

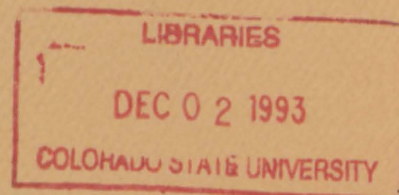
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THE CLIMATE OF FORT COLLINS, COLORADO

THE YEAR IN REVIEW – 1992 WATER YEAR
(1 October 1991 - 30 September 1992)

Nolan J. Doesken

Thomas B. McKee



Climatology Report #92-3

DEPARTMENT OF ATMOSPHERIC SCIENCE
COLORADO STATE UNIVERSITY
FORT COLLINS, COLORADO

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THE CLIMATE OF FORT COLLINS, COLORADO

THE YEAR IN REVIEW – 1992 WATER YEAR

1 October 1991 - 30 September 1992

Introduction

This report is an account of climatic conditions observed in Fort Collins, Colorado, during the 1992 water year. The purpose of this report is to document climatic conditions and anomalies so that the impacts climate has on the local environment and society can be better understood and appreciated.

The water year, defined as the 12-month period beginning October 1 and ending on September 30, is far superior to the traditional calendar year for climate monitoring and description in this part of the country because it relates closely to the annual water storage – water usage cycle. Statewide water-year summaries of a more general nature have been published annually by the Colorado Climate Center since 1977 as a part of the monthly climate-monitoring periodical, **Colorado Climate**. A detailed hydroclimatic description of the 1992 water year appears in the American Geophysical Union's Proceedings of the 1993 Hydrology Days (Doesken and Gillespie, 1993).

Data Collection

The data summarized in this report were collected at the Main Campus Weather Station at Colorado State University in Fort Collins, Colorado, approximately 500 feet northwest of the Lory Student Center. Data currently being collected include instrument measurements of air temperature, soil temperatures at various depths, dew point, relative humidity, wind speed, direction and gusts, solar radiation, precipitation (rates and total

amounts), snowfall, snowdepth, pan evaporation and pressure. Visual evaluations are made of cloud height, cloud amount, cloud types, horizontal visibility, weather conditions, types and intensities of precipitation and other significant meteorological phenomena. Daily values of maximum and minimum temperatures, precipitation, snowfall, evaporation and wind gusts are all evaluated for 24-hour periods ending at 1900 hours (7 p.m.) Mountain Standard Time. These records are maintained and are available on written forms and on digital media from the Colorado Climate Center at Colorado State University. Some of these data are also provided, through cooperative agreements, to the National Weather Service and are stored with weather records from the entire country at the National Climatic Data Center, Asheville, North Carolina.

Thorough instrumental and observational monitoring of climatic conditions in Fort Collins, Colorado began in 1889 with partial records dating back into the 1870's. With the help of ongoing support from the Colorado Agricultural Experiment Station, detailed monitoring has continued without interruption. The result of this commitment is an extremely valuable long-term data set for studying climatic conditions and their variations, one of the best available anywhere in the Rocky Mountain region.

Considerable effort is made to maintain long-term continuity in the Fort Collins observations. Much of the observational equipment and operational procedures are very similar to what they were when the station was begun. The daily observation time of 1900 (7 p.m.) MST has been maintained since uniform data collection began in 1889 except that an observational period ending at 5 p.m. was employed for precipitation measurements from late 1973 through 1980. Long-term records are as consistent as possible, but urbanization of the Fort Collins area has introduced noticeable trends in some climatic elements.

Warmer temperatures, higher dew point temperatures and lighter winds are some of the long-term effects that urbanization and irrigation have had on the Fort Collins climate record. The Weather Station has also experienced three relocations in its history, all associated with the development and expansion of campus facilities. Each move has the potential to introduce discontinuities into the climate records. Elements like wind, evaporation rates and minimum temperatures are especially sensitive to station location. The most recent station move occurred in 1961 when the Lory Student Center was built. Historical information about the Fort Collins Weather Station can be found in a number of reports such as Parshall (1961), Wirshborn (1977), and Doesken et al. (1991).

This report is an effort to document significant aspects of the climate of the past year and put them in perspective in relation to the observed conditions since 1889. This is the first of this type of detailed annual summary for Fort Collins. It is our hope that it can expand to become an annual series serving both as an historical document and also as a research reference for people working in climate-sensitive fields.

1992 Meteorological Conditions – A Narrative Review

History shows time and again that there is no such thing as an average year. Every year is different and unique in its own way. 1992 was no exception in Fort Collins. A modest warm anomaly was occurring during much of the period in the tropical Pacific Ocean (often referred to as an El Niño event). This was also the first complete year following the major eruption of Mount Pinatubo in the Philippines earlier in 1991. Both of these large-scale factors may have contributed to the regional weather patterns that affected Fort

Collins. However, the natural variations in climate are always so great that it is usually impossible to identify direct relationships.

October in Fort Collins began with plentiful sunshine and very warm temperatures. The 88°F maximum on October 16, 1991 tied the all-time record for the hottest temperature on any day in October. There were two brief hints of fall weather during the month. The foothills showed a dusting of snow as clouds lifted early on October 4. Then on the 23-24th, temperatures dropped and rain and drizzle dampened the area.

There had been some light frosts beginning back in late September, but as Halloween approached, most trees still held their leaves and many gardeners were still harvesting tomatoes. The official date of the first autumn freeze was October 5 when the mercury cooled to 31°F on campus. Surrounding rural areas and local low spots in and near Fort Collins experienced earlier freezes. Then late on October 27 a powerful cold front swept down from the north. By morning on the 28th, freezing drizzle and a little snow (the first of the year – right about on schedule) made for a rude and slippery morning. And then things got worse! Eight inches of fluffy snow fell from 7 p.m. on the 29th until it let up on the 30th. More importantly, the high temperature on the 30th was a frigid 21°F. That was the coldest daily maximum temperature ever recorded in Fort Collins for any day in October. Colorado State University's football team played a first-ever Halloween night (Thursday) football game. People feared one of the coldest games ever, but some downslope winds warmed the mercury to near the freezing point. Trick-or-treaters marched cheerfully through Christmas-like snow and complained very little.

As November began, an even colder blast of arctic air swept in. Temperatures during the daylight hours on both November 1 and 2 only reached 21°F. The low temperature early

on November 3 was a record-breaking -1°F. Terrible fears of what the rest of the winter might be like sent people swarming to buy parkas and insulated boots. Many stores were sold out. Furnace repairmen were also in great demand. Little did we know then, but by noon on November 3 the coldest weather of the winter was already behind us. On only three days during the remainder of the winter did the temperature stay below freezing all day. The coldest maximum temperature after that was only 25° on January 15. We also didn't realize it at the time, but this severe early coldwave was very destructive for local vegetation. Various types of trees never lost their leaves, and when spring arrived, tree mortality was found to be very great especially among trees like the Siberian elms.

November proved to be the snowiest month of the year for much of Colorado's high-country. Winter recreation got off to a great start as the mountain snows began to accumulate. Plenty of snow also fell east of the mountains and Denver totalled 29.6" for the month. It was a wet month for Fort Collins, but the heavy snows missed us. During the stormy episode November 15-19, 7.5" of snow was reported, but temperatures stayed at or above the freezing point, rain mixed with the snow, and very little accumulation occurred. Another strong storm developed over the Thanksgiving weekend. Forecasts called for a big snow, but Fort Collins only got a dusting (0.3" snow) and some cold winds as the storm passed to the south.

December was a very gentle month. Nights were chilly, but days were sunny and mild almost all month. The strong chinook winds that often blow in mid-winter were practically absent. The only moisture came on December 19 and 20 (0.01" water equivalent from 0.3" snow). The eastern portions of the city also got a little snow on New Year's Eve. The Christmas holiday was amazing. From December 23-28 there was hardly a cloud in sight as

a large high pressure ridge covered the region. It was a very easy year for holiday travel. Despite the mild weather, influenza was widespread throughout the city, and there were plenty of sick children and grownups during the Christmas holidays.

January was a little more exciting. A brief but powerful snowstorm pounded parts of the State on January 7. The weather station measured 6.8" of fairly wet snow in approximately 8 hours with most of the snow falling between 5 a.m. and noon. Winds were also strong, and local schools closed for the day. It was a very unusual storm in that snowfall was heaviest out near I-25 (close to 12") while only a few inches fell in west Fort Collins near Horestooth Reservoir. No severe cold temperatures followed the snow, and the next three days were sunny, so most city streets except in the easternmost parts of town were quickly cleared. Another decent snow came on January 12 (4.7" of fluffy dry snow) followed by cold weather. Snow remained on the ground for 17 days from these two storms – the only lengthy period with snowcover all winter. A brief blast of arctic air moved in late on the 14th. Strong northerly winds created ground blizzards and dangerous chill factors. By the morning of the 15th, the temperature dropped to -2°F, the coldest reading of the winter. Two degrees below zero may sound pretty cold, but only twice in the previous 103 years has the coldest temperature of the year been warmer. The coldest temperature for the winter of 1982-83 was -1°F and it only managed to hit 0° back in 1930-31. The coldest temperature ever recorded at the official Fort Collins Weather Station was a cruel -41° back on February 1, 1951.

The remainder of January and all of February was dry and mild. No measurable precipitation fell from January 13 until March 4. There were a few windy days, but nothing out of the ordinary for this region. The weather station reported a maximum wind gust for

the year of 59 knots (68 mph) on January 24. Late February brought some very warm temperatures to the city including the first 70° reading of the year on February 28.

The weather took a dramatic turn from dry to wet on March 4 when a record 2.16" of rain fell in just over 24 hours. This was the heaviest rain that Fort Collins had ever experienced so early in the season, and most of the moisture soaked into the ground. Four days later, on Sunday, March 8, another storm struck. It turned out to be the snowstorm of the year. Afternoon showers with some local hail or ice pellets turned abruptly to snow about 5 p.m. For the next 10 hours snow fell like crazy and northerly winds howled. Residents were amazed by thunder and lightning that accompanied the storm that evening. Wet snow fell at rates of up to 3" per hour, quickly clogging city streets and making travel in rural areas next to impossible. Hundreds of Fort Collins residents returning from weekend ski trips or visits to Denver found themselves stranded. Many spent the night in their cars along I-25. Amazingly, there were no fatalities. When the snow ended early on the 9th, a total of 16.7" of snow had fallen. All schools including Colorado State University and many businesses were closed March 9.

Just a little more winter weather came along later in March, and then that was it for the year. The last snow was recorded March 22, much earlier than usual. The last really chilly morning of the spring came on April 1 when the mercury fell to 19°F. April was remarkably warm, culminating in a high temperature of 89° on April 30, very close to the hottest temperature ever reported in April. Measurable precipitation only fell on 4 days in April, but a 0.94" rain on April 16 encouraged the spring flowers. The final spring freeze occurred on April 25, when the temperature dropped to 29°F. That was more than one

week earlier than the average last spring freeze date. Gardeners and fruit growers were off to a good start.

The dry and unusually warm weather continued into May. The normal spring showers didn't materialize. Rapidly deteriorating mountain snowpack conditions raised fears of Front Range drought problems. Irrigation water demand soared. Then the weather patterns shifted again. The last week of May was very cool. There wasn't much outdoor recreation going on Memorial Day (May 25) as low gray clouds covered the sky and daytime temperatures barely reached 50°F. It got even colder on the 27th when the afternoon temperature only climbed to 43° after a morning low of 38°F. Parts of eastern Colorado suffered a damaging late freeze during this episode. The last week of May also brought welcome rains totalling 1.24". The first of 7 hail events for the season was reported at the weather station on May 31.

June was memorable in Fort Collins. Hot weather was almost non-existent (the highest temperature of the month was only 90° on the 30th). Thunderstorms were reported on 16 days. Hail fell 5 days (on the CSU campus – other parts of town may have had more or less). At least 4 windstorms brought winds of 40 mph or greater. The main highlights of the month were wicked thunderstorms on June 8 (1.45" of rain at the station) and June 24 (2.49" in 1 hour at the station). The June 24 storm was heaviest over the northern half of the city where more than 3" of rain fell in several areas. Considerable street and basement flooding occurred and it was a sad day for gardeners as vegetation was pummeled by wind-driven hail over parts of north and central Fort Collins. A detailed meteorological description of this storm was published by Doesken (1992).

Storms weren't as severe in July and August, but the cool showery weather continued. July 4th was perfect (80s and sunny), but thunder was heard on 19 days in July. Fifteen days in August had measurable precipitation, but most showers were very light. Unusually strong cold fronts (for mid summer) moved in on several occasions, and there were no prolonged periods of hot weather. The daily maximum temperature only exceeded 90°F 3 days all summer (4 other days equalled 90°F) and the highest temperature of the year was a modest 94° on August 9. An amazing 23 days, June-August had daily high temperature less than 75°F. Perhaps the most unusual episode of all came late in August when moisture remaining from Pacific Hurricane Lester moved northeastward and on Aug. 23 combined with a fall-like storm system over the Rockies. During the daylight hours on both Aug 24 and 25, Fort Collins temperatures remained in the 50s, and steady cold rains added up to nearly 2".

The water year ended with yet another dramatic change in weather patterns. Following the hurricane, sunshine prevailed, temperatures warmed, humidity dropped, and only 0.02" of rain fell through the end of September. The longest episode all year with maximum temperatures over 80° occurred in mid September – 7 consecutive days. In fact, there were as many days in September with temperatures above 80° as there had been in July.

Monthly and Seasonal Summaries of The Climate for the 1992 Water Year in Fort Collins, Colorado

The tables and graphs on the following pages provide detailed 1992 Fort Collins climate information in various formats on monthly, daily, and bi-hourly time scales.

Temperatures and Degree Days

Temperatures during the 1992 water year were very pleasant in Fort Collins (Figure 1 and Table 1). The mild winter and cool summer minimized energy costs and made outdoor living and working more comfortable than usual. The combined winter months, December through February, were 4.7 degrees above average and ranked as the 4th warmest on record since 1889. The spring, March-May ended up 4.1 degrees above average and was the warmest spring ever recorded here in Fort Collins. The summer (June-August) was just the opposite, 2.8 degrees cooler than average, the 18th coolest summer in 104 years of record and the coolest since 1951. The mean annual temperature ended up 50.3°F, 1.4 degrees above average, the 4th warmest year since 1889.

Heating degree days, which are an indicator of space heating requirements for homes, businesses and public facilities, totalled 5565 for the 1992 water year compared to the 1961-1990 average of 6368. This suggested that heating requirements were nearly 13% less than average. Likewise, cooling degree days which are related to energy requirements for air conditioning (cooling) totalled only 284 compared to an average of 479. This was one of the kindest years on record for energy requirements but a tough year for suppliers' profit margins.

Crop growth near Fort Collins was influenced by above average growing degree day totals (base 65°F) during the spring and fall months, but below average heat units during the

mid-summer months. Overall, heating degree day totals for the growing season were close to average.

Precipitation and Snowfall

The 1992 water year precipitation had its ups and downs (Figure 2 and Table 2). It included the driest February, the 2nd driest September, the 2nd wettest March and the 3rd wettest June since complete records began in 1889. Six months were drier than average and six months were wetter. Total precipitation (20.47") was well above average and ranked as the 9th wettest year in Fort Collins since records began in 1889. Two months, March and June, accounted for all of the excess. In semiarid regions, such as the Fort Collins area, much of the precipitation for a year typically falls from a few heavy storms. This was certainly the case in 1992. Seven individual storms, most of which lasted just a few hours, contributed 11.65" to the annual total. The story of 1992 could have been much different had just a few storms followed a slightly different track.

It was a similar story for snowfall (Tables 2 and 3, Figures 3 and 4). Measurable snow fell on 23 days with at least 1" on 12 days. These totals are significantly fewer than average. But when it did snow, it snowed hard. Water-year snowfall totalled 50.3", only a little below average. More than 70% of the snow fell from just four storms. Most snow melted quickly this winter, and the days with snow on the ground (32) were fewer than normal.

Humidity, Wind And Evaporation

Humidity, wind and evaporation data are displayed in Table 4 and in Figures 5 and 6. The main feature of the 1992 water year was the unusually high relative humidities observed from late May into late August averaging close to 60%. Winds were quite light during the year and averaged just over 5.5 miles per hour. April was the windiest month. Please note that the weather station is very representative of conditions observed within areas of the city having relatively tall trees and moderate building density. Wind speeds are almost always higher in open areas and in the rural areas outside of Fort Collins. The strongest wind gust for the year occurred in January, 68 mph. Historically, strong winds in January are not unusual, and a peak gust of 68 mph for the year is close to average. The most interesting features of the strong wind patterns in Fort Collins during the year (Figure 8) were the lack of strong winds observed in March followed by the large number of windy days noted in June and September.

Evaporation rates are a function of temperatures, humidity, wind and solar radiation. Evaporation observed from the Class A pan at the CSU Weather Station was above average in March, April and much of May but was consistently less than average from late May through August. In combination with the above average precipitation over that period, Fort Collins ended up enjoying one of its greenest summers in recent memory. City water use, which is dominated by irrigation demand during the summer, was much less than expected as a result of these unusual weather conditions.

Sunshine, Cloud Cover and Solar Radiation

Clear days (0-30% cloud cover) totalled 109 during the 1992 water year in Fort Collins with December and January contributing the most clear days (Table 5). The most unusual features for the year were the cloudy weather in November and the persistent above average cloud cover (and below average solar radiation) during the summer. The 27 cloudy days (80-100% cloud cover sunrise-sunset) during July and August was the greatest summer cloudcover in many years. Solar energy, as measured on a horizontal surface, ended up at 15.5 megajoules per square meter per day which is about 2% below average. The annual distribution is shown in Figure 7. The dense and persistent cloudiness near the end of May and the late August rainy period are both very evident on this graph.

Soil Temperatures

The Fort Collins Weather Station closely monitors soil temperatures throughout the year at several depths from the surface to ten feet down. Soil temperatures are important for agriculture, but they also affect utilities, transportation and construction. Variations in energy consumption of many buildings show a small dependence on soil temperatures. The progression of soil temperatures through the year are shown in Figure 8. Soil temperatures, especially near the surface, are closely related to fluctuations in air temperature. After getting off to a cool start after Halloween, soil temperatures remained warmer than normal for most of the winter. The deepest frost penetration during the year was only about ten inches – not as deep as usual. Spring soil temperatures were generally warmer than average but then rose less than usual during the cooler than average summer. Episodic

weather changes and periods of heavy precipitation had a very noticeable affect on soil temperatures even as deep as 36 inches.

Daily Occurrences

Tables 3 and 6 summarize the number of occurrences of various weather phenomena. There were 86 days on which measurable precipitation fell during the year, 7 more than average. There were ten days on which at least 0.50" of precipitation fell (two more than average). Only 5 days received 3" or more of snowfall. The temperature reached or exceeded 90°F 7 times during the year compared to an average of 18 days. There was also a lack of extreme cold weather. There were only eight days with daily maximum temperatures of 32° or below compared to an average of 23 days. Also, there were only two days with minimum temperatures of 0°F or less compared to an average of 10. Thunder occurred on 60 days and hail occurred on 7 days. Wind gusts exceeded 40 mph on 27 days during the year. The greatest number of days with strong gusts occurred in June (very unusual) with 5.

Extremes

Table 7 lists the extremes of temperature, precipitation, snowfall, wind and hail observed during the 1992 water year. All new record temperatures, precipitation and snowfall established in 1992 are tabulated in Table 8. Two new daily record high temperatures were set during the year and one record minimum. Five new daily precipitation records were set and 3 record snowfalls. The 2.49" rainfall in just over one

hour on 24 June 1992 ranked as one of the heaviest short duration rains in Fort Collins' recorded history.

Climate Impacts

Climate continually has direct and indirect impacts on the natural world and also on society and our physical infrastructure. Table 9 identifies some of the obvious impacts that the climate of the 1992 water year had on Fort Collins.

Historical Perspective

Seasonal temperatures, precipitation, and snowfall for the 1992 water year are presented in historical perspective in Figure 9-14. The December-February winter months (Fig. 9) were one of the warmest winters since Fort Collins complete temperature records began over 100 years ago. Only 1934, 1954 and 1981 have been warmer. March-May 1992 (Fig. 10) was clearly the warmest spring ever observed in Fort Collins. Then along came the summer (Figure 11) – the coolest in several decades. The mean annual temperature (Figure 12) ended up well above average, continuing to indicate a long-term warming trend for this area. With out a doubt, 1992 will go down as a very unusual year for Fort Collins in terms of observed temperatures.

Accumulated precipitation for the 1992 water year fell many inches short of the 1961 record, but was still unusually wet (Figure 13) and the wettest since 1982. Long-term records show no detectable trend toward either wetter or drier conditions. Of interest is the fact that it has been 20 years since Fort Collins has had a year with less than 12 inches of

precipitation. Historically, years with less than 12 inches of precipitation have occurred at least once per decade.

Snowfall (Figure 14) was slightly below average and was considerably less than many of the snowy years that have occurred in the recent past. Fort Collins data suggests that a long-term trend toward heavier snowfall has been occurring.

Detailed Daily Weather Depiction

Climate is the integrated result of our ever changing weather. Figures 15 - 26 graphically portray month by month, the continuous changes in temperature (Degrees F), dew point temperature (Degrees F), wind speed (knots), wind direction (degrees – North = 360°, South = 180°), relative humidity (percent), atmospheric pressure (inches of Mercury), solar radiation (watts per square meter), sky cover (percent) and visibility (miles) that Fort Collins experienced during the 1992 water year. The data from which these graphs were constructed are available digitally from the Colorado Climate Center.

