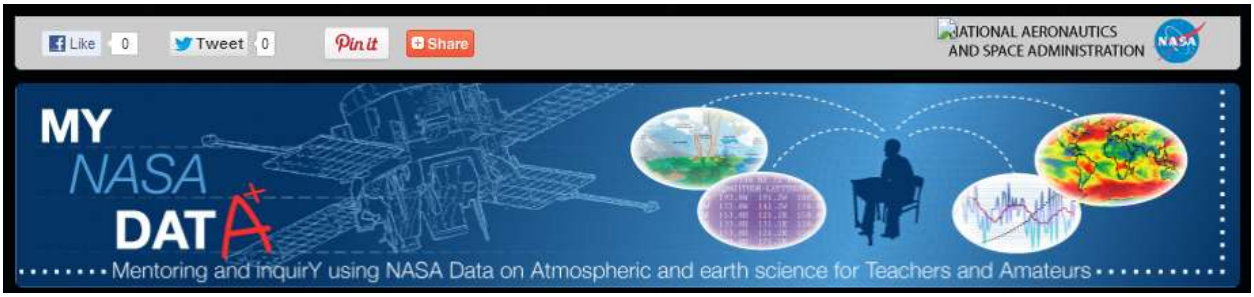
http://mynasadata.larc.nasa.gov/air-quality-and-composition/



Air Quality and Atmospheric Composition

Welcome to the Air Quality and Composition page on MY NASA DATA. This page links you to a powerful data viewer that will allow you to examine all of the air quality and composition parameters that are available on the MY NASA DATA website. You will be able to view sample images here and create data visualizations on the Live Access Server (LAS) that we've configured for you to view global and local data pertaining to these key areas of interest.

Lesson Plans & Activities

Aerosol Lesson Plans:

- Tropical Atlantic Aerosols (Middle School)
- Using MND to Determine Volcanic Activity (High School)

Air Quality Lesson Plan:

- Carbon Monoxide and Population Density (High School)
- Investigating Seasonal Variability in NO2 Concentrations (High School)

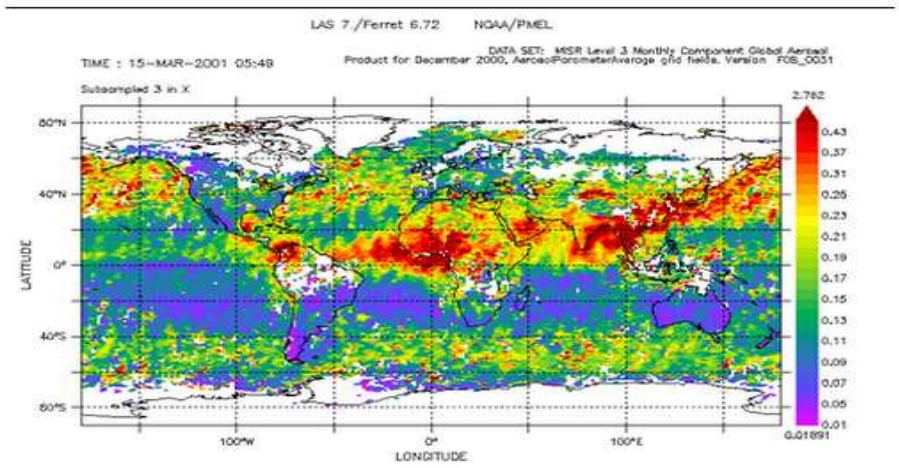
Atmospheric Water Vapor Lesson Plan:

- How much Water is Available for Precipitation (High School)
- Seasons (Elementary)

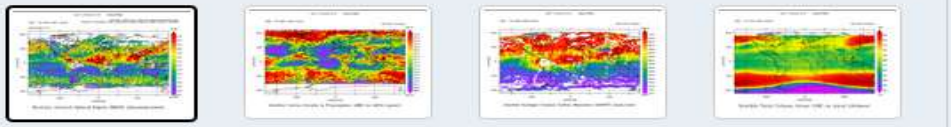
Activities

- Sky Color for Kids (Elementary)

Sample Plots from MY NASA DATA's Live Access Server



Monthly Aerosol Optical Depth (MISR) (dimensionless)



Click on the thumbnails above or the right arrow to navigate to line and Hovmoller plots.

