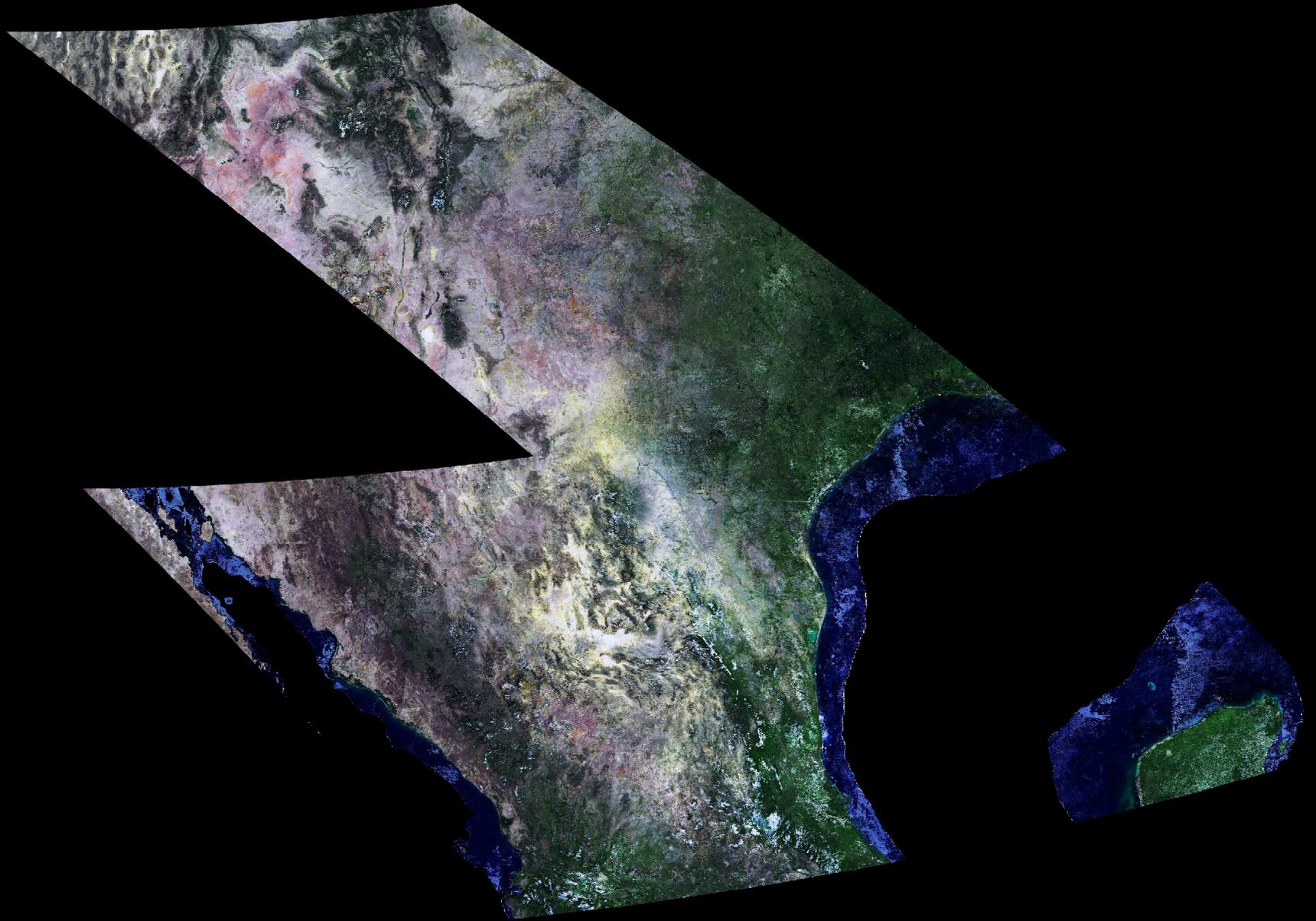
- sur_refl_szen
- sur_refl_vzen
- sur_refl_raz
- sur_refl_state_500m
- sur_refl_day_of_year