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**Table 1. Summary of Monthly Temperature and Degree Day Data
Fort Collins, CO -- 1992 Water Year**

MONTH	Temperatures in Degrees Fahrenheit							Temperature-based Degree Days						
	Mean Max	Departure from		Mean Min	Departure from		Mean Monthly	Departure from	Heating (Base 65)		Cooling (Base 65)		Growing (Base 50)	
		Average	Average		Average	Average			WY 1992	1961-90	WY 1992	1961-90	WY 1992	1961-90
OCT	66.0	1.7	34.2	-1.0	50.1	0.3	61	457	471	3	0	--	--	
NOV	45.9	-4.7	24.2	-0.2	35.1	-2.4	34	891	825	0	0	--	--	
DEC	46.2	4.2	18.4	2.3	32.3	3.2	81	1002	1113	0	0	--	--	
JAN	44.9	3.6	18.2	4.1	31.5	3.8	89	1029	1156	0	0	--	--	
FEB	52.7	7.2	26.0	6.8	39.4	7.0	103	736	913	0	0	--	--	
MAR	55.3	3.8	30.4	5.3	42.8	4.5	99	681	828	0	0	--	--	
APR	67.5	6.3	38.2	4.5	52.9	5.4	102	356	525	3	0	--	--	
MAY	72.8	3.0	45.0	2.0	58.9	2.5	95	193	272	10	5	364	245	
JUN	77.0	-2.7	51.3	-0.3	64.2	-1.5	52	56	77	37	98	447	485	
JUL	80.8	-4.7	54.9	-2.5	67.9	-3.6	19	22	0	115	205	556	680	
AUG	78.8	-4.3	52.8	-2.3	65.8	-3.3	7	55	12	88	139	501	530	
SEP	78.5	3.9	46.9	1.0	62.7	2.5	88	87	176	28	32	454	370	
ANNUAL	63.9	1.4	36.7	1.6	50.3	1.5	100	5565	6368	284	479	2322	2310	

1 = COOLEST
104 = WARMEST

**Table 2. Summary of Monthly Precipitation and Snowfall
Fort Collins, Colorado -- 1992 Water Year**

MONTH	Total Precip. (inches)	Departure from Average	1889-1992 Ranking	Total Snowfall (inches)	Departure from Average	1889-1992 Ranking
OCT	0.69	-0.28	44	8.4	4.9	90
NOV	1.48	0.78	97	9.8	1.6	83
DEC	0.01	-0.50	8	0.3	-8.5	15
JAN	0.63	0.20	89	11.6	3.7	90
FEB	T	-0.39	1	T	-6.9	3
MAR	4.44	3.09	103	20.2	7.4	91
APR	1.23	-0.53	34	0	-6.5	8
MAY	1.59	-1.09	24	0	-1.5	57
JUN	5.78	3.88	102	0	0	--
JUL	1.96	0.14	70	0	0	--
AUG	2.64	1.38	93	0	0	--
SEP	0.02	-1.28	2	0	-0.9	86
ANNUAL	20.47	5.4	95	50.3	-6.7	

1 = DRIEST
103 = WETTEST

1 = LEAST
103 = MOST

**Table 3. Summary of Daily Occurrences of Precipitation and Snowfall
Fort Collins, Colorado -- 1992 Water Year**

MONTH	Precip. .01 inches or more	Precip. .10 inches or more	Precip. .50 inches or more	Snow .1 inch or more	Snow 1 inch or more	Snow 3 inches or more	Snow on ground one inch or more
OCT	5	3	0	2	1	1	2
NOV	11	6	0	10	5	0	7
DEC	1	0	0	2	0	0	0
JAN	2	2	0	3	2	2	17
FEB	0	0	0	0	0	0	0
MAR	10	6	3	6	4	2	6
APR	4	3	1	0	0	0	0
MAY	12	4	1	0	0	0	0
JUN	11	7	3	0	0	0	0
JUL	13	4	1	0	0	0	0
AUG	15	4	1	0	0	0	0
SEP	2	0	0	0	0	0	0
ANNUAL	86	39	10	23	12	5	32

**Table 4. Summary of Monthly Relative Humidity,
Mean Dew Point, Wind Speeds and Pan Evaporation.
Fort Collins, CO -- 1992 Water Year**

MONTH	Mean RH %	Mean Dew Point (Deg. F)	Mean Wind Speed (mph)			Monthly Pan Evap. (inches)	Monthly Departure from Average (inches)
			Night	Day	All		
OCT	52	28.9	4.9	5.8	5.4	3.80	0.52
NOV	66	22.4	5.2	6.2	5.7	--	--
DEC	54	14.8	4.4	5.3	4.9	--	--
JAN	58	15.8	4.9	5.6	5.2	--	--
FEB	47	18.5	5.2	6.8	6.0	--	--
MAR	61	28.0	4.9	6.2	5.6	2.98	0.69
APR	49	32.9	5.4	7.4	6.4	5.45	0.56
MAY	57	41.8	5.3	6.5	5.9	5.67	-0.47
JUN	60	48.3	4.8	6.8	5.8	6.01	-1.18
JUL	57	50.6	4.2	6.3	5.3	6.35	-1.43
AUG	61	50.0	4.1	6.1	5.1	5.47	-0.89
SEP	48	40.5	4.4	6.1	5.2	5.46	0.39
ANNUAL	55.8	32.7	4.8	6.3	5.5	41.19	-1.81

**Table 5. Summary of Monthly Sky Cover, Solar Radiation on a Horizontal Surface, Clear, Partly Cloudy and Cloudy Days and Actual Station Pressure.
Fort Collins, CO -- 1992 Water Year**

MONTH	% Monthly Sky Cover	Monthly Solar (Mj/Sq M - day)	% Above or Below Average	NUMBER OF DAYS			Station Pressure (in.)
				Clear	Partly Cloudy	Cloudy	
OCT	42	13.96	4.18	13	11	7	25.00
NOV	62	8.25	-8.33	4	14	12	25.00
DEC	33	7.60	-1.30	16	9	6	25.01
JAN	40	8.89	1.02	17	7	7	24.99
FEB	46	12.47	5.68	12	8	9	24.98
MAR	56	14.38	-8.99	3	14	14	24.94
APR	53	19.72	4.34	7	11	12	24.95
MAY	58	20.25	-4.48	5	13	13	25.02
JUN	54	22.90	-2.97	5	16	9	24.96
JUL	55	21.28	-5.84	7	10	14	25.04
AUG	50	17.96	-10.65	7	11	13	25.12
SEP	34	18.48	9.35	13	13	4	25.03
ANNUAL	48.6	15.5	-1.9	109	137	120	25.00

Table 6. Summary of Daily Occurrences of Temperatures above and below given thresholds, thunder, hail and strong winds. Fort Collins, CO -- 1992 Water Year

NUMBER OF DAYS

MONTH	TMAX 90 and above	TMAX 32 and below	TMIN 32 and below	TMIN 0 and below	Thunder	Hail	Wind Gust greater than 40 MPH
OCT	0	2	9	0	0	0	1
NOV	0	3	25	1	0	0	3
DEC	0	2	31	0	0	0	2
JAN	0	1	31	1	0	0	4
FEB	0	0	23	0	0	0	2
MAR	0	0	22	0	2	0	0
APR	0	0	6	0	3	0	3
MAY	0	0	0	0	6	1	1
JUN	1	0	0	0	16	5	5
JUL	2	0	0	0	19	0	2
AUG	4	0	0	0	12	1	0
SEP	0	0	0	0	2	0	4
ANNUAL	7	8	147	2	60	7	27

**Table 7. Selected Climate Extremes for the 1992 Water Year.
Fort Collins, CO**

Annual Extremes

Highest Temperature	94°F	9 August 1992
Lowest Temperature	-2°F	15 January 1992
Greatest 1-Day Precipitation	2.49"	24 June 1992 – Most Fell in 1 Hour
Greatest Snowfall	12.7"	9 March 1992
Greatest Snowstorm	16.7"	8-9 March 1992 – Most Fell in 12 Hours
Largest Hail	3/4"	24 June 1992
Strongest Wind	68 MPH	24 January 1992

Table 8. New Record Temperatures, Precipitation and Snowfall Tied for Broken During the 1992 Water Year, Fort Collins, CO.

DATE	VALUE	TYPE OF RECORD
10/16	88°F	Record maximum for date – tied for record maximum for month of October.
10/17	67°F	Record high mean temperature for date, old record 61° in 1988.
10/30	21°F	Record minimum max for date, old record 28° in 1972.
10/30	21°F	Record low maximum for month, old record 26° in 1917 and 1969.
10/30	16°F	Record low mean temperature for date, old record 22° in 1905.
10/30	8.0"	Record snowfall for date, old record 5.0" in 1905.
11/2	21°F	Record low maximum for date, old record 26° in 1951.
11/3	-1°F	Record minimum for date, old record +7 in 1936.
1/7	0.46"	Record precipitation for date, old record 0.25" in 1891.
1/7	6.8"	Record snowfall for date, old record 3.5" in 1912 and 1921.
2/3	37°F	Record high minimum for date, old record 33° in 1890.
2/27	44°F	Record high minimum for date, old record 37° in 1986.
2/27	55°F	Record high mean temperature for date, old record 52° in 1972.
3/4	1.98"	Record precipitation for date, old record 0.64" in 1892.
3/9	0.95"	Record precipitation for date, old record 0.59" in 1958.
3/9	12.7"	Record snowfall for date, old record 5.0" in 1923.
4/11	45°F	Record high minimum for date, old record 44° in 1982.
4/30	89°F	Record maximum for date, old record 83° in 1955.
4/30	89°F	Record maximum for month, old record 88° in 1989.
4/30	68°F	Record high mean temperature for date, old record 65° in 1988.
6/24	2.49"	Record precipitation for date, old record 0.66" in 1958.
7/16	64°F	Record low maximum for date, old record 71° in 1899.
8/24	1.54"	Record precipitation for date, old record 0.58" in 1921.
8/24	60°F	Record low maximum for date, old record 63° in 1915.
8/24	55°F	Record low mean for date, old record 56° in 1915.
8/25	57°F	Record low maximum for date, old record 64° in 1915.

Table 9. Selected Impacts of the 1992 Water Year Climate on Fort Collins.

Impact	
1)	Considerable tree damage and mortality from Halloween cold wave.
2)	Low energy bills due to mild winter and lack of extreme cold events.
3)	Low energy bills for summer air conditioning and water pumping.
4)	Very low summer water demand in the city. Grasses could survive, even without irrigation, since >10" rain fell June-August.
5)	Great fruit crops from local fruit trees, even peaches. Fruit bruised by hail, however, in parts of city.
6)	Easy commuting year for cars and bicycles. Major transportation disruption by 2 snowstorms, each lasting 12-18 hours. Only a few other minor disruptions from snow and ice accumulation. Street deterioration not bad.
7)	Moderate agriculture hail damage from June storms, not much structural damage.
8)	Significant urban flood damage from June 24 storm.
9)	Public schools closed twice, CSU closed one day due to snowstorms.
10)	Minimal wind damage.

DAILY TEMPERATURES -- 1992 WATER YEAR FORT COLLINS, COLORADO

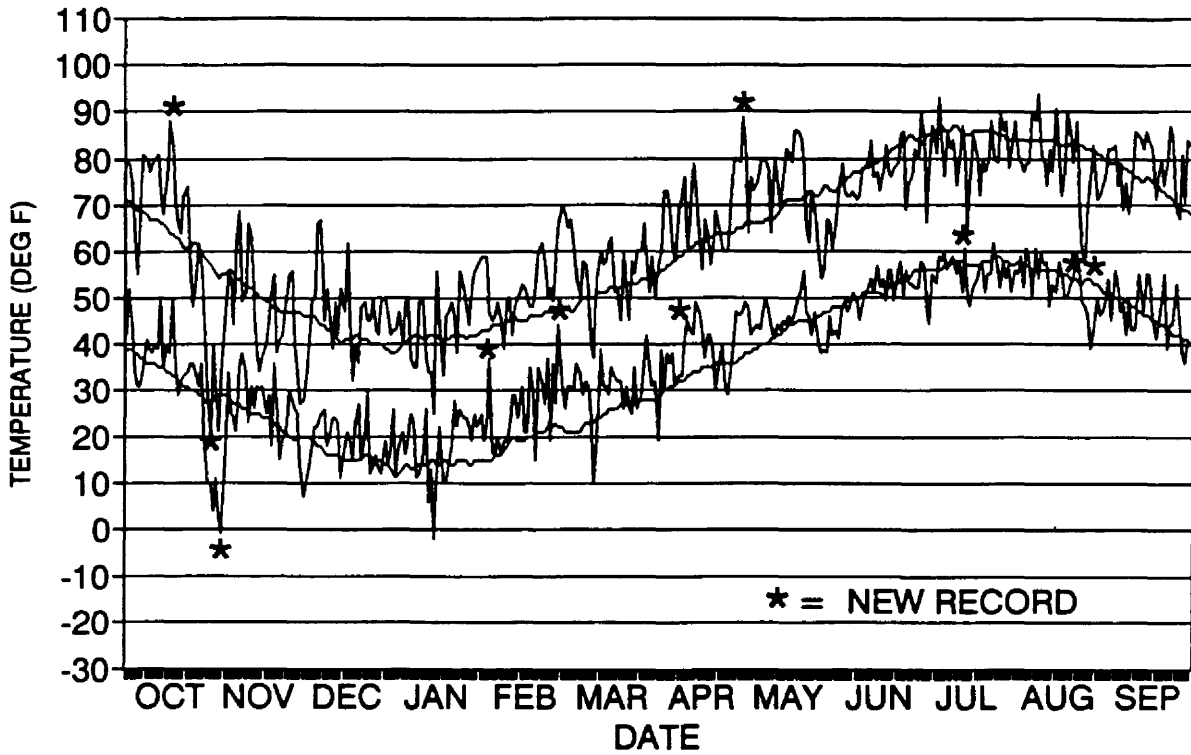


Figure 1. Daily maximum and minimum temperatures for the 1992 water year and comparison to 1961-1990 averages.

PRECIPITATION -- 1992 WATER YEAR FORT COLLINS, COLORADO

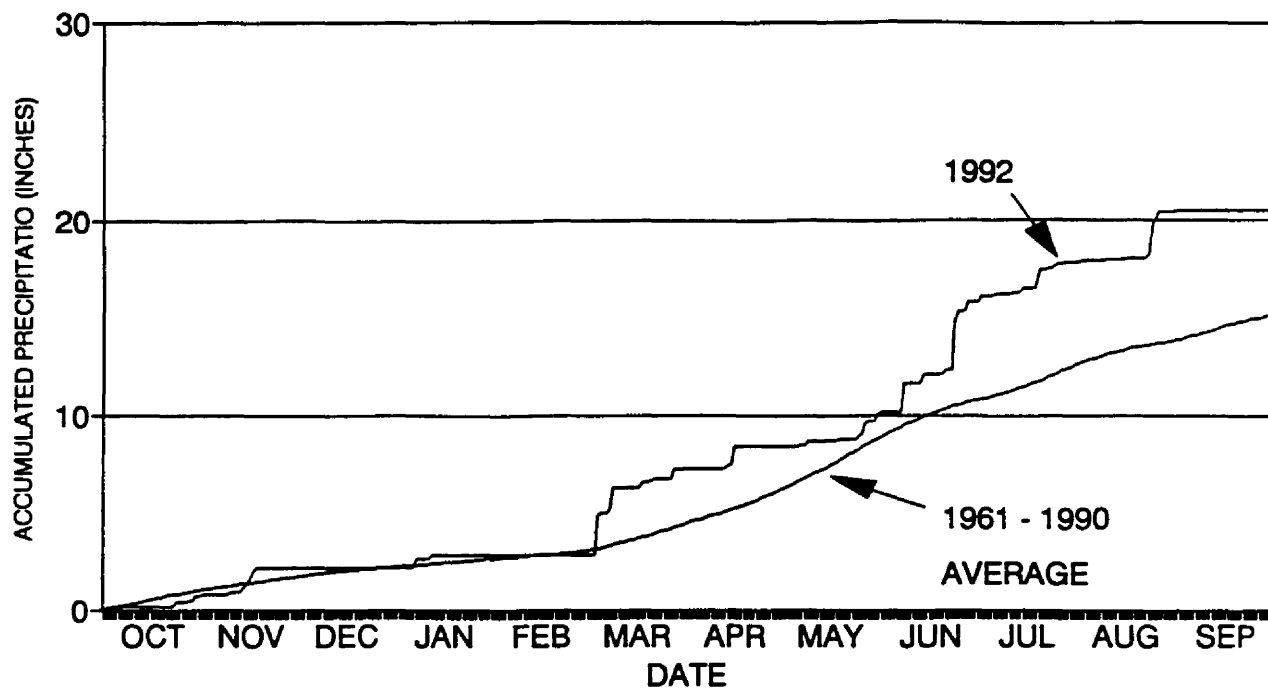


Figure 2. Daily precipitation accumulation in Fort Collins, Colorado for the 1992 water year in comparison to the 1961-1990 average.

SNOWFALL -- 1992 WATER YEAR FORT COLLINS, COLORADO

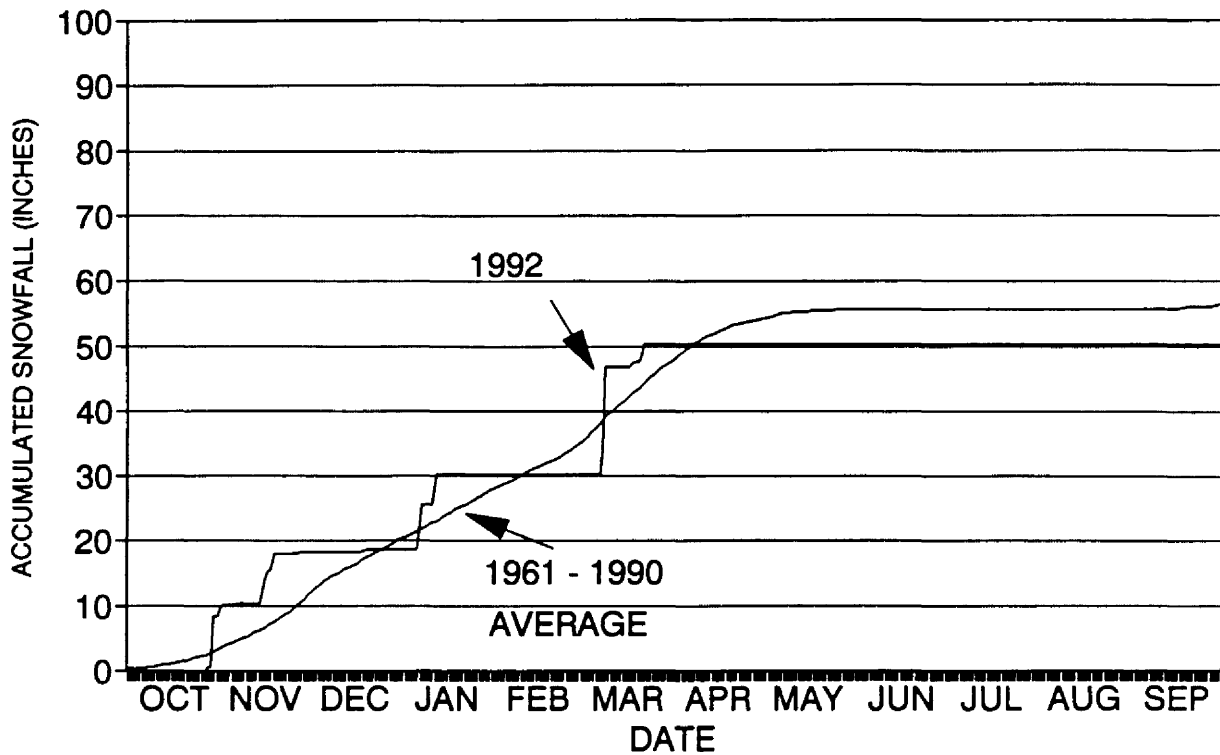


Figure 3. Daily snowfall accumulation in Fort Collins, Colorado for the 1992 water year in comparison to the 1961-1990 average.

