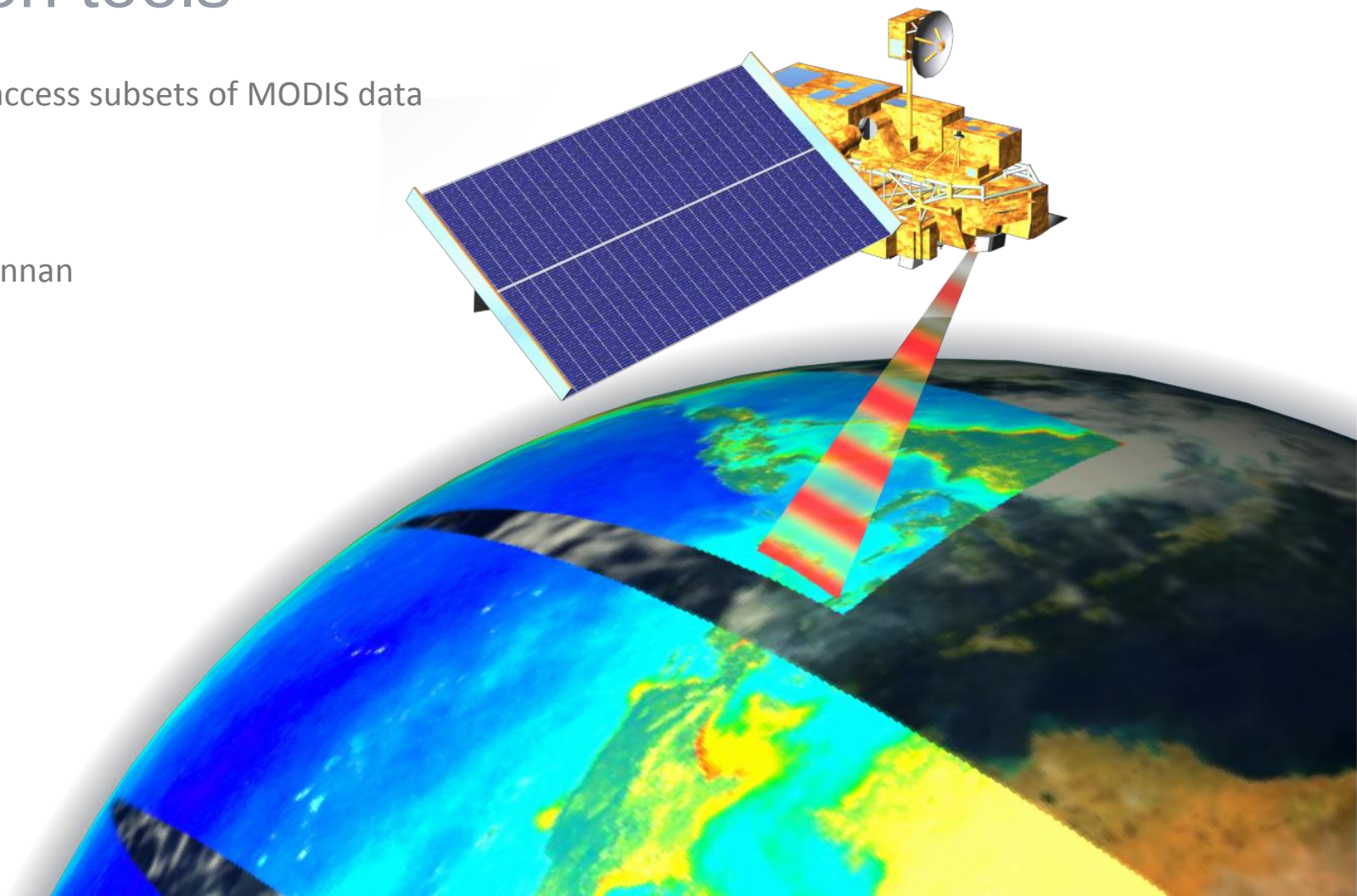
ORNL DAAC MODIS Subsetting and Visualization tools

Tools and services to access subsets of MODIS data

Suresh K. Santhana Vannan



What is MODIS ?

http://svs.gsfc.nasa.gov

What is MODIS ?

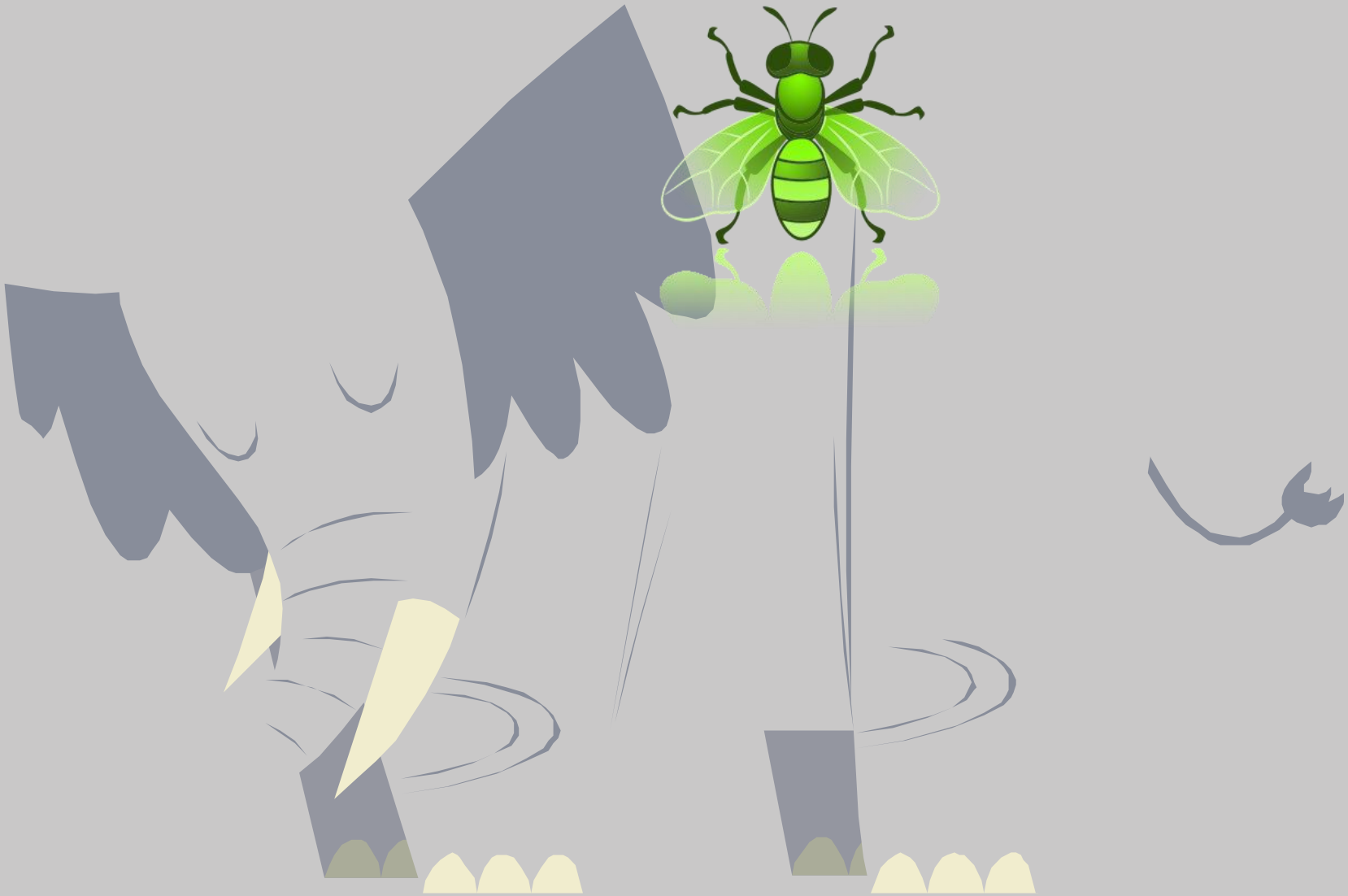
- MODerate Resolution Imaging Spectroradiometer
- Hyper-Spectral sensor onboard two satellites (Terra and Aqua)
- Terra MODIS and Aqua MODIS are viewing the entire Earth's surface every **1 to 2 days**, acquiring data in **36 spectral bands**, or groups of wavelengths
- http://modis.gsfc.nasa.gov/

MODIS is great!

but ……..