Spatial Subset: Input Lat/Long

	Latitude	Longitude
UL Corner:	40.0	-130.539229758
LR Corner:	20.0	-85.133637147

Run **Convert Format**

Exit





MODIS Reprojection Tool (MRT)

For more information on MRT:

<http://edc.usgs.gov/programs/sddm/modisdist/info/index.shtml>





Land Data Operational Product Evaluation (LDOPE) Tool

- The LDOPE software tools were developed to assist with the analysis and quality assessment of the MODIS Land (MODLAND) products.
- The tools have been developed with feedback from the MODLAND science team and incorporate the scientific knowledge, experience, and insights gained during the substantial MODLAND product development period.





LDOPE Tool

- Platforms supported
 - LINUX Redhat 7.3
 - IRIX 6.5
 - Solaris 2.8
 - Windows 2000/XP





LDOPE Tool

- Capabilities
 - Command_line interface
 - Provides 25 functions for data manipulation of MODIS data products
 - Includes reading attributes, computing SDS values, masking, mosaicking capabilities
 - Unpack_sds_bits function will unpack the QA information contained within the QA SDSs





LDOPE Tool

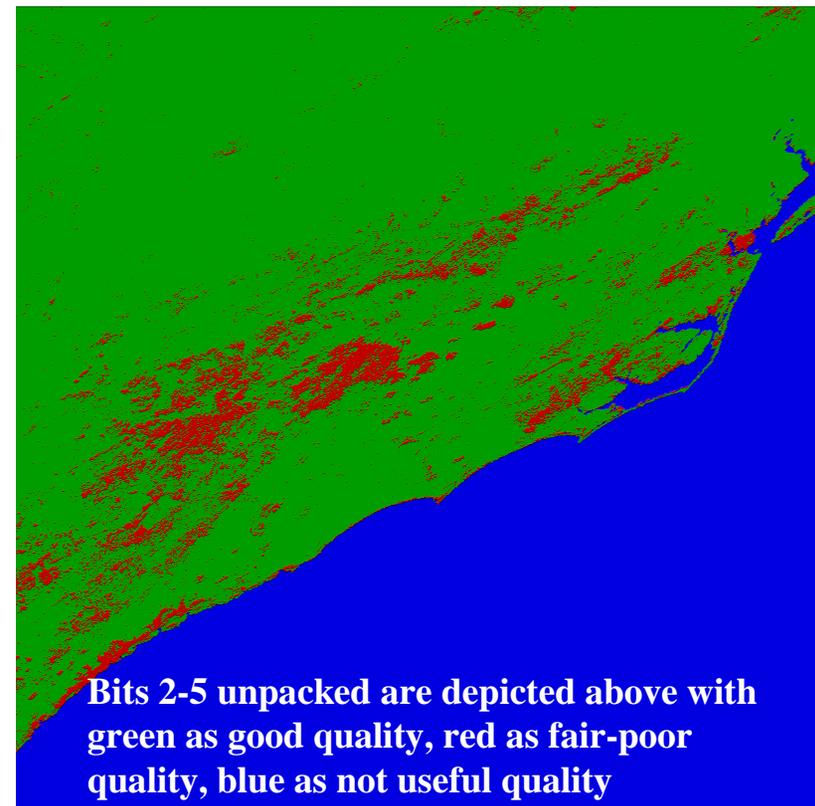
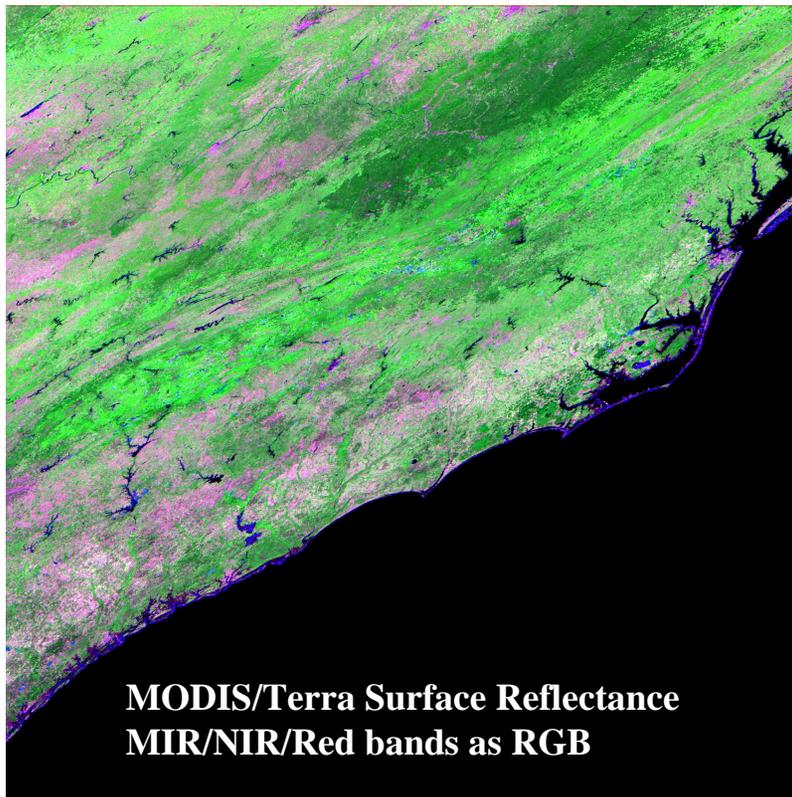
- Installation
 - Download location:
<http://lpdaac.usgs.gov/landdaac/tools/modis/index.asp>
 - Register as a user (automatically e-mails password)
 - Download all code for appropriate platform
 - Can download runtimes or source code to be compiled
 - Download User Guide and Release Notes
 - Unzip/untar archive file
 - Can execute runtimes on command-line or compile source code





