National Aeronautics and Space Administration

Trace Gas Data Access, Tools, and Analysis

Pawan Gupta and Melanie Follette-Cook

Satellite Remote Sensing of Air Quality, 18-19 November 2018

Learning Objectives

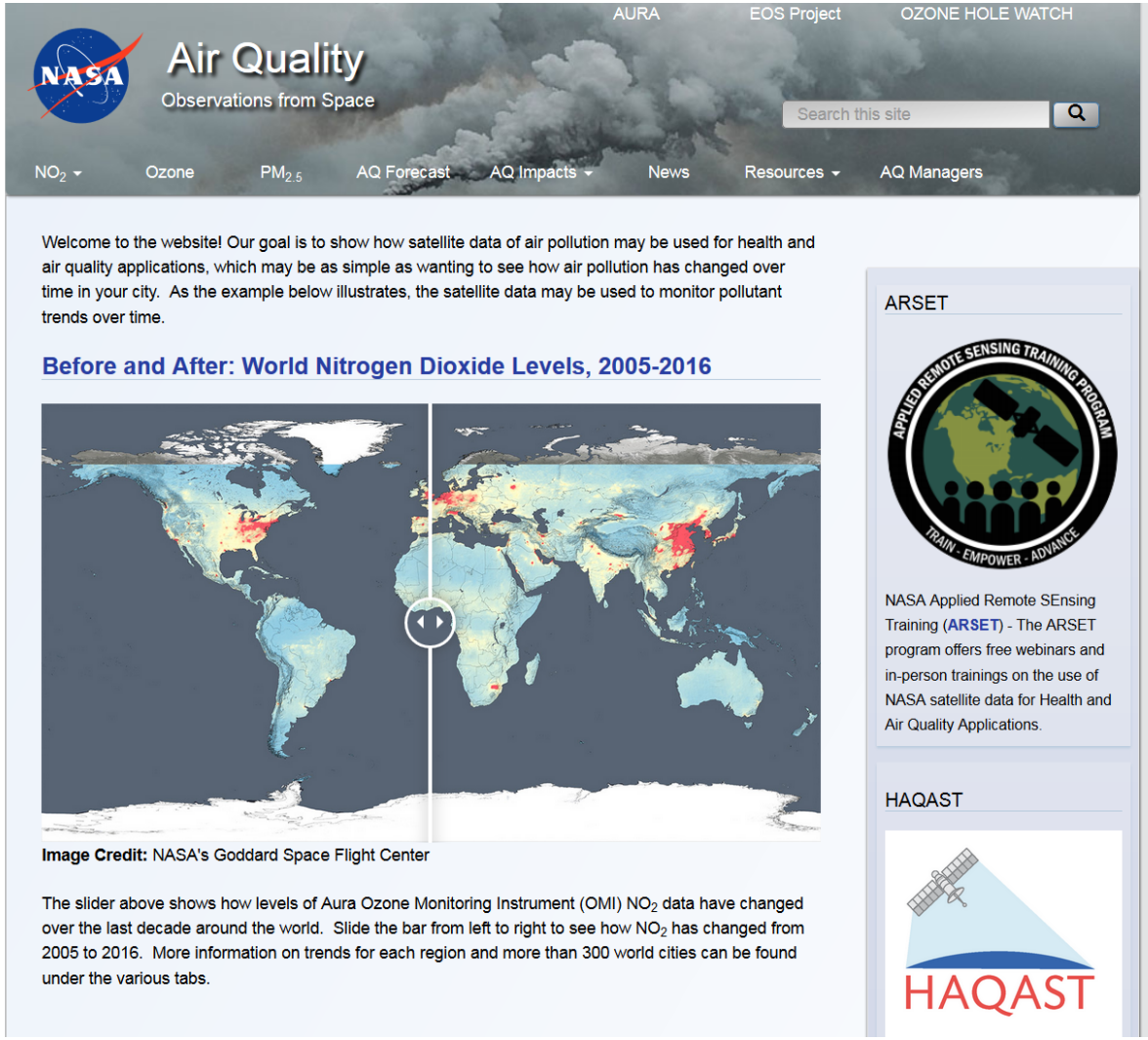
By the end of this training, you will be:

- able to navigate the NASA air quality website, which currently features OMI NO_2
- capable of looking up a NASA air quality forecast for your area
- familiar with OMI Level 3 NO_2 and SO_2 data products and the online visualization and access tool, Giovanni
- able to download Level 2 and 3 data using Earthdata

Goddard's Air Quality Website

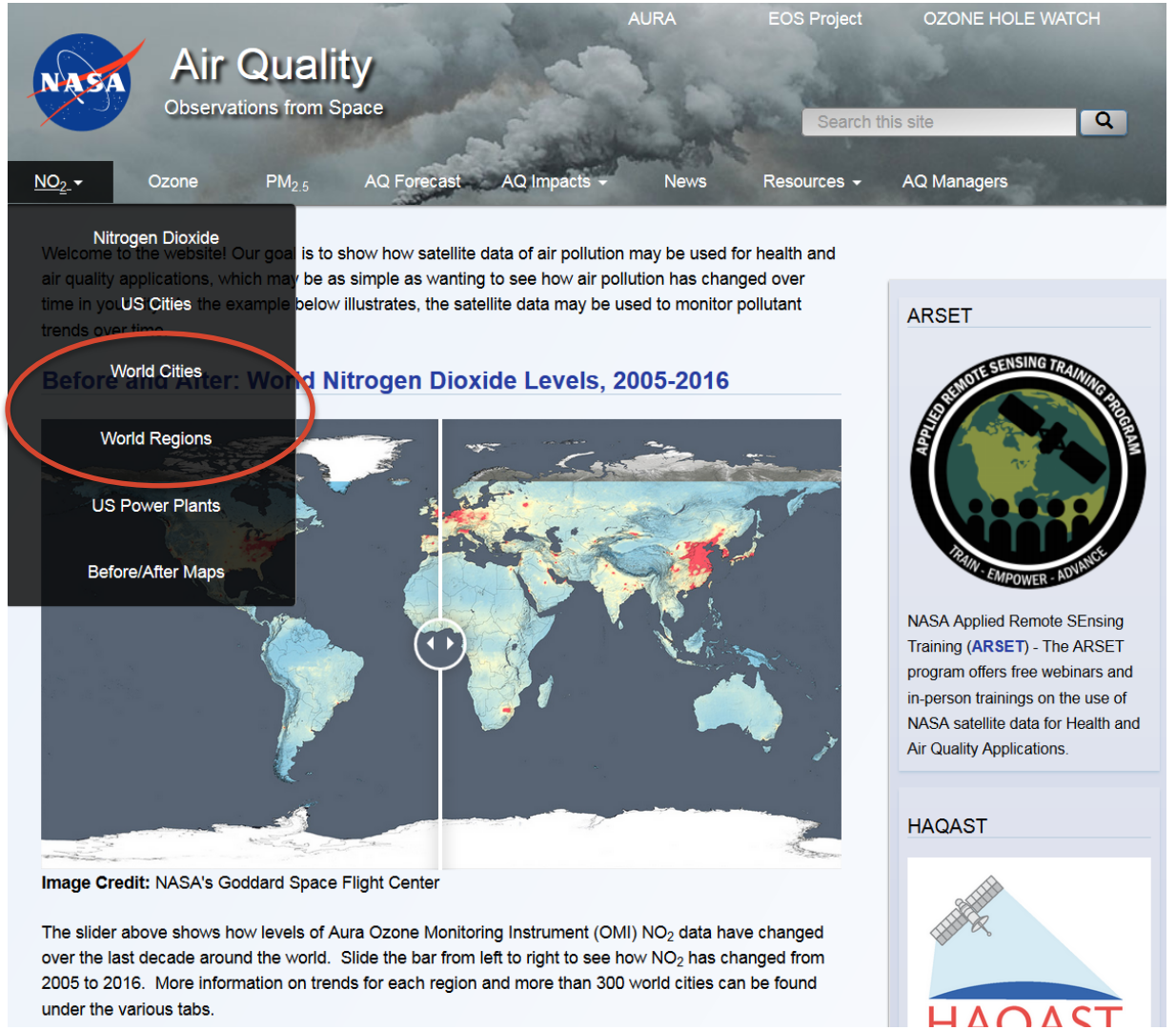
OMI NO_2: https://airquality.gsfc.nasa.gov

- Download pre-made plots of OMI NO_2 (OMNO2d v3) for over 300 world cities
- Download OMI NO_2 data (ASCII, Excel – not yet, but soon) for ~300 world cities

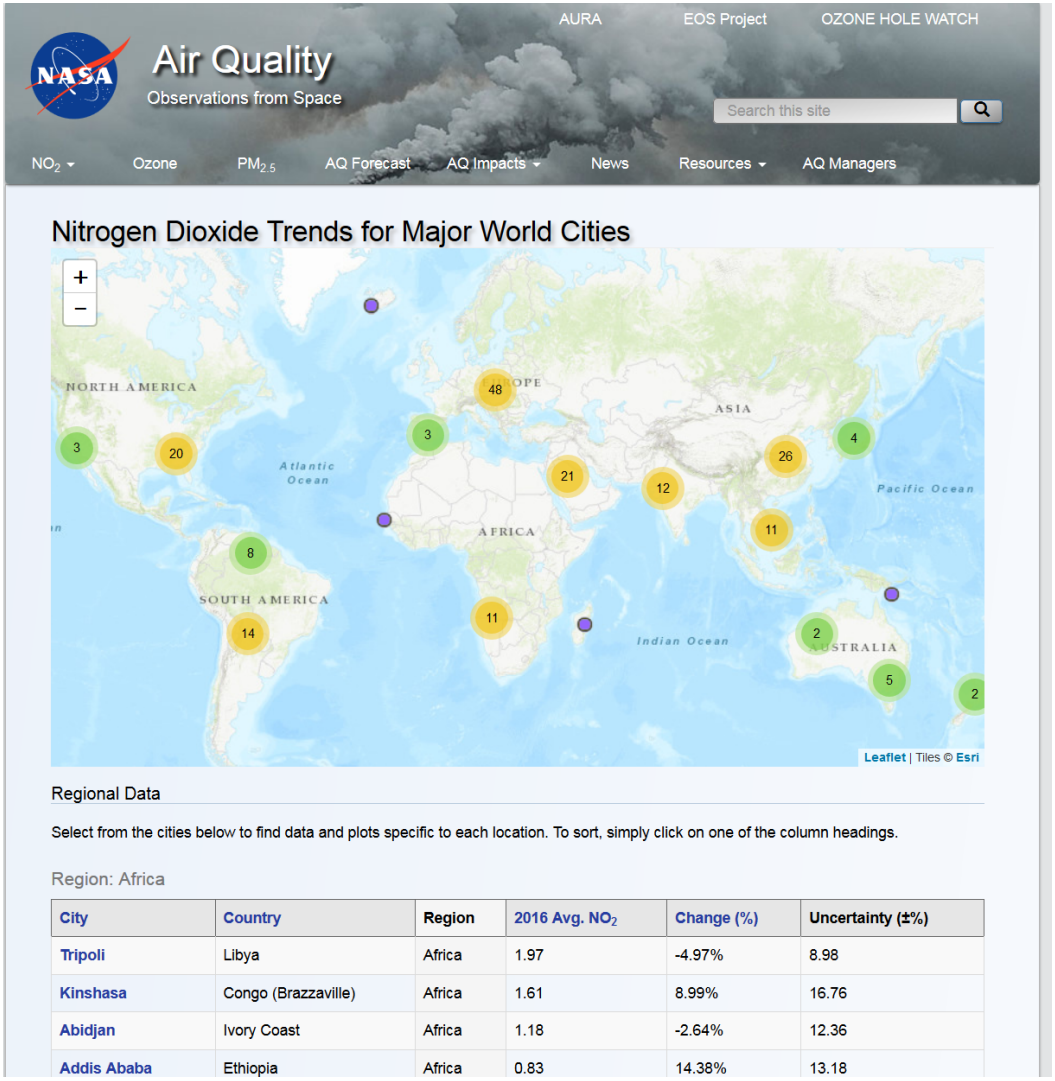


OMI NO_2

- There are several ways to get OMI NO_2 trend data for a city or region
  - Demo: via "World Cities"
  - Exercise: via "World Regions"

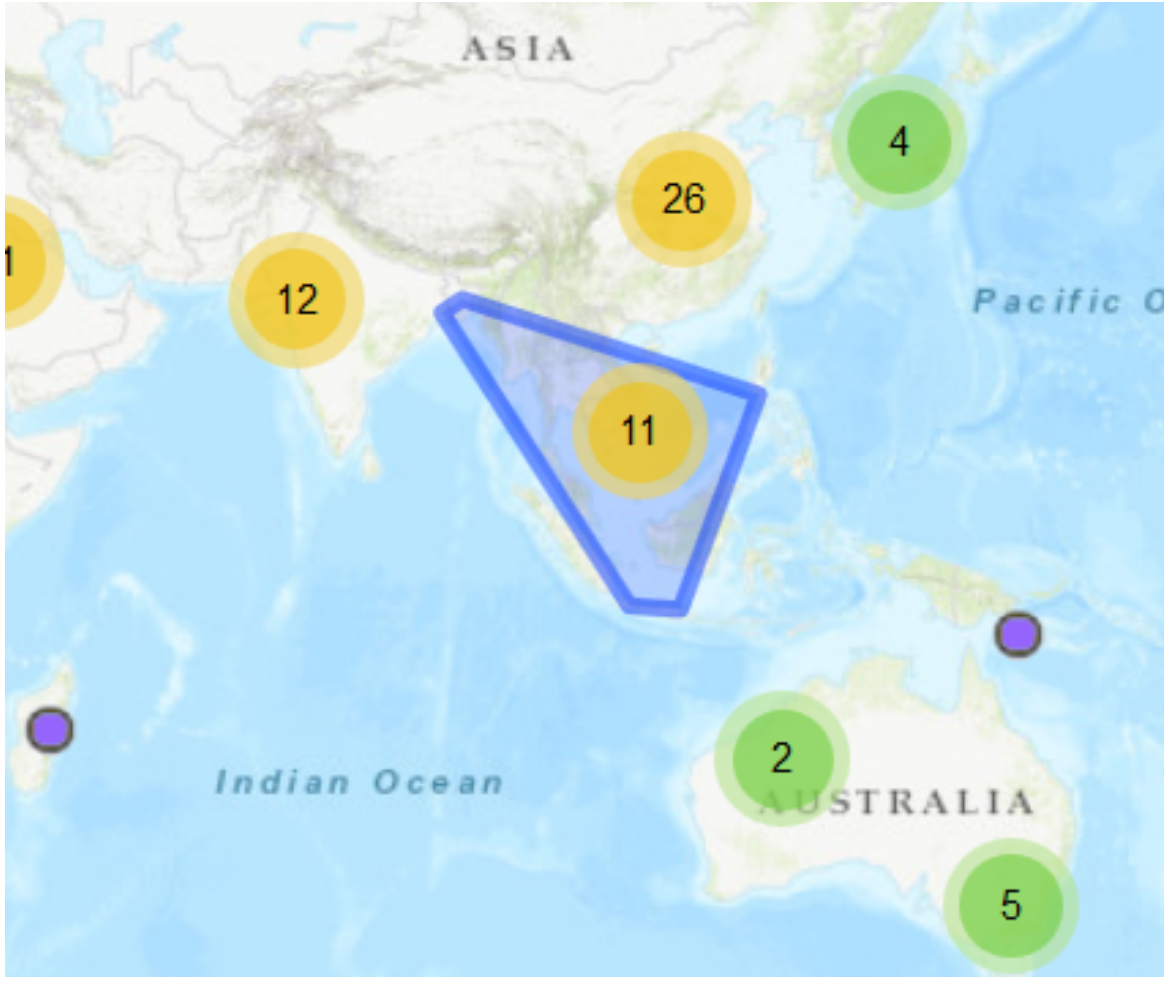


OMI NO_2: Demo via "World Cities"



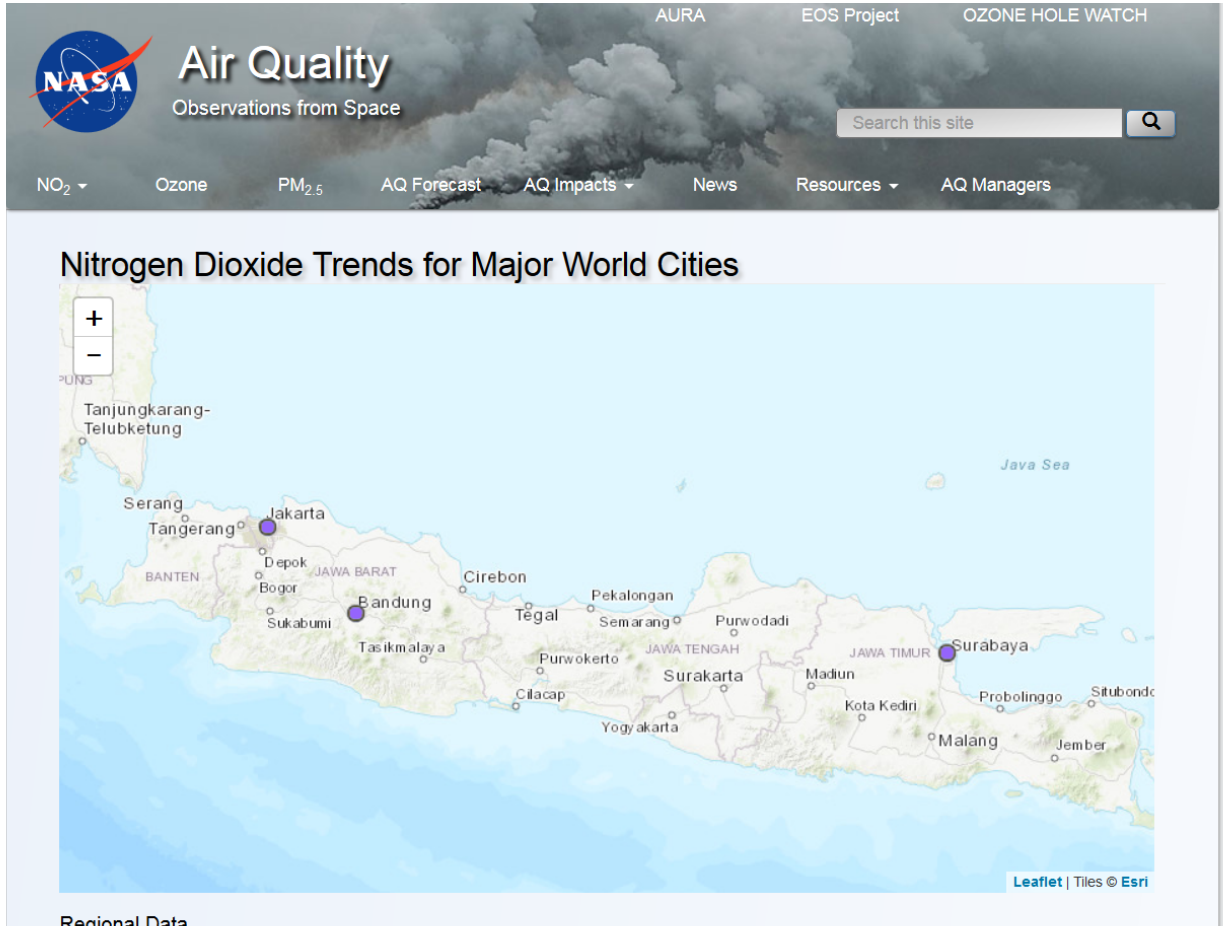
City	Country	Region	2016 Avg. NO_2	Change (%)	Uncertainty (±%)
Tripoli	Libya	Africa	1.97	-4.97%	8.98
Kinshasa	Congo (Brazzaville)	Africa	1.61	8.99%	16.76
Abidjan	Ivory Coast	Africa	1.18	-2.64%	12.36
Addis Ababa	Ethiopia	Africa	0.83	14.38%	13.18

