



MODIS GLOBAL Subsetting and Visualization Tool Webinar:

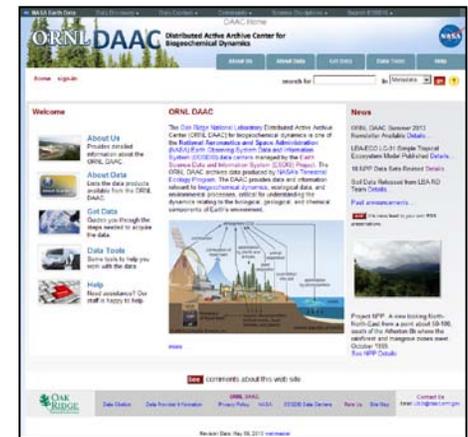
Bringing time-series satellite-based land data to the field scientist

Suresh K.S. Vannan and Tammy Walker Beaty

Oak Ridge National Laboratory Distributed Active Archive Center, ORNL DAAC

July 24 and 25, 2013

About ORNL DAAC



- The Oak Ridge National Laboratory Distributed Active Archive Center (**ORNL DAAC**) for **biogeochemical dynamics** is one of the National Aeronautics and Space Administration (**NASA**) Earth Observing System Data and Information System (**EOSDIS**) data centers managed by the Earth Science Data and Information System (**ESDIS**) Project, which is responsible for providing users with access to data from NASA's Earth Science Missions.
- The **mission** of the ORNL DAAC is to assemble, distribute, and provide data services for a comprehensive archive of terrestrial biogeochemistry and ecological dynamics observations and models to facilitate research, education, and decision-making in support of NASA's Earth Science.
- The ORNL DAAC archives data produced by NASA's Terrestrial Ecology Program in support of NASA's Carbon Cycle and Ecosystems Focus Area.
- <http://daac.ornl.gov>

About ORNL DAAC Data Products and Services

- The biogeochemical and ecological data products and services provided by the ORNL DAAC are organized by project and categorized into four primary groups:

Field Campaigns – ground-, aircraft-, and satellite-based measurements of biogeochemical features in specific ecosystems over multi-year time periods (e.g., BOREAS, FIFE, LBA, NACP, S2K)

Land Validation – comprehensive collection of assessments of ground-based observations coincident with satellite data useful for developing, calibrating, and validating ecosystem models (e.g., FLUXNET)

Regional and Global Data – collections for understanding the structure and function of various ecosystems across multiple spatial and temporal scales (e.g., Climate, Hydroclimatology, Soils, Vegetation, etc.)

Model Archive – code for benchmark model versions and associated published research results of specific model implementations (e.g., Biome-BGC, CENTURY, EDM, LEDAPS, MAPSS, PnET)

- 4 Categories (30 Projects) = ~1100 Data Products and Services



More about ORNL DAAC Services (Tools)

- The ORNL DAAC provides various tools and services to help researchers readily find and access data sets of interest with features such as: Search, Visualization, Subsetting, and Analysis

<http://daac.ornl.gov/tools.shtml>

- The focus of this Webinar is the **MODIS Global Subsetting and Visualization Tool**

Allows users to order MODIS **Land Product subsets** for any site, area, and time period globally.

Point and Gridded Data; Visualization; Subsetting; and Services

Helps users deal with large data volume, accessibility issues, data format, and processing time

- <http://daac.ornl.gov/modisglobal>

About the MODIS Global Subsetting and Visualization Tool

- **MOD**erate Resolution **I**maging **S**pectroradiometer

hyper-spectral sensor onboard two satellites (Terra and Aqua)

Views the entire Earth's surface every **1 to 2 days**, acquiring data in **36 spectral bands** (groups of wavelengths)

