LP DAAC Web Map Service (WMS)
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Introduction
The Open Geospatial Consortium (OGC) is an international organization dedicated to developing open web service interface standards for geospatial data served over the internet. A web map service (WMS) is an OGC standard that allows users to remotely access georeferenced map images via hypertext transfer protocol (HTTP) requests. These images do not transfer raw data values but transfer full resolution browse images that are useful as standalone images or as a base map in a GIS software program. The LP DAAC has made a subset of data products from the Moderate Resolution Imaging Spectroradiometer (MODIS) collection available as WMS layers. These layers can be requested and visualized, via HTTP, in an internet browser or in a program that connects to, and consumes, layers available on a WMS server.

Service URLs
The service URL is the path to the WMS server that provides the map layers and is a component of all WMS requests. The LP DAAC maintains a separate service URL for each data product (e.g. MOD11A2.006 or MOD13Q1.006) and its associated data layers (e.g. Daytime Land Surface Temperature (LST) or Normalized Difference Vegetation Index (NDVI)). The available services can be found in the following service catalog:
https://lpdaacgis.cr.usgs.gov/arcgis/rest/services/WMS?f=pjson

Service URL:
Each data product has its own unique service URL from which WMS request operations (e.g. GetCapabilities and GetMap) can be performed. Each service URL has the same structure. See below for an example.

Example service URL

https://lpdaacgis.cr.usgs.gov/arcgis/services/WMS/MCD12Q1_006_LC_Type1/ImageServer/WMSServer?

In the example service URL, https://lpdaacgis.cr.usgs.gov/arcgis/services/ is the base URL. The subsequent text, WMS/MCD12Q1_006_LC_Type1/ImageServer/WMSServer, is the path to the service where WMS/MCD12Q1_006_LC_Type1 is the service name from the service catalog mentioned above.

Available Data Layers
- MOD09A1.006: Terra MODIS, 8-Day, 500 meter, Surface Reflectance, True Color Composite (Red = band 1, Green = band 4, Blue = band 3)
  - Product information
- MOD11A2.006: Terra MODIS, 8-Day, 1,000 meter, Daytime Land Surface Temperature
- **Product information**
  - MOD13Q1.006: Terra MODIS, 16-Day, 250 meter, Normalized Difference Vegetation Index (NDVI)
    - **Product information**
  - MOD14A2.006: Terra MODIS, 8-day, 1,000 meter, Fire Mask
    - **Product information**
  - MOD15A2H.006: Terra MODIS, 8-Day, 500 meter, Leaf Area Index
    - **Product information**
  - MOD17A2H.006: Terra MODIS, 8-Day, 500 meter, Gross Primary Productivity
    - **Product information**
  - MOD44B.006: Terra MODIS, Yearly, 250 meter, Vegetation Continuous Fields
    - **Product information**
  - MCD12Q1.006: Yearly, 500 meter, Land Cover Type 1: International Geosphere-Biosphere Programme (IGBP) classification
    - **Product information**

**GetCapabilities**
GetCapabilities requests return information about the WMS service. The information returned provides the user insight into available map layers, available output formats, supported coordinate reference systems, and other parameters required to request the map layer from the WMS server.

- Name: MOD09A1_006_Surface_Reflectance
  - **GetCapabilities**
- Name: MOD11A2_006_LST_Day_1km
  - **GetCapabilities**
- Name: MOD13Q1_006_250m_16_days_NDVI
  - **GetCapabilities**
- Name: MOD14A2_006_FireMask
  - **GetCapabilities**
- Name: MOD15A2H_006_Lai_500m
  - **GetCapabilities**
- Name: MOD17A2H_006_Gpp_500m
  - **GetCapabilities**
- Name: MOD44B_006_Percent_Tree_Cover
  - **GetCapabilities**
- Name: MCD12Q1_006_LC_Type1
  - **GetCapabilities**
GetMap
GetMap requests retrieve a specified WMS map layer from the WMS server. Below is a series of GetMap requests. Each link will open a map layer in a web browser window.