Explore data in the Live Access Server

For all of the parameters below, after clicking on their respective links, please click on "Choose Dataset" button on the upper left hand side of the LAS page and then click on the cross directly to the left of the indicator that you'd like to view. For some browsers, the Choose Dataset dialogue box will automatically appear. We've provided a description of each parameter that is currently available. If you have any questions or issues with the LAS please email the MY NASA DATA support team.

- Monthly Average Cloud-free Aerosol Optical Depth 2007-2011 (CALIPSO)
- Monthly Average All-Sky Aerosol Optical Depth 2007-2011 (CALIPSO)
- Monthly Average All-sky Dust 2007-2011 (CALIPSO)
- Monthly Cloud Coverage (CALIPSO)
- Monthly Aerosol Optical Depth (MISR)
- Monthly Carbon Dioxide in Troposphere (AIRS on AQUA)
- Monthly Daylight Column Carbon Monoxide (MOPITT)
- Monthly Total Column Ozone (ISCCP)
- Monthly Total Column Ozone (OMI on Aura)
- Monthly Tropospheric Ozone Residual Climatology (TOR)
- Monthly Tropospheric Ozone Residual (TOR)
- Monthly Tropospheric Total Column NO2 (OMI)
- Monthly Lower Troposphere Precipitable Water (1000-680 mb) (ISCCP)
- Monthly Upper Troposphere Precipitable Water (680-310 mb) (ISCCP)

Related Missions

DISCOVER-AQ	DISCOVER-AQ is taking a closer look at the air quality near the surface of the Earth, helping us better understand the ingredients that make up the air we breathe. Upcoming airborne field campaigns are scheduled for January 2013 (California), late Summer 2013 (Texas), and 2014 (TBA).

Related Websites:

- MY NASA DATA's Cloud Training Module
- NASA Earth Observatory's Global Maps Page
- NASA DiscoverAQ (Air Quality)
- NASA's Global Climate Change Website
- NASA ARSET: Air Quality

// SD Common //Footer //RSS feed //Accordian Menu //Added CSS for a couple banner clean up and border

Investigating Seasonal Variability in NO2 Concentrations

Purpose: Students will examine data in several formats in order to determine the presence or absence of seasonal variability in tropospheric nitrogen dioxide (NO2) concentrations

Grade Level: 8 - 10

Estimated Time for Completing Activity: 50 minutes

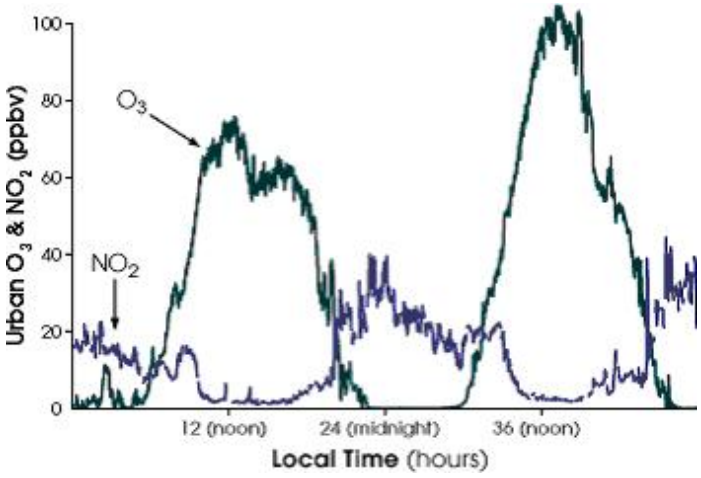


Image courtesy William Brune, Penn State Earth Systems Science Center

Teacher Feedback

National Standards:

