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**COMPARISON OF AWOS AND ASOS DATA FROM ELKO, NEVADA,
FROM SEPTEMBER 1999 THROUGH AUGUST 2000**

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[Note: Because of the large number of figures, only the text will be published in hard copy. The figures can be accessed on the Web version at <http://www.wrh.noaa.gov> under Technical Attachments.

Introduction

This study compares daily temperature and precipitation data from the AWOS and the FAA observer with the uncommissioned ASOS in Elko, Nevada, from September 1999 to August 2000. Daily maximum and minimum temperatures, and monthly average temperatures, plus monthly precipitation are compared in this study. The observations from both sites are compared to determine if there is a notable difference between daily and monthly values.

Purpose

The purpose of this study is to document the differences in temperature and precipitation data between the two observational data sets since the fall of 1999, and determine the possible impact of these differences. The possible influence of ASOS data on climatological records and trends plus the impact of forecasting spot temperatures for Elko will be discussed.

Background

Representative observational data is crucial for creating and maintaining an accurate climatology of a location. This task is made more difficult as climatological databases usually comprise of various data sets collected from various locations by different instrumentation around the site in question. For example, in Elko, Nevada, the official meteorological data has been collected since 1870 when Cooperative Observers began collecting data at the Central Pacific Railroad Company, even though no maximum and minimum temperature data were available until 1888 at the earliest. Other Cooperative sites were used through 1930 before the temperature and precipitation readings were taken at the J. C. Harris Airport in Elko, which is located in a valley in northeast Nevada near Interstate 80. The Elko AWOS is currently located at the J. C. Harris Airport, with the

uncommissioned ASOS located 500 feet to the east of the AWOS on the airport grounds. The scheduled commissioning date of the Elko ASOS is February 7, 2000.

Data

The data used for this study were obtained from records provided by the FAA observers from AWOS data at the J. C. Harris Airport and from the ASOS computer database available at WFO Elko. These data were consolidated and graphical tables and charts were made using Microsoft Excel. Several graphs and tables were made comparing the daily maximum and minimum temperatures between the two data sets and the monthly averages between the data sets. The monthly data sets from December 1999 and August 2000 were missing ASOS data from multiple days of the month. The monthly data presented for these months are for days when both sets of data were available, though no speculation on the differences in the monthly values is presented due to the possible impact of the missing data on the monthly averages.

Results and Discussion

Temperatures - The average monthly temperatures are warmer at the Elko ASOS than at the Elko AWOS for every month of this study (Figure 1). The average temperature from the ASOS is nearly one degree higher than the average temperature of the AWOS for the first half of 2000. A 1-degree difference between the two data sets may not seem like much, but the difference is notable when you compare these average temperatures to the climatological records. The official average temperature of 44.46 degrees from the AWOS makes the first half of 2000 the 11th warmest all time; however, if the ASOS value of 45.41 degrees is used, the first half of 2000 is the 5th warmest of all time.

Figure 1

Month	Average Temp	
	ASOS	AWOS
September	57.80	55.80
October	47.61	45.60
November	40.72	39.33
December*	27.06	25.94
January	30.85	29.97
February	36.79	35.95
March	37.68	37.27
April	48.78	48.38
May	54.63	53.58
June	63.87	61.72
July**	69.04	66.18
August***	69.58	67.06

Note: *ASOS Data from the 5th through 9th and the 31st are missing

**ASOS Data from the 19th are missing

***ASOS Data from the 9th, 10th, 14th, 23rd, and 24th are missing

Comparisons of average monthly maximum and minimum temperature data show a noticeable trend of warmer low temperatures at the Elko ASOS when compared to the Elko AWOS (Figs. 2 and 3). With the temperature readings being taken in a valley where strong nocturnal inversions are common, one could attribute some of the temperature discrepancy to differences in elevation between the two sites. The temperature sensor at the AWOS is located at 5050 feet above sea level (MSL) while the height of the ASOS temperature sensor is 5076 feet MSL. This 260-foot change in elevation would contribute to the higher minimum temperatures at the Elko ASOS.

The impact of this elevation change is significantly less on the daily maximum temperature. Ideally, the difference in temperature, assuming a dry adiabatic lapse rate, over 26 feet is 0.14 °F (0.08 °C). In fact, to get a 1.0 °F (0.56 °C) temperature change over a 26-foot vertical displacement, the lapse rate would be a superadiabatic 112.8 °C/km.

Figure 4 reiterates the greater difference seen in the minimum temperatures than the maximum temperatures. As shown below, a larger percentage difference is observed when comparing the minimum temperatures for every month in the study except April. The average low temperature difference is greater than 1 degree in every month except for March and April, while September through November in 1999, plus July and August in 2000, show differences of nearly 4 degrees, probably due to stronger and more frequent inversions in the summer and fall.

Figure 4

Month	Monthly High Temps			Monthly Low Temps		
	ASOS	AWOS	% Diff	ASOS	AWOS	% Diff
Sept	79.03	78.47	0.72%	36.57	33.13	9.39%
Oct	70.68	70.39	0.41%	24.55	20.81	15.24%
Nov	58.43	58.30	0.23%	23.00	20.37	11.45%
Dec *	43.12	43.08	0.09%	11.00	8.80	20.00%
Jan	41.90	41.74	0.38%	19.81	18.19	8.14%
Feb	46.76	46.31	0.96%	26.83	25.59	4.63%
Mar	51.74	51.58	0.31%	23.61	22.97	2.73%
Apr	66.47	65.83	0.95%	31.10	30.93	0.54%
May	71.97	71.06	1.26%	37.29	36.10	3.20%
June	84.90	83.20	2.00%	42.83	40.23	6.07%
July**	91.97	90.13	1.99%	46.10	42.23	8.39%
Aug***	90.23	89.12	1.24%	48.92	45.00	8.02%

Note: *ASOS Data from the 5th through 9th and the 31st are missing
 **ASOS Data from the 19th is missing
 ***ASOS Data from the 9th, 10th, 14th, 23rd, and 24th are missing

Looking at the data from the later part of 1999, a daily occurrence of ASOS minimum temperatures being 2 to 4 degrees warmer than the AWOS minimum temperature is seen. The data also show the daily maximums from both sites are within 2 degrees and most times are within 1 degree or are identical. The end of 1999 was marked by dry conditions.

Elko's first measurable snowfall did not occur until 17 November, allowing low temperatures to fall below normal. Strong nocturnal inversions formed allowing for a wide range of temperatures across the Elko region at night depending on the location of the observation.

The same trends are seen for the first 3 months of 2000, yet the difference in the low temperatures is less than that seen in the later third of 1999. With the onset of more nocturnal weather events, as is the climatological normal during the winter months in Elko, more uniform minimum temperatures are expected as the nocturnal inversions seen during the rest of the year are reduced or eliminated across mountain valleys.

April was unique as it is the only month where the high temperature variation was greater than the low temperatures. While no explanation for this is readily available, the overall trend of the ASOS temperatures being warmer than the AWOS temperatures is still present.

June and July had the greatest difference between the high temperatures. The temperature variation for June was 1.7 degrees, with July recording an even larger difference, 1.84 degrees. While no weather phenomena seemed to cause this sudden increase in variation, the maximum temperature differences between the ASOS and the AWOS suddenly increased following 16 May when temperatures warmed to 60 degrees. Temperatures remained above 60 for the rest of the month and rose steadily through July. The June and July temperature differences are similar to those seen in the later part of 1999, with low temperatures varying by as much as 7 degrees, and with high temperatures varying by 2 to 3 degrees F. Inversions were fairly strong during the late spring and early summer months.

Precipitation

The precipitation measurements show that the ASOS does seem to record more precipitation than the AWOS/FAA observer. As seen in Figures 5 and 6, the ASOS reported more precipitation than what the FAA observer reported for every month except September and May. However, a variety of factors may be at work giving us the differences seen. Since a human is currently responsible for the official measurements, an extra source of error is possible and has occurred as incorrect liquid equivalent measurements have been made in the past. With the lack of frequency of precipitation in the Great Basin, it is very difficult to get an accurate representation of the climatological precipitation in under a year. While the data may indicate the ASOS records more liquid precipitation, no conclusions can be drawn from a limited data set.