Users (Field researchers) have some inconveniences :

Volume



- Accessibility

- Data Format

- Processing Time

User community requested that we prepare MODIS Land Products in an easy-to-use format and size

- To validate remote sensing products
- To characterize field sites

MODIS Subsets for selected field sites

Data Formats Offered

ASCII – 7x7 km subsets

GeoTIFF – 25x25 km subsets

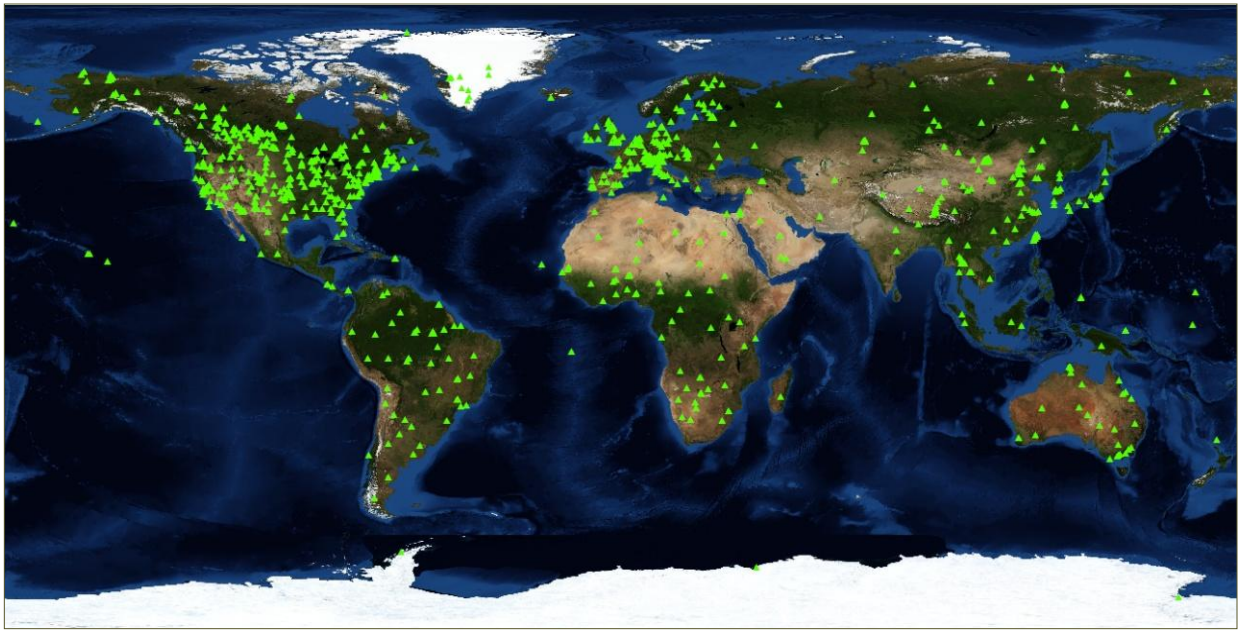
Products are:

8-day, 16-day or annual composite periods

1 km, 500 m or 250 m resolution

Documentation about subsets and links to detailed documentation of the MODIS products are provided

MODIS Products offered at ORNL-DAAC
Surface Reflectance
Surface Temperature
Land Cover
Vegetation Phenology
NDVI / EVI
LAI / fPAR
Net Photosynthesis
Annual NPP
Albedo (calc)
Reflectance – BRDF Adjusted

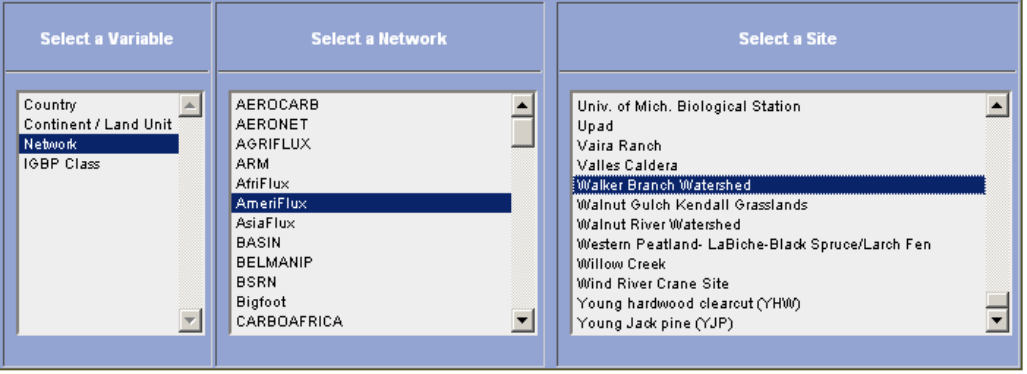


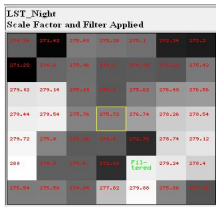
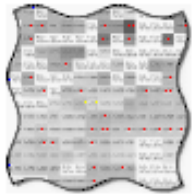
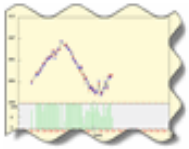
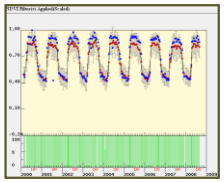
1147 field sites for MODIS Collection 5

