# WIPP ENVIRONMENTAL MONITORING DATA SUMMARIES

# Meteorological Conditions in the Vicinity of the WIPP Site

## Methods

CEMRC operates two identical meteorological towers at sampling sites in the vicinity of the WIPP (Fig. 2). The Near Field site is approximately 1 km northwest of the WIPP site at an elevation of 1088 m (latitude 32°22'40.385"N; longitude 103°47'55.425"W). The Cactus Flats site is approximately 19 km southeast of the WIPP site at an elevation of 1041 m (latitude 32°13'05.451"N; longitude 103°41'42.583"W).

Each station consists of a 10-meter tower equipped with sensors for temperature, relative humidity, barometric pressure, total solar radiation, Ultra-Violet B (UVB) radiation, wind speed and direction, and vertical wind speed. Data are collected every second, with averaging times of ten minutes. In addition, the maximum wind speed and total precipitation occurring over the 10-min averaging period are recorded.

Temperature, relative humidity and all wind parameters are measured at a height of 10 meters above ground level. Precipitation, barometric pressure, solar radiation and UVB are measured at heights of 0.4, 1, 2, and 3 m, respectively. The barometric pressure sensors are compensated for temperature, but are not referenced to mean sea level. The solar radiation sensors (pyranometers) measure the energy flux per unit area (W $m^{-2}$) of both direct and diffuse sky radiation. The UVB sensor measures direct and diffuse UVB in the 280-320 nm band.

The data are stored in electronic dataloggers and downloaded twice weekly. Once downloaded, the data are screened for outliers and other anomalies and uploaded to a main database. Performance checks of the sensors are conducted quarterly, and sensors are re-calibrated at the manufacturers' specified intervals.

This report summarizes meteorological data collected over the 12-month period from December 1999 through November 2000. In addition, data collected at the sites from 1 December 1998 through 30 November 1999 (12 month period) are compared with data from the same time interval during 1999-2000.

## Results

For the 2000 sampling period, data recovery exceeded 99% for all sensors, except the wind speed sensor at Near Field, and the UVB sensor at both locations. The Cactus Flats UVB sensor failed in June and was undergoing repairs and recalibration during late June through early August. At Near Field, the wind speed sensor suffered intermittent failures from late March through late July, and the UVB sensor was absent from the station for calibration during late August through mid-October. Other short-term (typically less than one hour) data losses occurred throughout the year due to sensor malfunction, repair, maintenance, and performance testing.

Averaged over the year, winds were from the east and southeasterly direction (E, ESE, SE and SSE quadrants, inclusive) 50% of the time at the Cactus Flats and 52% at the Near Field sites (Fig. 3). However, there were some distinctive seasonal variations in wind direction (Figs. 4-5). Wind direction was highly variable during the winter and spring (December through May) when compared with the summer and fall (June through November). During summer and fall, wind from the southeastern quadrant occurred over 64% of the time, but dropped to less than 41% during the winter and spring. The inter-annual and intra-annual variability in wind direction are important parameters in modeling dispersion pathways for potential airborne releases from the WIPP.

Wind velocities were very similar between sites. Wind velocities (10-min means) were less than 5.4 m $s^{-1}$ over 73% of the time, with speeds frequently from 3.1 to 5.4 m $s^{-1}$. Calm periods (wind velocities < 0.1 m $s^{-1}$) occurred less than 1% of the time over the year. Wind velocities > 5.4 m $s^{-1}$ occurred less than 26% of the time, but were more frequent during the

spring, and typically came from the west and west-northwest. The highest wind velocities recorded at each site were 27.1 m $s^{-1}$ (62 mph) on 5 September at the Near Field site, and 27.8 m $s^{-1}$ (63 mph) on 24 May at the Cactus Flats site.

Air temperatures at Near Field ranged from –6.1 to 40.4 $^{o}$C and from –6.1 to 40.2 $^{o}$C at Cactus Flats. The maximum temperatures were recorded on 30 June at Cactus Flats, and 1 July at Near Field. The lowest temperatures were recorded on 26 December 1999 at both locations. The annual mean temperatures were 18.6 $^{o}$C at Near Field and 18.2 $^{o}$C at Cactus Flats. At both locations, December was the coldest month (mean = 7.4 $^{o}$C at Near Field; mean = 7.0 $^{o}$C at Cactus Flats) and July was the hottest month (mean = 28.9 $^{o}$C at Near Field; mean = 28.5 $^{o}$C at Cactus Flats) (Fig. 6).

The annual mean relative humidity at Near Field was 42% and ranged from 5 to 100%. Humidity at the Cactus Flats site was nearly identical to Near Field, averaging 42% and ranging from 4 to 101%. Mean relative humidities were lowest when temperatures peaked in late spring and early summer (Fig. 7). It should be noted that the accuracy of the relative humidity sensors declines at relative humidities below 12% and above 94%, and readings outside these ranges should be interpreted with caution.

Barometric pressure did not exhibit an obvious seasonal trend at either site (Fig. 8). The annual mean was 893.7 mb at Cactus Flats and 898.3 mb at the Near Field site. The apparent 4.6 mb difference between the sites can be attributed to a 41 m difference in elevation. This difference is not significant if corrected using standard barometric conversions that incorporate elevation (U.S. Department of Commerce Weather Bureau, 1963, *Manual of Barometry, Vol. 1,* Washington D.C.).

Total solar radiation flux (W $m^{-2}$) was integrated over daily intervals to calculate total energy received per unit area (MJ $m^{-2}$). As is typical, solar radiation received at the sites peaked in the summer and was lowest during the winter months (Fig. 9). This pattern is due to a combination of increasing solar radiation intensity, less cloud cover and additional hours of daylight during the summer months. Over the year, the daily total solar radiation ranged from 4 to 64 MJ $m^{-2}$ at Near Field and 4 to 65 MJ $m^{-2}$ at Cactus Flats.