Figure 5

Monthly Precipitation		
Month	ASOS	AWOS
September	0.01	0.02
October	0.32	0.26
November	0.43	0.41
December	0.10	0.06
January	1.50	1.48
February	2.65	2.32
March	1.03	0.77
April	0.84	0.69
May	0.57	0.73
June	0.14	0.08
July**	0.03	0.04
August***	0.18	0.22
Total	7.80	7.08
Note: *ASOS Data from the 5th through the 9th and the 31st is missing **ASOS Data from the 19th is missing ***ASOS Data from the 9th, 10th, 14th, 23rd, and 24th is missing		

Conclusion

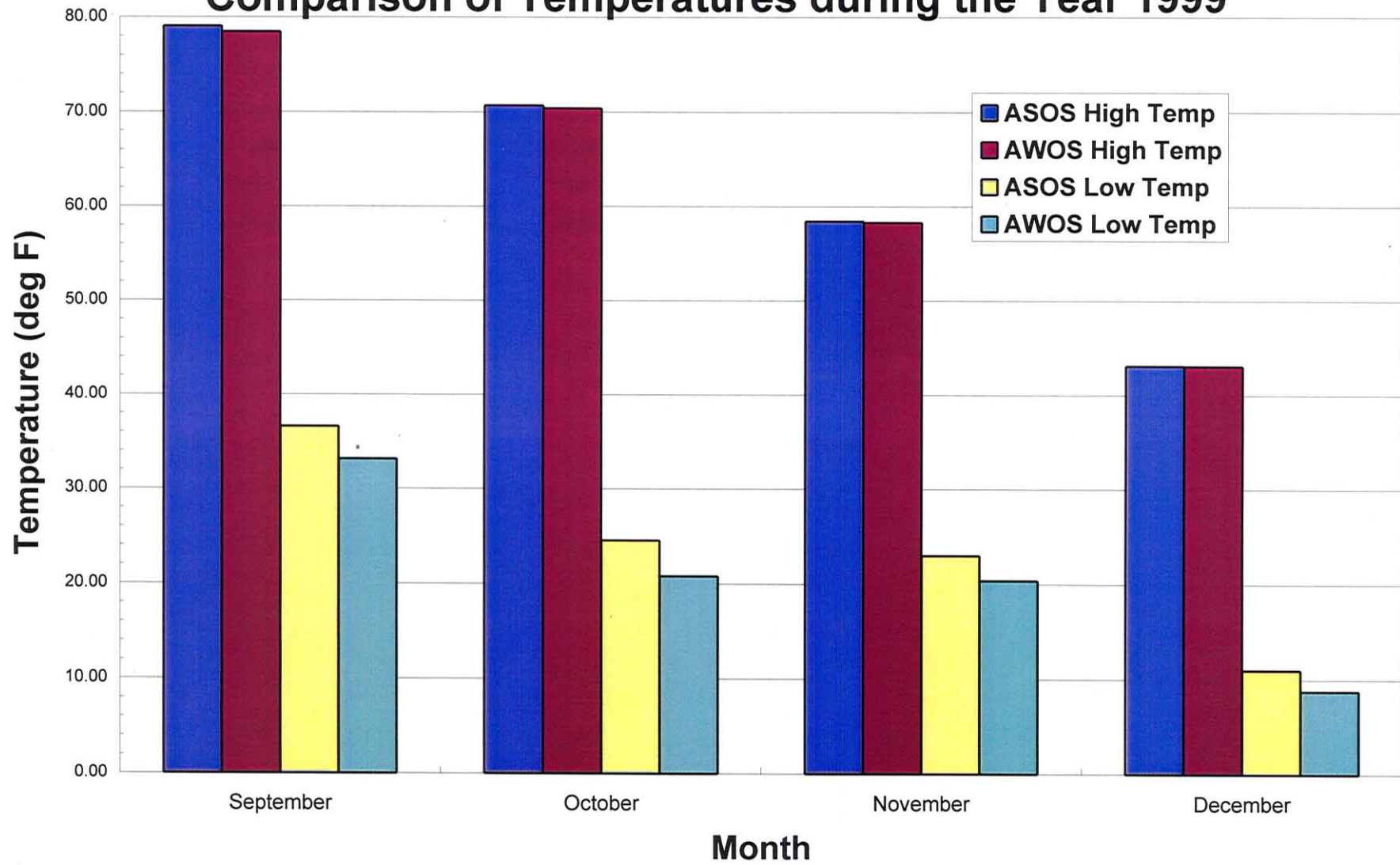
While this study encompasses only a year, the data seem to indicate the uncommissioned ASOS records warmer temperatures than the AWOS. With recent reports and concerns about global warming, it is of note that this comparison of “unofficial” data to the official observations show that instrumentation located only a couple hundred yards apart can give a notable temperature discrepancy. It is not the purpose of this study to determine what causes the Elko ASOS to record warmer temperatures than the AWOS. The main message is it appears the ASOS will probably record higher temperature values than the AWOS once the ASOS is commissioned and becomes the official site. This study should prove beneficial to forecasters once the ASOS becomes the official temperature site. Forecasters will be aware of the average temperature discrepancy and, if all other factors remain equal, it is quite possible that Elko may experience a rise in the overall temperature over time when the ASOS is used as the official data for Elko, Nevada.

Acknowledgements

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Figure 2

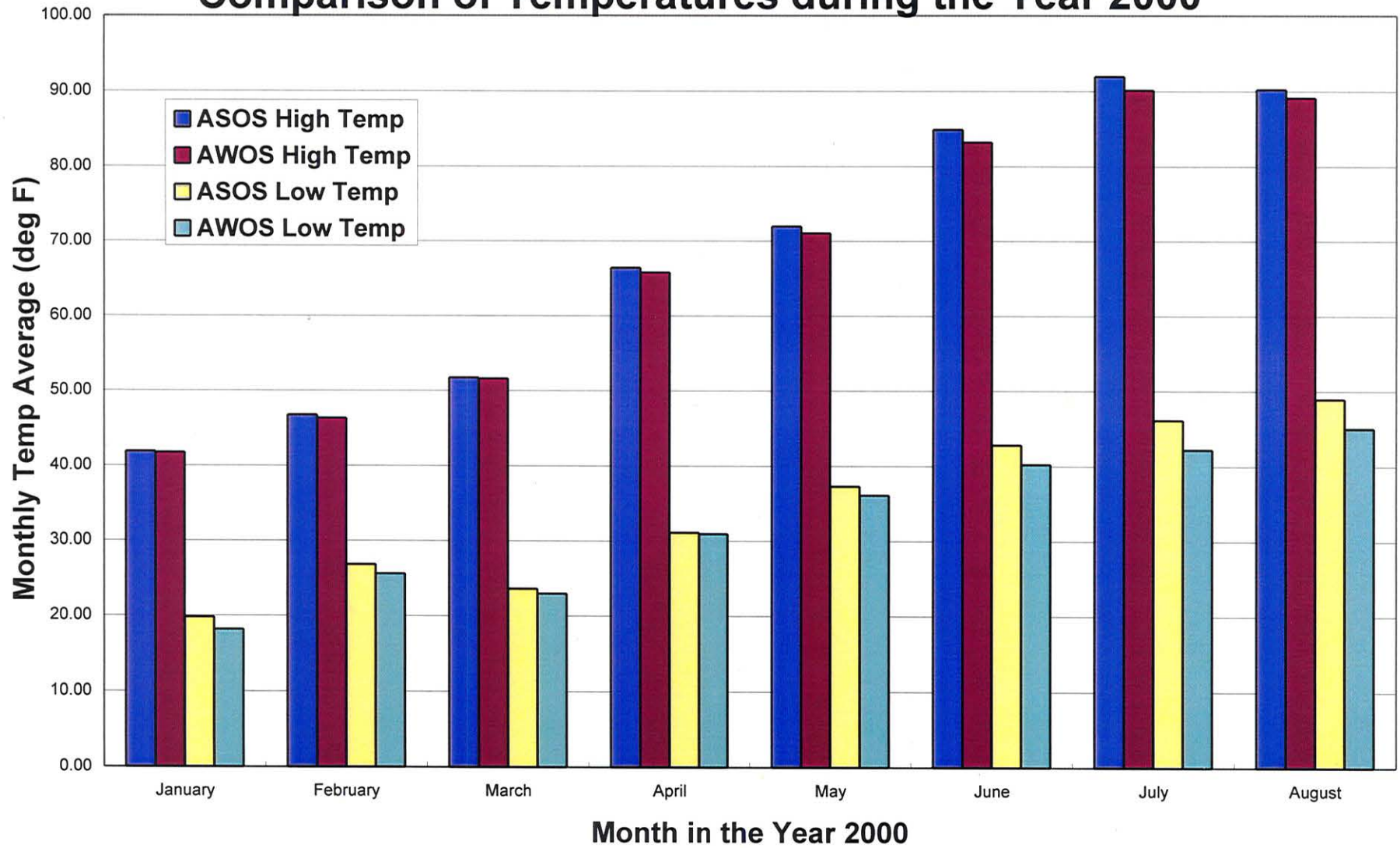
Comparison of Temperatures during the Year 1999



Monthly Averages for December do not include data from the 5th through the 9th and the 31st.

