THE GLOBE PROGRAM

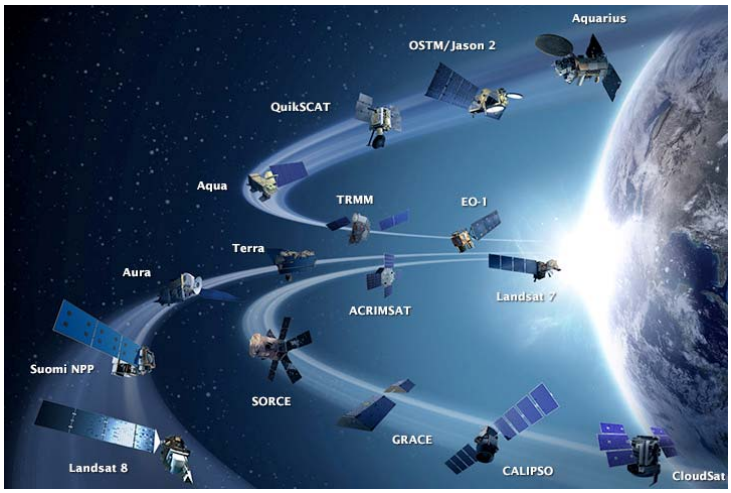
Global Learning and Observations to Benefit the Environment

Working with NASA's GIOVANNI Interactive Visualization and Analysis tool

Visualizing MODIS Aerosol Optical Thickness data

NASA's GIOVANNI Interactive Visualization and Analysis tool allows the exploring of a wide variety of satellite Earth observation data from instruments on board of NASA satellites both from the Earth surface and atmosphere.

Figure 1. NASA's Earth Science Satellite Fleet (source: NASA, Image of the Day, http://earthobservatory.nasa.gov/IOTD/view.php?id=81559).



The atmospheric data set includes satellite obtained information on aerosols, such as aerosol optical thickness data by the MODIS (Moderate Resolution Imaging Spectroradiometer) instruments on board of NASA's Terra and Aqua satellites. The Terra and Aqua satellites are polar orbiting satellites with a daily worldwide coverage. This means the satellites circle around the Earth passing the poles in every single orbit, but a different part of the rest of the Earth every time in such a way they can observe the entire Earth in a single day. The Terra satellite is part of the A-Train of Earth Observation satellites. It's daytime overpass is in the morning, generally between 10 am and noon. The daytime overpass of Aqua, passing over in the afternoon, generally is between 1 and 3 pm.

The GIOVANNI tool, although mostly used by scientists, is accessible for everyone who wants to explore… but what buttons should be clicked to see what you want to see? This guide is a stepwise recipe to explore MODIS Aerosol Optical Thickness (AOT) data, which can be used as a first comparison to GLOBE Aerosols sun photometer measurements.

Step by step guide

First go to the GIOVANNI website by typing in this URL in your webbrowser: http://disc.sci.gsfc.nasa.gov/giovanni.

On the front page of this website (see **Figure 2**) you will see the main menu, including a ***+What is GIOVANNI?***, on the left and in the middle a list of ***Giovanni Portals***. Now,

1. click on ***Application and Education Portal*** tab in this list. A drop down menu will appear.

Figure 2. Front page of the GIOVANNI Interactive Visualization and Analysis tool website.

2. Scroll down this menu and choose ***Education> Data-enhanced Investigation for Climate Science Education (DICCE) Basic Daily Data***. This will direct you to the GIOVANNI educators and students user interface (see **Figure 3**). Here, you can select several types of climate science related data and plot them either on a map or as a time series of a specific location. It is the starting point for the following two examples.

Figure 3. GIOVANNI sub webpage *Data-enhanced Investigation for Climate Science Education (DICCE) Basic Daily Data*.

