

Appendix 2b. Surface Meteorology

Surface Meteorological Data

NOAA's Environmental Technology Laboratory (ETL) collected 10-minute and 60-minute averaged data from standard 10 m meteorological towers at the same four sites as the wind profilers from July 1 to October 31, 1999. Data collected included surface pressure, 2-meter temperature and relative humidity, wind speed, wind direction, down-welling solar radiation, net radiation, mixing ratio, precipitation, and peak gusts.

Box plots in Figures 1–3 below show how some of the surface meteorological data relevant to visibility impairment at Big Bend varied by wind direction. For each box, the center line is the median, the tops and bottoms of the boxes are the 25th and 75th percentiles, and the whiskers extend to the maximum and minimum. Wind speeds tend to be lowest when the wind is from the east and west and highest for winds from north and south. Low wind speeds are indicative of stagnation while high wind speeds can bring more ventilation and can also transport emissions from more distant sources. Relative humidity (RH) is in general lowest when surface winds are from the east and highest when the wind is from the west. High RH enhances the scattering of hygroscopic aerosols and is also indicative of cloudiness which affects chemical transformations of aerosols. Temperatures are highest with wind from the east and lowest with wind from the west. Temperature inversely influences RH and influences secondary aerosol formation.

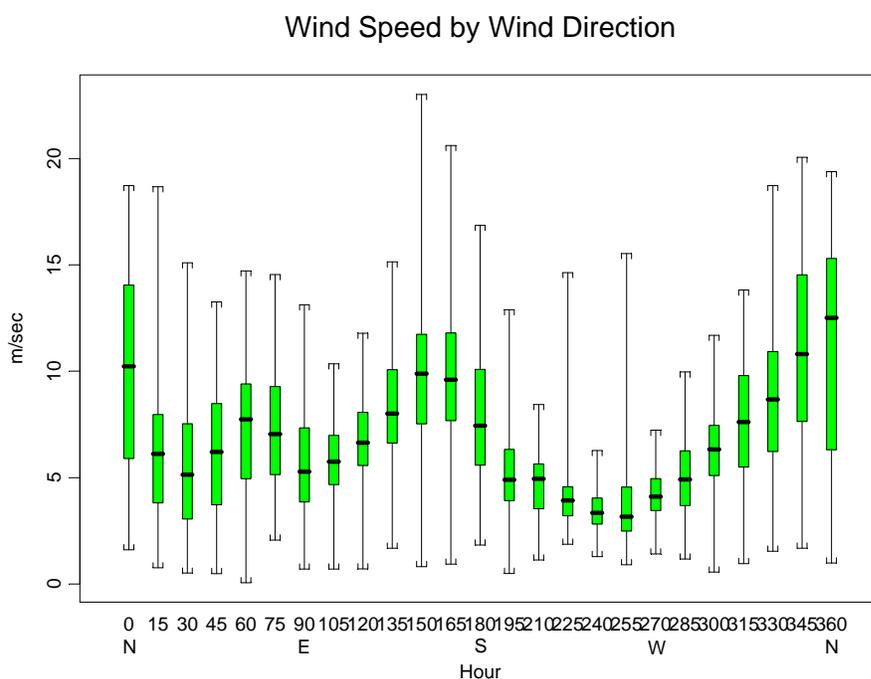


Figure 1. Wind speed by wind direction at Big Bend National Park.