SNOW ON GROUND -- 1992 WATER YEAR
FORT COLLINS, COLORADO

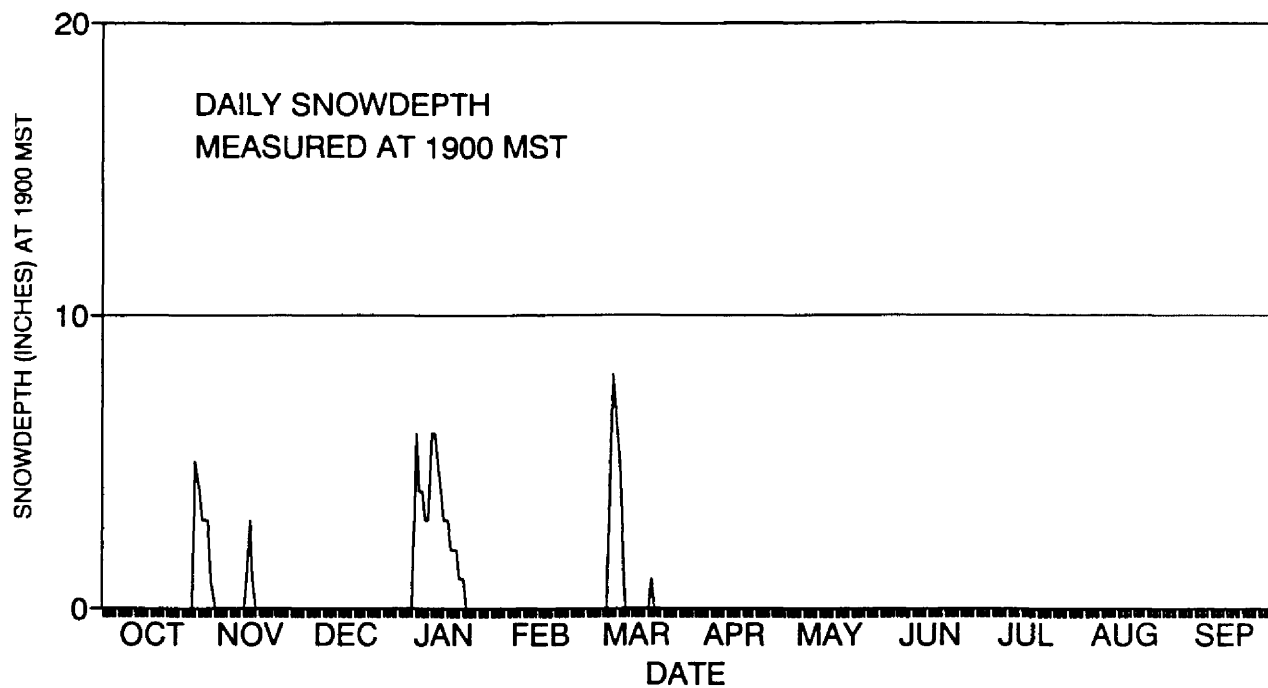


Figure 4. Daily snow depth in Fort Collins, Colorado for the 1992 water year.

DAILY EVAPORATION -- 1992 WATER YEAR
FORT COLLINS, COLORADO

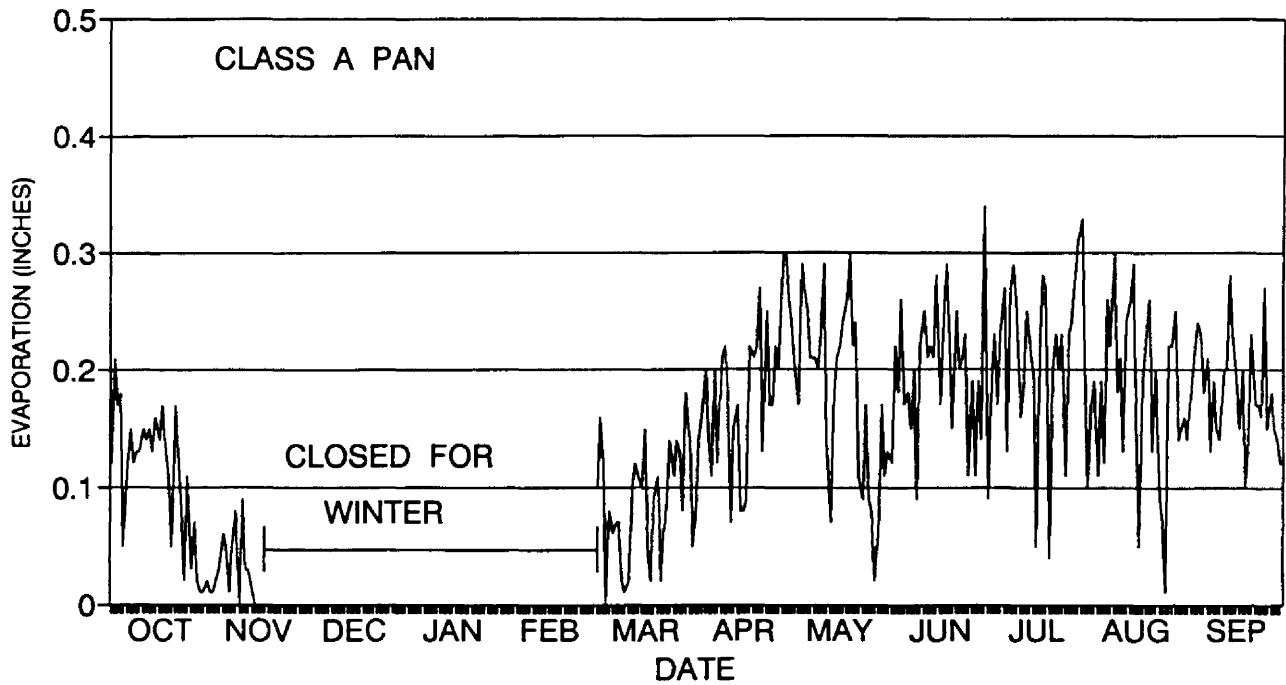


Figure 5. Daily Class-A pan evaporation data for Fort Collins, Colorado for the 1992 water year.

MAXIMUM DAILY WIND GUST FORT COLLINS, COLORADO

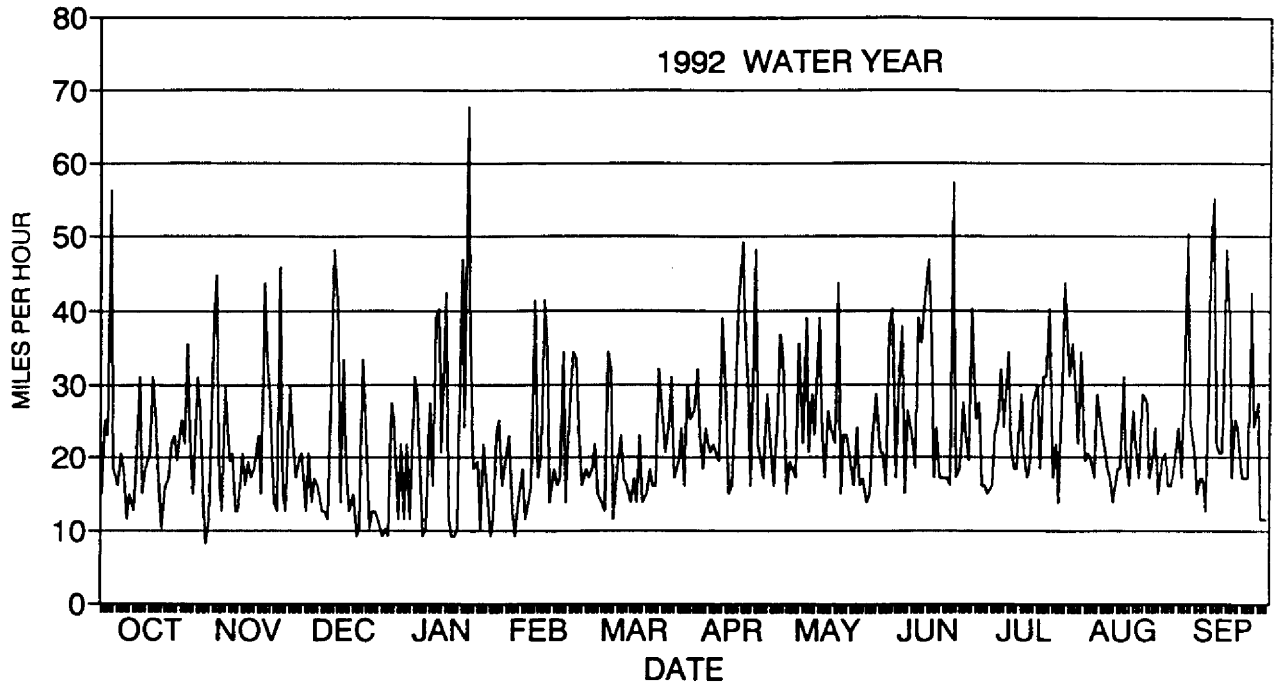


Figure 6. Daily peak wind gusts at the Fort Collins, Colorado main campus weather station. The anemometer is 60 feet above ground but is positioned in a relatively protected campus environment.

DAILY HEMISPHERIC SOLAR RADIATION FORT COLLINS, COLORADO

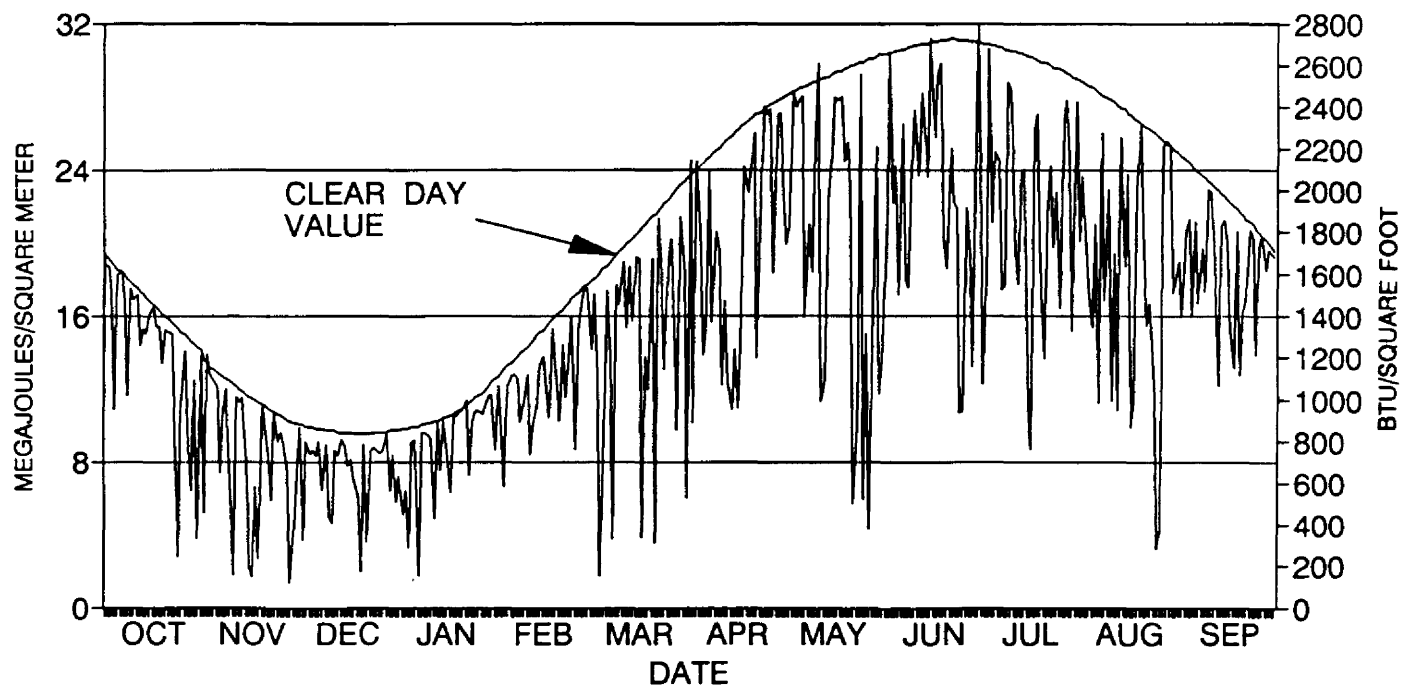


Figure 7. Daily solar radiation on a horizontal surface for Fort Collins, Colorado and comparison to typical clear-day values.

SOIL TEMPERATURES AT 0700 MST FORT COLLINS, COLORADO

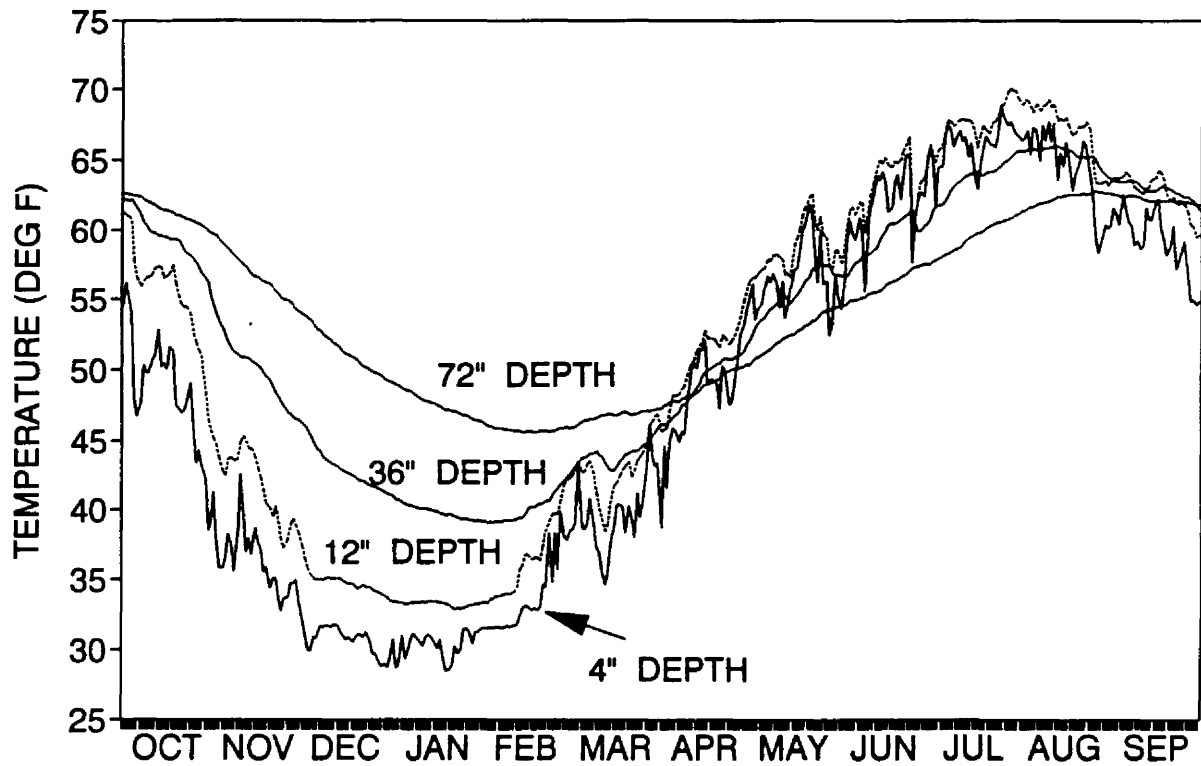


Figure 8. Daily soil temperatures at selected depths for Fort Collins, Colorado for the 1992 water year.

MEAN WINTER (DEC - FEB) TEMPERATURES FORT COLLINS, COLORADO 1890 - 1992

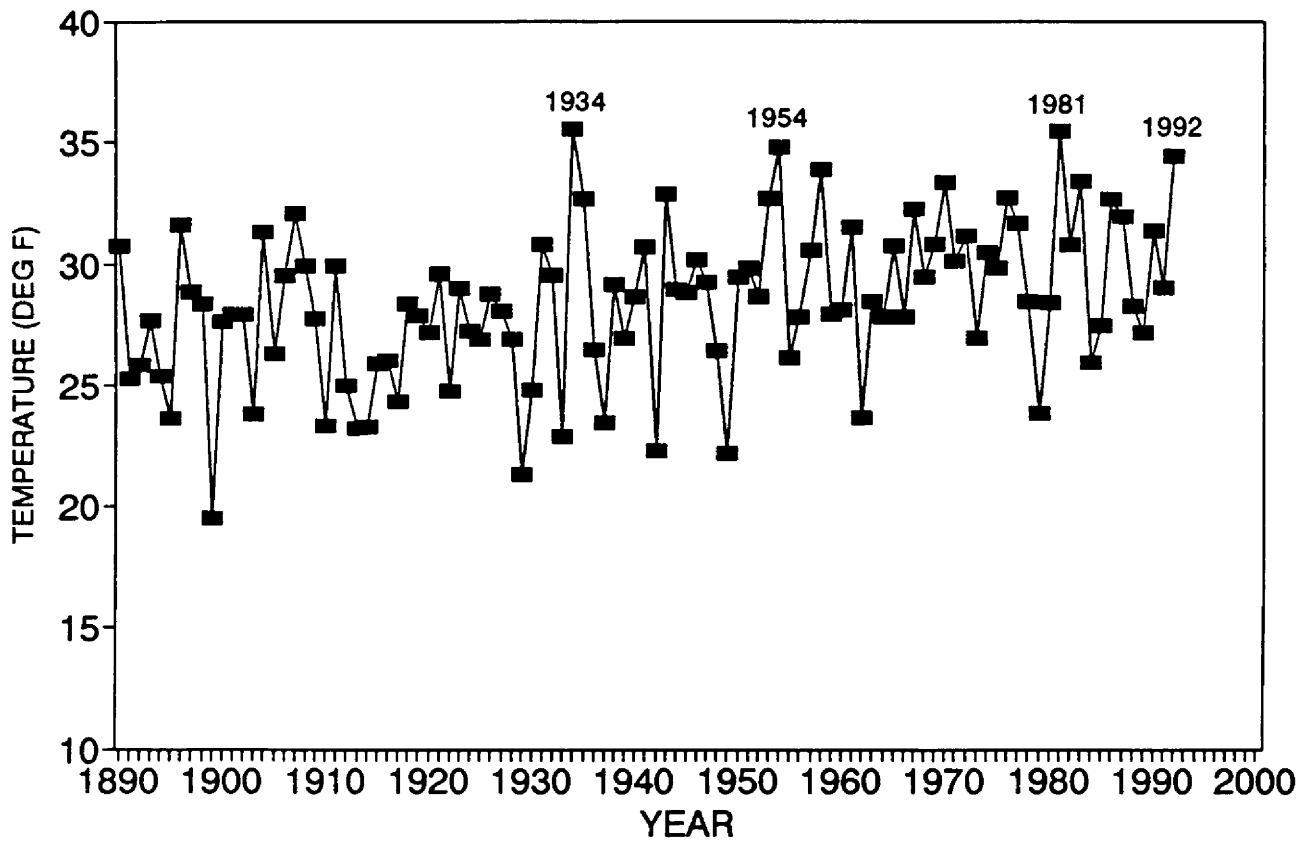


Figure 9. Time series of Fort Collins mean winter temperatures (December-February), 1890-1992.

MEAN SPRING (MARCH - MAY) TEMPERATURES FORT COLLINS, COLORADO 1889 - 1992

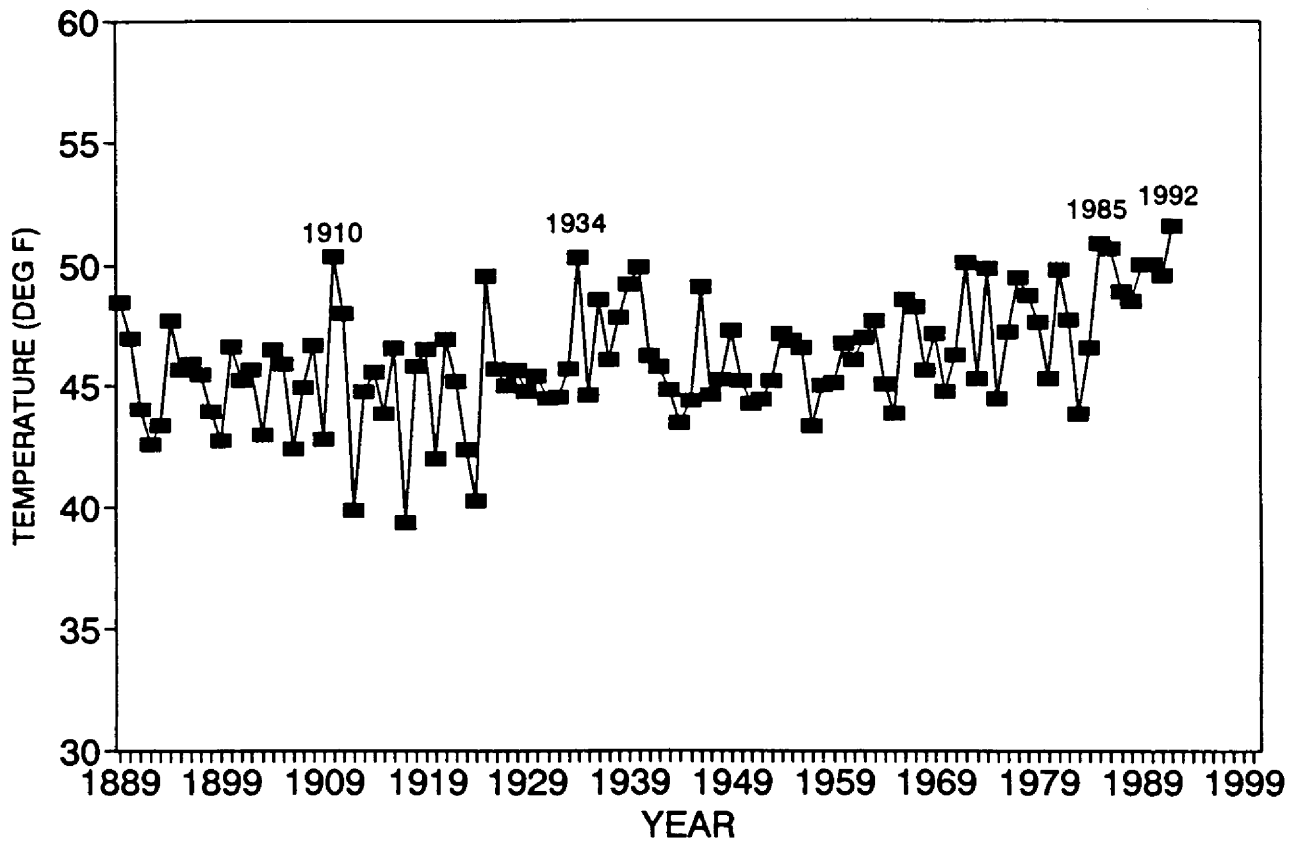


Figure 10. Time series of Fort Collins mean spring temperatures (March-May), 1889-1992.

