ESCI 1010 Lab 8
Air Pollution

Before Lab: Review pages 424-441 in your Weather and Climate textbook. Please pay special attention to the sections entitled: "Atmospheric Pollutants", "Atmospheric Conditions and Air Pollution", and "The Counteroffensive on Air Pollution". You may also elect to consult resources and policies available through the US Environmental Protection Agency (www.epa.gov).

Summary: This lab focuses on air pollution. Through this exercise you will explore patterns in pollution concentrations as well as weather conditions that contribute to poor air quality near the Earth's surface.

LAB EXERCISE

1. Recall that the concentrations of some components of the atmosphere vary with time and/or with place. Figure 8.1 summarizes the concentrations of fine particulate matter between 2001 and 2006. Fine particulates (2.5 micrometers or less) get past our body's defenses, can remain in our lungs for an extended time and are associated with a range of health impacts (see Figure 14-2 on page 426 of the textbook).

   Have a look at the map – what places (consult Google Earth (http://earth.google.com) if necessary) are exposed to the highest concentrations of fine particulates?

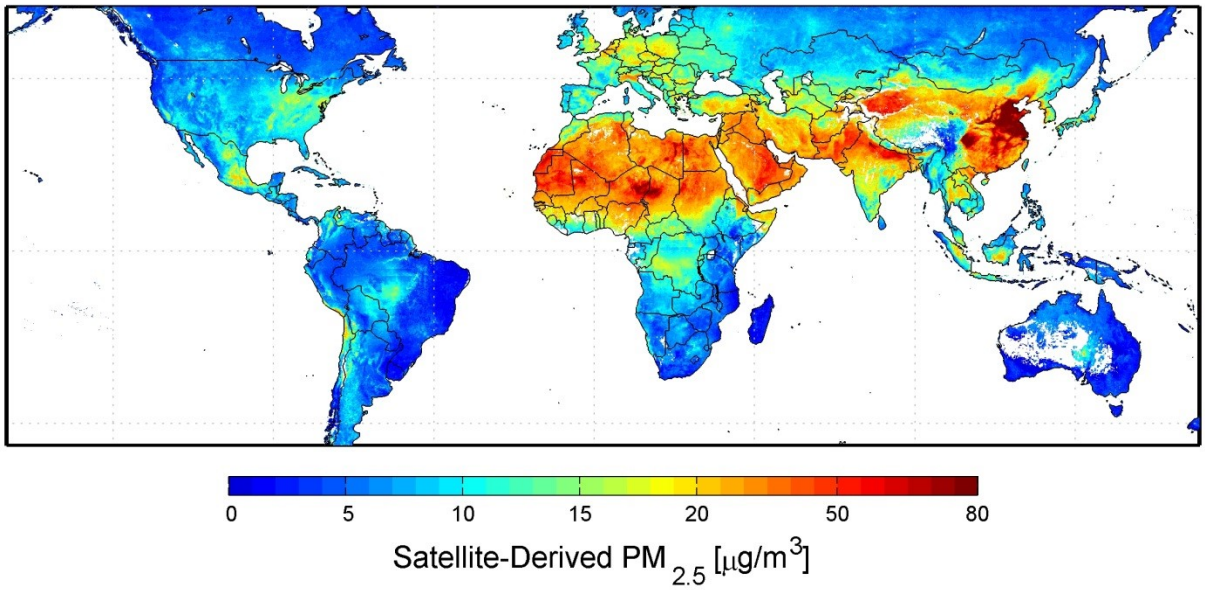


Figure 8.1: Global Perspective of Fine Particulate Matter (2.5 micrometers or less) 2001 – 2006. (source: NASA.gov)

2. Focusing now on the United States (Figure 8.2) identify and describe the spatial pattern in concentrations of particulate matter.