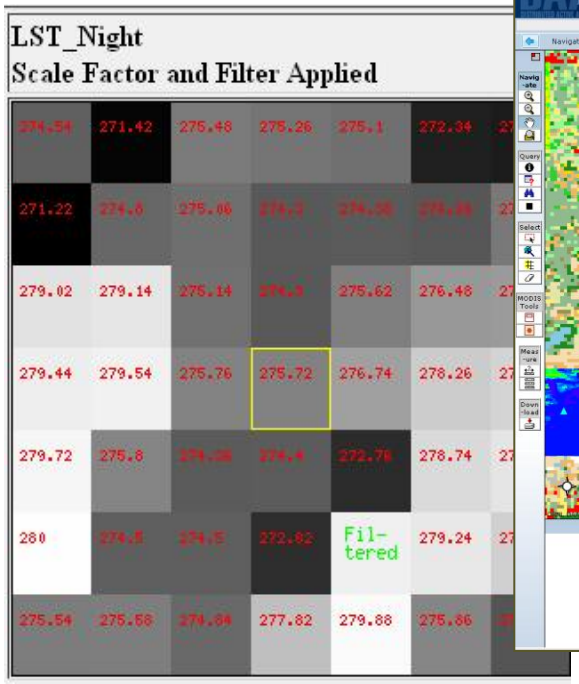
Demo

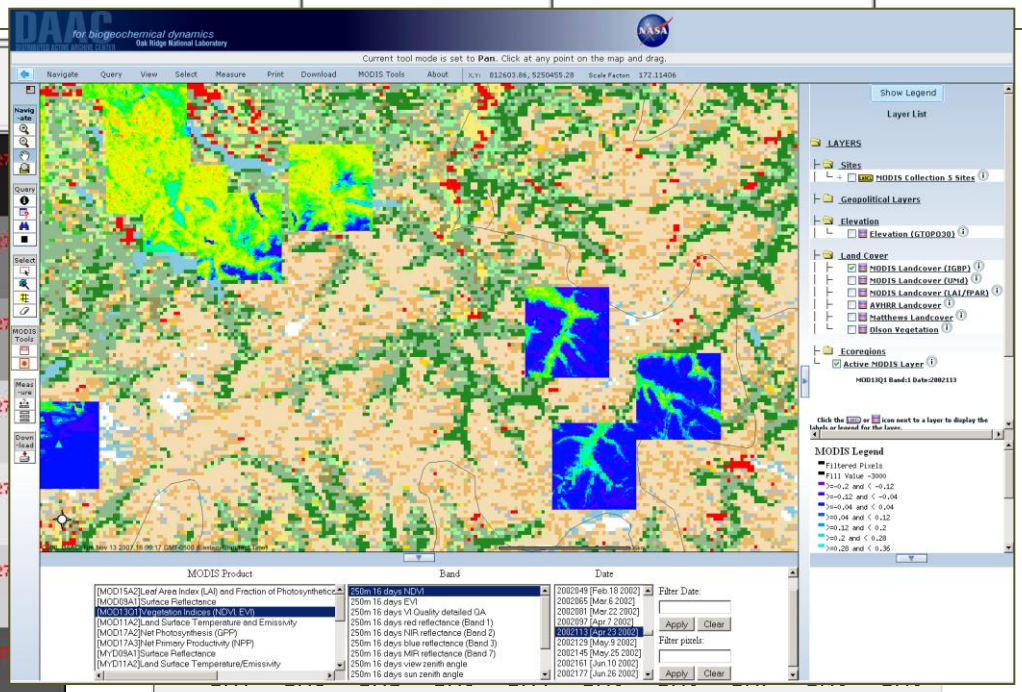
MODIS Fixed Site Subsets

http://daac.ornl.gov/modisfixedsite



MODIS Product for Walker Branch Watershed FLUXNET Site Link	Visualization					Data Download	
	Grid Visualization for individual composite period **Basic Version (Default QC setting)**	Grid Visualization for individual composite period **Advanced Version (User defined QC setting)**	Time Series **Basic Version (Default QC setting)**	Time Series **Advanced Version (User defined QC setting)**	**GeoTIFF WebGIS Visualization**	**ASCII** Help	**GeoTIFF** Help
						ASCII Download	GeoTIFF Download





MODIS Subsets for any location on globe

What we offer:

- MODIS land product subsets of any size (Maximum: 201x201 sq.km)
- MODIS land product subsets for any time scale within the period of record for a product
- Subsets are in ASCII and GeoTIFF format
- MODIS Collection 5 data

How it works:

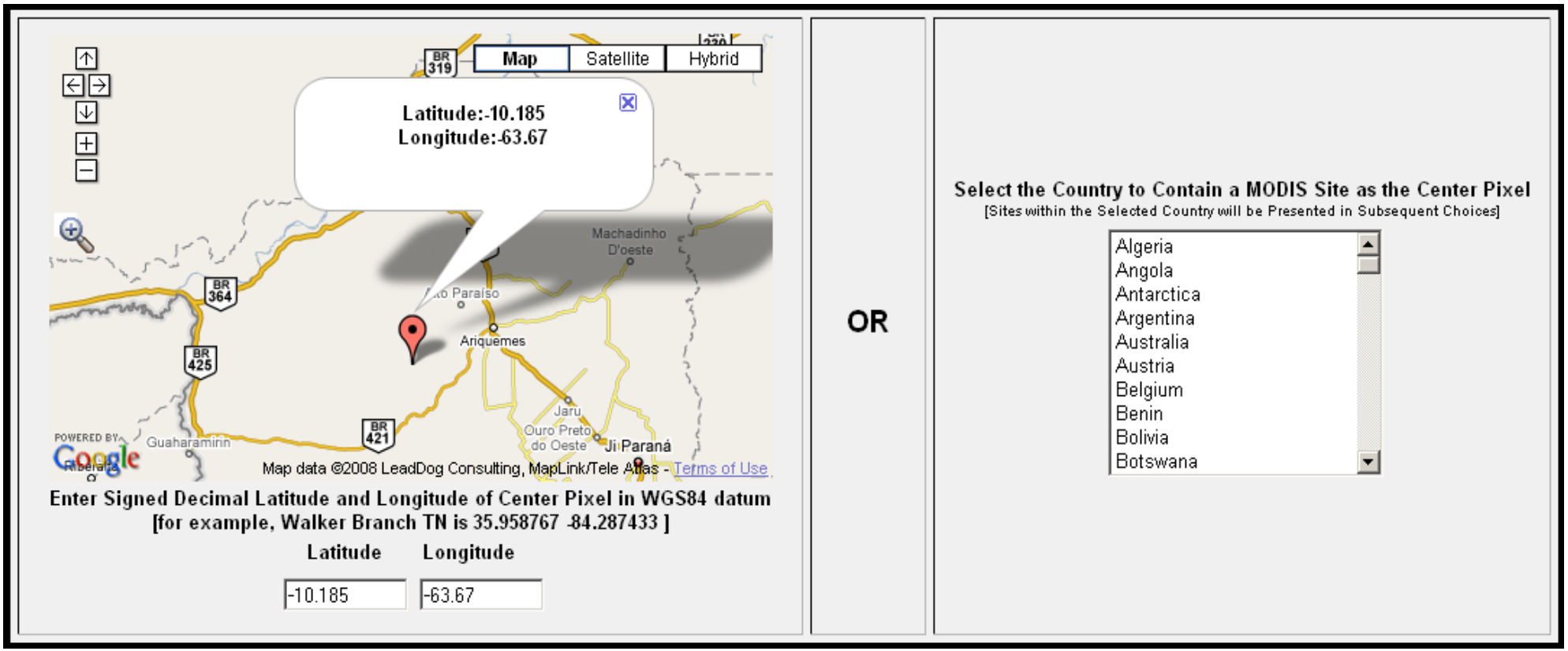
- User can input the coordinates for the site or select from a picklist of sites
- User chooses the areal extent and the time period
- Processing of subsetted product (selection of tiles, mosaicing, generating time series data file and graphs) takes 10 to 60 minutes for most products (depends on area, time period, and product)
- The tool will send an email message containing a URL where the output can be accessed

MODIS Products offered through the subsetting tool for Globe
Surface Reflectance
Surface Temperature
Landcover
Vegetation Phenology
NDVI / EVI
LAI / fPAR
Net Photosynthesis
Annual NPP
Albedo (calc)
Reflectance – BRDF Adjusted

Demo

MODIS Global Tool

http://daac.ornl.gov/modisglobal



MODIS Land Subsets
Oak Ridge National Laboratory DAAC

Data Visualization and Download

Process status

MODIS/Terra Vegetation Indices (NDVI/EVI)

16-Day L3 Global 250m SIN Grid [Collection 5]

Latitude [-10.185] Longitude [-63.67]
11m Horizontal Tile [11] Vertical Tile [10] Sample [3519] Line [88]

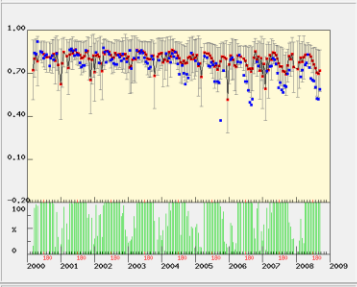
Order Details	
Product:	MOD13Q1
Coordinates:	Latitude: -10.185, Longitude: -63.67 (WGS84 datum)
Areal Extent:	Approximately 160.25 km Wide x 160.25 km High
Subset Date Range:	March. 05, 2000 (2000065) to September. 13, 2008 (2008257)
Map Links:	Google Map Google Earth MODIS Tile Mapper
Quality Control Conditions:	As Specified by Science Team (See QC table below)

Visualize Individual Composite Dates

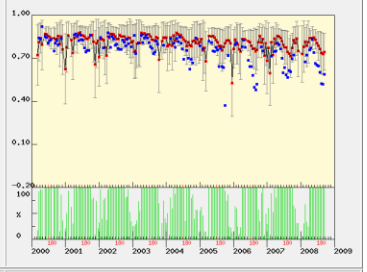
Note: This page contains many grids. Please scroll to the right/left and up/down to view all of the grids
[Historical acquisitions of MODIS data are being reprocessed. The reprocessing is expected to be complete Summer 2008.
The gap in time series would be eventually filled when the reprocessing is complete]