MEAN SUMMER (JUNE - AUG) TEMPERATURES FORT COLLINS, COLORADO 1889 - 1992

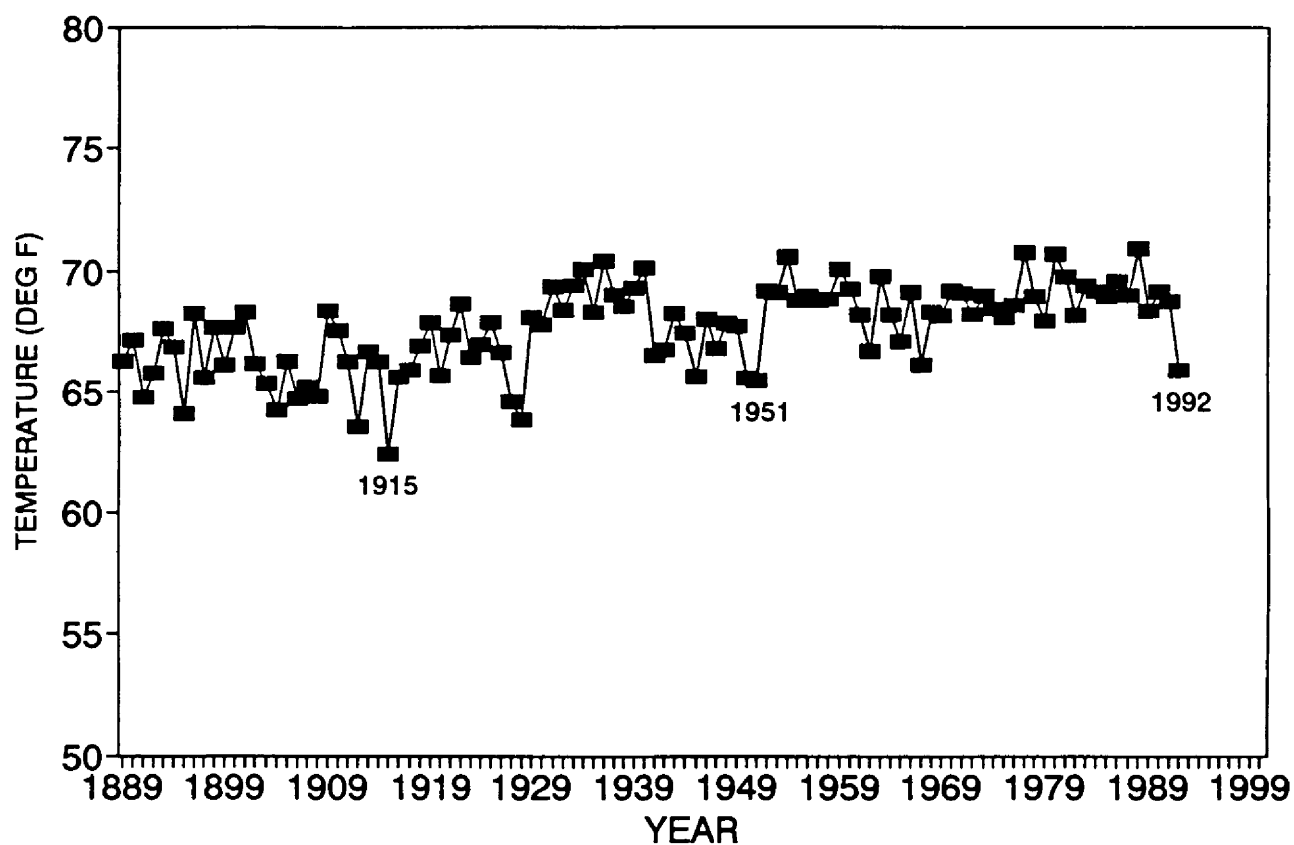


Figure 11. Time series of Fort Collins mean summer temperatures (June-August), 1889-1992.

MEAN ANNUAL (OCT - SEP) TEMPERATURES FORT COLLINS, COLORADO 1890 - 1992

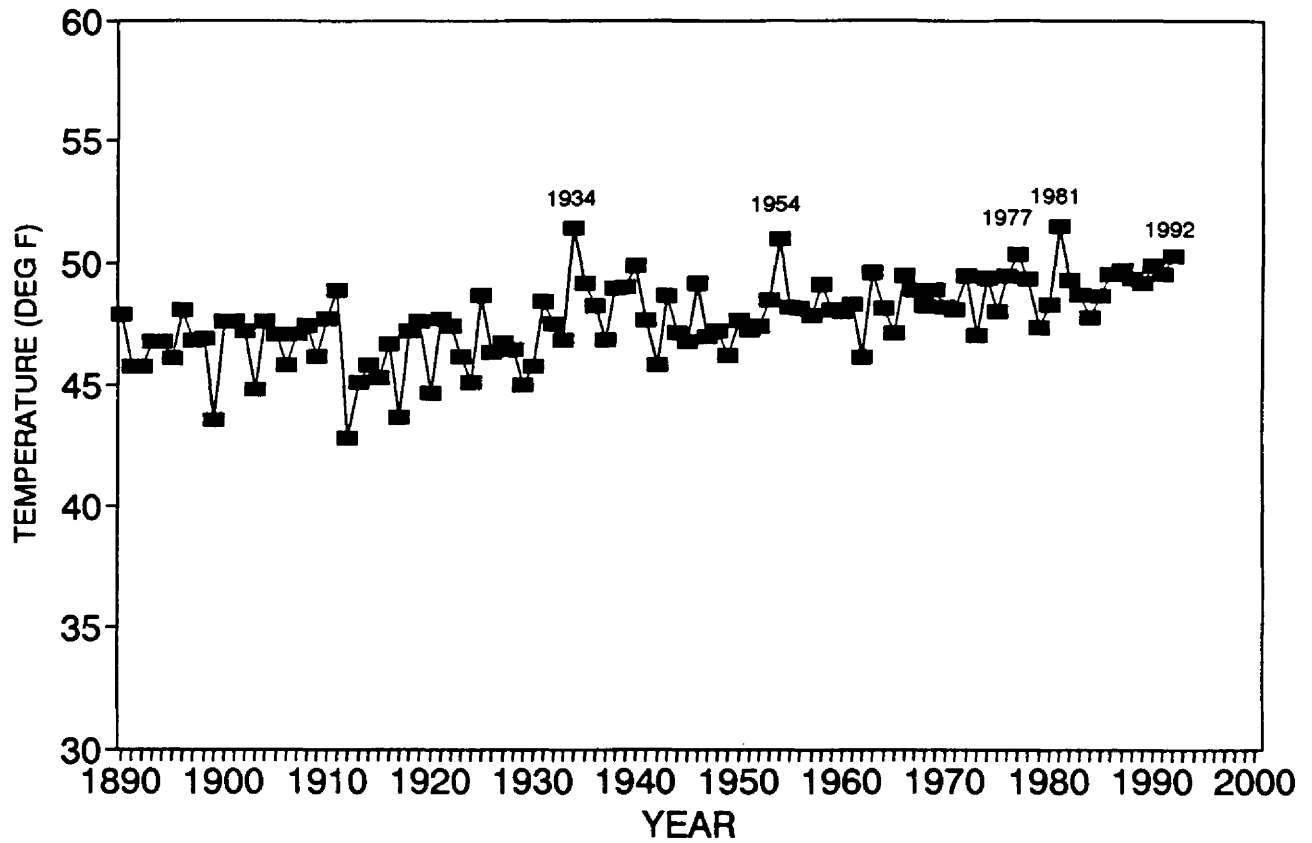


Figure 12. Time series of Fort Collins mean annual (water year) temperatures, 1890-1992.

WATER-YEAR PRECIPITATION TOTALS FORT COLLINS, COLORADO 1890 - 1992

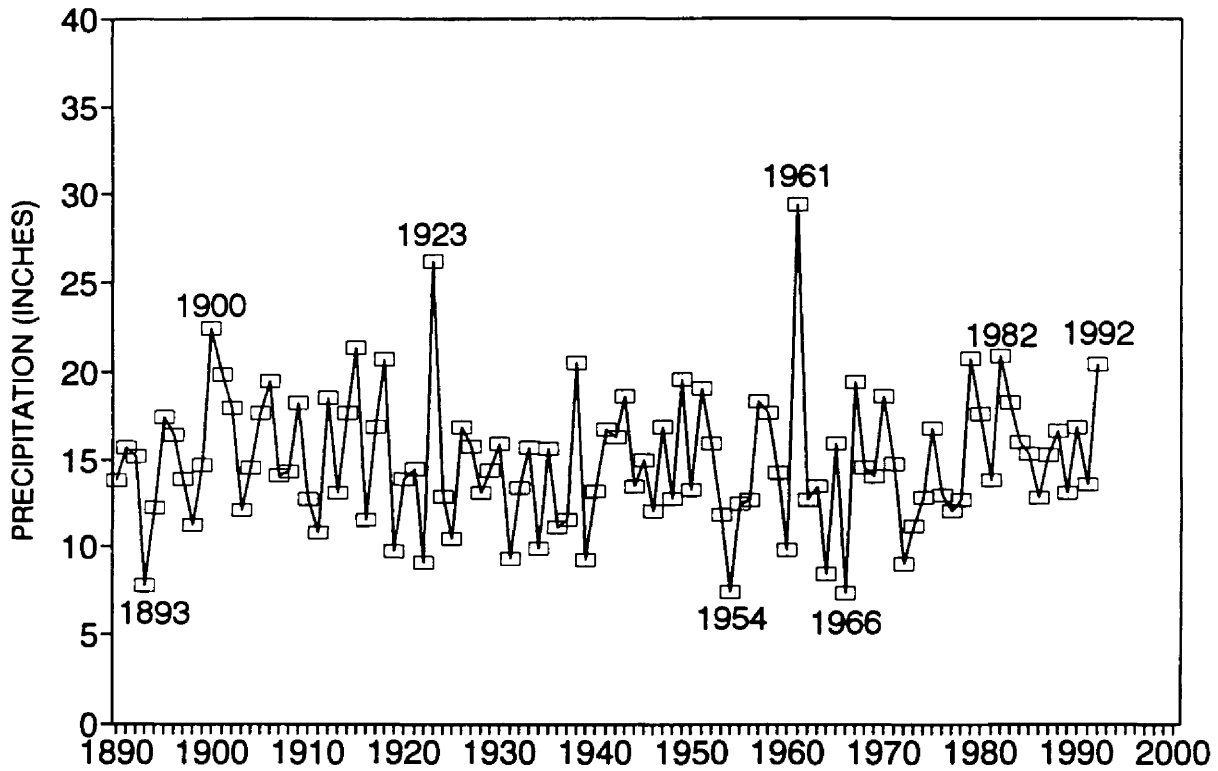


Figure 13. Time series of Fort Collins water year precipitation totals, 1890-1992.

SEASONAL SNOWFALL TOTALS, 1890-1992 FORT COLLINS, COLORADO

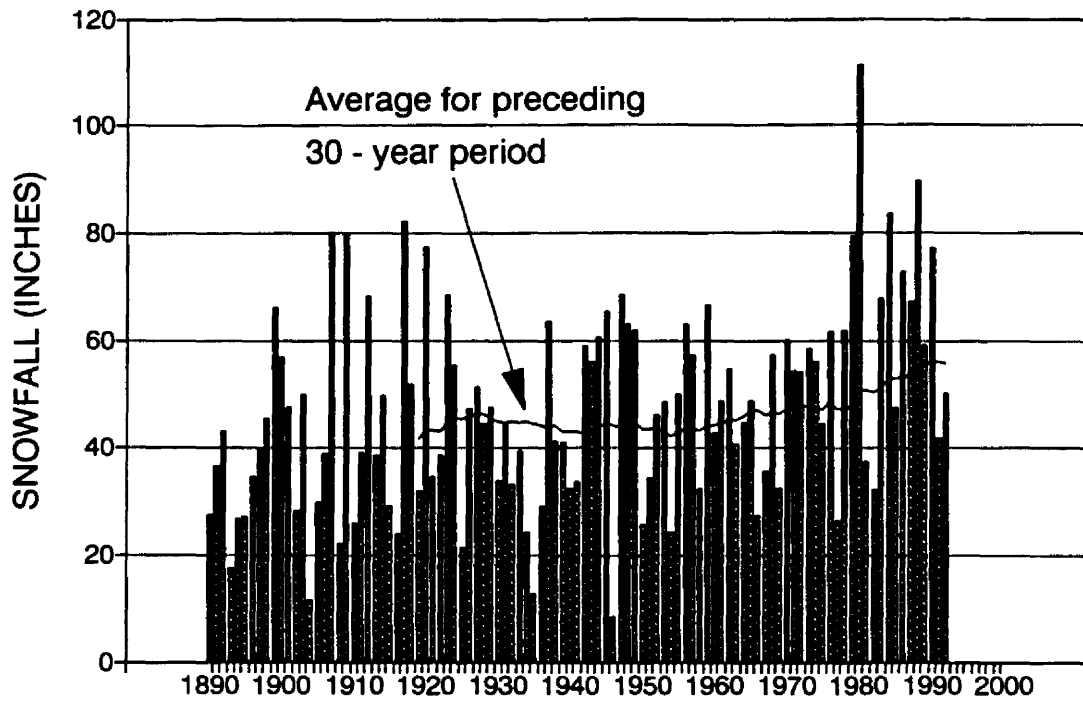


Figure 14. Time series of Fort Collins seasonal snowfall totals, 1890-1992.

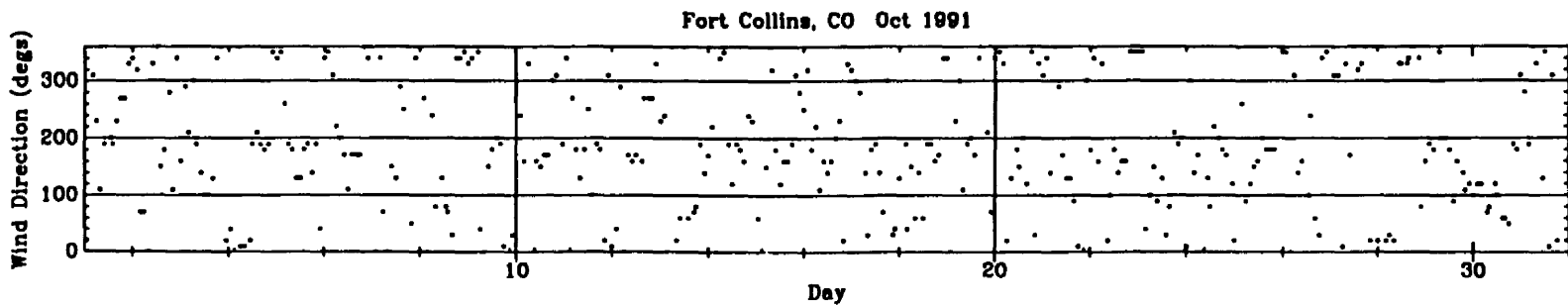
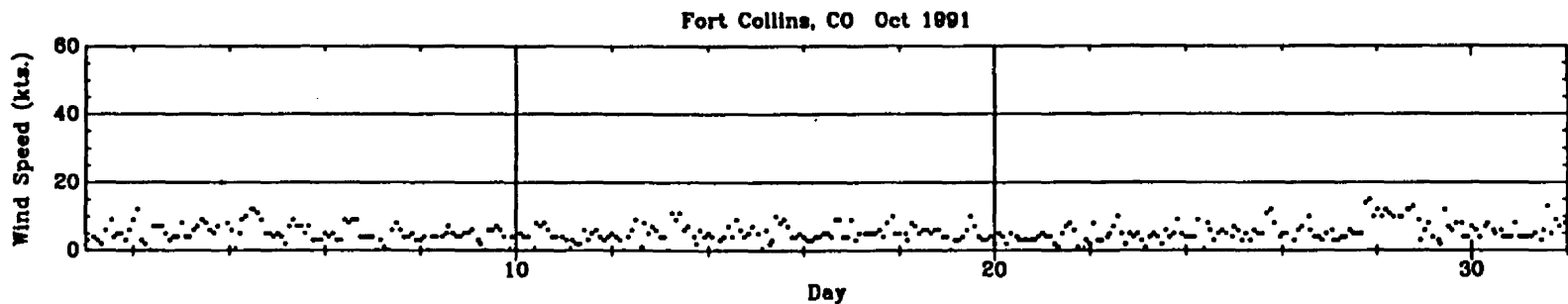
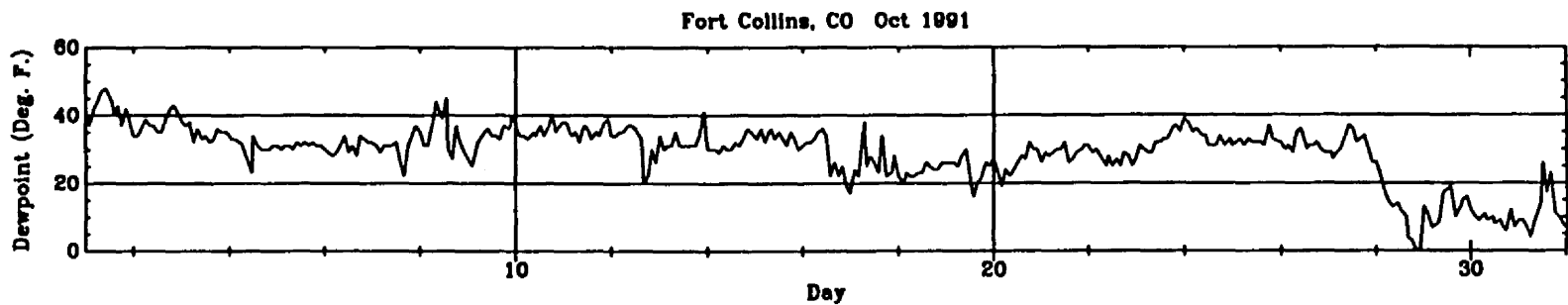
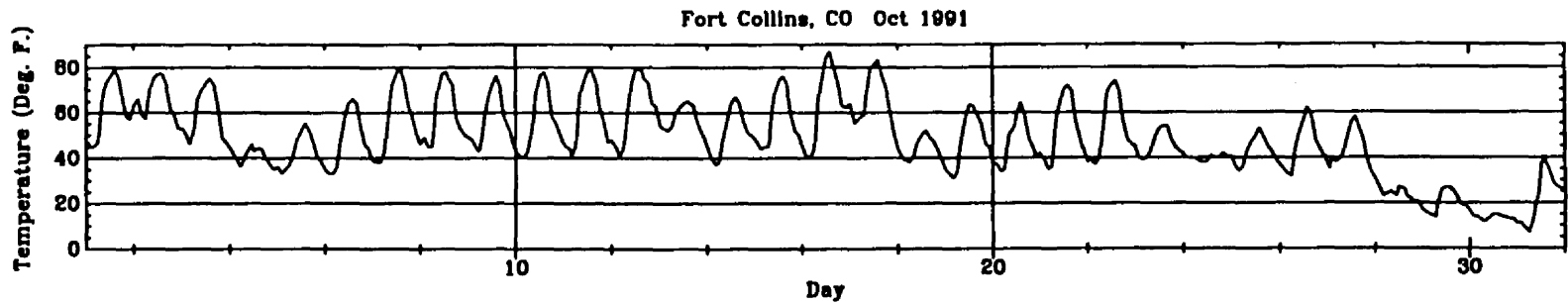


Figure 15a.

