

# Wind Rose Exercise

## Overview

There are two parts to this wind rose exercise utilizing two sets of meteorological data from two separate ambient air-monitoring sites, identified as Site 1 and Site 2. Part 1 of the exercise uses first quarter 2005 raw (not validated) meteorological data from Site 1. A wind rose for the quarter will be generated. Also, three 24-hour wind roses will be generated from the met data on three days when high pollutant concentrations were observed at the site during the first quarter of 2005. Part 2 of this exercise uses 2004 data gathered from Site 2. A 1-year wind rose and an ozone season wind rose will be generated from Site 2 data. The ozone season wind rose will only include winds between March 1 and October 31, and only include winds during daylight hours between 7 am and 6 pm. Although not part of this exercise, ozone violation wind roses could be made by only selecting days when ozone exceeded the 8-hour standard. Wind roses could be developed related to other pollutants as well, selecting multiple or single days in one or more years to be included in the wind rose.

## Procedure for Part 1

Data for this procedure has already been formatted to Lakes Format so it will work with the WRPLOT View wind rose software. The data file for this part is named Site 1 and is located in the Desktop folder named Wind Rose Exercise.

1. Double-click the WRPLOT View icon. The icon is located on the Desktop.
2. Click OK on the welcome screen
3. Click "Add File" on the upper right hand side of the screen
4. Click the upper drop down box beside "Look in" and select Desktop
5. Click the lower dropdown box to select "Lakes Format" as the file type
6. Double-click Wind Rose Exercise and select "Site 1", then click "Open"
7. There are several tabs near the top on the WRPLOT View screen (Met Data Information, Frequency Count, Frequency Distribution, Wind Rose, and Graph). Click on the tabs to see what is included under each tab. Then click the Wind Rose tab. This is a wind rose for the first quarter of 2005 at Site 1.

Do you see a potential problem with the data based on this image?

8. There are two ways to save this wind rose image. Double-click on the files after you save them to view them and see the differences.
  - a. To save just the part you see in the white box on the screen, click "Edit" in the upper left hand corner and select "Copy to File." Then select Metafile or Bitmap (metafile is a better resolution). When the save dialog box appears, make sure the Wind Rose Exercise folder is in the upper dropdown box as the save location, and name the file "**Site 1 quarter edit-save,**" so you know this is the edit save method when you view it.

- b. To save the file with additional information about the file included, click the “print” button on the right side of the WRPLOT View screen. The preferences tab in the lower left corner allows you to format the output and choose what information to include. Click the preferences button to see what’s there and then click cancel to return to the previous screen. Leave the setting at their default for now. Click on the icon on the right hand side of the screen that looks like a floppy disk. Save it to the Wind Rose Exercise folder and name it “**Site 1 quarter print-save.**” Then click close.
9. Click the “Met Data Information” tab. Notice that on the bottom left side of the screen there are “Specify Days” and “Specify Time” buttons.
  - a. Click the Specify Days button.
  - b. Right click anywhere over the Xs that you see and choose the “Unselect All” option.
  - c. Place the curser over February 3 and double-click to add an X to that box. February 3 should be the only box selected.
  - d. Click OK.
  - e. Click on the Wind Rose tab to see the wind rose for February 3.

Do you notice something interesting about wind speeds in the wind rose? They are showing low speeds and very high speeds with nothing in between. Let’s get a closer look at wind speeds. First, we will change the wind classes. Then we will look at the data itself.

10. On the top of the screen click on the “Wind Classes” button. You can edit numbers in the left column by double-clicking and typing in new numbers. You can also add more wind classes by clicking Add. When finished you left-click somewhere in the right column and they will automatically adjust to the new settings you entered in the left column.
  - a. After clicking on Wind Classes click “Add” three times
  - b. Pick wind speeds and enter them in the left column
  - c. Left-click on the right column then click OK
  - d. View the wind rose
  - e. Select other speed classes using the above procedure and view wind roses with a variety of wind classes.
  - f. Restore the default settings by clicking Wind Classes/Reset Default/OK
  - g. Save the wind rose
  - h. Click the Met Data Information tab
  - i. On the right hand side of the screen click on the “Preview” button. This is the data in Lakes Format. There are seven columns. From left to right they are: Site ID (5-numbers), Year, Month, Day, Hour, Wind Direction (degrees), and Wind Speed (Knots). For specific information about Lakes

Format use the Help function in the WRPLOT View software. Scroll down to February 3, 2005 and look at wind speeds. Do wind speeds make sense on this day? Scroll through all the data looking at the wind speed column. Are there other possible problems with wind speed? Close the preview display by clicking the X in the upper right hand corner.