Plot Years : Start Date: 2000 End Year: 2008

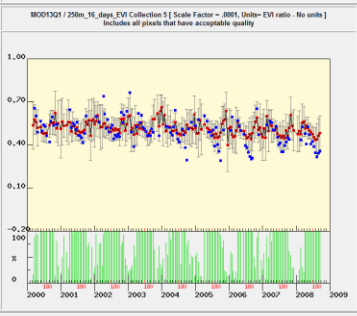
MOD13Q1 / 250m_16_days_NDVI Collection 5 [Scale Factor = .0001, Units= NDVI ratio - No units]
Includes all pixels that have acceptable quality



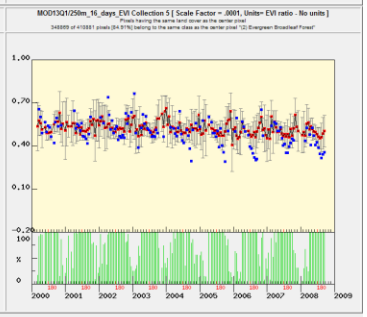
MOD13Q1/250m_16_days_NDVI Collection 5 [Scale Factor = .0001, Units= NDVI ratio - No units]
Pixels having the same land cover as the center pixel
348669 of 410881 pixels (84.91%) belonging to the same class as the center pixel "(2) Evergreen Broadleaf Forest"



MOD13Q1 / 250m_16_days_EVI Collection 5 [Scale Factor = .0001, Units= EVI ratio - No units]
Includes all pixels that have acceptable quality



MOD13Q1/250m_16_days_EVI Collection 5 [Scale Factor = .0001, Units= EVI ratio - No units]
Pixels having the same land cover as the center pixel
348669 of 410881 pixels (84.91%) belonging to the same class as the center pixel "(2) Evergreen Broadleaf Forest"



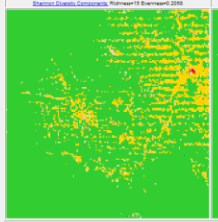
Color Legend	
Red	Average of all Pixels in Grid having Valid Data
Blue	Site/Tower Pixel having Acceptable Quality
Green	Percent of Pixels having Acceptable Quality

Subset Data Download Details

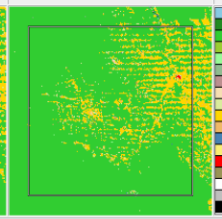
MODIS Land Product ASCII Data	Help
GIS data in ASCII Grid format	Help
QC-Filtered Data and Statistics Generated	Help
Land Cover Data in ASCII Grid Format	Help
Statistical Data of the subset	Help

MODIS Land cover

MODIS Land Cover Classification
(Collection 4 IGBP Type_1)
Landcover region for user Selected Area 161 km Wide x 161 km High
User Selected Area 160.25 km Wide x 160.25 km High
Shannon Diversity Components: Richness=15 Evenness=0.2669



MODIS Land Cover Classification
(Collection 4 IGBP Type_1)
201 km Wide x 201 km High with user selected Area Marked



MODIS Land Cover Legend
(Collection 4 IGBP Type_1)

- (0) Water
- (1) Evergreen Needleleaf Forest
- (2) Evergreen Broadleaf Forest
- (3) Deciduous Needleleaf Forest
- (4) Deciduous Broadleaf Forest
- (5) Mixed Forests
- (6) Closed Shrublands
- (7) Open Shrublands
- (8) Woody Savannas
- (9) Savannas
- (10) Grasslands
- (11) Permanent Wetlands
- (12) Croplands
- (13) Urban and Built-Up
- (14) Cropland/Natural Vegetation Mosaic
- (15) Snow and Ice
- (16) Barren or Sparsely Vegetated
- IGBP Water Bodies / Unclassified / Fill Value

QC Filter Conditions
QC explanation for MODIS/Terra Vegetation Indices: MOD13Q1_QC
QC bit word numbering (0,1,2,3,4,5,6 ... up to 7 at 32 bit int)

Filter Class	Bits	Binary	QA-bits (Left to Right)	Value(Binary)	Value(Integer)	Bands applied	QC band	Description	Display
MODLAND_QA	16	yes	14-15	00	0	all	250m_16_days_VI_Quality	VI produced, good quality	Presented
MODLAND_QA	16	yes	14-15	01	1	all	250m_16_days_VI_Quality	VI produced, but check other QA	Presented
MODLAND_QA	16	yes	14-15	10	2	all	250m_16_days_VI_Quality	Pixel produced, but most probably cloudy	Supressed
MODLAND_QA	16	yes	14-15	11	3	all	250m_16_days_VI_Quality	Pixel not produced due to other reasons than clouds	Supressed

Restart this Visualization Create subsets for this location

| MODIS Task for North America | ORNL DAAC | NASA | ORNL | Privacy Policy and Important Notices | Help/Question | Rate Up |
Website maintained by the Oak Ridge National Laboratory for the National Aeronautics and Space Administration.
Tel: +1 (865) 241-3952 or E-mail: ornldaac@ornl.gov webmaster@daac.ornl.gov

Creation Date Wed Oct 8 14:03:45 2008

Greetings,

You requested MOD13Q1 for the following area:

Location Centered on: Latitude [-10.185] Longitude [-63.67]
Size: Approximately 160.25 kilometers wide and 160.25 kilometers high
MODIS Tile Location: 250m Horizontal Tile [11] Vertical Tile [10] Sample [3519] Line [88]
Time Period: January. 01, 2001 to December. 19, 2001

To cite this data, see below:

Click on the following URL to obtain your results.
(The results will be available to view/download for 10 days.)

http://daac.ornl.gov/glb_viz_2/08Oct2008_14:58:39_041584979L-10.185L-63.673641L641_MOD13Q1_SURESH/index.html

Data Citation:

Oak Ridge National Laboratory Distributed Active Archive Center (ORNL DAAC). 2008. MODIS subsetted land products, Collection 5. Available on-line [http://daac.ornl.gov/MODIS/modis.html] from ORNL DAAC, Oak Ridge, Tennessee, U.S.A. Accessed Month dd, yyyy.

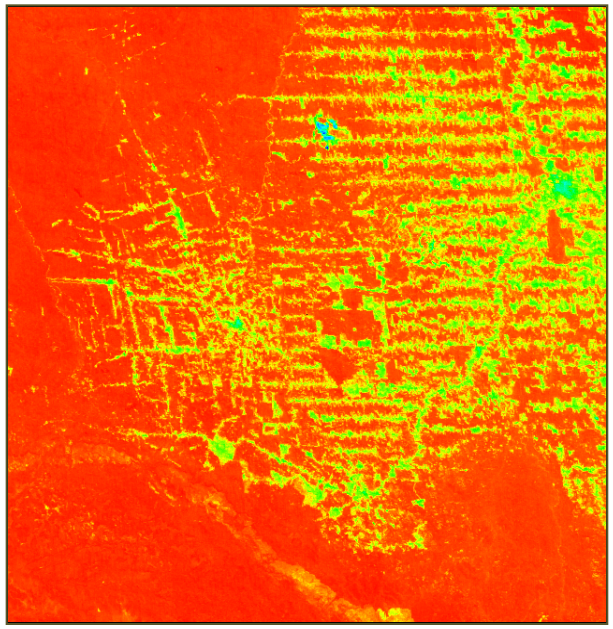
If you would like to receive further information about ORNL DAAC data, you may edit your areas of interest on your registration form at our Web site (http://daac.ornl.gov) at any time. Simply sign in and click "Profile" to retrieve your registration form.