Click on the Southeast Asia region

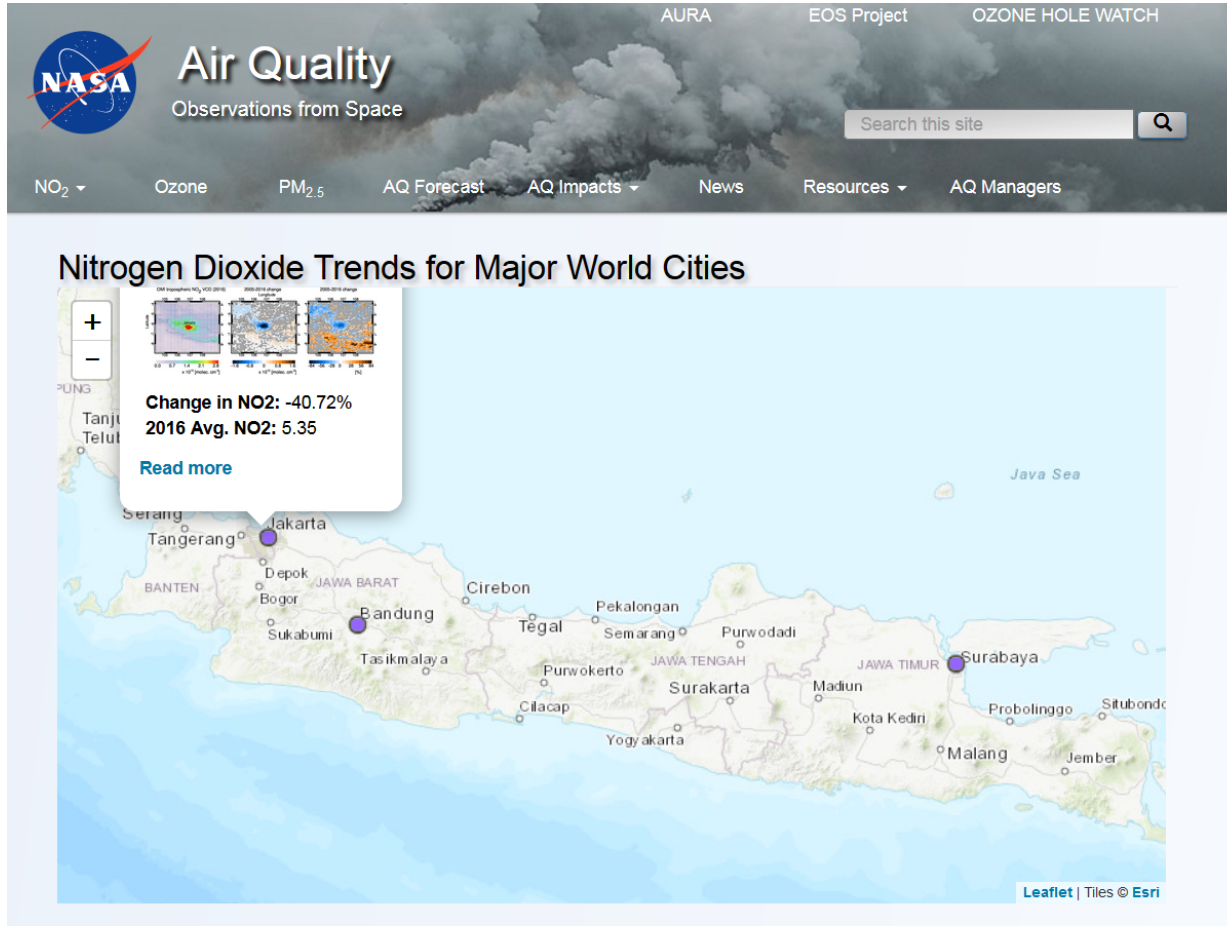


OMI NO_2: Demo via "World Cities"

Keep clicking until you reach Java

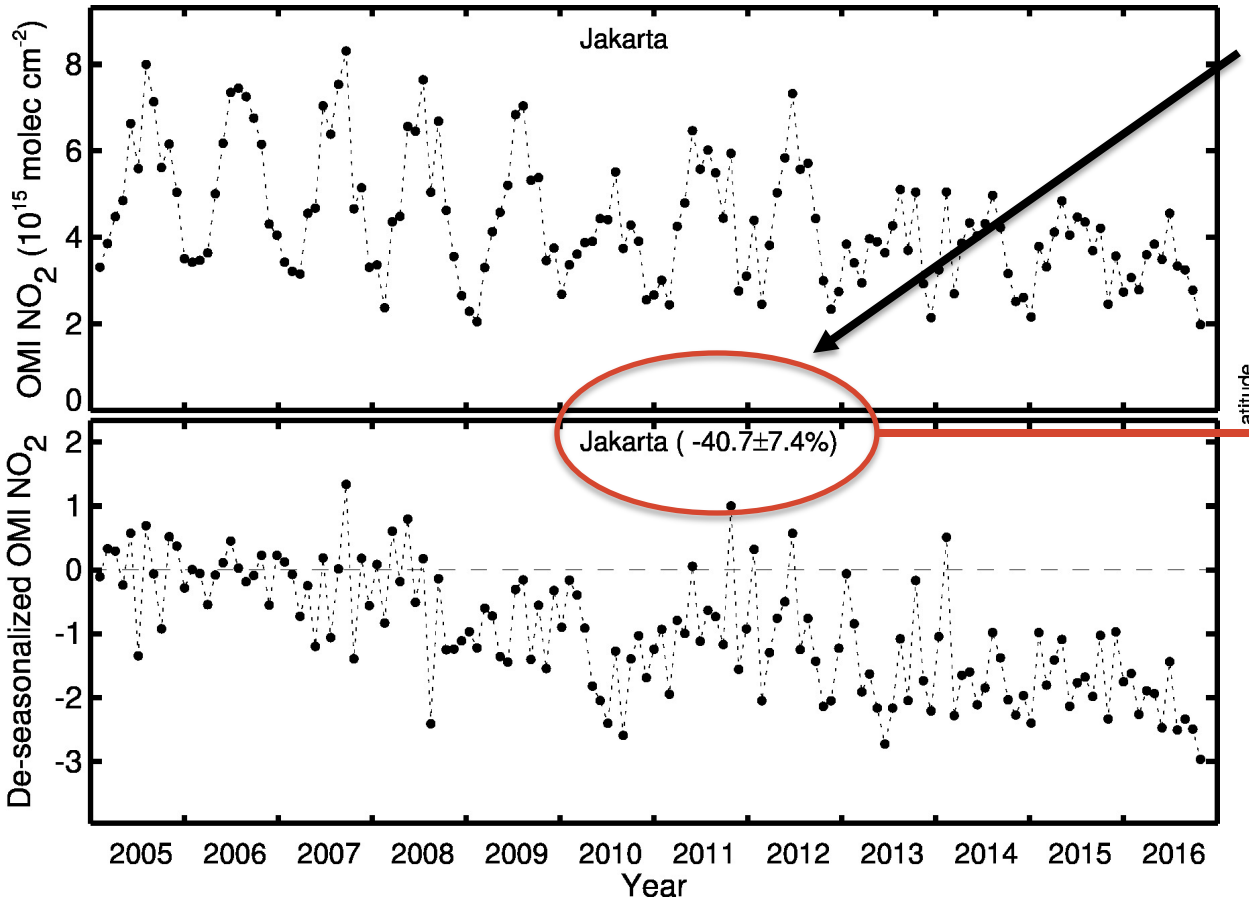


Click on "Jakarta" & "Read More"

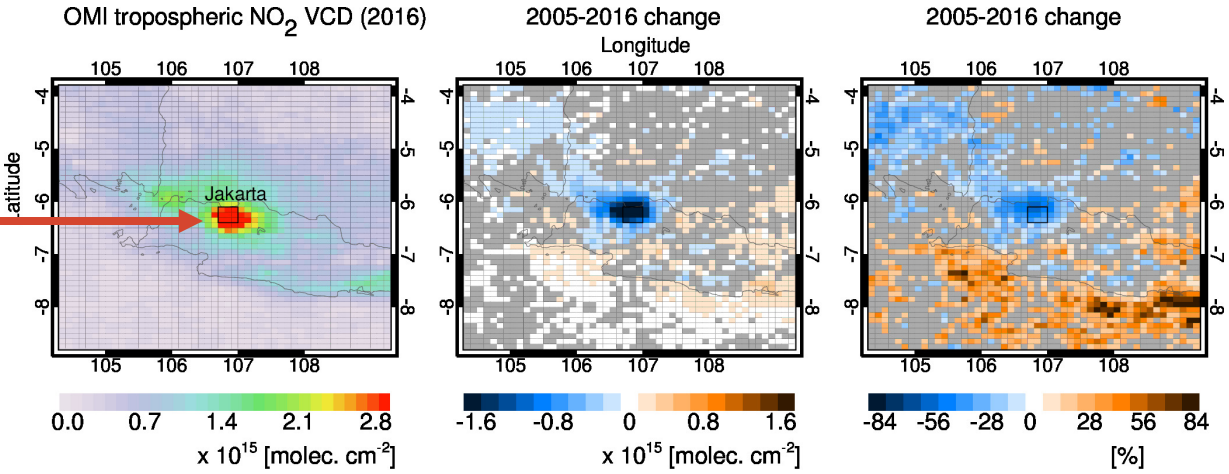


OMI NO_2: Demo via "World Cities"

Jakarta



Percent trend from 2005 to 2016 for the area inside the box



OMI NO_2: Demo via "World Cities"

- Why did OMI NO_2 levels decrease in Jakarta?

- What are the trends in OMI NO_2 in Bandung and Surabaya?

OMI NO_2: Exercise: via "World Regions"

- What is the trend in OMI NO_2 for your favorite city?

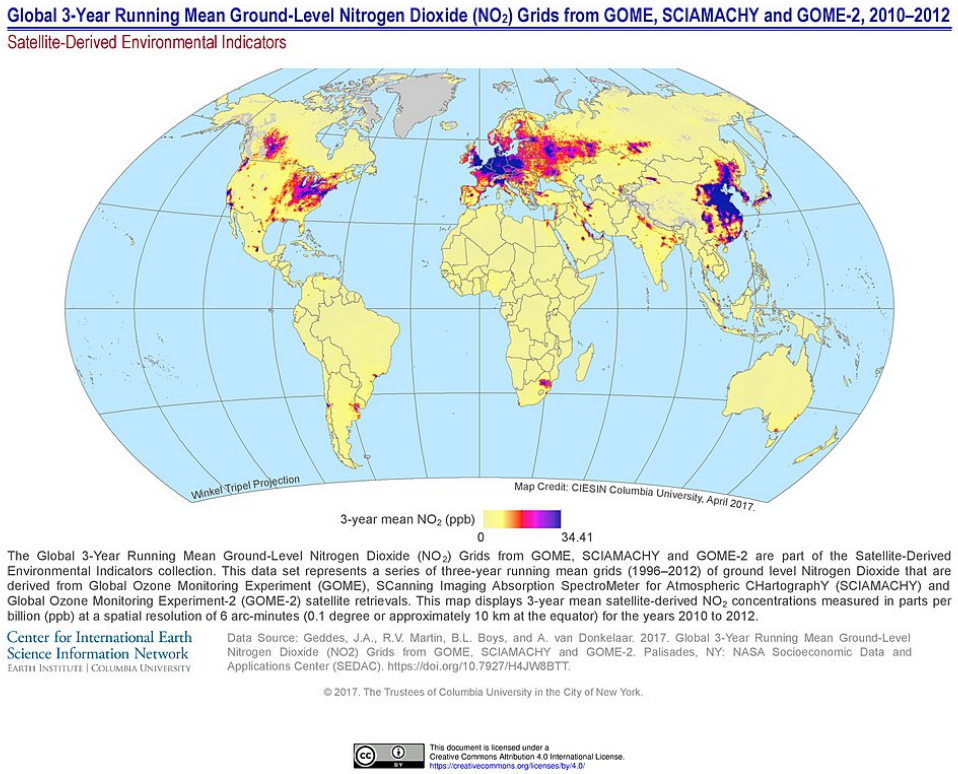
- Compare the trend in your favorite city to the trend in Ho Chi Minh City, Vietnam

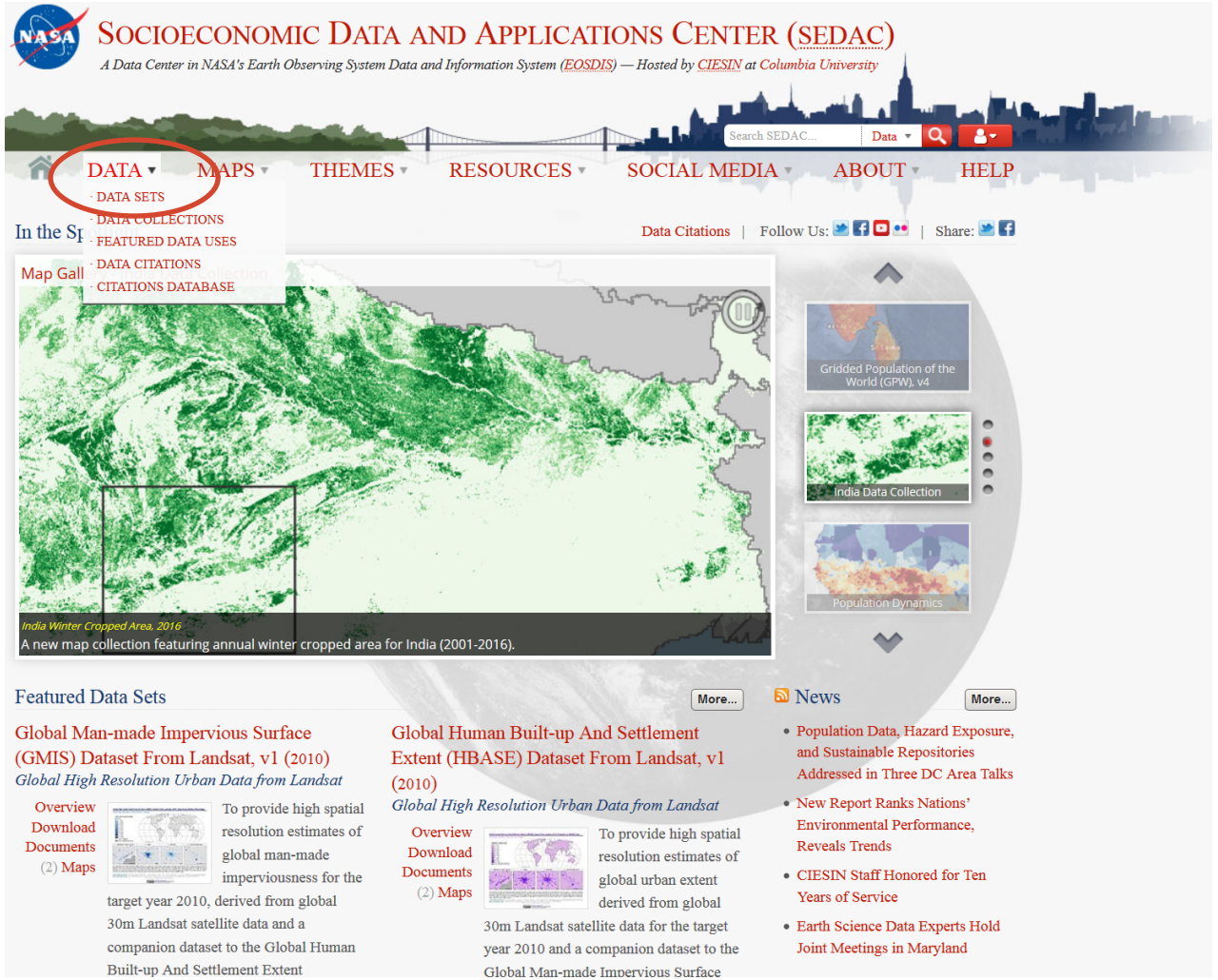
Annual Mean Surface NO_2 Estimates

GOME, SCIAMACHY, GOME-2 Annual Mean Surface NO_2

http://sedac.ciesin.columbia.edu/

- Download data and pre-made images of surface NO_2 inferred from satellite observations





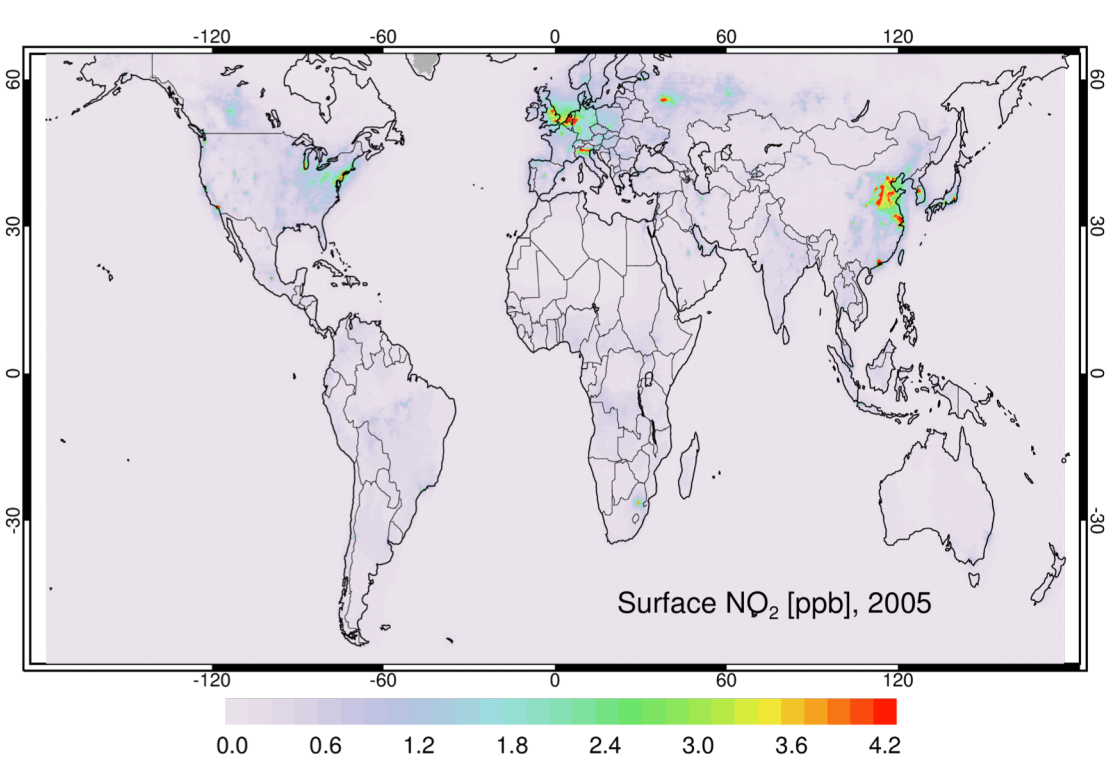
GOME, SCIAMACHY, GOME-2 Annual Mean Surface NO_2

