WEATHER AND CIRCULATION OF JANUARY 1982
A Stormy Month with Two Record Cold Waves

A. JAMES WAGNER

Climate Analysis Center, NMC/NWS/NOAA, Washington, D.C. 20233

1. Mean circulation

The 70 kPa mean circulation during January 1982 was characterized by a moderately amplified pattern with a broad, strong trough over eastern North America and the western Atlantic, a deep trough over European Russia, and only slightly deeper than normal troughs over Manchuria and the east-central Pacific (Figs. 1 and 2). A tendency toward a significant contribution from wavenumber 2 to the overall pattern can be seen by the amplified ridges over the eastern Pacific and western Europe. The channel of positive height anomaly connecting these two ridges across Greenland and the Arctic is related to varying positions of blocking during the month (Fig. 2). This pattern represents a change from December, when the blocking was stronger and more or less concentrated in one location over Greenland (Taubensee, 1982).

The mean 70 kPa wind maxima were located only slightly south of their normal locations over the west-

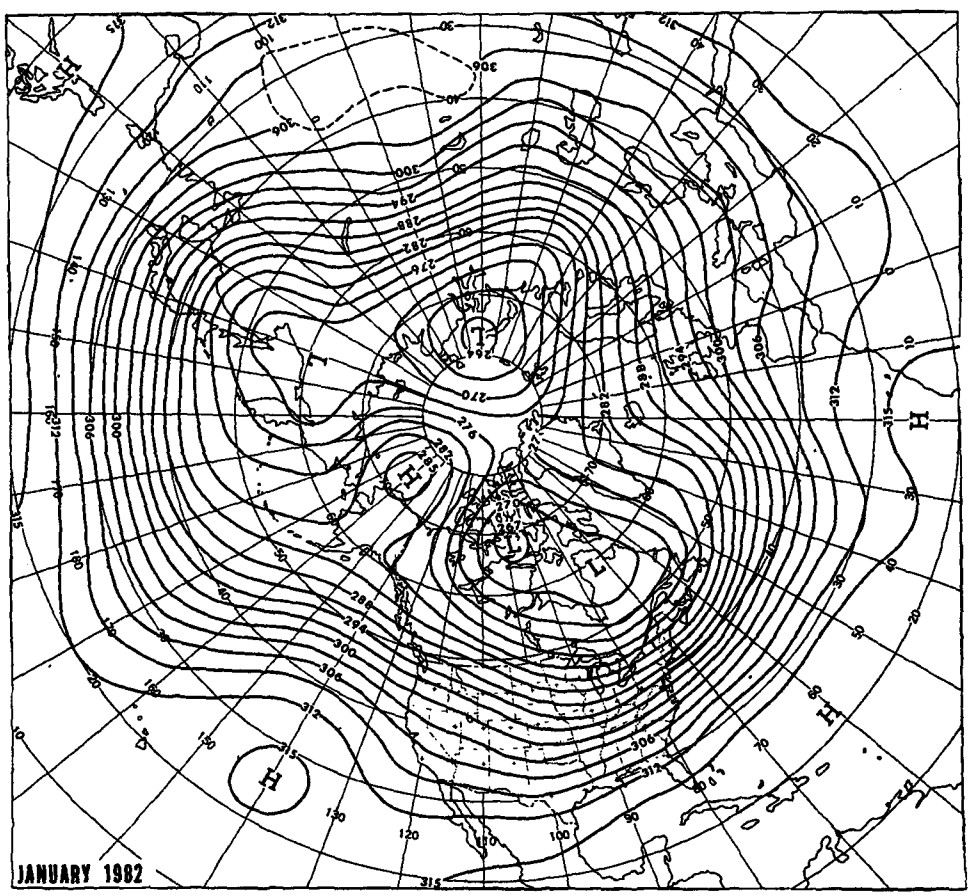

FIG. 1. Mean 70 kPa height contours (dam) for January 1982.