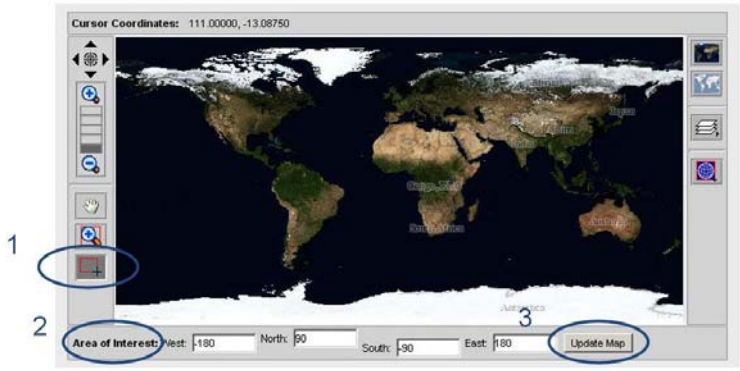
In the first example, we guide you through the making of a map of MODIS AOT over Europe. In **Example 2**, we show how to make a time series of MODIS AOT on a specific location, the location of Damstede school in Amsterdam, the Netherlands.

Example 1: MODIS Aqua AOT over Europe on 8 July 2013

On 8 July 2013, a plume of smoke aerosols originating from North American forest fires is observed over the southern part of Scandinavia. The smoke cloud was observed by instruments from the ground, causing elevated AOT levels which were also detected by MODIS Aqua.
To visualize MODIS Aqua AOT observed over Europe on this day, first,

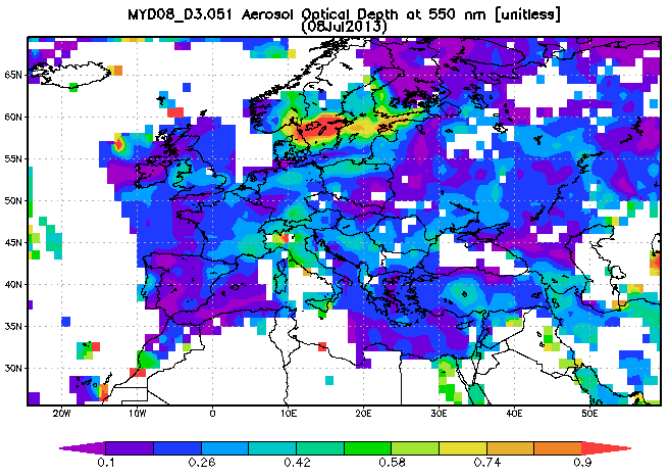
1. go to ***Select*** > ***Spatial*** section to select the visualization area. This you can do either by using the area selection tool (indicated by 1 in **Figure 4**) or by entering the corner coordinates (in degrees) of the desired area in the designated fill out boxed (2 in **Figure 4)**. Choose your option to select the area from 25 ˚W–60 ˚E and 25 ˚N–70 ˚N, and click ***Update Map*** (3 in **Figure 4)** to zoom in over Europe.

Figure 4. Selection of the desired area.



2. Second, go to the ***Parameter*** section. In the box ***Moderate Resolution Imaging Spectro-radiometer (MODIS)*** aerosol measurements obtained by either one of the MODIS instruments, on board of Aqua and Terra, is listed. To plot MODIS Aqua AOT, select ***Aerosol Optical Depth at 550 nm*** at the top of the list (where ***Data Product Info*** reads: ***MYD08_D3.051, MODIS-Aqua Ver. 5.1, 2002/07/04 - 2013/09/08***).
3. Then, go to the ***Temporal*** section and select the date, 8 July 2013.
4. In the ***Select Visualization*** section you can choose the type of visualization. Choose here, ***Lat-Lon map, Time-averaged***. By clicking ***Edit Preferences*** you can make edit the visualization preferences (for example, change the plotting scale or palette color). You don't need to change these preferences for now. The standard plotting preferences are good enough for a first view and can also be edited later on.
5. Now click the **Generate Visualization** button to view the selected satellite data. It may take a minute to see page with ***Visualization Results***, containing the map shown in **Figure 5**. The elevated AOT levels over the southern part of Scandinavia reveal the forest fire smoke plume.