LDOPE Tool

- Example of `unpack_sds_bits`





MODextract script

- LP DAAC provides an offline capability for downloading MODIS products via FTP from the LP DAAC DataPool.
- Script is downloaded and run locally on the end-user's machine.





MODextract script

- Platforms supported
 - GNU/LINUX 2.4.21 – 15.Elsmp
 - IRIX 6.5
 - Solaris 8
- *Windows is not currently supported.





MODextract script

- Capabilities
 - MODextract executes a user-supplied input parameter file
 - Only Gridded MODIS products with horizontal and vertical tile locations are supported (MOD13A1, MOD11A1, MOD17A2, etc)
 - Requires “expect” downloaded from:
<http://expect.nist.gov/>
 - Expect is a tool that automates interactive applications like FTP, rlogin, and telnet





MODextract script

- User Inputs
 - Data Set (e.g., MOD13A1)
 - Data Version (e.g., V004)
 - Tile Range
 - Date Range





Linking LPDAAC Software Tools

- Sample Script
 - Search for new data in Data Pool (**MODextract**)
 - ftp the data (**MODextract**)
 - Mosaic tiles together (**MRT**)
 - Reproject data covering study area (**MRT**)
 - Mask out data of questionable quality (**LDOPE**)
 - Output data to GeoTiff (**MRT**)



