

This folder and subfolders contain data for ArcGIS geoprocessing tools. The folder can be placed anywhere on your computer so long as you do not edit or delete any of its subfolders. In order to use the tools, open ArcToolbox within ArcMap and right click ArcToolbox root. Click “Add Toolbox” and navigate to the MODIS_Tools folder. Highlight MODIS.tbx and click “Open.” This will import the MODIS toolbox into ArcMap. This toolbox is coded in ArcPy for ArcGIS 10.5.

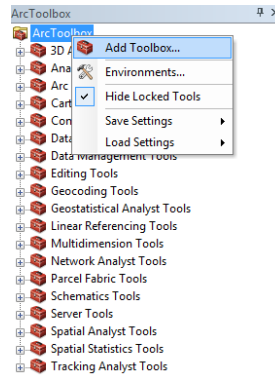


Figure 1 – Add Toolbox

1. Import Evapotranspiration

The Import Evapotranspiration tool allows you to easily access historical evapotranspiration data for any land surface. Actual evapotranspiration and potential evapotranspiration are both available, accessed via separate tools. The tools import the MOD16 global evapotranspiration product, which was developed by Dr. Qiaozhen Mu at the University of Montana. MOD16 is a level 4 data product derived from other MODIS products such as land surface temperature (MOD11) and albedo (MOD43). Using these data products and the Penman-Monteith equation, monthly averages of evapotranspiration are estimated for the entire globe with 1 km resolution. These estimates are available for every month going back to January 2000, when NASA first launched MODIS aboard the Terra satellite. The most recent data available is for December 2014, when this dataset stopped being updated.

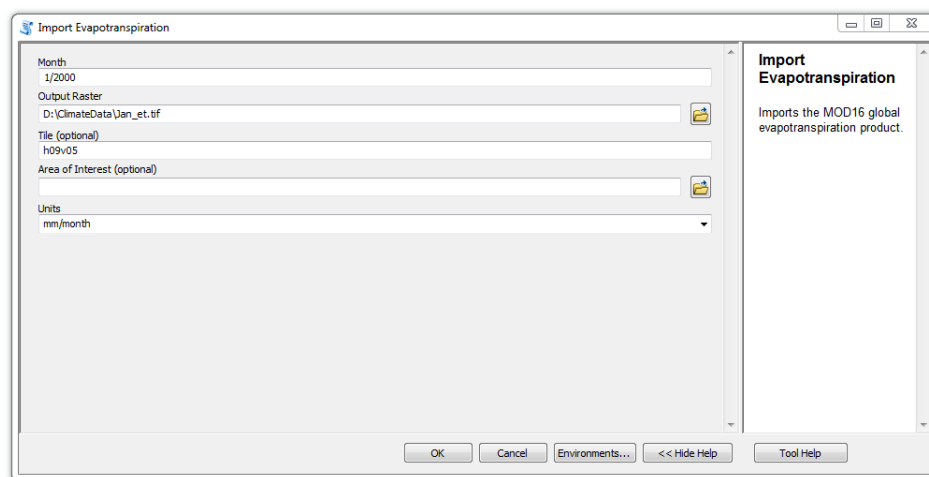


Figure 2 – Import Evapotranspiration

When you click the “Import Evapotranspiration” tool, you will be presented with the window shown in Figure 2. This window allows you to select the month and tile you would like data for. Or, you can specify an area of interest, and the tool will determine which tiles you need. If you specify both a tile, and an area of interest, the tool will download your tile and clip according to the AOI.