- **Math:** Representation
- **Science Content:** A Science as Inquiry
- **Science Content:** D Earth and Space Science
- **Science Content:** F Science in Personal and Social Perspectives

AP Environmental Science Topics

- Atmospheric circulation
- Atmospheric structure
- Formation of ozone
- Measurement units
- Seasons

Virginia Standards of Learning:

- **ES.1c:** The student will plan and conduct investigations in which scales, diagrams, maps, charts, graphs, tables, and profiles are constructed and interpreted.
- **ES.12:** The student will investigate and understand the origin and evolution of the atmosphere and the

interrelationship of geologic processes, biologic processes, and human activities on its composition and dynamics.

Vocabulary:

- air quality
- atmospheric column
- nadir
- nitrogen oxide
- number density
- OMI
- trace gas
- troposphere

Lesson Links:

- EPA Web site about NO2
- Graph of NO2 vs. Ozone
- EPA NOx website
- NPS Article on nitrogen deposition
- Population Density
- Live Access Server
- Understanding Scientific Units - Air Quality
- Convert this Lesson into a PDF

Background:

For background information about NO2, please refer to the EPA website and the graph of NO2 in the Lesson Links.

The dataset used in this lesson is monthly averages of NO2 as measured from NASA's EOS Aura spacecraft. NO2 is measured using the Ozone Monitoring Instrument (OMI). OMI is a nadir-pointing instrument that measures trace gases in a column of air directly below the spacecraft. NO2 concentrations are measured in number densities, or the amount of NO2 molecules found in a cubic centimeter of air. Alternately, units of parts per billion can be used, as in the graph at the top of the page. This tells how many NO2 molecules would be found in a sample containing a billion molecules of air. The OMI instrument measures the amount of NO2 in the entire vertical column of air below it, thus the units for OMI measurements are molecules per square centimeter (of the surface). See the units page for more explanation of this.

Measurements of nitrogen dioxide (NO2) [in blue on graph] and ozone (O3) [in green] indicate rise and fall over a 48-hour period. Nitrogen dioxide participates in ozone formation, so after its concentrations peak, so do concentrations of ozone. Ozone concentrations peak during hours of maximum sunlight, around the middle of the day. (Graph courtesy William Brune, Penn State Earth Systems Science Center)

Procedure:

Part I: Examining Seasonal variations in NO2

Obtaining NO2 data from the Live Access Server (LAS):

1. Click on the Live Access Server (Advanced Edition) link above in the lesson links section of the lesson.
2. If you are not automatically prompted with the data sets, click on' Choose Dataset' from the menu at the top of the screen then click on Atmosphere, Air Quality and then Tropospheric Total Column NO2 (OMI)
3. Change the location, by making the following changes to the compass rose below the navigation map to the left of the screen.
4. Click in the upper latitude box and type 41 N
5. Click in the lower latitude box and type 36 N
6. Click in the left longitude box and type 90 W

7. Click in the right longitude box and type 82 W
8. Click on 'Update Plot' found in the menu at the top of the page to see your updated plot.
9. Click on the 'Compare' found in the menu at the top of the page
10. For the plot in the upper left corner, choose January 2007. This can be done by scrolling down and using the drop down menus below each of the plots.
11. For the second variable, choose May 2007
12. Be sure to click 'Update Plot' at the top of the screen to see your new data plots.
13. You can now click on each of the plots to enlarge the image and save them for later use in the lesson.