Solar UVB flux (W $m^{-2}$) was integrated over daily intervals to calculate total energy received per unit area (MJ $m^{-2}$). The UVB radiation followed a pattern similar to that of the total solar radiation (Fig. 10).

Over the year, a total of 22.0 cm of precipitation was measured on 55 days at Cactus Flats and 26.3 cm of precipitation was measured on 48 days at Near Field (Fig. 11). At both sites, the month of October had the highest number of days on which precipitation was recorded (12 at each location). Both locations recorded the highest precipitation in June, with 9.7 cm at Cactus Flats on June 2, and 13.2 cm at Near Field on June 21.

Overall, 2000 was a slightly wetter year than 1999. In 1999, a total of 22.7 and 19.6 cm of precipitation was recorded at the Near Field and Cactus Flats sites, respectively. In 2000, 26.3 cm of precipitation was recorded at the Near Field site and 22.0 cm was recorded at the Cactus Flats site. Although 2000 was wetter, mean annual temperatures and relative humidities were approximately the same in both years. Although December 1998, and January, June and August 1999 were warmer when compared to the same months in 1999 and 2000, temperatures were approximately 3 $^{o}$C cooler in May 2000, and 2 $^{o}$C cooler in July 2000.

Tables presenting meteorological data summarized herein are available on the CEMRC web site at http://www.cemrc.org.

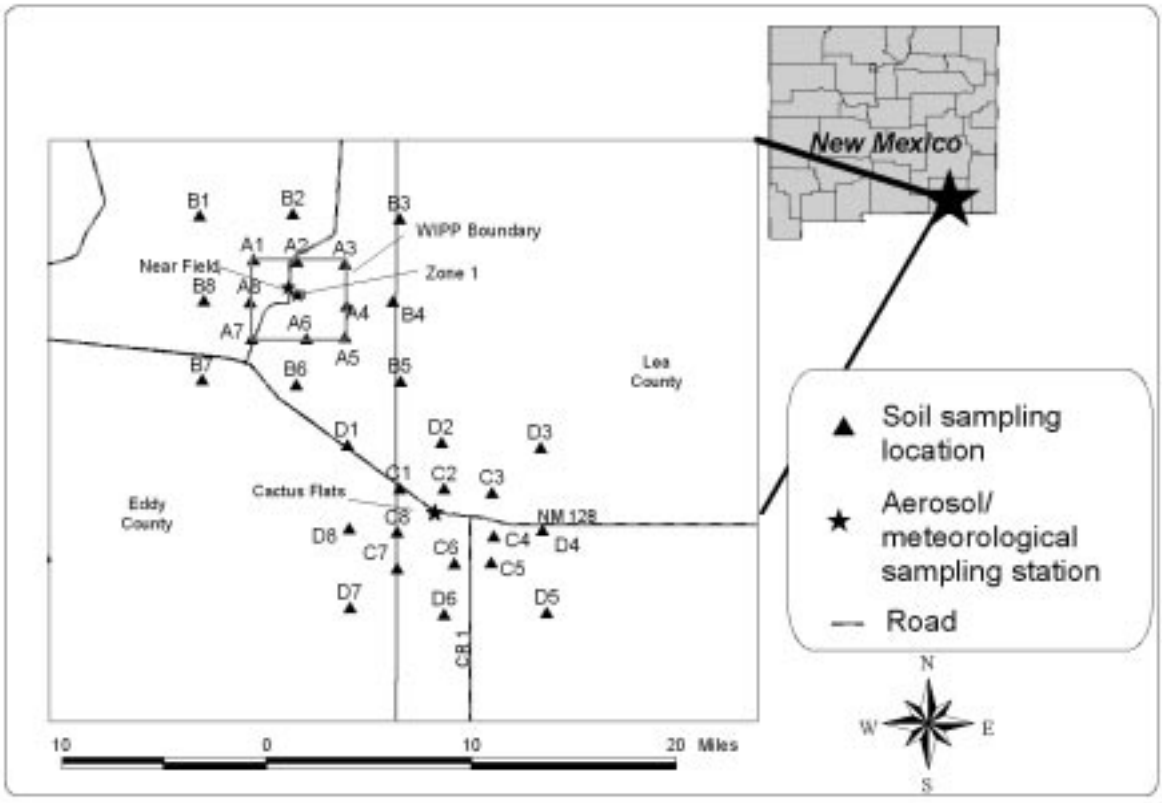
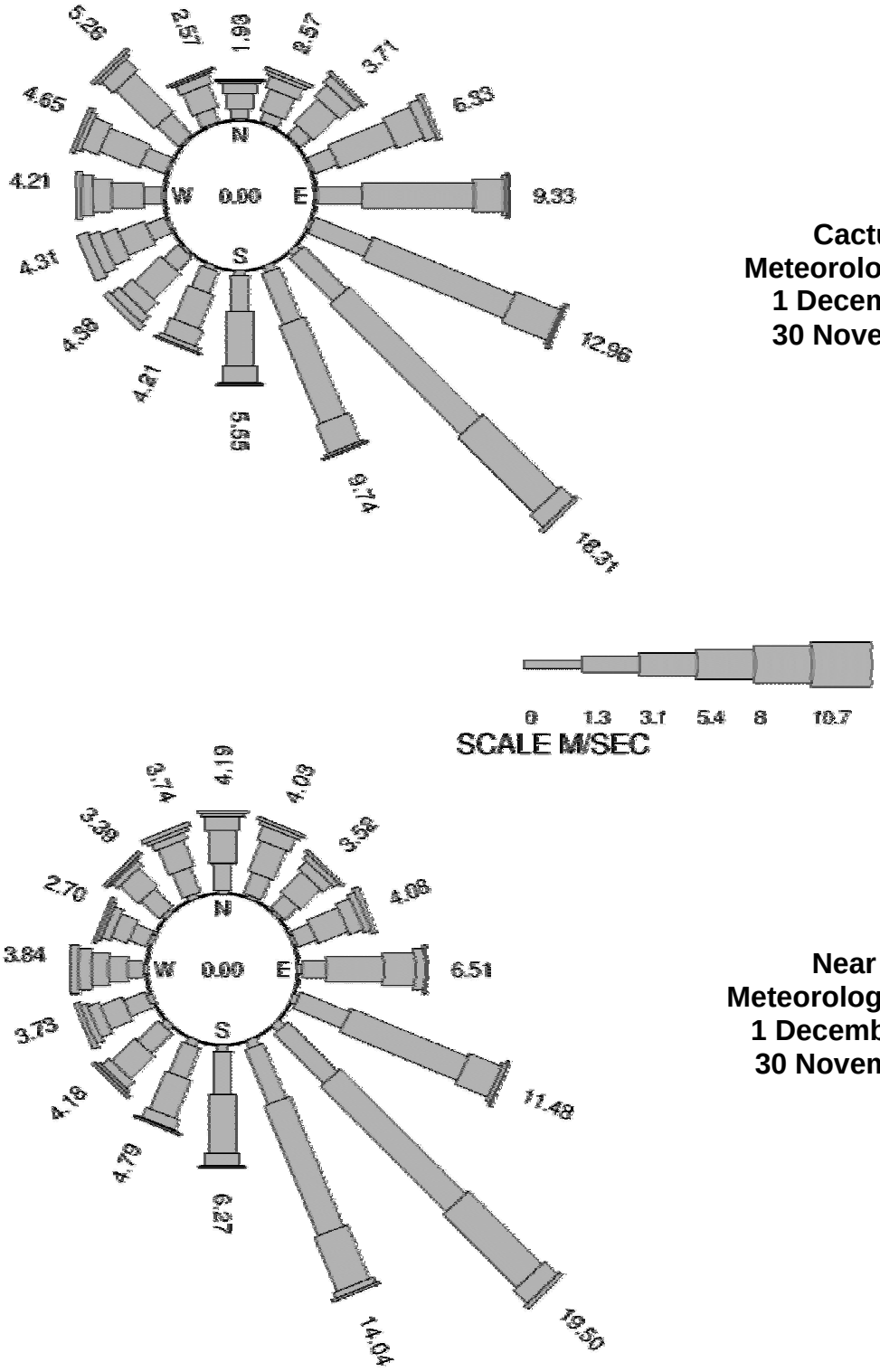