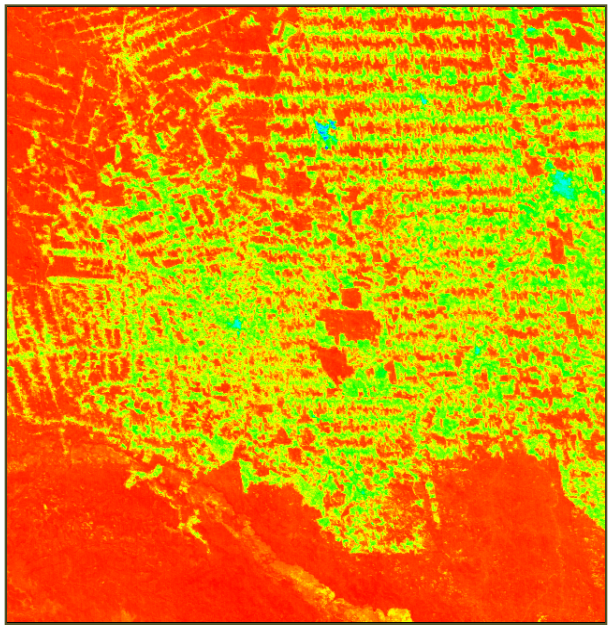
If you have questions about this information, please contact MODIS_Subsets@ornl.gov.

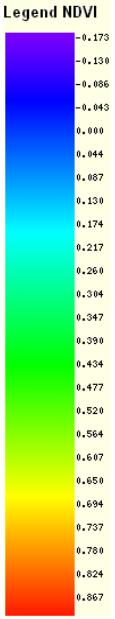
Thank you.

Subset Data Download Details

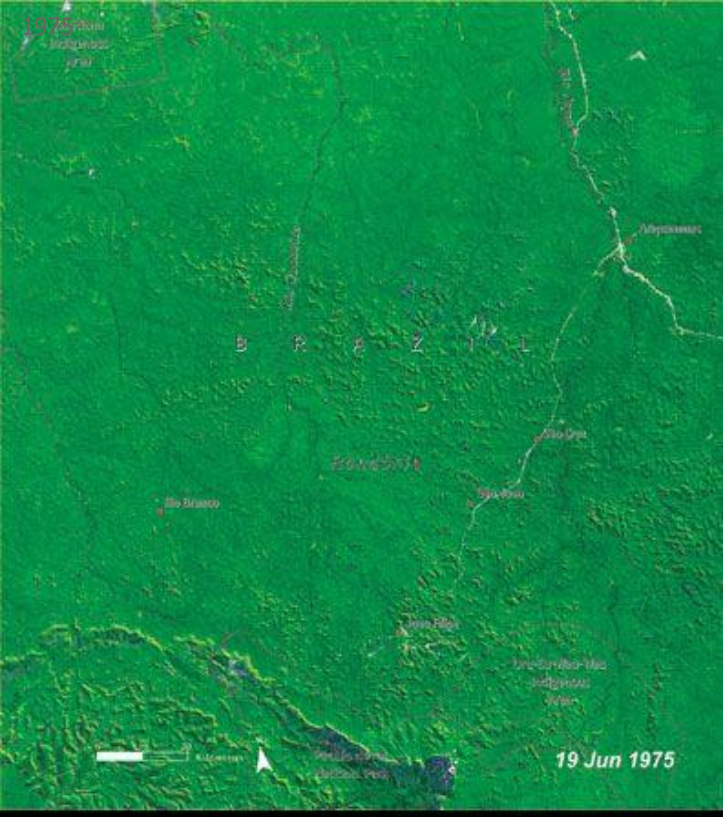
MODIS Land Product ASCII Data	Help
GIS data in ASCII Grid format	Help
QC-Filtered Data and Statistics Generated	Help
Land Cover Data in ASCII Grid Format	Help
Statistical Data of the subset	Help
GIS data in GeoTIFF format	Help

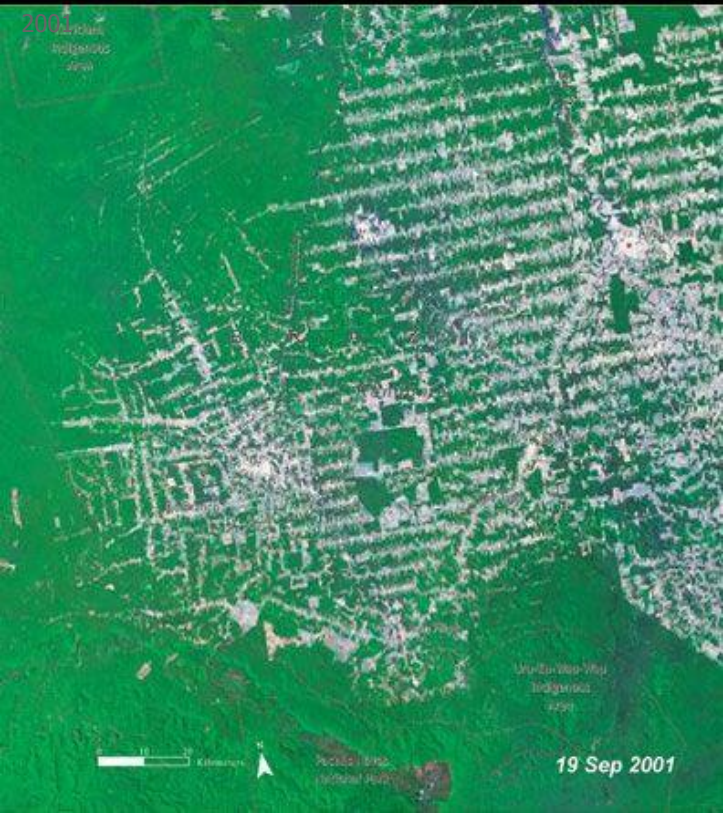




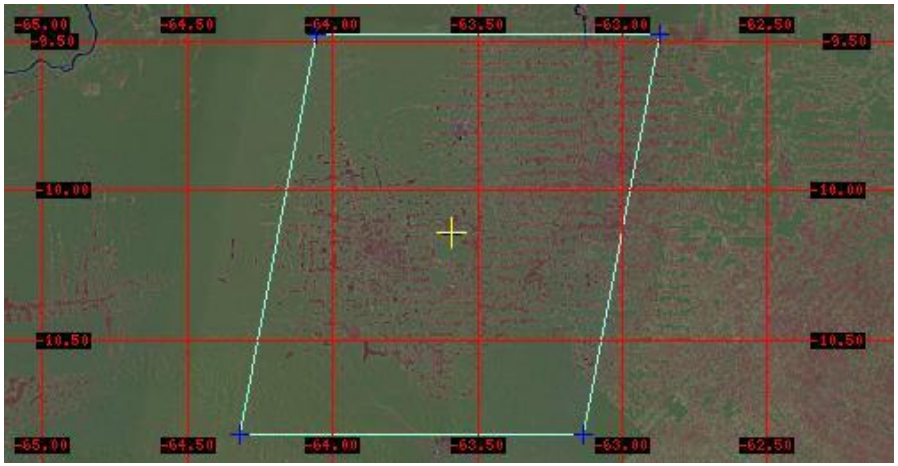


Deforestation
Ciudad de México
Puebla
Dominican Republic
Port-au-Prince
Puerto Rico
Guatemala
Guatemala
Honduras
Tegucigalpa
Nicaragua
Managua
Costa Rica
Panamá
Maracaibo
Caracas
Barranquilla
Barquisimeto
Valencia
Venezuela
Medellín
Tuluá
Bogotá
Cali
Colombia
Guyana
Guyane
French Guiana
Suriname
Roraima
Amapá
Quito
Ecuador
Belém
Rio Grande do Norte
São Luís
Fortaleza
Manaus
Teresina
Ceará
Amazonas
Maranhão
Natal
Paraíba
Piauí
Recife
Pernambuco
Brasil
Brazil
Perú
Acre
Maceió
Aracaju
Alagoas
Rondônia
Tocantins
Lima
Mato Grosso
Bahia
Salvador
Sergipe
Cuiabá
Goiás
Brasília
La Paz
Bolivia
Goiânia
Minas Gerais
Uberlândia
Campo Grande
São José do Rio Preto
Belo Horizonte
Espírito Santo
Vitória
Mato Grosso do Sul
Rio de Janeiro
São Paulo
Rio de Janeiro
Paraguay
Londrina
São Paulo
Paraná
Curitiba
Joinville
Santa Catarina
Florianópolis
Rio Grande do Sul
Porto Alegre
Uruguay
Santiago
Montevideo
Chile
Argentina