- Name: MOD09A1_006_Surface_Reflectance
  - GetMap
- Name: MOD11A2_006_LST_Day_1km
  - GetMap
- Name: MOD13Q1_006_250m_16_days_NDVI
  - GetMap
- Name: MOD14A2_006_FireMask
  - GetMap
- Name: MOD15A2H_006_Lai_500m
  - GetMap
- Name: MOD17A2H_006_Gpp_500m
  - GetMap
- Name: MOD44B_006_Percent_Tree_Cover
  - GetMap
- Name: MCD12Q1_006_LC_Type1
  - GetMap

Note: Each service supports the time dimension and thus requires the TIME parameter to be specified in the GetMap request to obtain the expected WMS layer.

Import WMS layers into a GIS
How to add a WMS layers to QGIS
1. To add a WMS layer to QGIS, go to Layer > Add Layer > Add WMS WMTS Layer…” from the standard toolbar in QGIS Desktop.
2. Click **New** in the **Data Source Manager | WMS/WMTS** window.

3. In the **Create a New WMS/WMTS Connection** window, add a name for the new connection and enter the service URL (https://lpdaacgis.cr.usgs.gov/arcgis/services/WMS/MOD11A2_006_LST_Day_1km/ImageServer_WMSServer?) into the appropriate fields. Click **OK**.
4. When the **Data Source Manager | WMS/WMTS** window is active, click **Connect**. This will connect to the WMS server and display all available layers. Select your layer of interest and click **Add**.

5. Close the **Data Source Manager | WMS/WMTS** window and explore the WMS layer that has been added to your viewer.
6. To leverage the time capabilities of the service, install the TimeManager plugin.

7. After the TimeManager plugin is installed, click **Plugins** (on the toolbar) > **TimeManager** > **Toggle visibility**.
The Time Manager panel will display below the map viewer.

8. In the Time Manager panel click Settings > Add raster (Time manager settings window)
9. Select the WMS layer and add the **Start time** and **End time**. Click **OK** in the *Select layer and column(s)* window and click **OK** again in the *Time manager settings* window.

10. In the *Time frame size* option, adjust the units to match the temporal resolution of the data layer (i.e. for MOD11A2_006_LST_Day_1km the *Time frame size* would be set to 8 days.)
11. Click through the time series using the play button (A) or the next arrow (B).

How to open and browse WMS layers in ArcGIS

The LP DAAC leverages ArcGIS Server to serve each WMS. This fact has an added benefit for users who have access to the ArcGIS software suite. Rather than connecting to each individual WMS, ArcGIS user can connect to LP DAAC Image Server endpoint and consume the layers as Image services. Instructions on how to connect to the Image Server are below.

1. Using the ArcCatalog window in ArcMap double-click on *Add ArcGIS Server*. 
2. In the *Add ArcGIS Server* window:
   a. Select **Use GIS services** and click **Next**
   
   ![Add ArcGIS Server window]

   b. In the **Server URL** box, enter the WMS endpoint URL:
      
3. Back in the ArcCatalog window in ArcMap:
   a. Select the newly added ArcGIS server from the list under the GIS Servers (A) folder.
   b. Select the WMS folder to list the available WMS layers/Image Services (B).
   c. Select the layer you want to view and drag into the ArcMap display (C).

4. The previous step adds an Image Service to the map viewer. Unlike OGC Web Maps Services, which return only a georeferenced map image, Image Services provide access to
image/raster data and thus can be treated as a raster – subjected to not only visualization, but also queries and geoprocessing in ArcGIS.

5. The Image Service time dimension is leveraged through the Time Slider tool. After adding the Image Service, open the layer properties and selection the Time tab. Ensure the Time Step Interval is properly set, e.g., MOD11A2_006_LST_Day_1km has an 8-day temporal resolution/Time Step Interval. Click OK.

6. Select the Time Slider tool (A) from the toolbar and click the next or play button (B) in the Time Slider tool to explore the time series.