***Figure 2. Sampling Locations in the Vicinity of the WIPP***
Aerosol sampling and meteorological monitoring is conducted at Near Field and Cactus Flats.



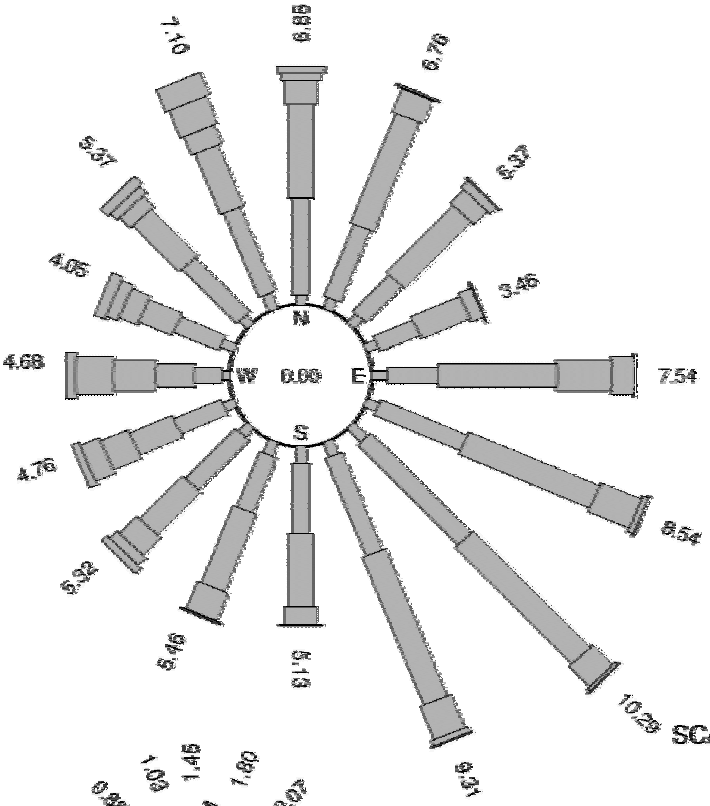

**Cactus Flats Meteorological Station 1 December 1999 - 30 November 2000**

**Near Field Meteorological Station 1 December, 1999 - 30 November 2000**

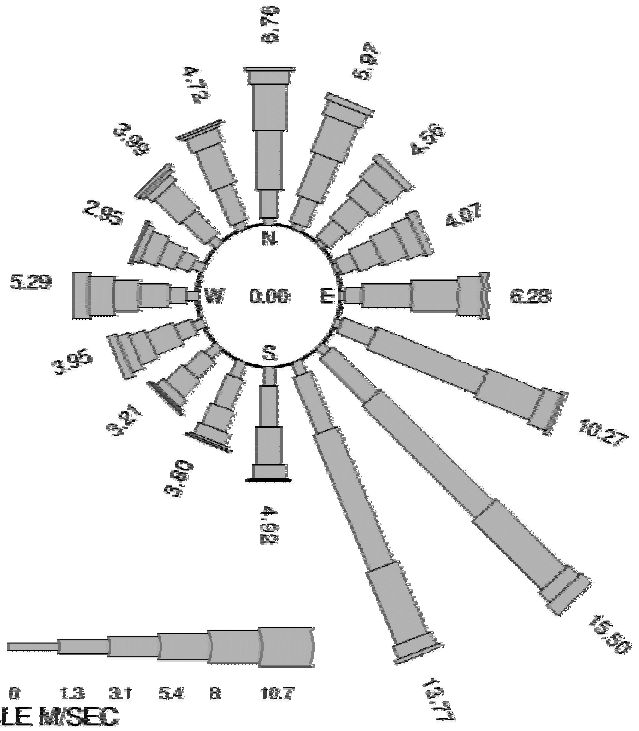
***Figure 3. Annual Wind Roses for Near Field and Cactus Flats***

Value in center of a rose is % time with no recordable wind. Value at outer end of each tube is % time wind blew