11. Use what you learned in the above procedure to create wind roses for February 27 and March 29. Save the wind roses with the date in the name so you can identify them later.

View the wind roses you saved.

What, if anything, do the 24-hour wind roses tell us about the possible source(s) and their direction(s) from the monitoring site?

Can we trust the wind data from Site 1 in this period?

Are you comfortable using this met data for detailed analysis of what contributed to the high pollutant concentrations?

### **Procedure for Part 2**

1. Click the Met Data Information tab
2. The data from Site 1 is highlighted. Click the "Remove" button on the right
3. Click the "Yes" button to remove the data
4. Click "Add File"
5. Select "Site 2" and click "Open"
6. Click the "Wind Rose" tab
7. Save the wind rose
8. Create an ozone season wind rose. This area's ozone season excludes November through February. We will also only include hours between 7 am and 6 pm.
  - a. Click the "Met Data Information" tab
  - b. Click the "Specify Days" button
  - c. Left-click over Jan. Then right click over Jan and choose "Unselect". Then Click OK. This unselects the month of January and removes that wind data from the wind rose.
  - d. Unselect Feb, Nov and Dec in the same way
  - e. Click the "Specify Time" button
  - f. Set the start time to 07:00 and the end time to 18:00 (this is 6 pm on a 24-hour clock). Then click OK.
  - g. Click the "Wind Rose" tab and view the Ozone season wind rose.
  - h. On the top of the screen you can change the number of directions that will be shown on the wind rose. Click the "Wind Directions" dropdown box and select 24. Select other numbers to see how the rose looks. Pick your

favorite view and save the wind rose. Later, compare the ozone season wind rose with the annual wind rose by viewing the saved roses.

Use what you learned above to view the Site 2 data (use the "Preview" button). Are there potential wind speed problems with this data? Both sites use Sonic sensors for wind speed and direction. What might you look at to determine if there is a pattern to the wind speed problems? What might have caused the wind direction problems at Site 1?

### Lessons

Locally collected wind data can be useful as a tool to help understand what may be contributing to air quality problems in an area. However, it can also be misleading and care must be taken in its collection and interpretation. Surface met data is short-distance in its use. Winds curve around surface features and pressure systems. They rise and fall. They can be flowing in completely different directions and speeds as you go up in elevation at a given location. Surface winds could be from the west, however the source actually contributing to the air quality problem at that particular time could be north of the site. NOAA's HYSPLIT backward trajectories from monitors and modeled forward plumes from sources, as well as access to met data at elevations (NOAA's wind grams) and other information should be used in conjunction with surface wind data collected at a site when trying to determine possible source impact in the area. Also, the collected wind data must be valid to be useful. Quality control procedures may not detect and correct all problems, especially if the problems are intermittent. It is important to view your data. Wind rose software such as that used in this exercise can provide a visual trigger to a potential problem with the met data collection system. Reviewing the data itself is also useful. An important test in any quality control procedure is the "Does it make sense" test. Is it possible to have 100 mph winds at your site as an average for a few hours when all the other data in the area shows calm or light winds? It certainly is not. However, the audit two months later might show that the equipment is working perfectly. In this instance there were very high concentrations at Site 1 (a real place with elders and children living there) for toxics and criteria pollutants on several days. The met data is highly suspect and is of little use in any detailed analysis. There is no perfect system. Strive to obtain the best data possible. You may need it months or years from now. You can't gather it again!

**NOAA's Air Resources Laboratory Web page:**

**<http://www.arl.noaa.gov/ready.html>**

WRPLOT View is available for free from Lakes Environmental and can be downloaded at:

**<http://www.weblakes.com/lakewrpl.html>**