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Savannah River Site Annual Meteorology Report for 2004 (U)

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Summary

Summaries of meteorological observations collected at the Savannah River Site in 2004 show a year that was overall cooler and drier than average. Although the annual rainfall of 42.9 inches was the eleventh *driest* of all the years over a period of record that began in 1952, rainfall was quite variable through the year. September's total rainfall of 10.26 inches was the highest in this 53 year record; conversely, the monthly rainfall in March, 0.81 inches, was the lowest on record. Rainfall of 0.01 inch or more occurred on 104 days during the year.

The annual average temperature for 2004, 63.4 °F, was the eleventh *coldest* of any year in an available record that dates to 1964. Cooler than average conditions were observed in 9 of the 12 months of the year. The coldest temperature during the year was 20.3 °F on the morning of December 15; the warmest observed temperature was 98.2 °F on the afternoon of July 14.

The most notable weather event of 2004 was an active Atlantic hurricane season that resulted in six named storms striking the Southeast U.S. during August and September. Although each of these storms posed a significant threat to the SRS, their eventual paths resulted in only minimal impacts. The remnants of hurricanes Frances and Jeanne produced 24-hr rainfall totals of 3.99 inches (Sept. 8) and 3.48 inches (Sept. 27), respectively. Surface winds associated with Jeanne resulted in sustained speeds approaching 15 mph with gusts to 35 mph on September 27.

An ice storm on January 26 produced an estimated accumulation of one-fourth to one-half inch of ice, resulting in scattered power outages and considerable damage to trees across the Site.

A strong cold front moving through the area on March 7 produced a 15-minute average surface wind of 24 mph with a gust to near 50 mph.

Background

The General SRS Climate

The Savannah River Site region has a humid subtropical climate characterized by relatively short, mild winters and long, warm, and humid summers (Oliver and Fairbridge, 1987).

Summer-like conditions typically last from May through September, when the area is frequently under the influence of the western extension of the semi-permanent Atlantic subtropical anticyclone (i.e. the 'Bermuda' high). Winds in summer are light and cold fronts generally remain well north of the area. Daily high temperatures during the summer months exceed 90°F on more than half of all days on the average. Scattered afternoon and evening thunderstorms are common.

The influence of the Bermuda high begins to diminish during the fall, resulting in lower humidity and more moderate temperatures. Average rainfall during the fall is usually the least of the four seasons.

In the winter months, mid-latitude low pressure systems and associated fronts often migrate through the region. As a result, conditions frequently alternate between warm, moist, subtropical air from the Gulf of Mexico region and cool, dry polar air. The Appalachian Mountains to the north and northwest of the SRS help to moderate the extremely cold temperatures associated with occasional outbreaks of Arctic air. Consequently, less than one-third of winter days have minimum temperatures below freezing on average, and days with temperatures below 20°F are infrequent. Measurable snowfall occurs an

average of once every 1-2 years.

Tornadoes occur more frequently in spring than the other seasons of the year. Although spring weather is somewhat windy, temperatures are usually mild and humidity is relatively low.

Overview of the Savannah River Site Meteorological Monitoring Program

Meteorological data are collected at SRS from a network of nine primary monitoring stations (Fig. 1). Towers located adjacent to each of eight primary operations areas (A, C, D, F, H, K, L, and P areas) are equipped to measure wind direction, wind speed, temperature, and dew point at a height of 61 meters (m) above ground. Temperature and dew point are also measured at 2m. A ninth tower near N-Area, known as the Central Climatology site (CLM), is instrumented with wind, temperature, and dew point sensors at four levels: 2m (4m for wind), 18m, 36m, and 61m. The CLM site is also equipped with an automated tipping bucket rain gauge, a barometric pressure sensor, and a solar radiometer near the tower at ground level. Data acquisition units at each station record a measurement from each instrument at 1-second intervals. Every 15 minutes, the 1-second data are processed to generate statistical summaries for each variable, including averages and instantaneous maxima, and the results are uploaded to a relational database for permanent archival. All aspects of the meteorological data collection program meet or exceed applicable regulatory criteria. Parker and Addis (1993) provide a complete description of the meteorological monitoring program at SRS.

Quality assurance of the data is conducted in two phases: an initial screening of recent

data, followed by an in-depth review and final quality classification. The initial screening, performed twice daily by qualified instrument technicians, consists of a thorough examination of 15-minute data retrieved from the database, in conjunction with a summary of instrument diagnostics obtained from the local data acquisition units. Potential problems are noted in a daily checksheet and, as needed, data acquisition unit software is instructed to assign a quality control tag to data collected from questionable instruments. Quality tags are also set during periods of calibration and maintenance.

The second phase of the quality assurance process is conducted according to formal procedure (SRNL, 2004). Daily checksheets generated during the initial screening, tower-specific logbook entries, initial quality tags, and time series plots of related data are reviewed to determine a final quality status for each record. All records permanently archived in the data base are identified as good, fatal, intermittent, biased, or uncalibrated.

Additional Measurements

Additional precipitation measurements are collected from a network of 12 plastic wedge rain gauges across the SRS (See Fig. 1). These gauges are read manually by security or operations personnel once per day, usually around 6 am. The daily data are reported to the SRS Atmospheric Technologies Center, reviewed to correct obvious flaws, and manually entered into a permanent electronic data base.

Additional measurements of temperature and relative humidity are recorded from a station located in A-Area, adjacent to 773-A. This station consists of a standard National Weather Service 'cotton region'

instrument shelter. Data collected from this station are manually tabulated for archival as daily high and low values of temperature and relative humidity. Tabulated values are then entered into a permanent electronic data base.

A major enhancement to the SRS meteorological monitoring program during 2004 was the resumption of data collection from instrumentation on a nearby television transmission tower. The new system utilizes fast-response sonic anemometers, water vapor sensors, and barometric pressure sensors, and slow-response temperature sensors and relative humidity sensors. Data are collected at 30m, 61m, and 304m above ground level. Spread-spectrum modems at each measurement level transmit raw data to a redundant set of PCs at SRNL. Data processing software on the PCs determine mean values and other statistical quantities every 15 minutes and uploads the results to the relational database. The detailed data sets produced by this system are expected to provide a valuable resource for use in ATG's operational weather forecasting activities, emergency response, atmospheric boundary layer research, and climate change studies.

Data Sources for the 2004 Report

Data summaries provided with this report consist of the following:

- Ground level measurements of *temperature (2m)*, *dew point temperature (2m)*, *wind speed (4m)*, *precipitation*, *barometric pressure*, and *solar radiation* from CLM, as well as meteorological quantities derived from these primary data, such as *relative humidity* (temperature and dew point), *wet bulb temperature* (temperature and dew point), *wet bulb globe temperature*

(temperature, dew point, wind speed, and solar radiation), and *cooling/heating degree days* (temperature).

- Joint occurrence frequencies of wind speed and direction from measurements taken at each of the four levels of the CLM tower and the 61m level of the eight area towers.
- Precipitation from the network of manually-read rain gauges

A series of SAS System software routines were used to extract the desired data sets from the data base and perform initial statistical processing on all records with a QA status of 'good'. More than 99% of the 2004 data used in this report met this criterion with one exception. The 2 meter dew point measurement was flagged as unacceptable from the period May 21 through August 16. Dew point data from the CLM 18-meter level was used as a substitute data source.

Output from the initial processing was then imported into an Excel spreadsheet to generate the final summaries that are presented in the report.

Long-term climatological records are available for temperature, precipitation, and relative humidity. Statistics generated from these data are used for comparisons with the 2004 summaries.

Available temperature and relative humidity records begin in 1964. From 1964-1995, climatological statistics used in this report were based on the record of daily high and low values recorded at the 773-A instrument shelter. After 1995, these statistics were based on the continuous record of 15-minute data from the 2m level of CLM.

Precipitation data are available from 1952. For the period 1952 through 1995, climatological statistics used in the report were based on the daily observations from the 773-A rain gauge. Summaries after 1995 were based on the automated 15-minute records collected from the CLM rain gauge.

Climatology of the SRS for 2004

Highlights

Meteorological data summaries for 2004 indicate that overall weather conditions at SRS were slightly cooler and drier than long-term averages. The total annual precipitation of 42.9 inches was the eleventh driest of all years in the available period of record. The annual average temperature of 63.4°F was the eleventh coldest of any year in the available record. Cooler than average conditions were observed throughout the summer months; otherwise, there were no prolonged departures from long-term average temperatures. Dry conditions during most of spring and summer period was offset by record rainfall in September. A summary plot of daily observations of temperature, precipitation, relative humidity, and wind speed is given in Fig. 2.

Monthly climatological discussions published by the National Weather Service, Climate Prediction Center (CPC), indicate that the relatively cool weather observed throughout much of the eastern U. S. for June through August was due to the persistent presence of a low pressure trough across east-central Canada from Hudson Bay southward to the Great Lakes region, and a relatively weak presence of a subtropical (Bermuda) high over the southwest Atlantic and Southeastern U.S. West to northwest flow that developed on the southwestern flank of this trough enabled cool fronts to propagate through the Southeast on several occasions.

During the latter half of August through September, the Bermuda high strengthened and centered over a position just off the U.S. east coast. The clockwise

circulation around the periphery of this high provided the mechanism for steering tropical systems westward then northward into Florida and Southeast U.S.

The upper trough returned to a position along the east coast on several occasions in December, accompanied by a strong polar jet that was responsible for several outbreaks of cold arctic air from Canada (NOAA, 2004a and 2004b).

Temperature

Monthly and annual average and daily extreme temperatures for 2004 are summarized in Table 1(a). Similar statistics for a 30-year climatological reference period (1974-2003) are given in Table 2. A plot of observed daily high and low temperatures for 2004 is shown in Fig. 3. Plots of annual average temperature, monthly average daily high and low temperature, and days exceeding critical temperature thresholds (<32°F, >90°F) for 2004 and the 30-year reference period are shown in figures 4, 5, and 6, respectively.

The annual average temperature of 63.4 °F was 1.2 degrees below the 30-year average. Monthly averages for 2004 were below their respective climatological values for all months in the year except March, May, and October. Furthermore, monthly averages for February and August ranked among the five coldest months on record. Temperatures above 90°F occurred on a total of 52 days during the year and only one-half of total days in July and August. Temperature extremes ranged from 20.3 °F on December 15 to 98.2 °F on July 14. Daily low temperature records were set on February 29, April 15, August 7, and December 15 (tie) and 16. Daily high temperature records were set on January 5 and March 28.

Monthly and annual total heating and cooling degree days (based on a reference temperature of 65°F) are summarized in Table 1(c).

Precipitation

Annual, monthly, and daily total rainfall statistics for 2004 are summarized in Table 1(a). Monthly and annual rainfall totals for the previous 30-years (1974-2003) are given in Table 3. Monthly and annual rainfall totals for the 12 plastic wedge gauges are summarized in Table 4. A plot of daily total rainfall (midnight to midnight) for the CLM site for 2004 is shown as Fig. 7. Annual and monthly rainfall for 2004 and the 30-year reference period are shown in figures 8 and 9, respectively.

Total precipitation at the CLM site, 42.9 inches, was about six inches less than the 30-year average and resulted in the eleventh driest year over the 53 years of available data. Monthly rainfall for March and July were the lowest and second lowest totals on record for those months, respectively. Conversely, September's total of 10.26 inches was the highest on record for the month. The heavy rain that occurred on September 8 (3.99 in) was due to the remnants of Hurricane Jeanne.

Measurable precipitation (>0.01 inch) occurred on 104 days and rainfall greater than 0.5 inch occurred on 23 days.

Atmospheric Moisture

Monthly and annual average and daily extreme dew point temperature, wet bulb temperature, and relative humidity for 2004 are summarized in Table 1(b). This table also presents monthly and annual

average daily maximum and minimum humidity. A plot of daily maximum and minimum humidity for 2004 is shown in Fig. 10. Plots of annual average humidity for 2004 and the 30-year reference period (1974-2003) and monthly average daily minimum humidity are shown in figures 11 and 12, respectively.

Average relative humidity for 2004 was 68 percent (%) with an average daily minimum of 45% and an average daily maximum of 86%. Days with relative humidity of 20% or less occurred in January, February, March, April, and December. The lowest relative humidity recorded during the year was 16% on April 4. Average daily minimum relative humidity was lower than long-term averages in March and April and greater than long-term averages during the fall.

Observed dew point temperatures ranged from 77.4 °F on September 7 to 5.1 °F on December 20. Wet bulb temperature ranged from 78.1 °F on September 1 to 18.3 °F on December 20.

Heat Stress

Restrictions on outdoor work due to excessive heat are based on values of the wet bulb globe temperature (WBGT) (WSRC, 1995). Hunter and Minyard (2000) provide a description of WBGT and the method used at SRS to calculate WBGT from standard meteorological measurements at CLM.

Monthly and annual maximum WBGT and statistics on heat stress category days for 2004 is summarized in Table 1(b). The highest WBGT for 2004 was 91.5 °F on July 12. Heat stress Category 5 (WBGT > 90.0 °F) occurred on 11 days during the summer of 2004. A total of 167 days reached at least

Category 1 (WBGT > 77.0 °F) from March through November of the year.

Wind

Monthly average and extreme wind speed at the CLM 4 meter level for 2004 is summarized in Table 1(c). Daily averaged wind speed for the year is plotted in Fig. 13. Figures 14(a) and 14(b) show wind rose plots depicting joint occurrence frequencies of the indicated wind speed category by wind direction sector at the 61 meter level of the eight area towers. Fig. 15 provides wind rose plots for the 4 levels of measurement at CLM. Seasonal wind rose plots for 2004 for data from the 61m level of CLM are shown in Fig. 16. Tables of the joint frequency data used to create the wind rose plots are given in Appendix A.

Wind speeds generally were strongest on average during the winter and spring months. The highest instantaneous wind speed recorded at the 4m level, 49.9 mph, occurred during the passage of a cold front on the evening of March 7. A strong winter storm moving through the Southeast U. S. on February 7 produced the highest daily average wind speed of 10.6 mph. The highest monthly average wind speed occurred in September due to the unusually high number of tropical weather systems affecting the area.

Wind rose plots for the area towers show typical annual patterns for the 61 meter level. This pattern consists of higher frequencies of wind from the northeasterly sectors and southwest to westerly sectors. Due to the location of the D area tower in the shallow valley formed by the Savannah River, wind direction is more frequently from the southeasterly and northwesterly sectors than for the other area towers. Wind roses for CLM also show typical

variations in the frequency patterns by level, with progressively higher frequencies of southeasterly winds and lower frequencies of northeasterly and southwesterly winds nearer the ground. Weber (2003) provides a complete description of the wind climatology at the CLM site.

Seasonal wind rose plots for the 61 meter level at CLM are indicative of the typical seasonal patterns observed at SRS.

Barometric Pressure

Annual and monthly average and extreme barometric pressure is summarized in Table 1(c). Daily average barometric pressure is plotted in Fig. 17. The lowest daily average and 15-minute minimum barometric pressure, 992.1 and 990.3 mb, respectively, were associated with the passage of a cold front on October 15. The highest daily average and 15-minute maximum barometric pressure, 1020.1 and 1027.2 mb, respectively, were associated with strong polar high pressure that built over the Southeast U. S. November 14 and 15.

Solar Radiation

Annual and monthly averages and extremes of daily total solar radiation are summarized in Table 1(c). This table also provides estimated monthly and annual estimates of percent observed solar radiation relative to theoretical clear sky maxima as an indicator of relative cloudiness. The monthly theoretical values were estimated from tables published by Budyko (1974). Daily total solar radiation for 2004 is plotted in Fig. 18. The average daily values ranged from 242 langley's per day (ly/day) in December to 544 ly/day in

May. The low value for daily average solar radiation in December is due to a low solar angle, as the percent of theoretical maximum for the month, 73%, implies December was characterized by ample

sunshine. Sunny days were also prevalent March and April. Individual daily extremes ranged from 28 ly/day on January 25 to 712 ly/day on July 8.