Part II: Graphing NO2 data in Excel

1. Return to the LAS page found in the lesson links section of the lesson.
2. If you are not automatically prompted with the data sets, click on' Choose Dataset' from the menu at the top of the screen then click on Atmosphere, Air Quality and then Tropospheric Total Column NO2 (OMI)
3. Under the 'Line Plots' option found on the left hand side of the screen, choose 'Time Series'
4. Enter the following location in the latitude and longitude box: 39 N, 85 W in the compass rose found under the navigation map to the upper left of the screen.
5. Under 'Date Range' use the drop down menu to select, Jan 2006 to Jun 2007
6. To save the data set as a text file to import into excel, click on 'Save As' Found in the menu at the top of the screen, use the drop down menu to select 'ASCII', verify your date and click 'OK' to save your file to your computer.
7. Once the file is saved, import the NO2 file into Excel. For information on how to import data, please see the tools section of the MY NASA DATA website.
8. Graph the time series NO2 data.

Questions:

Part I Questions:

1. What observations can be made about the plots? Explain your observations.

2. Why do you think the plots for these two months look the way they do?

3. What seasons occur during these two months?

4. Given the differences in seasons, are the similarities and differences what you expected?

5. Speculate why you think this location was chosen.

6. Predict how the data would behave if you were to graph a time series for a single location within this area

Part II Questions:

1. Describe any patterns you observe in the graph. Based on your answer from Part I, does the graph look like what was predicted? If not, what was different?

2. List possible reasons why the graph appears the way it does from January 2006 to June 2007.

Extensions:

Investigate other factors that affect NO2 variability:

1. Compare the NO2 from this location with the NO2 from the Los Angeles area in CA. How do the plots compare? Are there any similarities or differences? Explain your reasoning.

2. Explore the relationship between NO2 and population density using the Population Density lesson link. What comparisons can be drawn between population densities and NO2 concentrations?

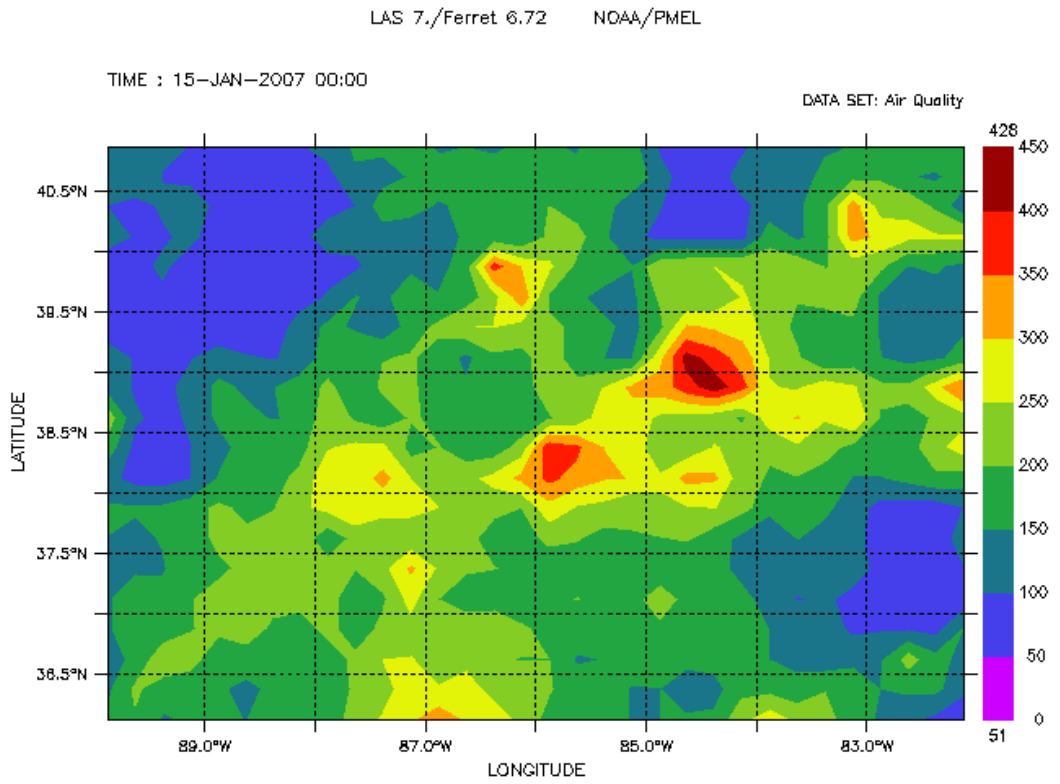
3. Predict what you think the NO2 concentrations for your area would be for spring and fall. Find the NO2 satellite data for your area and plot the time series data. Does the data agree with your predictions? Investigate possible causes for any discrepancies between your predictions and the data.