- **MODIS Global Subsetting and Visualization Tool (GUI)**

Site Selection from a pick list or entering a site's geographic coordinates

Area defining the site can be: from 1 pixel up to 201 X 201 km

Data for any available time period

- **MODIS Web Service**

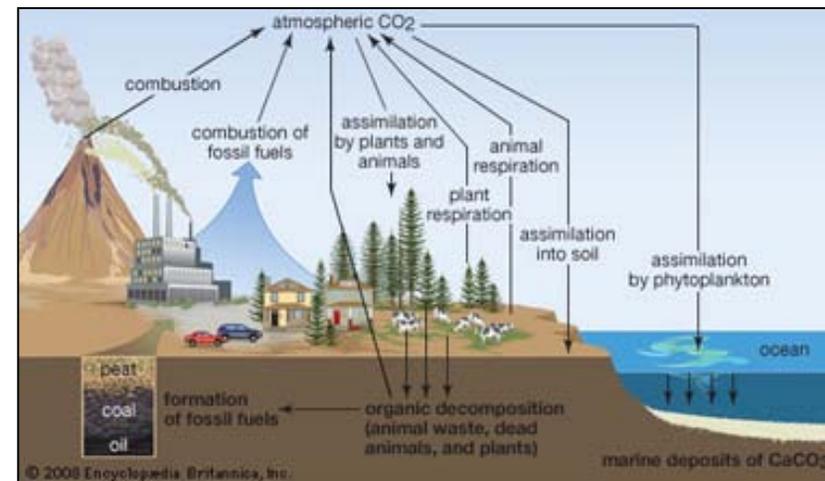
Programmatically obtain MODIS subsets from any land location, time period and area using Simple Object Access Protocol (SOAP) Web Service

MODIS Global Subsetting and Visualization Tool (Interactive and Web Service) Output

- Time series plots of the selected product measurement

Available selected products: <http://daac.ornl.gov/MODIS/MODIS-menu/products.html>

- ASCII file of the pixel values for the selected product along with quality information
- Average & standard deviations for the area selected
- A file that can be imported directly into GIS software
- A land cover grid (IGBP classification) of the area
- An estimate of heterogeneity (Shannon richness and evenness)
- MODIS Phenology time series
- Documentation (including QC Filter Conditions)



MODIS Global Subsetting and Visualization Tool = 6 Simple Steps

- Step 1: Select Location (enter coordinates, move the balloon around, or from a pick list), continue
- Step 2: Select Data Layer and Subset Size, continue
- Step 3: Select Temporal range, provide email address, continue
- Step 4: Order Description and Subset Creation, (Create Subset)
- Step 5: Order Summary and Verification
- Step 6: Order Notification and Data Retrieval – email with Unique URL for each order
- What you get: Visualization has interactive scroll bars, and optional display features; facilitates data download; and provides interface for ordering different land product for same location.

MODIS Global Subsetting and Visualization Web Service

- Simple Object Access Protocol (SOAP) Web Service

Examples: “getproducts()” – returns a list of available products; getbands(“MOD13Q1”) – returns list of available bands

- Allows users to:

Retrieve subsets through command line operations

Get subsets directly into software such as Kepler and Matlab; and integrate the subsets into client side workflows

Write custom code to use the subsets for visualization or data reformatting

- Several Client and Application examples: http://daac.ornl.gov/MODIS/MODIS-menu/modis_webservice.html

(e.g. JAVA, Perl and Python Clients; Kepler, R, and Matlab sample code)

ORNL DAAC Points of Contact

- ORNL DAAC User Services Office (uso@daac.ornl.gov)
- Suresh K.S. Vannan, ORNL DAAC Manager (santhanavans@ornl.gov)
- Tammy Walker Beaty, ORNL DAAC Deputy Manager (beatytw@ornl.gov)
- Bob Cook, ORNL DAAC Chief Scientist (cookrb@ornl.gov)

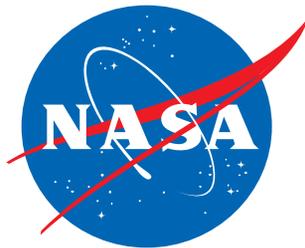
DEMOS

- **MODIS Global Subsetting and Visualization Tool**

<http://daac.ornl.gov/modisglobal>

- **MODIS Web Service**

<http://daac.ornl.gov/modiswebservice>



Additional Slides follow:

List of Available Products

Steps 1 through 6 of Placing an ORDER with Screen Captures

Output screen captures with explanations

Available MODIS Products

(<http://daac.ornl.gov/MODIS/MODIS-menu/products.html>)