B R A Z I L
19 Jun 1975


19 Sep 2001

Deforestation
Brasil
Brazil
Venezuela
Colombia
Guyana
Suriname
Ecuador
Perú
Bolivia
Paraguay
Uruguay
Argentina
Chile
Puerto Rico
Dominican Republic
Guatemala
Honduras
Nicaragua
Costa Rica
Panamá
Amazonas
Rondônia
Mato Grosso
Tocantins
Goiás
Minas Gerais
Bahia
Paraíba
Pernambuco
Alagoas
Sergipe
Espírito Santo
Rio de Janeiro
São Paulo
Paraná
Santa Catarina
Rio Grande do Sul
Rio Grande do Norte
Ceará
Maranhão
Piauí
Belém
Manaus
Lima
La Paz
Santiago
Montevideo
Caracas
Bogotá
Quito
Lima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-63.50
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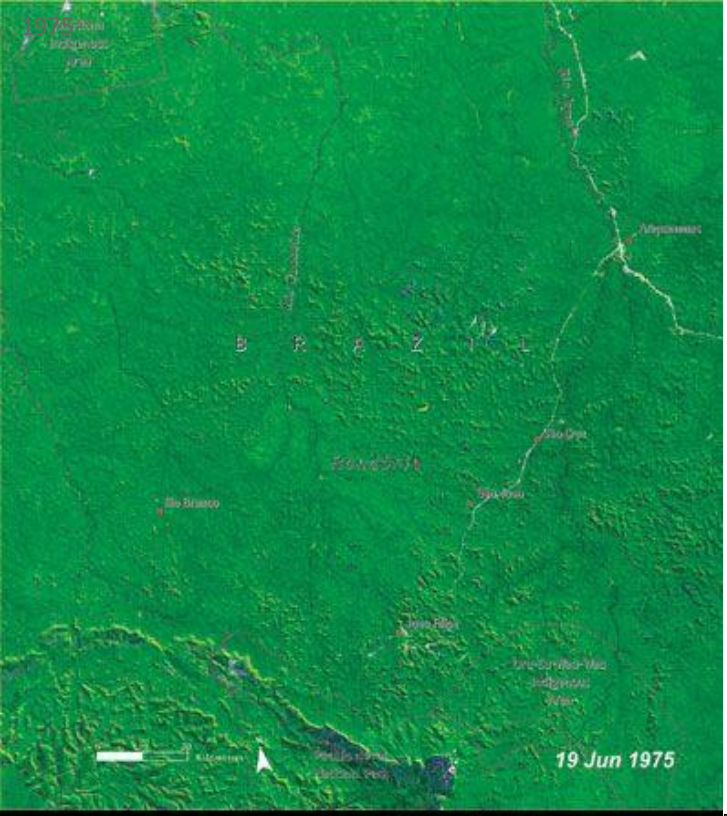
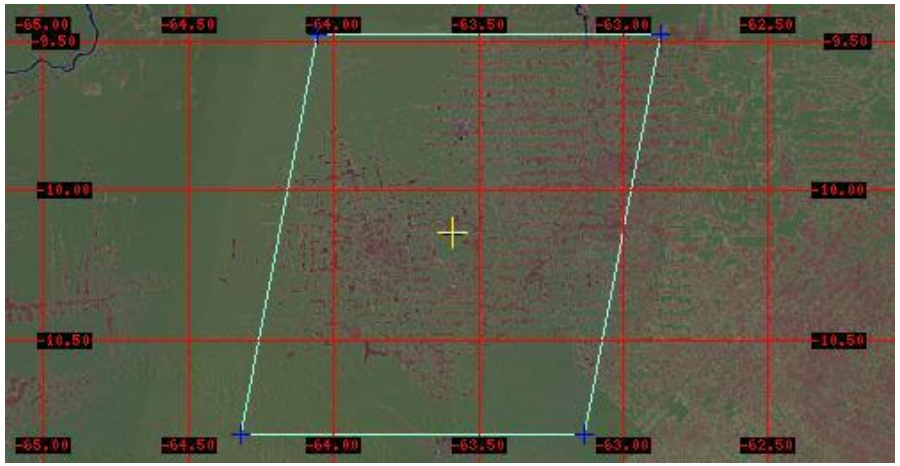
-10.50


19 Jun 1975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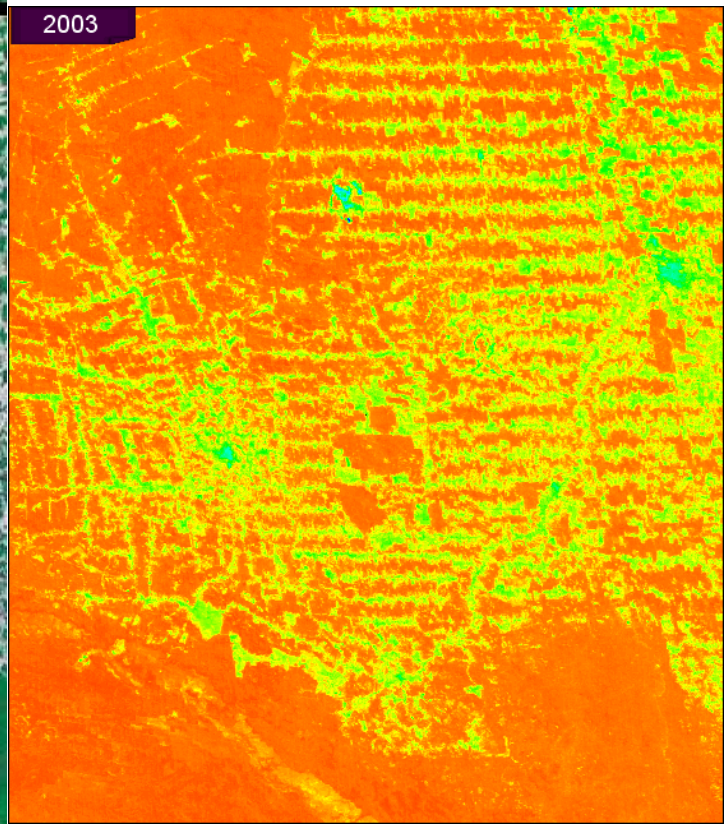
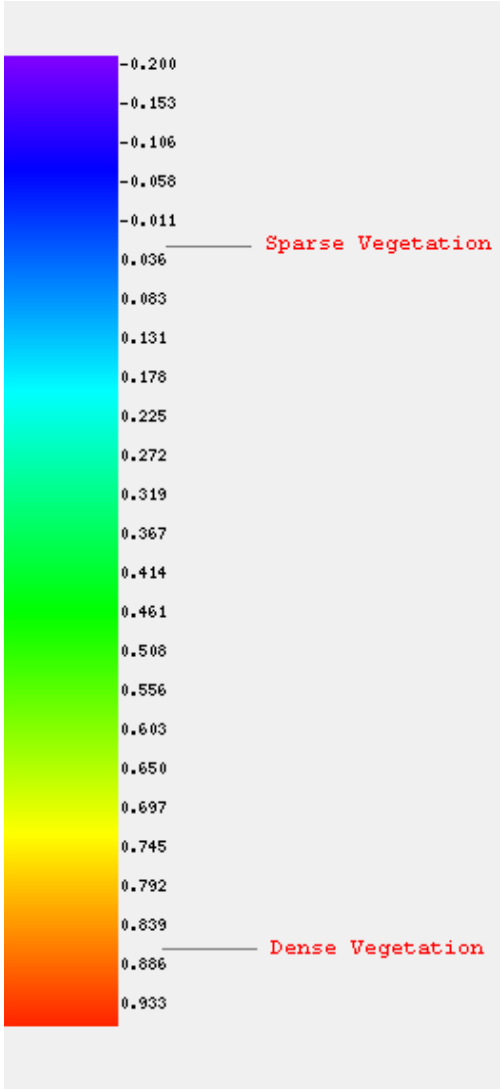
-10.00
-10.50