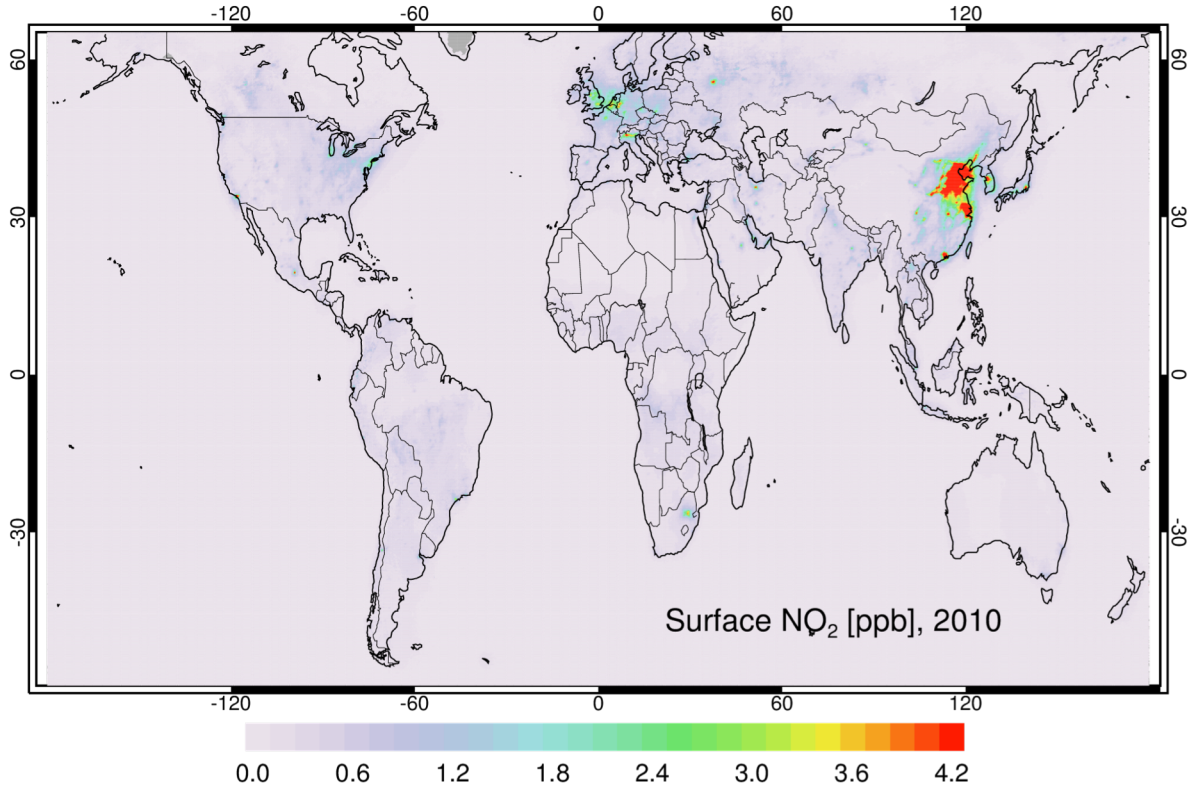
http://sedac.ciesin.columbia.edu/

- Download data of surface NO_2 inferred from satellite observations from 1996 to 2012
  - Download GeoTIFF files
  - Download ASCII and HDF files from http://fizz.phys.dal.ca/~atmos/martin/?page_id=232

OMI Annual Mean Surface NO_2

http://sedac.ciesin.columbia.edu/





Lok Lamsal (NASA)

OMI Monthly Mean Surface NO_2 Data

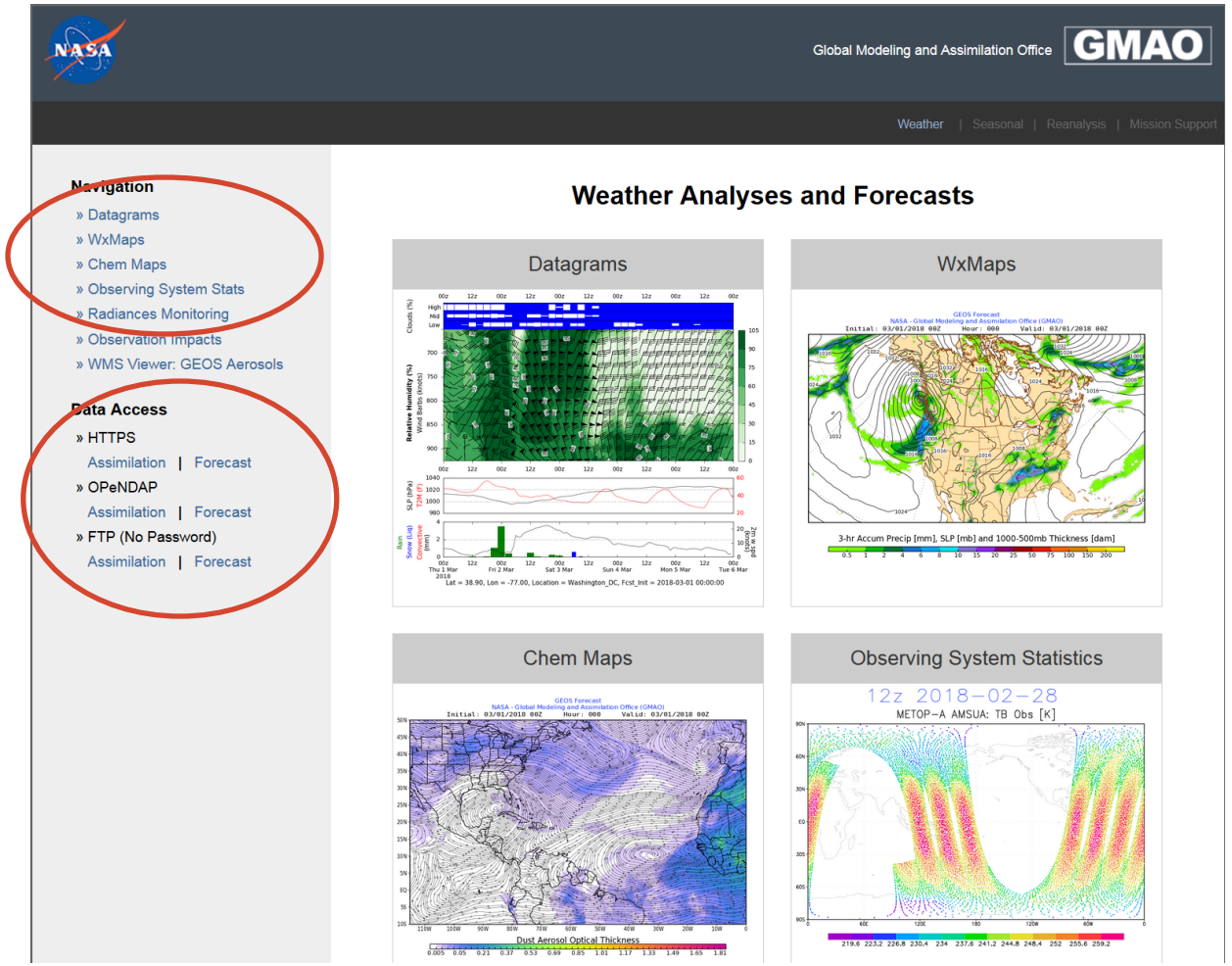
https://avdc.gsfc.nasa.gov/pub/data/satellite/Aura/OMI/V03/L4/OMI_Surface_NO2/Monthly/

- Download monthly mean surface estimates of NO_2 from OMI data (2005-2016)
- File formats are ".h5" so some software (e.g., Python, Matlab) may be necessary to read the files
- Within 5 years or so, hopefully one continuous NO_2 record (1996-present) will become available

NASA Atmospheric Composition Forecasts

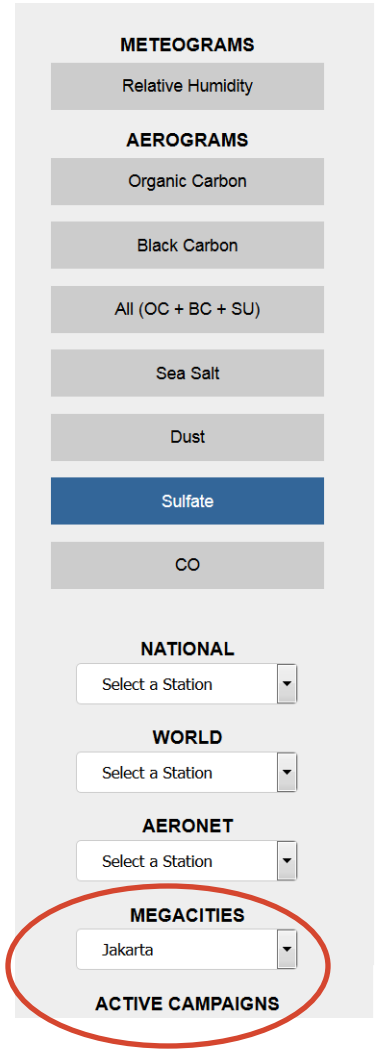
NASA Forecasts: https://fluid.nccs.nasa.gov/weather/

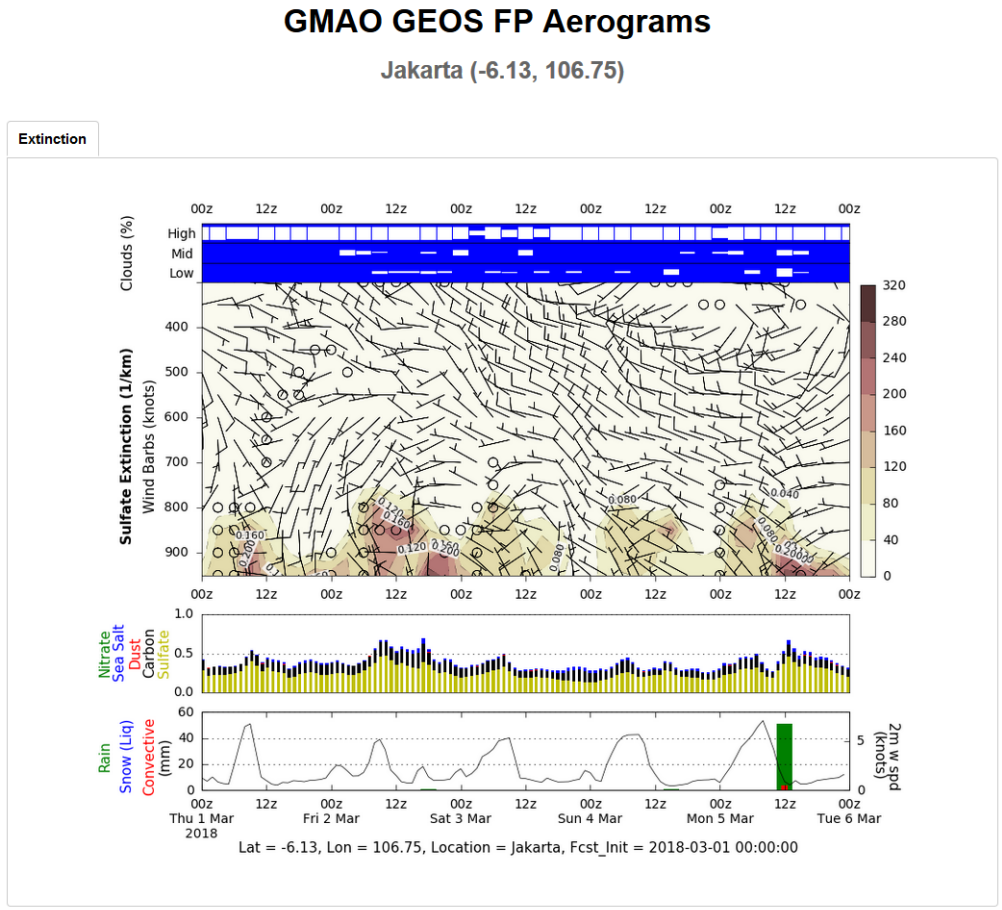
- NASA's global weather and atmospheric composition forecasts
  - Currently, the forecast system does include aerosols and CO, but not other trace gases like ozone and NO_2



NASA GMAO

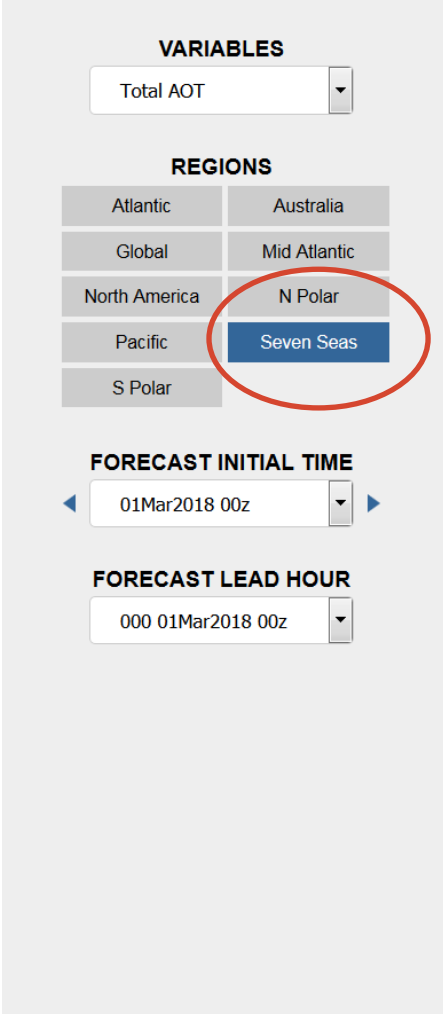
NASA Atmospheric Composition Forecasts: Datagrams

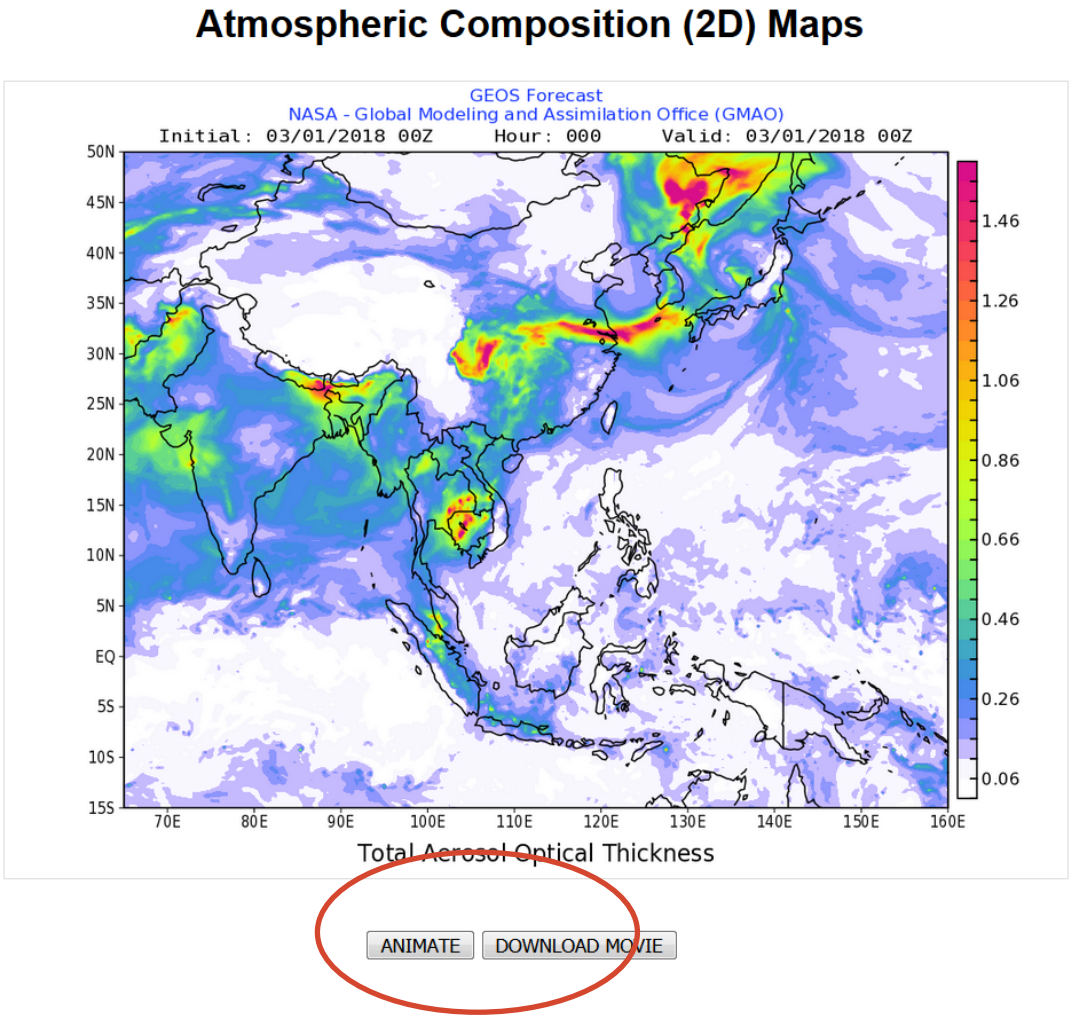




NASA GMAO

NASA Atmospheric Composition Forecasts: Datagrams





NASA GMAO

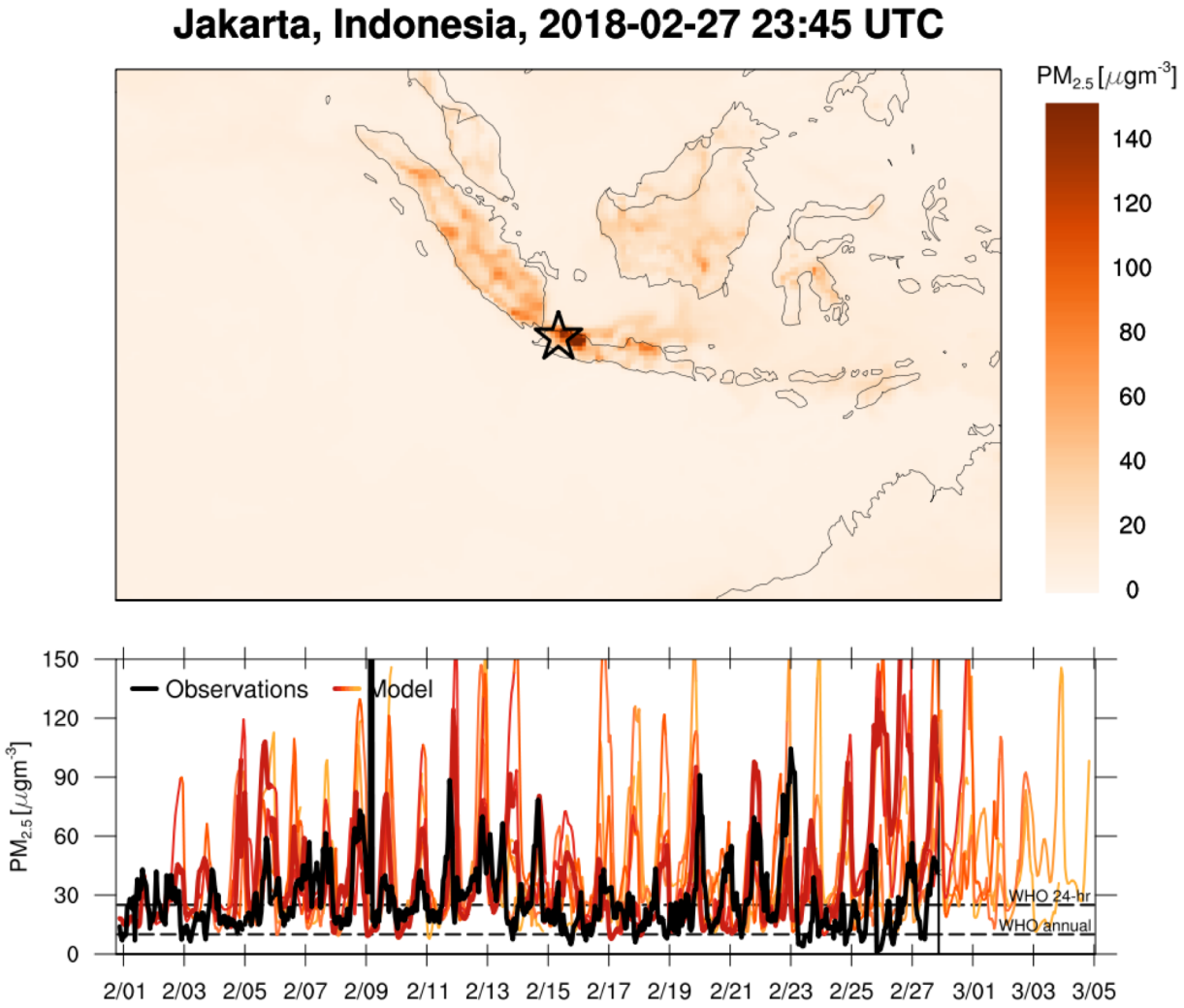
NASA Atmospheric Composition Forecasts: Datagrams

- Compare the forecast for the chemical composition of aerosols in Surabaya to that in Bandkok (Bangkok)

- What is the forecast for CO in Surabaya at the surface and 600 mb?