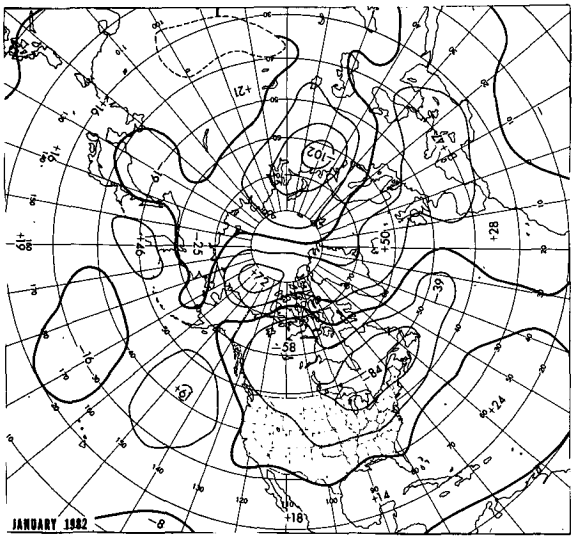

FIG. 2. Departure from normal of mean 70 kPa height (m) for January 1982.

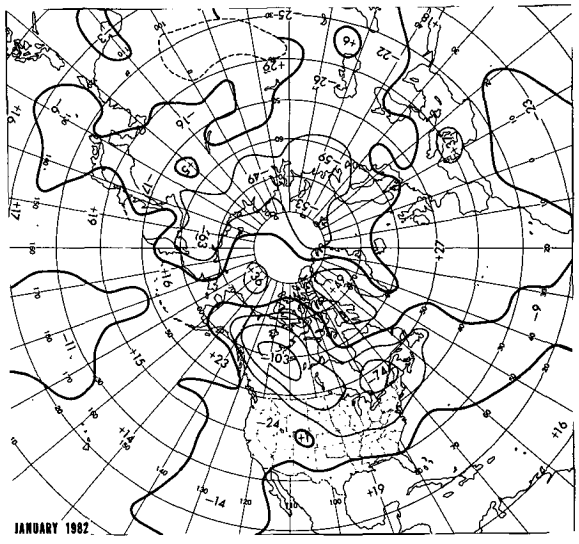

FIG. 4. Departure from normal of mean 100–70 kPa thickness (m) for January 1982.

ern and central Pacific and from the central United States eastward across the Atlantic (Fig. 3), but the mean wind speed profile for the western half of the Northern Hemisphere was more than 2 m s^{-1} stronger than normal at its peak near 40°N. Mean geostrophic wind speeds were most enhanced over the western Atlantic where the highest value of 21 m s^{-1} was 7 m s^{-1} above normal. Mean speeds were as much as 6 m s^{-1} greater than normal in the eastern European trough. Both of these regions were areas of enhanced baroclinicity and frequent storminess, where cold, Arctic air was in close juxtaposition to relatively mild air of maritime origin (Fig. 4).

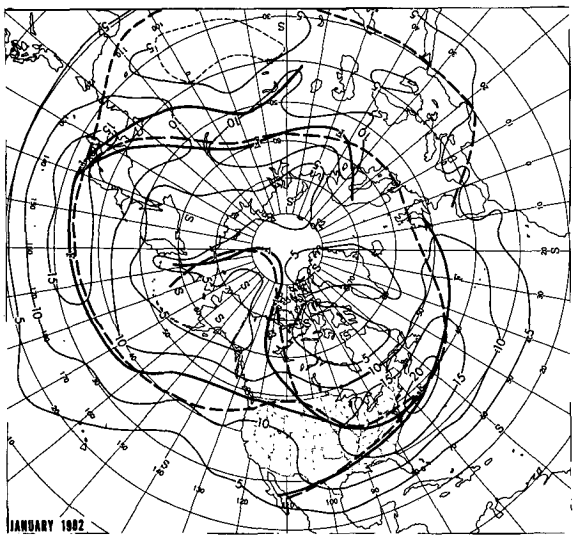

FIG. 3. Mean 70 kPa geostrophic wind speed (m s^{-1}) for January 1982. Solid arrows indicate observed axes of maximum wind speed and dashed lines, the normal.