- Surface Reflectance
- Surface Temperature
- Land Cover
- Vegetation Phenology (life cycle)
- NDVI/EVI (Normalized Difference Vegetation Index and Enhanced Vegetation Index)
- LAI / fPar (Leaf Area Index and Fraction of photo-synthetically active radiation absorbed by vegetation)
- Net Photosynthesis
- Annual NPP (Net Primary Production)
- Calculated Albedo (ratio of diffusely reflected to incident electromagnetic radiation)
- Reflectance – BRDF (bidirectional reflectance distribution function) adjusted

MODIS Global Tool, Step 1 - Select Location

- http://daac.ornl.gov/cgi-bin/MODIS/GLBVIZ_1_Glb/modis_subset_order_global_col5.pl



MODIS Land Subsets
Oak Ridge National Laboratory DAAC

MODIS Global Subsets: Data Subsetting and Visualization

Select Center of Area of Interest
Lat/Lon *OR* Field Site
then Continue



Enter Signed Decimal Latitude and Longitude of Center Pixel in WGS84 datum
[for example, Walker Branch TN is 35.958767 -84.287433]

Latitude	Longitude
<input type="text"/>	<input type="text"/>

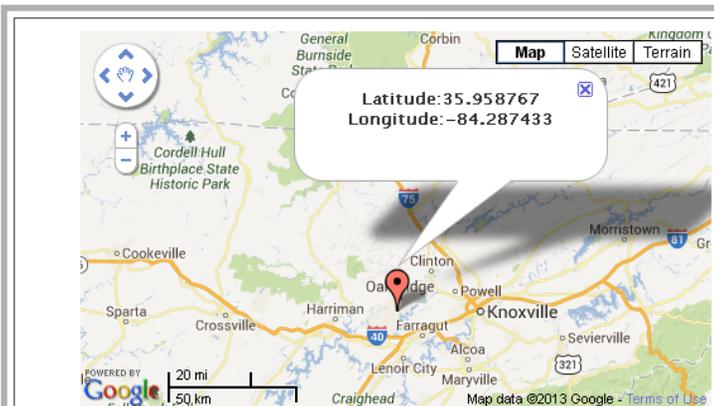
OR

Select the Country to Contain a MODIS Site as the Center of Area of Interest
[Sites within the Selected Country will be Presented in Subsequent Step]

- Algeria
- Angola
- Antarctica
- Argentina
- Australia
- Austria
- Belgium
- Benin
- Bolivia
- Botswana

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Enter Signed Decimal Latitude and Longitude of Center Pixel in WGS84 datum
[for example, Walker Branch TN is 35.958767 -84.287433]

Latitude	Longitude
<input type="text" value="35.958767"/>	<input type="text" value="-84.287433"/>

MODIS Global Tool, Step 2 - select data layer and subset size (LST and 50 X 50)

MODIS Land Subsets
Oak Ridge National Laboratory DAAC

MODIS Global Subsets: Data Subsetting and Visualization

Latitude [35.958767] Longitude [-84.287433]
1km Horizontal Tile [11] Vertical Tile [5] Sample [212] Line [484]
Select a Product and Subset Size, then Click on "Continue"

- [MCD43A] MODIS/Terra+Aqua BRDF and Calculated Albedo
- [MCD43A4] MODIS/Terra+Aqua Nadir BRDF-Adjusted Reflectance 16-Day L3 Global 500m SIN Grid
- [MOD09A1] Surface Reflectance
- [MOD11A2] Land Surface Temperature and Emissivity**
- [MOD13Q1] Vegetation Indices (NDVI, EVI)
- [MOD15A2] Leaf Area Index (LAI) and Fraction of Photosynthetically Active Radiation (FPAR) 8 Day Composite
- [MOD15A2GFS] Terra Gap-Filled, Smoothed Leaf Area Index (LAI) 8 Day Composite [Collection 4]
- [MOD16A2] Evapotranspiration
- [MOD17A2_51] Gross primary production (GPP) [Collection 5.1]

Specify the Number of Kilometers Encompassing the Center Location

Above and Below	Left and Right
(0-100)	(0-100)
<input type="text" value="50"/>	<input type="text" value="50"/>

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MODIS Global Tool, Step 3 - select temporal range, GeoTIFF Options, provide email address, and submit