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Table 1(a) - Means and Extremes of SRS Meteorological Data for 2004

Month	Temperatures (°F)													Precipitation (in)							
	Average					Extremes				Number of Days				Total	Departure from 30yr avg	Rank (1952-2003)	Greatest in 24 Hrs	Date of 24hr max	No. of Days		
	Avg. Daily High	Avg. Daily Low	Month Avg.	Departure from 30yr avg	Rank (1968-2004)	Highest	High Date	Lowest	Low Date	Maximum Above 90 °F	Maximum Above 100 °F	Minimum Below 32 °F	Minimum Below 20 °F						Greater Than 0.01 in.	Greater Than 0.1 in.	Greater Than 0.5 in.
Jan	56.8	33.5	43.7	-2.3	13	75.9	5th	20.9	8th	0	0	17	0	2.85	-1.49	13	1.74	26th	8	5	1
Feb	55.8	36.7	45.2	-4.8	5	72.3	6th	25.2	8th	0	0	7	0	6.71	+2.29	9	2.01	26th	11	8	5
Mar	71.4	46.6	58.5	+1.3	12	84.1	28th	29.9	11th	0	0	2	0	0.81	-3.92	1	0.18	21st	6	5	0
Apr	77.4	49.7	63.4	-0.9	12	88.8	24th	33.1	5th	0	0	0	0	1.34	-1.90	10	0.64	27th	6	3	1
May	86.1	63.4	74.0	+1.9	11	93.7	26th	44.3	4th	12	0	0	0	3.45	-0.15	26	1.64	12th	10	4	2
Jun	88.7	69.3	77.7	-0.7	14	95.4	12th	64.9	1st	9	0	0	0	6.41	+1.73	11	1.59	30th	14	11	5
Jul	91.7	71.1	80.1	-1.4	10	98.2	14th	66.2	20th	22	0	0	0	1.23	-4.23	2	0.52	3rd	9	3	1
Aug	87.6	68.9	77.3	-2.9	4	96.6	4th	56.1	8th	9	0	0	0	2.96	-1.96	13	1.25	31st	11	8	1
Sep	81.7	66.6	73.2	-1.9	9	88.4	1st	54.2	20th	0	0	0	0	10.26	+6.05	1	3.99	8th	7	6	4
Oct	75.5	59.1	66.2	+0.9	15	88.1	2nd	42.4	16th	0	0	0	0	1.02	-2.07	16	0.40	15th	10	2	0
Nov	67.3	47.1	56.1	-0.4	18	82.1	1st	30.7	26th	0	0	3	0	3.17	+0.20	16	1.59	24th	8	6	1
Dec	58.8	35.8	45.8	-2.4	11	76.6	9th	20.3	15th	0	0	12	0	2.69	-0.61	20	1.29	10th	4	3	2
Year	75.0	54.0	63.4	-1.2	11	98.2	14-Jul	20.3	15-Dec	52	0	41	0	42.90	-6.06	11	3.99	8-Sep	104	64	23

Rank by coolest

Rank by warmest

Rank by wettest

Rank by driest

Table 1(b) - Means and Extremes of SRS Meteorological Data for 2004

Month	Dew Point Temperature (°F)					Wet Bulb Temperature (°F)					Relative Humidity (%)					Wet Bulb Globe Temperature (°F)						
	Average	Highest	High Date	Lowest	Low Date	Average	Highest	High Date	Lowest	Low Date	Avg. Daily Maximum	Avg. Daily Minimum	Monthly	Lowest	Low Date	Highest	High Date	Number of Days				
																		Cat 1 and Above	Cat 2 and Above	Cat 3 and Above	Cat 4 and Above	Cat 5
Jan	30.3	62.5	5th	10.0	8th	38.2	66.9	5th	18.6	8th	79	43	62	20	8th	73.4	5th	0	0	0	0	0
Feb	33.3	65.0	6th	13.2	1st	40.2	65.1	6th	23.1	8th	82	47	66	19	21st	69.2	6th	0	0	0	0	0
Mar	40.8	61.3	5th	13.9	23rd	49.9	67.4	5th	26.0	23rd	73	33	55	17	12th	78.0	28th	2	0	0	0	0
Apr	44.9	63.0	11th	18.2	4th	53.7	68.4	26th	29.4	5th	77	31	54	16	4th	80.9	24th	8	0	0	0	0
May	59.7	70.8	23rd	34.4	4th	65.1	74.6	28th	40.0	4th	83	42	65	29	7th	91.2	20th	28	18	12	1	1
Jun	67.0	75.5	15th	48.0	1st	70.7	78.0	18th	60.7	2nd	92	47	73	28	7th	90.7	16th	30	29	18	8	3
Jul	68.1	73.6	3rd	54.1	16th	72.1	77.8	14th	61.8	16th	90	46	71	32	20th	91.5	12th	31	31	29	17	6
Aug	66.0	74.5	2nd	45.9	7th	70.0	77.6	2nd	53.6	8th	90	47	71	31	8th	90.3	4th	30	25	19	5	1
Sep	63.7	77.4	7th	43.8	20th	67.3	78.1	1st	50.3	20th	88	57	74	34	22nd	89.2	1st	25	7	1	1	0
Oct	58.7	73.0	2nd	39.1	15th	61.8	75.6	2nd	41.1	16th	92	57	79	39	17th	85.6	2nd	10	5	1	0	0
Nov	46.3	69.9	4th	22.8	15th	51.2	72.2	2nd	28.1	15th	89	49	72	28	16th	80.9	1st	3	0	0	0	0
Dec	35.4	65.6	9th	5.1	20th	41.4	67.0	9th	18.3	20th	92	40	71	19	21st	71.5	9th	0	0	0	0	0
Year	51.2	77.4	7-Sep	5.1	20-Dec	56.8	78.1	1-Sep	18.3	20-Dec	86	45	68	16	4-Apr	91.5	12-Jul	167	115	80	32	11

Table 1(c) - Means and Extremes of SRS Meteorological Data for 2004 (cont'd)

Month	Wind Speed (mph)				Barometric Pressure (mb)					Solar Radiation (ly)						Degree Days					
	Monthly Average	Max 15-min Average	Max Instantaneous	Date Max Inst.	Average	Lowest	Low Date	Highest	High Date	Average Daily Total	% of Theoretical Max	Minimum Daily Total	Date	Maximum Daily Total	Date	Heating Degree Days	Daily maximum	Date	Cooling Degree Days	Daily Maximum	Date
Jan	4.3	13.0	33.1	18th	1009.0	990.5	18th	1023.5	7th	251	0.70	28	25th	377	28th	663	34	26th	2	2	5th
Feb	4.9	18.0	34.8	7th	1010.4	997.6	6th	1023.8	9th	240	0.53	32	14th	497	28th	575	30	27th	0	0	
Mar	4.8	24.4	49.9	8th	1011.3	996.8	16th	1024.2	24th	429	0.75	96	30th	575	23rd	212	21	24th	11	4	6th
Apr	4.7	16.9	32.0	2nd	1005.4	992.6	8th	1019.9	18th	537	0.79	236	30th	676	28th	110	17	2nd	62	9	26th
May	4.1	17.1	38.3	2nd	1006.7	996.8	31st	1016.2	17th	544	0.72	271	17th	691	4th	12	8	5th	286	17	29th
Jun	4.0	14.8	36.8	7th	1006.5	997.2	1st	1012.2	9th	505	0.64	167	21st	668	2nd	0	0		381	20	13th
Jul	3.7	13.6	34.8	4th	1004.1	996.2	18th	1011.2	1st	531	0.69	270	1st	712	8th	0	0		467	20	15th
Aug	3.8	11.6	37.2	13th	1005.4	995.1	5th	1012.4	16th	453	0.64	215	13th	672	7th	0	0		383	18	5th
Sep	5.3	14.5	34.5	28th	1005.4	990.5	27th	1014.4	21st	366	0.60	80	27th	576	3rd	1	1	21st	248	13	17th
Oct	3.2	13.5	26.6	16th	1006.6	990.3	15th	1019.7	7th	286	0.57	76	28th	452	15th	44	9	17th	80	12	3rd
Nov	3.5	15.6	36.8	25th	1010.3	991.3	25th	1027.4	14th	252	0.63	72	23rd	392	5th	288	24	28th	23	8	4th
Dec	4.0	17.0	36.6	21st	1010.1	990.9	10th	1027.0	28th	242	0.73	69	24th	324	15th	600	34	21st	4	3	11th
Year	4.2	24.4	49.9	8-Mar	1007.6	990.3	15-Oct	1027.4	14-Nov	386	0.67	28	25-Jan	712	8-Jul	2505	34	21-Dec	1946	20	15-Jul

Table 2. Monthly and Annual Average and Extreme Temperatures, 1974-2004

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1974	59.6	50.8	62.2	66.2	75.3	77.5	81.5	80.9	75.3	64.5	56.6	49.0	66.6
1975	51.4	53.2	55.8	63.9	75.6	79.1	79.7	82.4	75.7	68.7	59.3	48.5	66.1
1976	44.2	55.7	61.5	64.8	68.9	75.6	80.4	78.0	73.1	60.1	48.7	44.8	63.0
1977	35.3	47.1	60.0	66.9	73.3	80.6	83.6	80.6	77.9	62.1	58.2	46.7	64.4
1978	39.3	41.3	54.2	65.7	70.9	79.7	82.1	81.2	77.1	65.6	60.7	49.6	64.0
1979	42.1	44.6	57.5	64.5	71.3	75.1	79.6	80.5	73.4	64.8	57.4	47.4	63.2
1980	45.9	44.3	52.6	63.5	71.2	78.3	83.8	82.5	79.2	62.7	52.8	46.0	63.6
1981	40.4	48.5	53.0	67.0	68.6	81.3	81.3	76.3	74.0	62.1	54.4	43.2	62.5
1982	43.0	50.0	58.9	62.4	75.7	78.8	80.9	80.1	75.0	66.2	58.7	54.8	65.4
1983	43.3	48.0	55.3	59.4	66.8	76.7	84.3	83.9	74.8	67.2	56.4	45.8	63.5
1984	45.0	51.7	56.5	62.6	71.9	80.1	80.1	80.8	74.0	73.4	53.4	56.9	65.5
1985	42.9	49.5	60.2	67.5	74.5	80.8	81.1	79.7	75.7	70.8	65.5	45.4	66.1
1986	45.4	54.6	57.9	66.4	74.4	82.7	86.9	80.1	78.4	67.1	61.3	49.3	67.0
1987	46.2	48.6	56.5	62.3	74.5	79.9	82.8	83.8	76.6	60.7	59.1	52.9	65.3
1988	42.3	47.8	56.8	64.2	70.4	76.8	81.6	81.4	75.4	61.2	58.0	49.1	63.8
1989	52.2	52.0	58.3	64.2	70.6	79.8	81.4	80.9	75.3	67.3	52.4	44.2	64.9
1990	54.9	57.5	60.0	64.0	72.9	80.5	83.7	83.8	79.0	69.4	59.9	54.6	68.4
1991	47.9	54.1	60.3	69.2	76.9	79.5	83.6	81.2	77.4	68.1	55.4	54.0	67.3
1992	49.5	54.1	57.2	65.0	71.2	78.9	83.7	80.7	76.9	65.0	57.1	48.0	65.6
1993	51.7	47.8	53.2	58.9	69.7	78.2	83.6	80.0	75.2	62.8	55.2	43.6	63.3
1994	41.5	50.1	60.2	68.0	71.2	82.3	81.8	81.2	77.4	67.2	62.3	53.3	66.4
1995	45.5	49.9	58.6	65.9	73.5	75.0	79.9	79.0	71.8	65.9	50.8	43.8	63.3
1996	44.6	50.1	50.6	61.6	72.9	76.5	79.3	76.0	72.7	62.1	51.6	48.8	62.2
1997	48.2	52.9	63.3	61.2	68.5	74.0	80.2	79.0	75.0	64.1	51.6	47.0	63.8
1998	49.7	51.1	53.6	62.7	74.6	82.1	82.6	80.3	75.8	66.9	60.5	53.6	66.1
1999	51.9	51.6	53.4	67.2	69.7	76.6	80.7	82.9	73.8	64.3	58.1	48.6	64.9
2000	44.4	50.2	58.5	60.7	75.1	78.0	79.9	77.6	71.7	62.5	53.1	38.2	62.5
2001	43.8	52.4	53.0	63.9	71.3	75.3	77.7	78.8	71.2	62.2	60.0	52.4	63.5
2002	47.3	48.0	57.6	68.1	70.2	77.5	80.5	78.4	75.4	66.7	51.7	44.5	63.8
2003	42.0	47.5	57.6	61.6	70.6	75.2	77.3	77.7	71.9	63.7	58.2	42.9	62.2
2004	43.7	45.2	58.5	63.4	74.0	77.7	80.1	77.3	73.2	66.2	56.1	45.8	63.4

Avg	46.0	50.0	57.2	64.3	72.1	78.4	81.5	80.2	75.1	65.2	56.6	48.2	64.6
Lowest Mon	35.3	41.3	50.6	58.9	66.8	74.0	77.3	76.0	71.2	60.1	48.7	38.2	62.2
Yr Lowest	1977	1978	1971	1993	1983	1997	1967	1973	1973	1976	1976	2000	1996
Rec Low	-3	10	11	29	38	48	56	56	41	28	18	5	-3
Yr Rec	1985	1996	1980	1983	1989	1984	1963	1986	1967	1976	1970	1962	1985
Highest Mon	59.6	57.5	63.3	69.2	76.9	82.7	86.9	83.9	79.2	73.4	65.5	56.9	68.4
Yr Highest	1974	1990	1997	1991	1991	1986	1986	1983	1980	1984	1985	1971	1990
Rec High	86	86	90	99	102	105	107	107	104	96	89	82	107
Yr Rec	1975	1989	1974	1986	1963	1985	1986	1983	1990	1986	1987	1984	1986