Figure 3

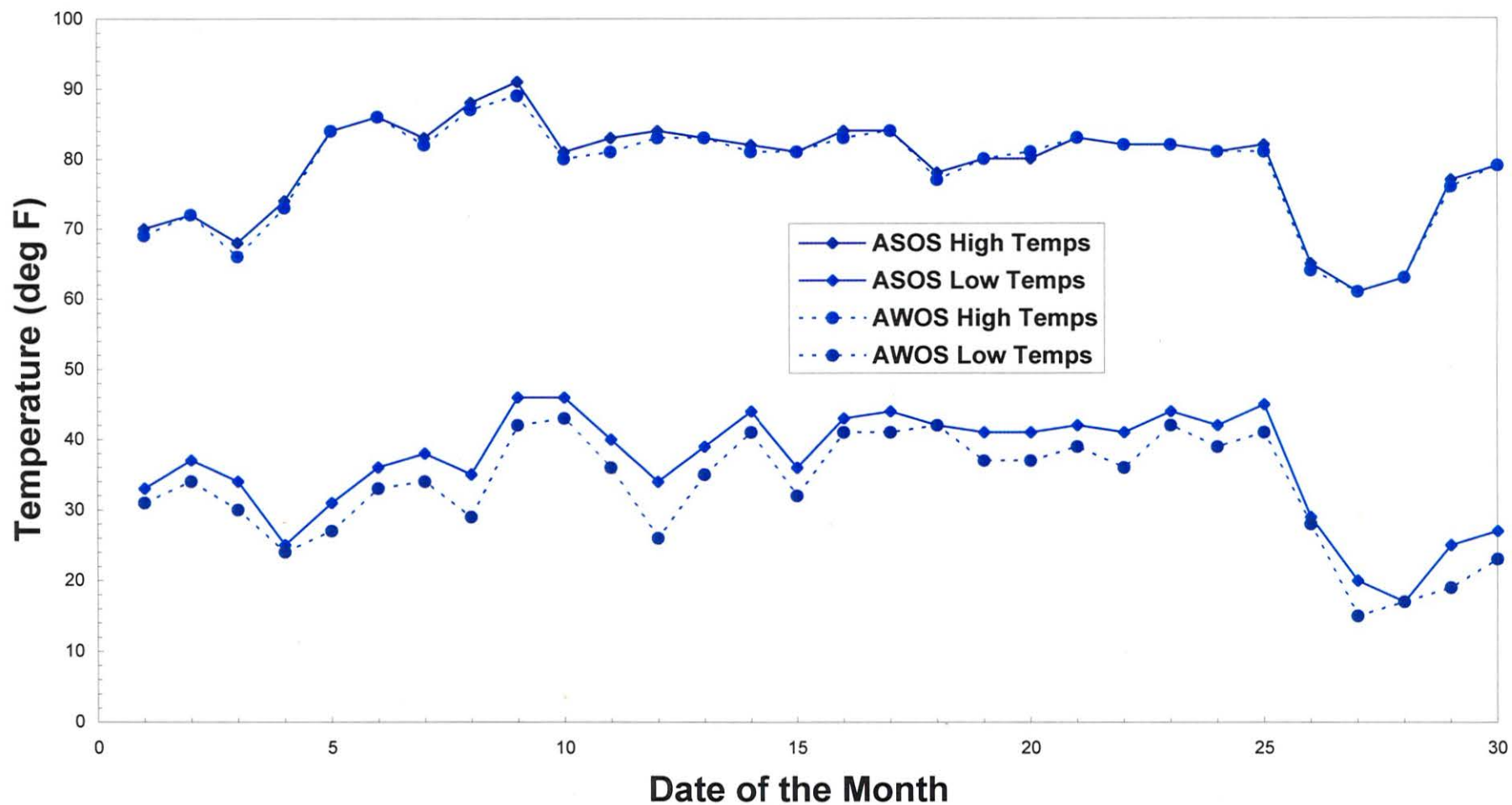
Comparison of Temperatures during the Year 2000



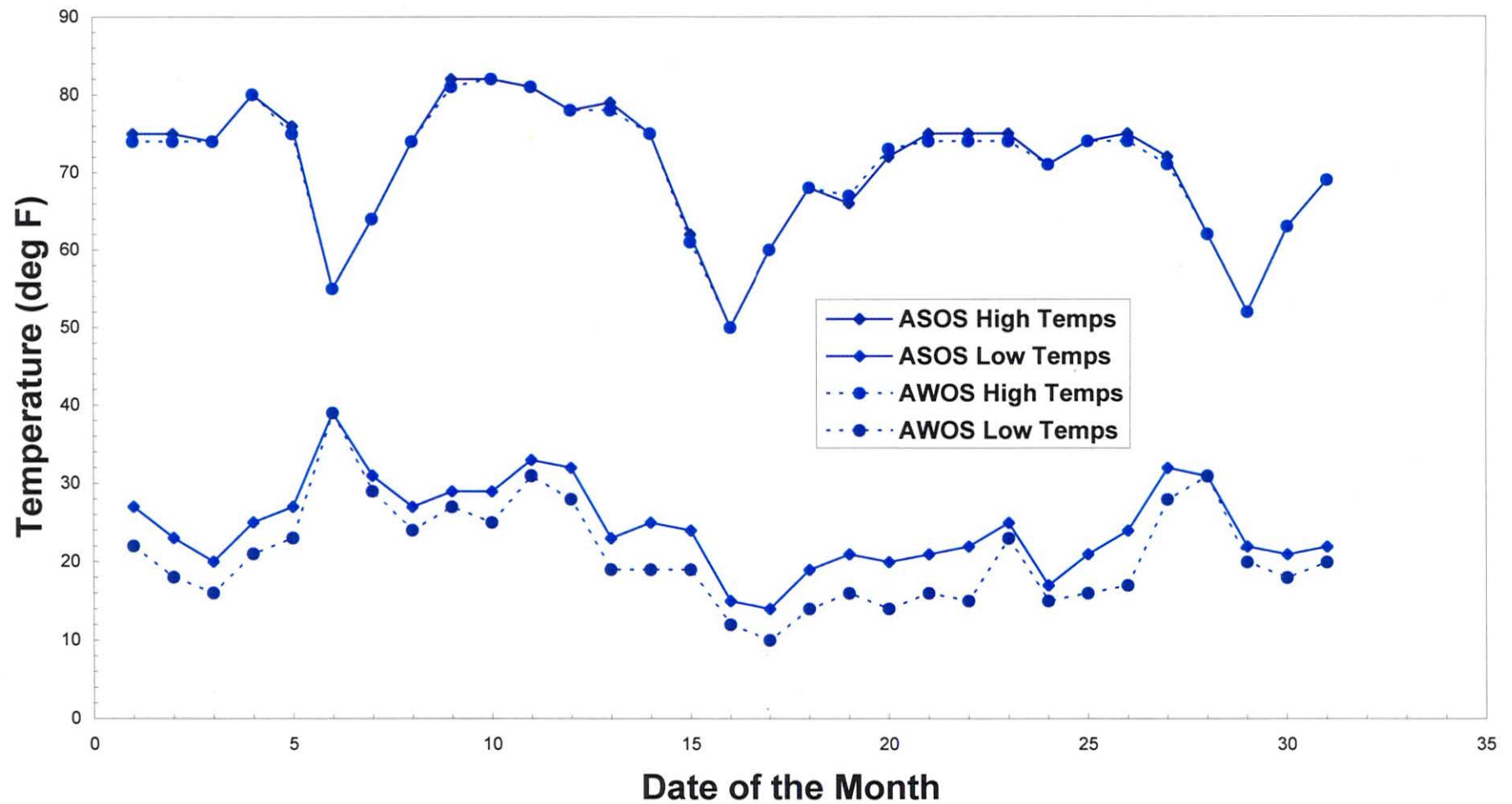
Monthly Averages for July do not include data from the 19th.

Monthly Averages for August do not include data from the 9th, 10th, 14th, 23rd, and 24th.

