



Big South Fork National River and Recreation Area Annual Climate Summary for 2007

Natural Resource Data Series NPS/APHN/NRDS—2010/040



On the Cover

RAWS Weather Station at Big South Fork Headquarters
Photograph by Jim Hughes

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Glossary

Climatological Normal - The prevailing set of weather conditions calculated over a 30-year period, presently 1971-2000. Note that the climatological normal taken over different periods of time (30 years, 1000 years) may be different (NOAA 2008).

COOP- Citizen Operated Weather Station

RAWS- Remote Automated Weather Station

Abstract

The climate in BISO for 2007 reflected both local scale climatological disturbances, and the larger synoptic climatic signal experienced by the southeastern United States. Above average temperatures occurred in 8 out of 12 months, however the well-below average precipitation was the bigger concern for resource managers, park staff, and park visitors.

The average annual temperature for 2007 for the Big South Fork RAWS Station was 1.1 °F warmer (56.8 °F) than the 6-year average for the life of the station (55.7 °F), with the summer months exhibiting temperatures well above average. The same pattern held true for the Allardt and Stearns 2S stations, with the mean annual temperature exceeding the 30-year “Climatological Normal” (see Glossary) for 1971-2000, by 2.6 and 1.4 °F, respectively.

Precipitation was well below average and the year was marked by extended periods without rain. River resources were notably impacted by low precipitation with 2007 flow measurements at Leatherwood Ford (24 year period) recording the lowest average monthly flow for June and second lowest for August and September (USGS NWIS 2008). Average precipitation was alarmingly low for Big South at 35.77, with 54.53 being average for the previous 6 years (-18.8 inches, 65.6% of average). The 2007 average annual precipitation at Stearns 2S and Allardt was also low, at 41.7 and 46.9 in., departing from the previous 6-year averages by -7.6 in., and -9.5 in. An unusually high rainfall amount of 3.5 inches occurred on July 24 at the Stearns 2S station that most likely affected the northern part of the park.

Wind, measured only at Big South RAWS, was primarily out of the southwest, with an average velocity of 3.95 km/hr (2.74 mph) compared with the 6 year average of 4.46 km/hr (2.79 mph). A comparison of current and historical wind data revealed little significant difference between 2007 and the 6-year period of record for the station.

Introduction

Big South Fork National River and Recreation Area (BISO) is located in the northern Cumberland Plateau, on the Tennessee-Kentucky border, approximately 50 miles NW of Knoxville, TN (Figure 1). BISO is a temperate eastern park, and the climate is characterized by relatively high annual precipitation, high summer average humidity, and periodic flooding of the river from large rain events (Emmott et al. 2005).

Methods

For this report, three representative stations in the immediate vicinity of the park were selected for data analysis. These stations are geographically well distributed, and have individual characteristics which make them desirable for reporting purposes. The stations are: Big South Remote Automated Weather Station (RAWS), located at park headquarters, Stearns 2S (1.8 miles NE of the park) and Allardt (4.5 miles SW of the park) (Figure 1). Though the Big South RAWS station has the disadvantage of having a relatively short period of record (it began collecting data on 10/1/2000), this station will likely be maintained over the long-term because of its utility for fire weather monitoring in the park. Stearns 2s and Allardt are both National Weather Service Cooperative Weather Monitoring (COOP) sites with long periods of record, making them ideal for long-term comparisons. Allardt began collecting data on 1/1/1928; Stearns on 8/1/1948.

Results

Data Completeness, Quality and Record for Reporting

Monthly averages for the COOP stations are represented by the Climatological Normal (30 year history, 1971-2000), however the Big South station averages come from the complete yearly record of 2001-2006.

For 2007, data completeness and quality was good, with all stations reporting more than 95% of all potential measurements. A summary of data completeness is provided in Table 1. However, there is reason to believe precipitation readings at the Big South RAWS station may not be accurate. There is much evidence that there was a sensor problem after recent maintenance in September 2007; the Big South station readings for the months following September, had much lower readings than Allardt and Stearns COOP stations. BISO staff also noticed possible problems with the precipitation sensor. Therefore, Big South RAWS precipitation data should be used with caution. Local variations do occur and we cannot rule out the possibility that the data is representing a real microclimate precipitation deficiency.

Table 1. BISO data completeness (percentages) for 2007. For complete station metadata and descriptions of the weather monitoring equipment, see Davey et al., 2007.

Station	Temperature	Precipitation	Wind	Humidity	Solar Radiation
Allardt (COOP)	100	100	NA	NA	100
Stearns 2S (COOP)	95	95	NA	NA	NA
Big South (RAWS)	100	100	100	100	100

