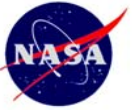# Subsetting Tools for MODIS Land Products: Time-series data for field sites[1]

R.B. Cook, S.K. Santhana Vannan, S.K. Holladay, and T.W. Beaty
Environmental Sciences Division, Oak Ridge National Laboratory[2], Oak Ridge, Tennessee 37831-6407

Introduction

Satellite imagery provides a means of extending our understanding of vegetation dynamics from site-specific studies to larger regions. However, preparing time-series of remote sensing products for small areas is computationally challenging. The ORNL Distributed Active Archive Center (DAAC) has developed two tools to facilitate the use of Moderate Resolution Imaging Spectroradiometer (MODIS) data to examine vegetation dynamics. The tools produce subsets of MODIS Land Products.

1st Tool: MODIS ASCII Subsets
2nd Tool: Subsetting and Visualization Tool for North America

http://daac.ornl.gov/MODIS/modis.html

Background

- Products Subsetted: Terra MODIS Collection 4 / 4.8 and Aqua MODIS Collection 4 (see table)
- Sinusoidal Projection
- Data from 2000 to present
- 8-day, 16-day, and annual composite periods
- Documentation provided that describes the subsetted products; links provided to full documentation at MODIS Web sites at LP DAAC

MODIS Land Products Subsetted
Surface Reflectance
Surface Temperature
Land Cover
Phenology
NDVI / EVI
LAI / fPAR
Net Photosynthesis
Annual NPP
Albedo (Model and Calculated)
Reflectance – BRDF Adjusted

Data Processing: General

- Data reformatted from HDF-EOS into ASCII values using the MODIS Reprojection Tool and custom Perl code
- ASCII file for each site / product combination contains ASCII values and QA flags for individual pixels
- File available for download
- Visualization of data as grid or as a time series prepared using Perl code and Perl graphics library
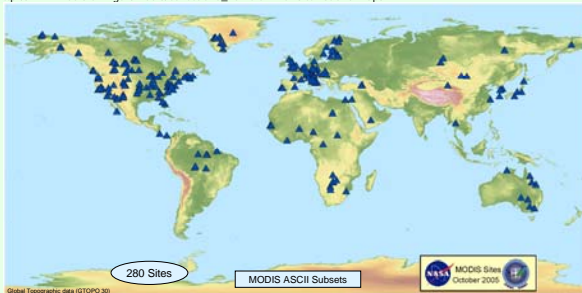
1st Tool: MODIS ASCII Subsets

Processing for MODIS ASCII Subsets

- Subsetted data (original size: 31 x 11 km) received from MODIS processing stream and converted at the ORNL DAAC into ASCII (7 x 7 km)
- Subsets also converted to GeoTIFF (31 x 11 km), using Geospatial Data Abstraction Library Tools
- Subsets posted on DAAC's ftp site
- User can also access Web interface to select sites and specific MODIS Land Products from Web Map Server, Google Earth, or picklist

Sites located worldwide

Collection 4 sites include global flux tower sites (FLUXNET) and sites participating in NASA's MODIS validation program. Sites are chosen because of a willingness to share *in situ* site data (*quid pro quo*).
For **Collection 5**, the number of sites will increase to 1,049 (not shown). See http://www.modis.ornl.gov/modis/collection5_home.cfm for site list and maps

280 Sites

Global Topographic data (GTOPO 30)

Next Steps for MODIS ASCII Subsets: Collection 5

- Collection 5 processing began in September 2006; number of sites increased from 280 to 1,049
- Some products will be available at finer resolution in Collection 5
    - Land Cover will be 500-m resolution
    - Vegetation Indices (NDVI & EVI) will be 250-m resolution
   - Albedo Products will be 500-m resolution

1st Tool (continued)