19 Sep 2001


2003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0.036
0.083
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0.178
0.225
0.272
0.319
0.367
0.414
0.461
0.508
0.556
0.603
0.650
0.697
0.745
0.792
0.839
0.886
0.933
Sparse Vegetation
Dense Vegetation

MODIS Web Service

Get MODIS Subsets through machine to machine interaction

SOAP (Simple Object Access Protocol) based

Retrieve Subsets using:

- Command line (Perl)
- Workflows (Kepler)
- JAVA desktop software

Demo

MODIS Web Service – JAVA client

Example Usage: What is the MODIS land cover value at 32.707072 N, -94.120474 W

```perl
#!/usr/local/activeperl/bin/perl
#!/usr/bin/perl

################
# ORNL DAAC MODIS Web service - Perl client
#################
##Using SOAP LITE module
use SOAP::Lite ;

#SOAP web service connection
$params= SOAP::Lite
    -> service('http://daac.ornl.gov/cgi-bin/MODIS/GLBVIZ_1_Glb_subset/MODIS_webservice.wsdl')
    -> xmlschema('http://www.w3.org/2001/XMLSchema')
    -> getsubset(32.707072,-94.120474,MCD12Q1,Land_Cover_Type_1,A2001001,A2001001,0,0);

#Printing the data

   while( my($key, $value) = each %$params )
    {
        if($key ne 'subset')
            {
            print "$key : $value\n";
            }
        else
            {
            @subset=$value;
            print "$key :\n";
            for (my $i = 0; $i < @subset; $i++)
            {
                for (my $j = 0; $j < @{$subset[$i]}; $j++) { print  "$subset[$i][$j]";}
            }

    }
   }
```

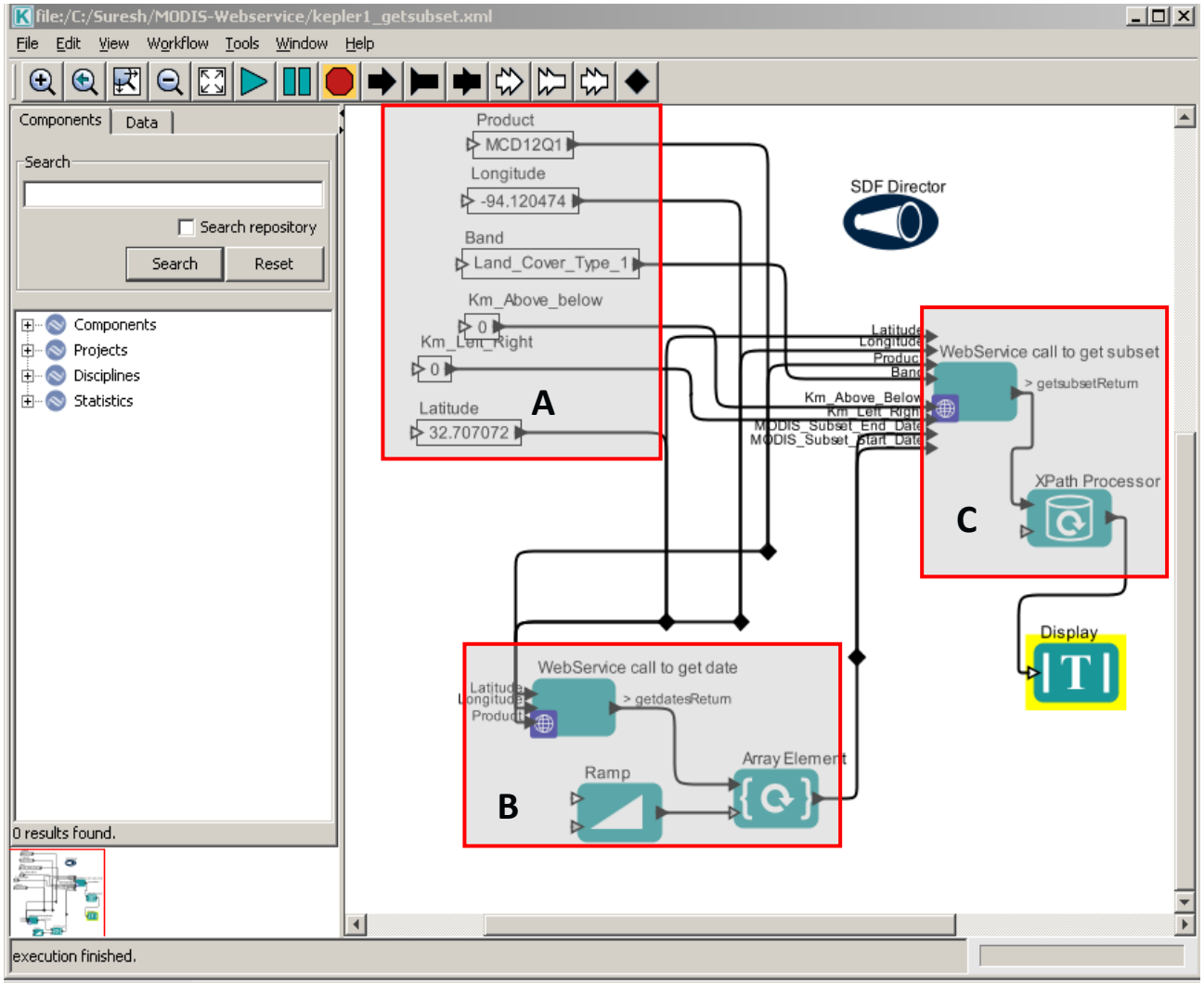
Perl Client

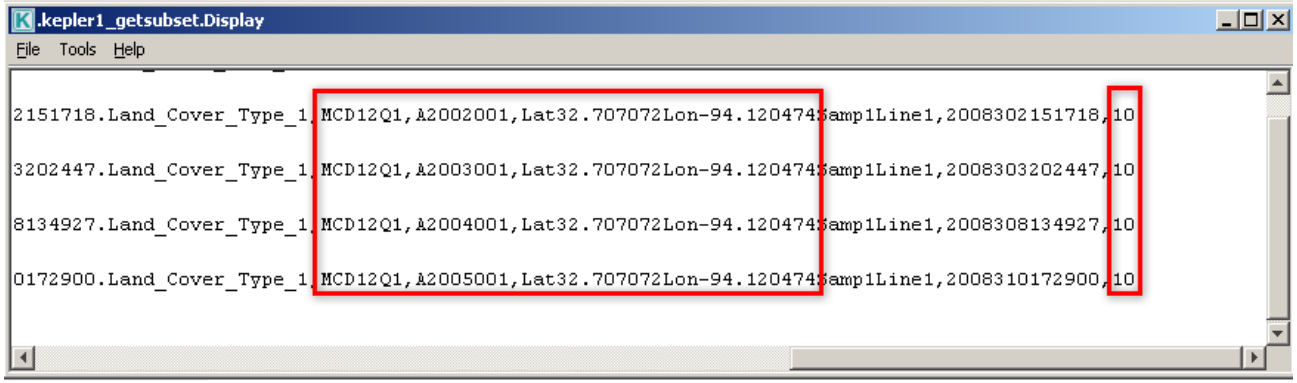
- 0 - Water
- 1 - Evergreen Needleleaf Forest
- 2 - Evergreen Broadleaf Forest
- 3 - Deciduous Needleleaf Forest
- 4 - Deciduous Broadleaf Forest
- 5 - Mixed Forests
- 6 - Closed Shrubland
- 7 - Open Shrubland
- 8 - Woodly Savannas
- 9 - Savannas
- 10 - Grasslands
- 11 - Permanent Wetlands
- 12 - Croplands
- 13 - Urban and Built-Up
- 14 - Cropland-Natural Vegetation Mosaic
- 15 - Snow and Ice
- 16 - Barren or Sparsely Vegetated
- 255 - Fill Value

```
C:\Suresh\MODIS-Webservice>MODIS_webservice_client.pl
longitude : -94.120474
band : Land_Cover_Type_1
ncols : 1
nrows : 1
yllcorner : 3636078.20
subset :
MCD12Q1.A2001001.h10v05.005.2008295170759.Land_Cover_Type_1,MCD12Q1,A2001001,Lat32.707072Lon-94.120474Samp1Line1,2008295170759,10
cellsize : 926.62543305583381
latitude : 32.707072
scale : 0
xllcorner : -8806648.10
header : HDFname,Product,Date,Location,Processed_Date,Subset_Data...

units : Not Available
```