Table 3. Monthly and Annual Rainfall, 1974-2004

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1974	2.42	6.66	3.03	3.05	3.35	2.80	4.44	6.77	3.32	0.09	1.99	4.11	42.03
1975	4.98	6.64	5.92	4.42	5.15	3.83	8.55	3.83	5.18	1.74	3.41	2.03	55.68
1976	4.18	1.08	3.83	2.50	10.90	4.35	1.95	1.64	5.48	4.92	4.19	5.08	50.10
1977	3.72	1.62	6.86	1.27	1.79	2.47	3.42	7.30	5.50	4.27	1.63	3.86	43.71
1978	10.02	1.31	3.06	3.53	3.64	3.42	4.11	5.10	4.06	0.06	3.54	1.87	43.72
1979	3.59	7.74	3.09	6.49	8.94	1.54	7.85	2.12	6.13	1.35	3.95	2.17	54.96
1980	5.12	3.48	10.96	1.69	3.49	2.99	0.90	2.03	5.86	2.14	2.50	1.91	43.07
1981	0.89	5.02	4.72	2.07	6.90	4.29	3.96	5.79	0.54	2.81	1.00	9.55	47.54
1982	3.94	4.46	2.51	5.68	2.73	4.28	11.49	5.02	4.62	3.87	2.41	4.85	55.86
1983	3.75	7.22	6.62	5.77	1.67	6.57	4.85	6.32	3.56	1.92	5.39	4.15	57.79
1984	3.51	7.09	6.05	8.00	9.79	2.54	7.28	5.52	0.60	0.31	0.90	1.38	52.97
1985	3.01	6.92	1.31	0.84	1.70	4.62	8.10	4.38	0.49	6.34	6.36	2.48	46.55
1986	1.46	3.58	4.08	1.45	3.84	3.03	2.96	10.90	1.54	4.19	5.82	5.83	48.68
1987	7.39	7.55	4.97	0.70	3.57	5.64	4.87	4.93	3.56	0.29	2.74	1.42	47.63
1988	4.15	3.19	2.91	4.78	2.85	7.12	1.78	6.80	4.40	3.39	2.17	2.91	46.45
1989	1.42	3.59	5.52	4.89	2.60	6.67	11.46	3.27	4.87	3.36	3.00	4.41	55.06
1990	3.07	2.38	2.37	1.21	2.95	0.89	7.31	8.07	0.62	19.62	1.41	1.57	51.47
1991	7.03	1.84	7.89	4.73	3.06	2.17	7.89	9.26	4.40	0.99	1.55	3.32	54.13
1992	4.45	3.89	2.98	2.40	1.34	6.27	3.69	4.83	6.38	3.11	7.78	2.86	49.98
1993	7.45	3.62	8.37	1.74	1.43	3.27	3.12	2.23	7.29	0.99	1.87	1.81	43.19
1994	4.80	3.91	6.42	1.05	1.45	5.08	7.47	3.47	0.99	10.01	3.05	4.62	52.32
1995	6.96	7.97	0.92	1.28	1.77	8.15	5.71	6.92	5.75	2.64	2.38	4.47	54.92
1996	3.65	2.43	6.64	2.40	2.96	3.04	5.57	6.91	3.67	2.16	2.32	3.20	44.95
1997	4.20	5.45	2.69	4.38	2.38	6.90	7.09	2.01	4.89	4.08	5.51	9.09	58.67
1998	7.73	8.90	6.69	7.35	4.05	4.65	5.27	2.88	4.81	0.78	0.82	1.80	55.73
1999	5.31	2.29	3.44	1.95	1.26	7.52	4.91	3.14	4.46	2.57	1.50	1.21	39.56
2000	5.77	0.73	3.95	1.34	1.36	4.74	2.47	4.49	7.70	0.02	3.50	1.53	37.60
2001	3.11	2.68	7.21	1.28	3.85	6.49	4.79	3.55	3.33	0.50	1.03	0.54	38.36
2002	2.85	2.13	3.86	2.58	1.69	2.30	5.95	5.47	3.45	3.19	4.00	3.58	41.05
2003	1.73	5.00	7.09	8.43	5.57	10.99	8.91	4.59	2.70	3.03	1.21	1.93	61.18
2004	2.85	6.71	0.81	1.34	3.45	6.41	1.23	2.96	10.26	1.02	3.17	2.69	42.90

Avg	4.34	4.42	4.73	3.24	3.60	4.68	5.46	4.92	4.21	3.09	2.97	3.30	48.96
Min	0.89	0.73	0.81	0.70	1.31	0.89	0.90	1.04	0.49	0.02	0.21	0.46	28.82
Yr Min	1981	2000	2004	1972	1965	1990	1980	1963	1985	2000	1958	1955	1954
Max	10.02	8.90	10.96	8.43	10.90	10.99	11.49	10.90	10.26	19.62	7.78	9.55	73.47
Yr Max	1978	1998	1980	2003	1976	2003	1982	1964	2004	1990	1992	1997	1964

Table 4 - SRS Rainfall (in inches) for 2004, Manual Gauges

Month	700-A	Barricade 2	Barricade 3	Barricade 5	100-C	400-D	200-F	200-H	100-K	100-L	100-P	SRTC
Jan	3.45	3.71	4.58	3.07	2.95	2.70	4.63	4.77	2.81	2.25	2.43	3.79
Feb	6.74	5.89	7.26	7.32	6.77	7.11	6.81	6.94	6.72	6.82	6.81	6.28
Mar	1.35	1.09	1.15	0.72	0.70	0.86	0.99	0.84	0.86	0.59	0.61	1.44
Apr	1.83	2.11	3.56	2.04	1.50	1.28	1.69	1.83	1.04	1.56	1.64	1.94
May	2.95	4.31	2.34	3.48	4.13	2.79	2.47	2.58	5.08	3.24	2.28	2.50
Jun	8.38	11.27	13.21	8.27	6.79	7.83	8.49	10.23	9.82	4.58	4.42	8.71
Jul	4.54	4.24	1.91	3.69	3.20	2.91	3.01	2.76	4.49	3.15	2.82	4.66
Aug	2.36	5.00	4.93	6.49	3.10	2.12	4.21	6.02	3.17	3.58	5.68	2.74
Sep	8.66	8.08	7.67	7.19	9.36	7.05	10.54	10.68	9.53	9.88	8.90	8.72
Oct	0.37	0.82	1.05	1.21	1.19	0.59	3.32	1.37	1.25	1.19	0.93	0.66
Nov	4.61	4.76	5.29	4.74	4.01	2.74	4.11	4.25	2.91	3.09	3.00	4.74
Dec	1.67	2.43	3.67	2.16	2.10	2.54	3.81	2.80	1.94	1.74	1.89	1.72
Annual	46.91	53.71	56.62	50.38	45.80	40.52	54.08	55.07	49.62	41.67	41.41	47.90