from the direction of the tube outer opening. Within each tube, segment lengths indicate relative frequency of wind speeds (m $sec^{-1}$) given on scale.

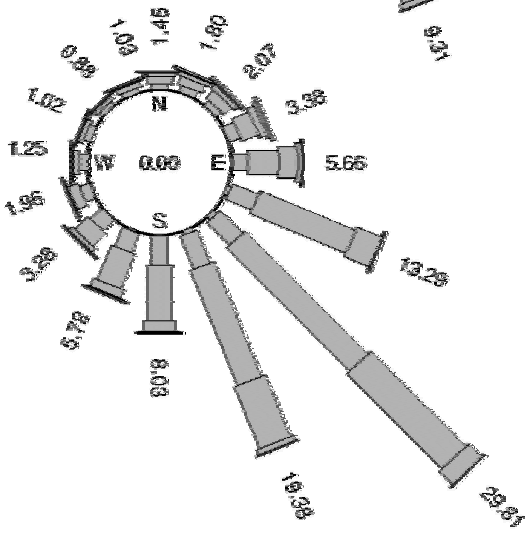
**Near Field Meteorological Station 1 December 1999 - 29 February 2000**




**Near Field Meteorological Station 1 March, 2000 - 31 May 2000**




**Near Field Meteorological Station 1 June 2000 - 31 August 2000**




**Near Field Meteorological Station 1 September 2000 - 30 November 2000**

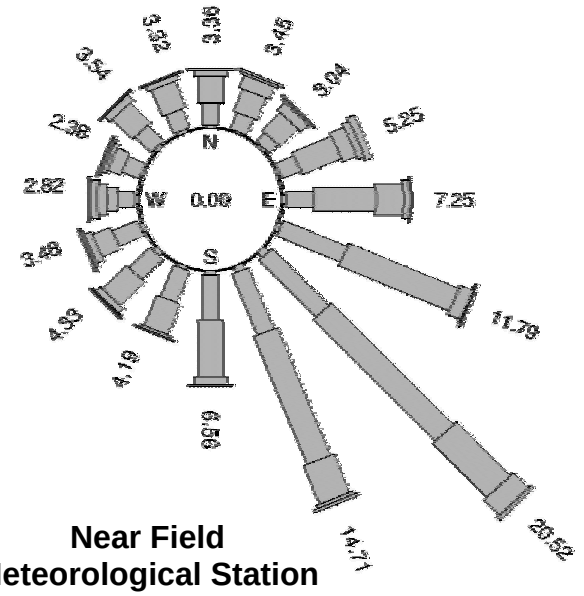
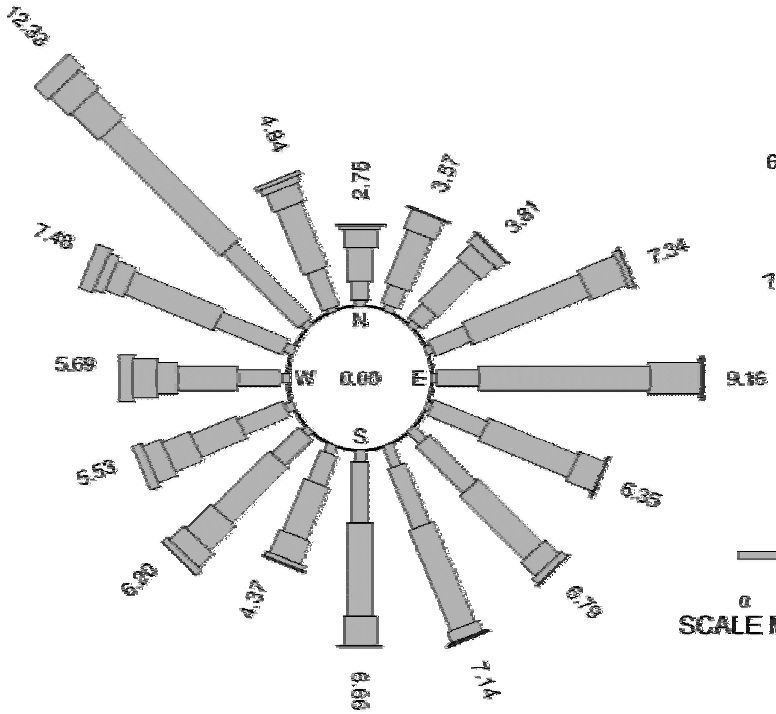