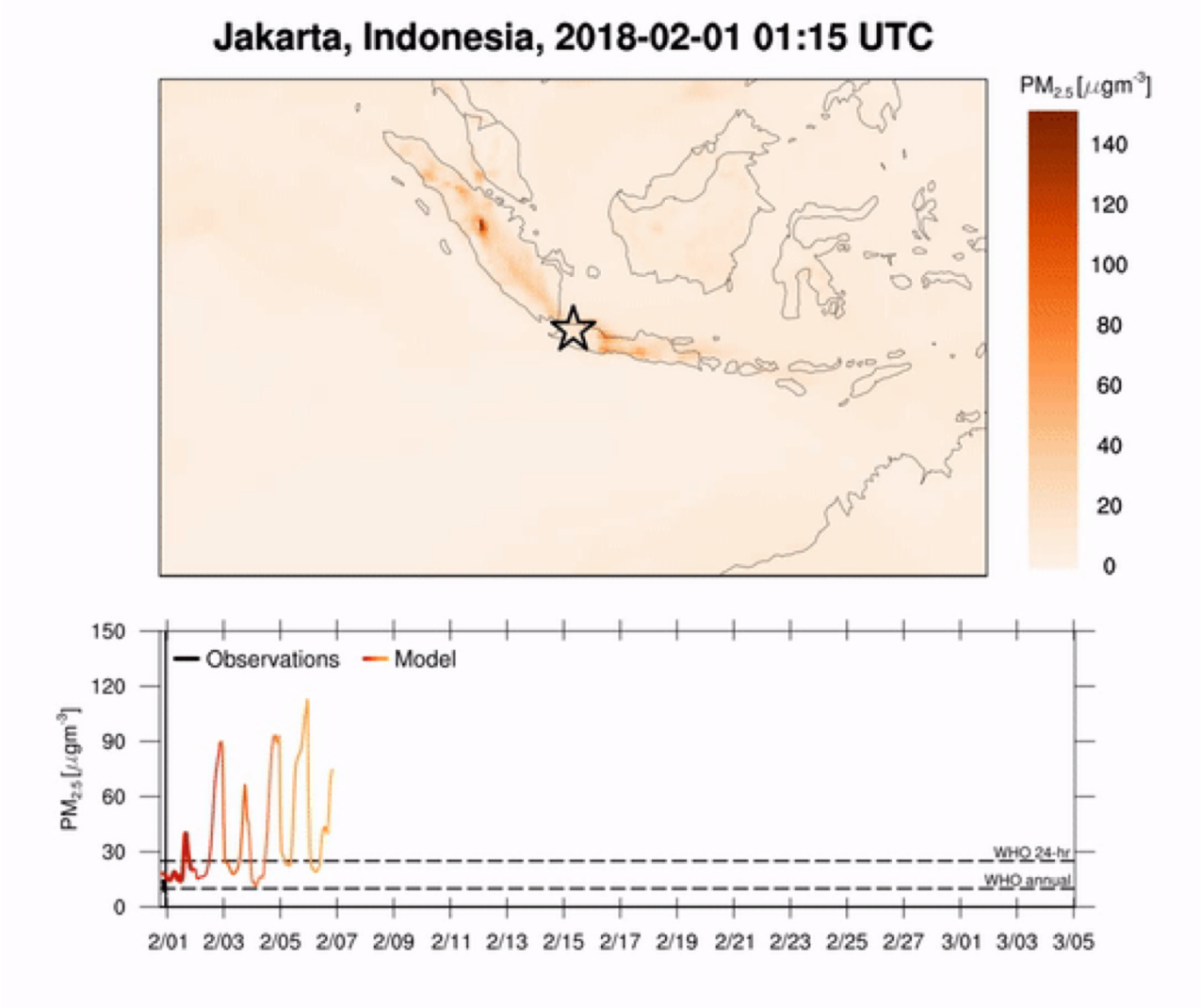
NASA's Upcoming Air Quality Forecasts

- NASA's global weather and atmospheric composition forecasts
  - Currently, the forecast system does include aerosols and CO, but not other trace gases like ozone and NO_2
  - At some point in 2018, surface particulate matter, ozone, NO_2, and other trace gases will be added to the system



Christoph Keller, NASA GMAO

NASA's Upcoming Air Quality Forecasts



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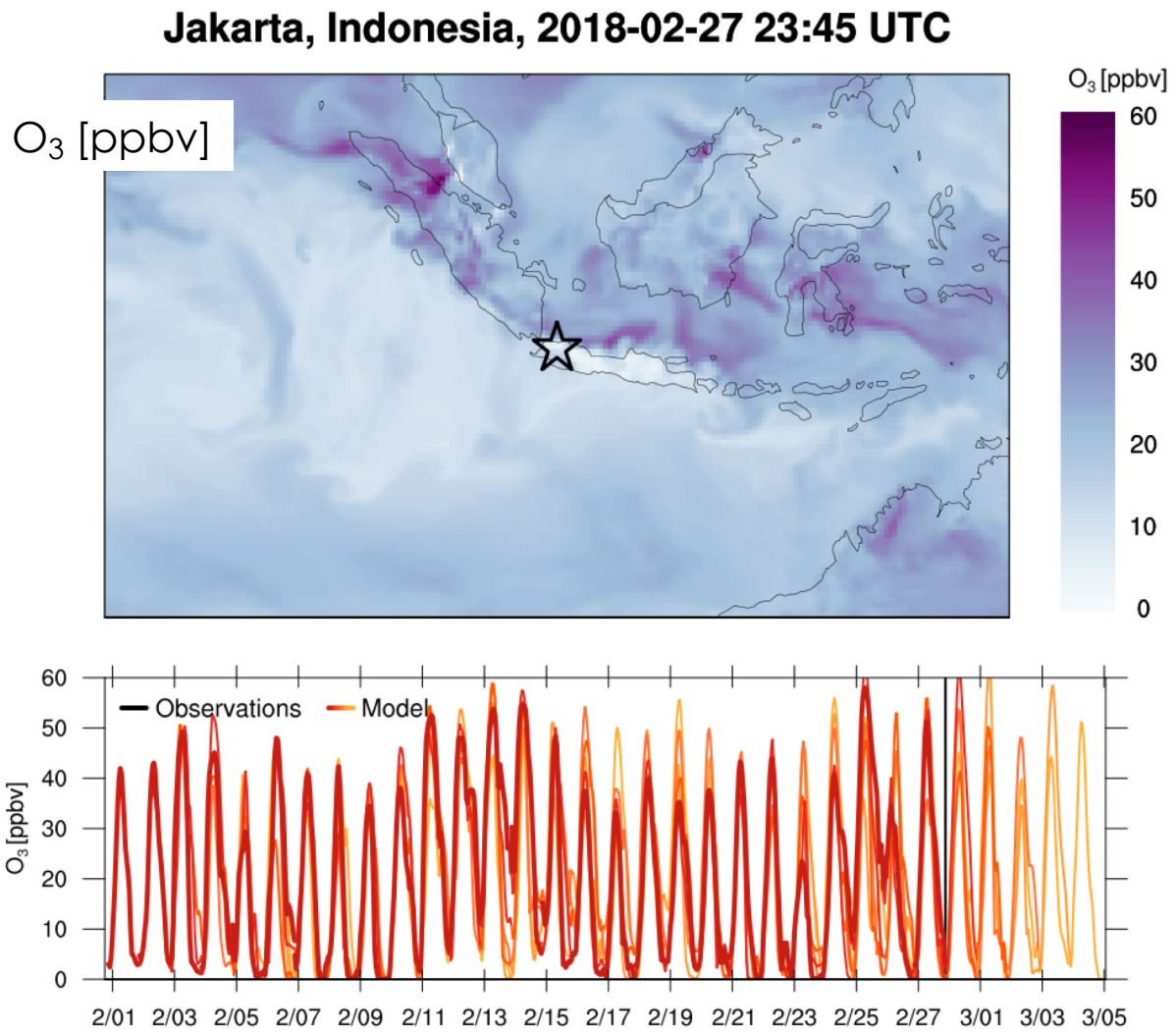
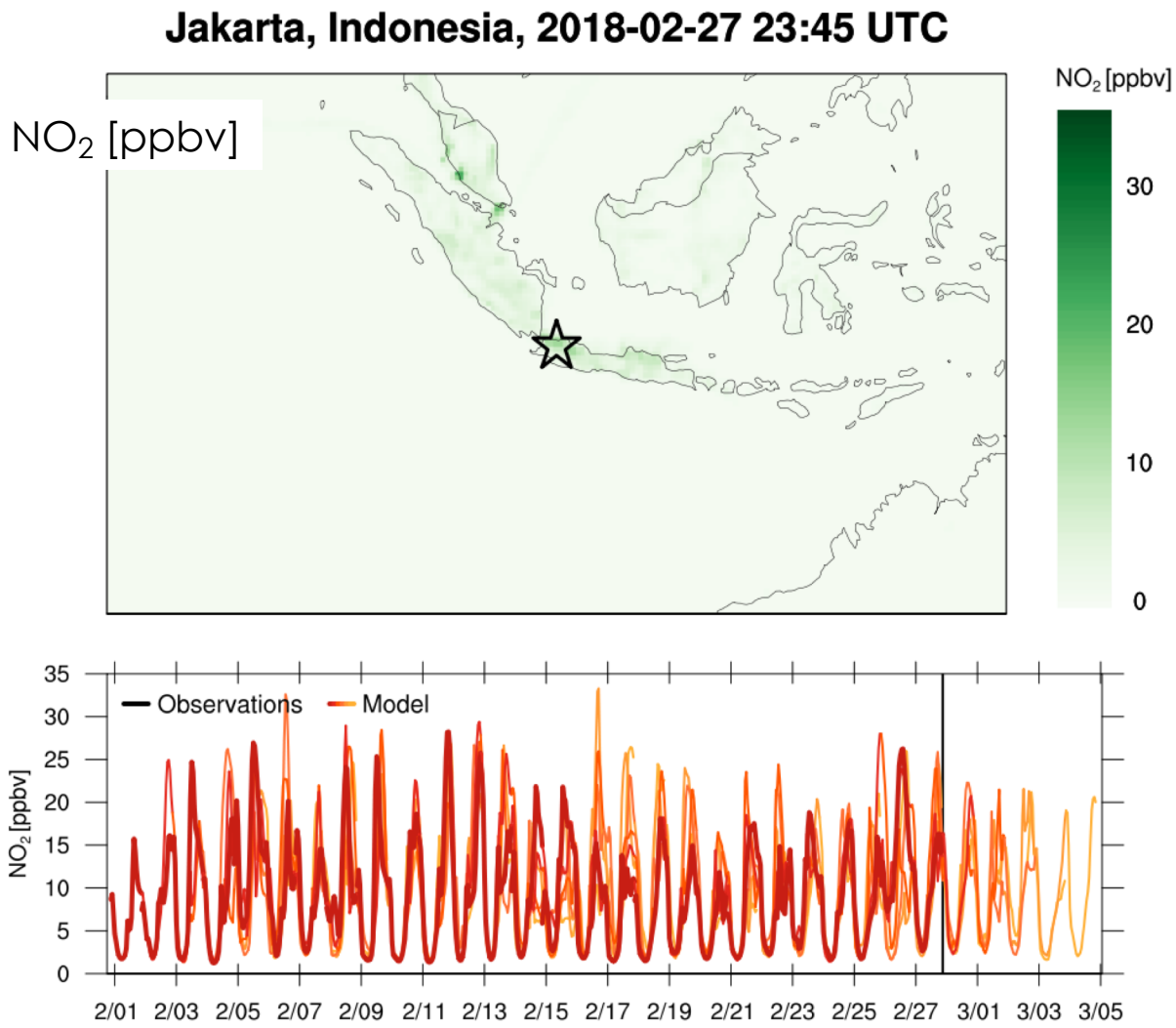
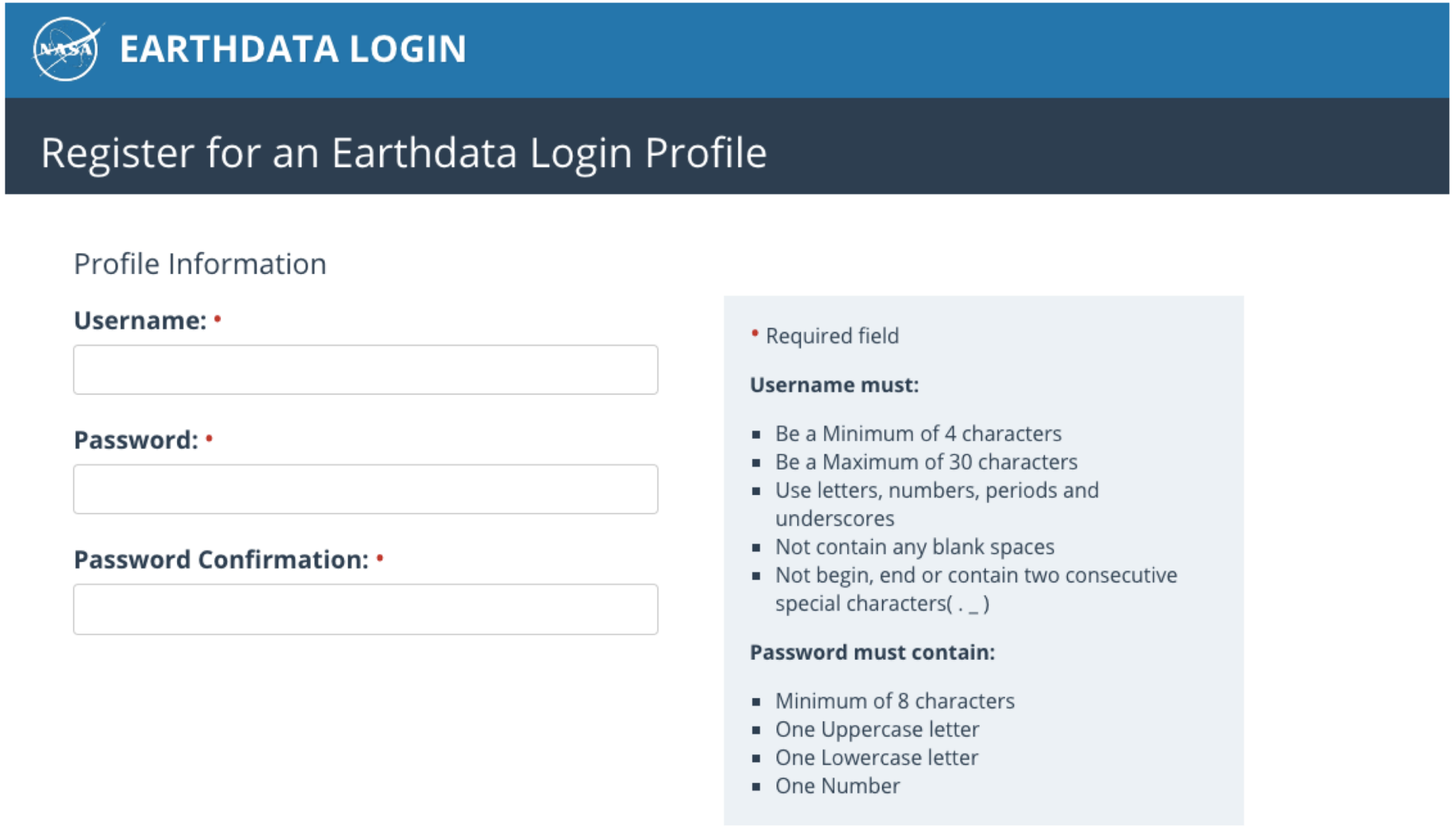
NASA's Upcoming Air Quality Forecasts





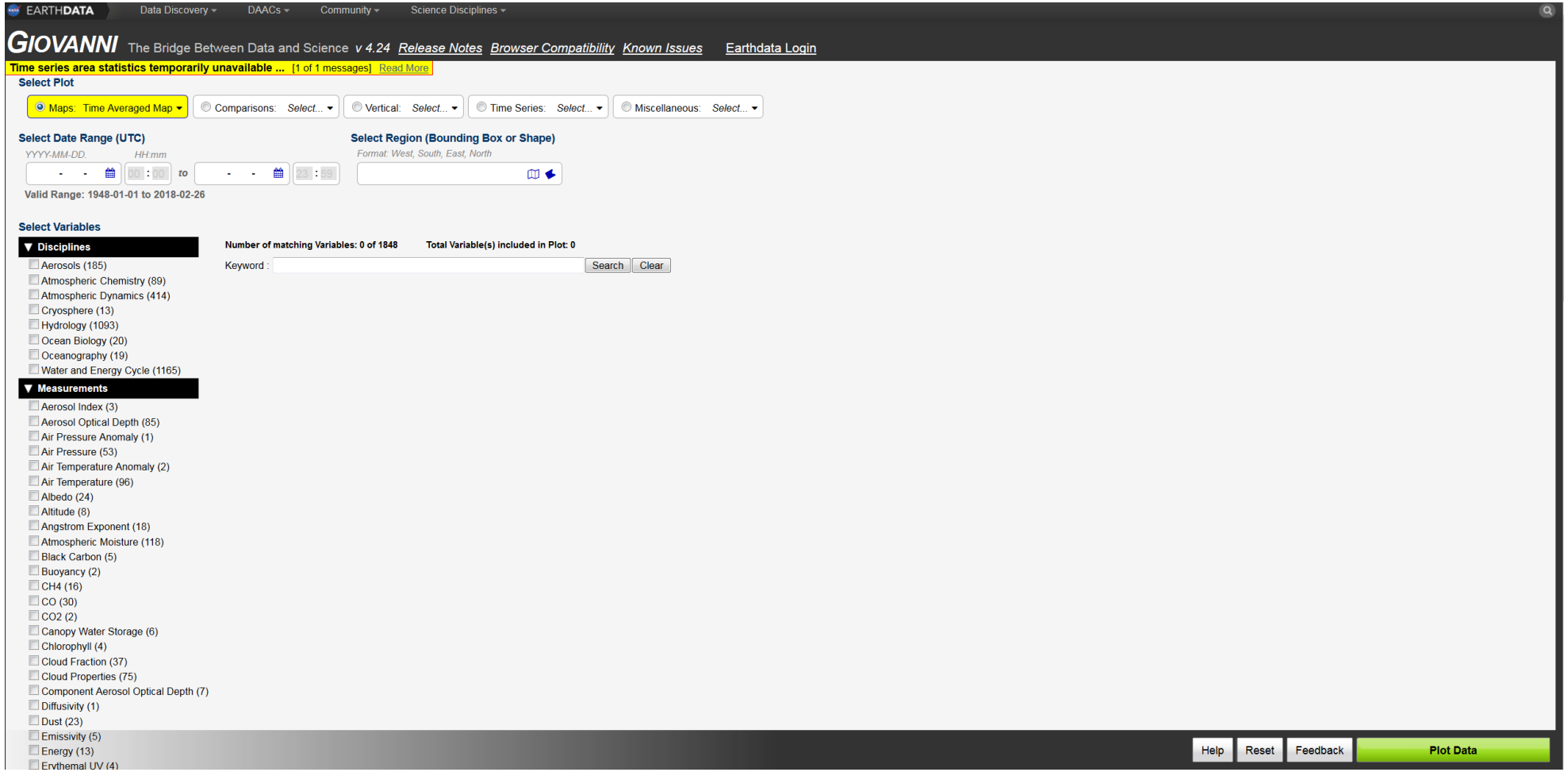
Giovanni -
The Bridge Between Data and Science
an Online Visualization and Analysis Tool