MODIS Land Subsets
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MODIS Global Subsets: Data Subsetting and Visualization
MODIS/Terra Land Surface Temperature/Emissivity (LST)
8-Day L3 Global 1 km SIN Grid
Latitude [35.958767] Longitude [-84.287433]
1km Horizontal Tile [11] Vertical Tile [5] Sample [212] Line [484]
The Requested Data Area is Approximately 101 Kilometers Wide and 101 Kilometers High

Select Starting Date

- Day 065 of the Year 2000 [Mar. 05,2000]
- Day 073 of the Year 2000 [Mar. 13,2000]
- Day 081 of the Year 2000 [Mar. 21,2000]
- Day 089 of the Year 2000 [Mar. 29,2000]**
- Day 097 of the Year 2000 [Apr. 06,2000]
- Day 105 of the Year 2000 [Apr. 14,2000]
- Day 113 of the Year 2000 [Apr. 22,2000]
- Day 121 of the Year 2000 [Apr. 30,2000]
- Day 129 of the Year 2000 [May. 08,2000]
- Day 137 of the Year 2000 [May. 16,2000]

Select Ending Date

- Day 113 of the Year 2013 [Apr. 23,2013]
- Day 121 of the Year 2013 [May. 01,2013]
- Day 129 of the Year 2013 [May. 09,2013]
- Day 137 of the Year 2013 [May. 17,2013]
- Day 145 of the Year 2013 [May. 25,2013]
- Day 153 of the Year 2013 [Jun. 02,2013]**
- Day 161 of the Year 2013 [Jun. 10,2013]
- Day 169 of the Year 2013 [Jun. 18,2013]
- Day 177 of the Year 2013 [Jun. 26,2013]
- Day 185 of the Year 2013 [Jul. 04,2013]

[Pre-selected Dates Reflect ALL Available Dates for the Selected Product/Location]

-Data available

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000												
2001												
2002												
2003												
2004												
2005												
2006												
2007												
2008												
2009												
2010												
2011												
2012												
2013												

GeoTIFF Options

- Generate GeoTIFF in MODIS Sinusoidal Projection
- Generate GeoTIFF and Reproject to Geographic Lat/long

Enter Your Email Address
[You will be notified via email when the data has been prepared]

beatytw@ornl.gov

Continue

Restart this Visualization

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MODIS Global Tool, Step 4 – Order Verification and Subset Creation



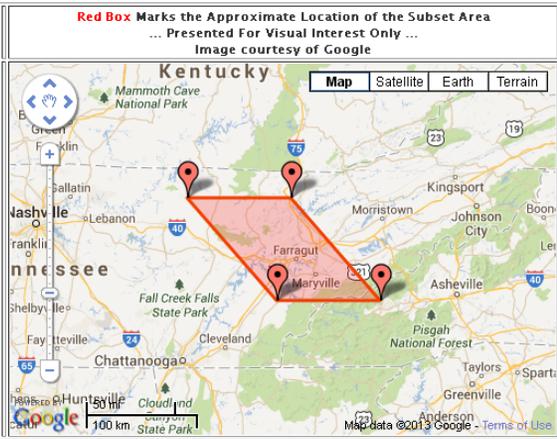
MODIS Land Subsets
Oak Ridge National Laboratory DAAC

MODIS Global Subsets: Data Subsetting and Visualization

Order Verification

MODIS/Terra Land Surface Temperature/Emissivity (LST)
8-Day L3 Global 1km SIN Grid
Latitude [35.958767] Longitude [-84.287433]
1km Horizontal Tile [11] Vertical Tile [5] Sample [212] Line [484]
The Requested Data Area is Approximately 101 Kilometers Wide and 101 Kilometers High
The Time Period Considered Will Include March. 29, 2000 to June. 02, 2013

Red Box Marks the Approximate Location of the Subset Area
... Presented For Visual Interest Only ...
Image courtesy of Google



The Email Address `beatytw@ornl.gov` will Receive Data Retrieval Instructions
If the Selected Parameters Above are Correct, Select "Create Subset" to Begin Processing,
or use the Browser's "Back" Button to Access Previous Choices,
or Select "Restart this Visualization" to Restart the Selection Process