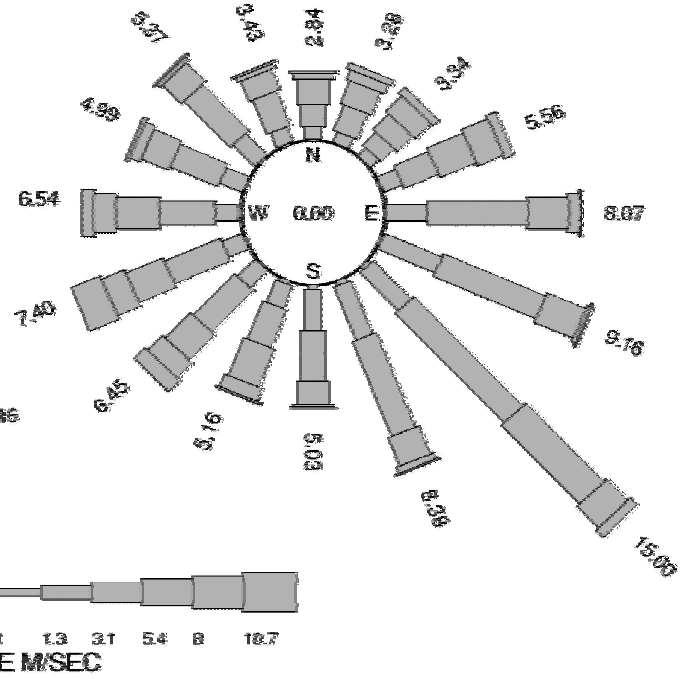

***Figure 4. Seasonal Wind Roses, Near Field***

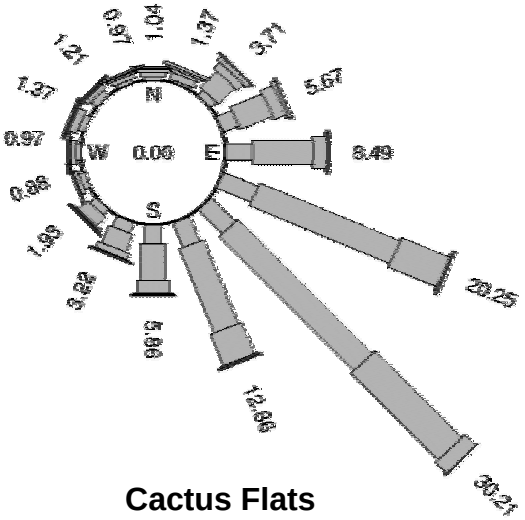
See page 19 for explanation.

**Cactus Flats**
**Meteorological Station**
**1 December 1999 -**
**29 February 2000**

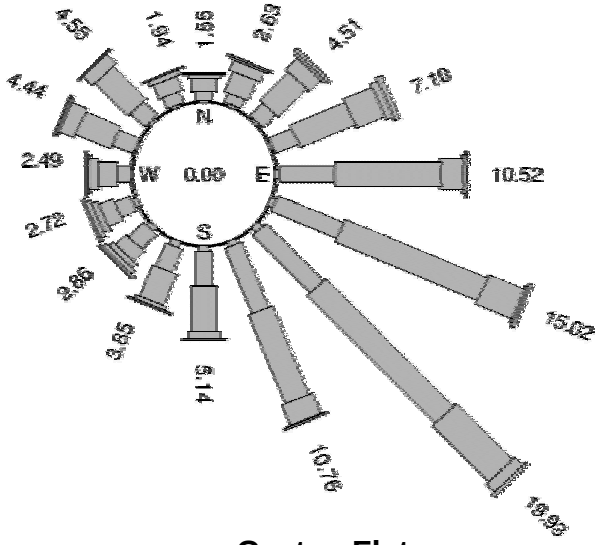



**Cactus Flats**
**Meteorological Station**
**1 March 2000 -**
**31 May 2000**




**Cactus Flats**
**Meteorological Station**
**1 June 2000 -**
**31 August 2000**




**Cactus Flats**
**Meteorological Station**
**1 September 2000 -**
**30 November 2000**

***Figure 5. Seasonal Wind Roses, Cactus Flats***

See page 19 for explanation.