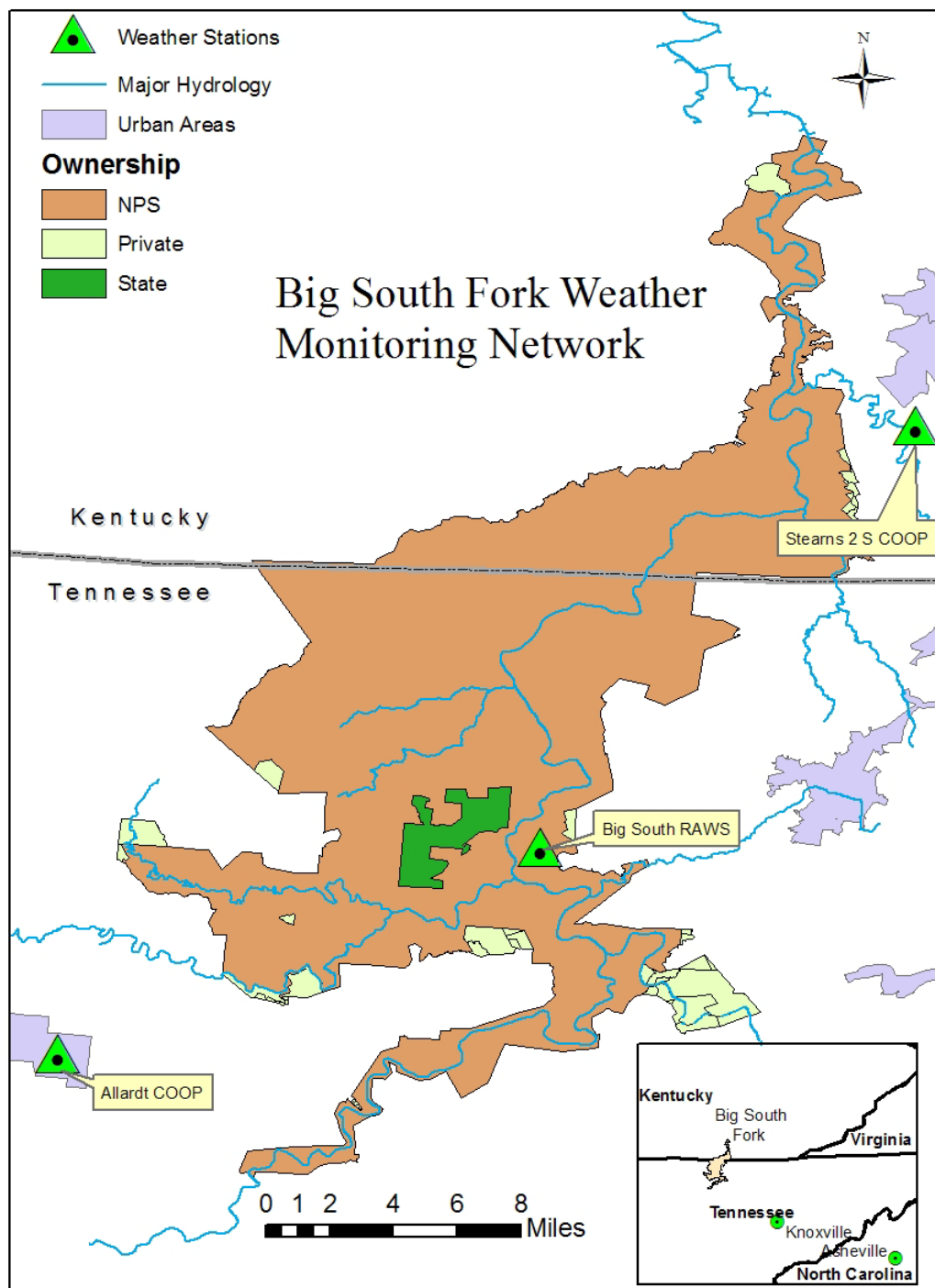


Figure 1. Map of Big South Fork National River and Recreation Area weather monitoring stations.

Temperature

Data records for temperature have been collected for some stations on the Cumberland Plateau for almost 90 years; Stearns COOP station since 1928. Nationally, temperature records indicate a fluctuating temperature cycle that has shown steady increases since 1976 (NOAA 2008). In 2007, data from Stearns and Allardt showed average monthly temperatures 5 degrees F above average for March, August, and October; the data record for the Big South station showed similar trends, with March 7.2 degrees above the 6 year average temperature for that month. All reporting stations showed February as the only month with a significantly below average monthly temperature: -4.7, -5.5, and -7.7 (Allardt, Big South, and Stearns, respectively).

These increased temperatures were consistent with NOAA reports showing that the 2007 average temperature for the contiguous United States in March was more than 5 degrees F warmer than average, making it the second warmest March on record. March was 5.6 degrees F (3.1 degrees C) warmer than the 20th century mean of 42.5 degrees F (5.8 degrees C) (NOAA 2008). Besides March, August and October, temperatures for the rest of the year were close to long term averages except for a notable above average December: +5.8, +4.6, +3.6 degrees F (Allardt, Big South, and Stearns, respectively).

Table 2. 2007 monthly temperature summaries for Allardt (COOP) (degrees F).

Month	Mean Max.	Mean Min.	Mean	Departure from Normal 1971-2000	Highest	High Date	Lowest	Low Date
Jan	48.1	30.9	39.5	5.0	66	14	5	29
Feb	43.6	23.9	33.8	-4.7	66	28	10	16
Mar	66	43.2	54.6	8.1	84	25	22	18
Apr	64.7	42	53.4	-1.4	83	30	17	8
May	78.5	52.2	65.4	2.9	85	1	34	19
Jun	82.1	59.4	70.8	1	87	17	51	22
Jul	80.9	63.2	72.1	-1.4	87	9	53	22
Aug	89.4	67.1	78.3	6.1	96	16	61	18
Sep	81.5	57.9	69.7	3.4	91	5	44	30
Oct	72.2	50.1	61.2	5.4	86	8	30	30
Nov	58.6	35.4	47	0.6	71	21	23	24
Dec	53.4	34.3	43.9	5.8	75	11	18	17
Annual	68.2	46.6	57.5	2.6	96	Aug	5	Jan

Table 3. 2007 monthly temperature summaries for Stearns 2S (degrees F).

Month	Mean Max.	Mean Min.	Mean	Departure from Normal 1971-2000	Highest	High Date	Lowest	Low Date
Jan	47.7	27.1	37.4	3.8	70	6	6	30
Feb	40.7	17.3	29	-7.7	67	22	6	12
Mar	66.2	35.4	50.8	5.1	85	26	19	19
Apr	65.2	36.2	50.7	-2.9	83	4	15	8
May	81.4	48.9	65.2	3.4	89	31	31	20
Jun	85.5	55.8	70.7	0.7	91	18	48	22
Jul	84.6	60.5	72.6	-1.4	97	9	48	23
Aug	91.2	65.5	78.4	5.7	98	25	58	13
Sep	83.9	55.3	69.6	3.5	91	25	40	17
Oct	73.9	45.6	59.8	5.1	88	9	27	31
Nov	58	29.9	44	-1.7	73	22	19	30
Dec	52.5	28.3	40.4	3.6	75	12	17	1
Annual	69.2	42.2	55.7	1.4	98	Aug	6	Feb

Table 4. 2007 monthly temperature summaries for Big South (RAWS) (degrees F).