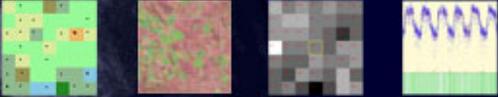
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MODIS Global Tool, Step 5 – Order Summary



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MODIS Global Subsets: Data Subsetting and Visualization Order Summary

MODIS/Terra Land Surface Temperature/Emissivity (LST)
8-Day L3 Global 1 km SIN Grid
Latitude [35.958767] Longitude [-84.287433]
1 km Horizontal Tile [11] Vertical Tile [05] Sample [212] Line [484]
The Requested Data Area is Approximately 101 Kilometers Wide and 101 Kilometers High
The Time Period Considered Will Include March. 29, 2000 to June. 02, 2013
The Email Address "beatytw@ornl.gov" will Receive Data Retrieval Instructions
Order Submitted
Request Identifier: 18Jul2013_11:13:13_640444369L35.958767L-84.287433S101L101_MOD11A2
Status:
There are zero orders in queue. Your order will be executed immediately.

[Restart this Visualization](#)

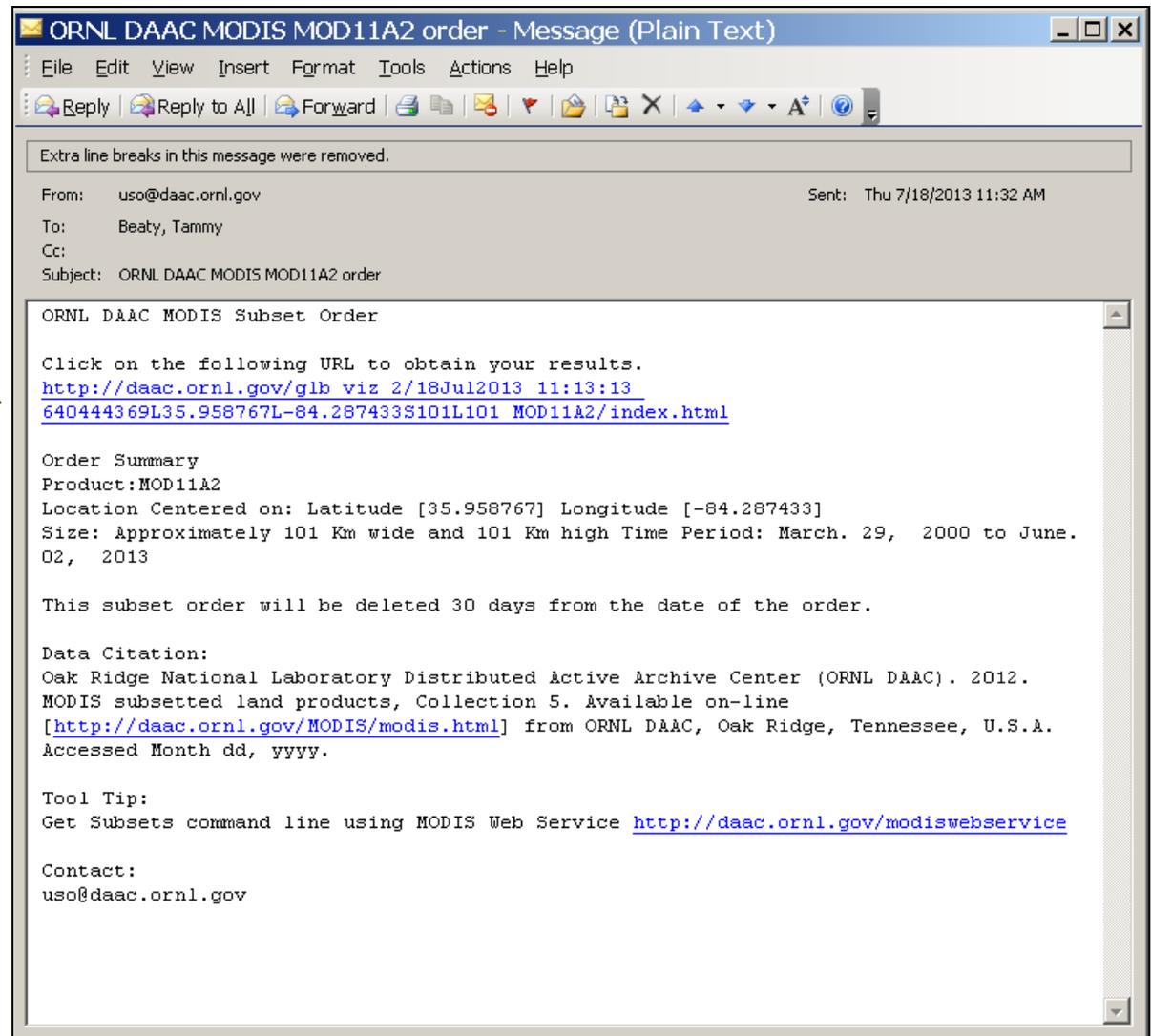
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Revision Date:Wed Mar 7 15:06:46 2012