2. Temperature

Temperature averaged well below normal over most of the Nation east of the Continental Divide with the exception of the southern Great Plains and the Gulf Coast region, where they were within a few degrees of normal. West of the Rocky Mountains, a mixed pattern prevailed due to highly changeable weather patterns and local effects such as anomalously deep snow cover laid down at some locations in Idaho and Oregon early in the month (Fig. 5).

The moderately amplified ridge over the eastern Pacific was far enough off the West Coast to drive the coldest air into the midsection of the United States, tapping a pool of anomalously cold air in western Canada, which was displaced southward by northerly flow east of the blocking ridge over the Beaufort Sea (Figs. 1 and 4). The vigorous south-

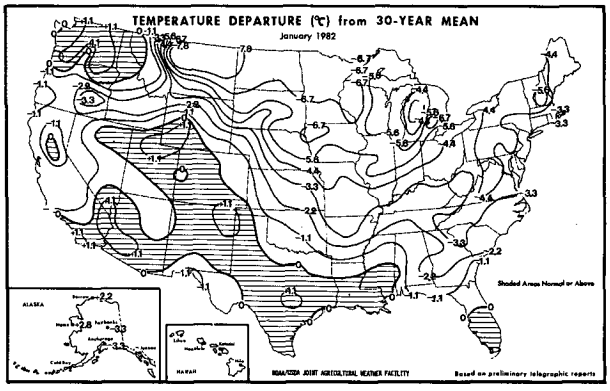

FIG. 5. Departure from normal of average surface air temperature (°F) for January 1982 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service and World Agricultural Outlook Board, 1982).

TABLE 1. Record and near-record monthly mean temperatures observed over the United States during January 1982.*

Station	Temperature	Anomaly	Remarks
Concord, NH	−11.7 (10.9)	−5.4 (−9.7)	2nd coldest January (1871)
Rochester, NY	−8.8 (16.1)	−4.4 (−7.9)	Tied for 4th coldest January
Milwaukee, WI	−12.4 (9.7)	−5.4 (−9.7)	Tied for 4th coldest January
International Falls, MN	−23.6 (−10.5)	−6.0 (−12.4)	Coldest January
Duluth, MN	−19.6 (−3.2)	−6.5 (−11.7)	2nd coldest January
St. Cloud, MN	−19.5 (−3.1)	−6.7 (−12.0)	3rd coldest January
Minneapolis, MN	−16.5 (2.3)	−5.5 (−9.9)	4th coldest January
Rochester, MN	−16.1 (3.0)	−5.5 (−9.9)	5th coldest January (1909)
Waterloo, IA	−15.8 (3.6)	−7.1 (−12.1)	4th coldest January
Omaha, NE	−12.1 (10.2)	−5.6 (−10.0)	2nd greatest number of days with minima zero or below (18)
Great Falls, MT	−14.3 (6.3)	−7.9 (−14.2)	5th coldest January (1900)
Haure, MT	−19.5 (−3.1)	−8.0 (−14.4)	5th coldest January (1900)
Williston, ND	−21.0 (−5.8)	−7.8 (−14.1)	5th coldest January (1900)
Fargo, ND	−21.7 (−7.0)	−7.2 (−12.9)	2nd coldest January (1900)

* Temperature and anomalies are in °C; number in parentheses are in °F. Year of beginning of period of record is shown in parentheses when known.

ward-displaced polar low complex over northeastern Canada steered the Arctic air rapidly eastward to the Atlantic coast and limited the northward extent of the subtropical ridge, which, although stronger than normal, was confined to low latitudes over the Gulf of Mexico and western Atlantic.