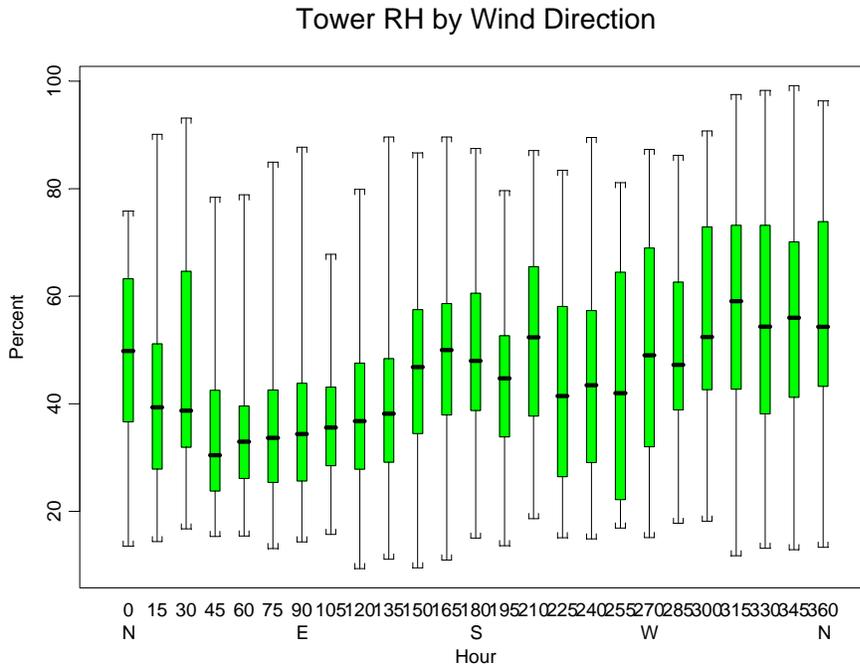


Figure 2. Relative Humidity (RH) by wind direction at Big Bend National Park.

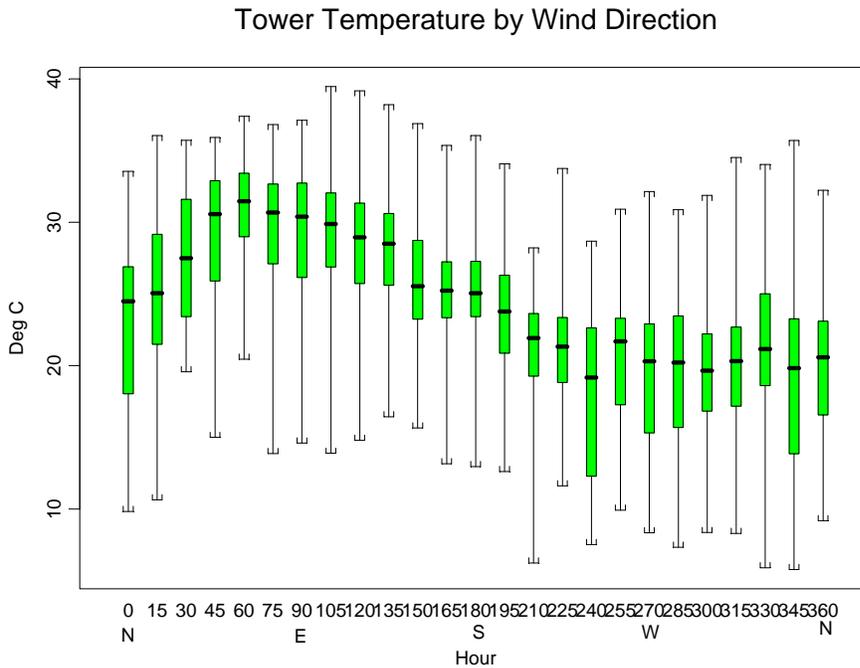


Figure 3. Temperature by wind direction at Big Bend National Park.

The box plots in Figure 4 show how the 2-meter wind direction at Big Bend varies diurnally. Note the directional shift at about the time of sunrise. During daylight hours, winds are mostly from the east through southeast quadrant, while at night winds are mostly from the

south through southwest. This diurnal shift mostly explains the wind direction dependence on the temperature and RH; the higher temperatures and lower RH from the easterly directions occur mostly during the day, while the lower temperatures, higher RH, and westerly directions are occurring mostly at night.