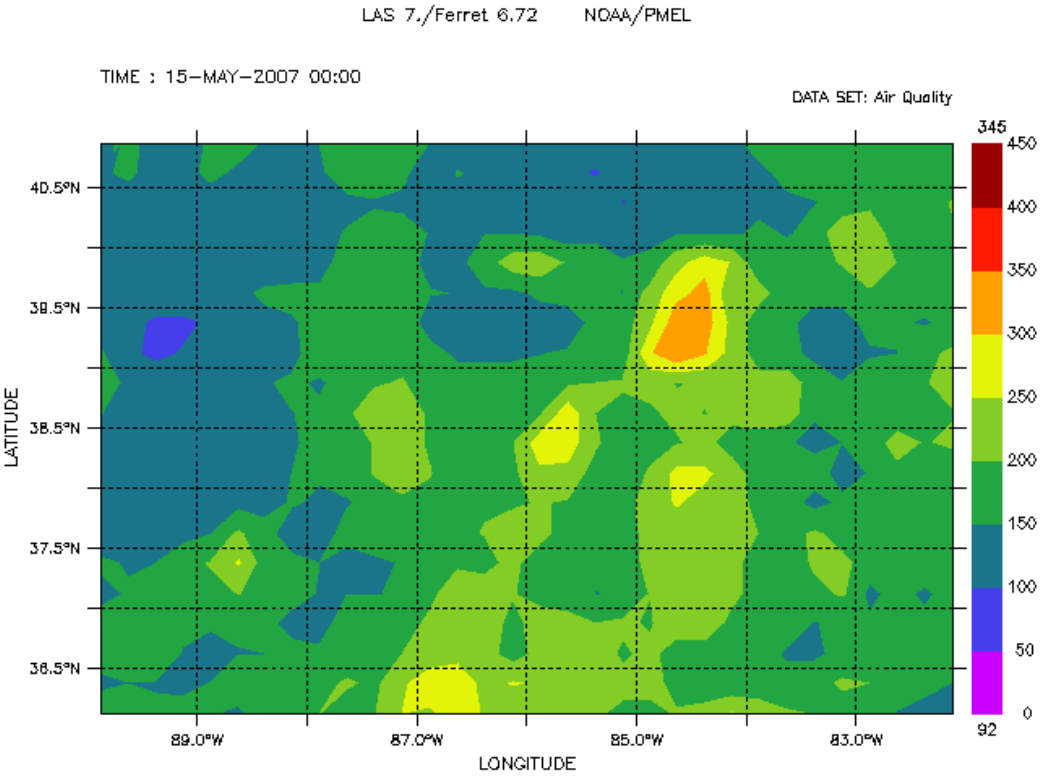
Lesson plan contributed by Brooke Carter, Greenbelt, Maryland