Although only International Falls, MN reported a new record coldest January in 1982, many other cities in the north-central section of the United States recorded January 1982 as one of the coldest on record (Table 1). It is somewhat difficult to infer the true character of the month from the mean charts, as there was considerable variation from week to week. Had the circulation pattern remained in a steady cold pattern, there would have undoubtedly been more monthly mean records, as happened in 1977 (when the circulation was remarkably steady), as well as in 1978 and 1979 (Wagner, 1977, 1978, 1979). With its succession of severe cold waves, January 1982 bore some resemblance to January 1963 (O'Connor, 1963) although the circulation and temperature anomaly patterns were displaced farther west in the earlier case. In 1982, true Arctic air penetrated west of the Continental Divide for only a few days early in the month, and the coldest air swept more forcefully into the Northeast than it did in 1963. It is of historical interest to note that in addition to cold Januarys of the late 1970's and 1963, the only other Januarys with record and near-record cold in the Midwest were those of 1918 and 1912.

3. Precipitation

Most of the United States had greater than the normal amount of precipitation during January 1982 (Fig. 6). In the extensive area with more than twice the normal totals, much or most of the precipitation fell as snow, leading to numerous records (Table 2). The coincidence of the heaviest precipitation relative to normal with the largest negative temperature anomalies is rather unusual during the cold season except for over the Great Plains and in limited areas of lake effect type snows, and is in sharp contrast to the predominantly mild and dry character of January 1981 (Wagner, 1981). A search of the Climate Analysis Center records disclosed only one other January within the last 50 years in which extremely cold and extremely wet conditions coincided over such a large area as in 1982, and that was in 1979 when practically the entire country averaged well below normal, and numerous monthly records were set for cold, wetness and heavy snowfalls (Wagner, 1979).

It is not obvious from the January 1982 mean flow or its anomaly (Figs. 1 and 2) why this month was exceptionally wet. A comparison with the corresponding figures for January 1977 and January 1979 shows that there was anomalous northerly and continental flow over the whole country during January 1977 and noticeable southerly anomalous flow over

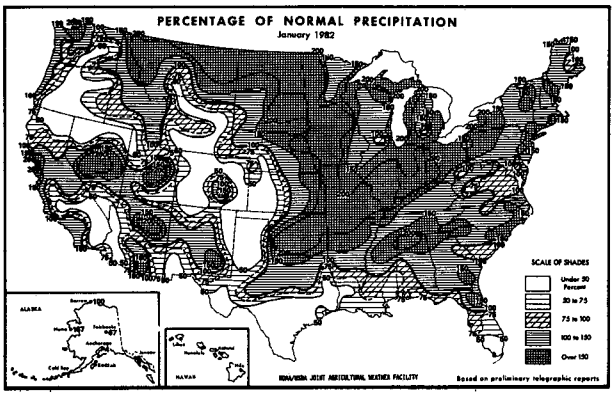

FIG. 6. Percentage of normal precipitation for January 1982 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service and World Agricultural Outlook Board, 1982).

the eastern half of the United States during January 1979, thereby explaining the relative dryness and wetness of those two cold months. A synoptic explanation of the heavy precipitation observed during January 1982 can be obtained only by an examination of the individual weeks, due to the high variability of the circulation regimes within the month.

4. Variability within the month

a. 3–9 January

Development of a ridge just off the west coast of the United States and a progression of a 5-day mean trough from the Great Plains during the previous week (Taubensee, 1982) to the Mississippi River Valley made way for an extensive penetration of Arctic air into the West and into the northern and central Great Plains (Figs. 7A, 7B). The northern part of the eastern Pacific ridge, which had already taken on the characteristics of a block the previous week, retrograded further into the Bering Sea. On the first few days of the month, unseasonally warm humid tropical air pushed into the Gulf Coast States, contributing to the above normal temperatures there.