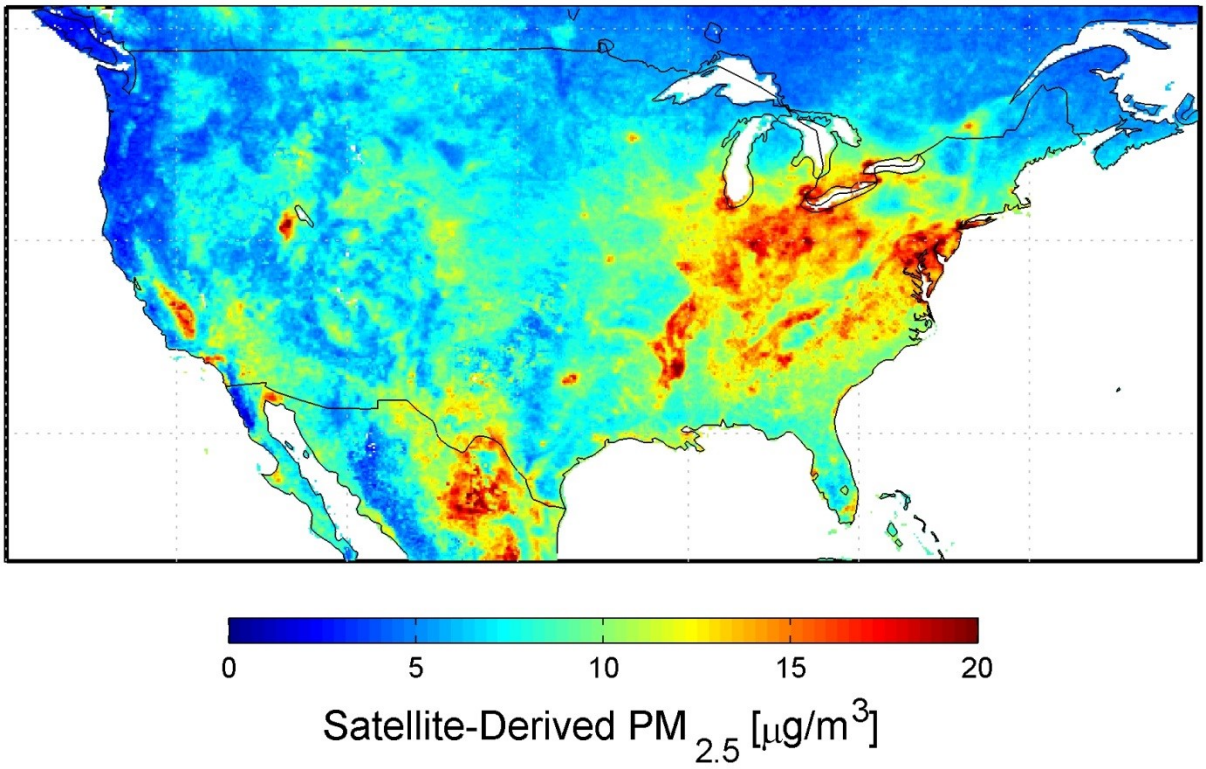


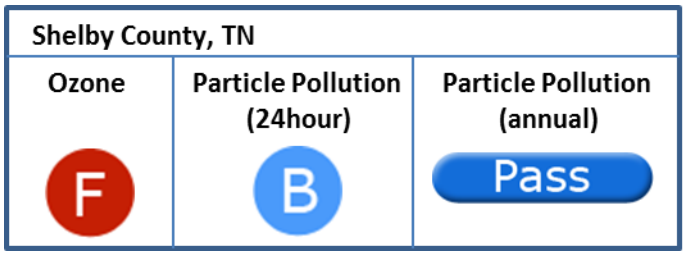
Figure 8.2: United States Perspective of Fine Particulate Matter (2.5 micrometers or less) 2001 – 2006. (source: NASA.gov)

a. What places have highest concentrations? What places have the lowest concentrations?

b. Recalling the discussion about particulates in the textbook on pages 424-426, explain (account for) the pattern you identified.

3. The American Lung Association issues a report on the air quality of places in the United States each year (www.stateoftheair.org). When comparing 277 metropolitan areas in 2013 the Memphis area ranks 37 for high ozone days; 112 for 24-hour particle pollution; and 65 for annual particle pollution.