Fig. 1 SRS Meteorological Monitoring Network

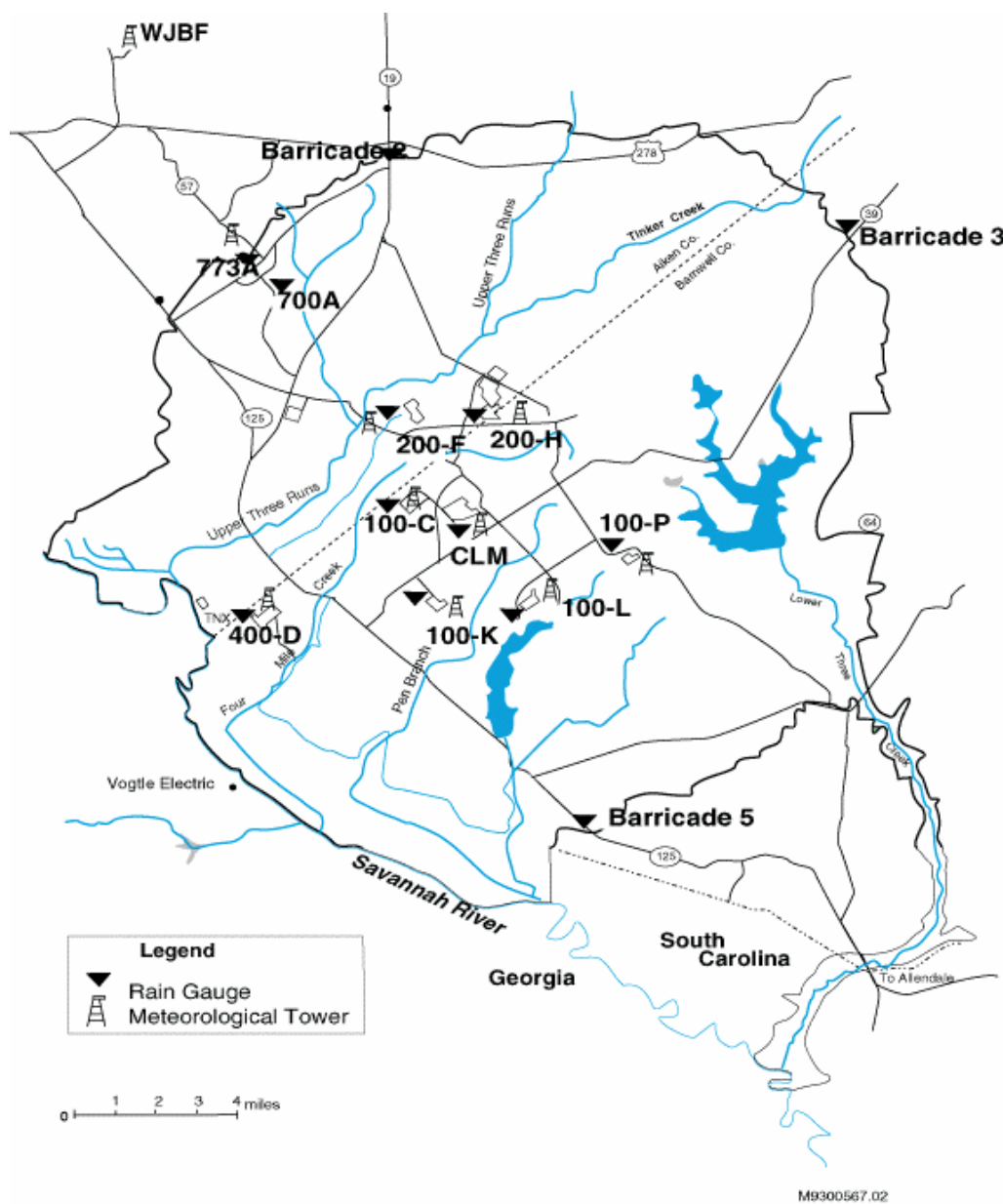


Fig. 2 - Summary of Daily Data for 2004

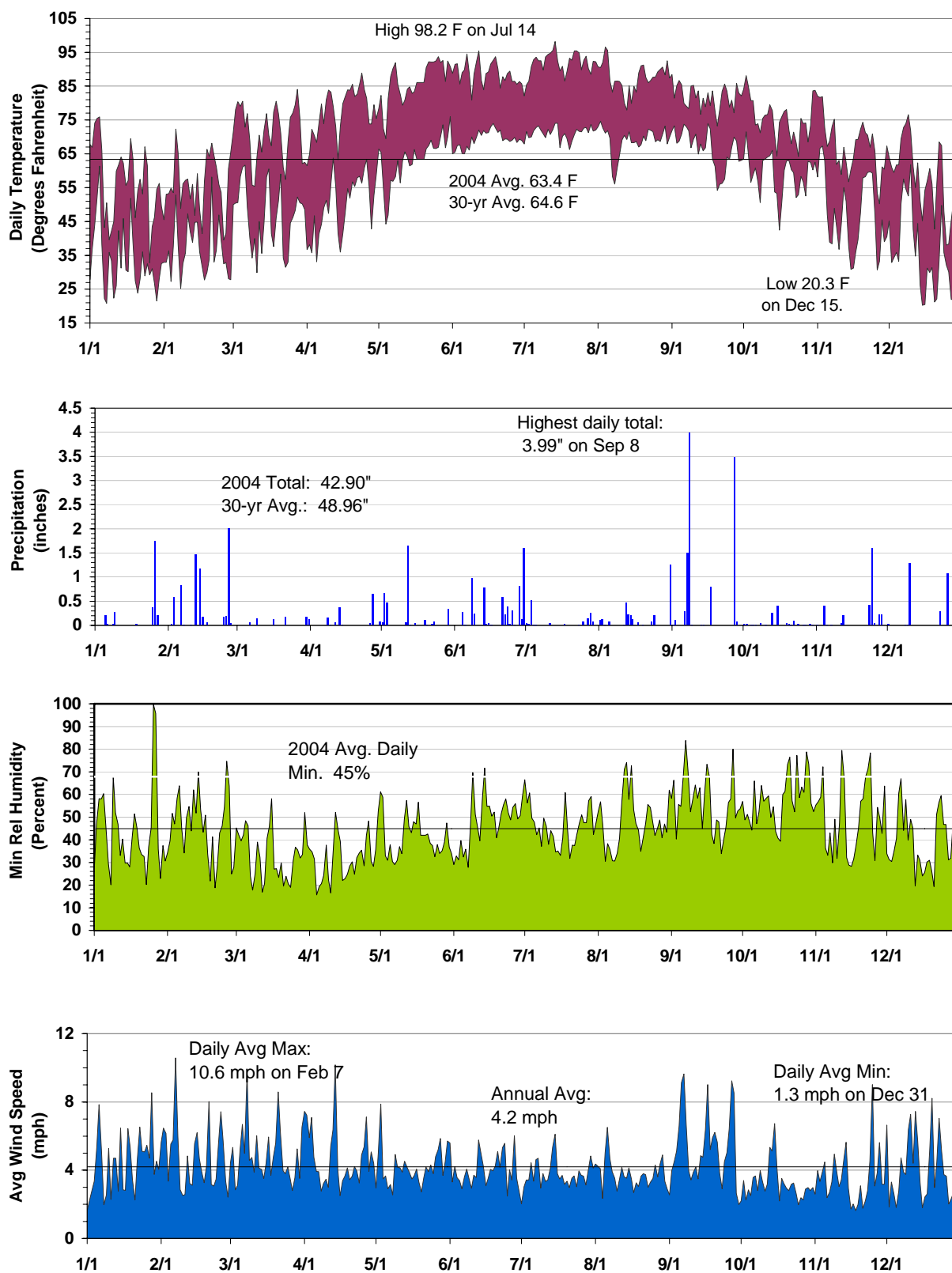


Fig. 3 - Daily High and Low Temperatures for 2004

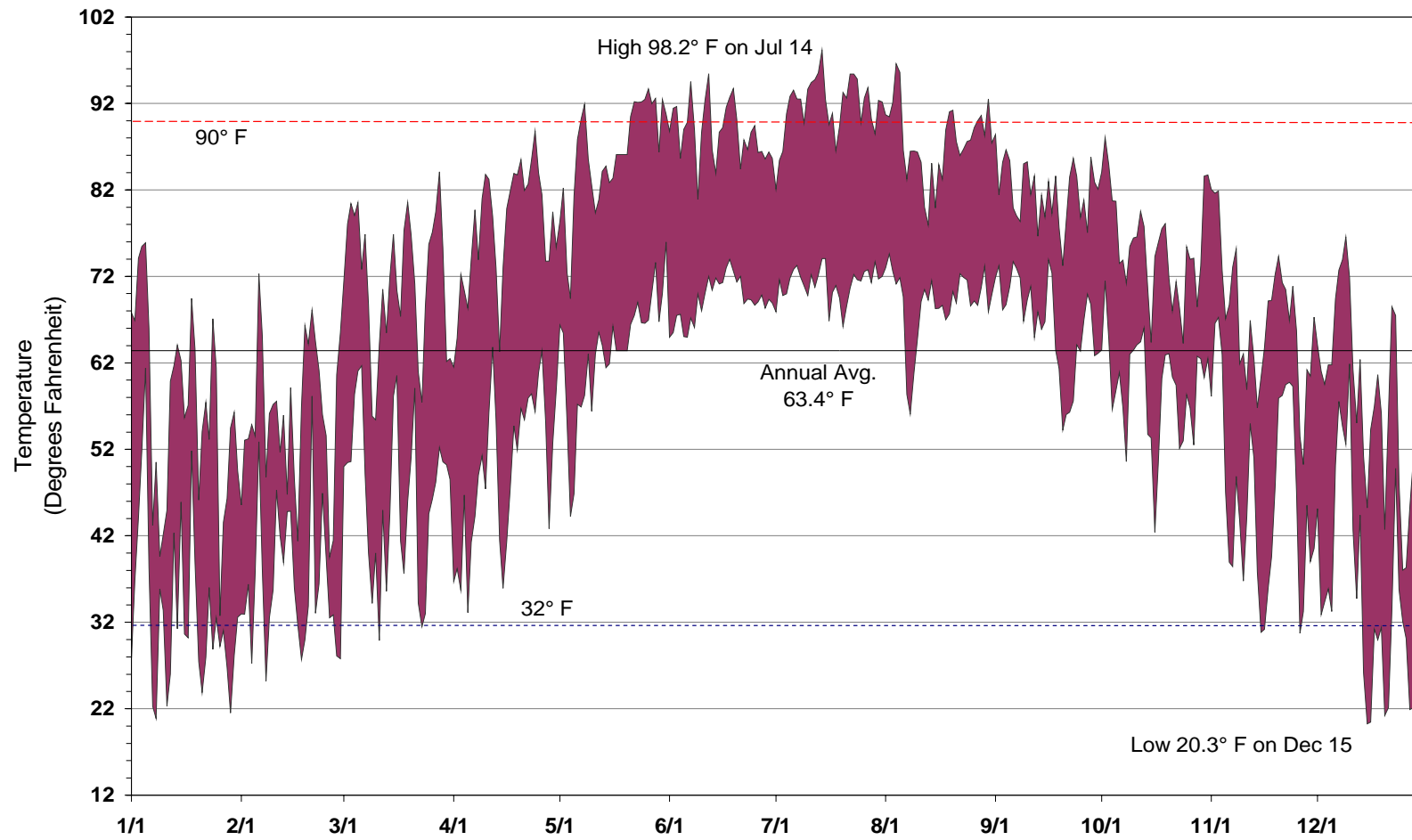


Fig. 4 - SRS Annual Average Temperature 1974-2004

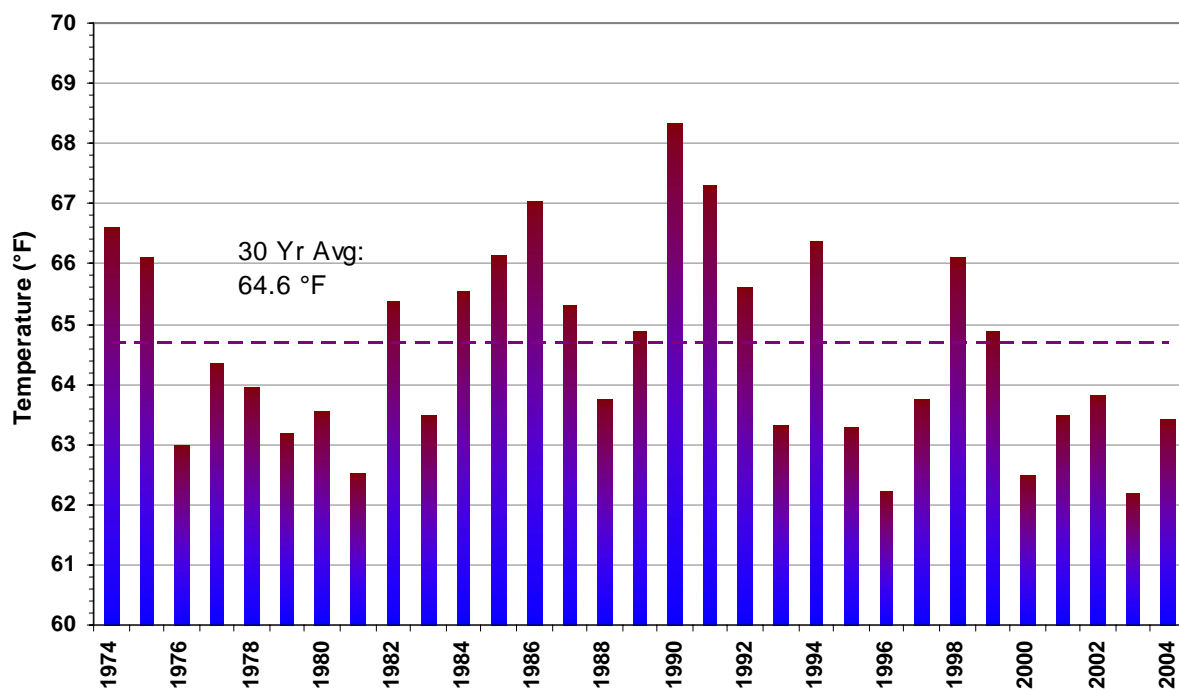


Fig. 5 - SRS Monthly Average Temperature

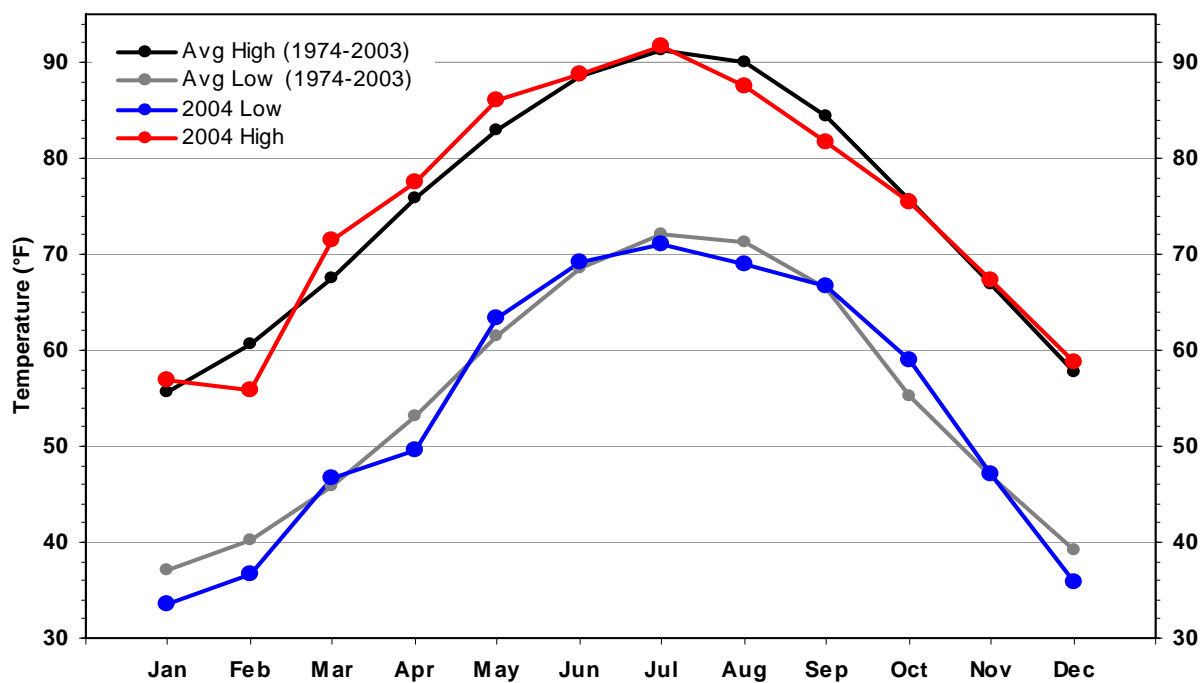


Fig. 6 - Number of Freezing (<32 F) and Sweltering (>90 F) Days

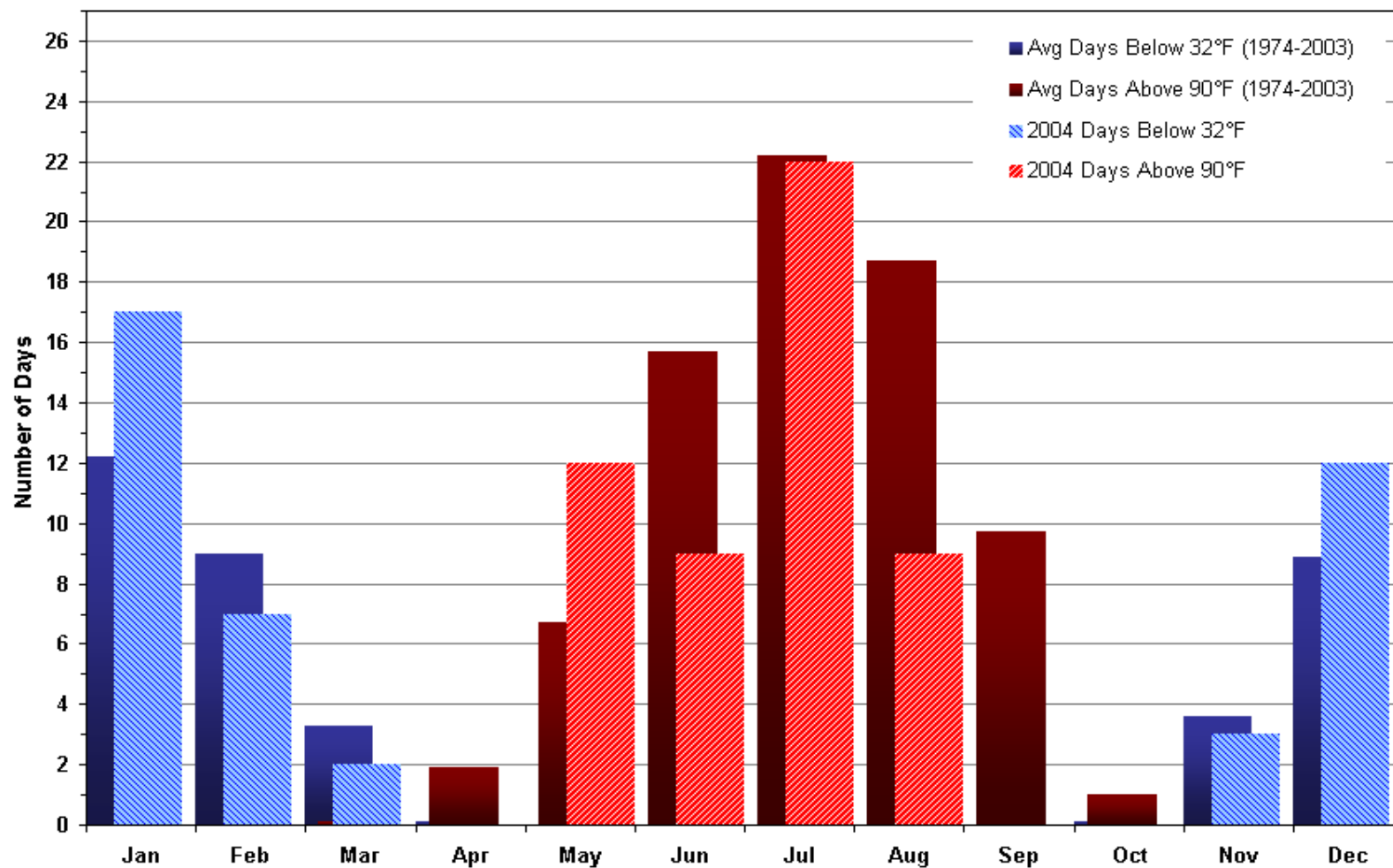




Fig. 8 - SRS Annual Precipitation 1974-2004

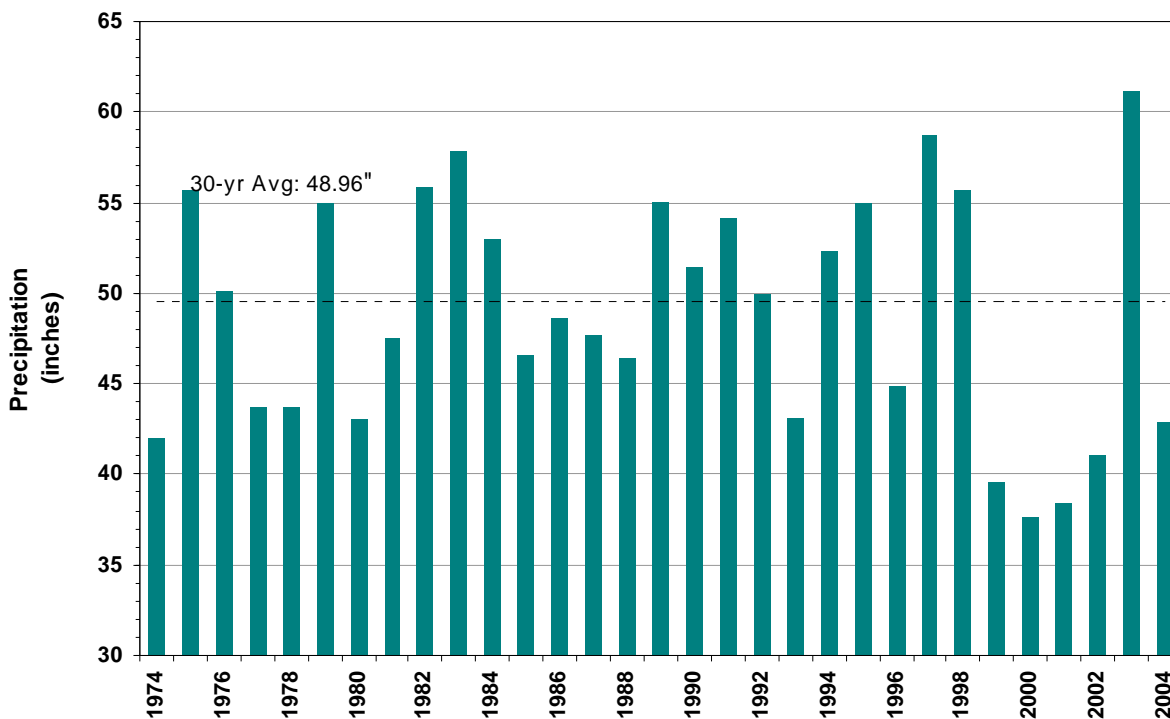