Month	Average	Departure from 6 yr. Average	Max.	Min.
Jan	38.39	2.1	68	6
Feb	33.04	-5.45	67	9
Mar	54.02	7.24	87	21
Apr	52.9	-3.82	88	16
May	66	2.84	90	33
Jun	70.91	3.01	93	49
Jul	72.41	-1.23	92	52
Aug	77.72	4.63	99	61
Sep	68.88	3.17	93	41
Oct	60.06	2.1	90	28
Nov	44.5	-3.59	73	20
Dec	42.67	4.55	76	17

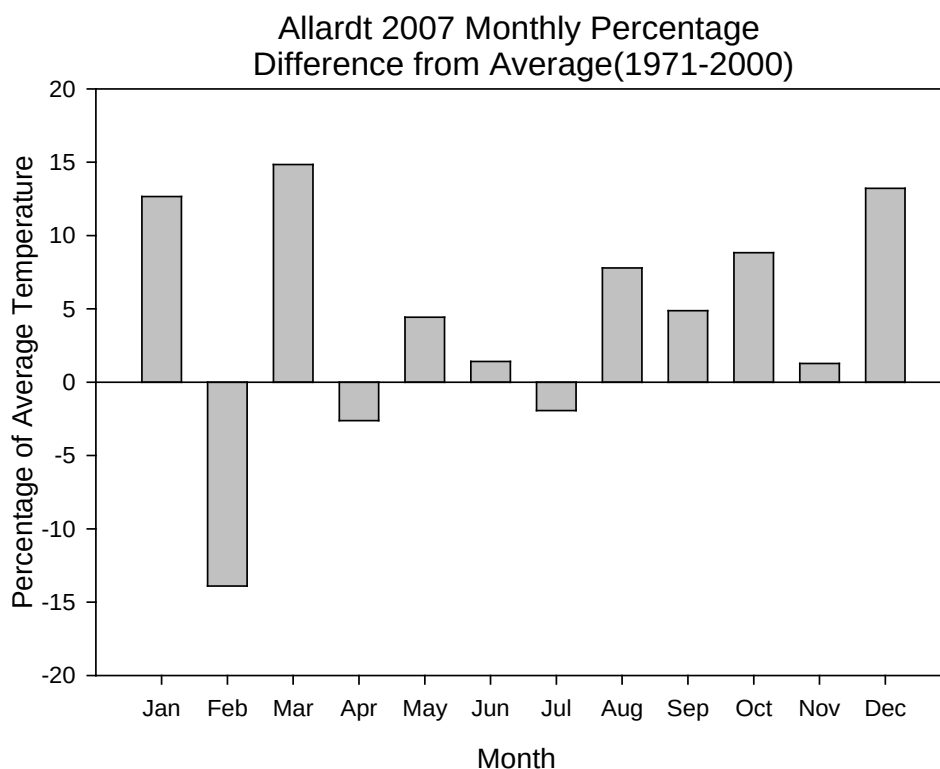
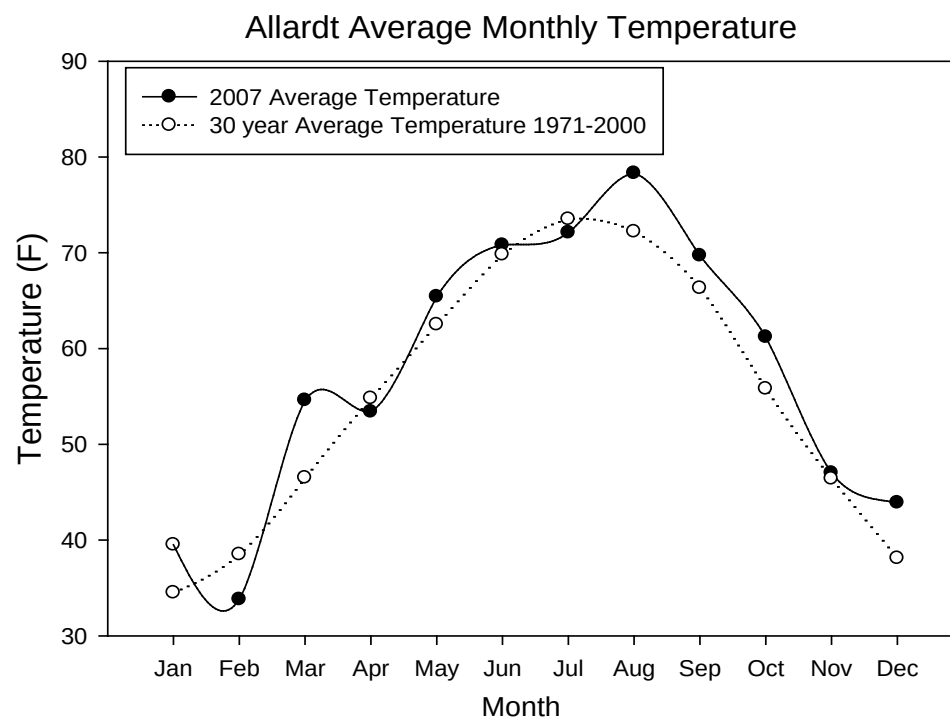


Figure 2. Comparison of 2007 average monthly temperatures with monthly averages for the Climatological Normal (1971-2000) for Allardt: a) absolute differences and b) percentage differences.