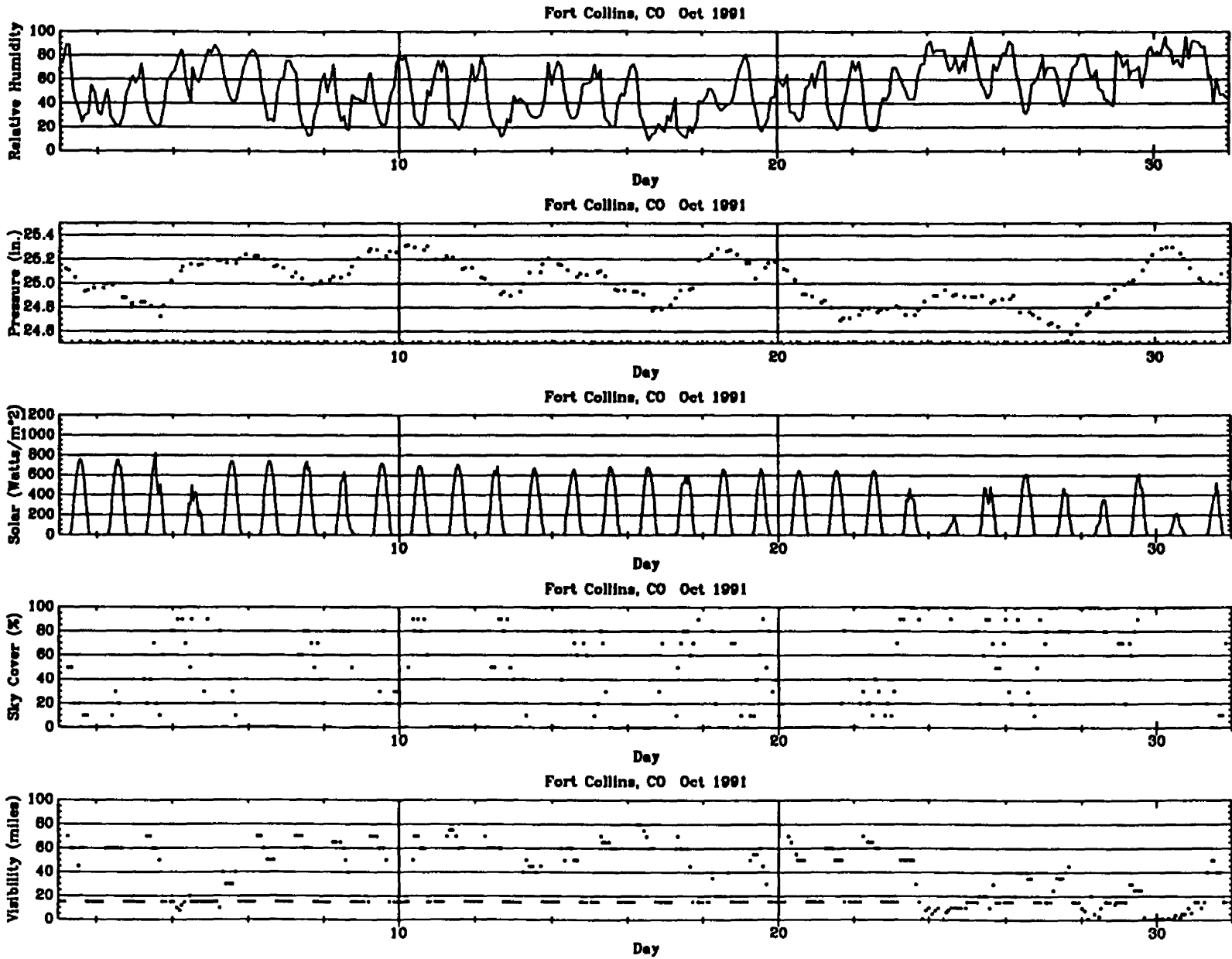


Figure 15b.

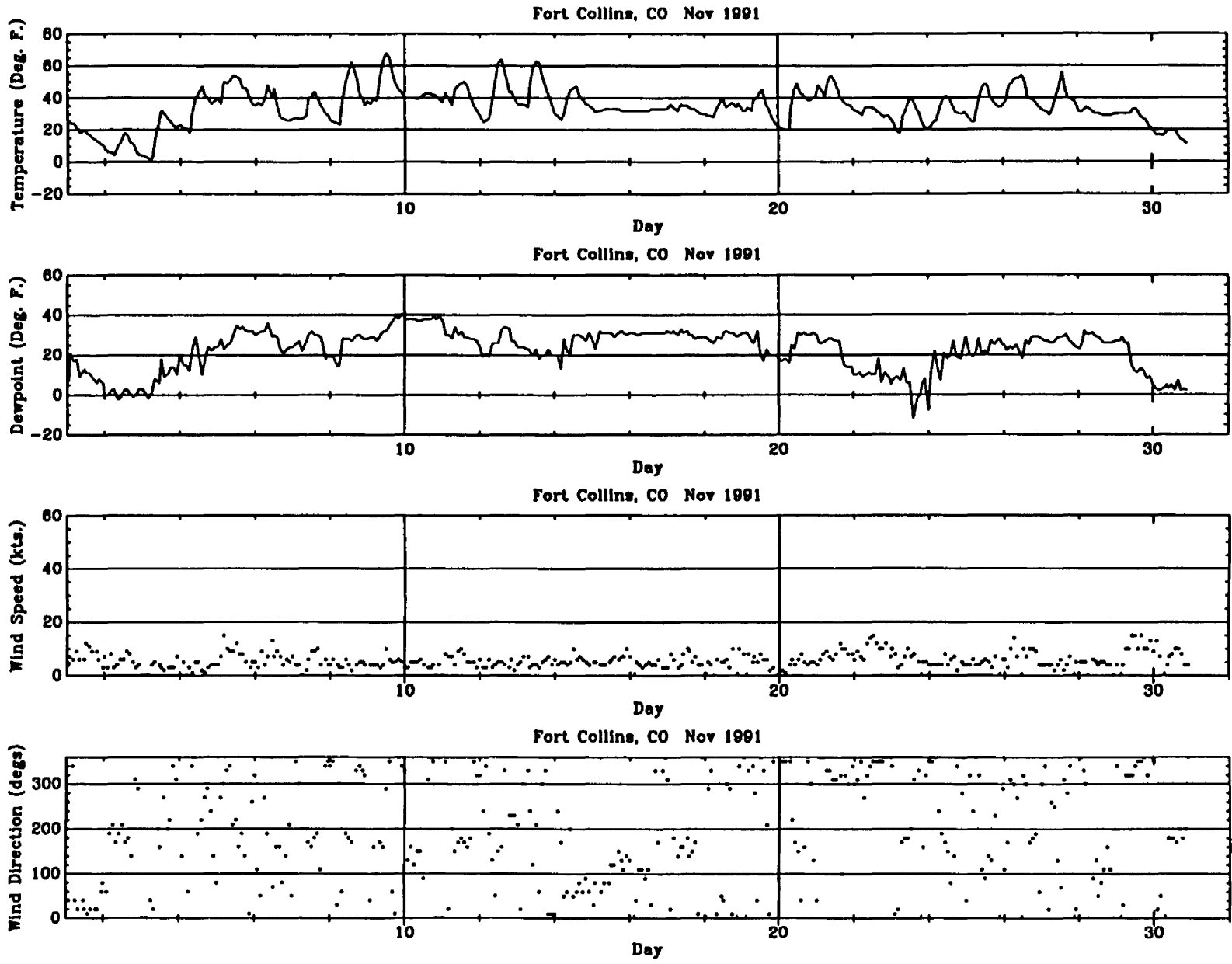


Figure 16a.

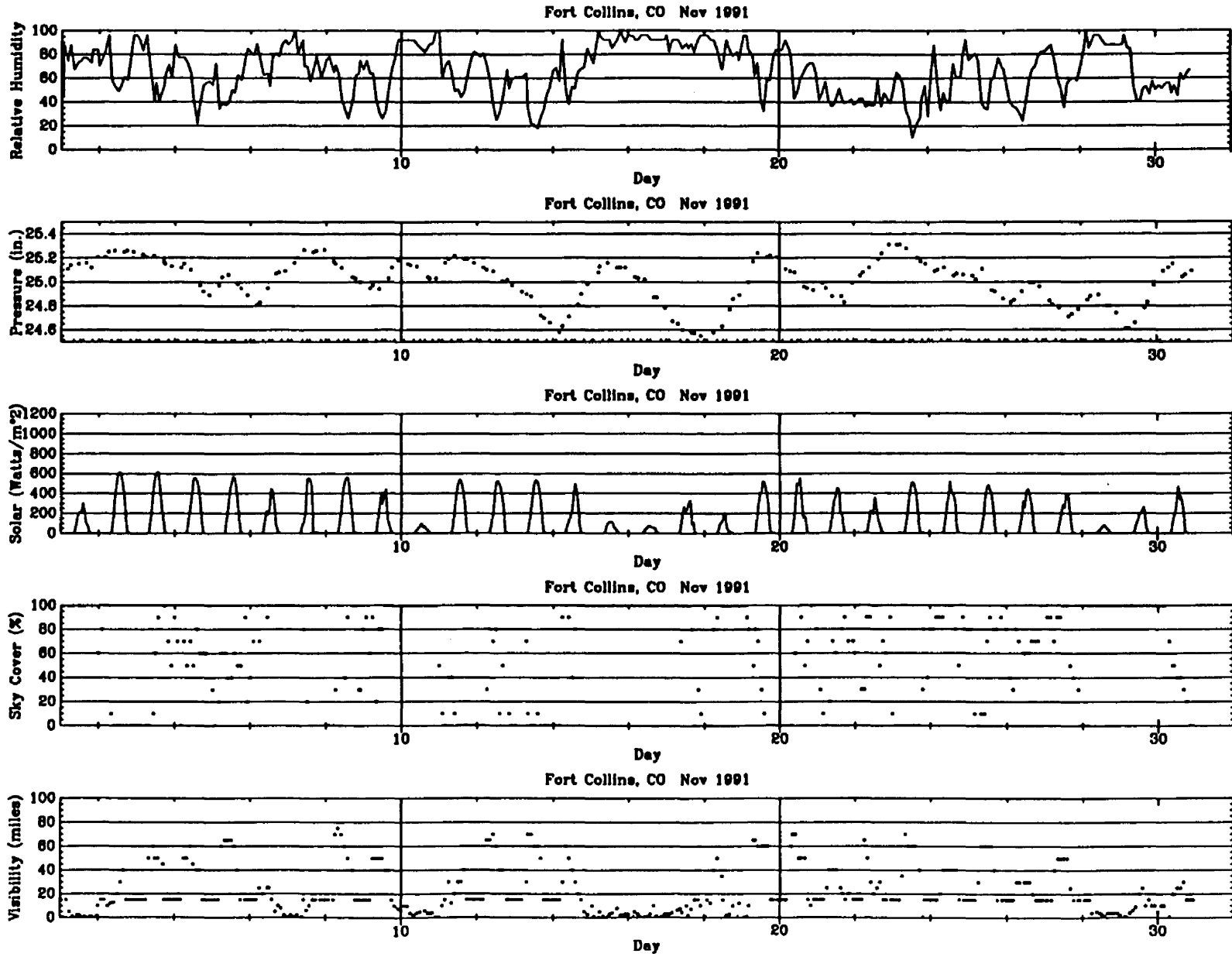


Figure 16b.

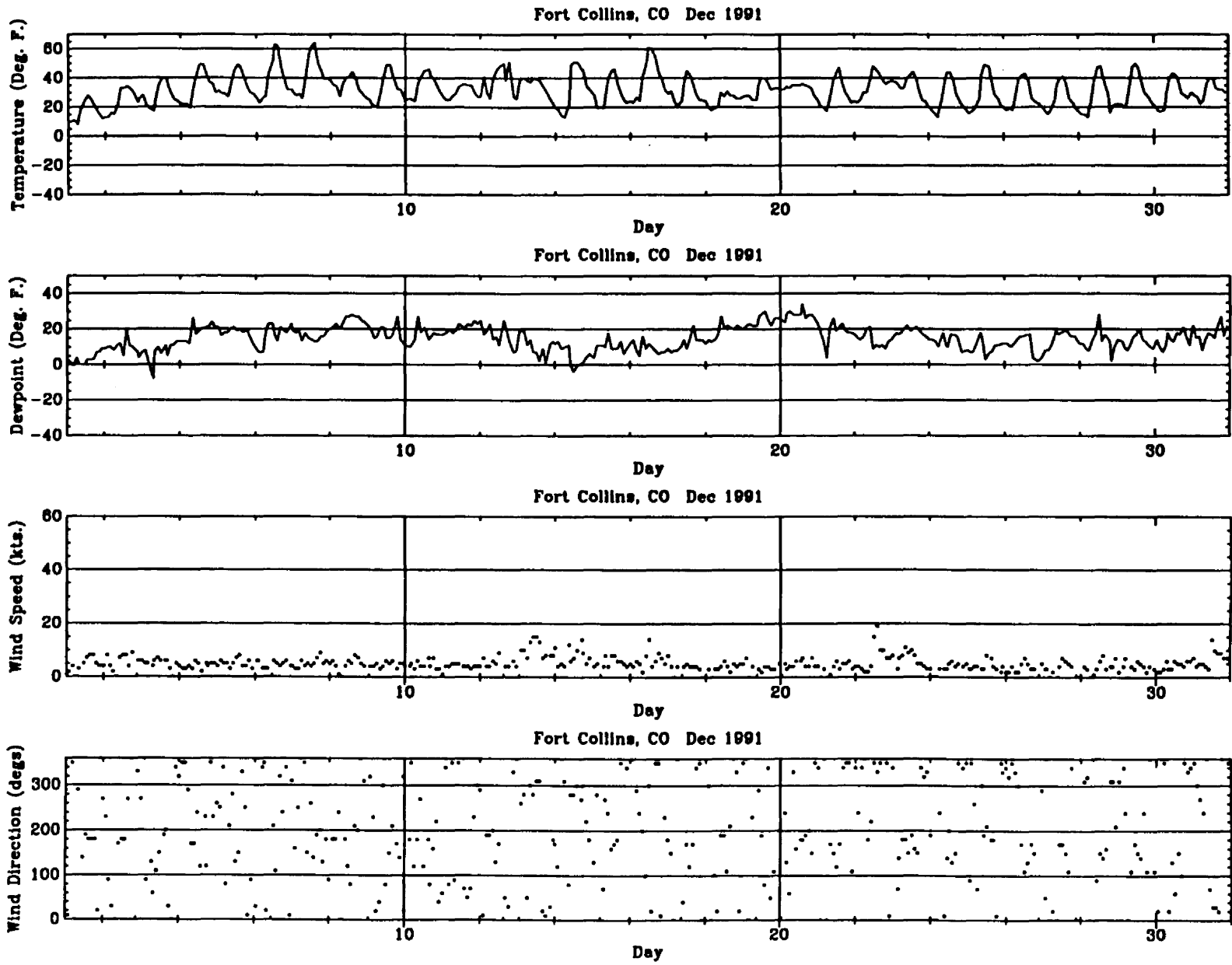


Figure 17a.

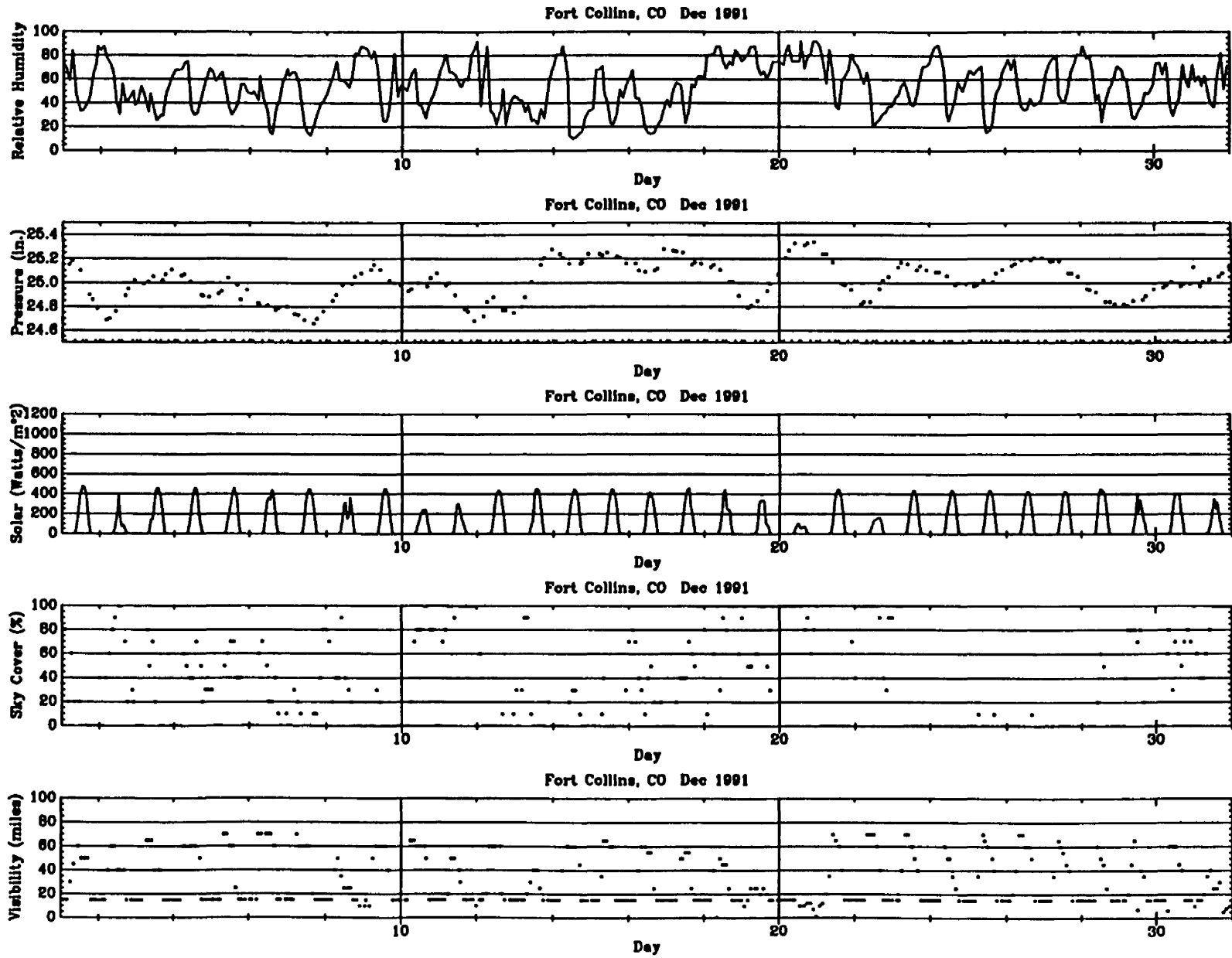


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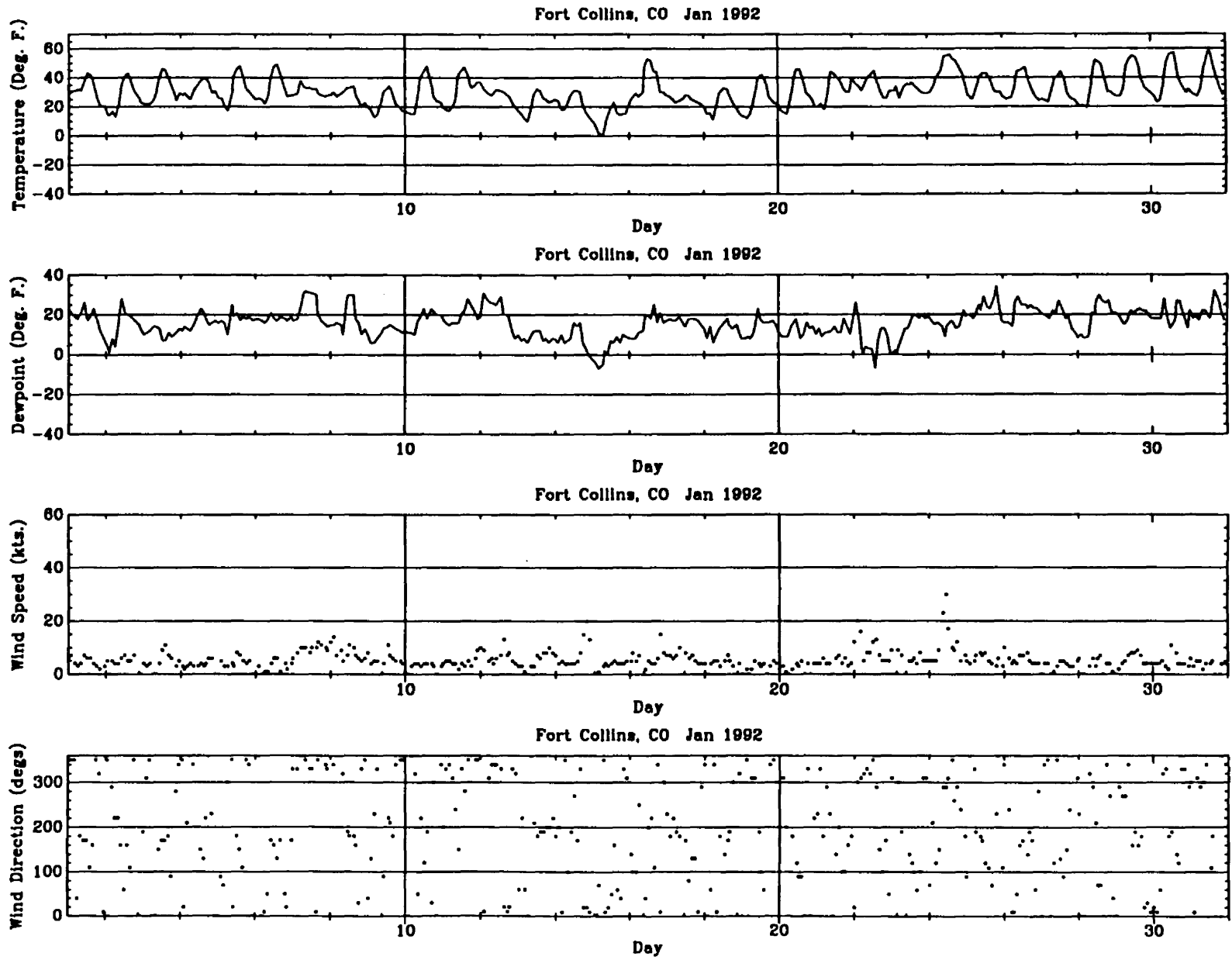


Figure 18a.

