

## Nairobi Air Quality Workshop, Nairobi, Kenya, 11 February 2019

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We're going to use the online Giovanni tool (<https://giovanni.gsfc.nasa.gov/giovanni/>) to answer a few questions about NO<sub>2</sub> over East Africa using observations from the Ozone Monitoring Instrument (OMI):

1. What information does OMI provide about NO<sub>2</sub>?
2. What is the tropospheric column concentration of NO<sub>2</sub> over East Africa? We will focus on concentrations averaged over June to August 2006.
3. How do tropospheric column concentrations of NO<sub>2</sub> in East Africa compare to column concentrations in South Africa during the same time period?
4. Are tropospheric column concentrations higher in South Africa in June-August 2006 or December 2005 to February 2006?

Instructions guide: → indicates an action. **Text in red** is a description of the result.

### **Task 1:**

Let's first ensure we know enough about the satellite and instrument to proceed with the data analysis.

- a. What is NO<sub>x</sub>?
- b. What are the sources of NO<sub>x</sub>?

→ Go to [https://en.wikipedia.org/wiki/Aura\\_\(satellite\)](https://en.wikipedia.org/wiki/Aura_(satellite)) for information about the Aura satellite that the instrument is on to answer these questions:

- c. Why was it launched?
- d. What year was it launched?
- e. How does it orbit the Earth?
- f. At what time does it pass overhead?
- g. What instruments does it have onboard?

→ Go to <https://aura.gsfc.nasa.gov/omi.html> for information about the OMI instrument and answer the following questions:

- h. What is the ground or pixel resolution of the instrument?
- i. What wavelength range does it measure?
- j. Where is this in the electromagnetic spectrum?
- k. What air pollutants does it measure?

**In what follows we are going to use the NASA Giovanni tool to look at maps of tropospheric column NO<sub>2</sub> in East Africa and compare these to maps over South Africa.**

### **Task 2:**

Follow these individual steps to use the Giovanni tool.

→ Go to <https://giovanni.gsfc.nasa.gov/giovanni/>. If you get a “Welcome to Giovanni” box, click “Login” and enter the unique username and password you created when you registered for Earthdata.

Wait to be redirected to the application.

→ On the left side of the screen under “Disciplines” select “Atmospheric Chemistry (76)”.

This will lead to a decrease in the number of options available under “Measurements” and also display a table of variable options.

→ Under “Measurements” select “NO<sub>2</sub> (2)”.

This will display 2 options in the table of variables. Take a look at the information provided. There are details of the variable (total column, tropospheric column), the source (in this case the satellite instrument, OMI), temporal averaging (daily only – other variables can include monthly, daily, hourly, 3-hourly etc.), spatial averaging (0.25 degrees or about 25 km), date ranges for which the data is available, and units (1/cm<sup>2</sup> is actually molecules per square centimetre or molecules cm<sup>-2</sup>)

→ In the Variables table select the tropospheric column NO<sub>2</sub> data (“NO<sub>2</sub> Tropospheric Column...”).

→ Under “Select Date Range (UTC)” either choose the range 1 June 2006 to 31 August 2006 by clicking on the blue calendar icon or enter the range manually (date format: YYYY – MM – DD).

The date and region boxes should now no longer be empty.

→ Under “Select Region (Bounding Box or Shape)” click the blue folded page icon. A map will appear. Drag a box over East Africa. No need to be precise here. Just be sure to include all countries of participants (Kenya, Rwanda, Tanzania). Close the box by clicking the arrow on the top right of the box. There is also the option to enter the coordinates manually in the format minimum longitude; minimum latitude; maximum longitude; maximum latitude)

→ Click the green “Plot Data” button on the bottom right of the page.

You will be redirected to a new page with a bar that tracks the progress of processing the data. Once complete it will generate a map of the data you selected.

→ Click the “Options” menu at the top right of the map, then click the Options symbol.

This will display all the options available to customize your map.

→ Change the colorbar by clicking “View All Pallettes” and selecting the “Air Quality Index (Cust), 8” colorbar (or any other colorbar you prefer).

→ Change the colorbar range. First ensure that Minimum is set to 0.0. Then change maximum to 5e15.

→ Change Smoothing from Off to On if you would like to display smoothed data (rather than averaged in each grid square).

→ Keep Scaling set to Linear.

→ Once done click “Re-Plot” to apply changes.

→ Click “Options” to minimize the options screen.

Once you're satisfied with the way the data is plotted, go ahead and download the data.

→ Click “Download” right of the “Options” tab. Choose PNG. A file will download with some default filename. Rename this file so that you can identify it again later.

→ Question: What are the spatial features in the map? Where is NO<sub>2</sub> high and where is it low? What do you think causes these spatial features?

### **Task 3:**

→ Click “Back to Data Selection”

→ Follow the same procedure to plot Jun-Aug 2006 OMI tropospheric NO<sub>2</sub> over South Africa. Place it on the same colorscale and color bar as the East Africa map.

Notice that on the plot page all your previous work is stored in the browse history.

→ Once you have the 2 maps place them side by side (in Powerpoint or a similar programme) and compare the output. What are the differences? Why do you think these differences occur?

### **Task 4:**

→ Click “Back to Data Selection”

→ Follow the same procedure to plot December 2005 to February 2006 OMI tropospheric NO<sub>2</sub> over South Africa. Place it on the same colorscale and color bar as the previous plots and place the 2 South Africa maps side by side.

→ Questions: What is the difference between these two plots? What do you think causes this difference?