Fig. 9 - SRS Monthly Precipitation

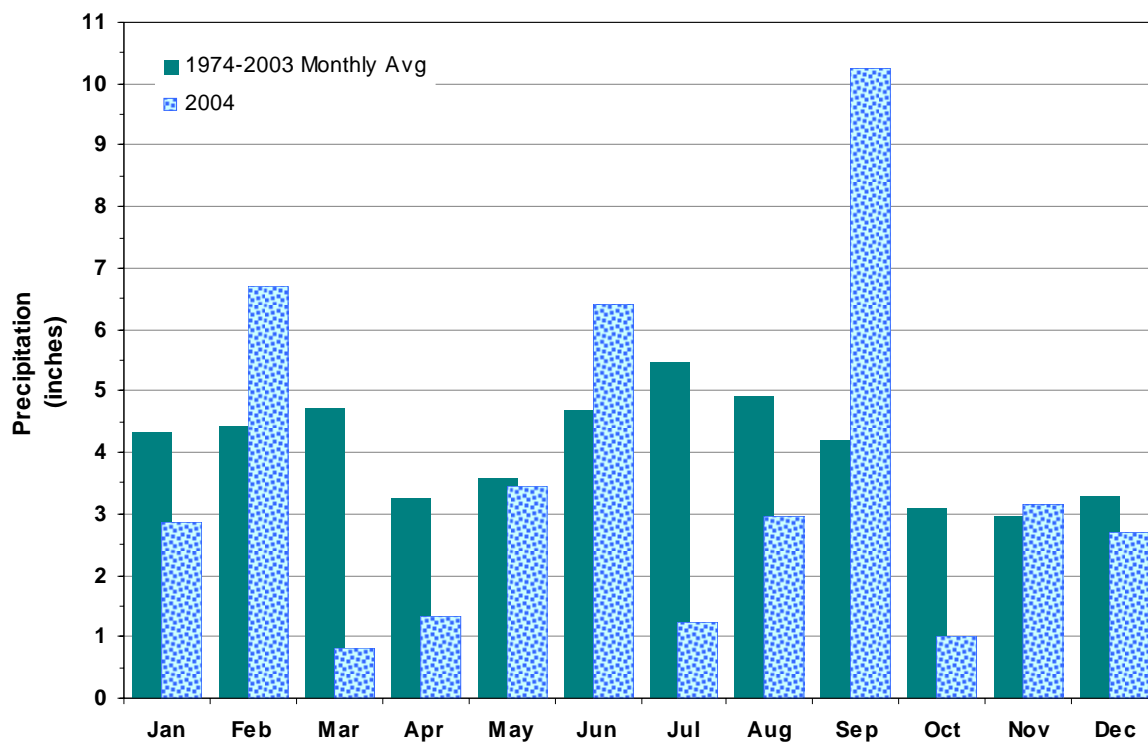


Fig. 10 - Daily High and Low Humidity for 2004

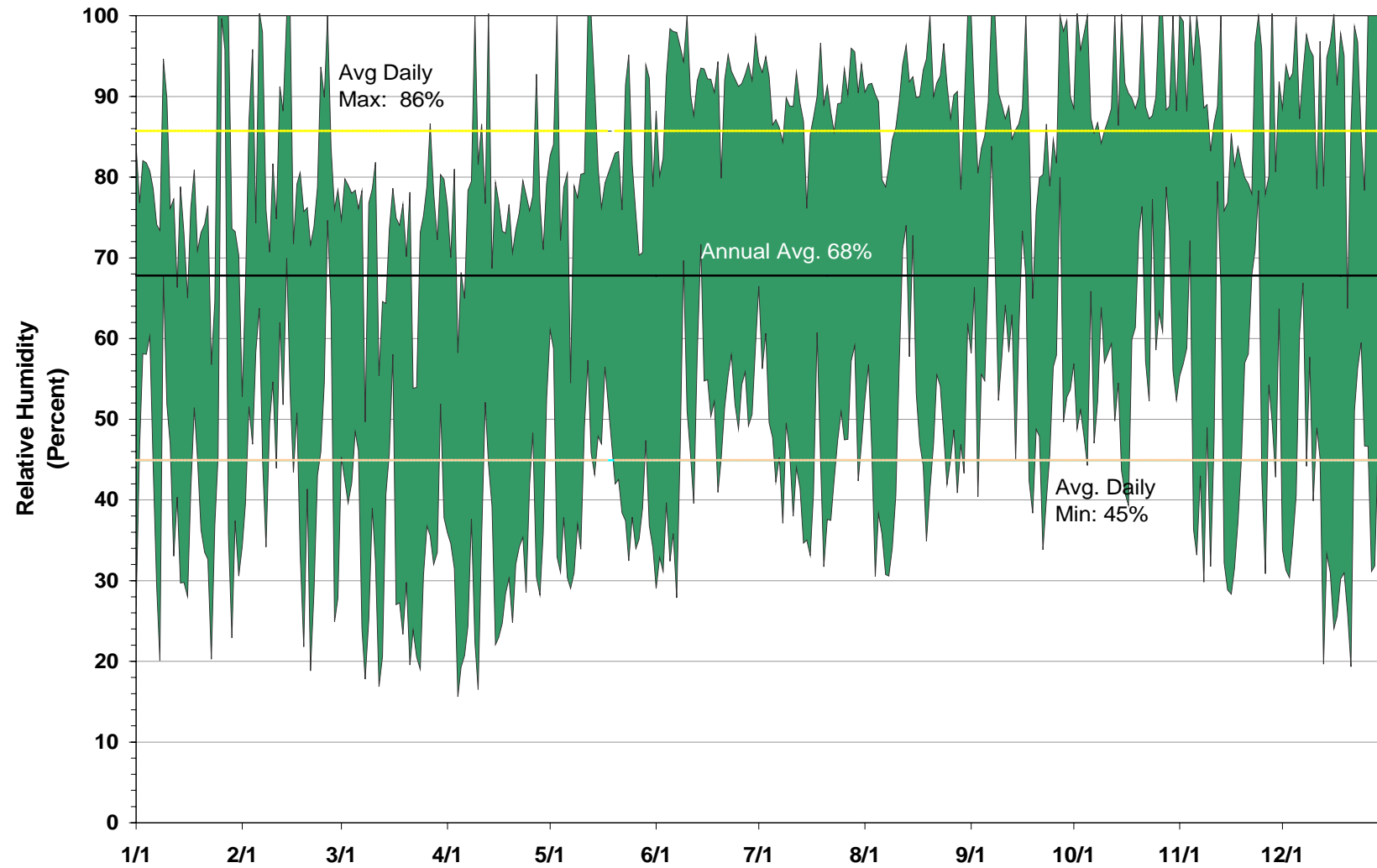


Fig. 11 - SRS Annual Average Humidity 1974-2004

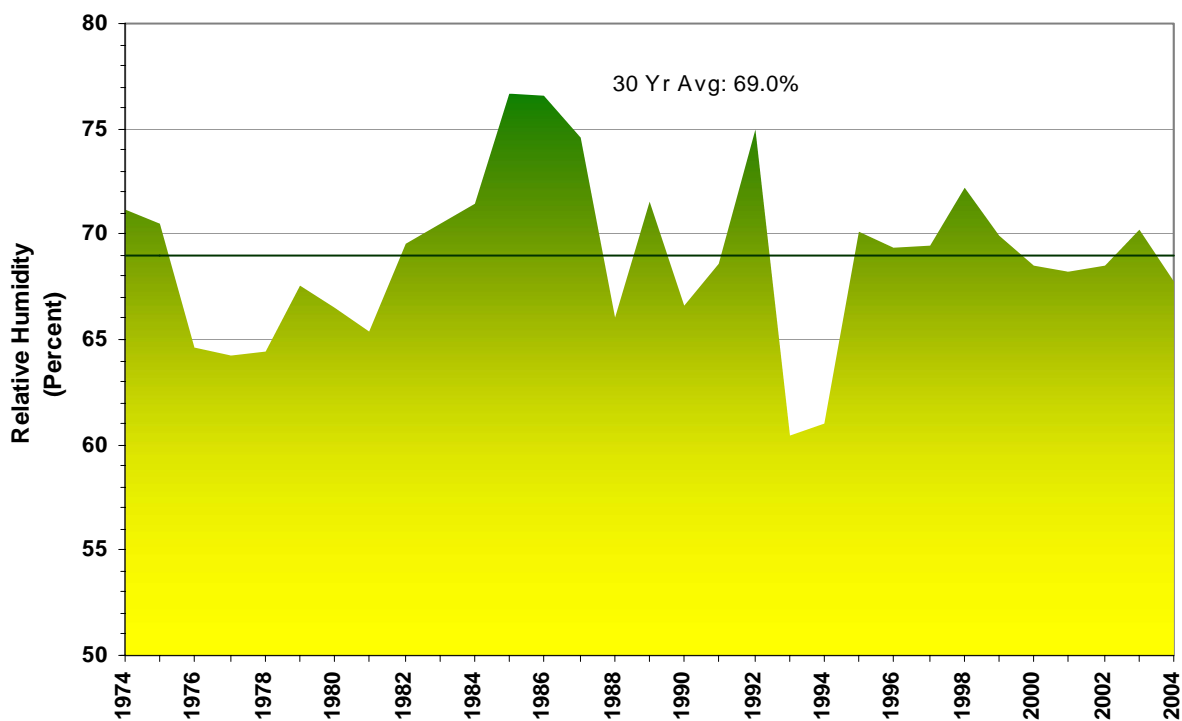


Fig. 12 - SRS Monthly Average Minimum Humidity

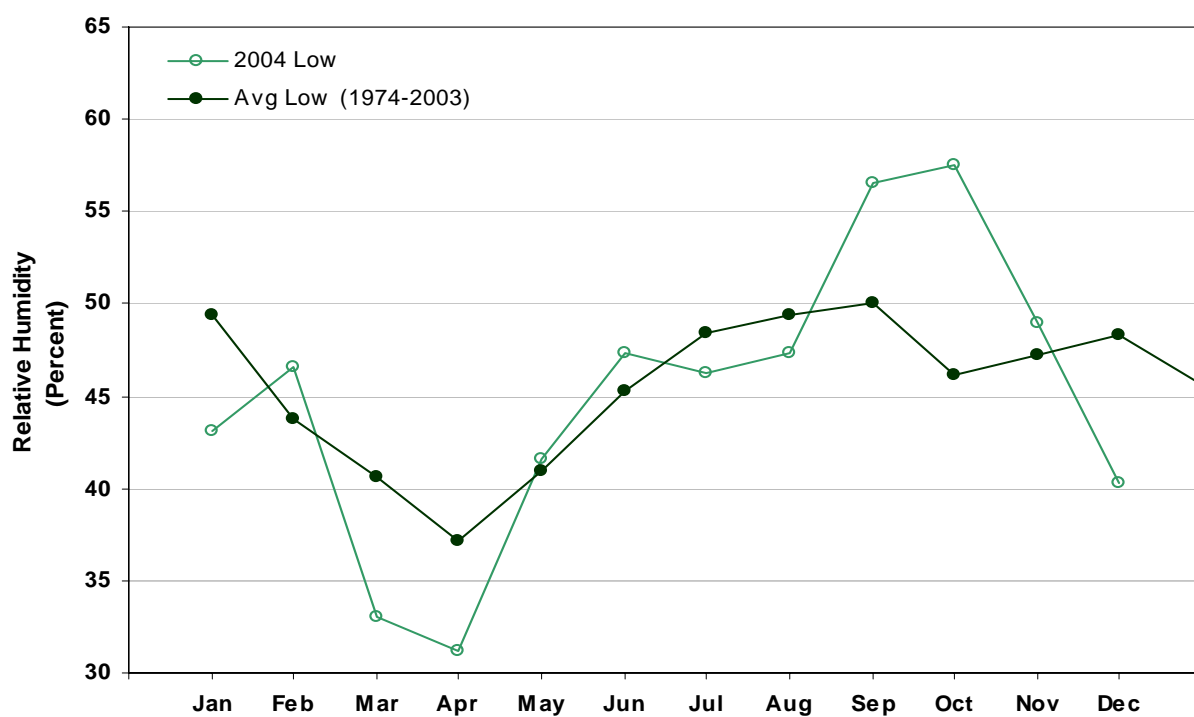


Fig. 13 - Daily Average Wind Speed for 2004

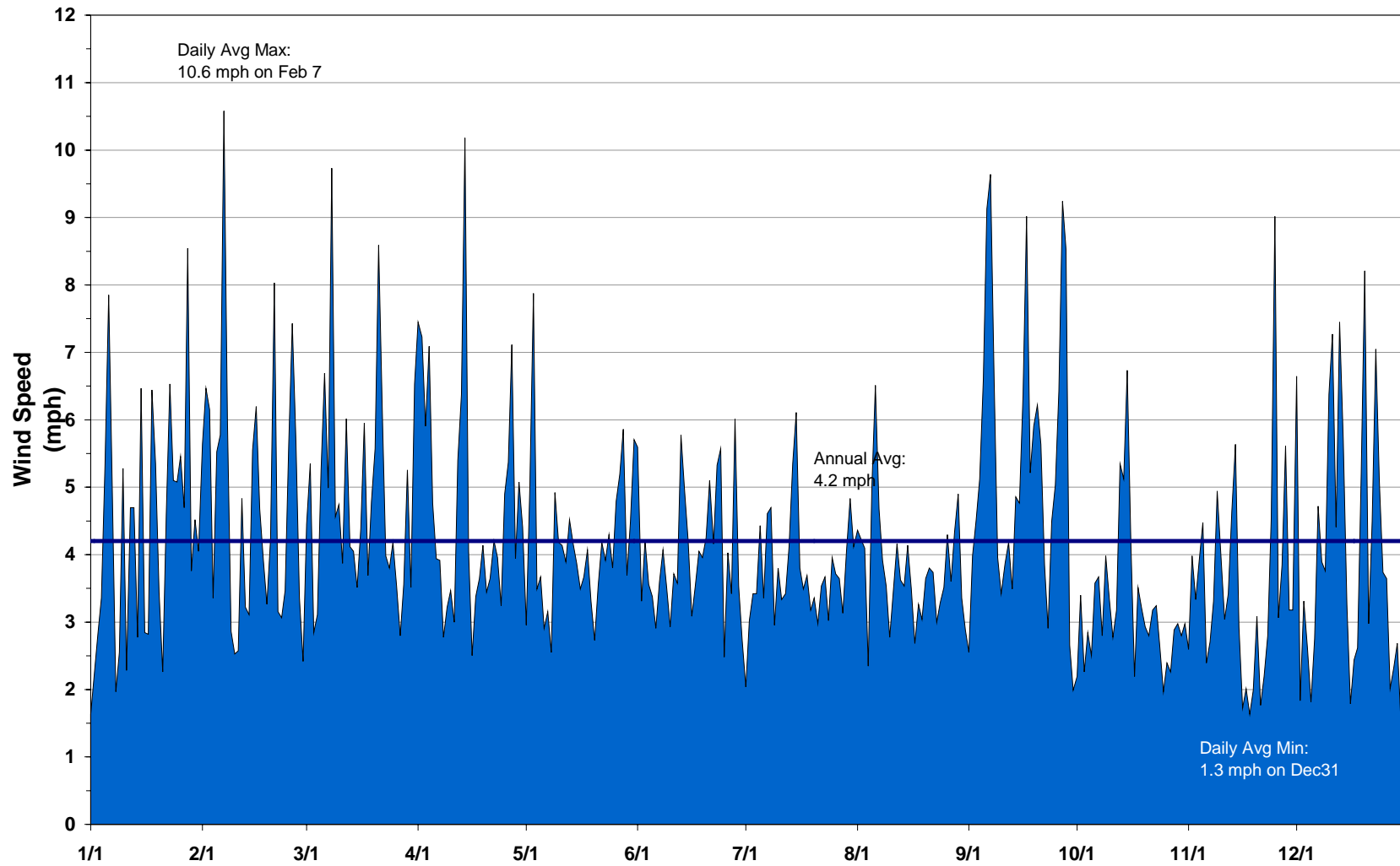
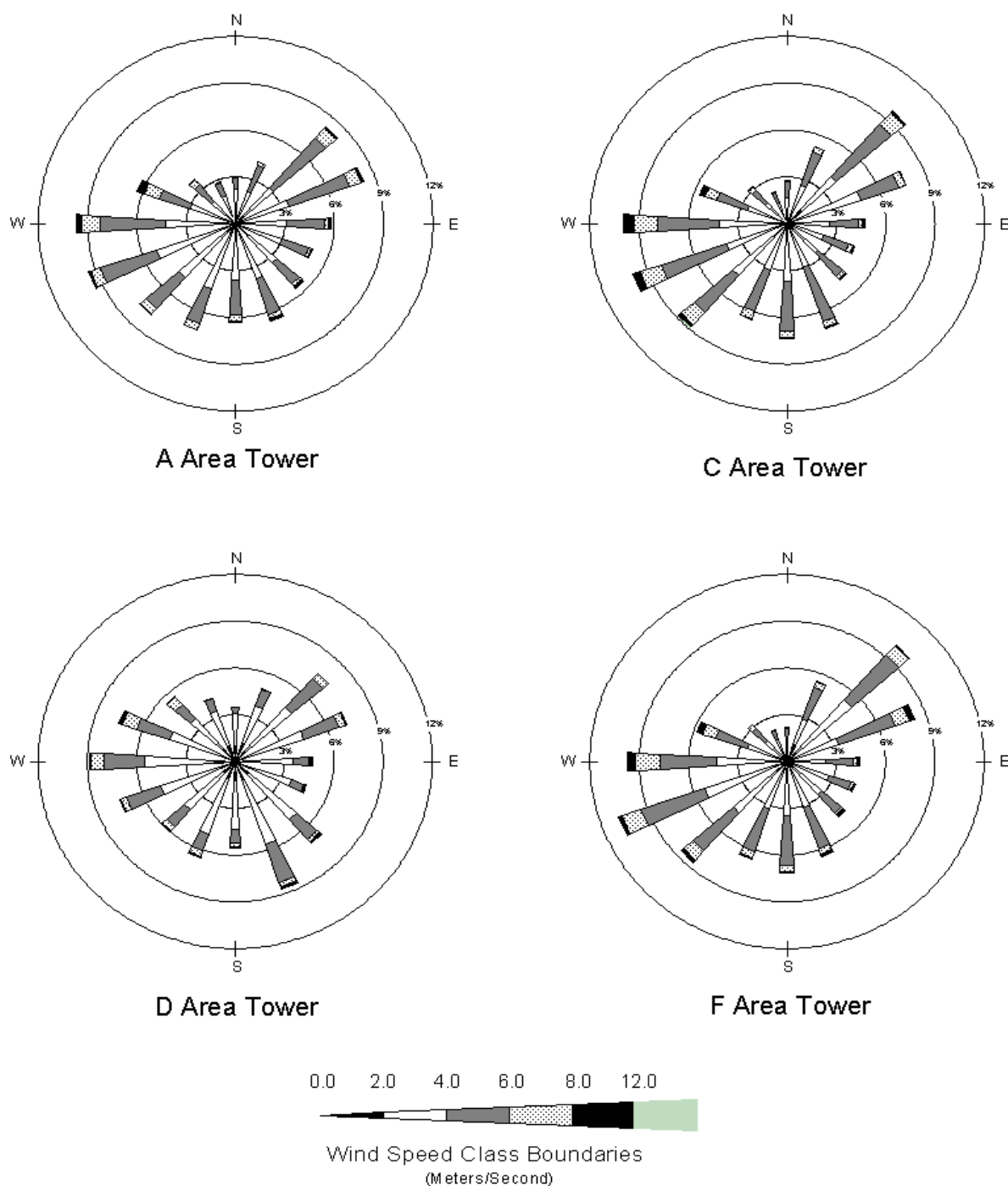
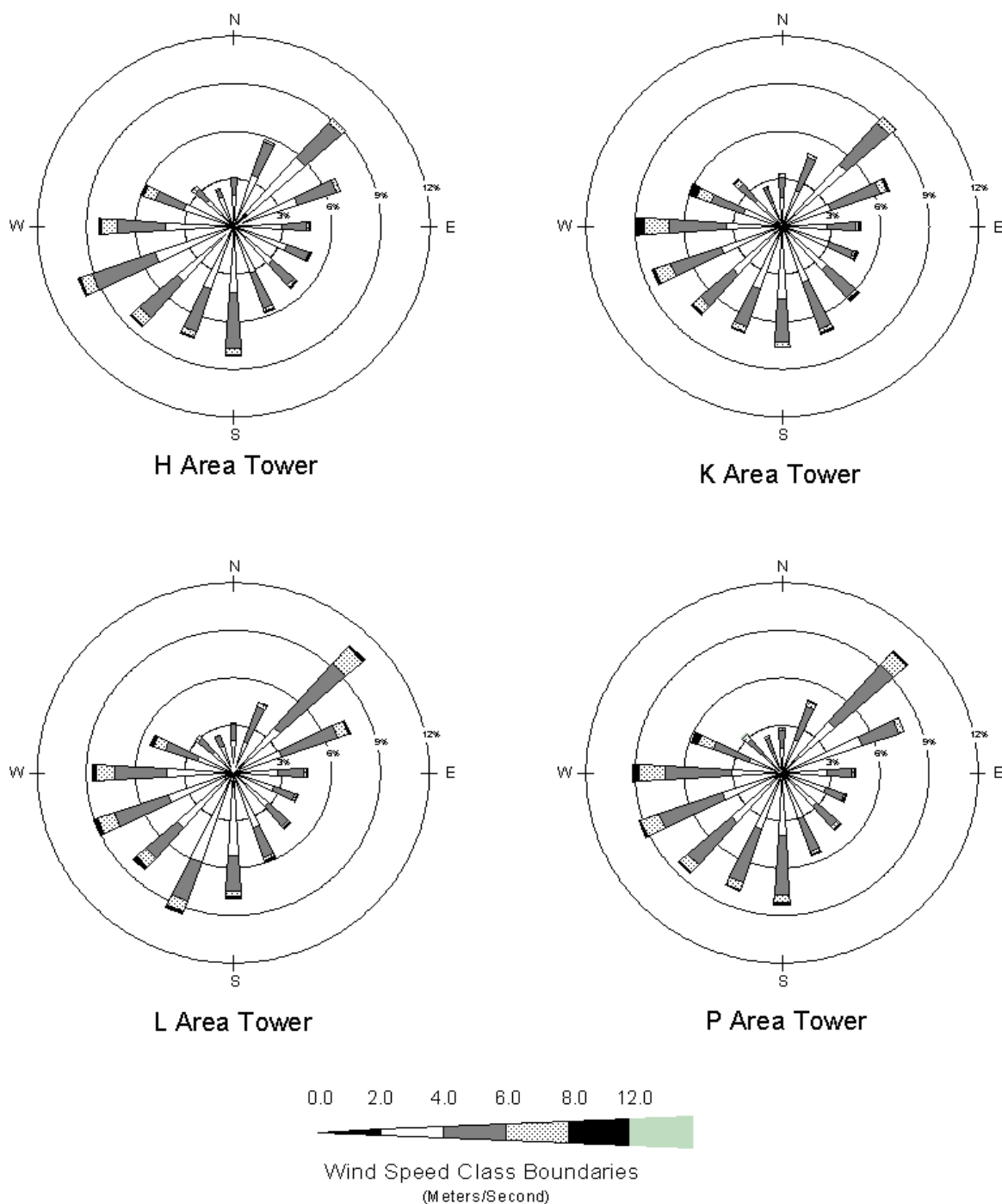
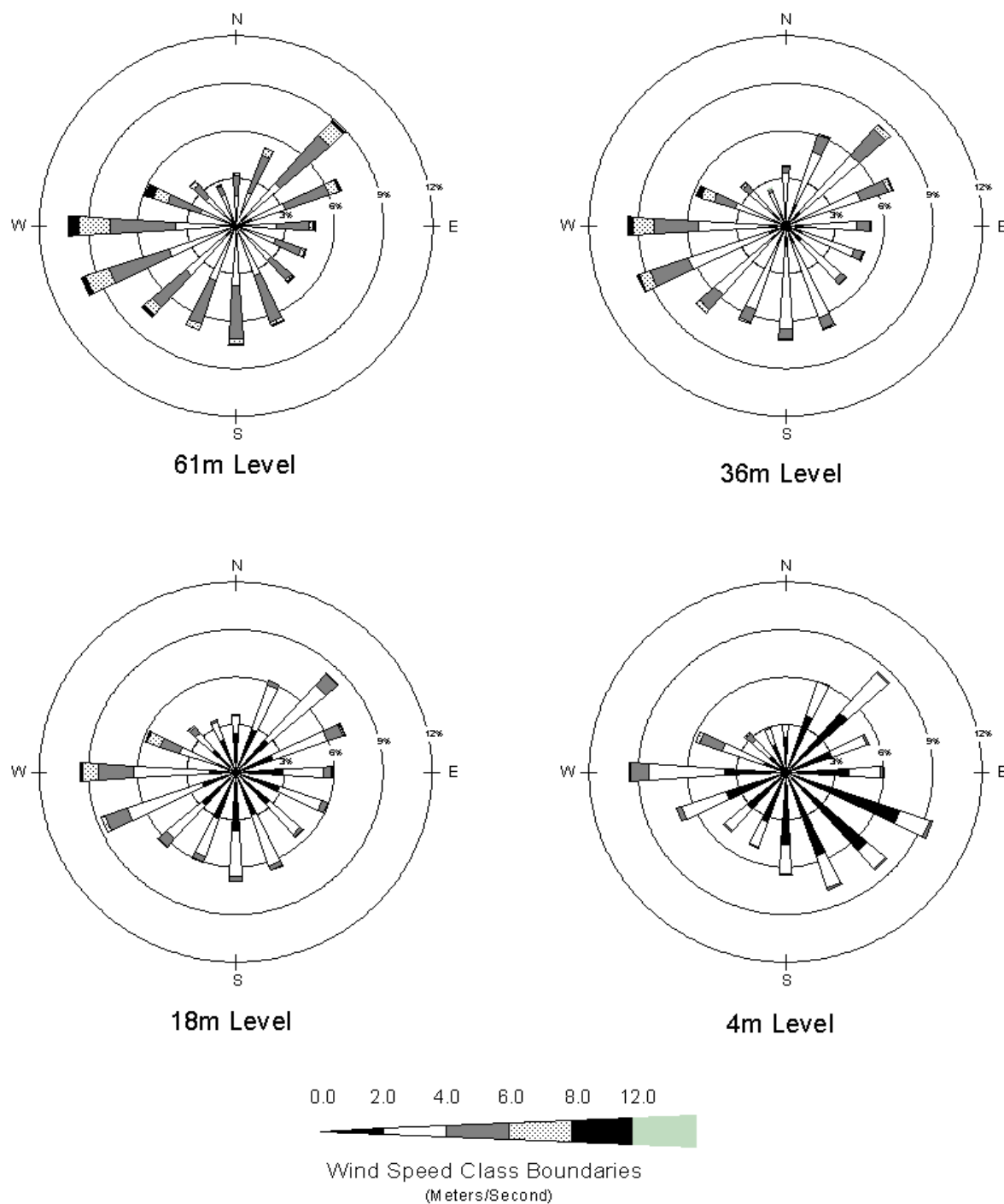


Fig. 14(a) - Annual Wind Rose Plots for 2004, 61-m Level