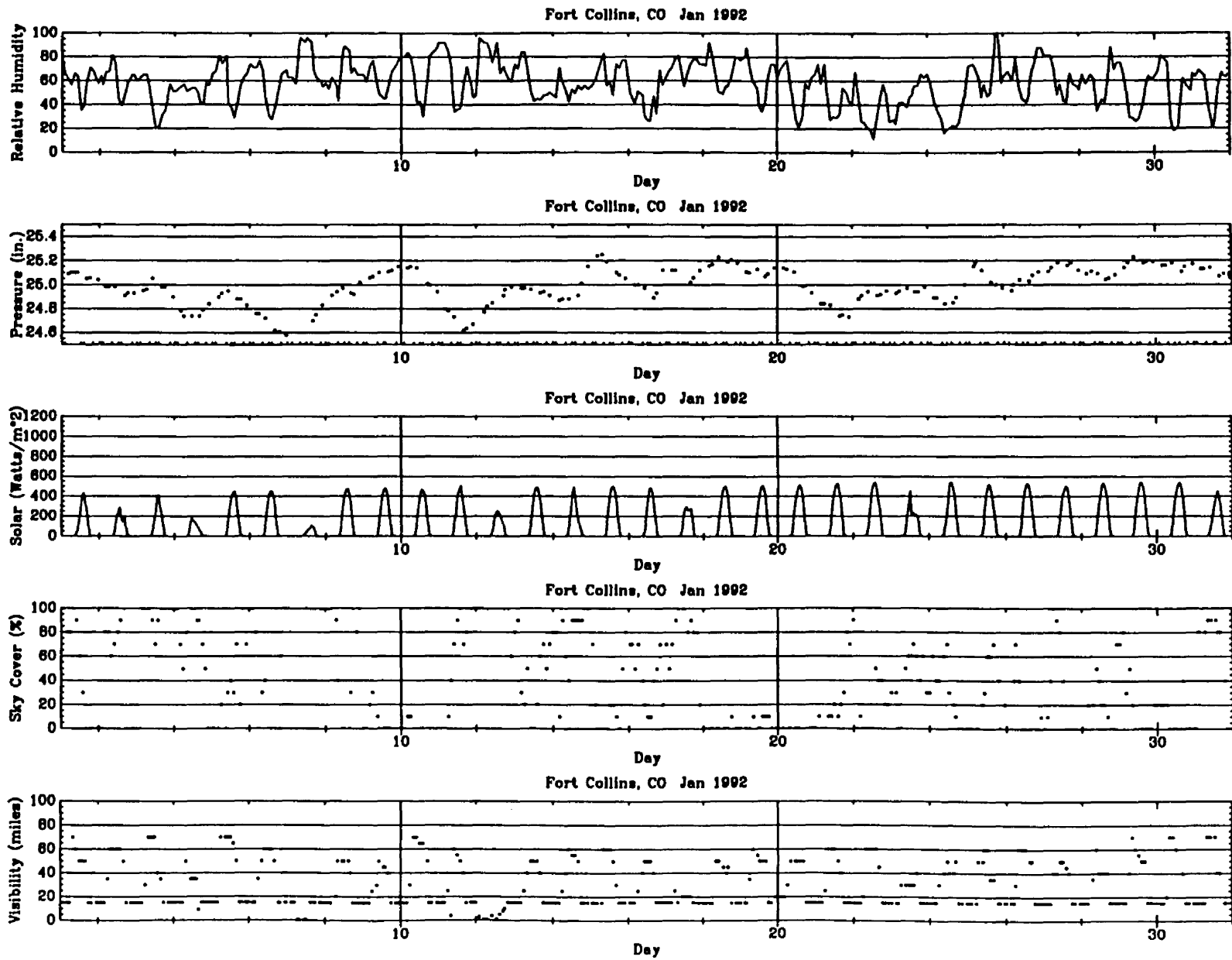


Figure 18b.

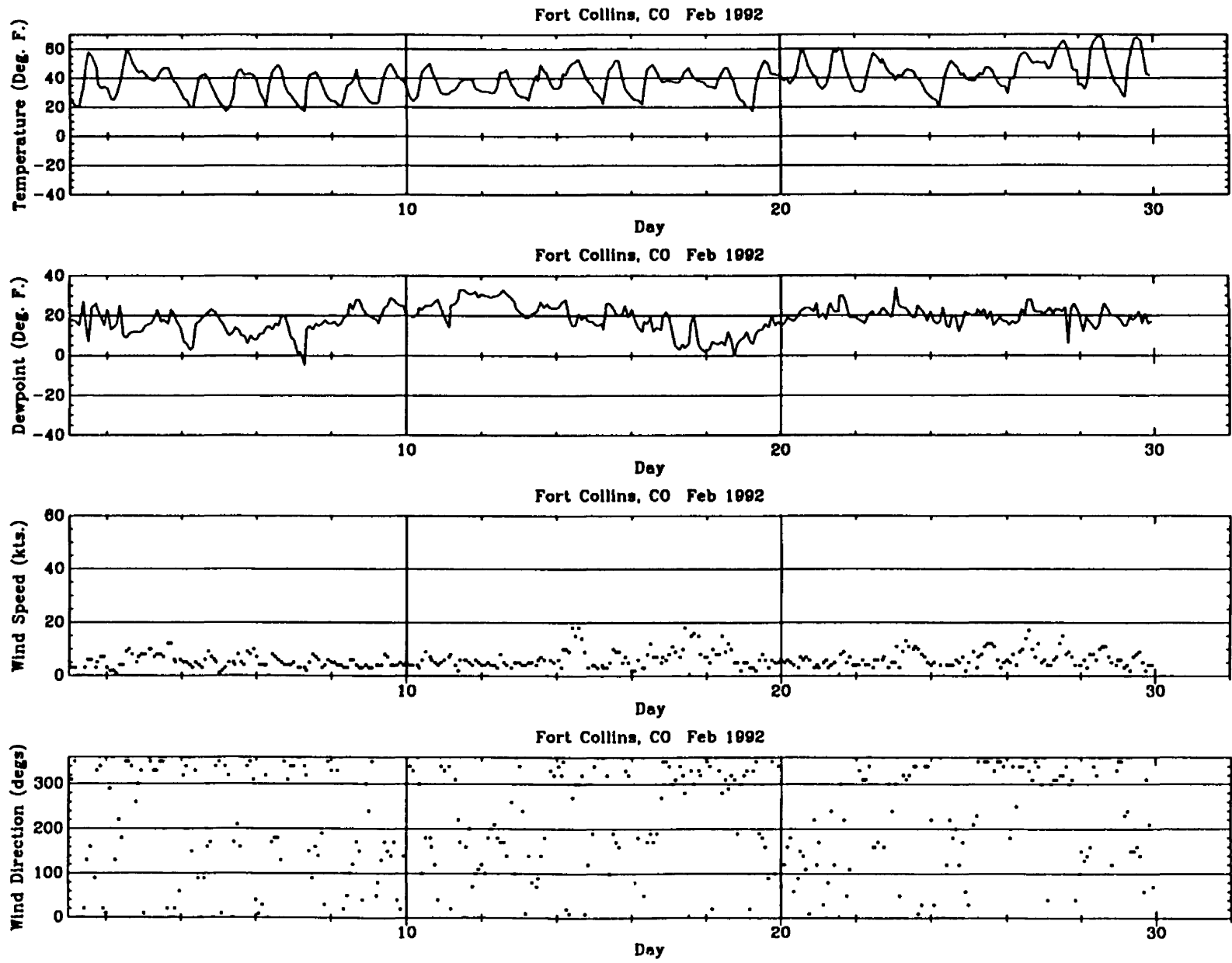


Figure 19a.

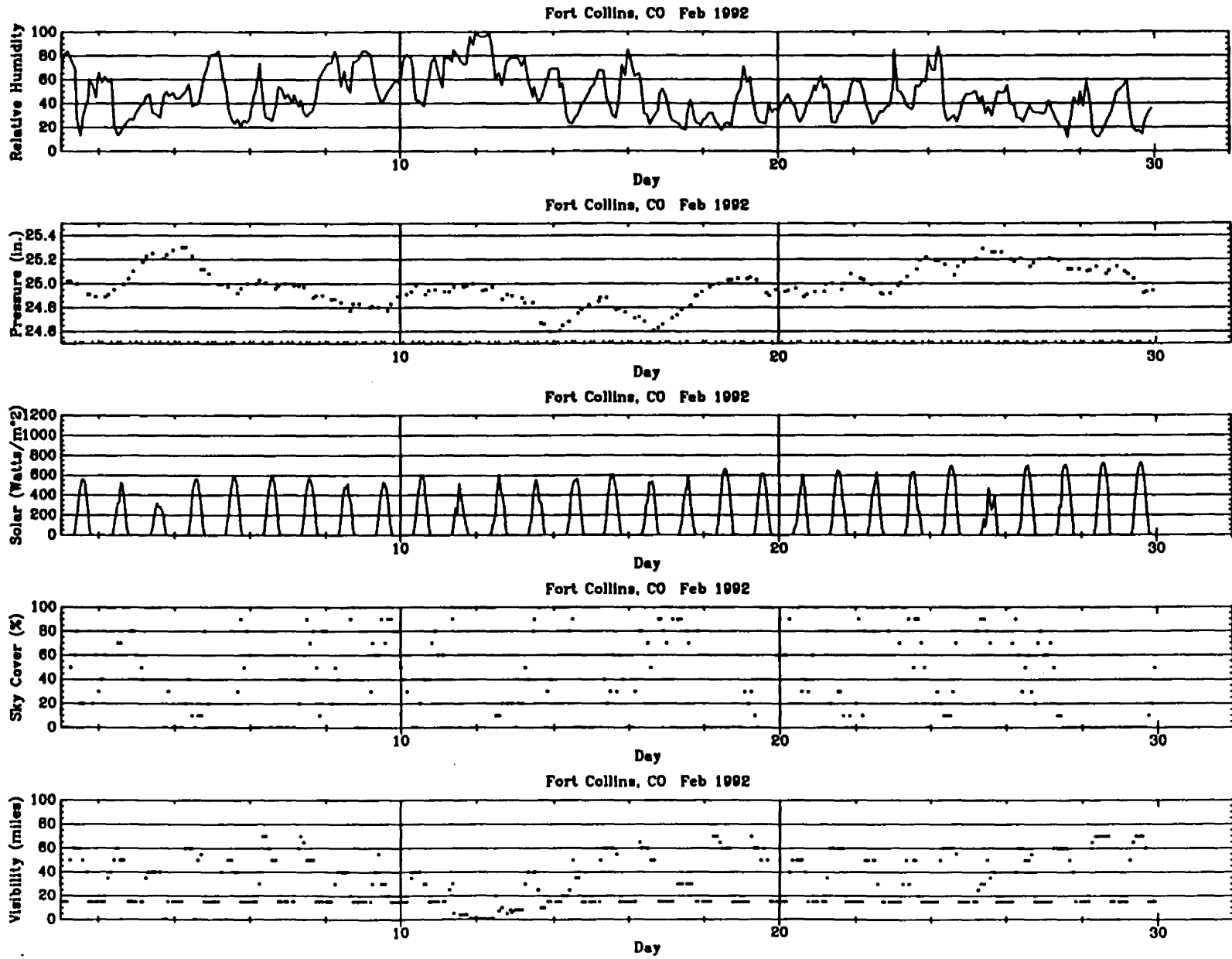


Figure 19b.

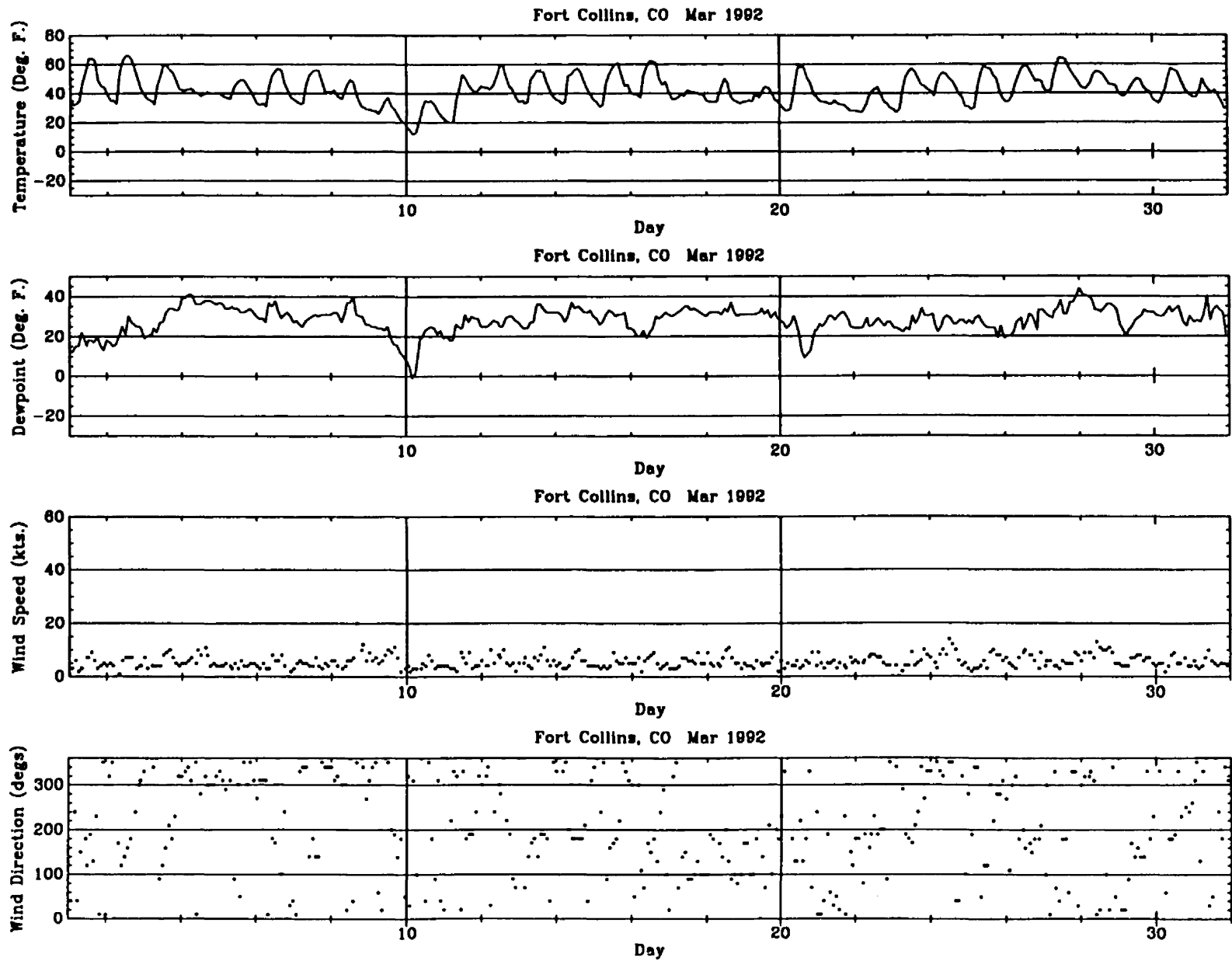


Figure 20a.

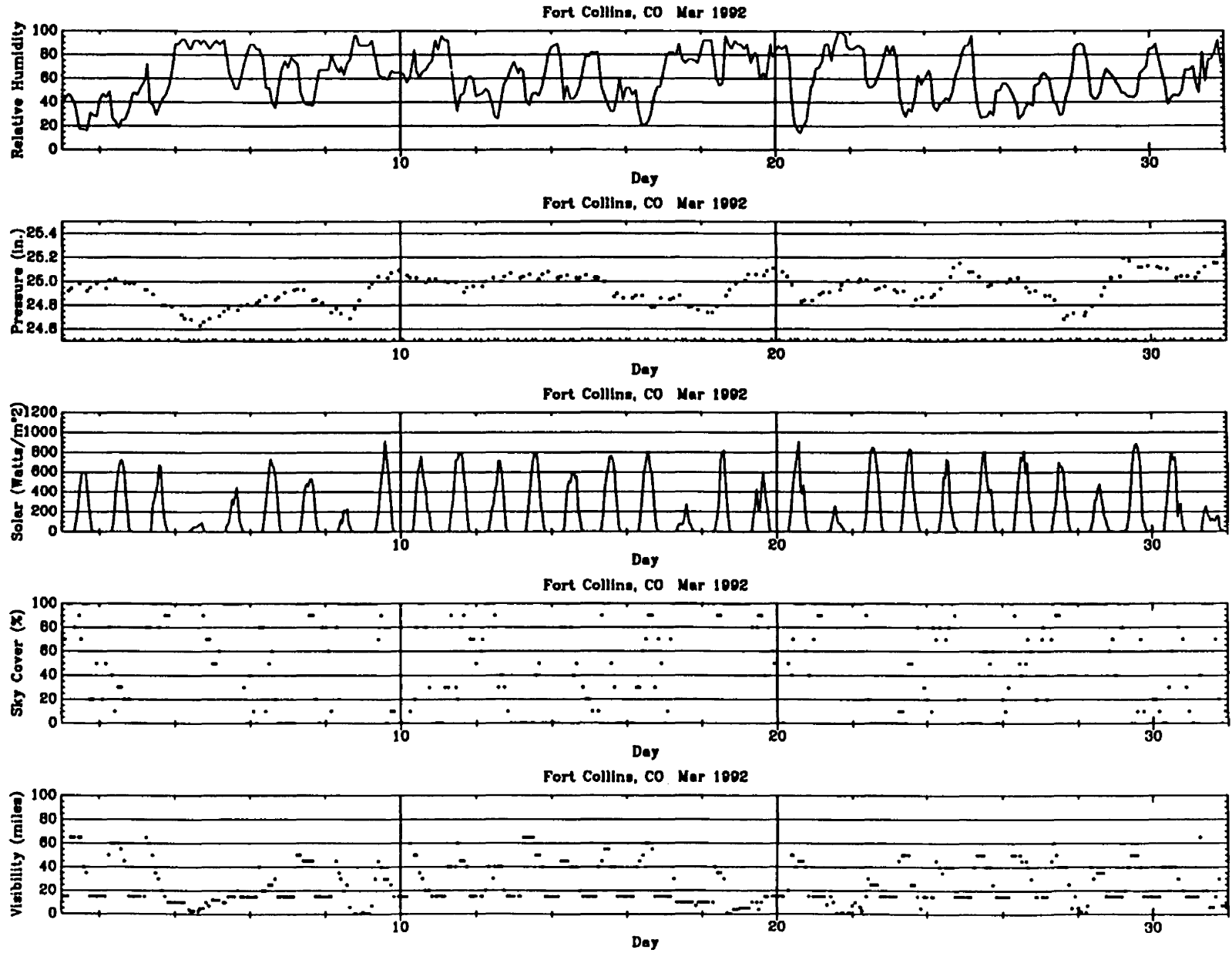


Figure 20b.

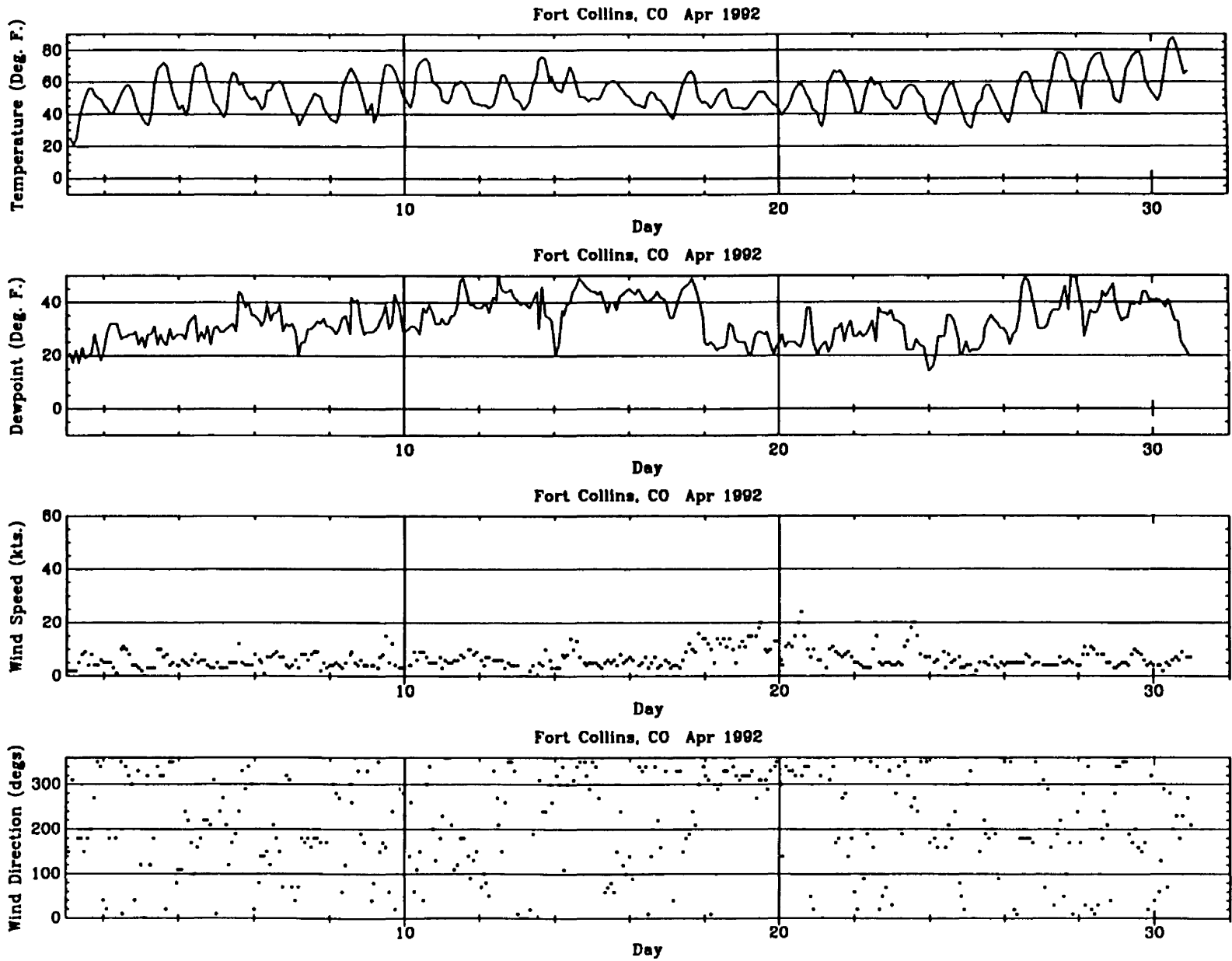


Figure 21a.