   Our air quality report card from the American Lung Association looks like this:



   The failing score for Ozone reflects 22 Orange Ozone days. The Air Quality Index (AQI) is a standardized index for communicating air quality to the general public each day (recall discussion beginning on p. 431 of your text). On orange days air quality is unhealthy for sensitive populations.

   Data provided in Table 8-1 and 8-2 summarize the hourly ground level ozone recordings for two sites in Shelby County, TN. We will use those sites to help us understand the presence of ground level ozone in our community.

Table 8-1: Ground Level Ozone Values for Site 21

Hour of Day (CST)	Ozone Concentration (ppm)		Hour of Day (CST)	Ozone Concentration (ppm)
0:00	0		12:00	0.054
1:00	0		13:00	0.057
2:00	0		14:00	0.057
3:00	0		15:00	0.058
4:00	0		16:00	0.058
5:00	0		17:00	0.048
6:00	0		18:00	0.030
7:00	0		19:00	0.019
8:00	0		20:00	0.005
9:00	0		21:00	0.001
10:00	0.040		22:00	0.003
11:00	0.049		23:00	0

Table 8-1: Ground Level Ozone Values for Site 1004

Hour of Day (CST)	Ozone Concentration (ppm)		Hour of Day (CST)	Ozone Concentration (ppm)
0:00	0		12:00	0.053
1:00	0		13:00	0.056
2:00	0		14:00	0.059
3:00	0		15:00	0.061
4:00	0		16:00	0.063
5:00	0		17:00	0.063
6:00	0		18:00	0.056
7:00	0		19:00	0.044
8:00	0.040		20:00	0.036
9:00	0.047		21:00	0.038
10:00	0.048		22:00	0.034
11:00	0.051		23:00	0

3a. Using the ground level ozone concentrations recorded for each site over the course of a day plot a curve for each site (21 and 1004) on the graph below (Figure 8-3). Label each site.