MODIS Global Tool, Step 6 – order notification and data retrieval

- Link to visualization and data 

- Citation 



MODIS Global Tool, Data Files can be downloaded

- Each order page has links to the data files (on http server)
- Help files explain contents and format

Subset Data Download Details	
MODIS Land Product ASCII Data	Help
GIS data in ASCII Grid format	Help
QC-Filtered Data and Statistics Generated	Help
Land Cover Data in ASCII Grid Format	Help
Statistical Data of the subset	Help
GIS data in GeoTIFF format	Help

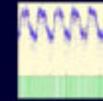
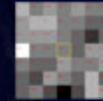
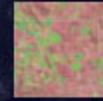
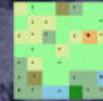
Understanding the Output

- Screen shots follow with annotations



MODIS Land Subsets

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Data Visualization and Download

Process status

18.83 Minutes elapsed

Process Completed

MODIS/Terra Land Surface Temperature/Emissivity (LST)

8-Day L3 Global 1km SIN Grid

Latitude [35.958767] Longitude [-84.287433]

1km Horizontal Tile [11] Vertical Tile [05] Sample [212] Line [484]

Order Details	
Product:	MOD11A2
Coordinates:	Latitude: 35.958767, Longitude: -84.287433 (WGS84 datum)
Areal Extent:	Approximately 101 km Wide x 101 km High
Subset Date Range:	March. 29, 2000 (2000089) to June. 02, 2013 (2013153)
Map Links:	Google Map Google Earth MODIS Tile Mapper
Quality Control Conditions:	As Specified by Science Team (See QC table below)

