

Title:	Mapping Global Temperature and Ozone Using AIRS
Product Type:	Curriculum
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Target audience:	Undergraduate
Format:	Tutorial (pdf document)
Software requirements* :	ArcMap 9 or higher (ArcGIS Desktop)
Data:	All data required are obtained within the exercise.
Estimated time to complete:	1.5 hrs.
Learning objectives:	<ul style="list-style-type: none"> • Download and import data from the AIRS instrument • Understand Dobson units for ozone measurements • Map monthly worldwide total atmospheric ozone using ArcGIS • Map monthly worldwide surface temperature using ArcGIS

*Tutorials may work with earlier versions of software but have not been tested on them



Mapping Global Temperature and Ozone Using AIRS

Objective:

- Download and import data from the AIRS instrument
- Understand Dobson units for ozone measurements
- Map monthly worldwide total atmospheric ozone using ArcGIS
- Map monthly worldwide surface temperature using ArcGIS

Monthly temperature and ozone data is useful for studying weather, climate change, stratospheric ozone depletion and air pollution. AIRS provides daily global coverage of these data.

Download monthly ozone (O₃), and temperature data

Visit the AIRS website http://airs.jpl.nasa.gov/data/get_AIRS_data/

Select Get AIRS Data.

Look for AIRS Level- 3 Products (Version 5 or newer): without- HSB // AIRS IR Only // with- HSB data

Then locate L3 monthly gridded standard retrieval product using AIRS IR and AMSU, without HSB. The HSB, Humidity Sounder for Brazil, measures water vapor in the atmosphere and is not necessary for O₃ and temperature data.

Product: AIRX3STM.

Level 3 data provides the mean and standard deviation values for the datasets.

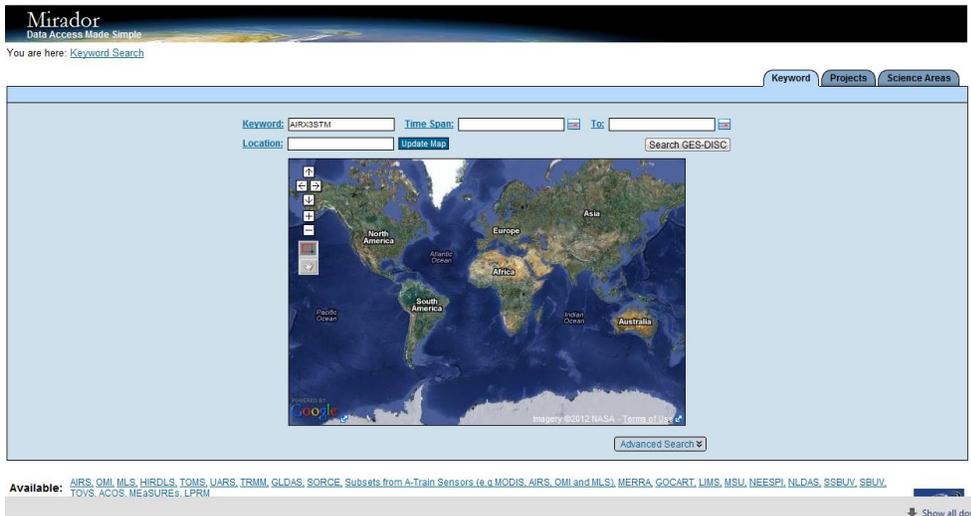
AIRS3STD	L3 daily gridded standard retrieval product using AIRS IR-only	1°x1°, 24 atm pressure levels; 12 pressure levels for H2O related variables.	2007-06-01 - present	54	Search
AIRH3STD	L3 daily gridded standard retrieval product using AIRS IR and AMSU, with-HSB	1°x1°, 24 atm pressure levels; 12 pressure levels for H2O related variables.	2002-08-30 - 2003-02-05	75	Search
AIRX3STB	L3 eight-day gridded standard retrieval product using AIRS IR and AMSU, without-HSB	1°x1°, 24 atm pressure levels; 12 pressure levels for H2O related variables.	2002-08-30 - present	103	Search
AIRS3STB	L3 eight-day gridded standard retrieval product using AIRS IR-only	1°x1°, 24 atm pressure levels; 12 pressure levels for H2O related variables.	2007-06-03 - present	85	Search
AIRH3STB	L3 eight-day gridded standard retrieval product using AIRS IR and AMSU, with-HSB	1°x1°, 24 atm pressure levels; 12 pressure levels for H2O related variables.	2002-08-30 - 2003-02-05	103	Search
AIRX3STM	L3 monthly gridded standard retrieval product using AIRS IR and AMSU, without-HSB	1°x1°, 24 atm pressure levels; 12 pressure levels for H2O related variables.	2002-08-30 - present	104	Search
AIRS3STM	L3 monthly gridded standard retrieval product using AIRS IR-only	1°x1°, 24 atm pressure levels; 12 pressure levels for H2O related variables.	2007-06-01 - present	86	Search
AIRH3STM	L3 monthly gridded standard retrieval product using AIRS IR and AMSU, with-HSB	1°x1°, 24 atm pressure levels; 12 pressure levels for H2O related variables.	2002-08-30 - 2003-02-05	108	Search
AIRX3QPS	L3 5-day quantized cluster analysis product using AIRS IR and AMSU, without-HSB	5°x5°	2002-08-30 - present	41	Search
AIRS3QPS	L3 5-day quantized cluster analysis product using AIRS IR-only	5°x5°	2007-06-01 - present	41	Search