Figure 5. MODIS Aqua AOT over Europe at 8 July 2013 revealing the forest fire smoke plume over southern Scandinavia (in red and yellow).



6. To edit the plotting preferences or select a different area or time period, scroll down the ***Visualization Results*** and make the desired changes and click the ***Submit Refinements*** button at the bottom to see the results.
7. To download the visualized data go the ***Download Data tab***. You can save the graph to your disk by right-clicking on the ***.gif*** file name in the ***Output Files*** section of ***Two Dimensional Map Plot***.

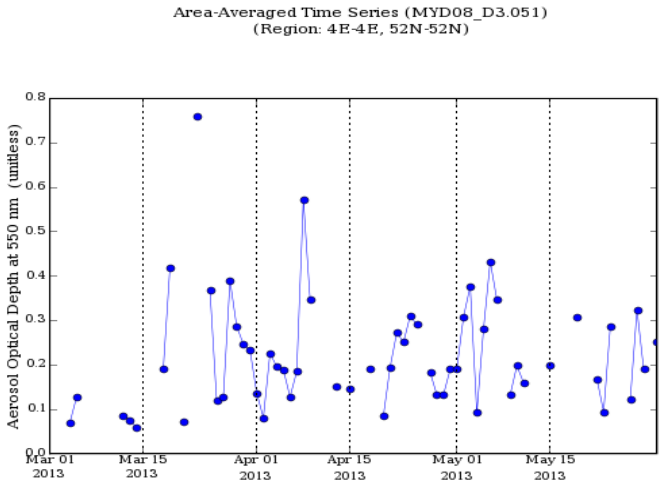
Example 2: MODIS Aqua AOT for Damstede school in the GLOBE Aerosols spring campaign 2013

In 2013, the European GLOBE Aerosols Spring Measurement Campaign lasted from 1 March to 31 May. In this period schools throughout Europe participated in taking sun photometer measurements. Here we will extract a time series of MODIS Aqua AOT for the same period and for the location of Damstede school in Amsterdam, the Netherlands.

We start from the ***Data-enhanced Investigation for Climate Science Education (DICCE) Basic Daily Data*** user interface. (So, go back to the main page of this user interface if you just ran through **Example 1**).

1. First, we need to select the location of the school in the ***Select*** > ***Spatial*** section. Damstede school is located at 52.833 °N, 4.933 °E. Enter the coordinates of Damstede school in the designated boxes (see 2 in **Figure 4).** This you need to do twice, once in the boxes ***North*** and ***West***, once in the boxes ***South*** and ***East***. Then click ***Update Map*** (3 in **Figure 4)** to select the location.
2. Next, go to the ***Parameter*** section and check MODIS Aqua AOT in the box ***Moderate Resolution Imaging Spectro-radiometer (MODIS)*** (see step 2 of **Example 1**).
3. Go to the ***Temporal*** section and select the time period, 1 March – 31 May 2013.
4. In the ***Select Visualization*** section, choose ***Time series***.
5. Then, click the **Generate Visualization** button to view the time series of the selected data set. In a few seconds, you will be directed to the ***Visualization Results***, where you will see the time series of MODIS Aqua AOT data as is shown in **Figure 6**.

Figure 6. MODIS Aqua AOT at the location of Damstede school in Amsterdam the Netherlands, 1 March – 31 May 2013.



6. Follow step 7 of **Example 1** to select a different location, period or to edit other visualization preferences.
7. See step 8 of **Example 1** to see how to download the graph. To make a download to view and plot the data with another program, for example with MS Excel, go to ***Input Files*** in the ***Time-Series Rendering*** section, check ***ASC*** and press ***Download Batch*** button. This will start the download of the data in a text file (ASCII format) suitable for a wide range of data processing programs.

You are now ready to start exploring MODIS Aerosol Optical Thickness data, make you own MODIS AOT maps and time series!