Click here for Teachers Notes

Investigating Seasonal Variability in NO2 Concentrations – Answer Key

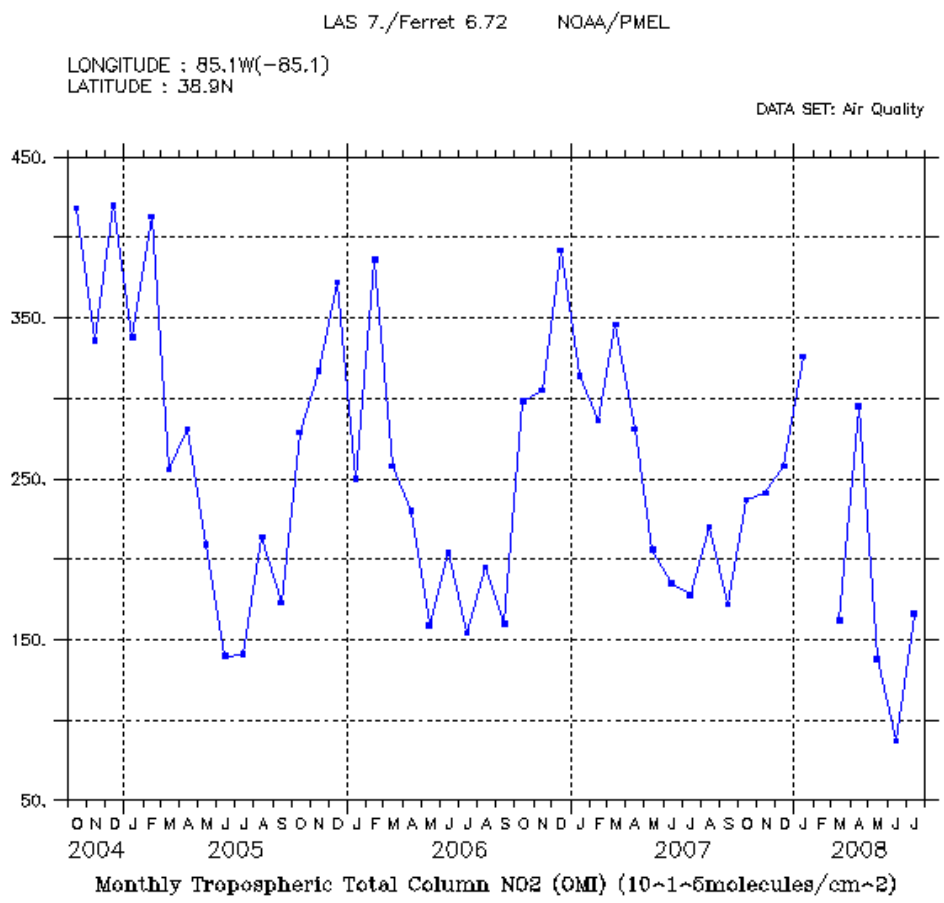
Part I Plots





Part II Plot

Time Series Plot, graphed in LAS *(graph in Excel should look similar)*



Part I Questions:

1. What observations can be made about the plots? Explain your observations.

Looking at the scale for the plots, it appears there are more dark red contours in the January plot, indicating higher concentrations of NO2 in January than in May.

2. Why do you think the plots for these two months look the way they do?

Answers will vary.

3. What seasons occur during these two months?

January plot is Northern Hemisphere Winter, May plot is Northern Hemisphere Summer.

4. Given the differences in seasons, are the similarities and differences what you expected?

Example- Students may think NO2 would be high in summer due to warmer air temperatures or additional car traffic.

5. Speculate why you think this location was chosen.

Example- Location is close to Cincinnati, a major metropolitan area.

6. Predict how the data would behave if you were to graph a time series for a single location within this area.

Answers will vary.

Part II Questions:

1. Describe any patterns you observe in the graph. Based on your answer from Part I question 7, does the graph look like what was predicted? If not, what was different?

Answers will vary.

2. List possible reasons why the graph appears the way it does from January 2006 to June 2007.

Example- Students may relate NO2 values to various sources such as car emissions or emissions from factories. Students should also note responses related to the chemical makeup of NO2. NO2 photosynthesizes into ozone. Refer students to the diurnal cycle graph of NO2 and O3. Notice how NO2 concentrations decrease as sunlight is strongest. Similarly, more NO2 is present during winter than summer because of differences in sunlight.