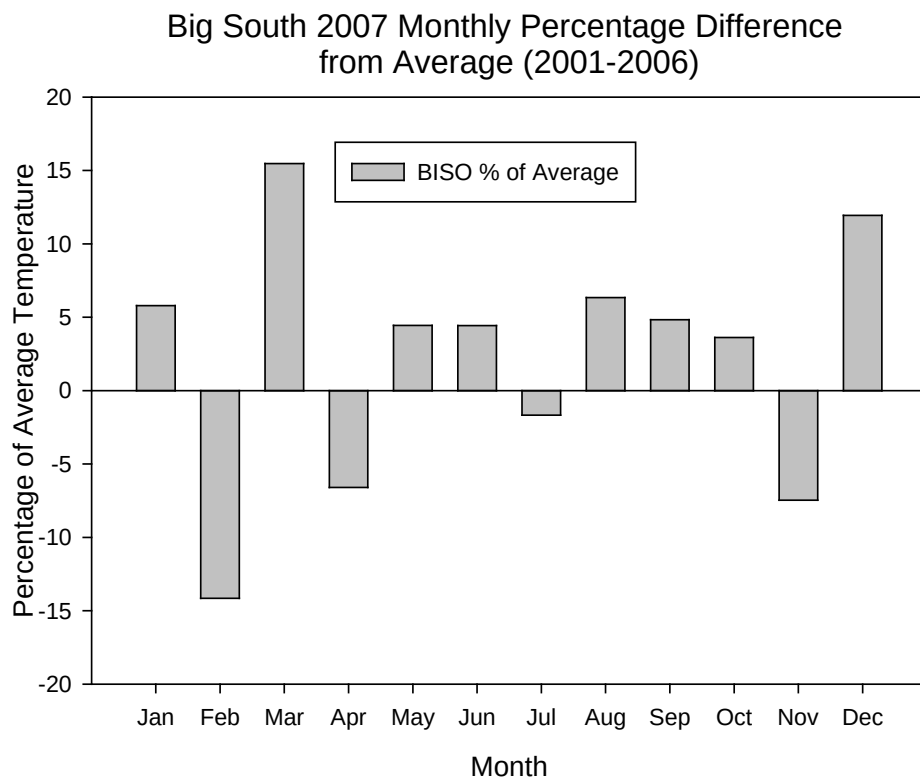
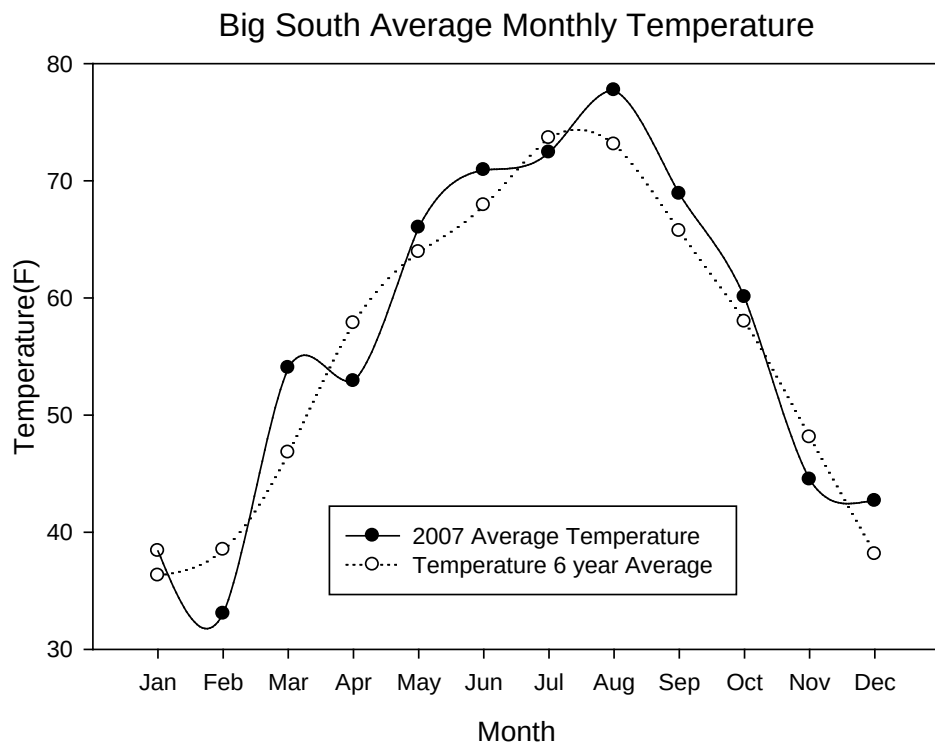


Figure 3. Comparison of 2007 average monthly temperatures with monthly averages for the period of record (2001-2006) for Big South RAWS: a) absolute differences and b) percentage differences.

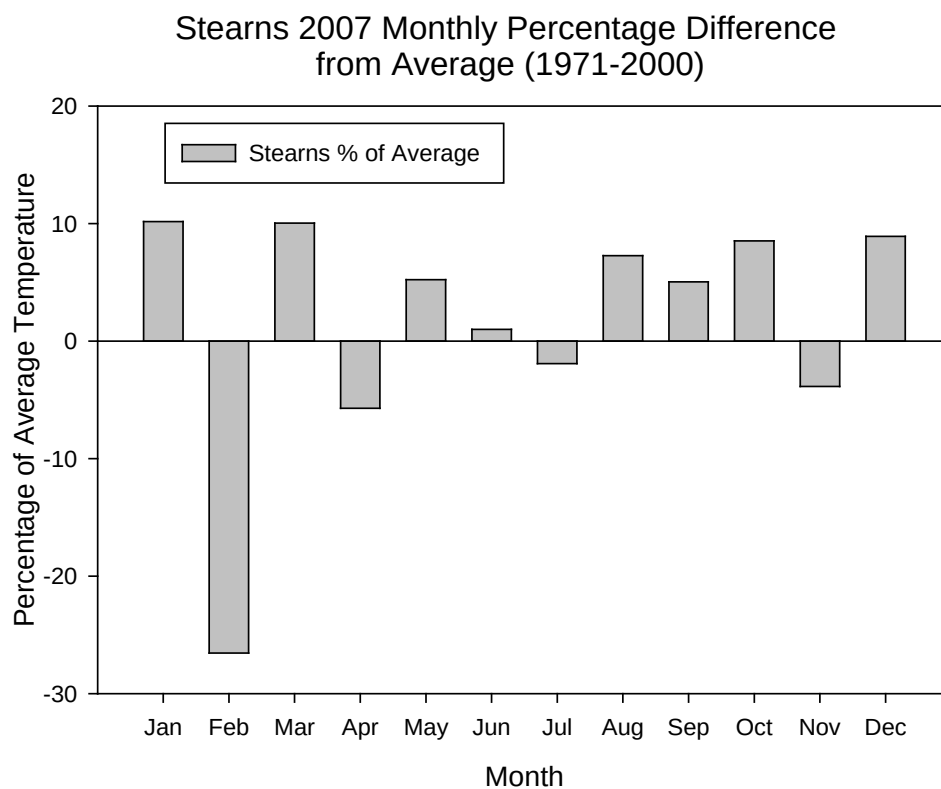
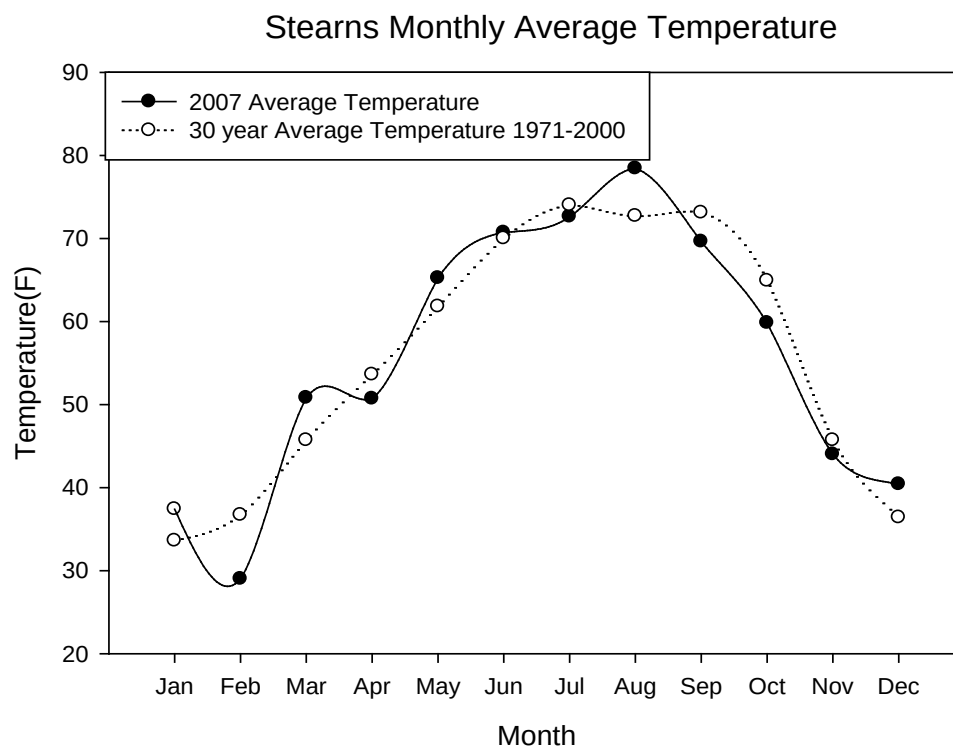