Spatial Resolution is 1° x 1°, 24 atm pressure levels; 12 pressure levels for H₂O related variables.

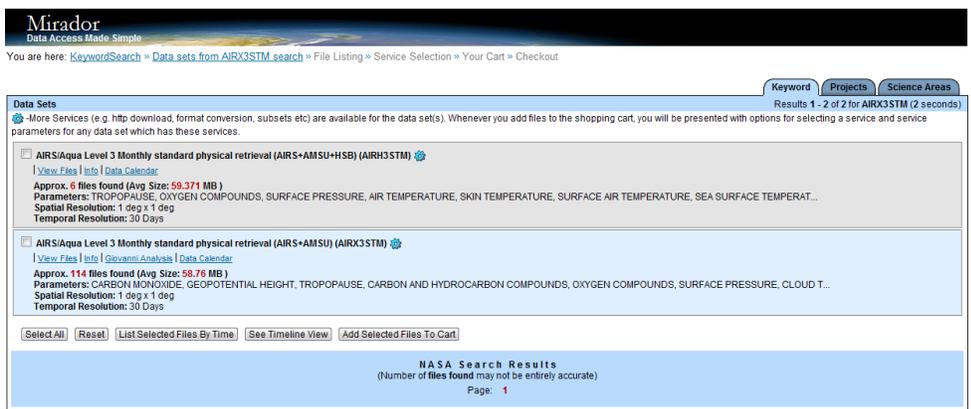
The spatial resolution for the global data is 1 degree latitude by 1 degree longitude. The data is measured at 24 different atmosphere pressure levels from the surface to the top of the atmosphere and water related variables (ex. water vapor) are measured at 12 levels from the surface to 100 mb air pressure.

Click on Data Access and a page will come up with several data service names and corresponding URL's. Click on the Data Service Access URL under MIRADOR and that link will take you to the Mirador website shown in image below.

The Mirador website is a data search and order tool. On the website click Search GES-DISC without selecting any parameters because the data provides global coverage.



Choose View file (all, 005, or 006) under AIRS/ Aqua Level 3 Monthly standard physical retrieval (Airs + AMSU) (AIRX3STM)



Select a month of interest with an attached link and > click HTTP.

The screenshot shows the NASA Earth Science Data Gateway interface. At the top, there are navigation tabs for 'Data Discovery', 'Data Centers', 'Community', and 'Science Disciplines'. A search bar is located in the top right corner. Below the navigation, there is a 'Mirador Data Access Home' section with a search bar and a 'Search' button. The main content area displays search results for 'AIRS/Aqua Level 3 Monthly standard physical retrieval (AIRS AMSU)'. A table lists several files with columns for 'File Names/Descriptive File Names' and 'Start Time'. The files are listed with their respective dates and times, and each row includes a 'One Click Download' link.