Visit https://urs.earthdata.nasa.gov/users/new



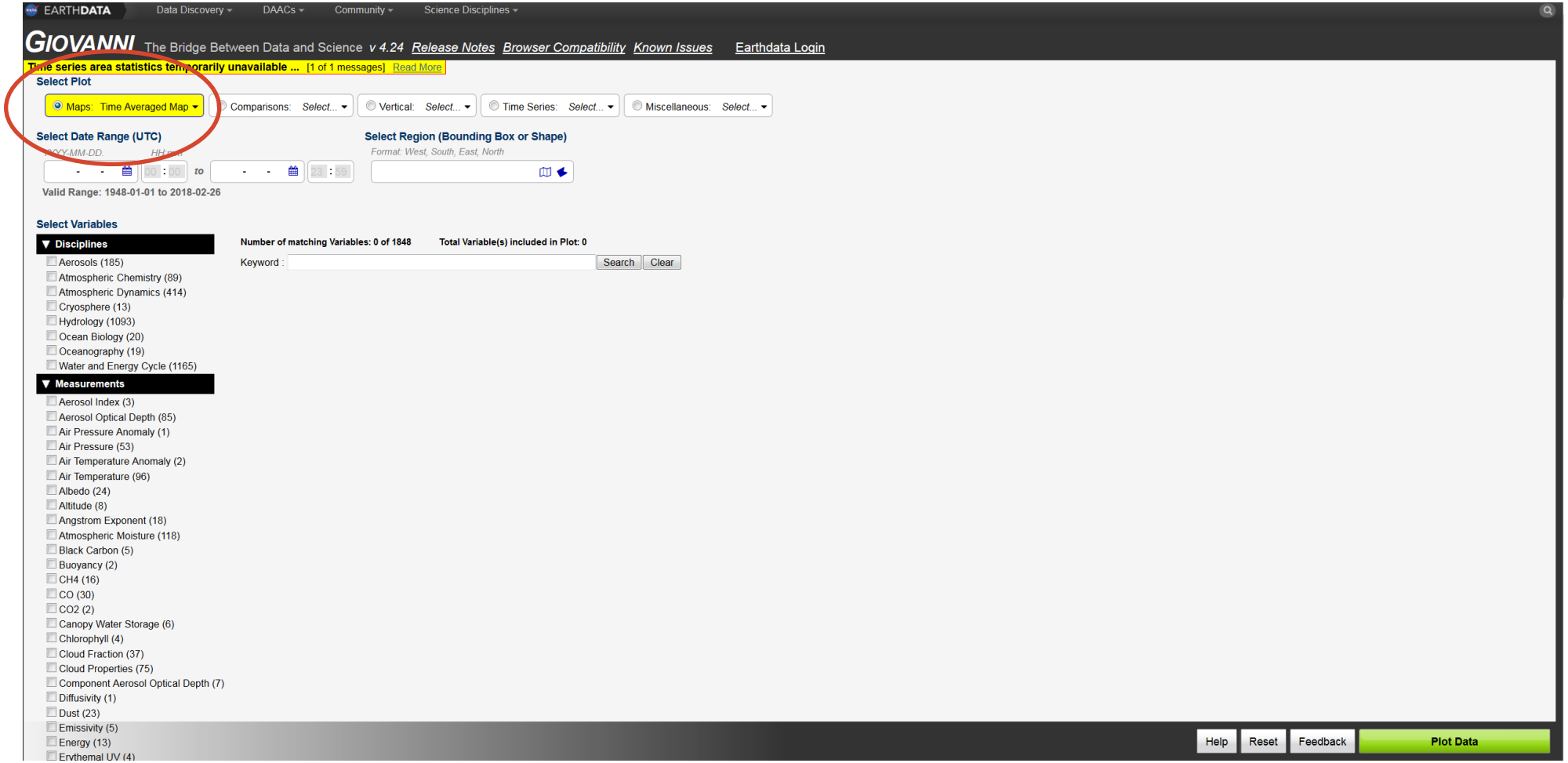
Time Averaged Maps: Step 1

- Go to the Giovanni website: http://giovanni.gsfc.nasa.gov/giovanni/



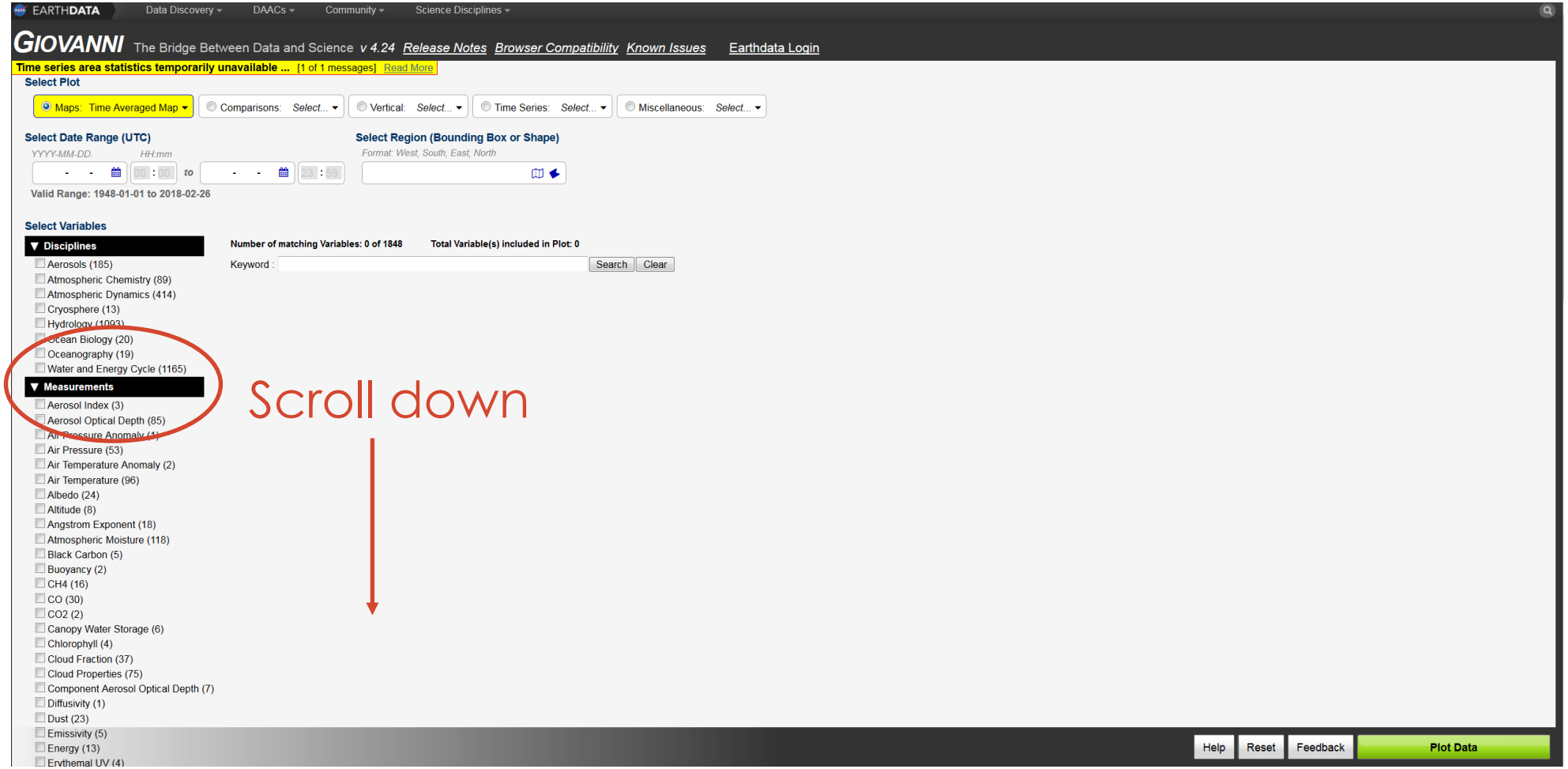
Time Averaged Maps: Step 2

- Under **Select Plot**, go to **Maps** and select **Time Averaged Map**



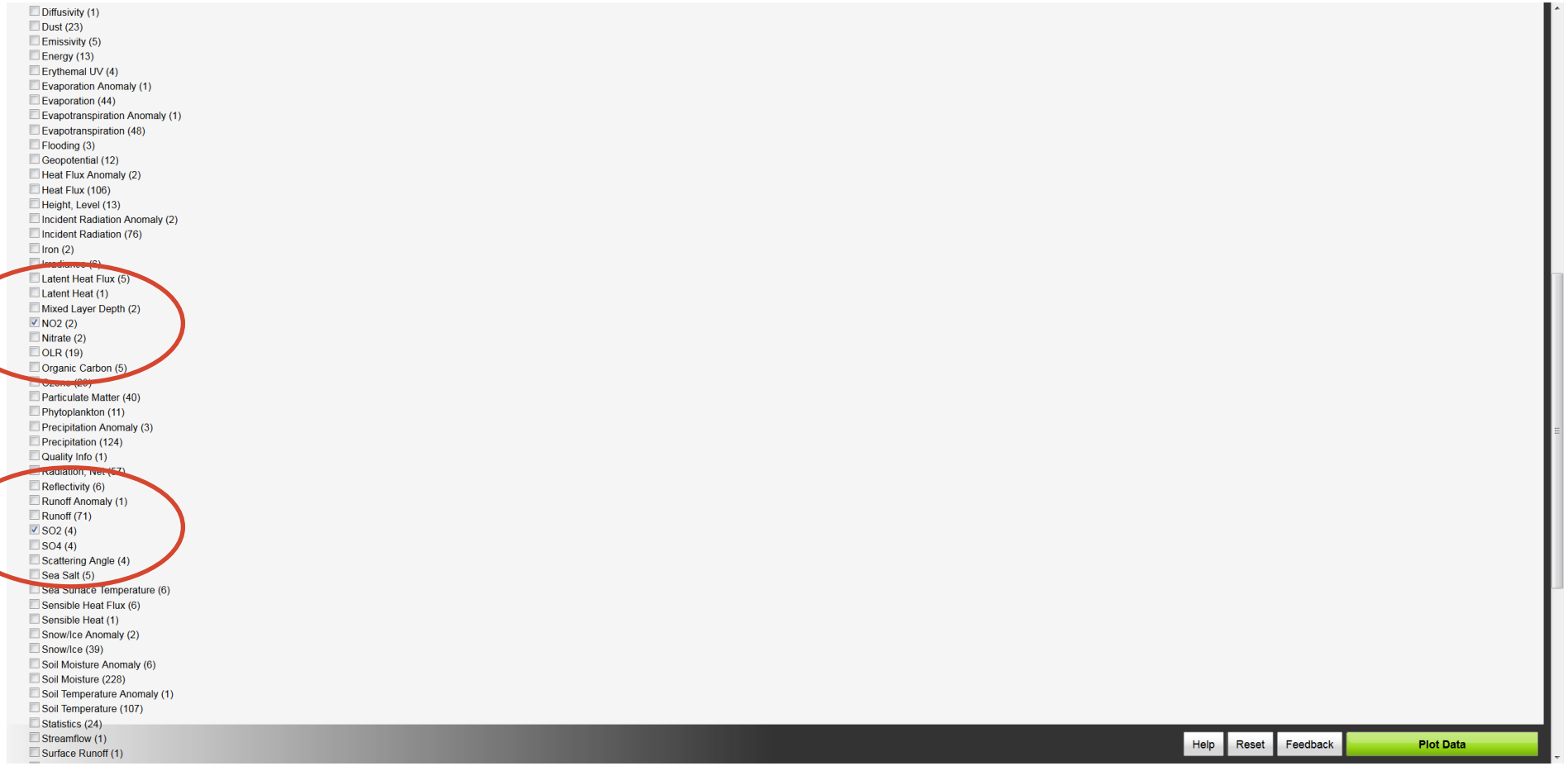
Time Averaged Maps: Step 2

- Under **Measurement**, select **NO_2** and **SO_2**



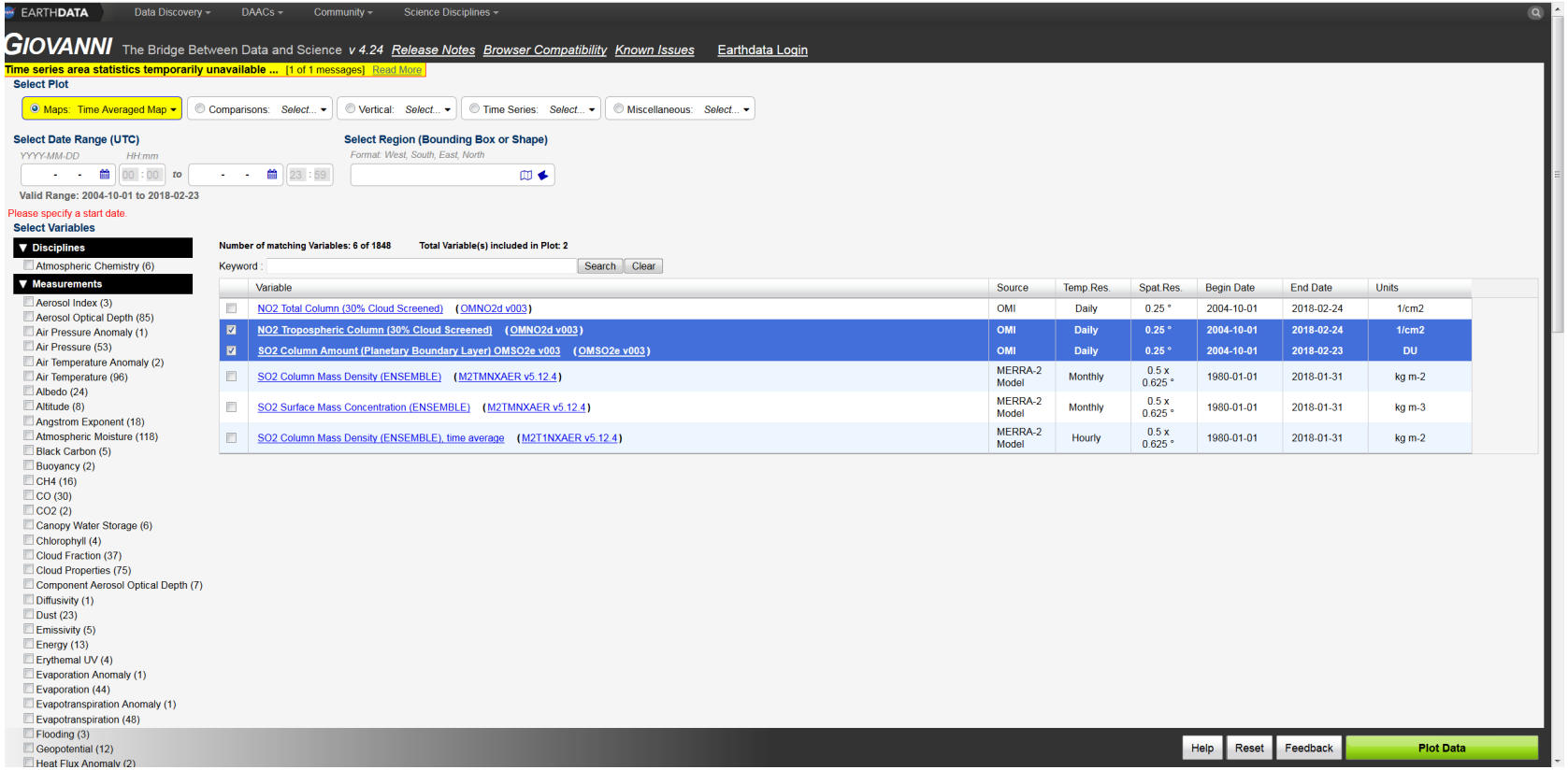
Time Averaged Maps: Step 2

- Under **Measurement**, select **NO_2** and **SO_2**



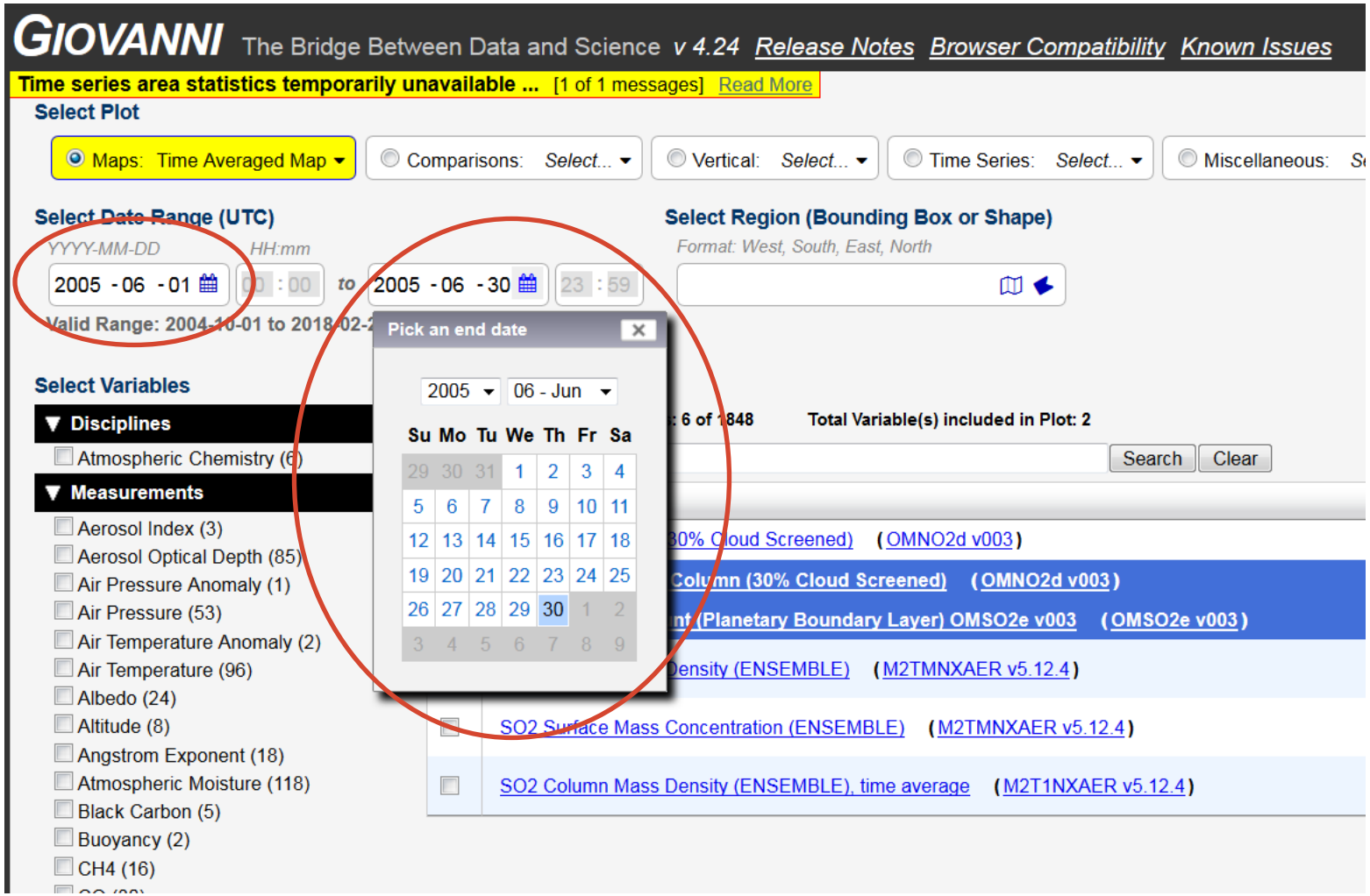
Time Averaged Maps: Step 3

- Select the following two variables:
  - NO_2 Tropospheric Column (30% Cloud Screened) (OMNO2d_v003)
  - SO_2 Column Amount (Planetary Boundary Layer) OMSO2e_v003 (OMSO2e_v003)