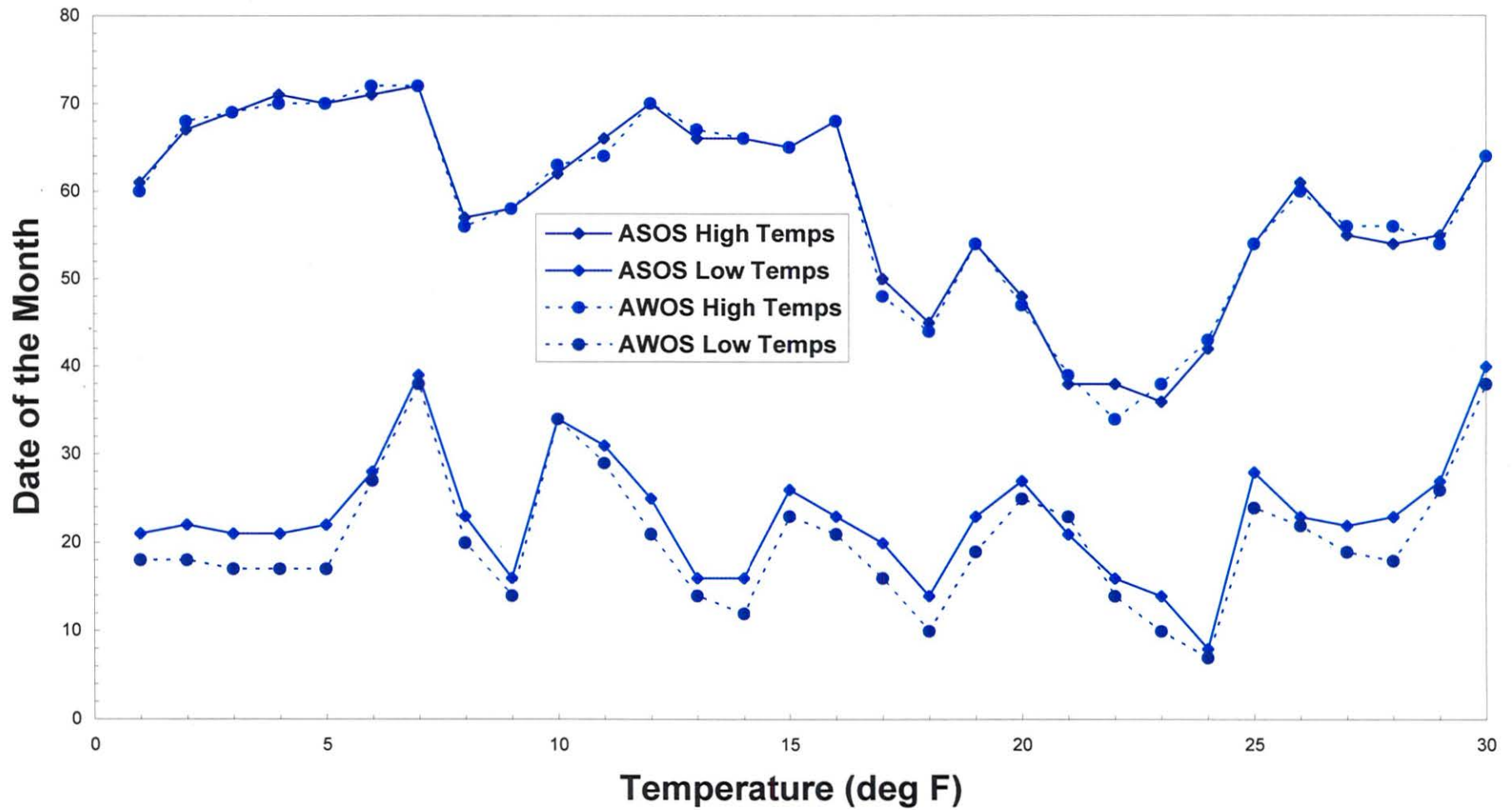
Comparison of ASOS and AWOS Temperatures for September, 1999



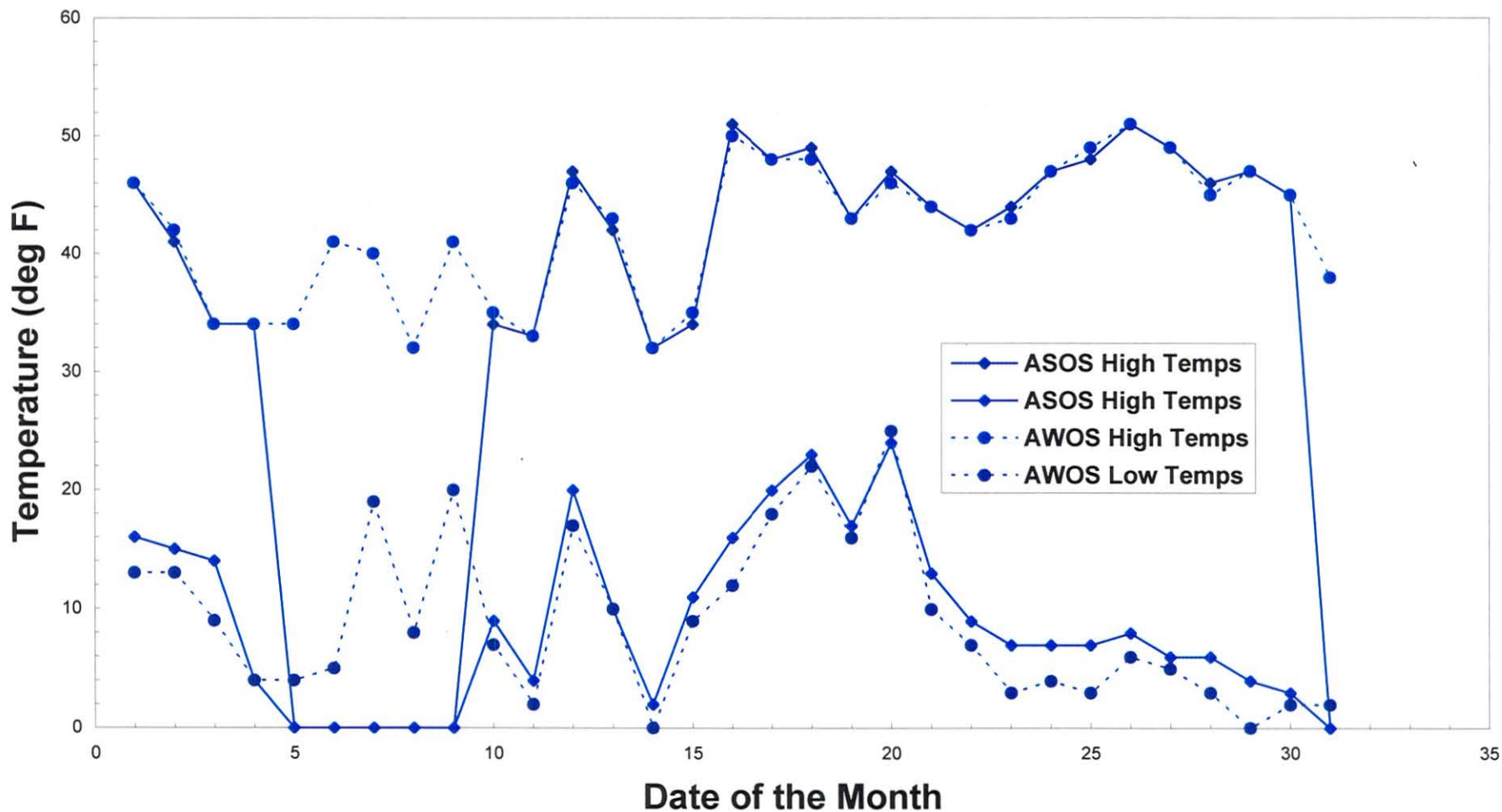
Comparison of ASOS and AWOS Temperatures for October, 1999