File Names/Descriptive File Names	Start Time
AIRS_2012.02.01.L3.Ret.S58829.v5.2.2.0.012082103232.hdf (105.02 MB)	2012-02-01 00:00:00
AIRS_2012.01.01.L3.Ret.S58831.v5.2.2.0.012039130413.hdf (105.32 MB)	2012-01-01 00:00:00
AIRS_2011.12.01.L3.Ret.S58831.v5.2.2.0.012012133728.hdf (105.02 MB)	2011-12-01 00:00:00
AIRS_2011.11.01.L3.Ret.S58830.v5.2.2.0.011547182321.hdf (105.32 MB)	2011-11-01 00:00:00
AIRS_2011.10.01.L3.Ret.S58831.v5.2.2.0.011307104527.hdf (105.02 MB)	2011-10-01 00:00:00
AIRS_2011.09.01.L3.Ret.S58830.v5.2.2.0.011277174305.hdf (104.93 MB)	2011-09-01 00:00:00

(FTP is not used because sometimes it does not finish downloading completely.) Once the HTTP file has downloaded drag it into ArcMap. 249 subdata products are within the file. Select subdataset 9 TotO3_A_ascending (32-bit floating-point), which is the ozone data. Ascending data means only data collected in the day time is used. Descending describes data collected at night.

The screenshot shows the 'Subdataset Selection' dialog box in ArcMap. The dialog contains a list of subdatasets with their IDs and descriptions. Subdataset 9, 'TotO3_A_ascending (32-bit floating-point)', is selected. The dialog also includes buttons for 'Select All', 'Clear All', 'OK', and 'Cancel'. There are also checkboxes for 'Add as a RGB layer' and 'Do not ask again'.

Subdataset ID	Description
subdataset 6	[180x360] TotH2OVap_A_ct ascending (16-bit integer)
subdataset 7	[180x360] TotH2OVap_A_sdev ascending (32-bit floating-point)
subdataset 8	[180x360] TotH2OVap_A_err ascending (32-bit floating-point)
subdataset 9	[180x360] TotO3_A_ascending (32-bit floating-point)
subdataset 10	[180x360] TotO3_A_ct ascending (16-bit integer)
subdataset 11	[180x360] TotO3_A_sdev ascending (32-bit floating-point)

The data will be displayed as all gray. Change the symbology to classified (ArcGIS 9 may require that data is exported to GRID format first), add 20- 30 classes, and choose a color ramp where higher values are a darker color and lower values a light color. Add a Light Gray Canvas or Shaded Relief base map and make the O₃ layer transparent to view the global distribution of O₃. The ozone data measures the amount of ozone in a 3D column of atmosphere. The column size is horizontally 1° x 1° (45m x 45m) and vertically it extends from the surface up to the altitude where the pressure falls to 24 millibars (mb), typically around 25 km. This measures ozone in the troposphere and the stratosphere. The column of ozone (ozone burden) is measured in Dobson Units (DU).

Since the ozone is not evenly distributed within the column, a fractional measure like parts per million would vary greatly within the column, hence Dobson units, which represent a total count of molecules are the standard used. If the ozone in the column is compressed evenly to zero degrees Celsius and one

atmosphere pressure the thickness of the slab that would be created is expressed in Dobson units. One Dobson unit is equal to 0.01 mm (<http://toms.gsfc.nasa.gov/dobson.html> or <http://ozoneaq.gsfc.nasa.gov/dobson.md>).

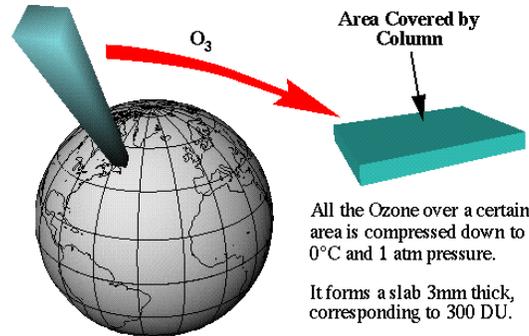


Figure 1. Dobson Unit illustration from <http://toms.gsfc.nasa.gov/dobson.html>.