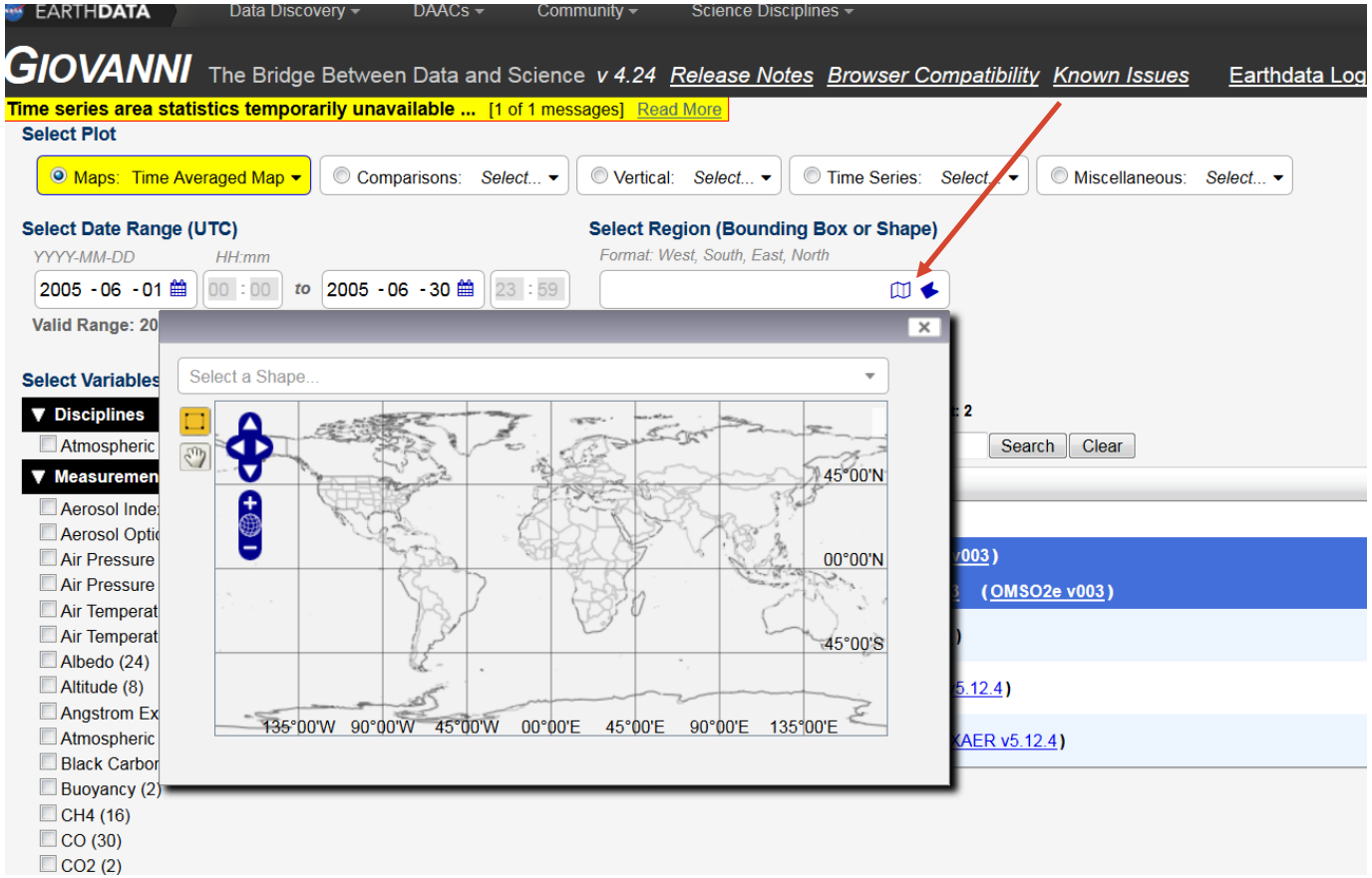
Time Averaged Maps: Step 4

- Set the date range as **June 1, 2005** to **June 30, 2005**



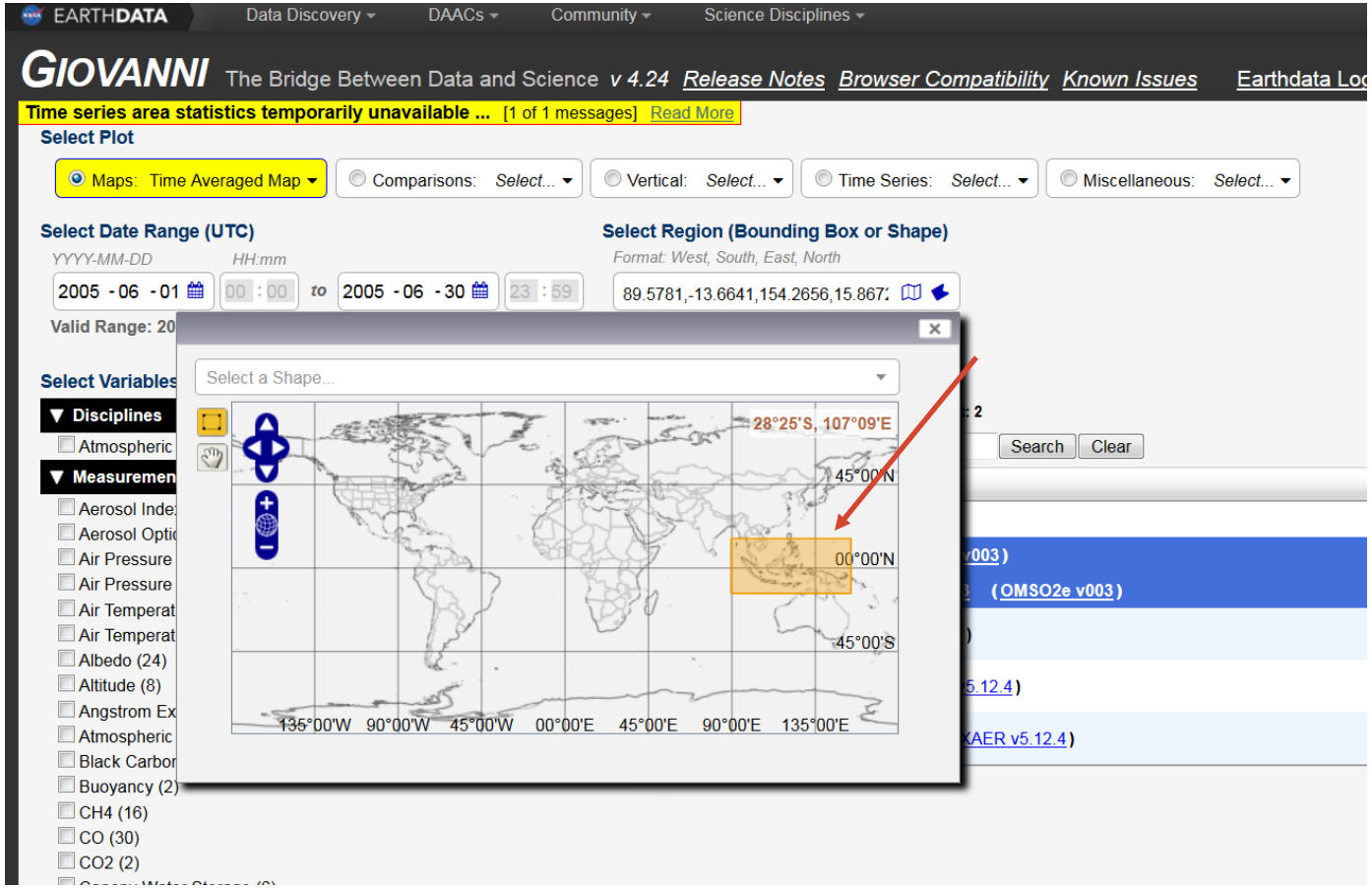
Time Averaged Maps: Step 5

- Select your region either by typing in coordinates, or by clicking **Show Map** and drawing a box (about 10 x 10 degrees) around your area of interest



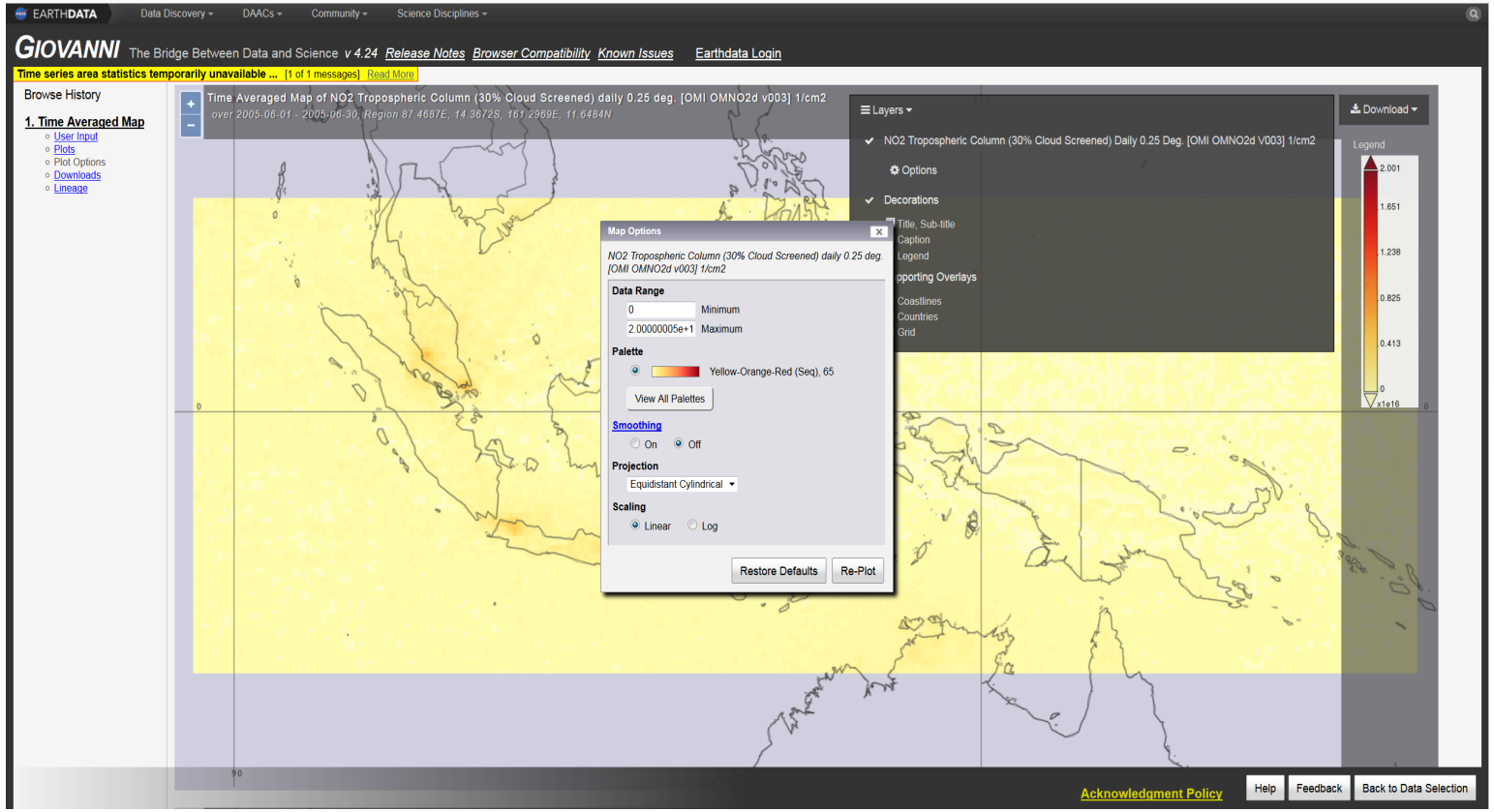
Time Averaged Maps: Step 5

- Select your region either by typing in coordinates, or by clicking **Show Map** and drawing a box (about 10 x 10 degrees) around your area of interest
- If you pick too large of an area or time period, it will take a long time for your image to be created
- Click on **Plot Data** (green button) in lower right-hand corner



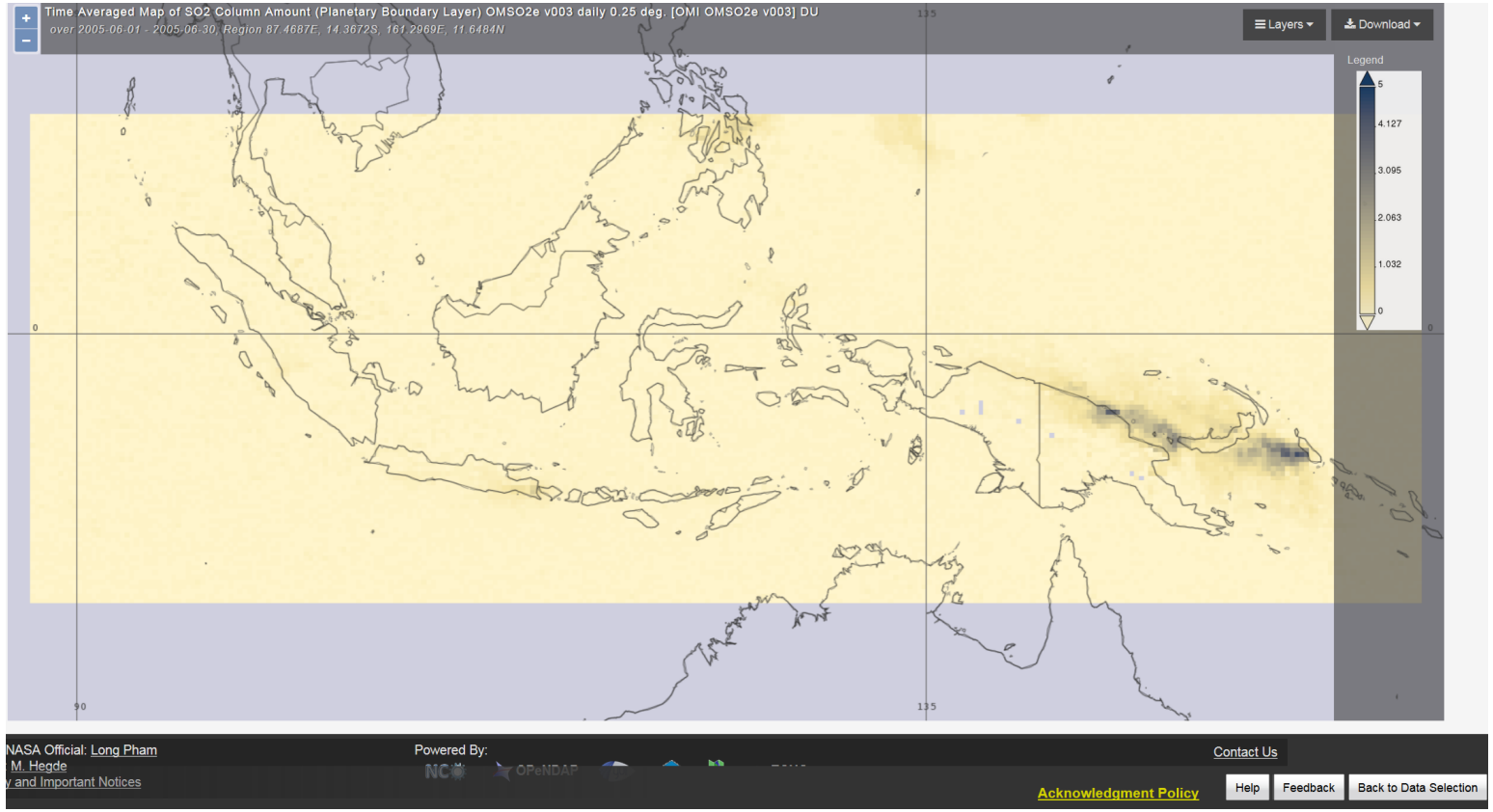
Time Averaged Maps: Step 6: SO_2

- Scroll down to view the various maps. You can change the color scale, max, and min under the **Options** button on the top right of each map. You can download each image (either as .png or a GeoTIFF) under the button



Time Averaged Maps: Step 6: SO_2

- Scroll down to view the various maps. You can change the color scale, max, and min under the **Options** button on the top right of each map. You can download each image (either as .png or a GeoTIFF) under the button



Time Averaged Maps: Step 7

- In the panel on the left, under **Time Averaged Map**, click the **Downloads** link
- Here you can download the maps in .png or GeoTIFF formats, or the data in NetCDF format

Time Averaged Maps: Step 8

- Click the **Back to Data Selection** button in the lower right and keep all parameters the same, except change the range to **November 1, 2017** to **November 30, 2017** and plot the map again
- Now you have two maps of NO_2 and SO_2 for two time periods to compare

Time Averaged Maps – Questions

- What are two differences in the NO_2 and SO_2 maps generated for the two time periods?

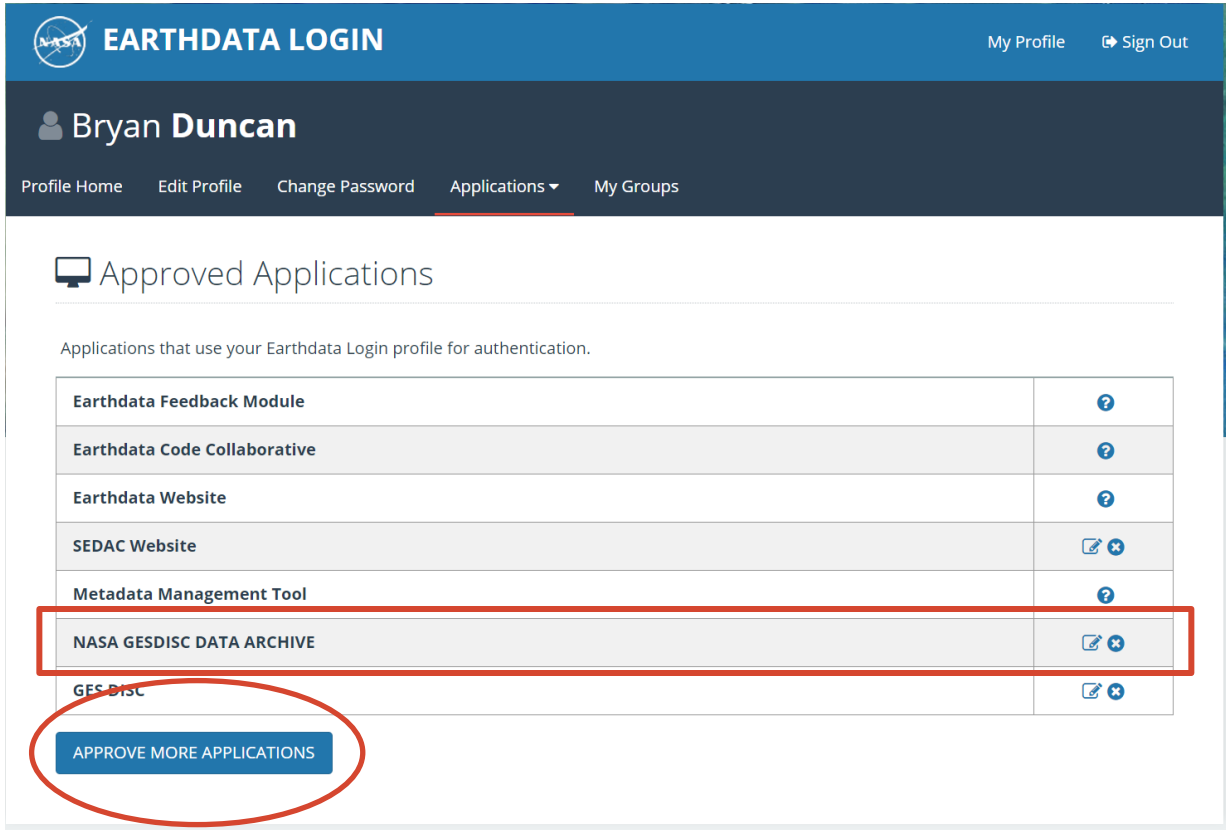
- Did you observe any increasing or decreasing trends in NO_2 or SO_2 over your area of interest?