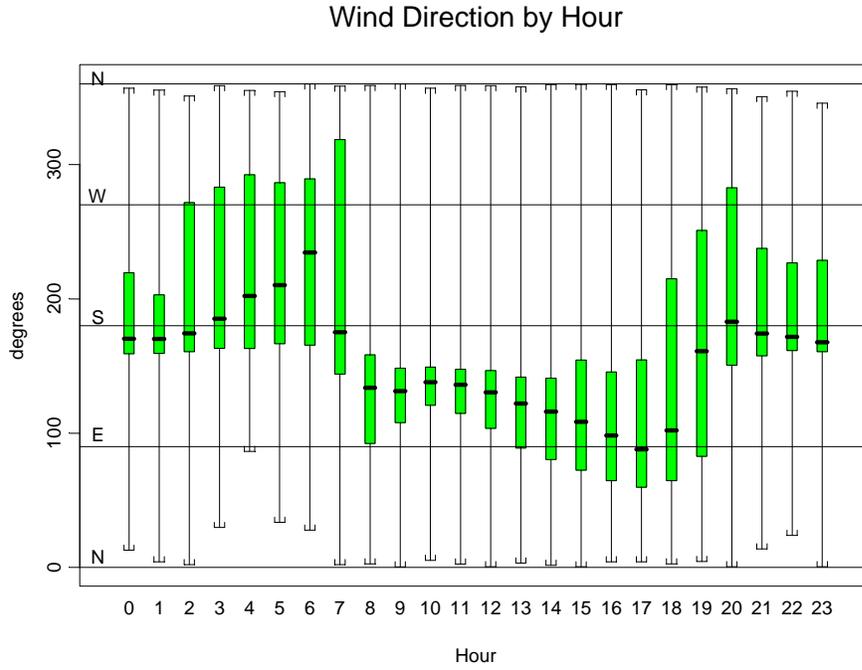


Figure 4. Two meter wind direction by hour at Big Bend National Park.

Wind roses, showing the frequency of winds from all directions at 6:00 am and 6:00 pm are shown in Figures 5 and 6.

Hour 6

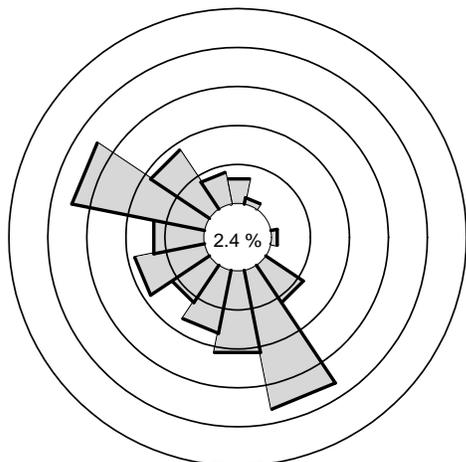


Figure 5. Daytime (6 GMT or 0 CST) 2 m wind rose at Big Bend. Each ring represents 5% of the observations. Winds with speeds less than 1 m/sec are considered calm or light and variable with indeterminate direction. 2.4% of the observations were calm.

Hour 18

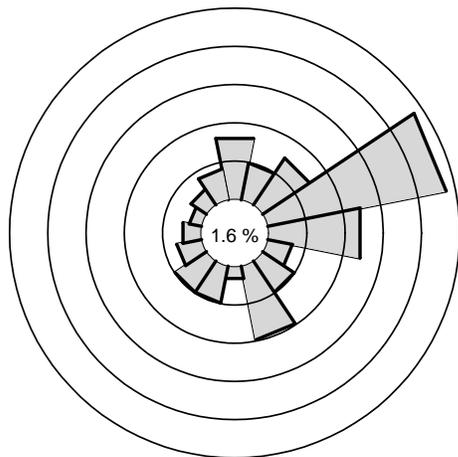


Figure 6. Nighttime (18 GMT or 12 CST) 2 m wind rose at Big Bend. Each ring represents 5% of the observations. Winds with speeds less than 1 m/sec are considered calm or light and variable with indeterminate direction. 2.4% of the observations were calm.