As this air was displaced by the first of a series of storms, severe weather including tornadoes broke out in the South, with relatively heavy precipitation spreading through the area and up the East Coast (Fig. 7C). On 4 January a storm from the Pacific seemed to concentrate most of its moisture in the San Francisco Bay area, where a record of over 12.7 cm (5 inches) of rain fell within a 24 h period, causing severe flooding and mudslides. This system is reflected in the mean trough near the California coast (Fig. 7A). As the storm moved inland, the accom-

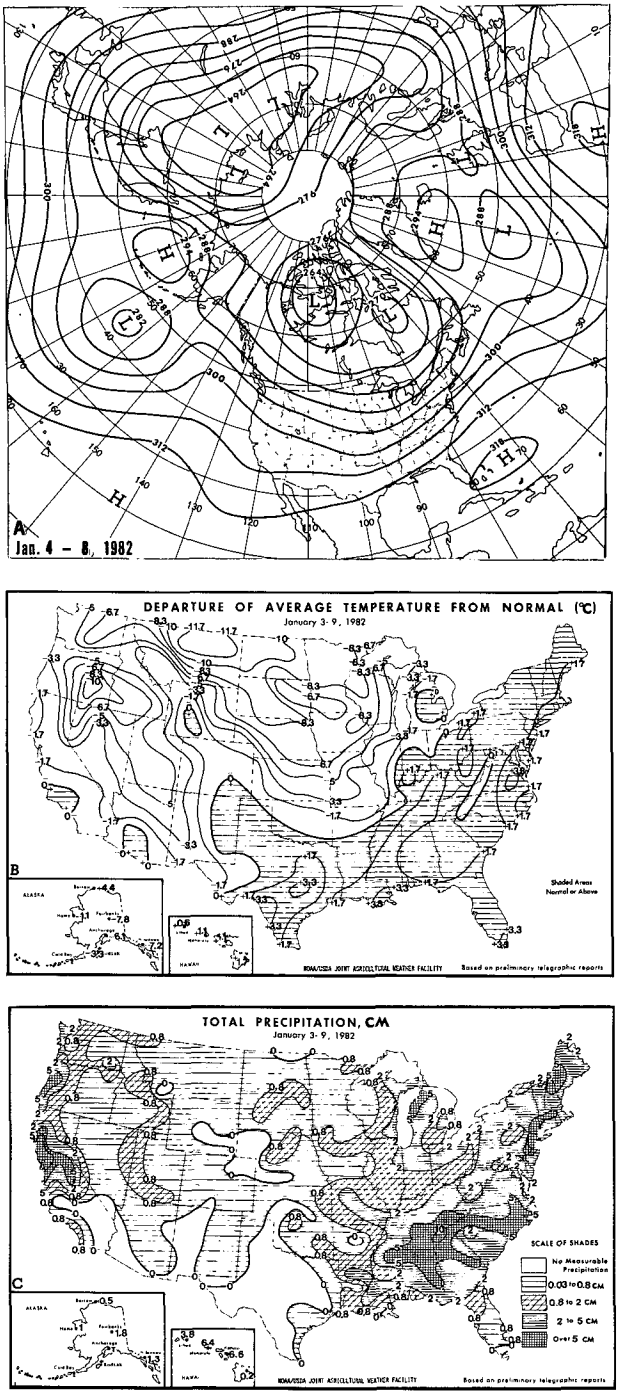

FIG. 7. (A) Mean 70 kPa contours (dam) for 4–8 January 1982, (B) departure from normal of average surface air temperature (°C), and (C) total precipitation (cm) for week of 3–9 January 1982 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service and World Agricultural Outlook Board, 1982).

TABLE 2. Record and near-record monthly precipitation totals observed over the United States during April 1982.*

Station	Total	Anomaly	Remarks
Fort Wayne, IN	74.9 (29.5)		Snowiest month
Buffalo, NY	17.48 (6.88) (53.2)	+10.11 (+3.98)	Wettest January; 3rd snowiest January
Saulte Ste. Marie, MI	(4.52) (71.0)	+6.60 (+2.60)	Wettest January Snowiest month
Muskegon, MI	26.01 (102.4)		Snowiest month
Houghton Lake, MI	96.5 (38.0)		Snowiest January
Waterloo, IA	46.0 (18.1)		3rd snowiest January
Sioux City, IA	73.9 (29.1)		Snowiest month
Rochester, MN	69.3 (27.3)		Snowiest January
Minneapolis, MN	6.22 (2.45) 11.79 (46.4)	+4.37 (+1.72)	Wettest January Snowiest month
Fargo, ND	76.2 (30.0)		2nd snowiest January
Williston, ND	61.7 (24.3)		Snowiest January
Missoula, MT	68.6 (27.0)		3rd snowiest January

* Precipitation totals and anomalies are in cm; numbers in parentheses are in inches.