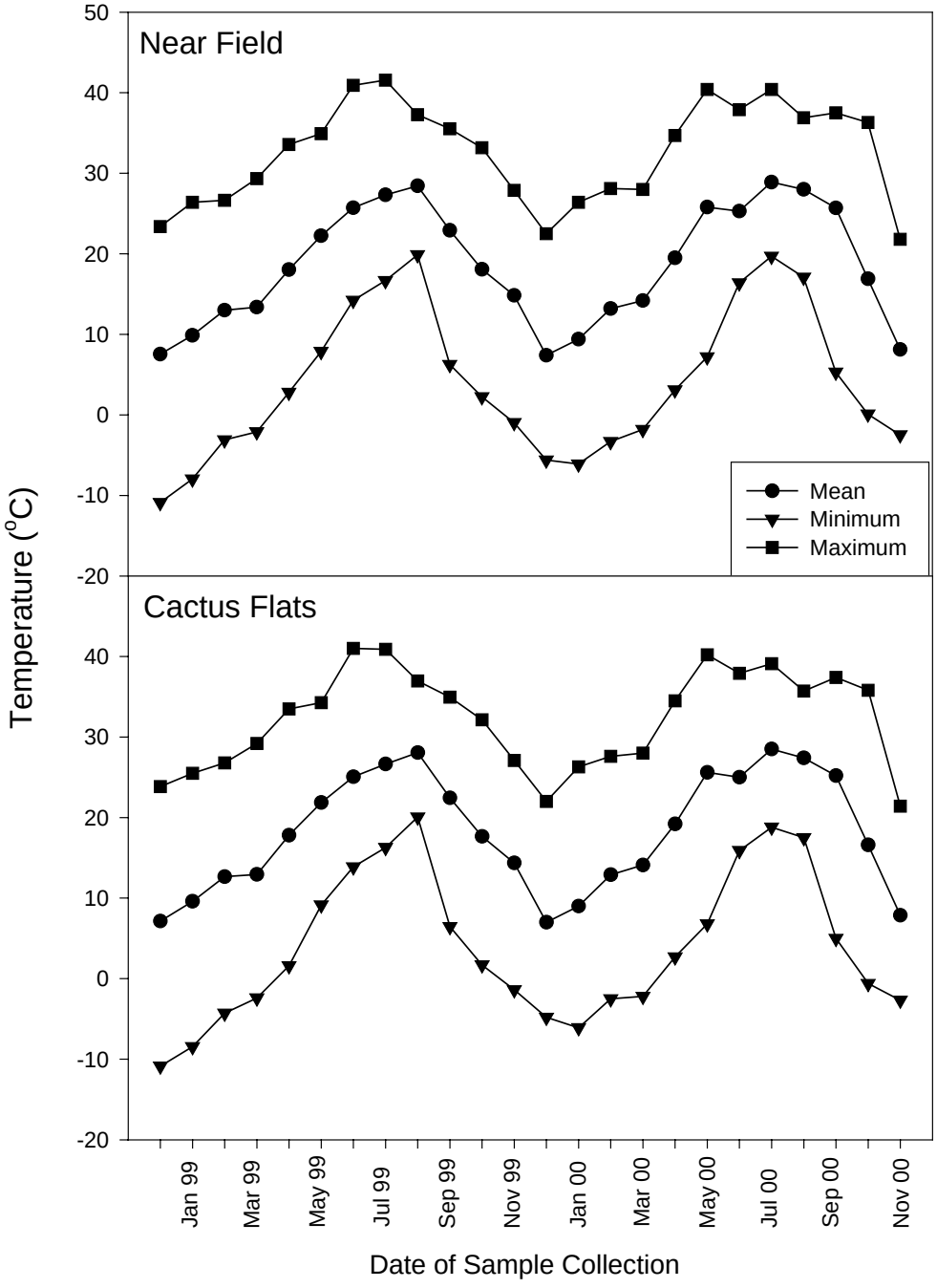



***Figure 6. Monthly Mean, Minimum and Maximum Temperature at Near Field and Cactus Flats during December 1998 - November 2000***

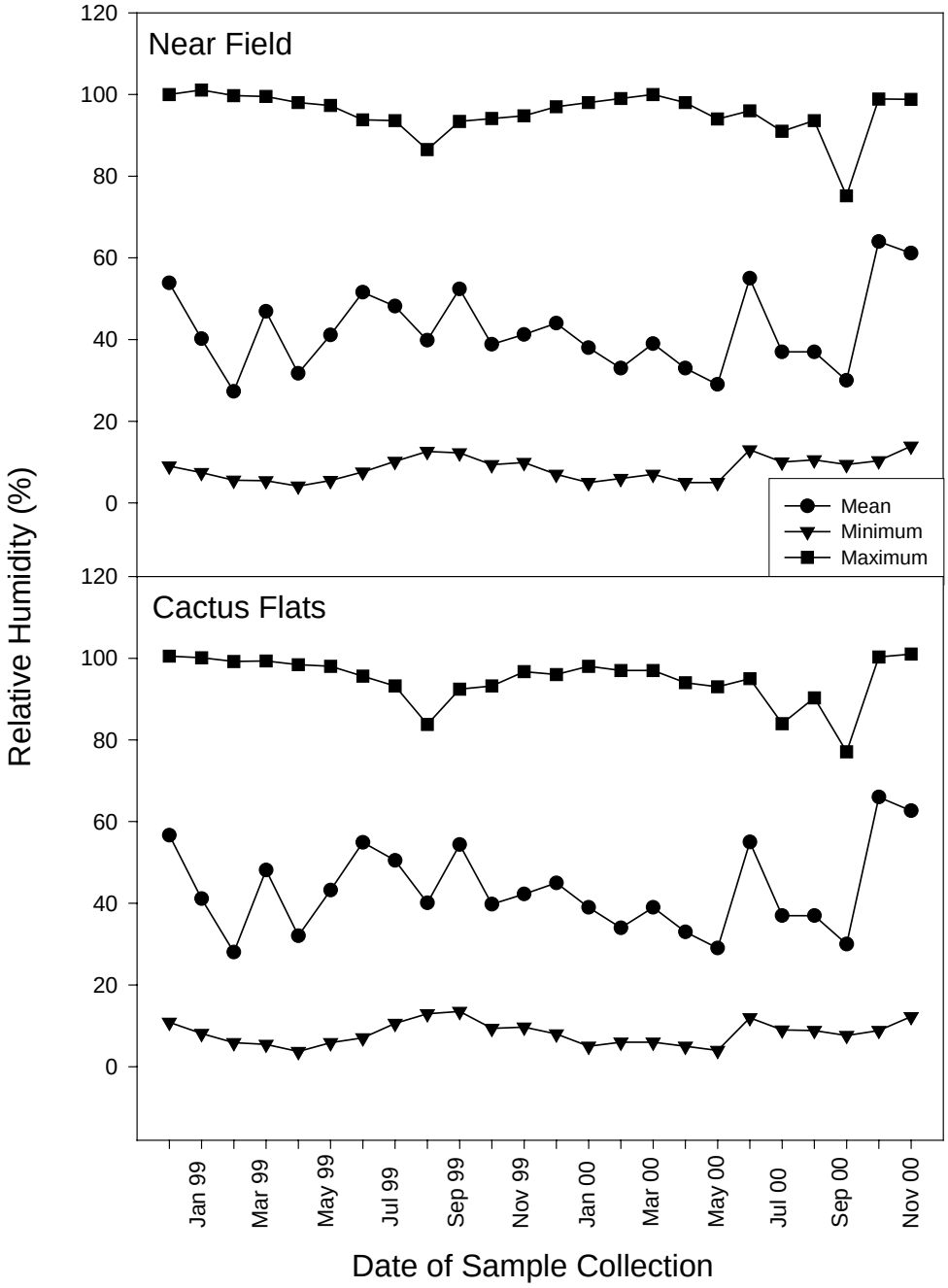



***Figure 7. Monthly Mean, Minimum and Maximum Relative Humidity at Near Field and Cactus Flats during December 1998 - November 2000***

Relative humidity sensor may have reduced accuracy at < 12% and > 94%.