Earthdata: Download Level 2 and 3 Data

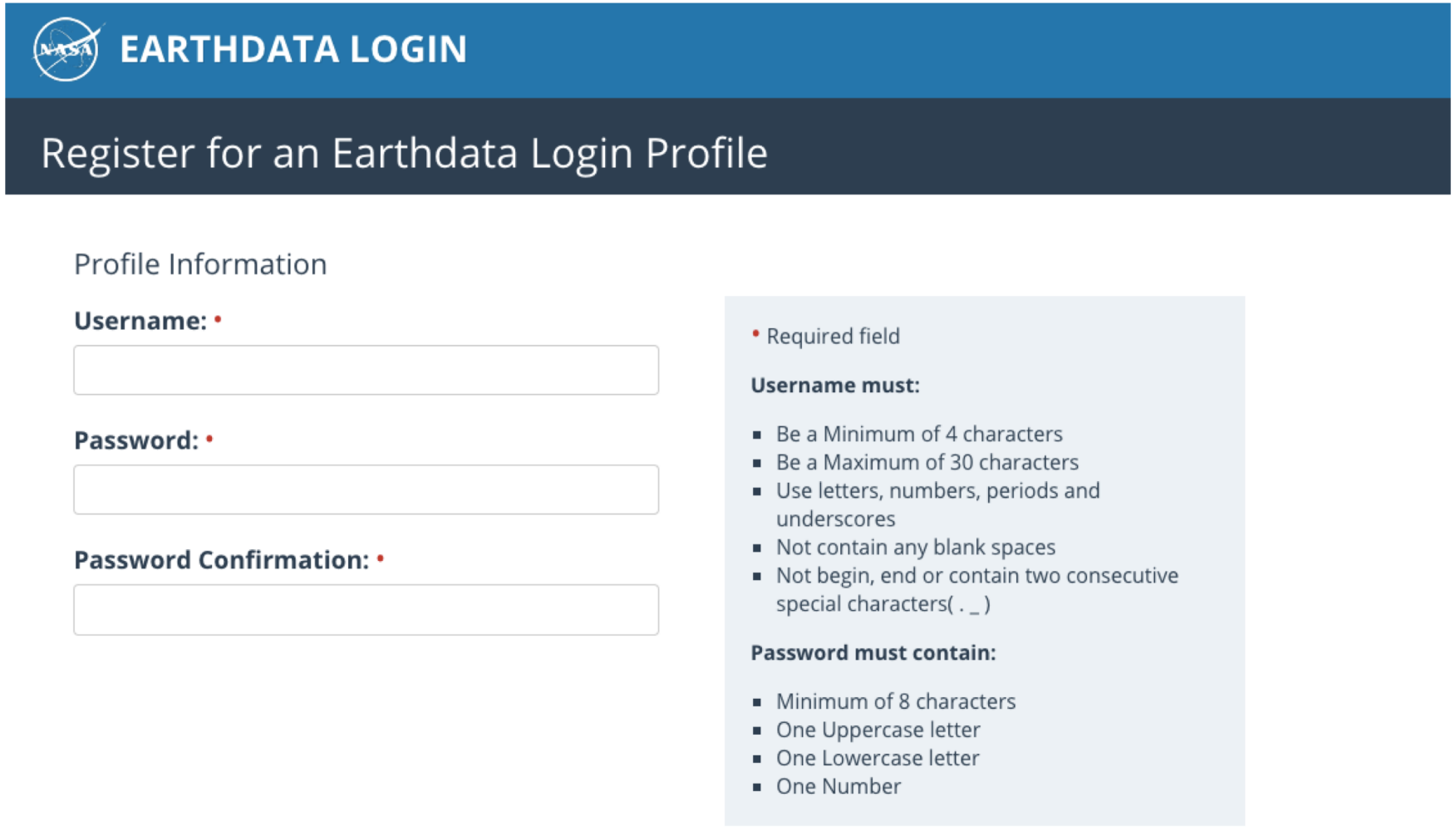
Step 1b: Add NASA GESDISC to your Applications

- Login to Earthdata (https://urs.earthdata.nasa.gov)
- Click on **Applications**, then **Authorized Apps**
- If NASA GESDISC DATA ARCHIVE isn't in your Approved Applications then click on **Approve More Applications**
- Look for NASA GESDISC DATA ARCHIVE in the list or search
- Add NASA GESDISC DATA ARCHIVE to your applications

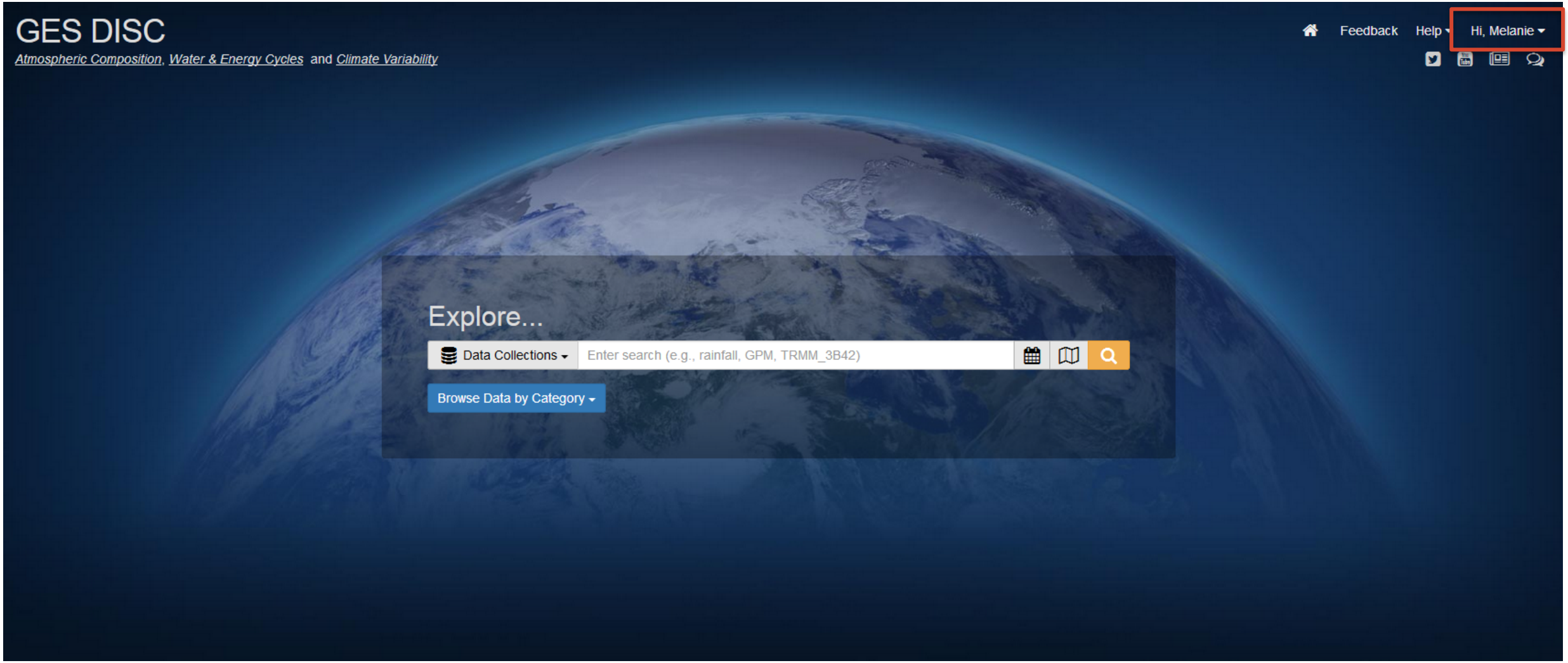
You should see NASA GESDISC DATA ARCHIVE in list of approved applications



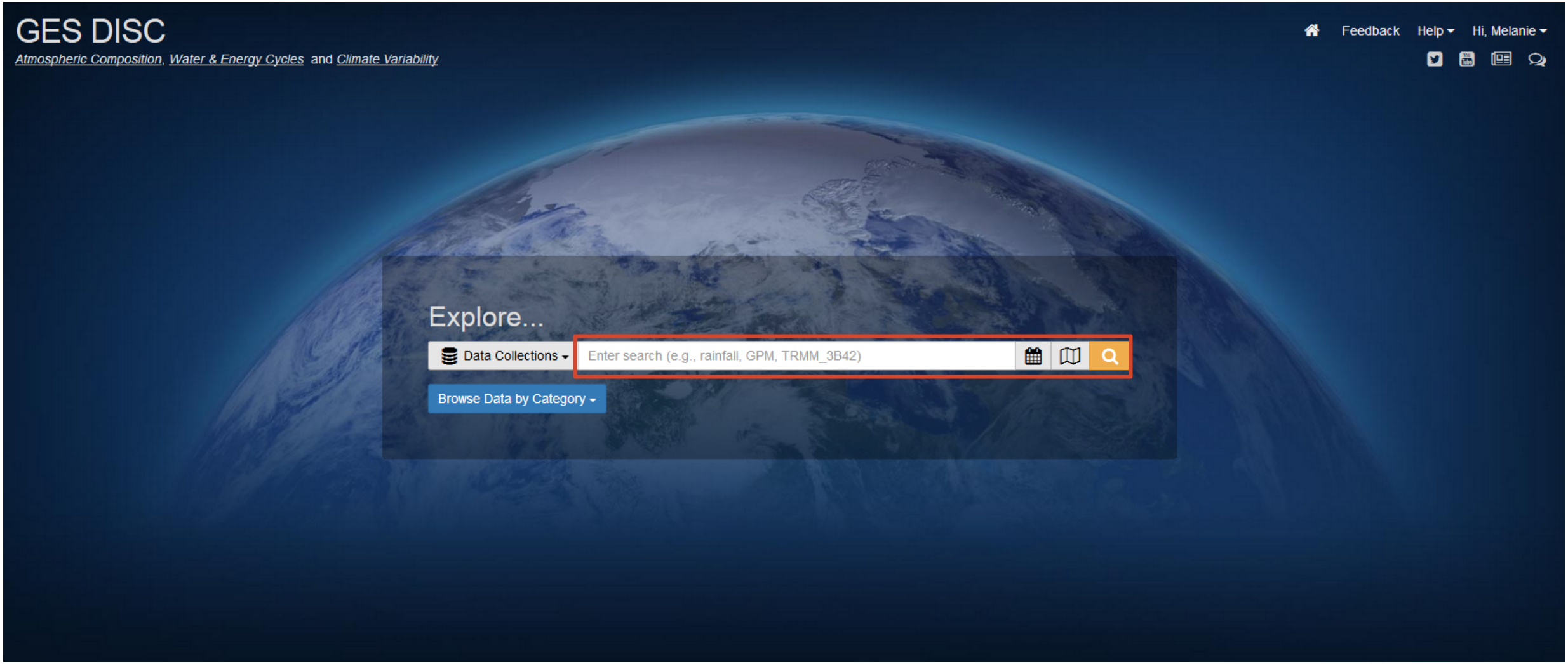
Step 1a: Visit https://urs.earthdata.nasa.gov/users/new



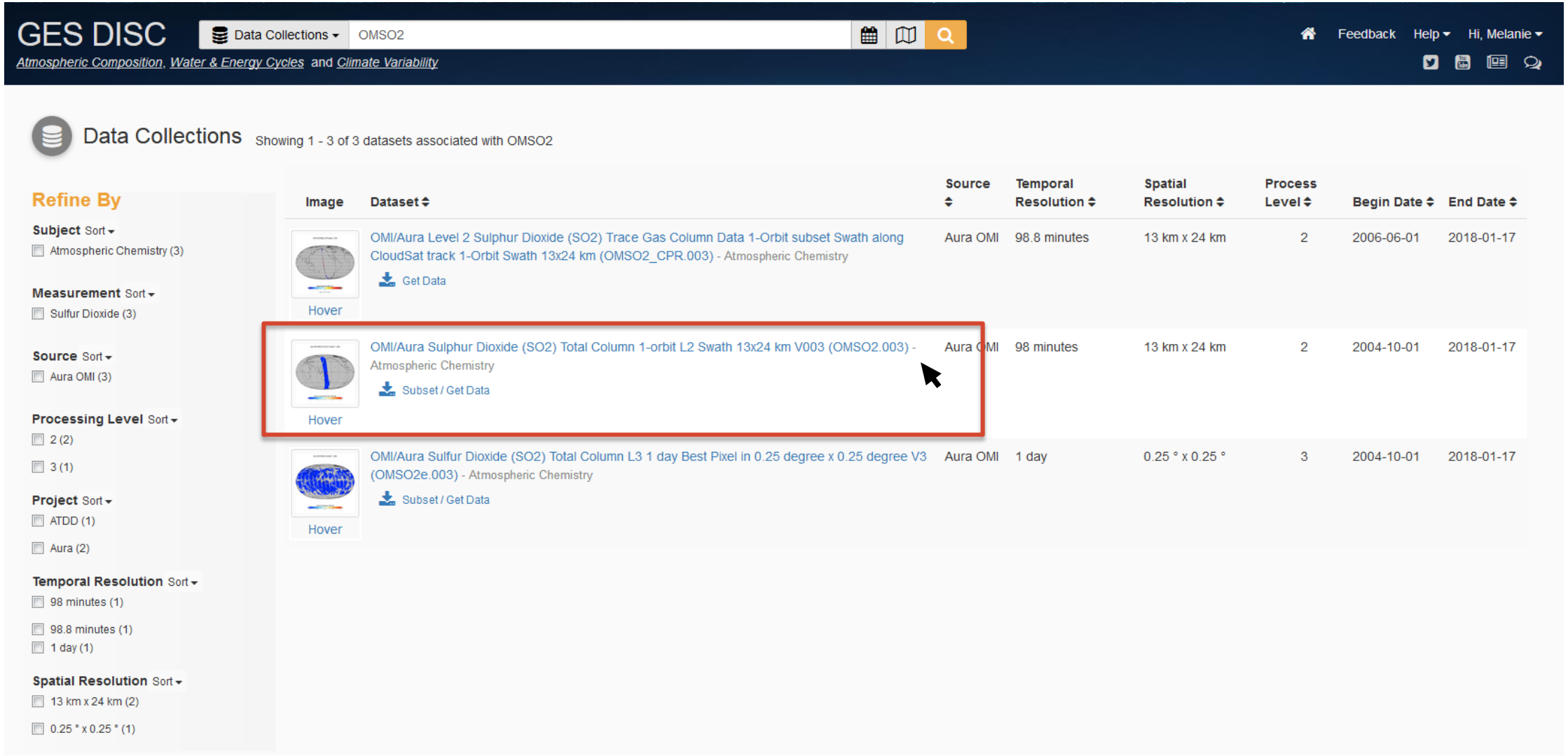
Step 2: Login at https://disc.gsfc.nasa.gov/



Step 3: Enter Search Keywords (e.g. OMNO2 or OMSO2)



Step 4: Make a Product Selection



Step 5: Choose Data Access (we will use Earthdata)

GES DISC

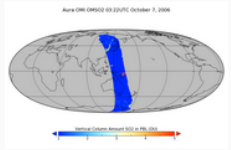
Data Collections ▾ | OMSO2

Feedback | Help ▾ | Hi, Melanie ▾

Atmospheric Composition, *Water & Energy Cycles* and *Climate Variability*

Go to Search Results

OMSO2: OMI/Aura Sulphur Dioxide (SO2) Total Column 1-orbit L2 Swath 13x24 km V003



The Aura Ozone Monitoring Instrument (OMI) Sulfur Dioxide Product 'OMSO2' Version 3 is now available to the public from the NASA Goddard Earth Sciences Data and Information Services Center (GES DISC). The OMSO2 product contains three values of SO2 Vertical column corresponding to three a-priori vertical profiles used in the retrieval algorithm. It also contains quality flags, geolocation and other ancillary information. The lead scientist for the OMSO2 product is Nickolay Kroktov. The shortname for this Level-2 OMI total column SO2 product is OMSO2.

The OMSO2 files are stored in the version 5 EOS Hierarchical Data Format (HDF-EOS5). Each file contains data from the day lit portion of an orbit (~53 minutes). There are approximately 14 orbits per day. The maximum file size for the OMSO2 data product is approximately 21 MB.