Wind rose plots depict the frequency of occurrence of wind direction sector (direction from which the wind blows) by wind speed category

Fig. 14(b) - Annual Wind Rose Plots for 2004, 61-m Level

Wind rose plots depict the frequency of occurrence of wind direction sector (direction from which the wind blows) by wind speed category

Fig. 15 - Annual Wind Rose Plots for 2004, Central Climatology, All Levels

Wind rose plots depict the frequency of occurrence of wind direction sector (direction from which the wind blows) by wind speed category.

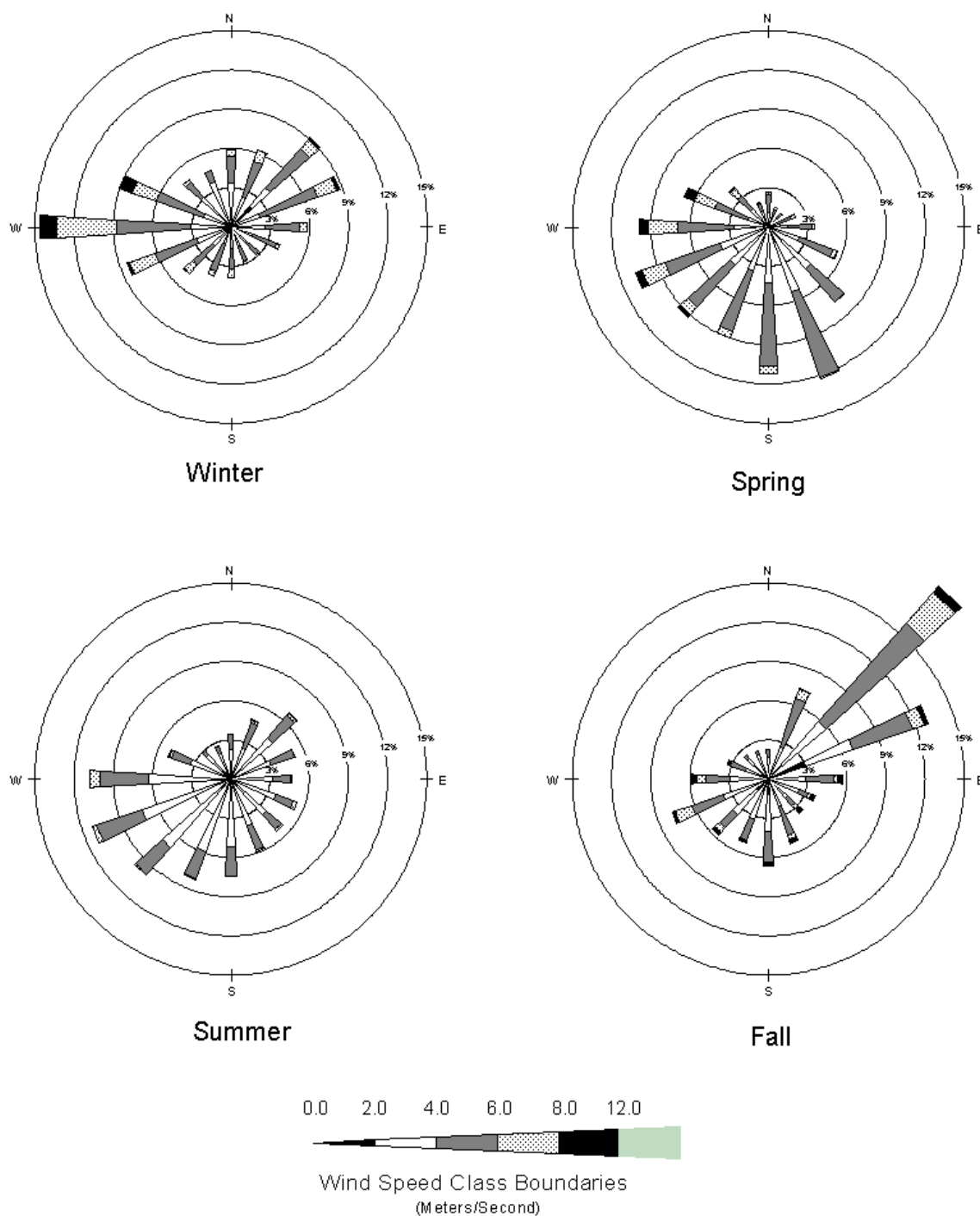
Fig. 16 - Seasonal Wind Rose Plots for 2004, Central Climatology, 61-m Level