Comparison of ASOS and AWOS Temperatures for November, 1999

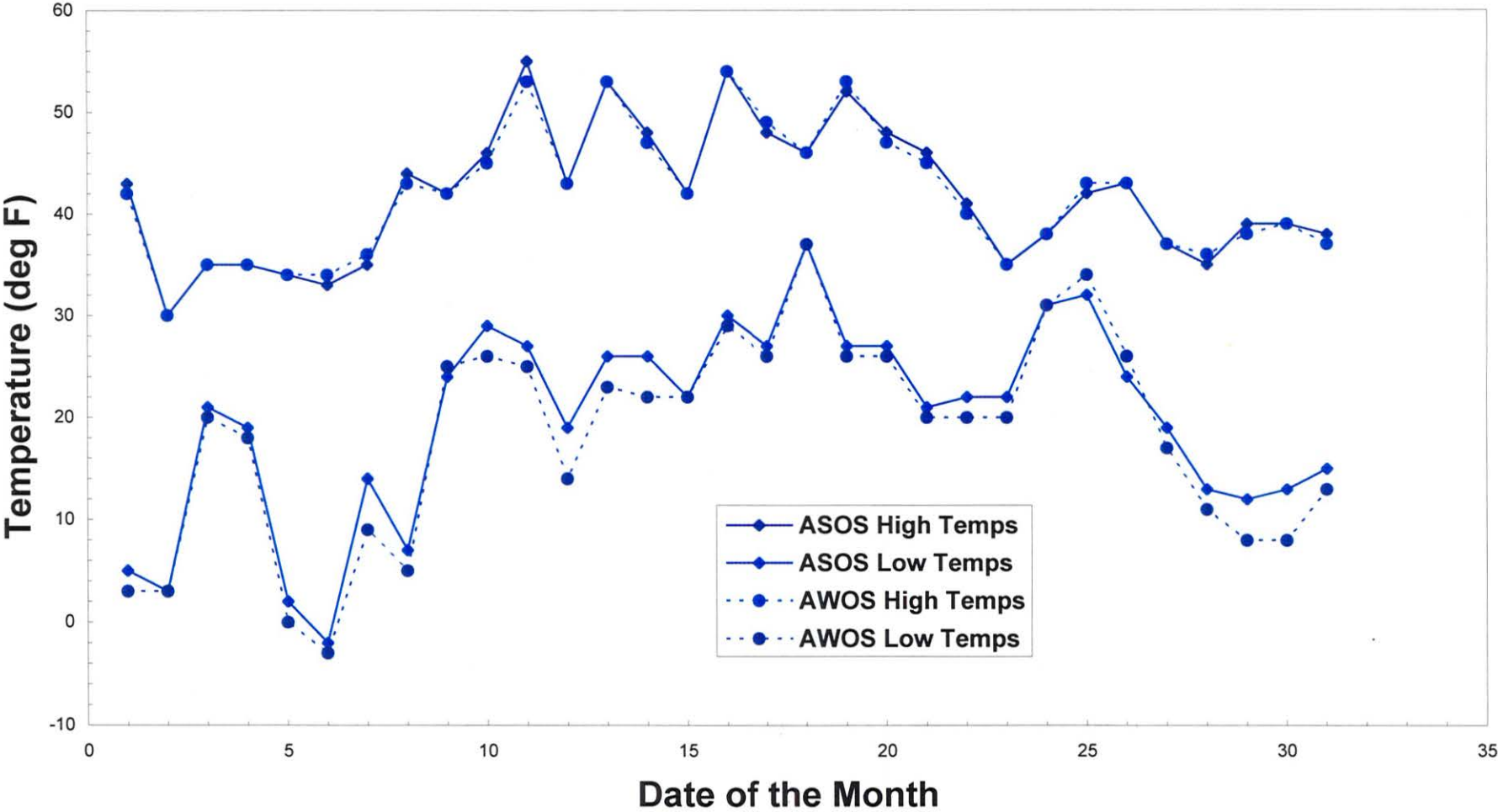


Comparison of ASOS and AWOS Temperatures for December, 1999

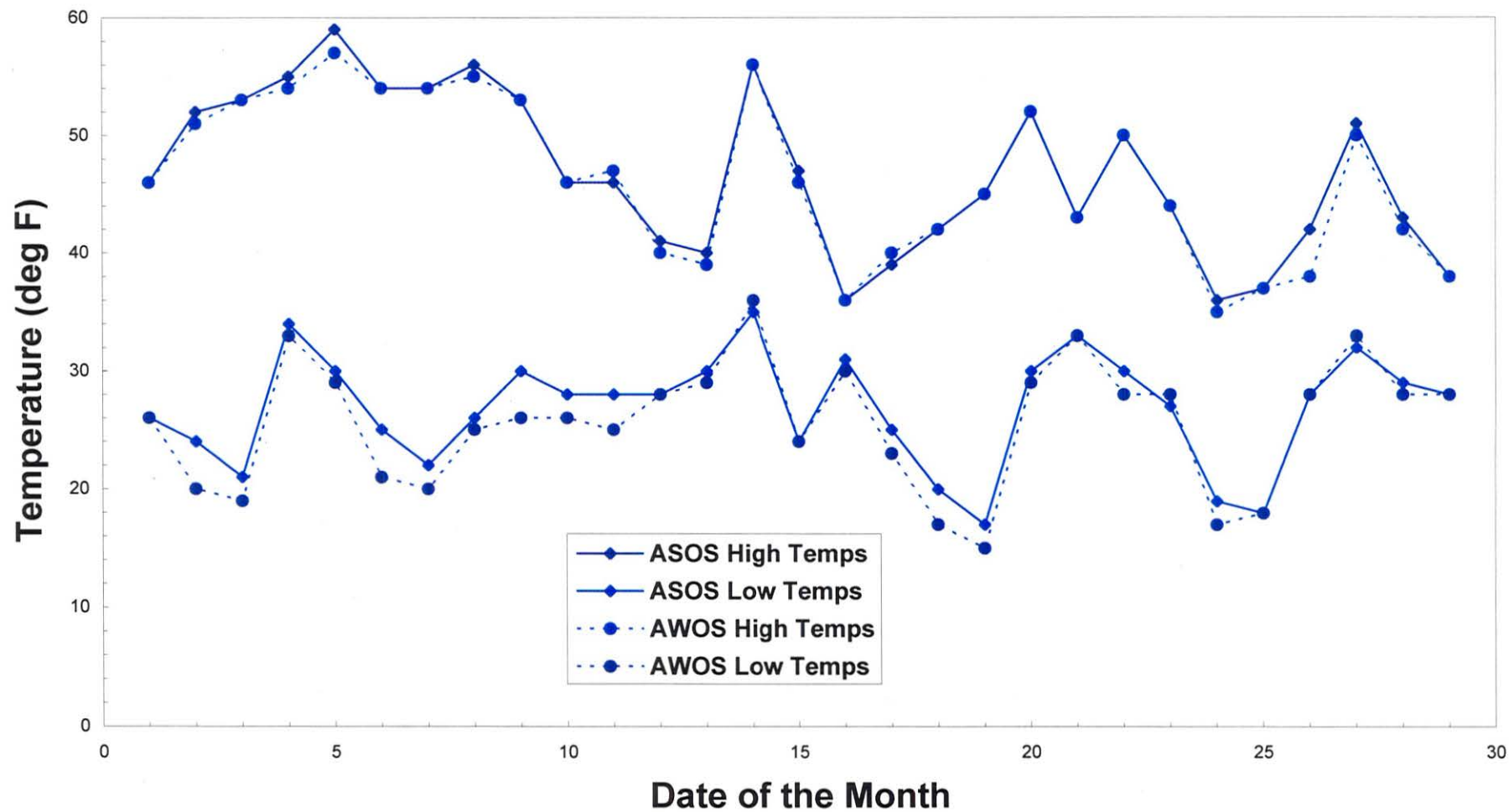


ASOS Data Missing from the 5th through the 9th and from the 31st.