Figure 4. Comparison of 2007 average monthly temperatures with monthly averages for the Climatological Normal (1971-2000) for Stearns 2S: a) absolute differences and b) percentage differences.

Precipitation

Data around Big South Fork NRRRA was spatially variable, though all stations recorded well below-average precipitation. Precipitation data has been collected at Allardt since 1/1/1928, Big South since 10/1/2000, and Stearns 2s COOP Station since 7/1/1948. The 2007 records show annual precipitation (as rainfall) was quite low with the annual totals being (47, 36 and 42 inches) (Table 3) for Allardt, Big South and Stearns 2s, respectively. July was the only relatively wet month with the Stearns climate station recording 4.5 inches more than normal for the month (Table 3; Figures 10 and 11). Spring precipitation was uncharacteristically low, with May having -2.25 to -3.85 inches from normal monthly precipitation. August and September showed 2 to 4 inch deficits from normal as well. This was the second driest summer for Tennessee since records began in 1895, and the driest for the period for January-October (NCDC 2008).

Table 5. Average monthly precipitation (inches) at Allardt COOP (30 years, 1971-2000), Big South (2001-2006, 6 year record), Stearns (30 years, 1971-2000) (all values in inches).

Month	Allardt 2007	Difference from Average	Big South 2007	Difference from Average	Stearns 2007	Difference from Average
January	3.77	-1.14	3.34	-1.32	3.94	-0.36
February	2.45	-1.63	1.93	-2.89	1.26	-2.64
March	3.5	-1.96	3.44	-1.01	3.6	-1.07
April	4.81	0.69	4.72	-1.47	4.17	0.52
May	2.1	-3.54	1.27	-3.45	3.1	-2.25
June	8.62	3.44	4.02	-0.21	2.34	-2.21
July	4.55	-0.59	5.95	0.26	8.82	4.48
August	2.13	-2.53	1.22	-2.36	1.88	-1.83
September	2.61	-1.1	1.43	-3.85	0.91	-3.02
October	3.83	0.62	3.22	0.18	3.96	0.68
November	4.97	0.31	2.79	-1.79	3.96	-0.37
December	3.57	-1.38	2.44	-2.14	3.8	-1.16
Totals	46.91	-8.81	35.77	-17.91	41.74	-9.23

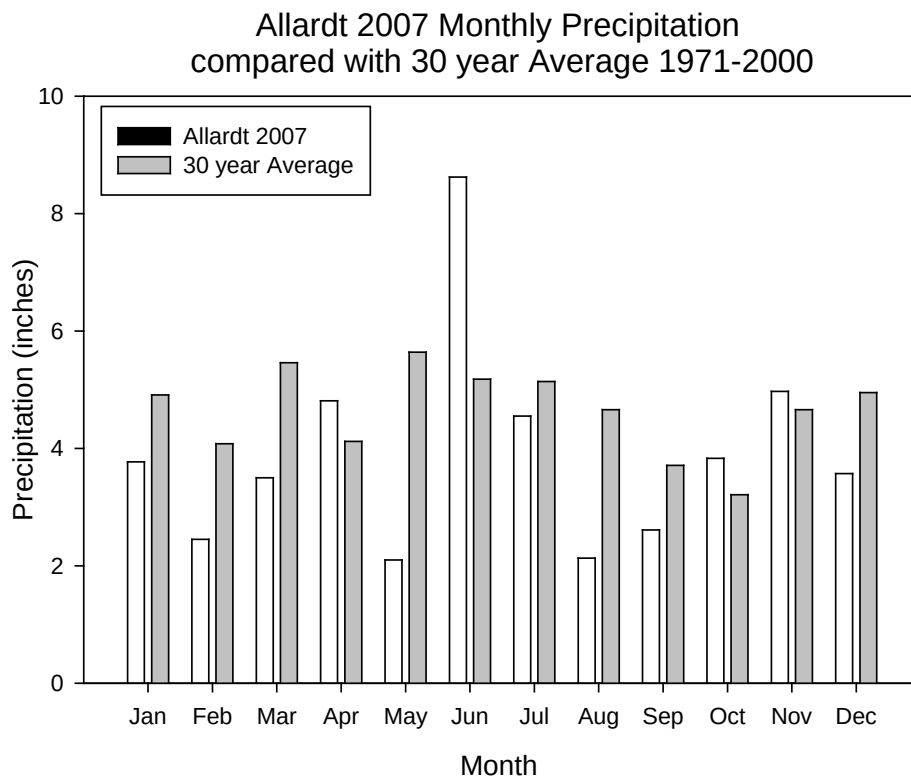
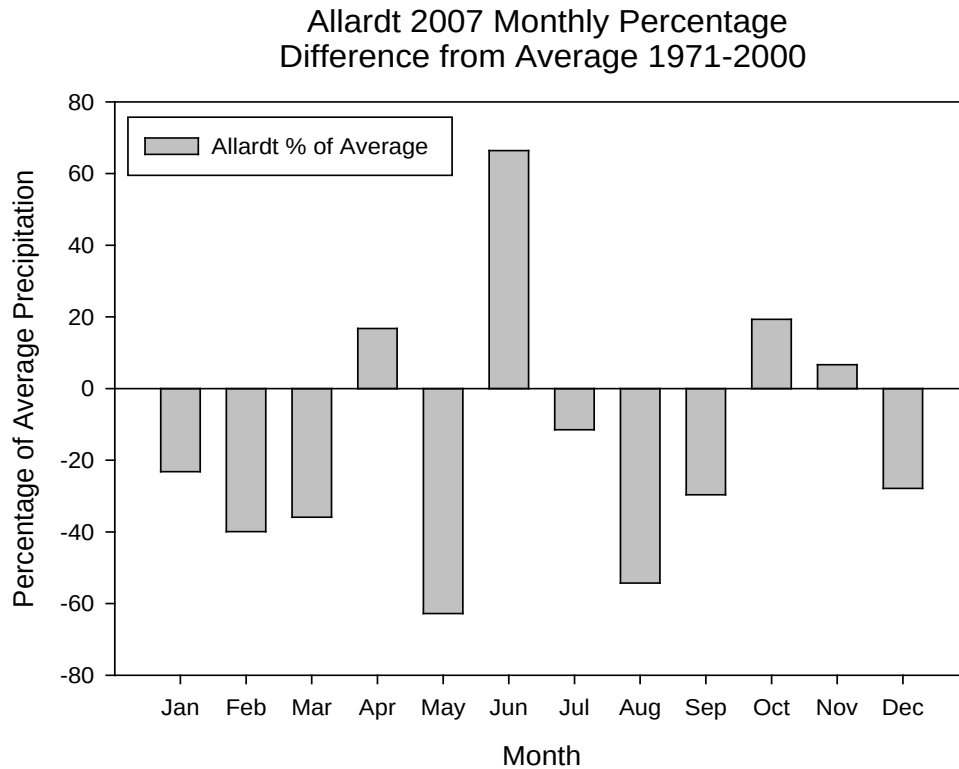