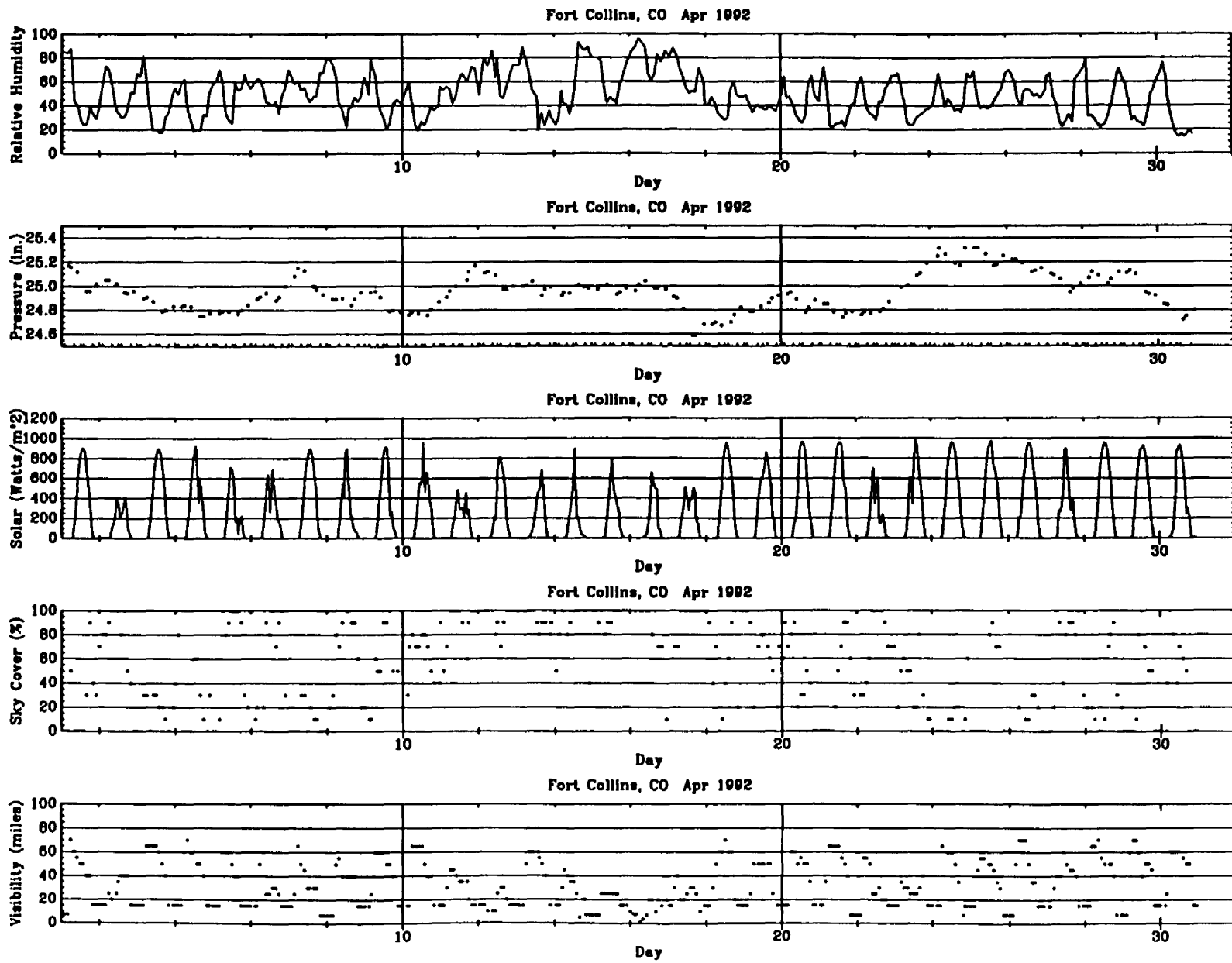


Figure 21b.

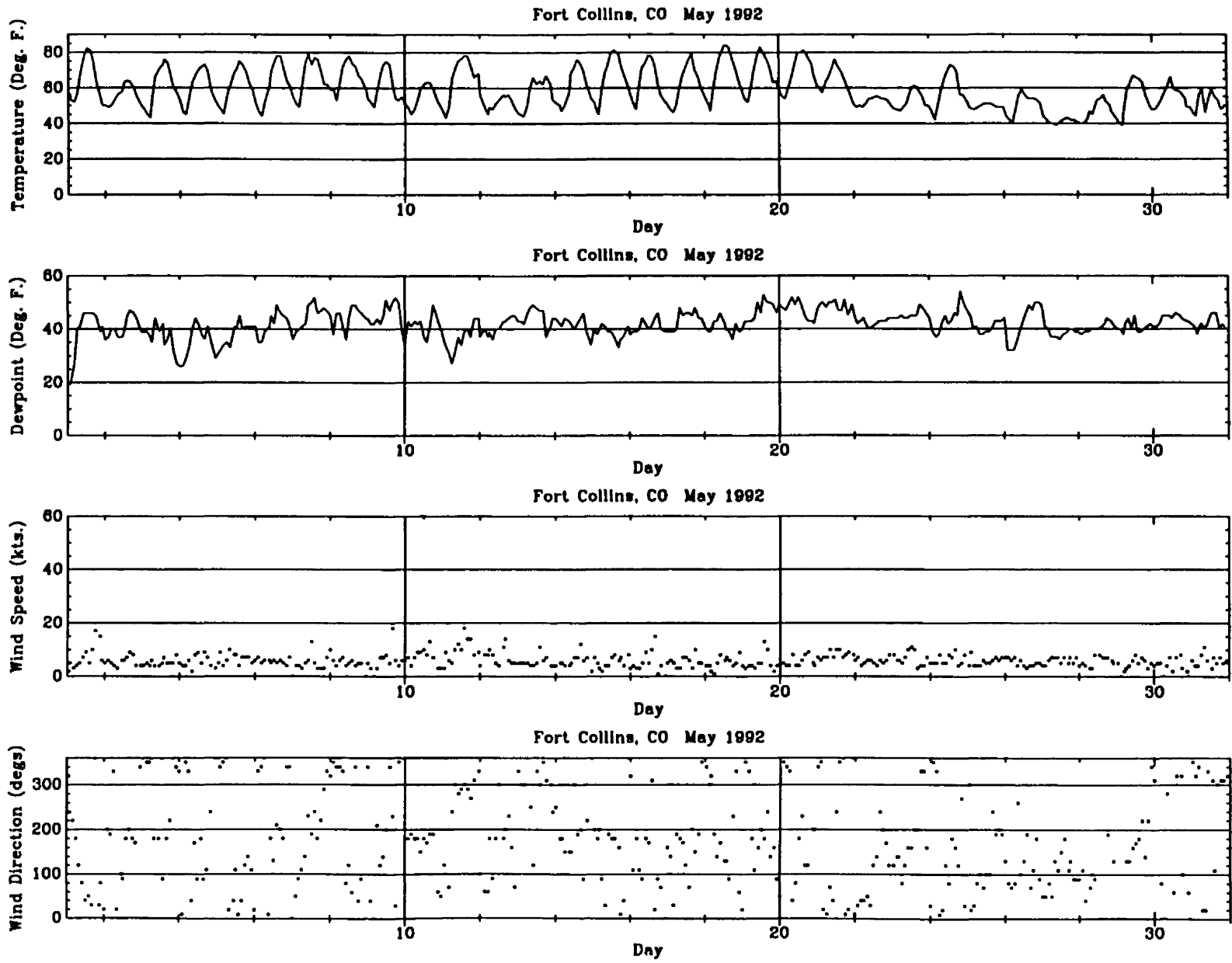


Figure 22a.

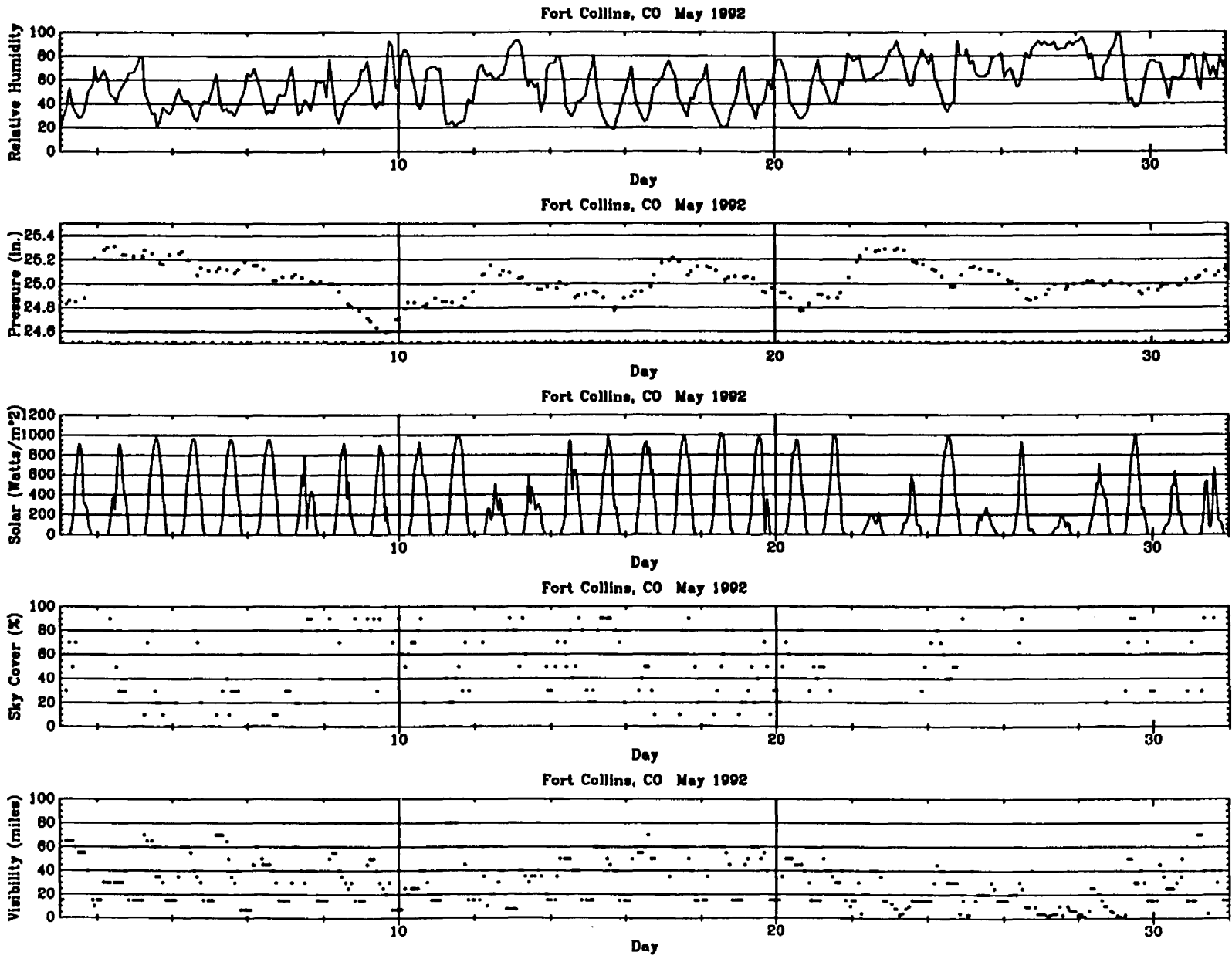


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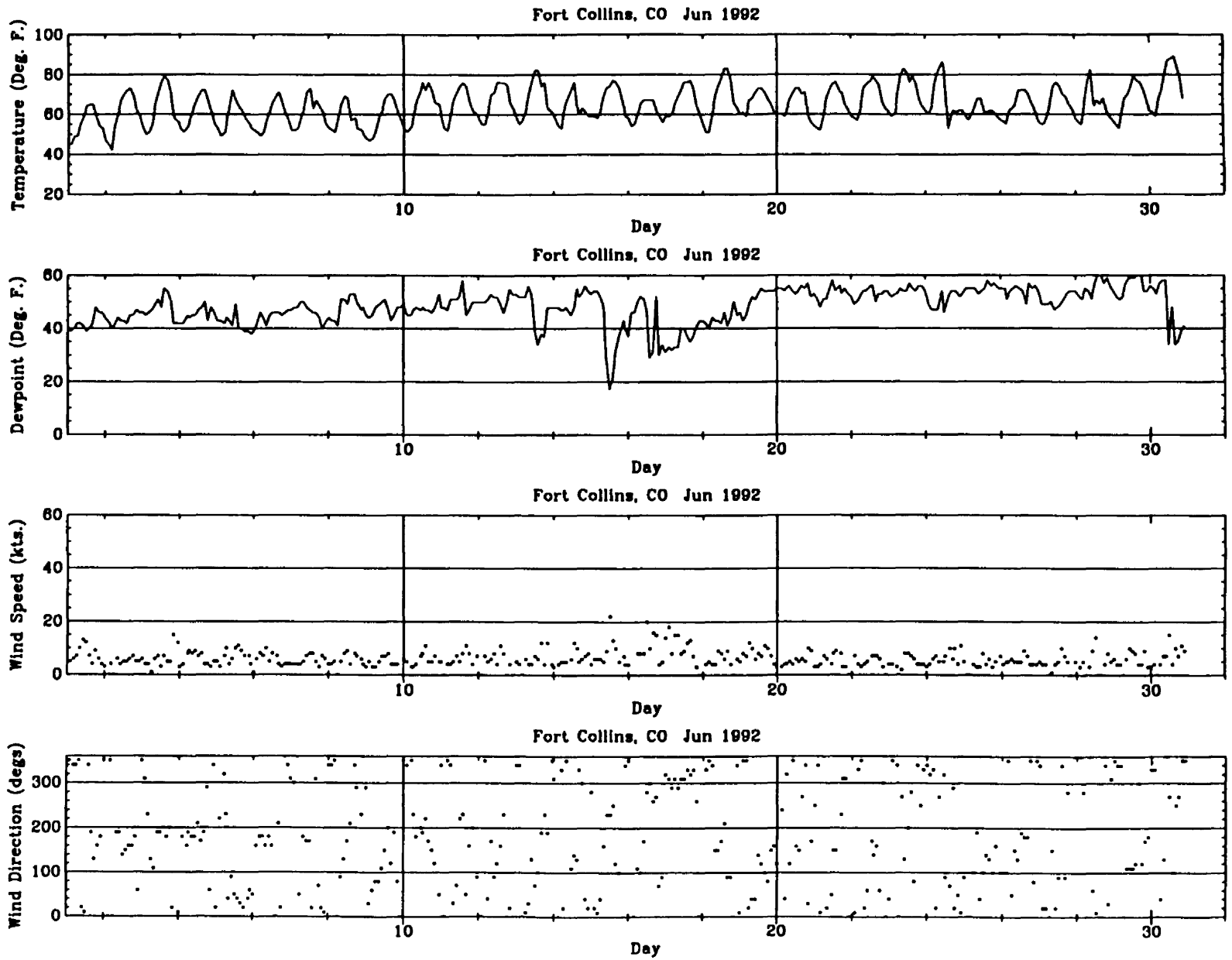


Figure 23a.

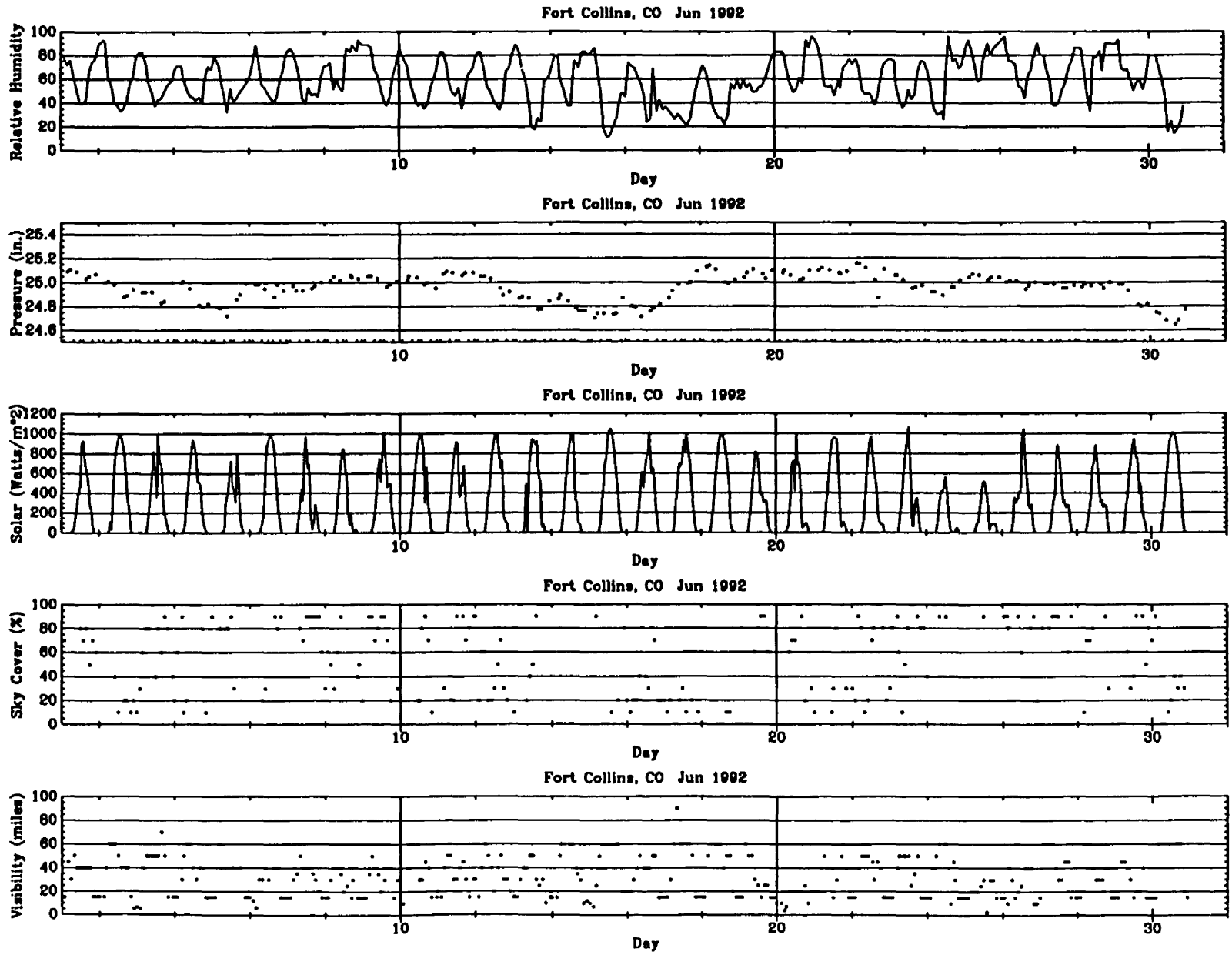


Figure 23b.