Fig. 17 - Daily Average Barometric Pressure for 2004

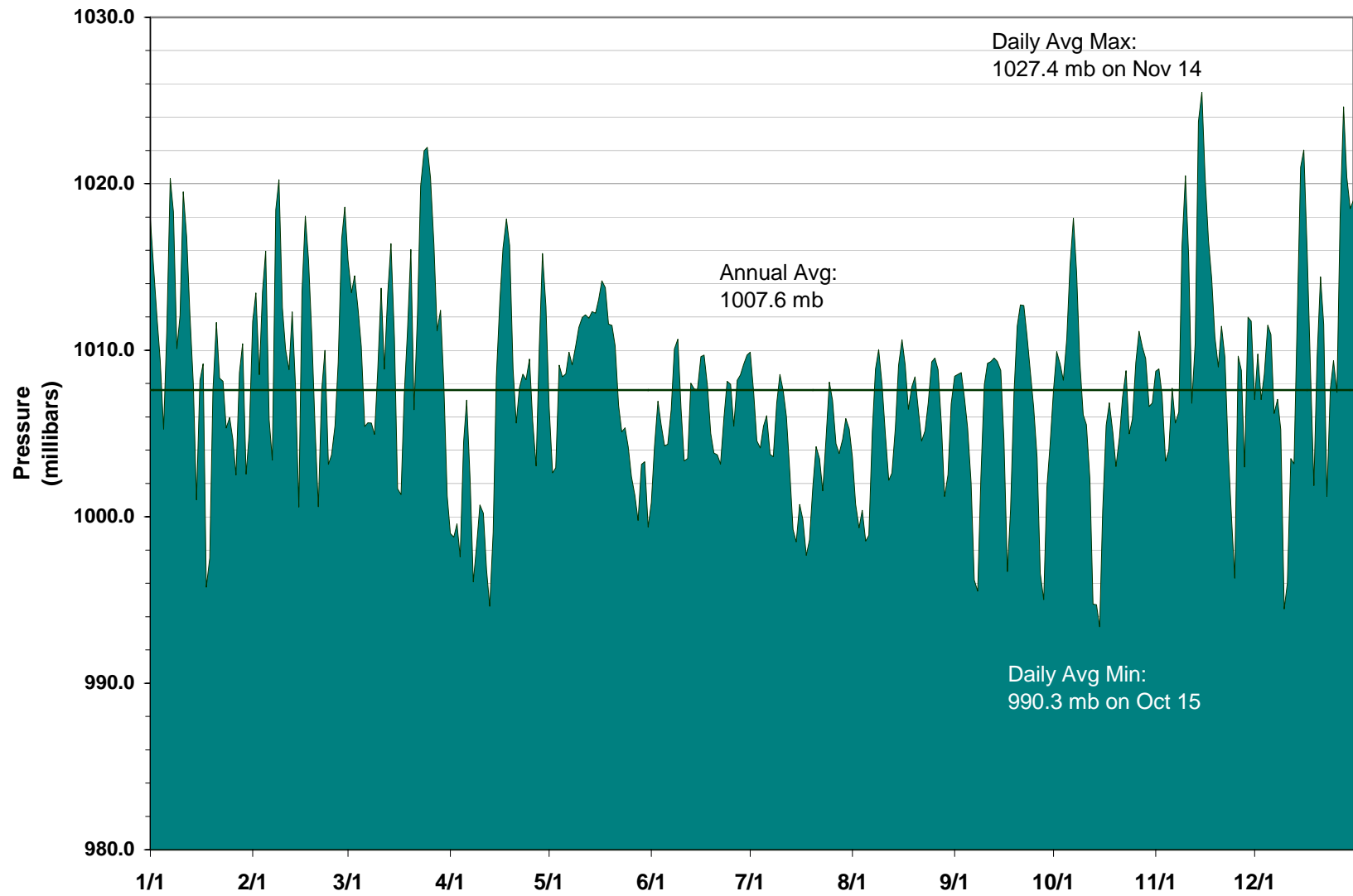
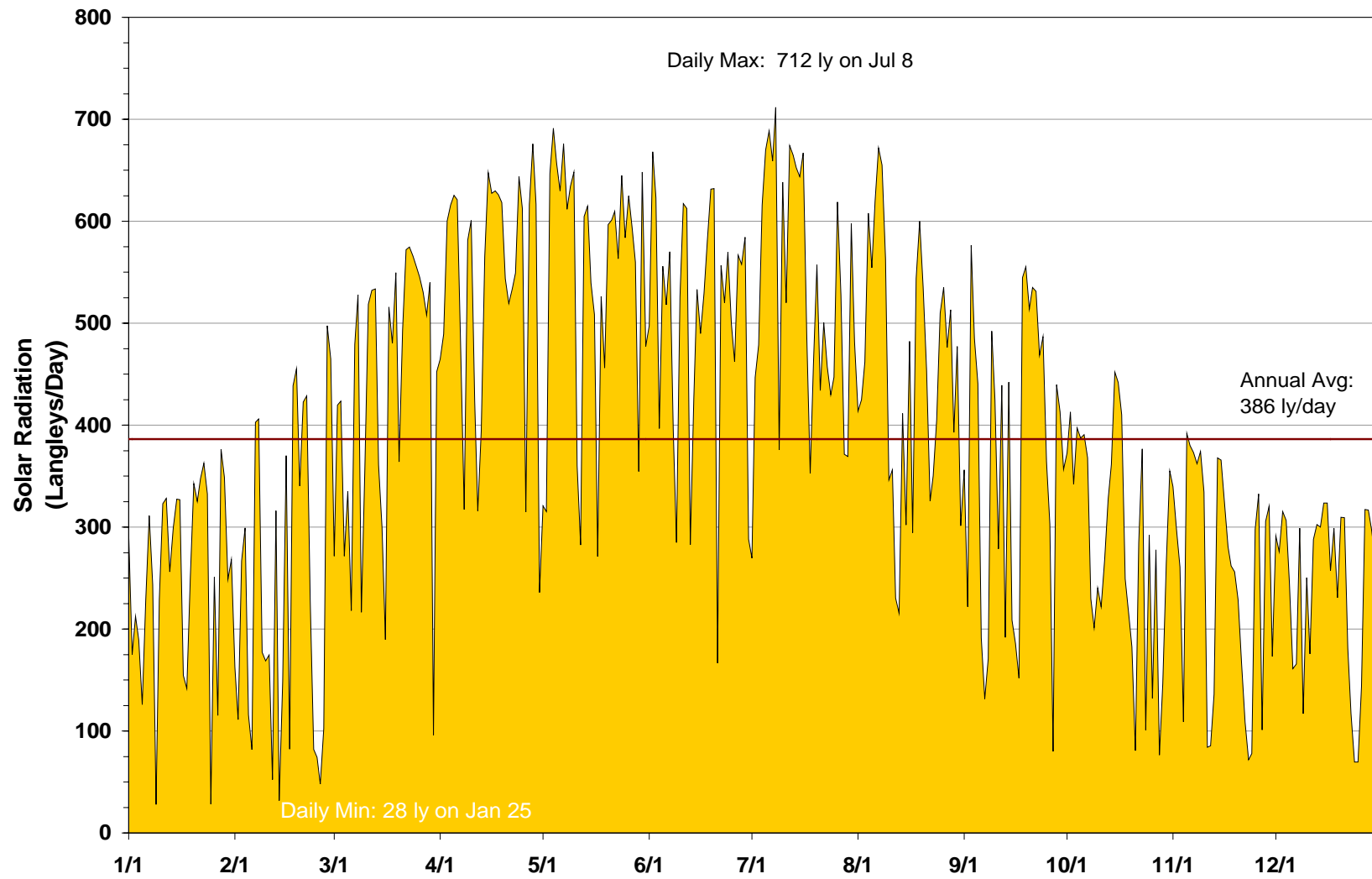


Fig. 18 - Daily Solar Radiation for 2004



**Table A.1 - Joint Occurrence Frequencies of Wind Direction Sector
by Wind Speed Category for the A Area Tower, 2004**

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.00638	0.01571	0.00754	0.00040	0.00000	0.00000	0.03003
NNE	0.00515	0.01688	0.01788	0.00196	0.00006	0.00000	0.04193
NE	0.00729	0.02374	0.04207	0.00854	0.00114	0.00000	0.08277
ENE	0.00461	0.02966	0.03888	0.00774	0.00131	0.00000	0.08220
E	0.00612	0.02522	0.02303	0.00222	0.00137	0.00000	0.05795
ESE	0.00524	0.02516	0.01642	0.00199	0.00094	0.00003	0.04978
SE	0.00606	0.02738	0.01819	0.00202	0.00188	0.00000	0.05553
SSE	0.00720	0.03051	0.02388	0.00276	0.00188	0.00006	0.06629
S	0.00774	0.02866	0.02177	0.00396	0.00085	0.00003	0.06302
SSW	0.00769	0.03649	0.02320	0.00438	0.00054	0.00000	0.07230
SW	0.00800	0.03789	0.02718	0.00404	0.00071	0.00000	0.07782
WSW	0.00780	0.04301	0.03598	0.00643	0.00111	0.00000	0.09433
WSW	0.00757	0.03521	0.03945	0.01187	0.00282	0.00000	0.09692
WNW	0.00734	0.02192	0.02004	0.00951	0.00430	0.00000	0.06310
NW	0.00447	0.01480	0.01412	0.00370	0.00074	0.00006	0.03789
NNW	0.00490	0.01392	0.00894	0.00037	0.00000	0.00003	0.02815
Total	0.10355	0.42616	0.37856	0.07190	0.01964	0.00020	1.00000

**Table A.2 - Joint Occurrence Frequencies of Wind Direction Sector
by Wind Speed Category for the C Area Tower, 2004**

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.00382	0.01248	0.01057	0.00060	0.00003	0.00000	0.02750
NNE	0.00607	0.01975	0.02257	0.00336	0.00009	0.00003	0.05187
NE	0.01211	0.02796	0.04489	0.01009	0.00117	0.00000	0.09622
ENE	0.00644	0.04067	0.02445	0.00459	0.00034	0.00000	0.07650
E	0.00485	0.02083	0.01807	0.00202	0.00148	0.00000	0.04725
ESE	0.00416	0.01947	0.01599	0.00319	0.00088	0.00000	0.04369
SE	0.00522	0.02009	0.01949	0.00228	0.00140	0.00000	0.04848
SSE	0.00524	0.02460	0.03654	0.00356	0.00134	0.00000	0.07128
S	0.00650	0.03013	0.03195	0.00428	0.00094	0.00000	0.07379
SSW	0.00630	0.02539	0.02790	0.00510	0.00068	0.00000	0.06538
SW	0.00713	0.03719	0.03132	0.01069	0.00285	0.00009	0.08926
WSW	0.00644	0.03266	0.04192	0.01337	0.00467	0.00003	0.09910
WSW	0.00593	0.03583	0.03739	0.01397	0.00670	0.00003	0.09984
WNW	0.00553	0.02009	0.01949	0.00778	0.00348	0.00003	0.05640
NW	0.00416	0.01371	0.01086	0.00254	0.00040	0.00000	0.03167
NNW	0.00311	0.01134	0.00661	0.00057	0.00014	0.00000	0.02178
Total	0.09300	0.39220	0.40003	0.08798	0.02660	0.00020	1.00001

**Table A.3 - Joint Occurrence Frequencies of Wind Direction Sector
by Wind Speed Category for the D Area Tower, 2004**

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.01016	0.02083	0.00407	0.00009	0.00000	0.00000	0.03515
NNE	0.01241	0.02516	0.01141	0.00048	0.00003	0.00000	0.04949
NE	0.00882	0.03737	0.02499	0.00421	0.00026	0.00000	0.07565
ENE	0.00848	0.03575	0.02260	0.00447	0.00043	0.00000	0.07172
E	0.00902	0.02633	0.00934	0.00128	0.00120	0.00000	0.04716
ESE	0.00968	0.02633	0.00806	0.00097	0.00083	0.00000	0.04585
SE	0.01139	0.03848	0.01662	0.00194	0.00171	0.00000	0.07013
SSE	0.01241	0.04395	0.02567	0.00305	0.00174	0.00003	0.08684
S	0.01272	0.03074	0.00882	0.00239	0.00122	0.00000	0.05590
SSW	0.01204	0.03692	0.01153	0.00404	0.00046	0.00000	0.06498
SW	0.01013	0.03122	0.01415	0.00376	0.00074	0.00000	0.06000
WSW	0.01010	0.03814	0.02166	0.00364	0.00083	0.00000	0.07437
WSW	0.01264	0.04295	0.02459	0.00754	0.00120	0.00000	0.08891
WNW	0.01016	0.03199	0.02155	0.00891	0.00219	0.00000	0.07480
NW	0.01107	0.02536	0.01235	0.00646	0.00066	0.00006	0.05596
NNW	0.01067	0.02382	0.00828	0.00023	0.00006	0.00003	0.04309
Total	0.17191	0.51533	0.24568	0.05345	0.01352	0.00011	1.00000

**Table A.4 - Joint Occurrence Frequencies of Wind Direction Sector
by Wind Speed Category for the F Area Tower, 2004**

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.00359	0.00846	0.00948	0.00068	0.00003	0.00000	0.02224
NNE	0.01110	0.01765	0.02130	0.00421	0.00011	0.00000	0.05438
NE	0.00766	0.04519	0.03812	0.00812	0.00091	0.00000	0.09999
ENE	0.00604	0.02708	0.03636	0.00945	0.00339	0.00006	0.08237
E	0.00507	0.01874	0.01632	0.00231	0.00165	0.00000	0.04408
ESE	0.00655	0.02070	0.01421	0.00165	0.00103	0.00000	0.04413
SE	0.00547	0.02261	0.01563	0.00177	0.00174	0.00000	0.04721
SSE	0.00564	0.02543	0.02827	0.00310	0.00171	0.00000	0.06415
S	0.00715	0.02790	0.03158	0.00396	0.00094	0.00000	0.07152
SSW	0.00681	0.02580	0.02819	0.00458	0.00071	0.00003	0.06611
SW	0.00886	0.03485	0.03249	0.00797	0.00222	0.00000	0.08639
WSW	0.00883	0.04390	0.04126	0.01219	0.00216	0.00000	0.10834
WSW	0.00783	0.03542	0.03420	0.01472	0.00510	0.00000	0.09726
WNW	0.00658	0.01902	0.02044	0.00812	0.00387	0.00006	0.05808
NW	0.00470	0.01333	0.01065	0.00293	0.00037	0.00000	0.03198
NNW	0.00362	0.01159	0.00615	0.00031	0.00009	0.00003	0.02178
Total	0.10546	0.39764	0.38463	0.08607	0.02602	0.00017	1.00000

**Table A.5 - Joint Occurrence Frequencies of Wind Direction Sector
by Wind Speed Category for the H Area Tower, 2004**

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.00586	0.01395	0.01087	0.00046	0.00000	0.00003	0.03116
NNE	0.00860	0.02570	0.02194	0.00159	0.00006	0.00000	0.05789
NE	0.01116	0.04696	0.02954	0.00393	0.00017	0.00003	0.09179
ENE	0.00589	0.03526	0.02496	0.00253	0.00020	0.00000	0.06885
E	0.00535	0.02414	0.01514	0.00182	0.00043	0.00000	0.04688
ESE	0.00595	0.02838	0.01429	0.00094	0.00051	0.00000	0.05006
SE	0.00572	0.02636	0.01728	0.00185	0.00094	0.00000	0.05214
SSE	0.00552	0.02564	0.02348	0.00222	0.00100	0.00000	0.05786
S	0.00766	0.03421	0.03484	0.00441	0.00063	0.00000	0.08174
SSW	0.00743	0.03430	0.02840	0.00367	0.00066	0.00000	0.07445
SW	0.00712	0.03845	0.03111	0.00626	0.00114	0.00000	0.08407
WSW	0.00583	0.04483	0.04093	0.00768	0.00137	0.00000	0.10064
WSW	0.00578	0.03578	0.02977	0.00982	0.00171	0.00000	0.08285
WNW	0.00677	0.02579	0.01804	0.00763	0.00179	0.00000	0.06003
NW	0.00555	0.01699	0.00879	0.00256	0.00034	0.00000	0.03424
NNW	0.00527	0.01452	0.00484	0.00068	0.00003	0.00003	0.02536
Total	0.10545	0.47123	0.35422	0.05806	0.01096	0.00008	0.99999

**Table A.6 - Joint Occurrence Frequencies of Wind Direction Sector
by Wind Speed Category for the K Area Tower, 2004**

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.00404	0.01403	0.01326	0.00174	0.00003	0.00000	0.03310
NNE	0.00578	0.01839	0.02214	0.00202	0.00009	0.00000	0.04841
NE	0.00612	0.04605	0.03546	0.00495	0.00023	0.00000	0.09281
ENE	0.00444	0.02718	0.03162	0.00487	0.00100	0.00000	0.06911
E	0.00458	0.02314	0.01736	0.00179	0.00140	0.00000	0.04827
ESE	0.00649	0.02399	0.01560	0.00168	0.00114	0.00000	0.04890
SE	0.00626	0.02991	0.02328	0.00168	0.00168	0.00000	0.06282
SSE	0.00714	0.03031	0.03102	0.00225	0.00140	0.00000	0.07212
S	0.00840	0.03709	0.02744	0.00290	0.00051	0.00000	0.07633
SSW	0.00786	0.03381	0.02490	0.00410	0.00057	0.00000	0.07124
SW	0.00692	0.03344	0.02653	0.00635	0.00134	0.00000	0.07457
WSW	0.00652	0.03307	0.03248	0.01065	0.00151	0.00000	0.08422
WSW	0.00595	0.02818	0.03515	0.01528	0.00581	0.00003	0.09039
WNW	0.00535	0.01955	0.02103	0.00968	0.00501	0.00014	0.06077
NW	0.00470	0.01736	0.01380	0.00370	0.00083	0.00003	0.04042
NNW	0.00404	0.01201	0.00925	0.00097	0.00020	0.00006	0.02653
Total	0.09458	0.42752	0.38033	0.07460	0.02271	0.00026	1.00000

**Table A.7 - Joint Occurrence Frequencies of Wind Direction Sector
by Wind Speed Category for the L Area Tower, 2004**

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.00589	0.01452	0.01047	0.00103	0.00000	0.00000	0.03191
NNE	0.00379	0.01676	0.02345	0.00310	0.00009	0.00000	0.04719
NE	0.00945	0.02846	0.05399	0.01398	0.00174	0.00000	0.10762
ENE	0.00470	0.02684	0.03612	0.00692	0.00111	0.00000	0.07568
E	0.00524	0.02237	0.01580	0.00157	0.00054	0.00000	0.04551
ESE	0.00581	0.02069	0.01324	0.00165	0.00063	0.00000	0.04201
SE	0.00595	0.02240	0.01659	0.00122	0.00117	0.00000	0.04733
SSE	0.00584	0.03054	0.02038	0.00165	0.00114	0.00000	0.05954
S	0.00894	0.04363	0.02234	0.00336	0.00091	0.00000	0.07918
SSW	0.00902	0.05046	0.02607	0.00712	0.00179	0.00003	0.09450
SW	0.00697	0.03931	0.02519	0.00751	0.00290	0.00003	0.08191
WSW	0.00638	0.03578	0.03495	0.01090	0.00256	0.00000	0.09057
WSW	0.00623	0.03447	0.03208	0.01139	0.00265	0.00000	0.08681
WNW	0.00487	0.01867	0.02072	0.00717	0.00228	0.00000	0.05371
NW	0.00381	0.01358	0.01150	0.00219	0.00029	0.00003	0.03140
NNW	0.00427	0.01358	0.00677	0.00048	0.00003	0.00000	0.02513
Total	0.09714	0.43206	0.36967	0.08123	0.01981	0.00008	1.00000