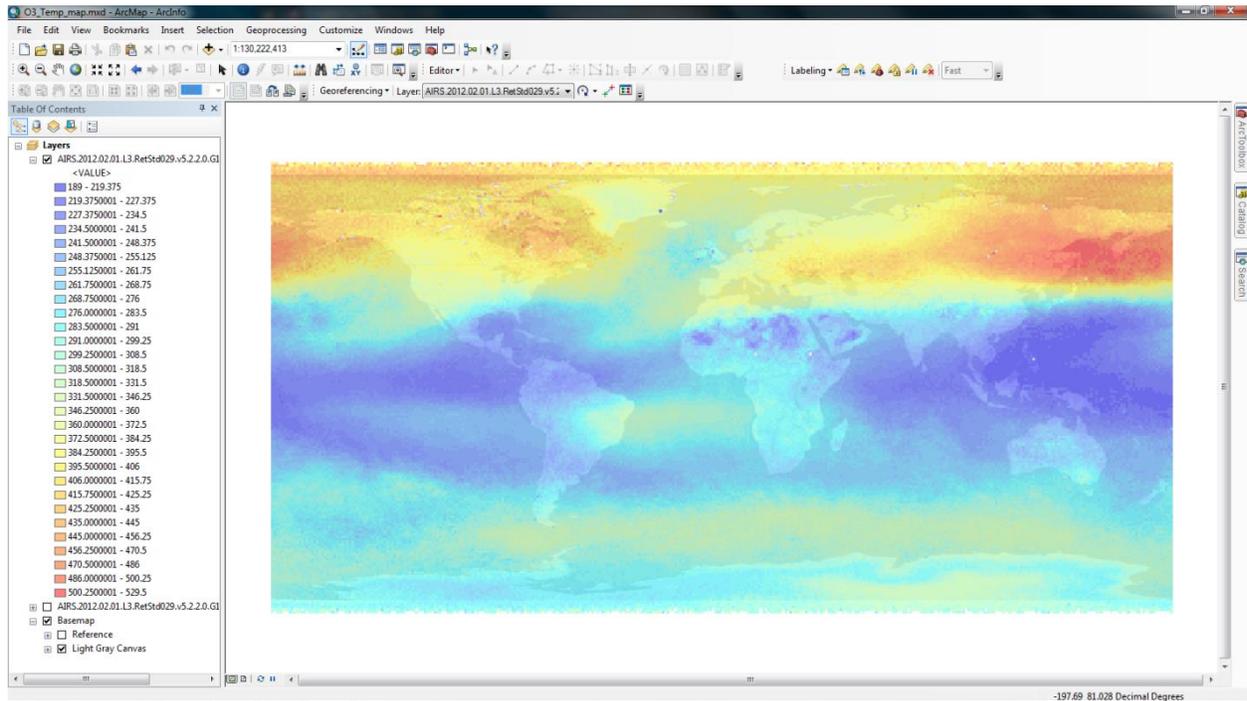
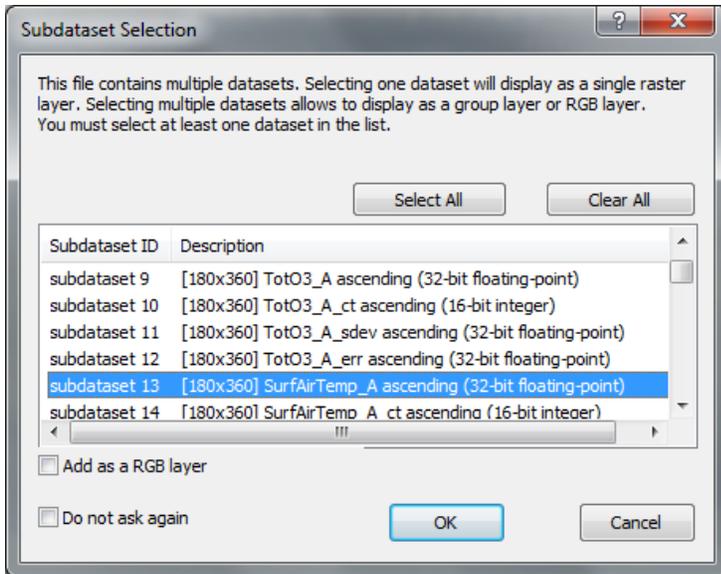