Figure 5. Comparison of 2007 average monthly precipitation with monthly averages for the Climatological Normal (1971-2000) for Allardt: a) percentage differences and b) absolute differences.

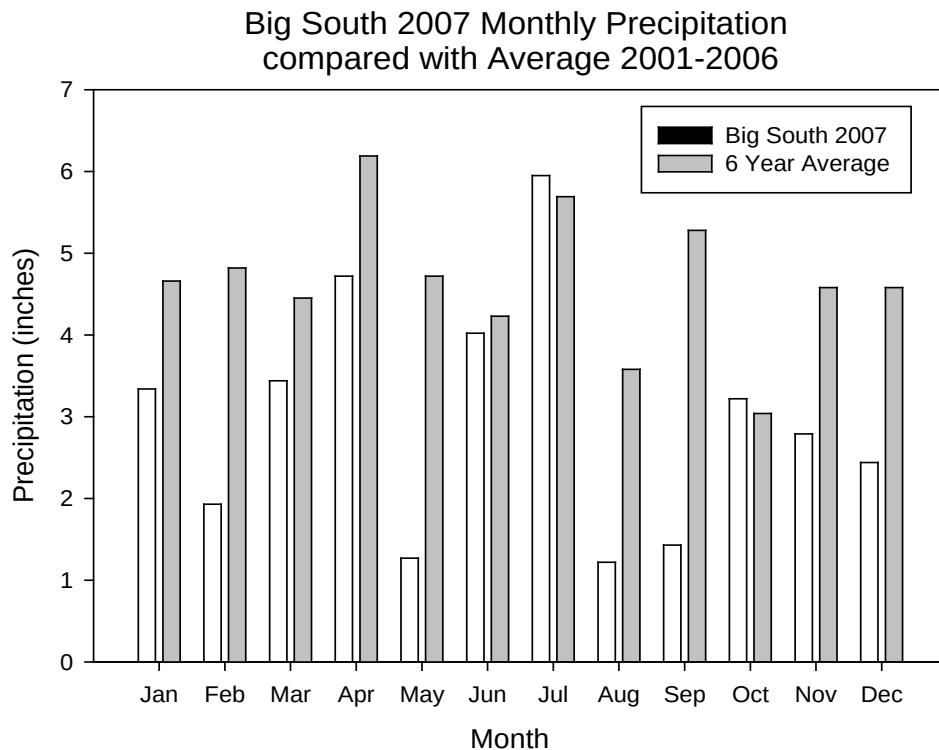
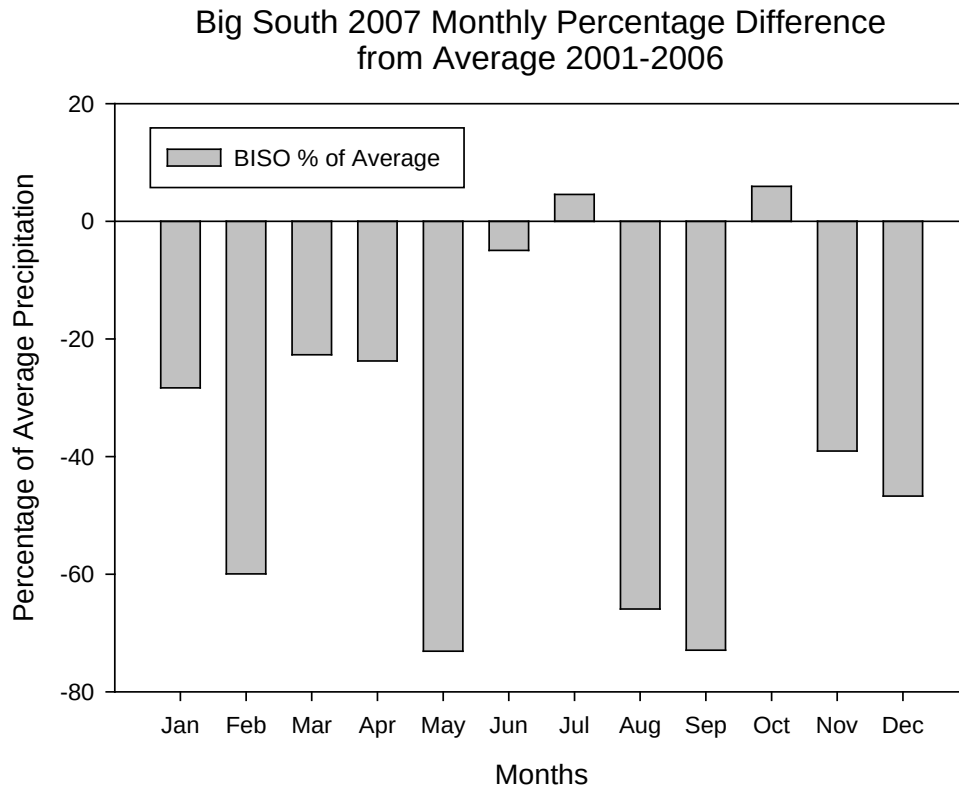


Figure 6. Comparison of 2007 average monthly precipitation with monthly averages for the period of record (2001-2006) for Big South RAWS: a) percentage differences and b) absolute differences.