**Table A.8 - Joint Occurrence Frequencies of Wind Direction Sector
by Wind Speed Category for the P Area Tower, 2004**

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.00427	0.01105	0.01196	0.00131	0.00003	0.00000	0.02861
NNE	0.00575	0.01654	0.02252	0.00319	0.00026	0.00000	0.04825
NE	0.01099	0.03194	0.04823	0.01070	0.00137	0.00000	0.10323
ENE	0.00646	0.04578	0.02366	0.00316	0.00020	0.00000	0.07926
E	0.00575	0.02184	0.01480	0.00191	0.00048	0.00000	0.04478
ESE	0.00606	0.02243	0.01164	0.00131	0.00068	0.00000	0.04213
SE	0.00643	0.02186	0.01674	0.00216	0.00137	0.00000	0.04857
SSE	0.00658	0.02403	0.02189	0.00188	0.00114	0.00000	0.05551
S	0.00752	0.03180	0.03803	0.00495	0.00137	0.00000	0.08367
SSW	0.00686	0.03083	0.03567	0.00478	0.00085	0.00000	0.07900
SW	0.00575	0.03587	0.03550	0.00626	0.00157	0.00000	0.08495
WSW	0.00564	0.03280	0.04136	0.01176	0.00142	0.00000	0.09298
WSW	0.00487	0.02582	0.04108	0.01569	0.00458	0.00003	0.09207
WNW	0.00376	0.01742	0.02337	0.00974	0.00473	0.00003	0.05904
NW	0.00327	0.01059	0.01423	0.00404	0.00097	0.00006	0.03317
NNW	0.00293	0.01019	0.01033	0.00117	0.00011	0.00006	0.02480
Total	0.09289	0.39078	0.41102	0.08401	0.02112	0.00017	1.00000

**Table A.9 - Joint Occurrence Frequencies of Wind Direction Sector
by Wind Speed Category for the 4m Level Central Climatology Tower, 2004**

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.02201	0.00771	0.00011	0.00000	0.00000	0.00000	0.02983
NNE	0.03795	0.02218	0.00048	0.00000	0.00000	0.00000	0.06061
NE	0.05013	0.03322	0.00171	0.00000	0.00000	0.00000	0.08506
ENE	0.02955	0.02280	0.00179	0.00000	0.00000	0.00000	0.05414
E	0.03846	0.01922	0.00174	0.00006	0.00000	0.00000	0.05947
ESE	0.07393	0.01924	0.00208	0.00014	0.00000	0.00000	0.09539
SE	0.06701	0.01460	0.00122	0.00000	0.00000	0.00000	0.08284
SSE	0.05634	0.02124	0.00108	0.00000	0.00000	0.00000	0.07865
S	0.04606	0.01819	0.00077	0.00003	0.00000	0.00000	0.06505
SSW	0.03359	0.01654	0.00071	0.00000	0.00000	0.00000	0.05084
SW	0.03117	0.01802	0.00122	0.00000	0.00000	0.00000	0.05041
WSW	0.03812	0.02943	0.00330	0.00000	0.00000	0.00000	0.07085
WSW	0.03760	0.04577	0.01190	0.00040	0.00000	0.00000	0.09568
WNW	0.01358	0.02716	0.01443	0.00279	0.00003	0.00000	0.05799
NW	0.01329	0.01398	0.00532	0.00077	0.00000	0.00000	0.03336
NNW	0.01859	0.01031	0.00080	0.00009	0.00006	0.00000	0.02983
Total	0.60736	0.33960	0.04868	0.00427	0.00009	0.00000	1.00000

**Table A.10 - Joint Occurrence Frequencies of Wind Direction Sector
by Wind Speed Category for the 18m Level Central Climatology Tower, 2004**

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.02477	0.01079	0.00051	0.00003	0.00000	0.00000	0.03610
NNE	0.02850	0.02946	0.00296	0.00003	0.00000	0.00000	0.06095
NE	0.02702	0.04623	0.00982	0.00048	0.00000	0.00000	0.08355
ENE	0.02408	0.03524	0.01005	0.00125	0.00006	0.00000	0.07068
E	0.02878	0.02471	0.00501	0.00091	0.00009	0.00000	0.05950
ESE	0.02841	0.02776	0.00353	0.00057	0.00009	0.00000	0.06035
SE	0.02758	0.02491	0.00222	0.00043	0.00000	0.00000	0.05514
SSE	0.02872	0.03373	0.00296	0.00031	0.00000	0.00000	0.06573
S	0.03704	0.02892	0.00288	0.00009	0.00000	0.00000	0.06892
SSW	0.03157	0.02497	0.00367	0.00017	0.00000	0.00000	0.06038
SW	0.02781	0.02844	0.00666	0.00068	0.00000	0.00000	0.06359
WSW	0.02158	0.04868	0.01418	0.00262	0.00023	0.00000	0.08728
WSW	0.01623	0.04626	0.02155	0.00942	0.00140	0.00000	0.09485
WNW	0.01287	0.02320	0.01264	0.00834	0.00162	0.00000	0.05867
NW	0.01907	0.01366	0.00484	0.00134	0.00006	0.00000	0.03897
NNW	0.02175	0.01204	0.00142	0.00006	0.00009	0.00000	0.03535
Total	0.40576	0.45900	0.10490	0.02673	0.00362	0.00000	1.00000

**Table A.11 - Joint Occurrence Frequencies of Wind Direction Sector
by Wind Speed Category for the 36m Level Central Climatology Tower, 2004**

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.00951	0.02351	0.00473	0.00011	0.00003	0.00000	0.03789
NNE	0.01443	0.03476	0.01142	0.00083	0.00006	0.00000	0.06149
NE	0.01207	0.04771	0.02161	0.00376	0.00014	0.00000	0.08529
ENE	0.01050	0.03746	0.01768	0.00310	0.00031	0.00000	0.06906
E	0.01093	0.03240	0.00777	0.00111	0.00029	0.00000	0.05249
ESE	0.01119	0.03305	0.00567	0.00046	0.00043	0.00000	0.05078
SE	0.01273	0.03234	0.00376	0.00060	0.00003	0.00000	0.04945
SSE	0.01156	0.04990	0.00703	0.00105	0.00000	0.00000	0.06954
S	0.01332	0.05158	0.00669	0.00083	0.00006	0.00000	0.07248
SSW	0.01304	0.04321	0.00823	0.00103	0.00006	0.00000	0.06556
SW	0.01241	0.04543	0.01250	0.00299	0.00026	0.00000	0.07359
WSW	0.01082	0.05218	0.02445	0.00709	0.00137	0.00000	0.09590
WSW	0.00999	0.04373	0.02719	0.01230	0.00347	0.00000	0.09667
WNW	0.00865	0.02403	0.01378	0.00800	0.00316	0.00000	0.05762
NW	0.01122	0.01813	0.00535	0.00177	0.00020	0.00000	0.03667
NNW	0.00900	0.01378	0.00256	0.00011	0.00006	0.00003	0.02553
Total	0.18136	0.58320	0.18039	0.04512	0.00991	0.00003	1.00000

**Table A.12 - Joint Occurrence Frequencies of Wind Direction Sector
by Wind Speed Category for the 61m Level Central Climatology Tower, 2004**

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.00501	0.01389	0.01298	0.00117	0.00003	0.00003	0.03311
NNE	0.00595	0.01637	0.02494	0.00493	0.00023	0.00000	0.05241
NE	0.00957	0.02605	0.04057	0.01093	0.00219	0.00000	0.08930
ENE	0.01016	0.02189	0.02832	0.00606	0.00140	0.00000	0.06784
E	0.00475	0.02015	0.01978	0.00265	0.00122	0.00000	0.04856
ESE	0.00567	0.02021	0.01645	0.00253	0.00085	0.00000	0.04572
SE	0.00712	0.02149	0.01688	0.00162	0.00111	0.00000	0.04822
SSE	0.00900	0.02434	0.03060	0.00216	0.00091	0.00000	0.06701
S	0.00808	0.02986	0.03322	0.00319	0.00066	0.00000	0.07501
SSW	0.00700	0.02929	0.02915	0.00384	0.00043	0.00000	0.06972
SW	0.00874	0.03251	0.02761	0.00646	0.00171	0.00000	0.07703
WSW	0.00763	0.03581	0.03869	0.01495	0.00273	0.00000	0.09980
WSW	0.00530	0.03171	0.04000	0.01924	0.00601	0.00000	0.10225
WNW	0.00578	0.01734	0.02115	0.00925	0.00535	0.00000	0.05887
NW	0.00666	0.01762	0.01019	0.00299	0.00040	0.00000	0.03786
NNW	0.00524	0.01560	0.00595	0.00043	0.00006	0.00003	0.02730
Total	0.11165	0.37414	0.39648	0.09240	0.02528	0.00006	1.00000

Table A.13 - Joint Occurrence Frequencies of Wind Direction Sector by Wind Speed Category for the 61m Level Central Climatology Tower, Winter 2004

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.00870	0.02530	0.02003	0.00458	0.00000	0.00000	0.05861
NNE	0.00584	0.01866	0.02896	0.00870	0.00023	0.00000	0.06239
NE	0.02141	0.01832	0.04052	0.00859	0.00240	0.00000	0.09123
ENE	0.00412	0.01900	0.04682	0.01568	0.00229	0.00000	0.08791
E	0.00675	0.01923	0.02621	0.00595	0.00011	0.00000	0.05826
ESE	0.00469	0.01362	0.01877	0.00263	0.00000	0.00000	0.03972
SE	0.00343	0.01202	0.01282	0.00069	0.00000	0.00000	0.02896
SSE	0.00595	0.00996	0.01156	0.00080	0.00000	0.00000	0.02827
S	0.00412	0.01202	0.01568	0.00687	0.00069	0.00000	0.03938
SSW	0.00424	0.01007	0.02175	0.00401	0.00000	0.00000	0.04006
SW	0.00572	0.01305	0.01969	0.00904	0.00103	0.00000	0.04853
WSW	0.00538	0.02198	0.03423	0.02083	0.00229	0.00000	0.08471
WSW	0.00424	0.02679	0.05666	0.04567	0.01351	0.00000	0.14686
WNW	0.00641	0.01614	0.03743	0.01969	0.01053	0.00000	0.09020
NW	0.00778	0.02324	0.01545	0.00195	0.00023	0.00000	0.04865
NNW	0.00790	0.02839	0.00962	0.00034	0.00000	0.00000	0.04624
Total	0.10668	0.28777	0.41621	0.15602	0.03331	0.00000	1.00000

Table A.14 - Joint Occurrence Frequencies of Wind Direction Sector by Wind Speed Category for the 61m Level Central Climatology Tower, Spring 2004

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.00170	0.00951	0.01381	0.00136	0.00011	0.00000	0.02649
NNE	0.00091	0.00566	0.00668	0.00215	0.00000	0.00000	0.01540
NE	0.00170	0.00385	0.00589	0.00249	0.00000	0.00000	0.01393
ENE	0.00181	0.00623	0.01019	0.00374	0.00000	0.00000	0.02197
E	0.00260	0.01189	0.01902	0.00204	0.00000	0.00000	0.03555
ESE	0.00589	0.01868	0.02785	0.00351	0.00011	0.00000	0.05605
SE	0.00940	0.03363	0.03329	0.00079	0.00000	0.00000	0.07711
SSE	0.01234	0.04065	0.06850	0.00147	0.00000	0.00000	0.12296
S	0.00544	0.03702	0.06454	0.00510	0.00023	0.00000	0.11232
SSW	0.00487	0.03080	0.04857	0.00544	0.00023	0.00000	0.08990
SW	0.00566	0.03295	0.04337	0.00827	0.00226	0.00000	0.09250
WSW	0.00600	0.03306	0.04461	0.01823	0.00555	0.00000	0.10745
WSW	0.00317	0.02321	0.04291	0.02231	0.00781	0.00000	0.09941
WNW	0.00283	0.01404	0.02706	0.01574	0.00883	0.00000	0.06850
NW	0.00351	0.01449	0.01336	0.00770	0.00136	0.00000	0.04042
NNW	0.00249	0.01042	0.00611	0.00068	0.00023	0.00011	0.02004
Total	0.07031	0.32609	0.47577	0.10100	0.02672	0.00011	1.00000

Table A.15 - Joint Occurrence Frequencies of Wind Direction Sector by Wind Speed Category for the 61m Level Central Climatology Tower, Summer 2004

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.00567	0.01688	0.01179	0.00045	0.00000	0.00011	0.03490
NNE	0.00510	0.01994	0.02085	0.00215	0.00023	0.00000	0.04827
NE	0.00635	0.03581	0.02289	0.00193	0.00057	0.00000	0.06754
ENE	0.00544	0.02697	0.01926	0.00079	0.00000	0.00000	0.05246
E	0.00521	0.02720	0.01292	0.00136	0.00023	0.00000	0.04691
ESE	0.00646	0.03003	0.01439	0.00283	0.00023	0.00000	0.05394
SE	0.00748	0.02935	0.01462	0.00170	0.00011	0.00000	0.05326
SSE	0.00895	0.02901	0.02006	0.00079	0.00011	0.00000	0.05892
S	0.00975	0.04249	0.02198	0.00057	0.00000	0.00000	0.07479
SSW	0.00759	0.05099	0.02198	0.00079	0.00011	0.00000	0.08147
SW	0.01065	0.05926	0.02776	0.00045	0.00034	0.00000	0.09847
WSW	0.00963	0.06255	0.03626	0.00397	0.00000	0.00000	0.11241
WSW	0.00907	0.05371	0.03773	0.00771	0.00034	0.00000	0.10856
WNW	0.00827	0.02448	0.01564	0.00181	0.00045	0.00000	0.05065
NW	0.00929	0.01575	0.00465	0.00057	0.00011	0.00000	0.03037
NNW	0.00669	0.01439	0.00544	0.00057	0.00000	0.00000	0.02708
Total	0.12159	0.53881	0.30822	0.02844	0.00283	0.00011	1.00000

Table A.16 - Joint Occurrence Frequencies of Wind Direction Sector by Wind Speed Category for the 61m Level Central Climatology Tower, Fall 2004

Sector	Wind Speed Category, meters/sec						Total
	0-2	2-4	4-6	6-8	8-12	>12	
N	0.00527	0.01179	0.00561	0.00023	0.00000	0.00000	0.02289
NNE	0.00618	0.02026	0.03846	0.00790	0.00046	0.00000	0.07326
NE	0.00996	0.04842	0.10096	0.03205	0.00584	0.00000	0.19723
ENE	0.03033	0.03800	0.04865	0.00893	0.00332	0.00000	0.12924
E	0.00618	0.02232	0.02209	0.00206	0.00458	0.00000	0.05723
ESE	0.00584	0.01889	0.00756	0.00263	0.00309	0.00000	0.03800
SE	0.00687	0.01271	0.00778	0.00321	0.00435	0.00000	0.03491
SSE	0.00813	0.01500	0.02232	0.00321	0.00355	0.00000	0.05220
S	0.01202	0.02839	0.02324	0.00137	0.00195	0.00000	0.06696
SSW	0.01088	0.02198	0.01671	0.00092	0.00126	0.00000	0.05174
SW	0.01225	0.02358	0.01419	0.00446	0.00240	0.00000	0.05689
WSW	0.01122	0.02518	0.02598	0.01328	0.00218	0.00000	0.07784
WSW	0.00515	0.02370	0.01877	0.00710	0.00538	0.00000	0.06010
WNW	0.00653	0.01179	0.01248	0.00160	0.00103	0.00000	0.03343
NW	0.00813	0.01316	0.00343	0.00046	0.00000	0.00000	0.02518
NNW	0.00572	0.01362	0.00343	0.00011	0.00000	0.00000	0.02289
Total	0.15064	0.34879	0.37168	0.08951	0.03938	0.00000	1.00000