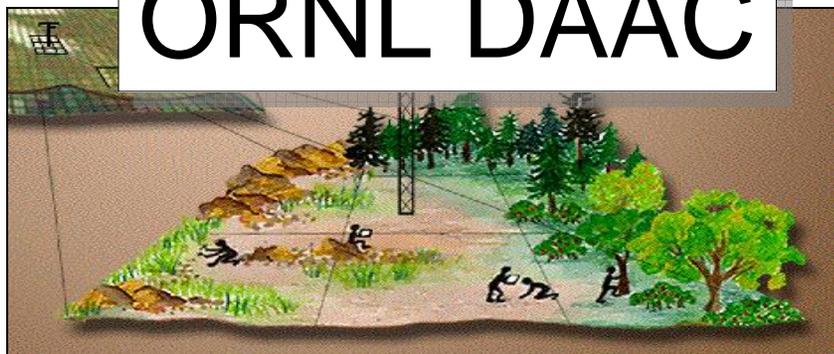


Extending the use of EOS Data: EOS Validation Core Site Support





ORNL DAAC

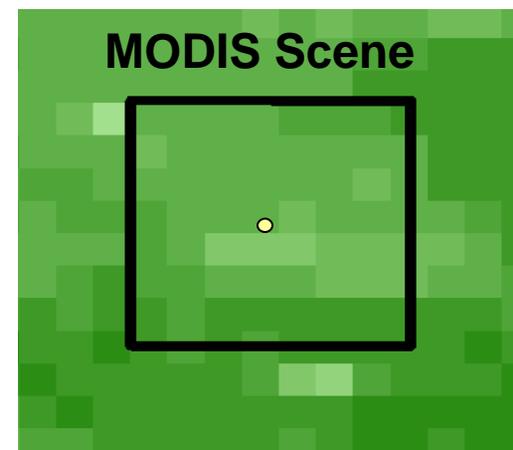


Field and tower data are combined with high resolution imagery to produce high resolution products.

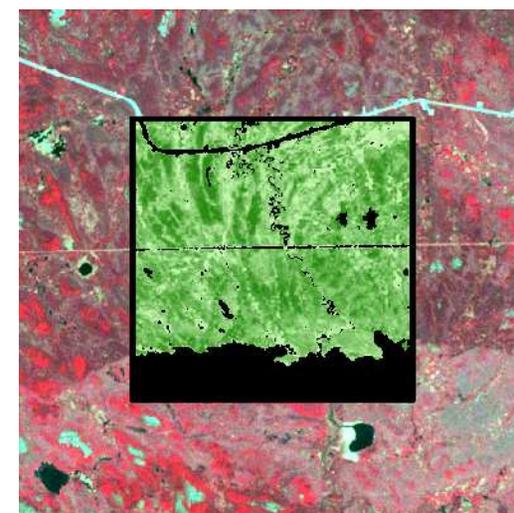


Aggregate Data Products

MODIS Scene



Correlate



Some graphics courtesy of BigFoot project

EOS Land Validation Core Sites

- 26 sites stratified by six biomes
- Based on existing stations, resources, experts
 - FLUXNET, AERONET, BigFoot, LTER, etc.
 - Long-term monitoring
 - Jointly nominated by Instrument and Validation PIs

• Remote Sensing Data

Landsat 5, ETM+, IKONOS, ASTER, MODIS, airborne sensors, subsetted over the core sites

• *in situ* Site Data

Collected by various groups at core sites, available via Mercury

• Networks

AERONET, FLUXNET, etc.

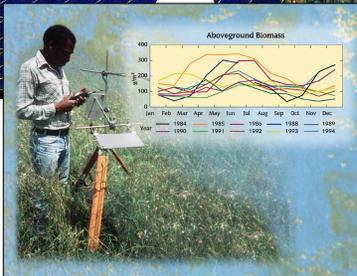
• Ancillary Site Data/GIS Layers

- site variables

- elevation

- land cover

- reference layers (e.g., political boundaries, airports, water bodies)