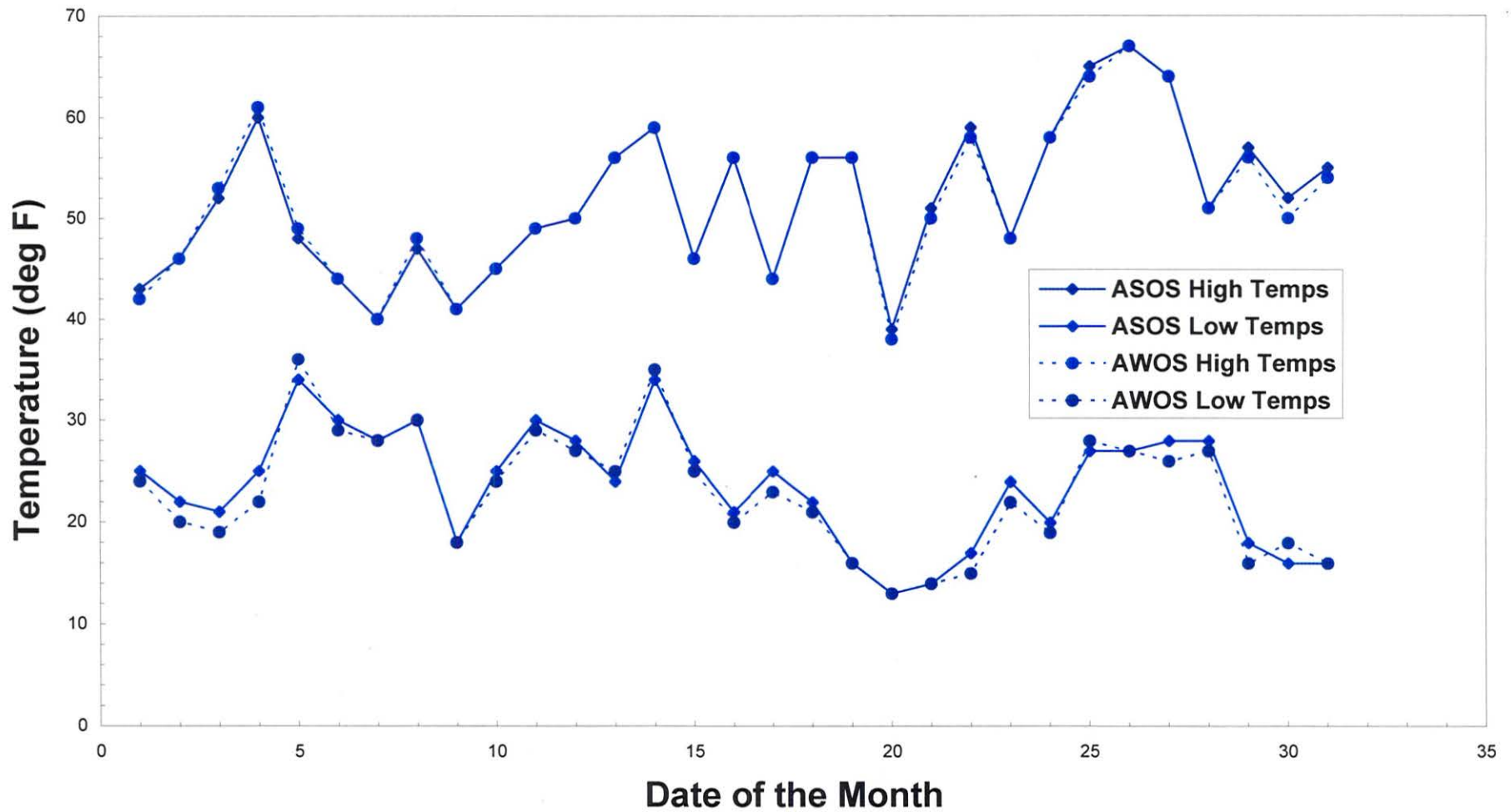
Comparison of ASOS and AWOS Temperatures for January, 2000



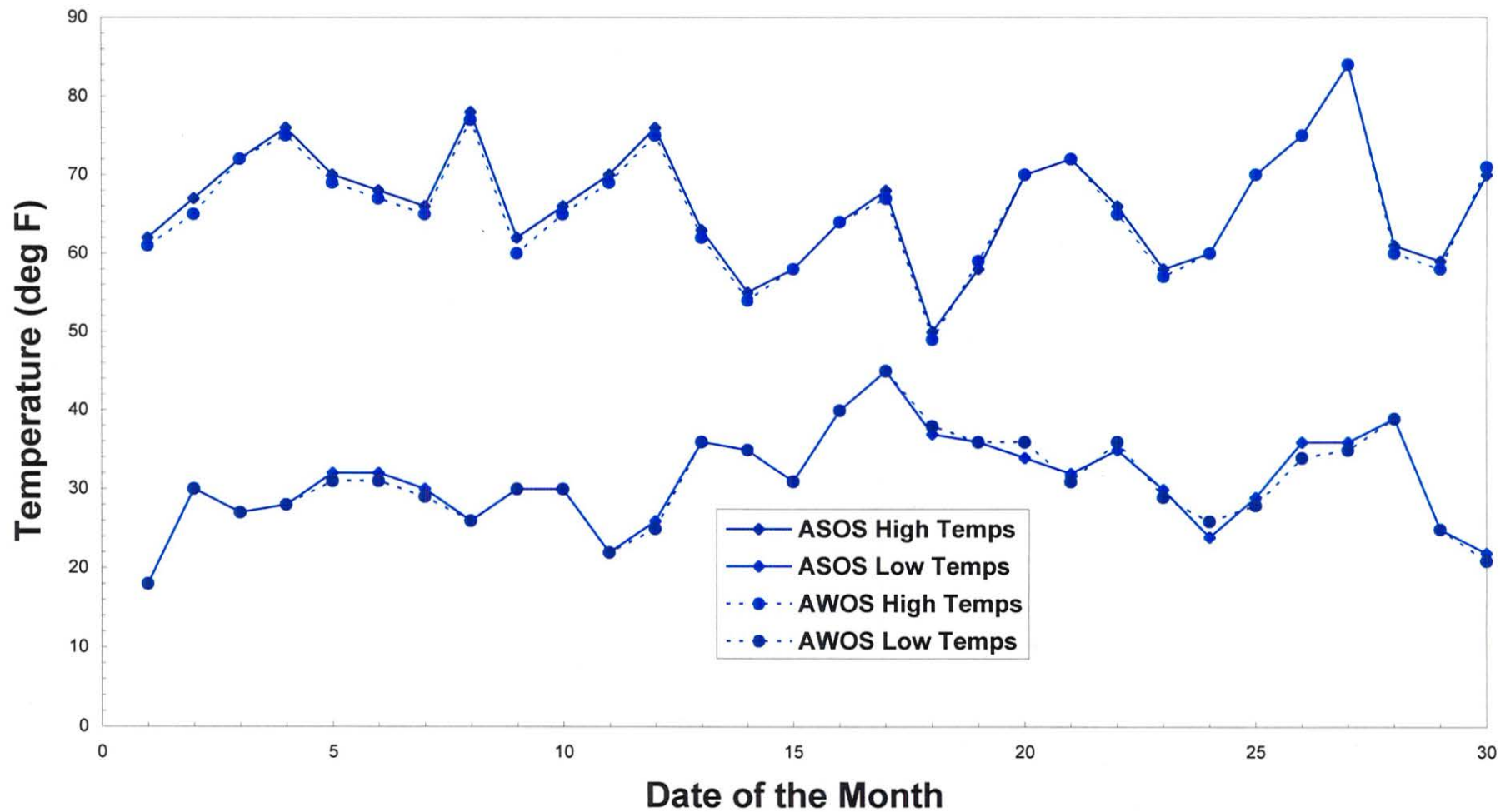
Comparison of ASOS and AWOS Temperatures for February, 2000



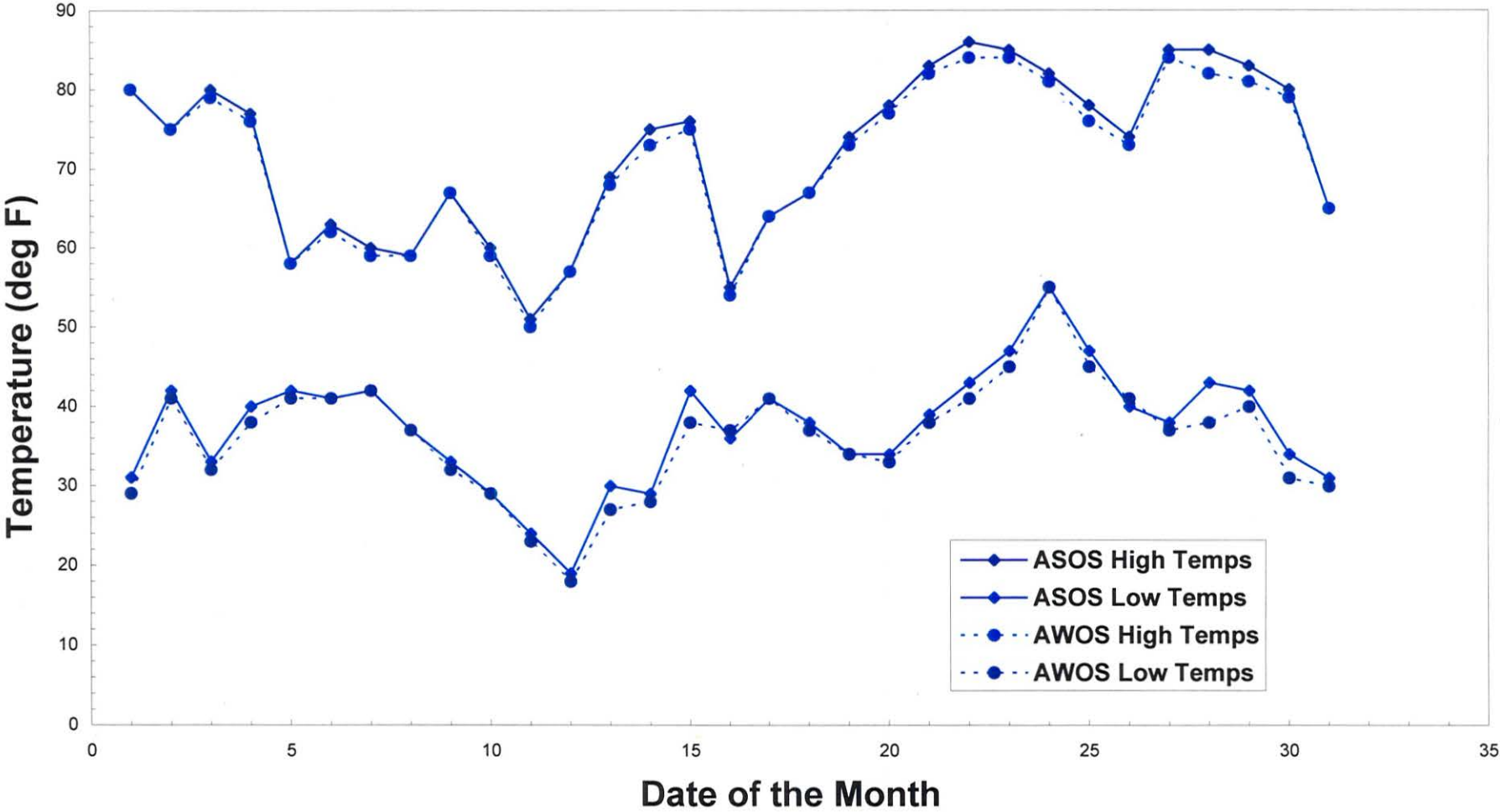
Comparison of ASOS and AWOS Temperatures for March, 2000