Embedded Links contain visualization options

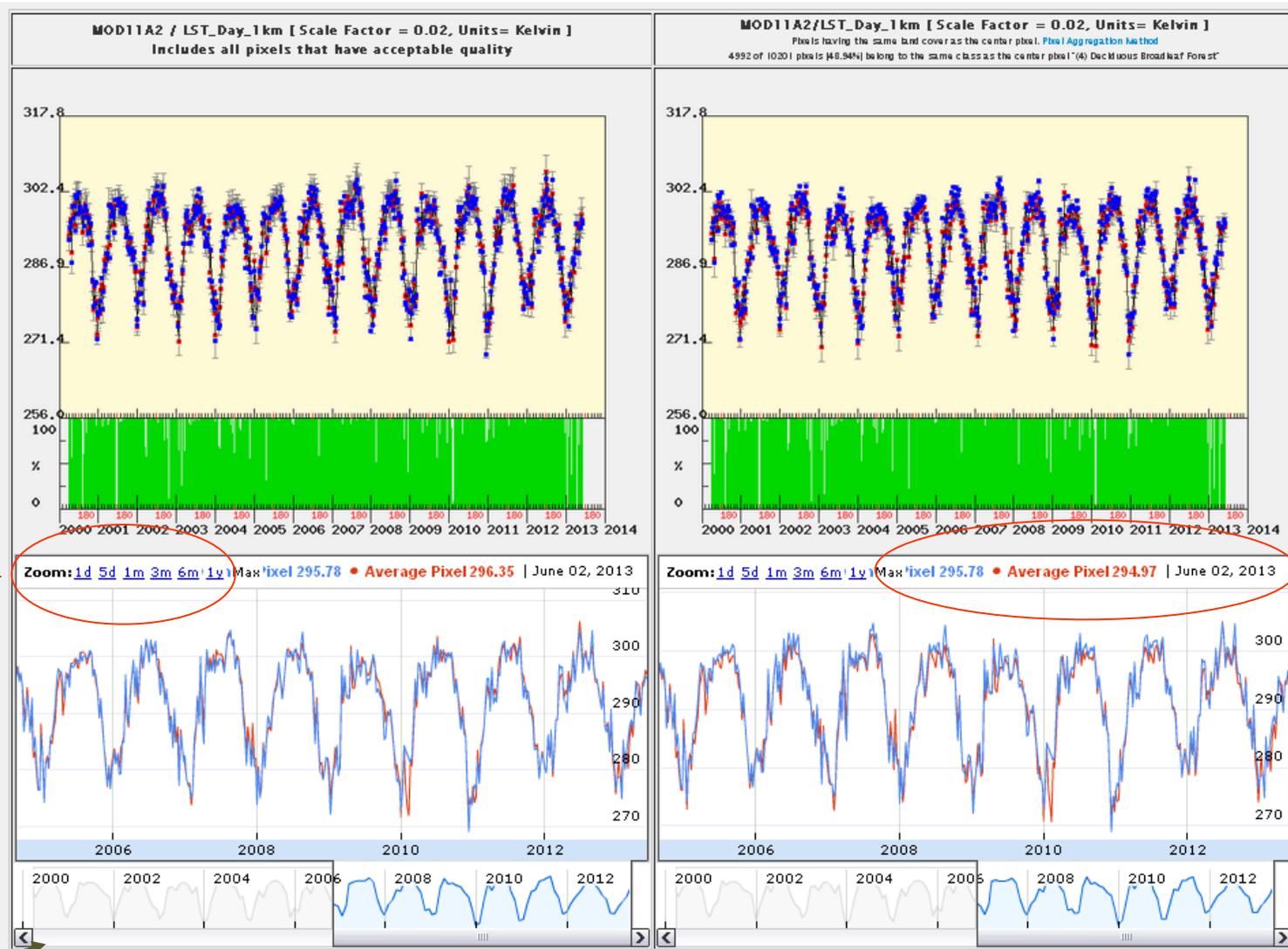
Visualize Individual Composite Dates

Note: This page contains many grids. Please scroll to the right/left and up/down to view all of the grids