Figure 2. Monthly average ozone data for February 2012 collected at 1:30pm local time in DU.

Add temperature data to the map.

Use the same file that was downloaded and add it to the map again. This time select subdataset 13 SurfAirTemp_A ascending (32-bit floating-point).



Change the symbology to classified with 20- to 30 classes, and choose a color ramp that represents air temperatures.

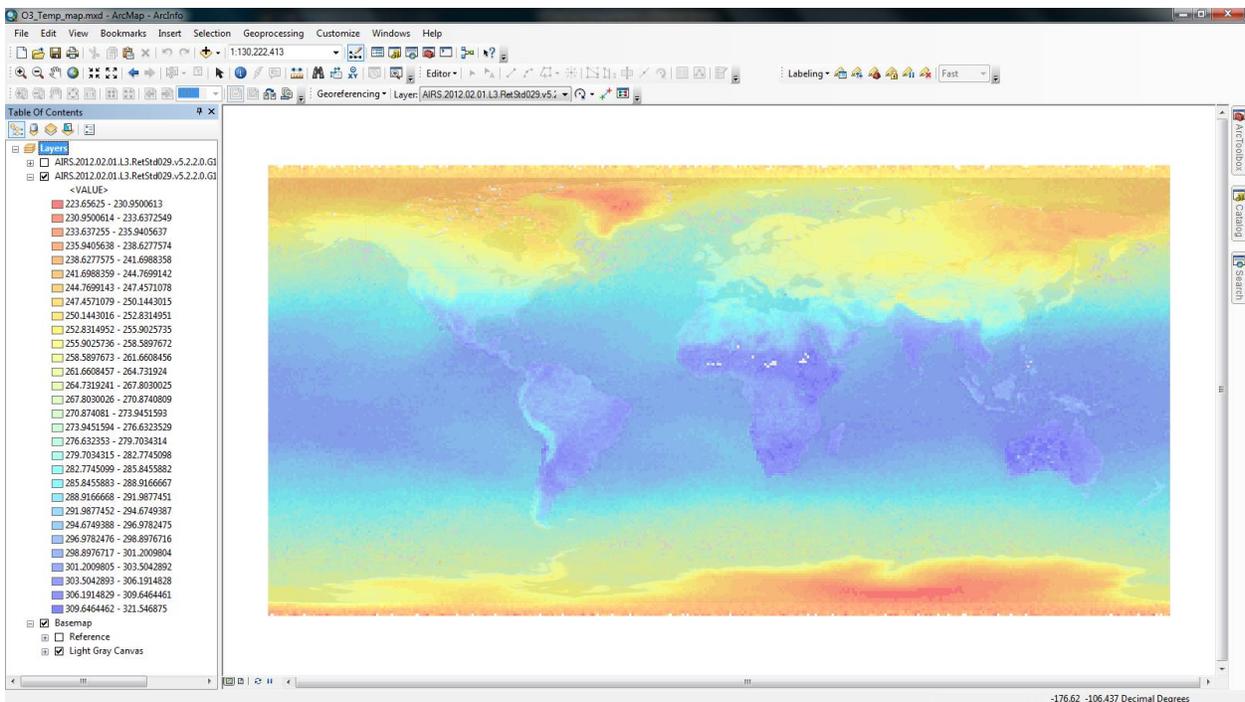


Figure 3. Monthly average surface temperature data for February 2012 in K.

View the results. Temperature is measured in the atmosphere at the Earth's surface in Kelvin (K).