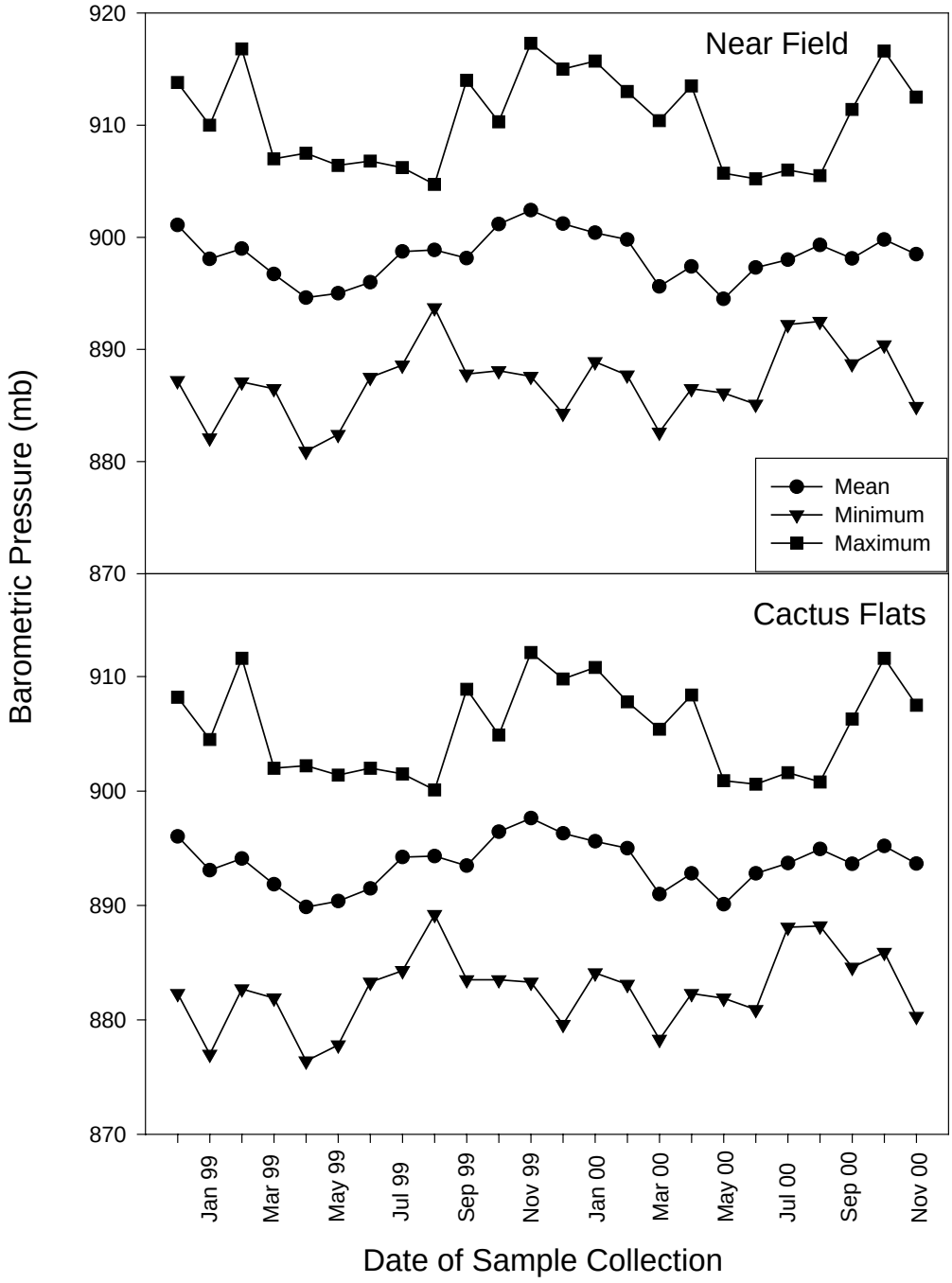



***Figure 8. Monthly Mean, Minimum and Maximum Barometric Pressure at Near Field and Cactus Flats during December 1998 - November 2000***