Embedded options within subset order

Plot Years : Start Date: 2000 End Year: 2013

NEW Stack Time series



Zoom Options

Cursor display within Visualization

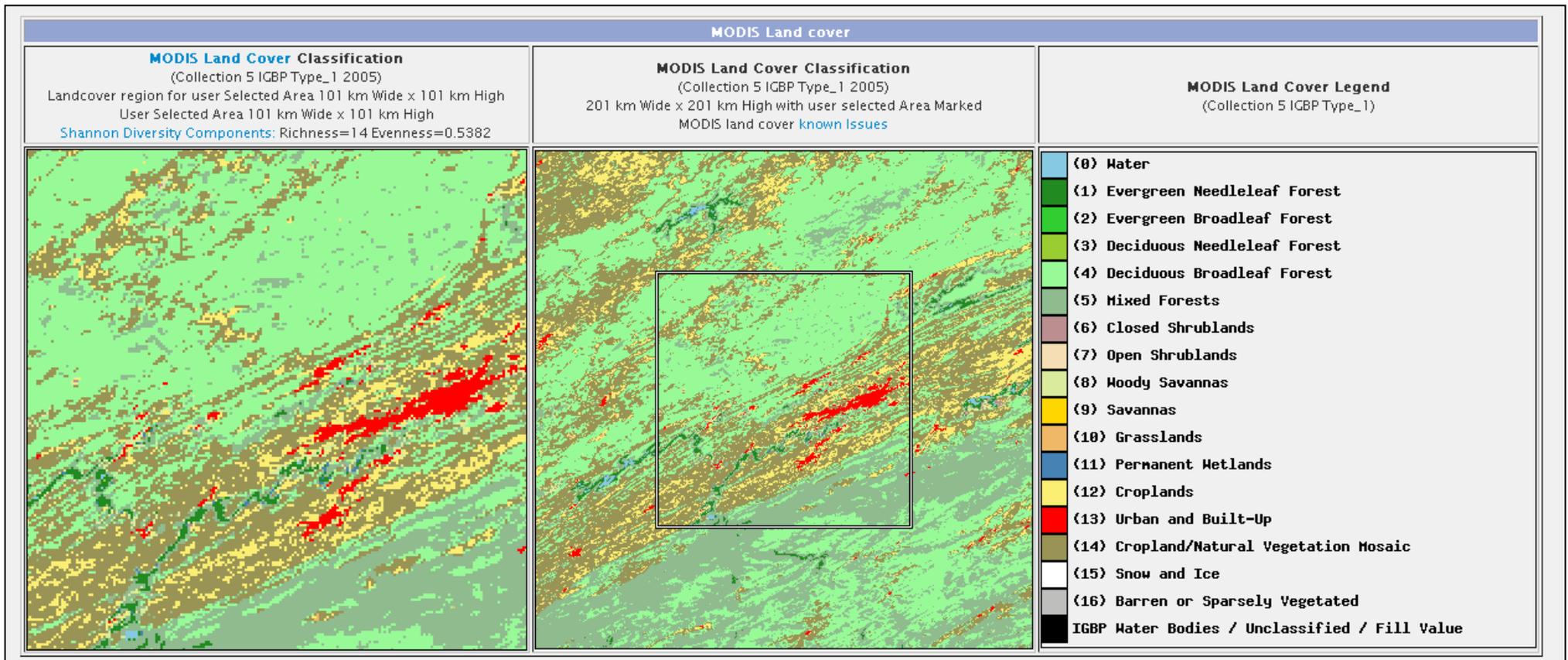
Scroll Bar

Color Legend	
Red	Average of all Pixels in Grid having Acceptable Quality
Blue	Site/Tower Pixel having Acceptable Quality
Green	Percent of Pixels having Acceptable Quality
Rainbow	Average of all Pixels in Grid having Acceptable Quality(Stacked)

- Subset Download Details – links to data files produced by subset order
- Help Links provided

Subset Data Download Details	
MODIS Land Product ASCII Data	Help
QC-Filtered Data and Statistics Generated	Help
Statistical Data of the subset	Help
GIS data in GeoTIFF format	Help
Landcover data in GeoTIFF format	Help

- MODIS IGBP Land Cover Classification Map with legend



- Quality Filter Conditions and QC explanations Summary
- Option to restart the Visualization or Create another subset for the same location

QC Filter Conditions									
QC explanation for MODIS/Terra Land Surface Temperature/Emissivity LST_QC									
QC bit word numbering (0,1,2,3,4,5,6,...n):(n=7 or 15 or 31)									
Filter Class	Bits	Binary	QA-bits (Left to Right)	Value(Binary)	Value(Integer)	Bands applied	QC band	Description	Display
Mandatory_QA	8	yes	6-7	00	0	LST_Day_1km	QC_Day	LST produced, good quality, not necessary to examine more detailed QA	Presented
Mandatory_QA	8	yes	6-7	01	1	LST_Day_1km	QC_Day	LST produced, other quality, recommend examination of more detailed QA	Presented
Mandatory_QA	8	yes	6-7	10	2	LST_Day_1km	QC_Day	LST not produced due to cloud effects	Supressed
Mandatory_QA	8	yes	6-7	11	3	LST_Day_1km	QC_Day	LST not produced primarily due to reasons other than cloud	Supressed
Mandatory_QA	8	yes	6-7	00	0	LST_Night_1km	QC_Night	LST produced, good quality, not necessary to examine more detailed QA	Presented
Mandatory_QA	8	yes	6-7	01	1	LST_Night_1km	QC_Night	LST produced, other quality, recommend examination of more detailed QA	Presented
Mandatory_QA	8	yes	6-7	10	2	LST_Night_1km	QC_Night	LST not produced due to cloud effects	Supressed
Mandatory_QA	8	yes	6-7	11	3	LST_Night_1km	QC_Night	LST not produced primarily due to reasons other than cloud	Supressed