Kepler- Scientific Workflow





Step A:

Provide inputs such as
- Product
- Band
- Latitude, Longitude
- Size of the subset

Step B:

Kepler uses the MODIS Web Service to find all dates that have MCD12Q1 (Land Cover) data for location 32.707072 N, -94.120474 W

Step C:

Kepler uses the MODIS Web Service to get the subsets for each available MODIS date.

The subset is displayed

Check in Google Maps for aerial photo of this location

Terrestrial Vegetation Phenology links to Bird Migration Phenology

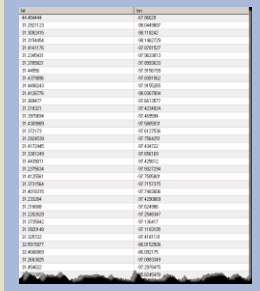
Extract MODIS NDVI for each bird observation location using ORNL DAAC's MODIS Subsetting Web Service

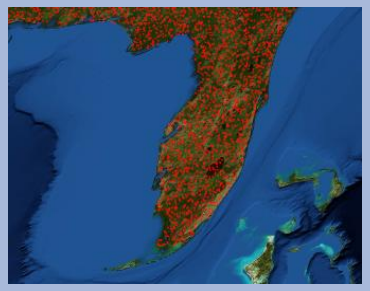
300,000 locations for 10 years: Web service accessed 35 million times

500 bird species, 1 TB location-specific data (NDVI, Climate, land cover, census, etc.)

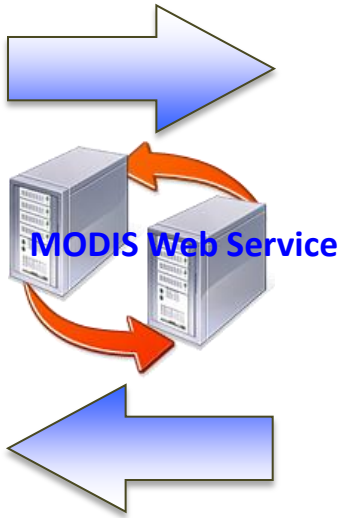
Latitude, Longitude of bird Observations from eBird database providing presence/absence

eBird



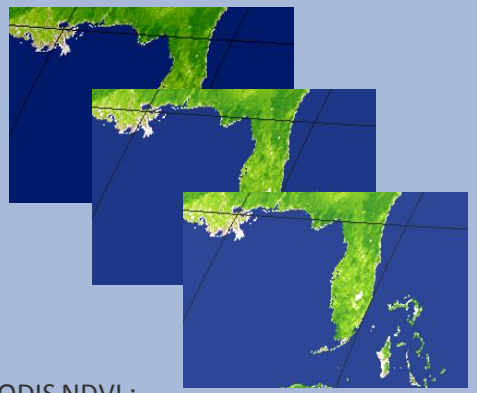


Observation (Latitude, longitude, time)



MODIS NDVI value

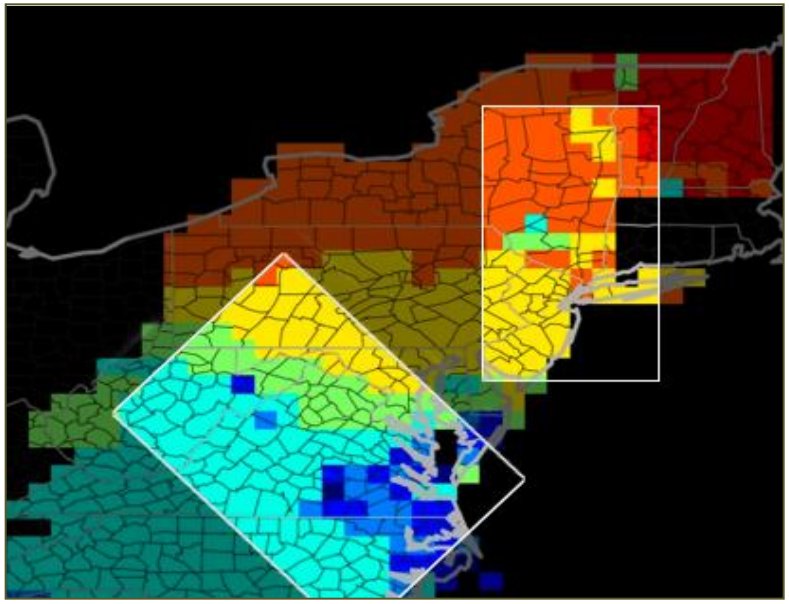
ORNL DAAC



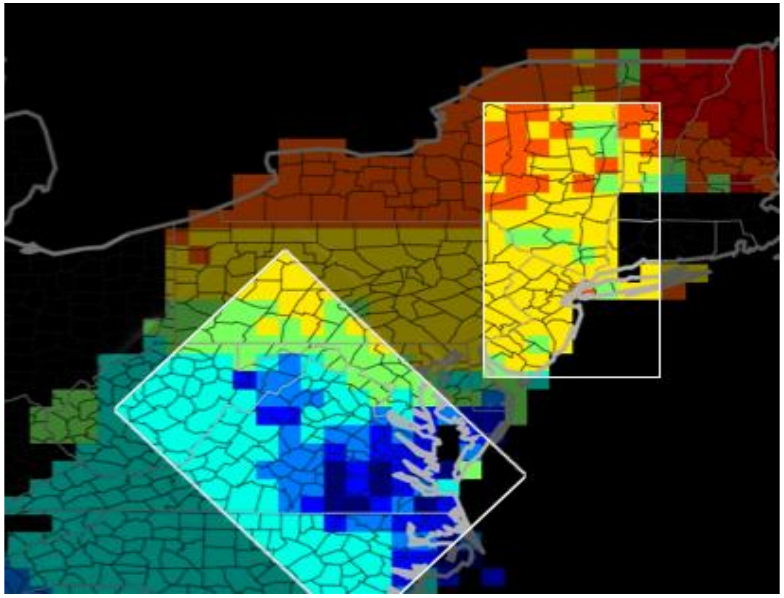
MODIS NDVI :

- 16 day composite value
- 250-m spatial resolution
- Data from 2000 onwards

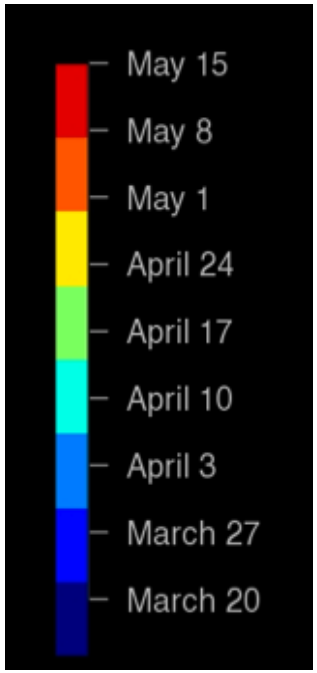
How is migration timing, direction, and speed of Red-eyed Vireo migration affected by climate change (early greening)?



Spring Arrival Dates



Spring Arrival Dates
with Advanced Greening (14 days)



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