Reference: <http://www.ntsg.umd.edu/project/modis/mod16.php>

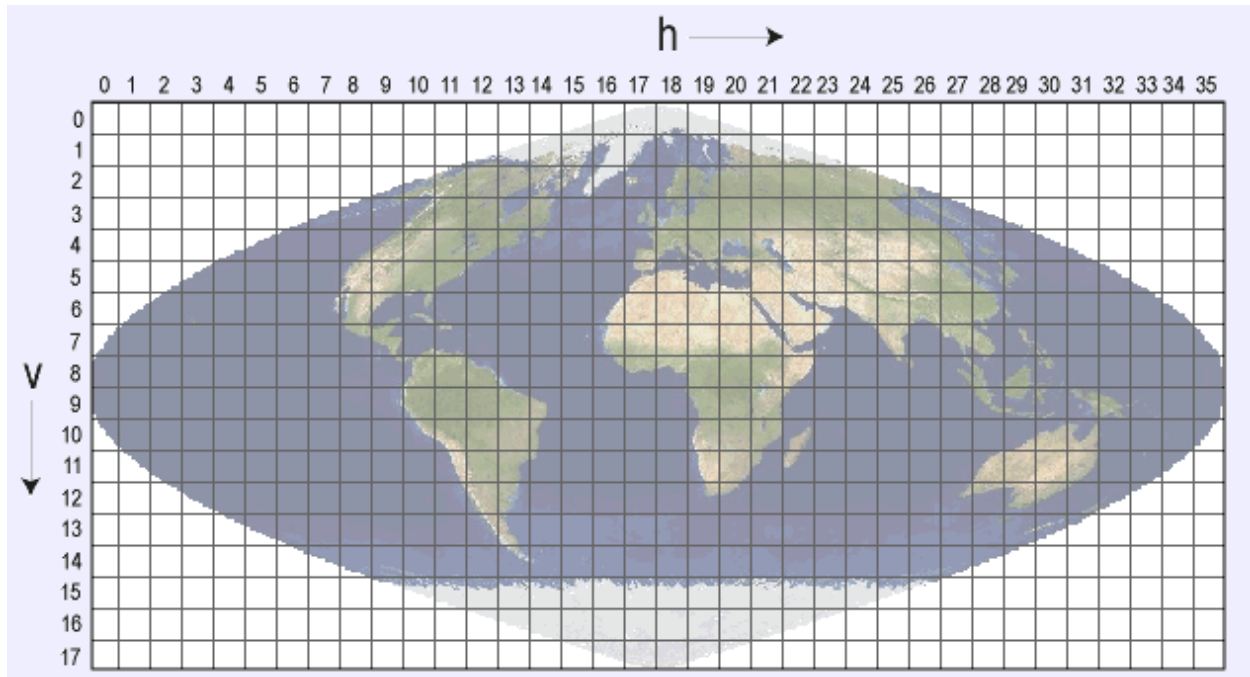


Figure 3 – MODIS Tiles

2. Import Land Surface Temperature

The Import Land Surface Temperature tool accesses MOD11-A1, the daily averaged land surface temperature product. The MOD11 product uses historical data from MODIS and the generalized split-window LST algorithm developed by researchers at the Goddard Space Flight Center. This algorithm is optimally used to separate ranges of atmospheric column water vapor and lower boundary air surface temperatures into tractable sub-ranges. Estimates are available for every day going back to January 2000, when NASA first launched MODIS aboard the Terra satellite. Data from Aqua are available starting in July 2002. Units are in degrees Celsius.

Use of the Import Land Surface Temperature tool is similar to the Import Evapotranspiration tool. The crucial difference time steps. While MOD16 is averaged over each month, this tool provides daily averages. In fact, it is possible to access two different rasters for any given day – one based on imagery from Aqua and one from Terra. The two satellites have different overpass times, so on any given day one might provide significantly better imagery than the other. These images are often incomplete because any pixel obscured by clouds has been labeled “NoData.” It is not recommended that you mosaic images from different satellites together.

Reference: https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table/mod11a1_v006

3. Vegetative Indices

There are two vegetative indices you can import using this toolbox. Researchers at the Goddard Space Flight Center compute them from atmospherically corrected bi-directional surface reflectances that have been masked for water, clouds, heavy aerosols, and cloud shadows. Blue, red, and near-infrared reflectances, centered at 469-nanometers, 645-nanometers, and 858-nanometers, respectively, are used to determine to "greenness" of each pixel. The scale is from 0 (rock) to 1 (total canopy cover). Negative numbers indicate open water.

The normalized difference vegetation index (NDVI) is a venerable indicator first measured by the Landsat I in 1972. It is calculated according to the formula

$$\text{NDVI} = \frac{(\text{NIR} - \text{VIS})}{(\text{NIR} + \text{VIS})}$$

where NIR is the near-infrared radiance and VIS is observed radiation in the visible spectrum. Over the years, many attempts have been made to improve upon this humble formula, and the enhanced vegetation index (EVI) was developed in 1999 to take advantage of the advanced capabilities of MODIS. EVI minimizes canopy background variations and maintains sensitivity over dense vegetation conditions. The EVI also uses the blue band to remove residual atmosphere contamination caused by smoke and sub-pixel thin cloud clouds. Both vegetative indices are monthly averages, and are available from either satellite with MODIS (Aqua or Terra).

Reference: <https://modis.gsfc.nasa.gov/data/dataproduct/mod13.php>