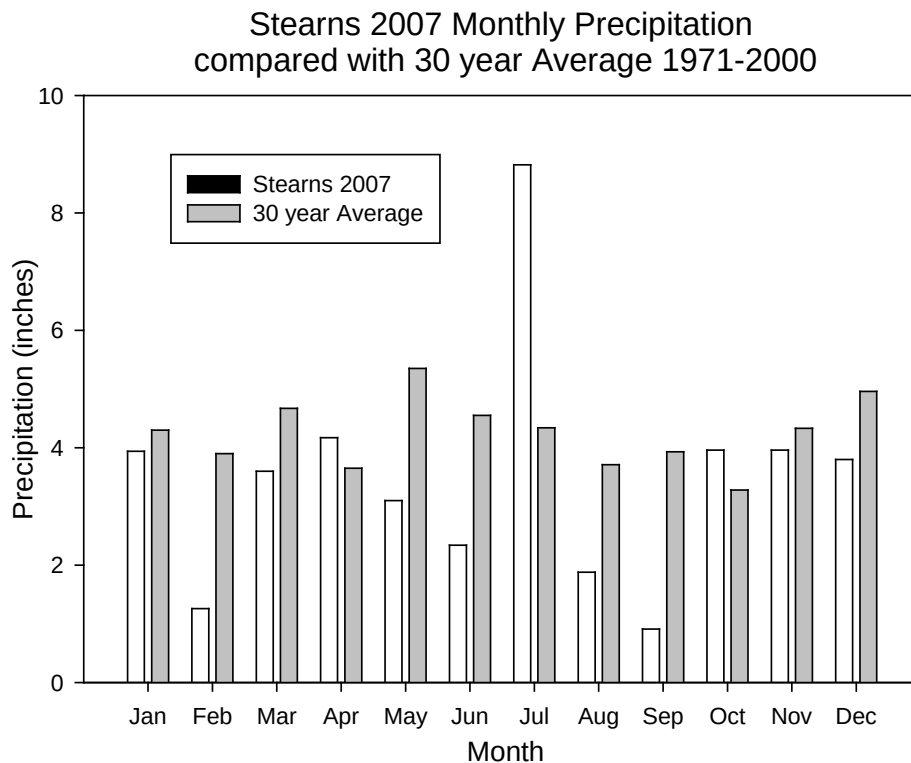
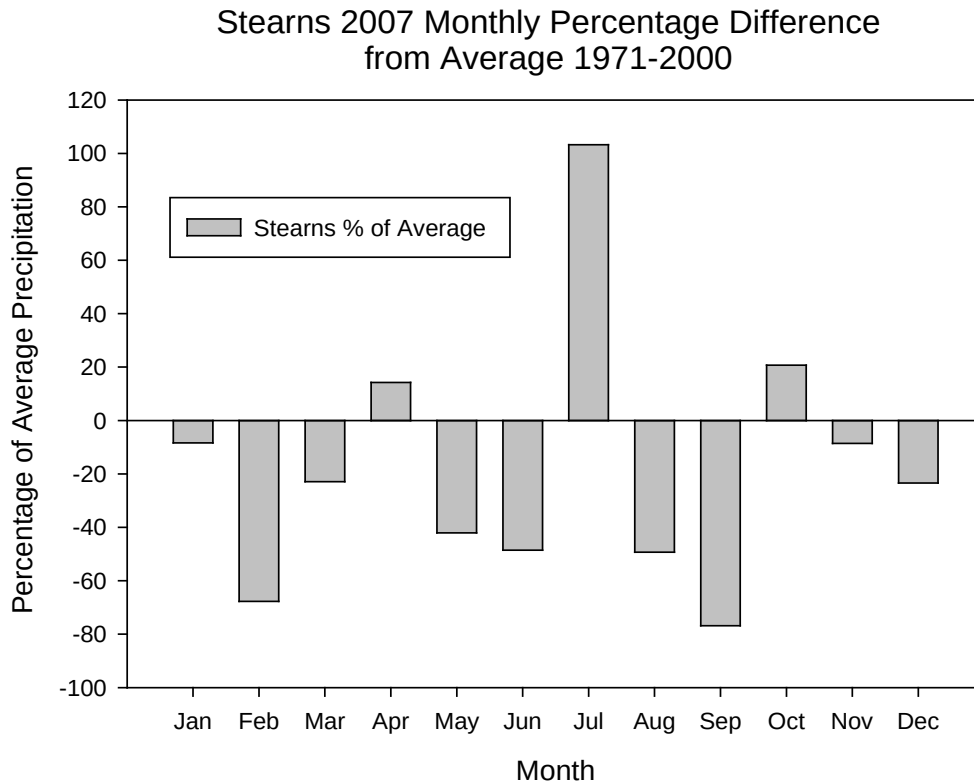


Figure 7. Comparison of 2007 average monthly precipitation with monthly averages for the Climatological Normal (1971-2000) for Stearns 2S: a) percentage differences and b) absolute differences.

Wind

Wind in the Cumberland Plateau usually indicates the direction from which the precipitation bearing storms originate. In 2007, wind data (Figure 14) showed that storms were primarily tracking out of the south and southwest. Wind for the Big South mainly blew out of the southwest, 232 degrees with an average velocity of 2.74 mph. March showed the highest mean maximum wind speed 28 mph (Figure 15), and April had the highest mean wind speed of 3.73 mph. The entire record 2000-2006 showed some questionable wind direction averages, so the comparison with 2007 was omitted from the report.