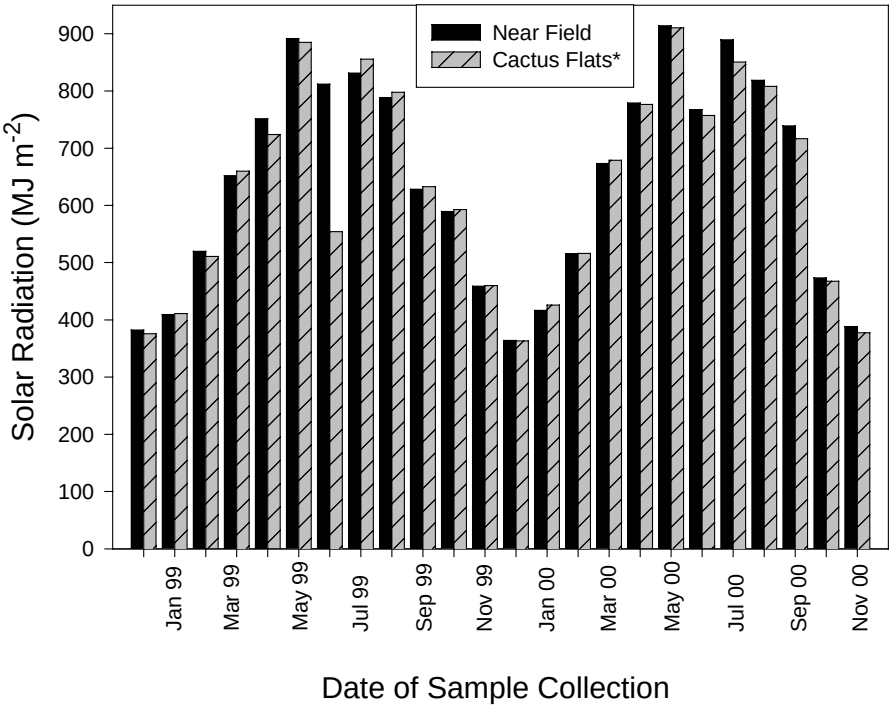



***Figure 9. Monthly Total Solar Radiation at Near Field and Cactus Flats during December 1998 - November 2000***

*The low value for June 1999 at Cactus Flats resulted when the sensor was damaged by a lightning strike.

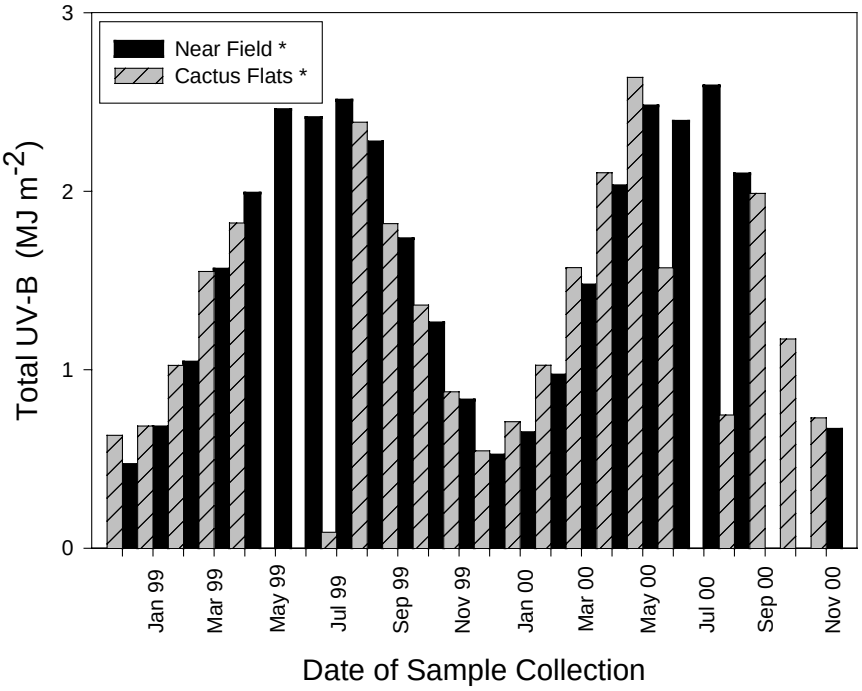



***Figure 10. Monthly Total UV-B Radiation at Near Field and Cactus Flats during December 1998 - November 2000***

*Cactus Flats sensor inoperative April-July 1999, June-July 2000. Near Field sensor inoperative August-October 2000.

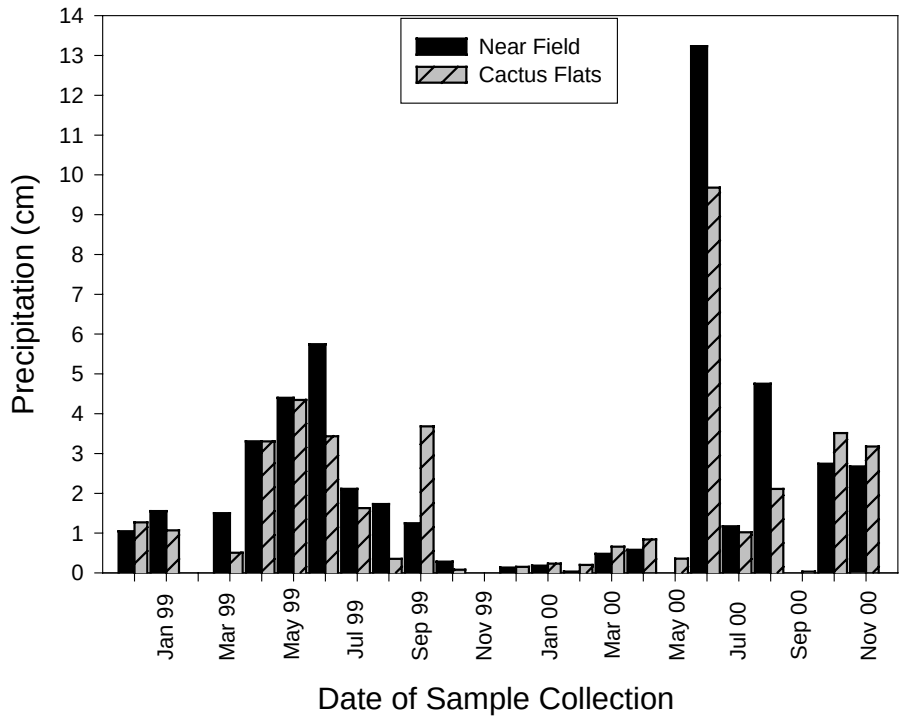



***Figure 11. Monthly Total Precipitation at Near Field and Cactus Flats during December 1998 - November 2000***