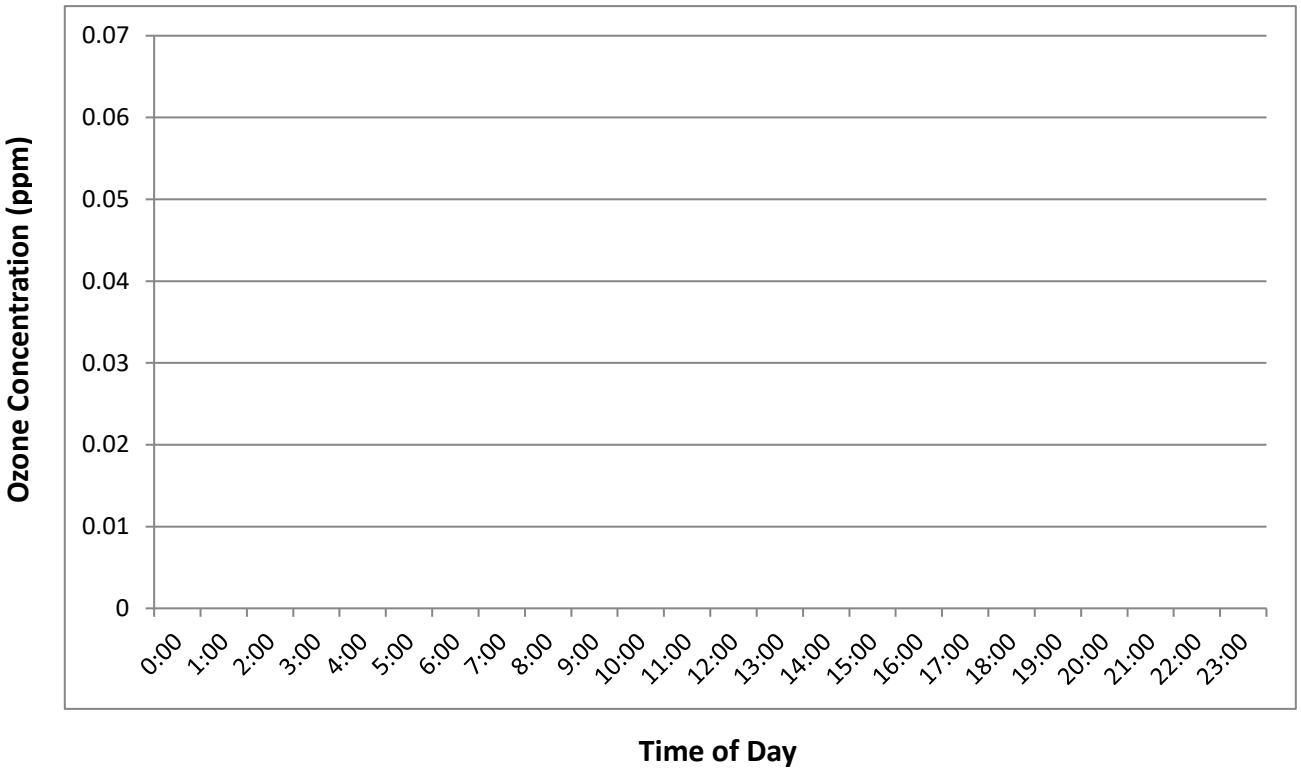


Figure 8-3: Ground Level Ozone Concentration Curves (Shelby County, TN).

3b. Based on your curves from exercise 3a, describe the pattern in ozone concentration levels over a twenty-four hour day. What is the timing of the peak in ground level ozone concentrations?

3c. What's going on here? Explain or account for the timing of the highest ground level ozone concentrations. (Hint: consider the ingredients required to form ground level ozone; see Figure 8-4).

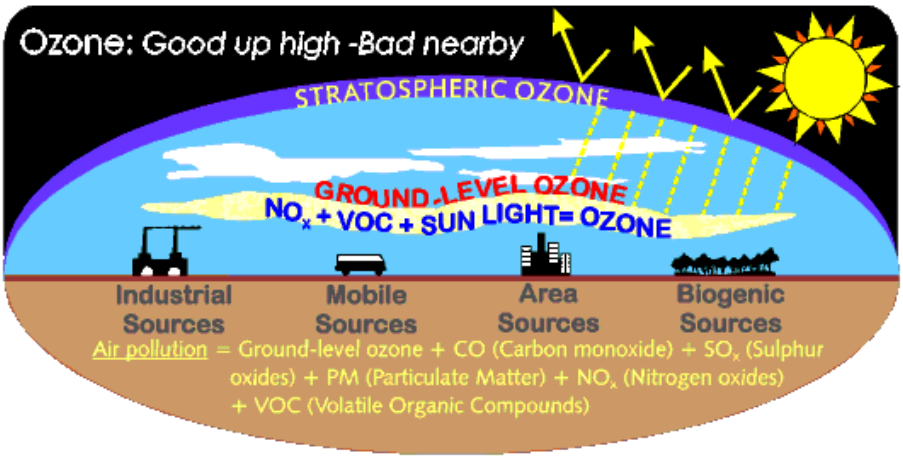


Figure 8-4: Ground Level Ozone Formation.

4. Now that you've considered the temporal characteristics of ground level ozone let's think about space. Given the ingredients or conditions that promote the formation of ground level ozone:
    a. Identify a place in the world where you would expect to experience a problem with this air pollutant.

    b. Identify a place in the world where you would not expect ground level ozone to contribute to air pollution.

    c. What criteria did you use to select these two places?

    d. List two actions that could reduce the concentrations of ground level ozone.

5. Progress has been made to improve air quality in the United States. Despite efforts some places continue to be plagued by air quality concerns. Los Angeles, CA is often considered an example of such a place. We've looked at sources and ingredients of pollution; now let's consider the roles weather conditions play in pollution.

   Describe how the geographic location of Los Angeles influences the air pollution the city and residents experience. (Be sure to apply ESCI 1010 concepts related to wind, temperature, and stability in your response).