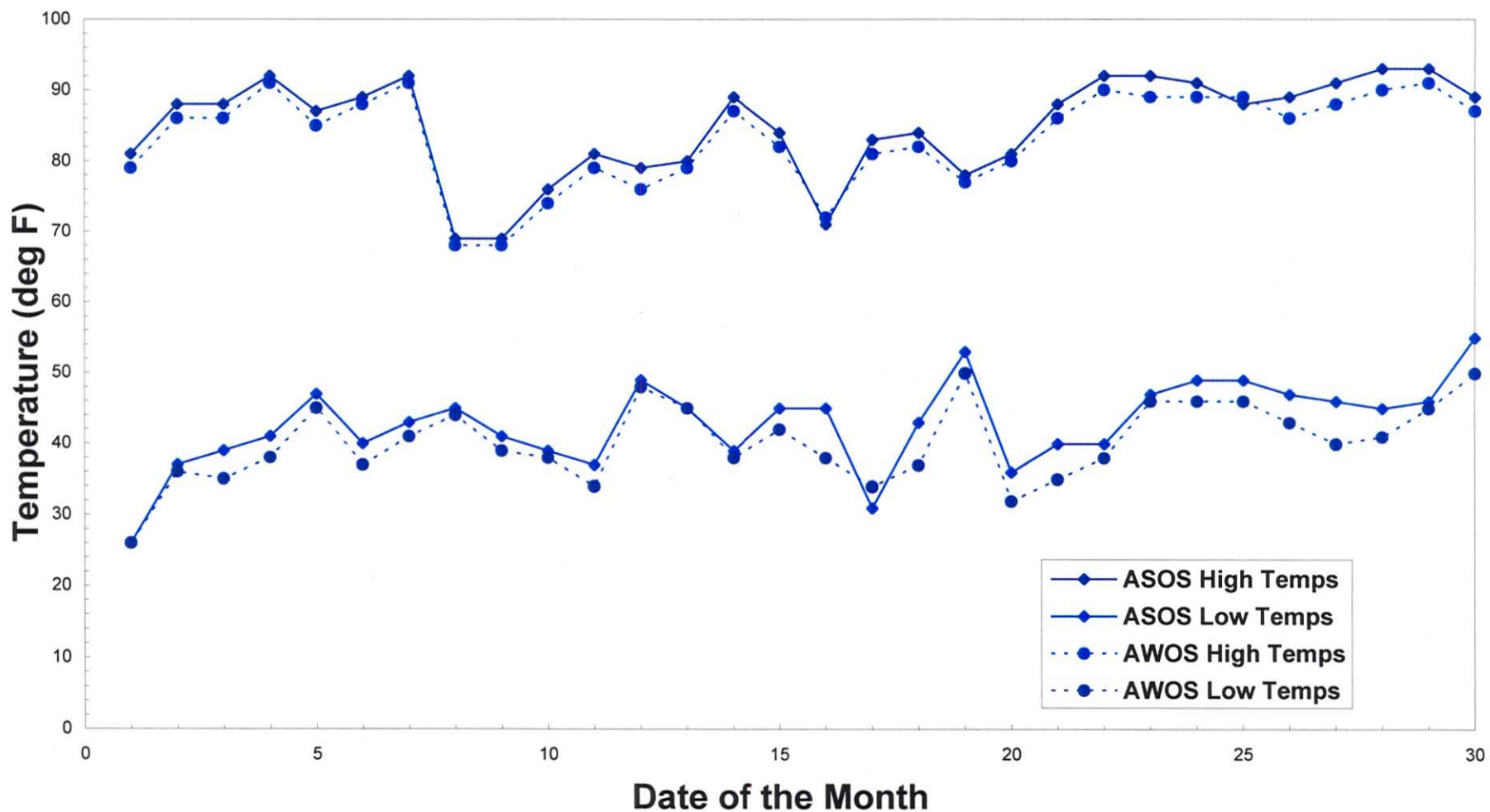
Comparison of ASOS and AWOS Temperatures for April, 2000



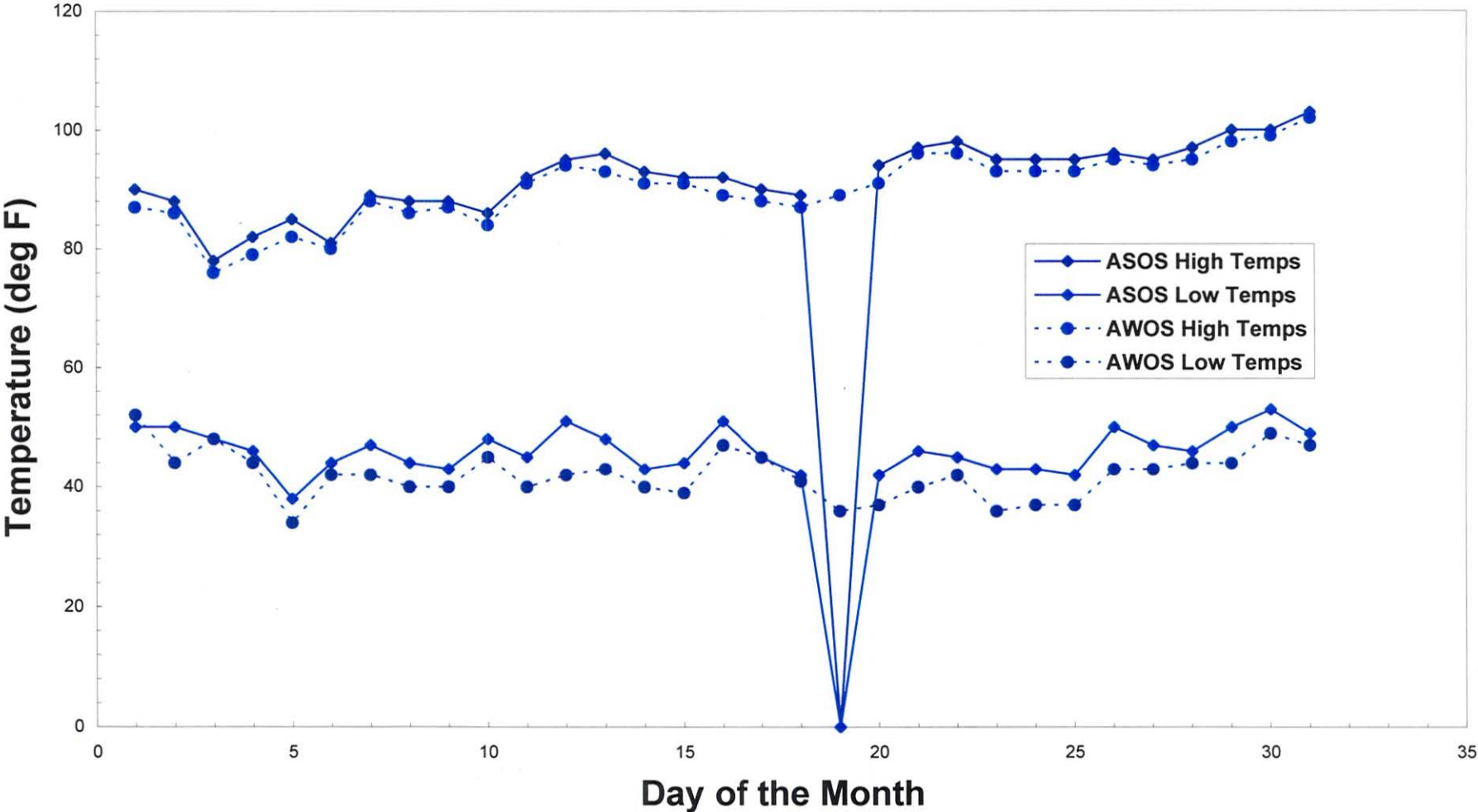
Comparison of ASOS and AWOS Temperatures for May, 2000