Example: MODIS Land Cover

Grids for a single date for any Terra or Aqua MODIS Land Product

- Example is a 7x7 km grid of land cover for one of the 280 sites
- IGBP Classification shown; other classifications available
- Sites selected from picklist, Google Earth, or Web Map Server
- User selects date of interest (8-day, 16-day, or annual composite period)
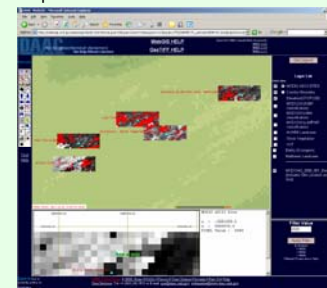
Example: MODIS Vegetation Indices
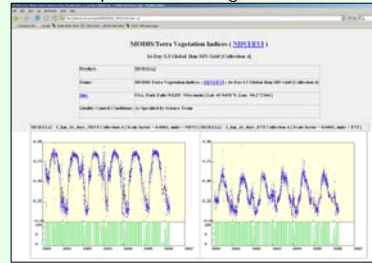
Time-series graphs of 8- day and 16-day products from 2000 to present for a site

- Example is vegetation indices
- Green bars are percentage of pixels that meet quality criteria, blue dots are individual pixels that have acceptable quality, and red dots are the average of acceptable values

Example: MODIS Subsets as GeoTIFF Images

GeoTIFF Images available for individual 8- day or 16-day periods

- Example at right is vegetation indices (MOD13A2) for five sites in northern Wisconsin, USA
- Underlying map layer is elevation (GTOPO30); other layers can be selected
- Site / Product / Date combinations can be selected using a picklist
- Selected Site / Product GeoTIFFs can be downloaded for a date or all dates
- GeoTIFFs can be viewed in WebGIS Tool (in Sinusoidal Projection) along with other map layers
- WebGIS Took can be used to filter values or determine values of individual pixels (lower panel)

Example: MODIS Subsets Combined with Tower Observations

MODIS Subset Time Series can be combined with ground-based data

- Albedo (calculated) and Vegetation Indices (NDVI) from Missouri Ozark Flux Tower Site
- Ground data from instrument on flux tower, MODIS data is average of 49 1-km pixels surrounding tower
- Missouri Ozark ground-based data courtesy of Lianhong Gu and Bai Yang, ORNL

http://www.modis.ornl.gov/modis/
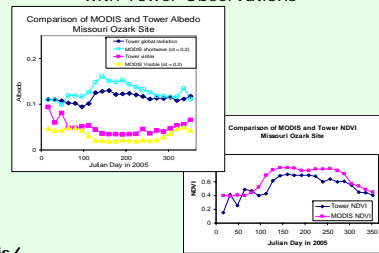
2nd Tool: Subsetting and Visualization Tool for North America

The second tool facilitates the creation of subsets of MODIS Land Products in ASCII format for user-selected areas (1 x 1 km up to 201 x 201 km) in North America and for any time period during the MODIS record.

- 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

Example: MODIS Land Cover for user selected site in Southern California

Tool provides land cover grid (IGBP classification shown) of the area, along with an estimate of heterogeneity (Shannon's Diversity Index).
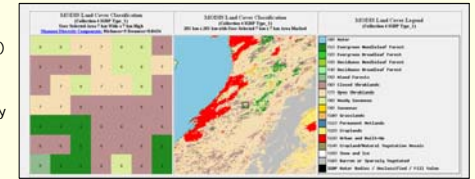
Vegetation Index, Area in Southern California EVI MOD13A2

MODIS subset data presented as time series, with average and standard deviation shown for pixels in area selected. Tool also provides statistics for all pixels in selected area that have same land cover class as center pixel. Fire in late 2003 causes discontinuity in EVI.
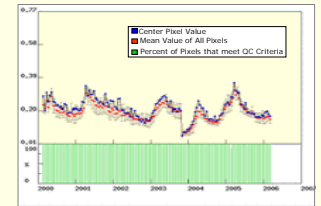
Data and Summary Statistics in ASCII Format along with Documentation

Tool provides ASCII file of the pixel values along with quality information, statistics on pixels in the area selected, and an ASCII Grid file that can be imported directly into GIS software. Detailed documentation provided for each file.

http://www.modis.ornl.gov/modis/NorthAmerica_Tool/index.cfm

Tool will expand to Global Coverage for Collection 5

- For Collection 5 MODIS data, the tool will be expanded to provide subsets of MODIS Land Products world-wide