Science for a Changing World



EOS

EARTH OBSERVING SYSTEM



Remote Sensing Data for Core Sites



EOS Validation Core Site Data

	ARM CART	Barton Bendish	Bondville	BOREAS NSA	BOREAS SSA BERMS	H. J. Andrews LTER	Harvard Forest LTER	Howland	Ji-Parana	Jornada LTER	Konza Prairie LTER	Krasnoyarsk	Mandalgobi	Maricopa Ag. Center	Mongu (SAFARI 2000)	SALSA	Sevilleta LTER	Skukuza	Tapajos (SAFARI 2000)	Uardry	USDA BARC	VA Coast Reserve LBA	Walker Reserve LTER	Park Falls LTER	Barrow	Lake Tahoe
MODIS Subsets																										
SeaWiFS subsets																										
ETM+	1	5	13	5	1	4	15	1	1	5	9	3	1	11	1	8	11	2	1	12	4	1	2	4	5	
IKONOS	1	1	1	4	1	4	7	1	2	4	4	1	1	1	2	3	5	2	2	3	3	1	1	4	1	5
ASTER	1													7	4		4						3			12
Global LC Test Sites																										
GeoCover: 1990's era TM																										
MQUALs																										
AVIRIS																										
Ancillary report (CRESS)																										
Ancillary data (GLCF)																										
AERONET																										
EO-1 coverage																										

in situ Data for Core Sites

EOS Core Site in situ data activities

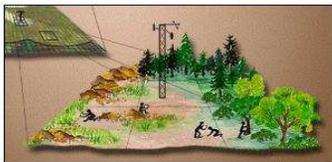
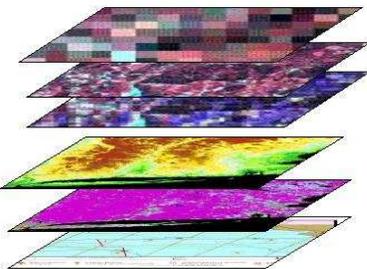
	ARM/CART	Barton Bendish	Bondville	BOREAS NSA	BOREAS SSA BERMS	Cascades	Harvard Forest LTER	Howland	Ji-Parana	Jornada LTER	Konza Prairie LTER	Krasnoyarsk	Mandalgobi	Maricopa Ag. Center	Mongu (SAFARI 2000)	SALSA	Sevilleta LTER	Skukuza	Tapajos (SAFARI 2000)	Uardry	USDA BARC	VA Coast Reserve LBA	Walker Reserve LTER	Park Falls LTER	Barrow	Lake Tahoe
EOS Val																										
AERONET										P																
FLUXNET	3		1	1	1	3	1	3	3	1				1		P	3	1	1		1	3	2			
LAI Net																										
BigFoot																										
Networks / Field Studies	A		B	B	G	H, E	L		E, H, P	E, F, H		H	S	E	G	S	L	C		E, G	E	E				
Real Time																										

EOS Val - sites with studies funded by the EOS Validation NRA

FLUXNET - number indicates multiple towers in 200x200 km EOS Core Site area

Field studies - A-ARM, B-BOREAS, C-CIGNS, F-FIFE, E-LTER, G-GTNET, H-Landcover helicopter, L-LBA, P-PROVE, S-SAVE/S2K

Real-Time Validation - inter-comparison of MODIS, eddy covariance data, field data, and model outputs



Graphic courtesy of the BigFoot program



- Questions/Discussion





- Extra Slides





NAMING CONVENTIONS: DATA SET NAMES

MOD09A1 MODIS/Terra Surface Reflectance 8-Day L3 Global 500m SIN Grid V004

MOD09A1	ShortName
MODIS/Terra	Instrument/Source
Surface Reflectance	Geophysical Parameter
8-Day	Temporal Extent
L3	Processing Level
Global	Global or Swath
500m	Spatial Resolution
SIN Grid	Gridded or Not
V004	Data Set Version





NAMING CONVENTIONS: FILE NAMES

MOD09A1.A2003245.h08v05.004.2004015234712.hdf

MOD09A1	ShortName
A2003245	Acquisition Julian Date A-YYYYDDD
h08v05	Tile Number horizontalvertical
004	Data Set Version
2004015234712	Production Julian Date Time YYYYDDDDHHMMSS
<u>hdf</u>	Data Format