Comparison of ASOS and AWOS Temperatures for June, 2000

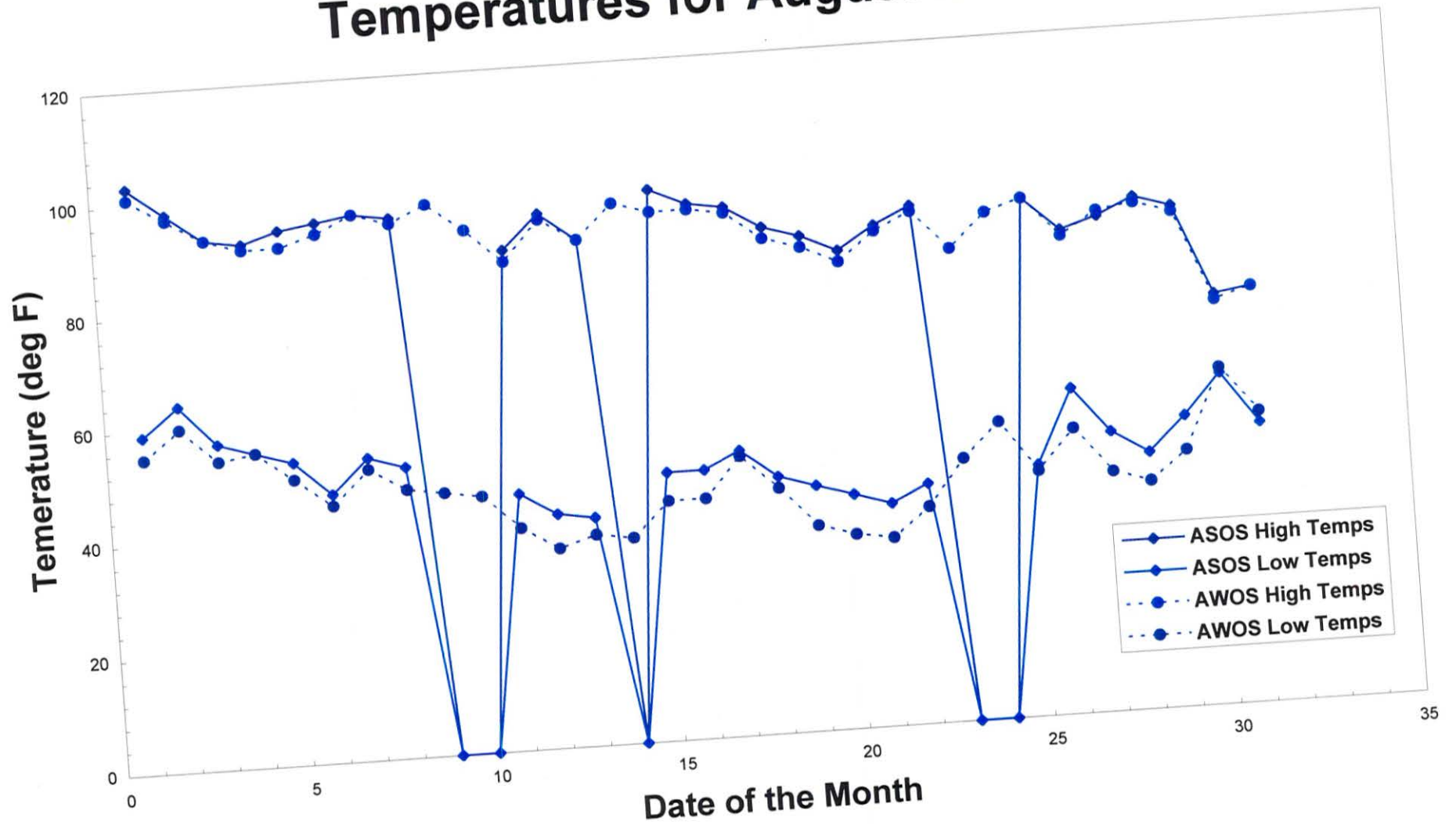


Comparison of ASOS and AWOS Temperatures for July 2000



Note: ASOS Data for the 19th of July are unavailable.

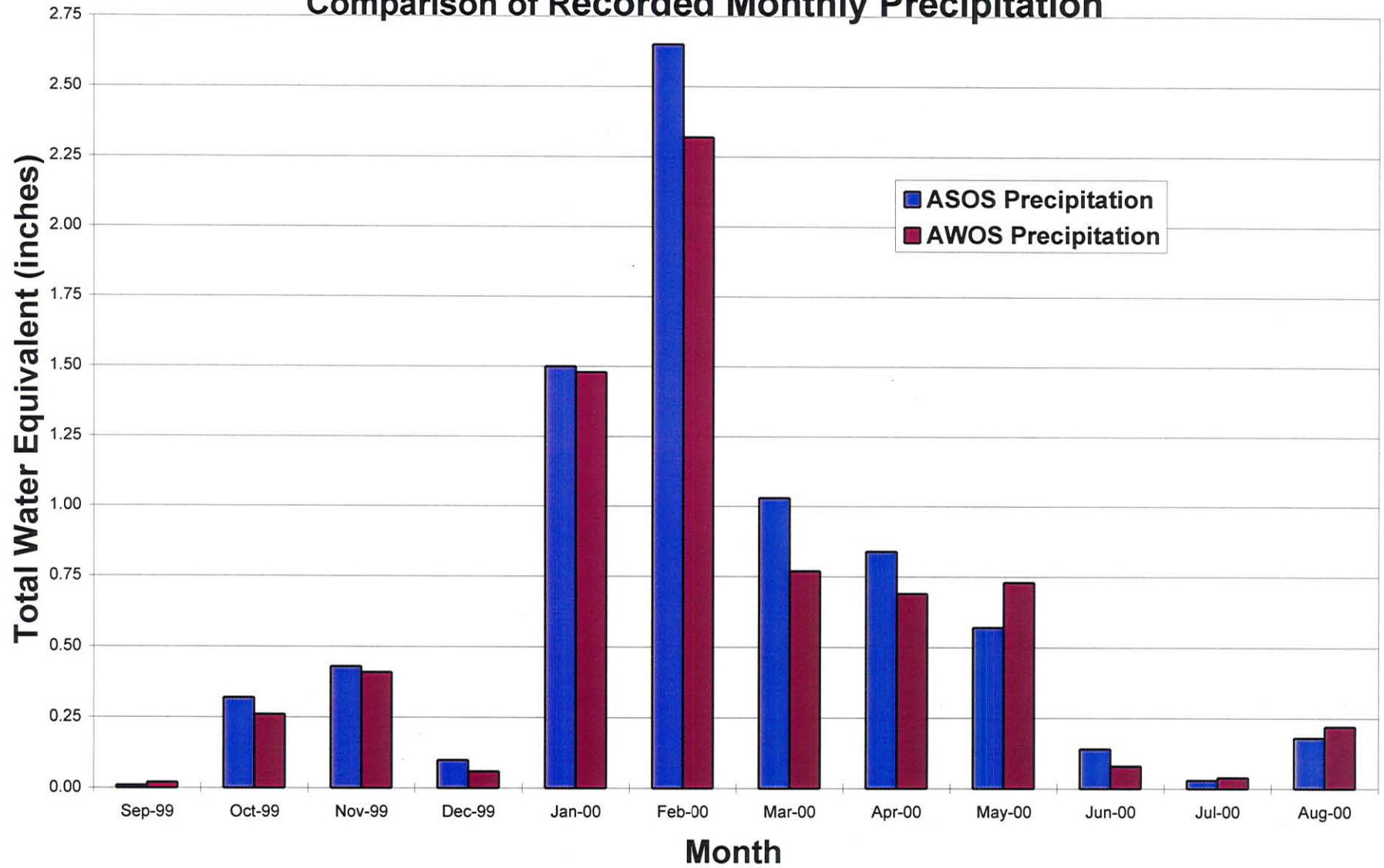
Comparison of ASOS and AWOS Temperatures for August 2000



ASOS Data from the 9th, 10th, 14th, 23rd, and 24 are unavailable

Figure 6

Comparison of Recorded Monthly Precipitation



Note: ASOS Data Missing for the following dates: December:5-9,31 July:19 August:9,10,14,23,24