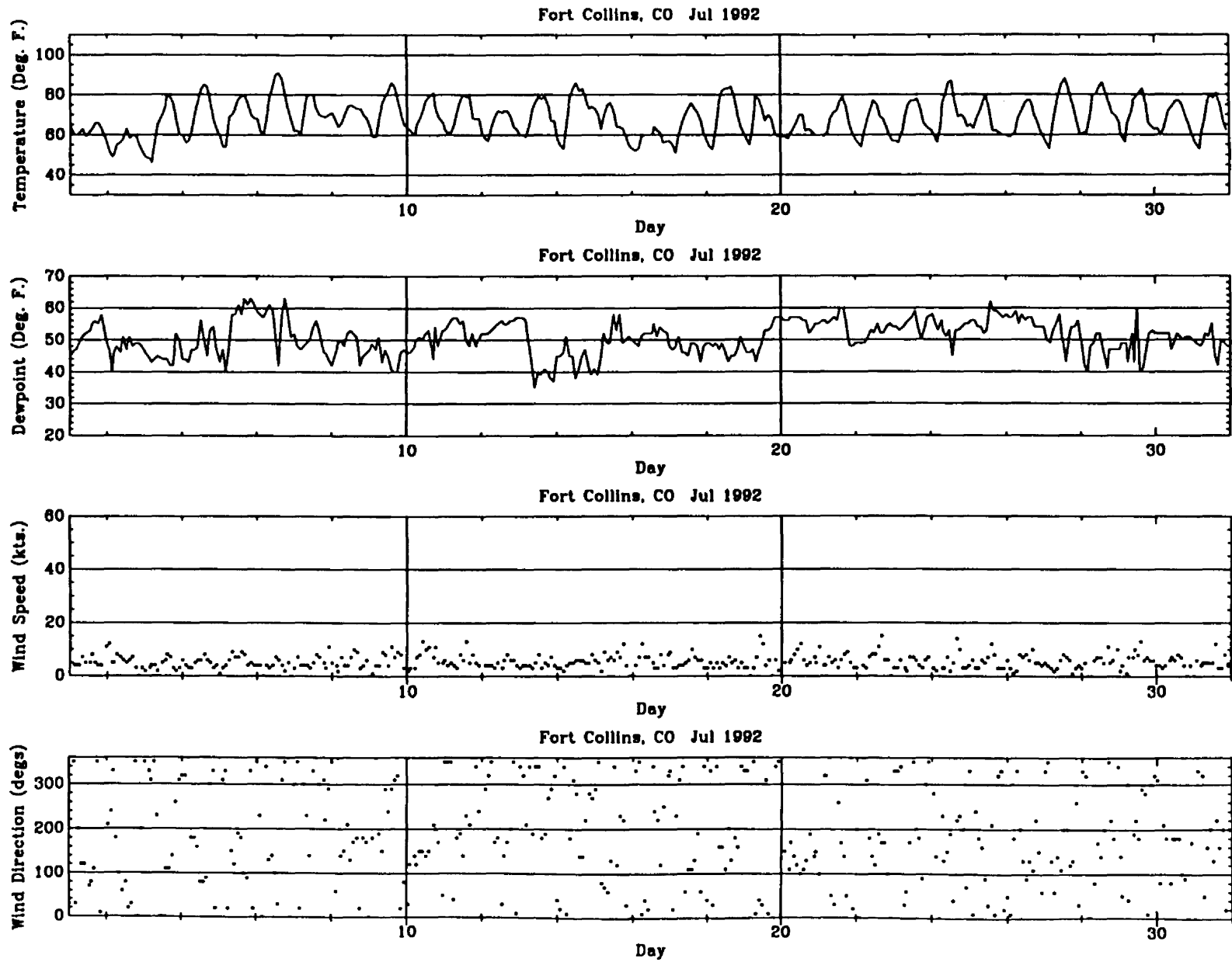


Figure 24a.

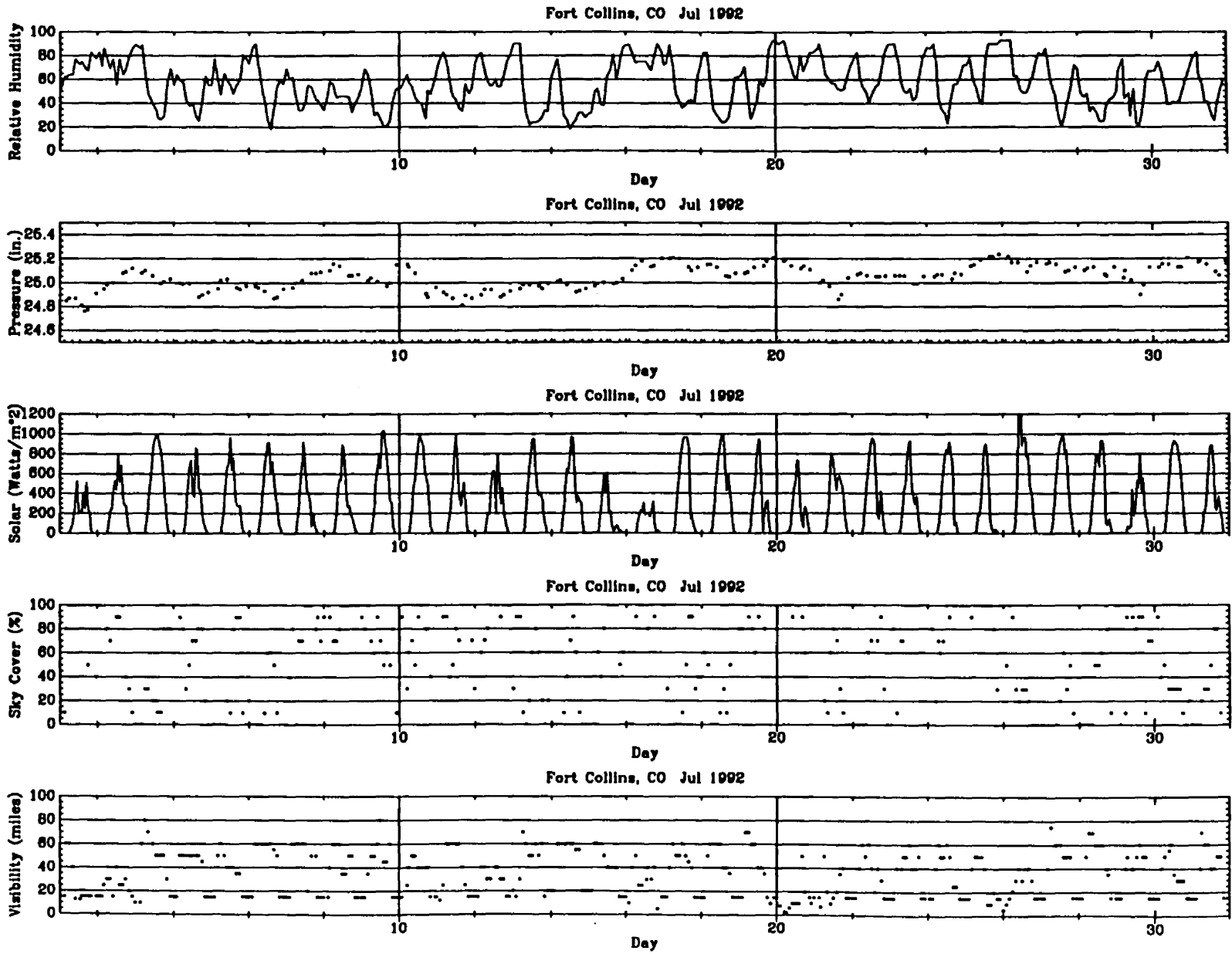


Figure 24b.

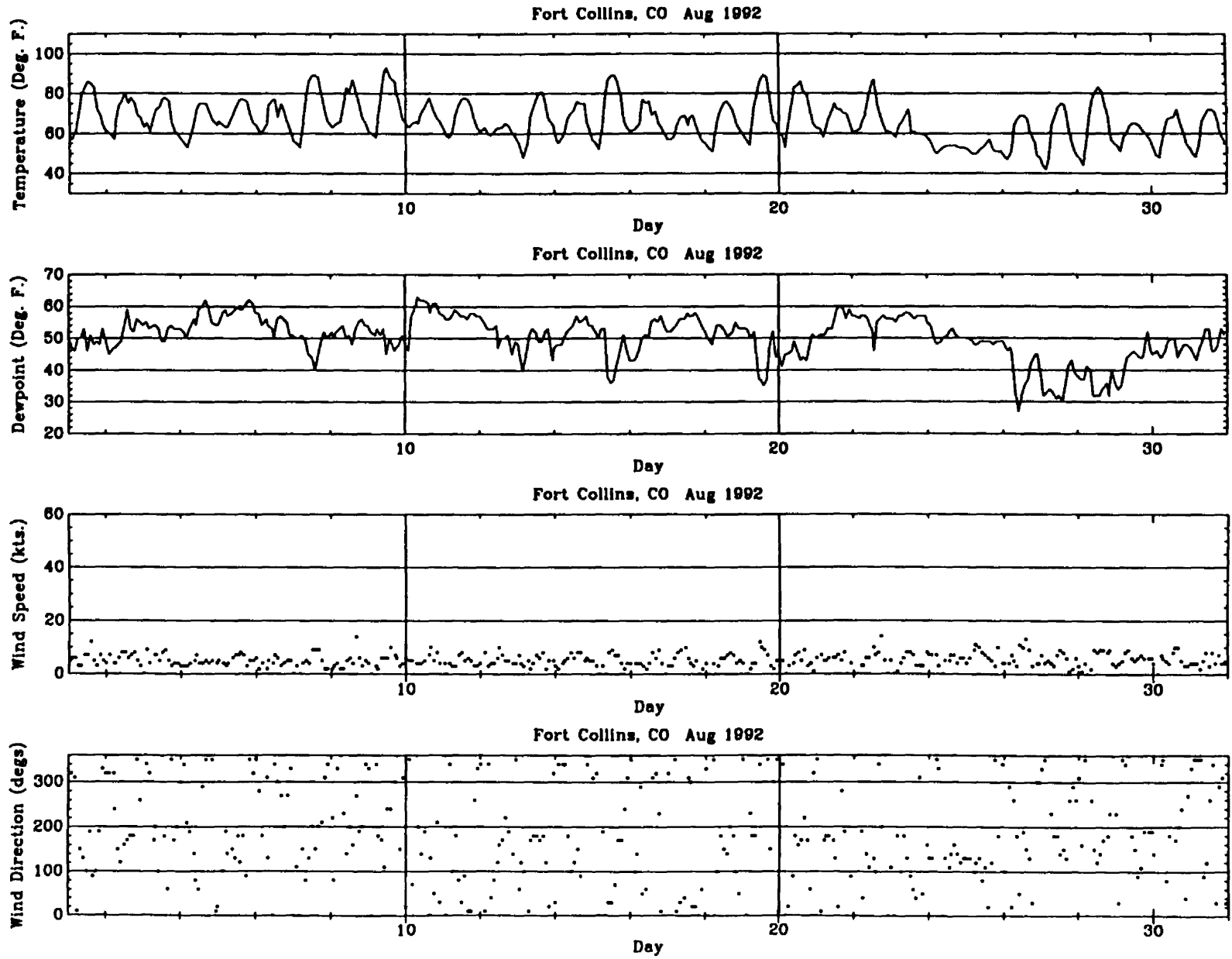


Figure 25a.

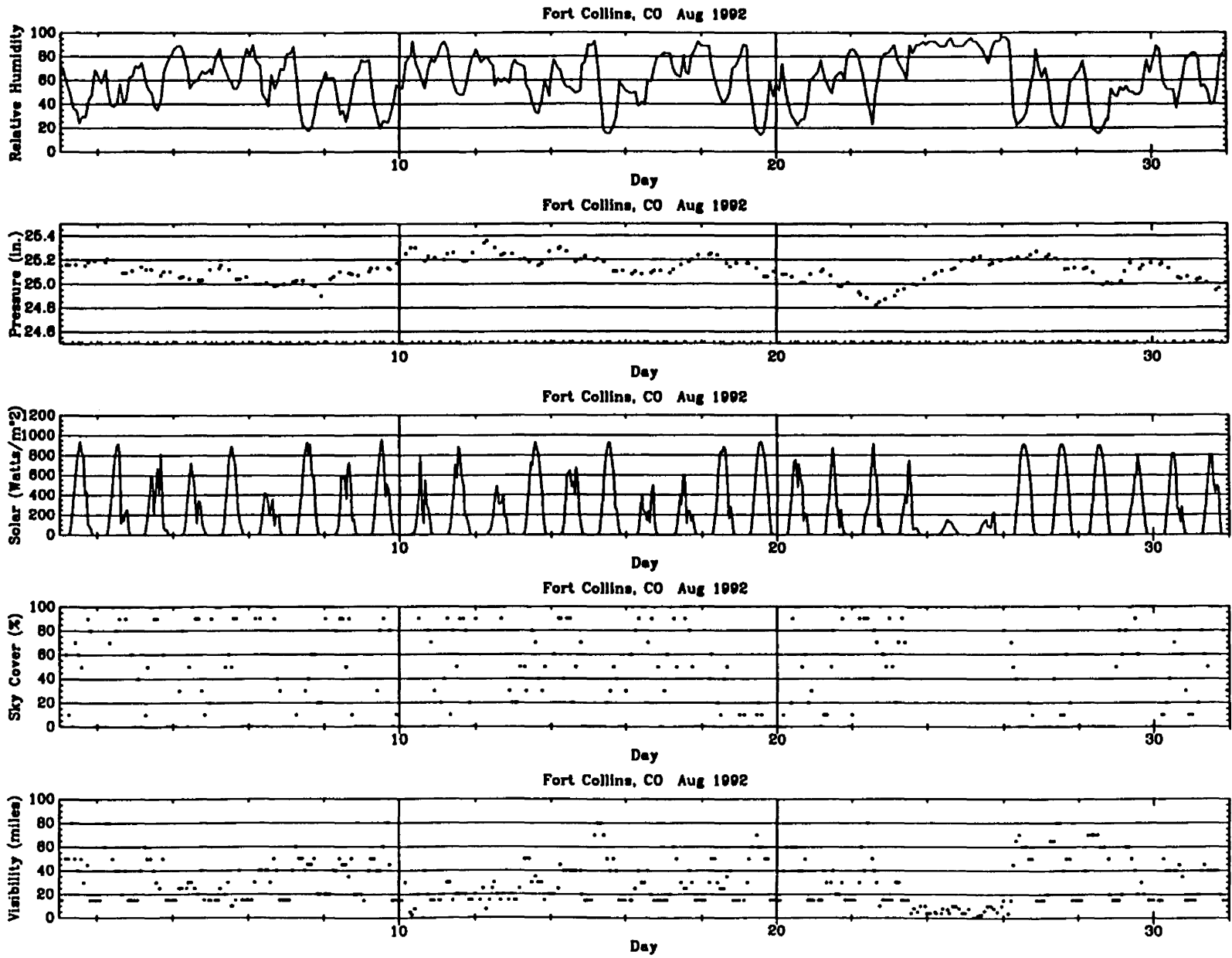


Figure 25b.

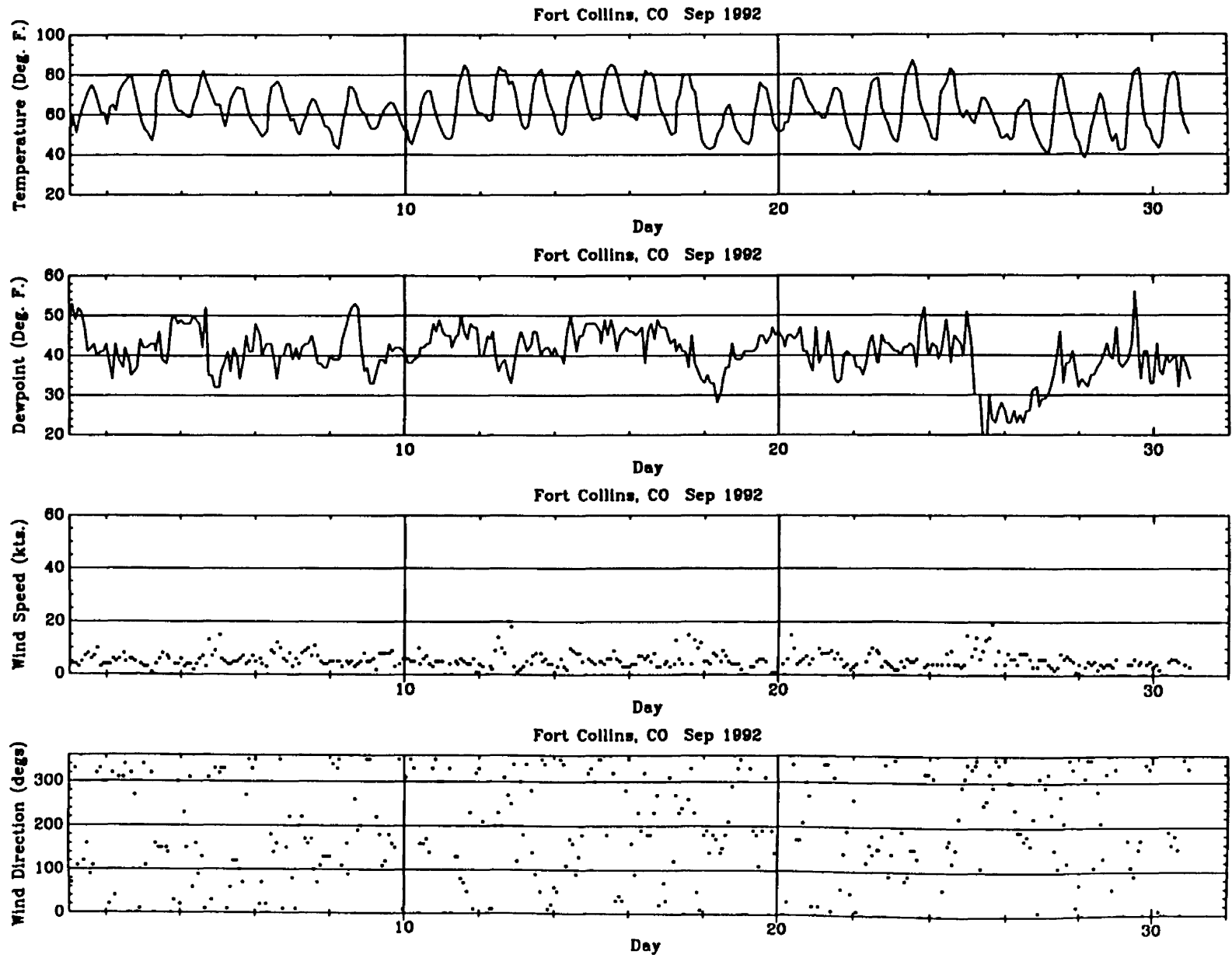


Figure 26a.

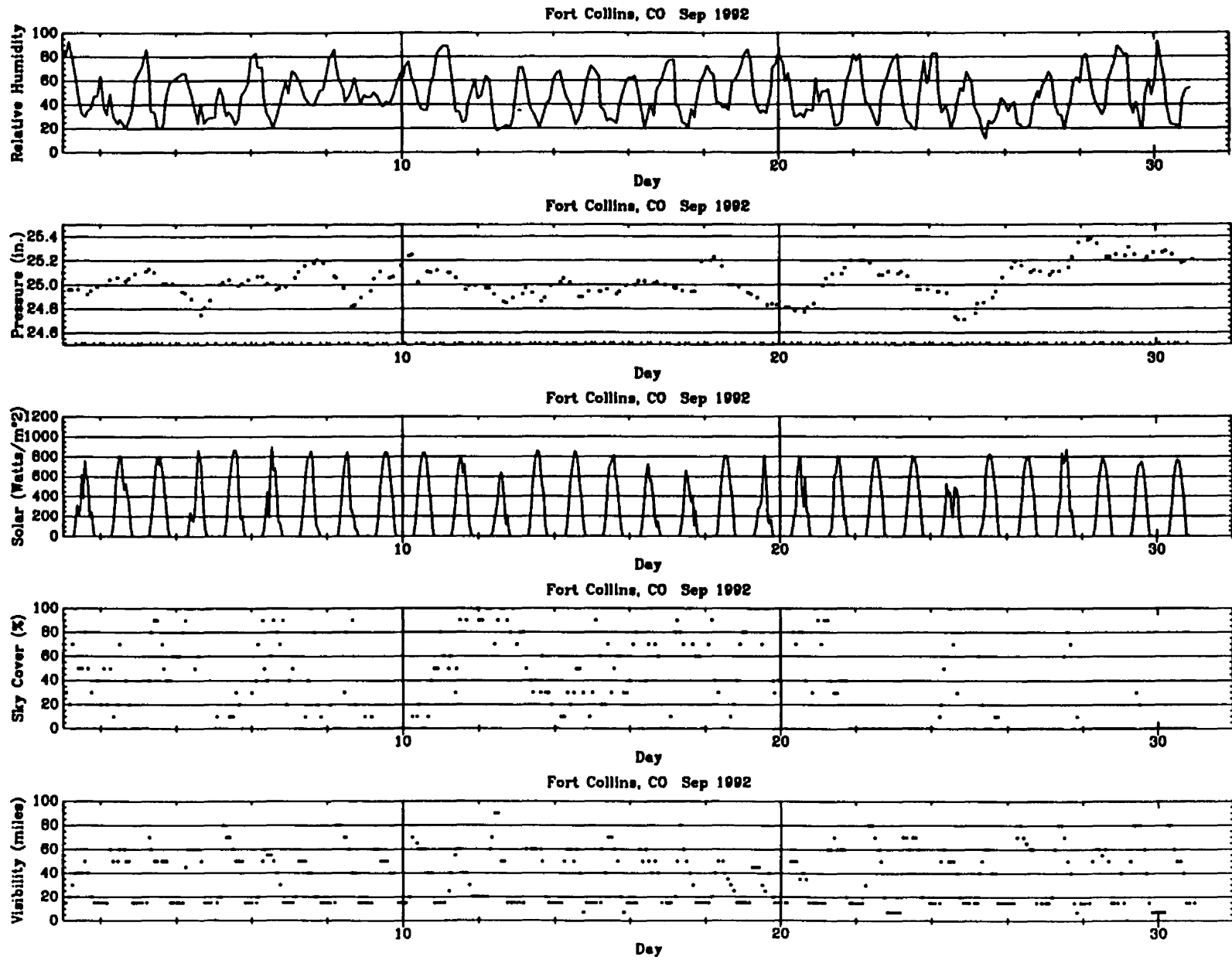


Figure 26b.