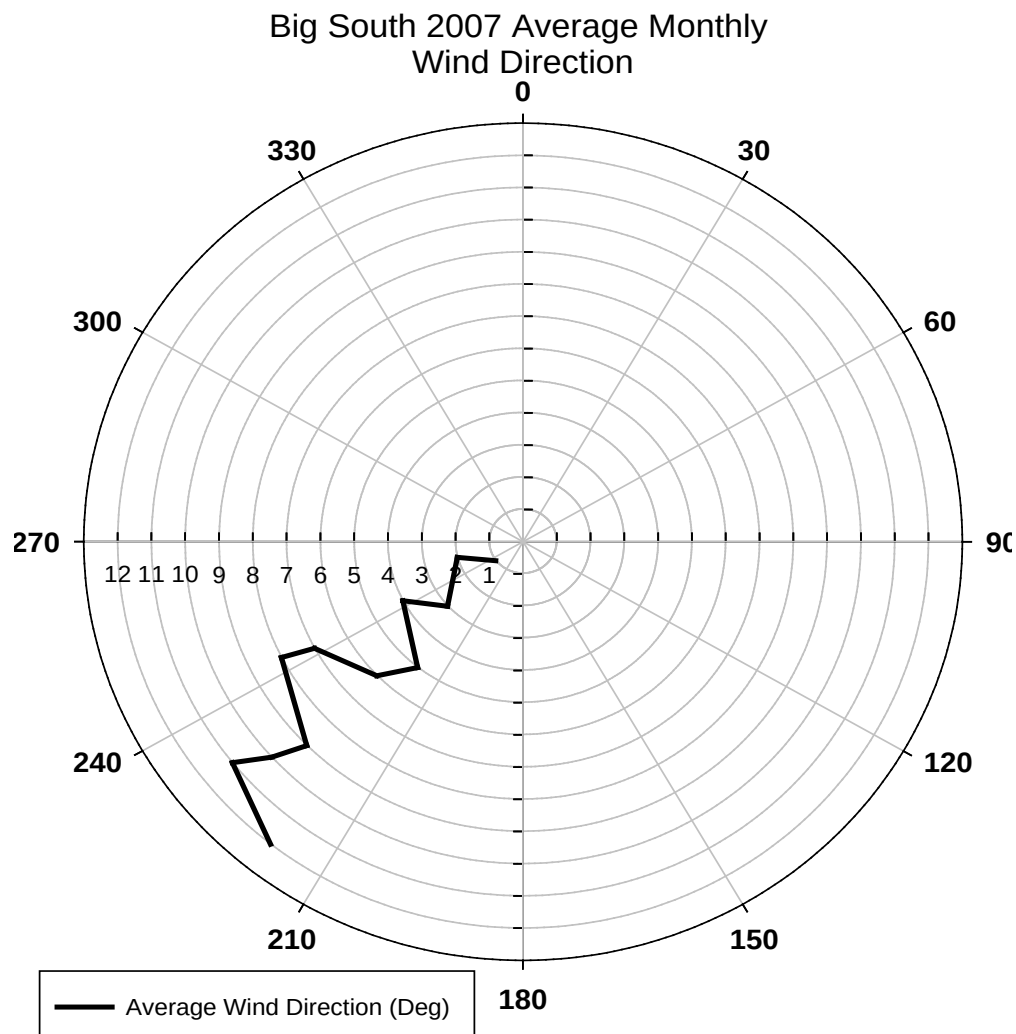


Figure 8. Big South average wind direction by month (1=Jan to 12=Dec).

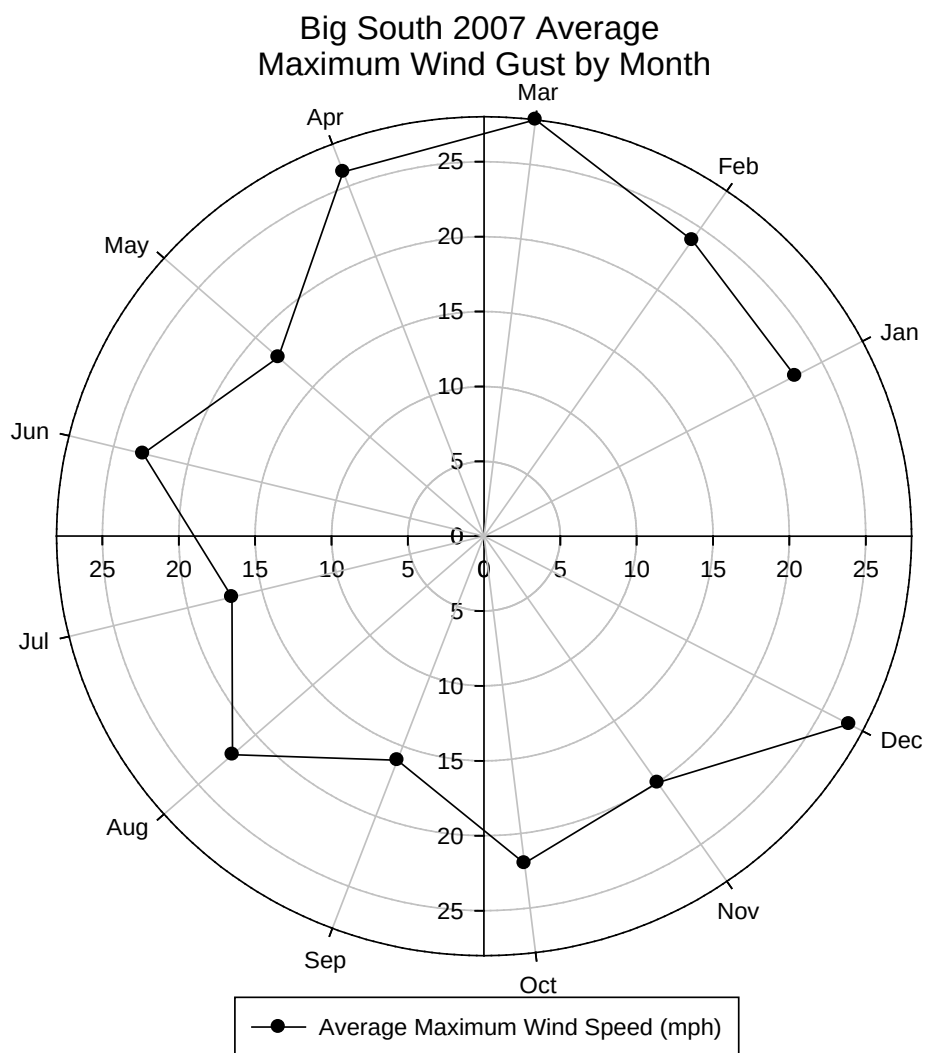


Figure 9. Big South average maximum wind gust by month for 2007.

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