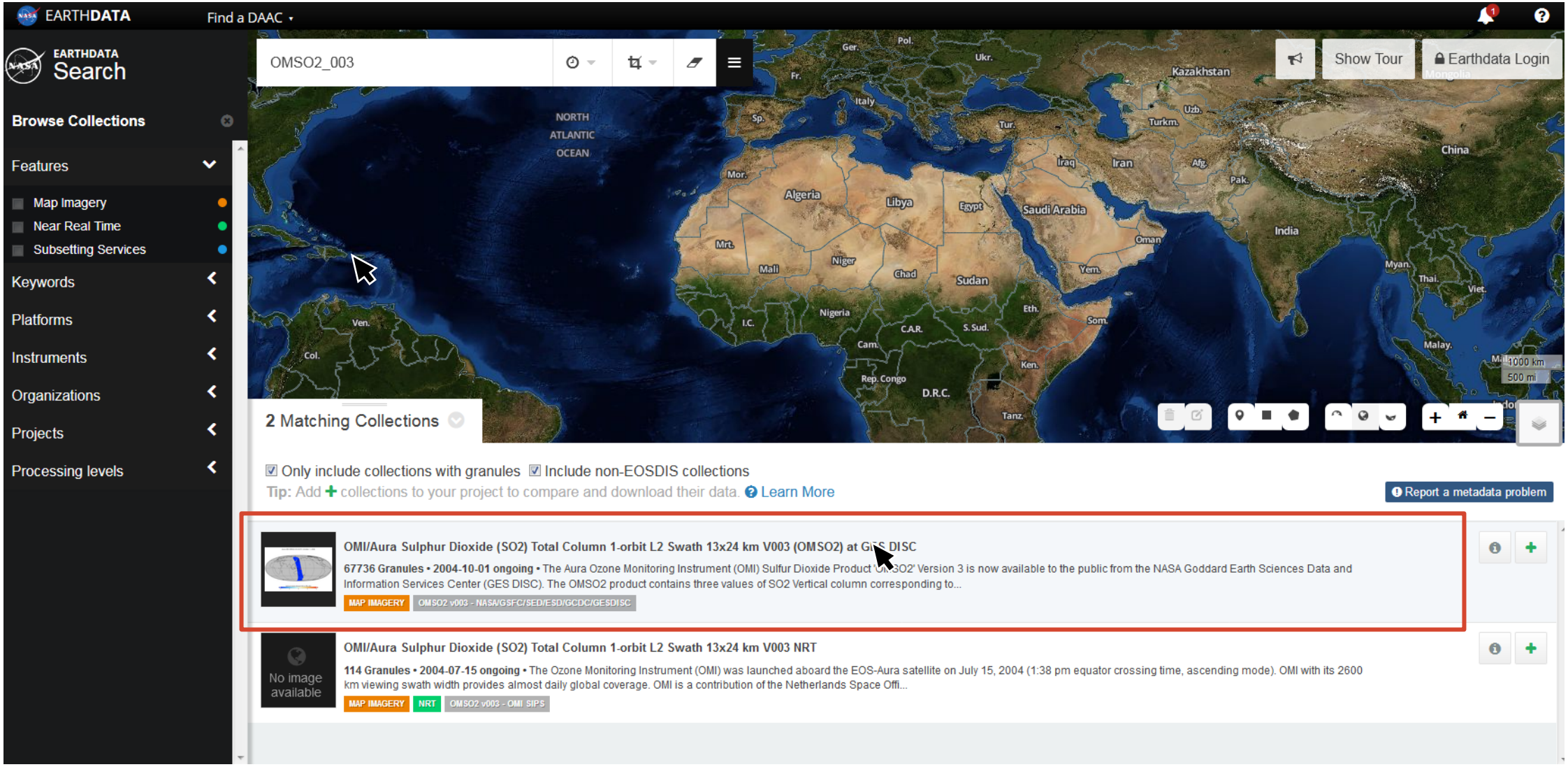
Data Access

- Online Archive
- EARTHDATA Search
- Simple Subset Wizard
- OPENDAP DATA

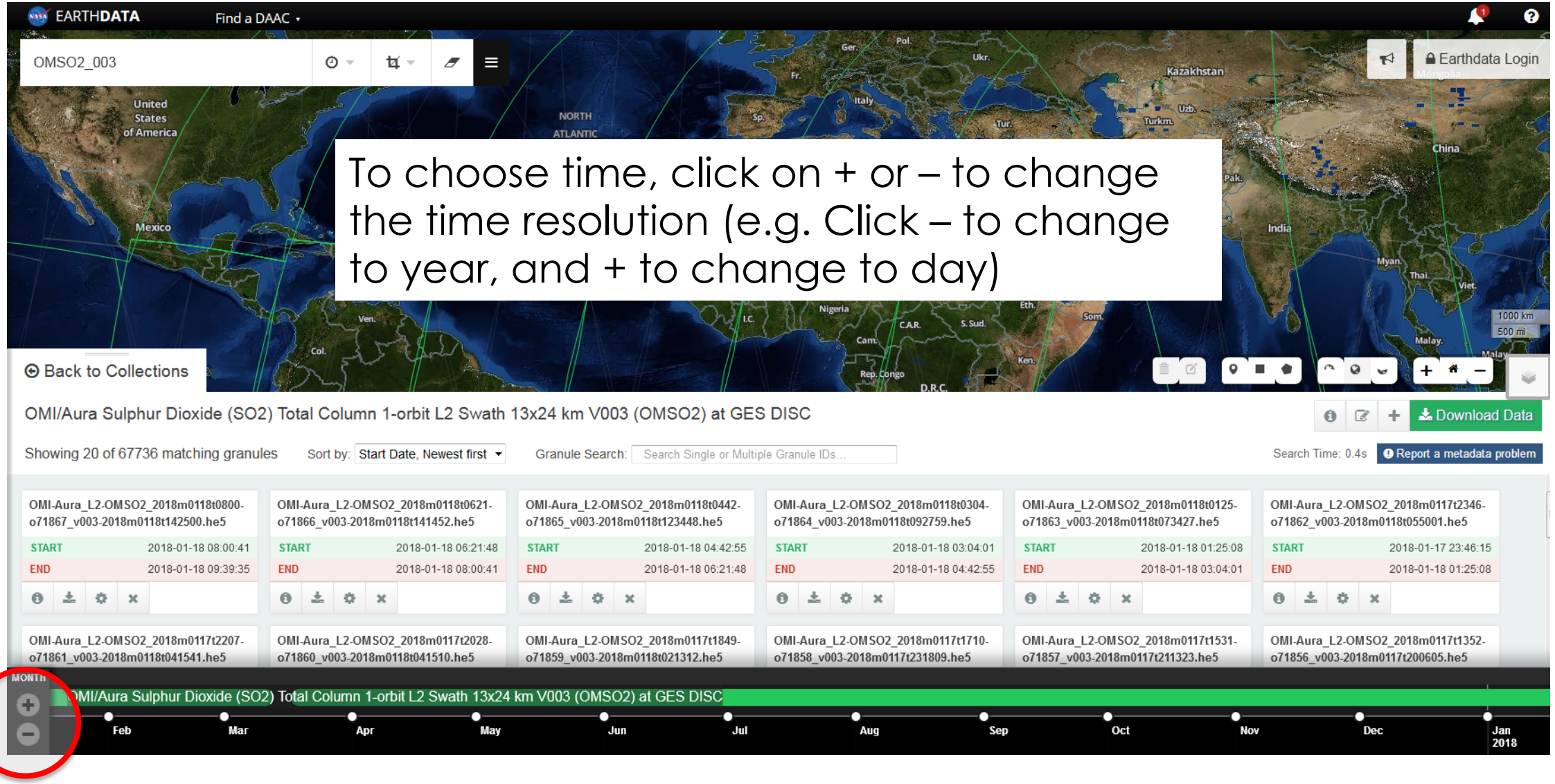
Product Summary | Data Citation | Documentation

Shortname:	OMSO2
Longname:	OMI/Aura Sulphur Dioxide (SO2) Total Column 1-orbit L2 Swath 13x24 km V003
DOI:	10.5067/Aura/OMI/DATA2022
Version:	003
Format:	HDF5
Spatial Coverage:	-180.0,-90.0,180.0,90.0
Temporal Coverage:	2004-10-01 to present
File Size:	26 MB per file
Data Resolution	
Spatial:	13 km x 24 km
Vertical:	80 km
Temporal:	98 minutes

Step 6: Select Product

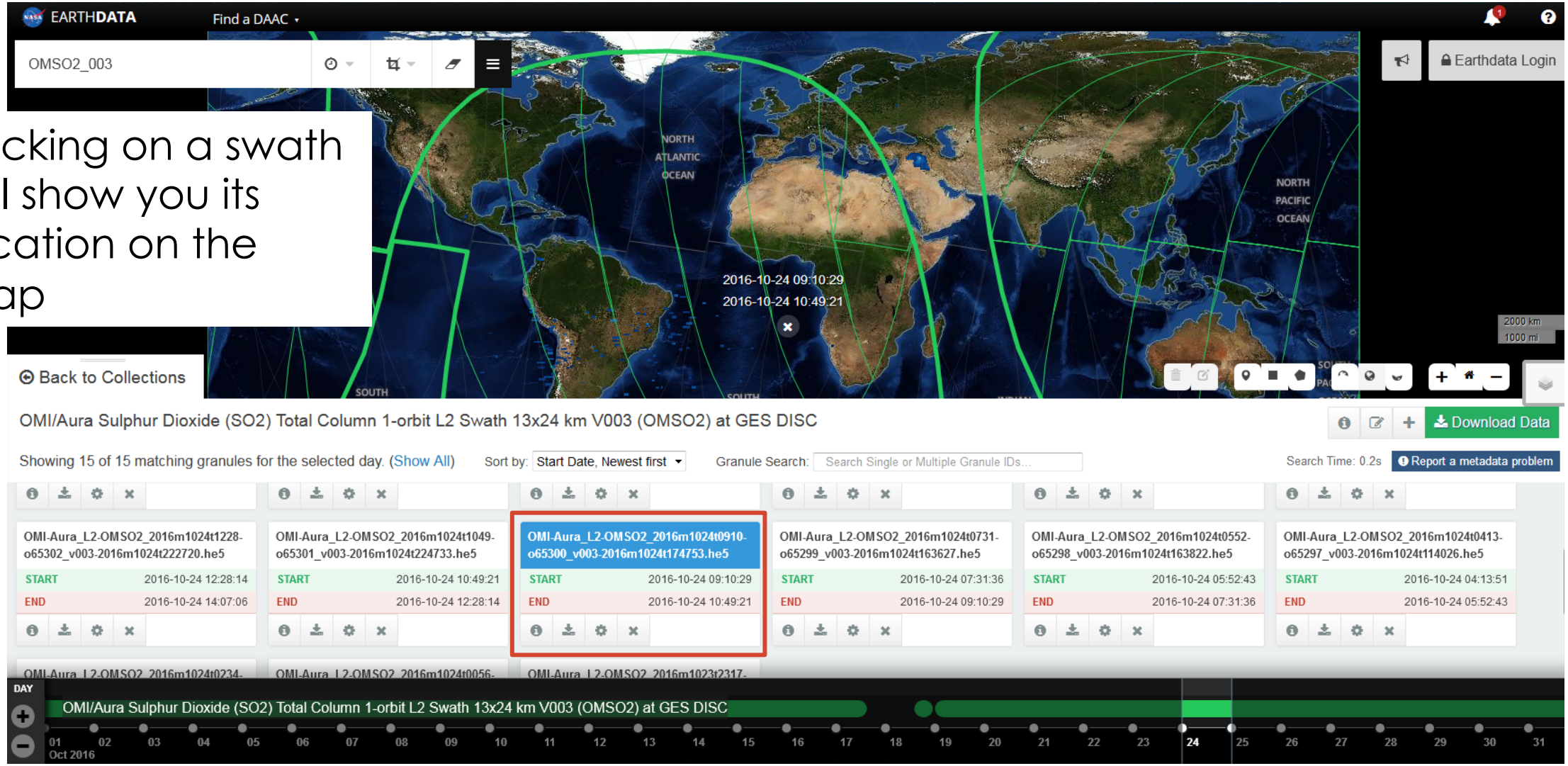


Step 7: Select Time

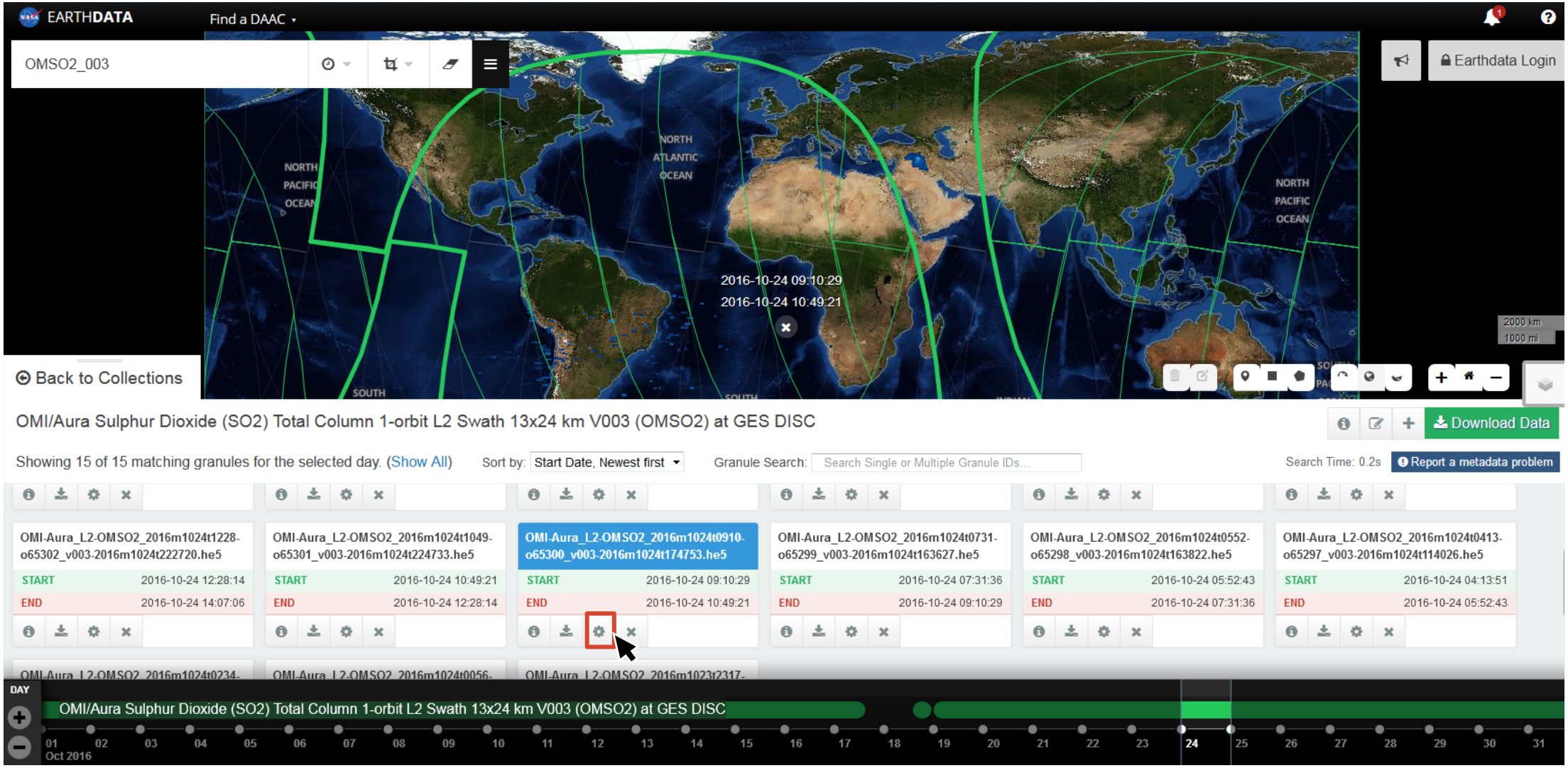


Step 8: Select Swath

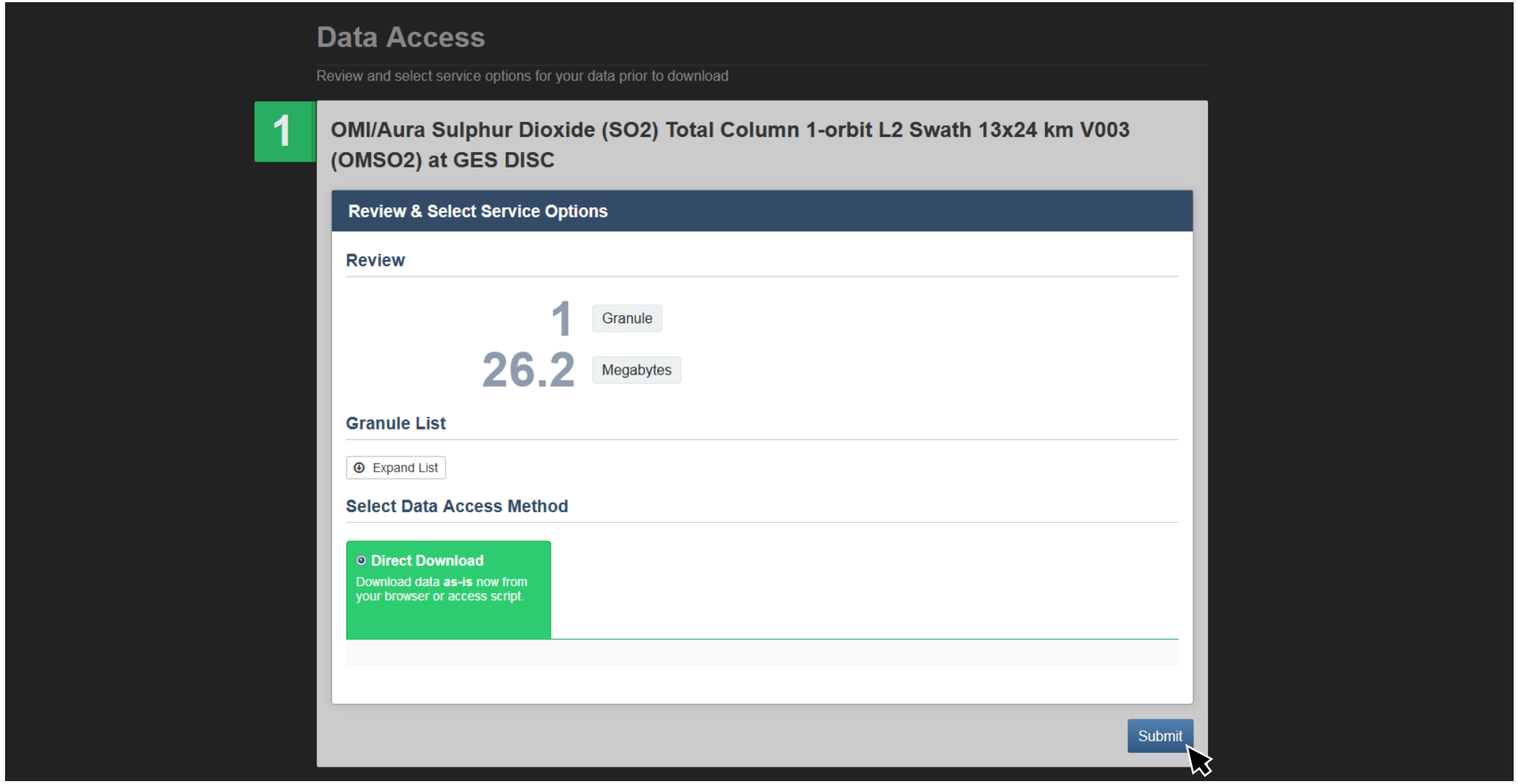
Clicking on a swath will show you its location on the map



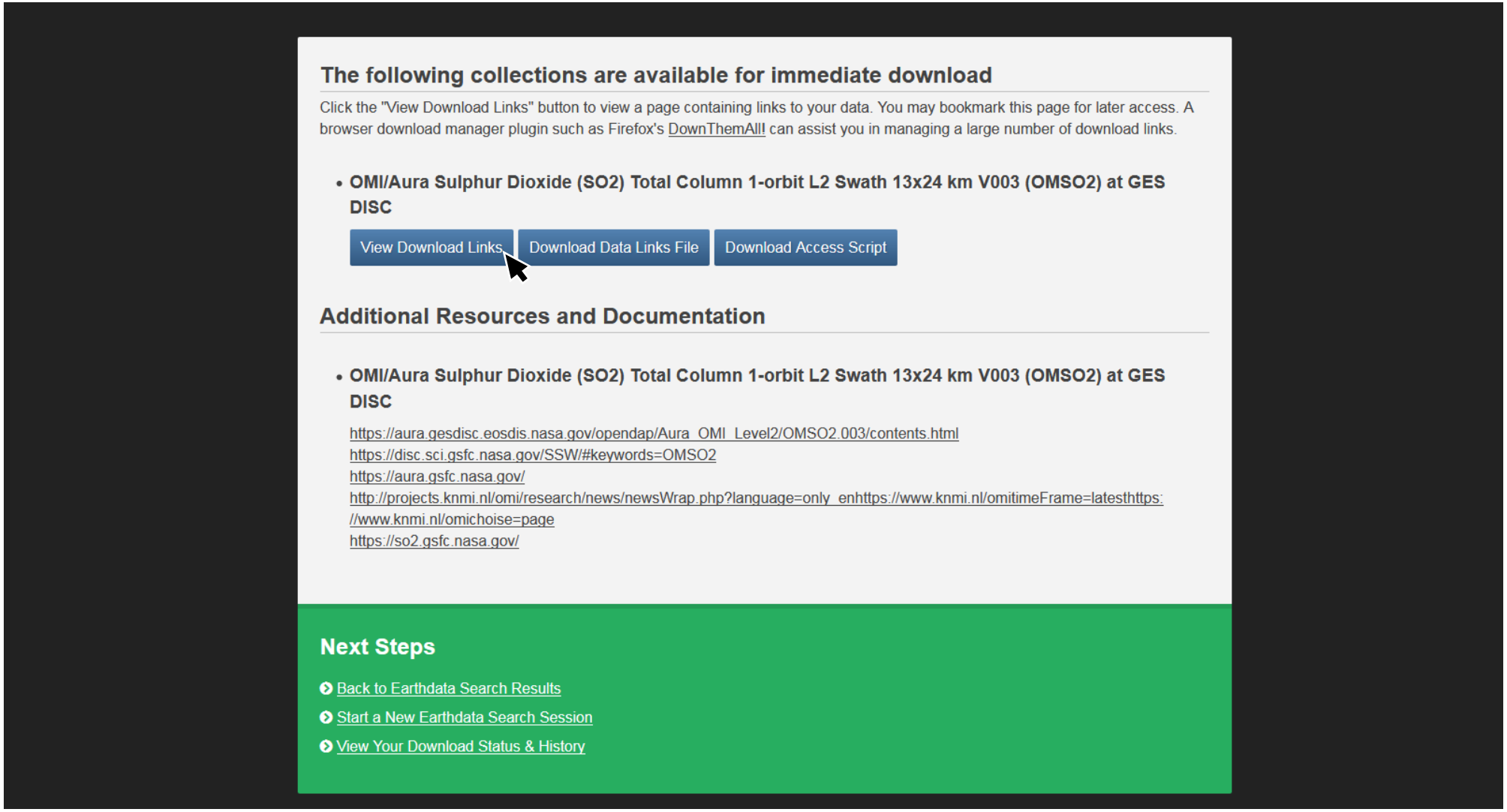
Step 9: Download a Single Granule by Clicking the Gear Icon



Step 10: Choose “Direct Download” and Click “Submit”



Step 11: Click “View Download Links” to Download



Step 12: Download the Data

- http://aura.gesdisc.eosdis.nasa.gov/data//Aura_OMI_Level2/OMSO2.003/2016/298/OMI-Aura_L2-OMSO2_2016m1024t0910-o65300_v003-2016m1024t174753.he5

Click on the provided link and save the data in your directory where you will run your python scripts

Questions