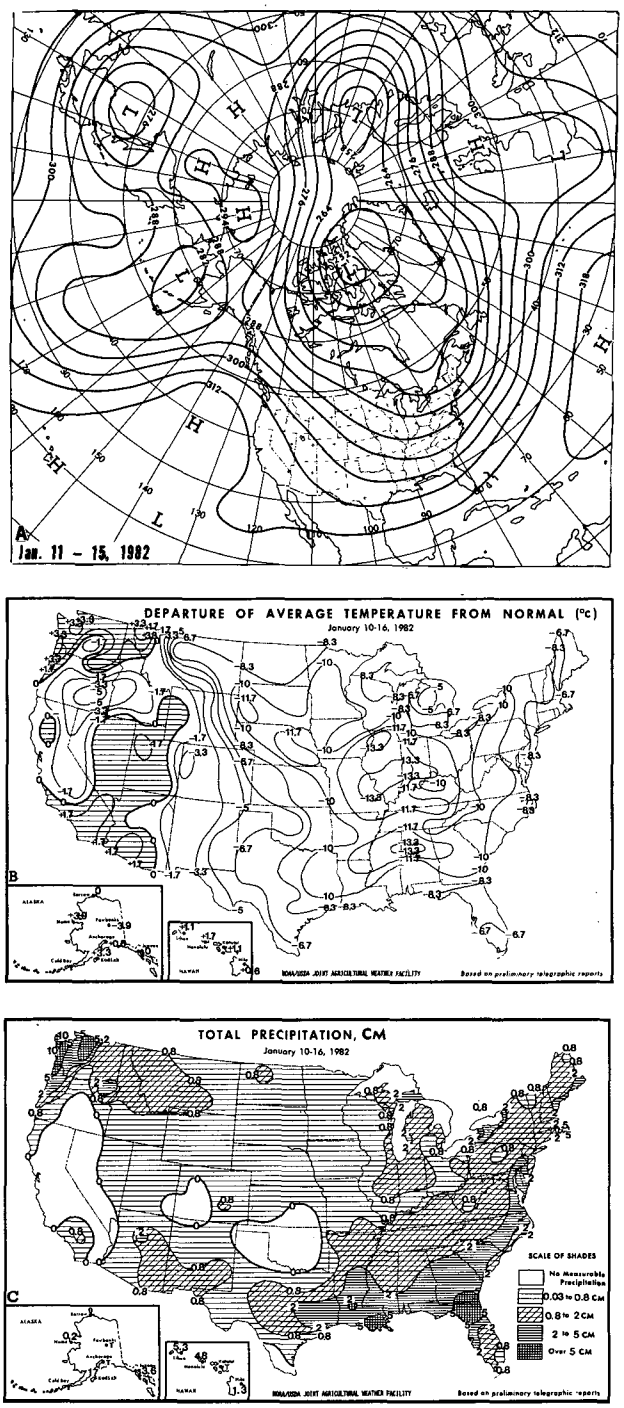

FIG. 8. As in Fig. 7 except for (A) 11–15 January 1982, and (B) and (C) week of 10–16 January 1982.

panying precipitation fell as heavy snow over the Sierras and much of the Great Basin.

The first Arctic High followed the storm quickly, splitting into two centers and pushing frigid air southward on both sides of the Continental Divide. The fresh snow cover in the Great Basin augmented the nocturnal radiation and led to very low minimum temperatures when the storm cleared away. Toward the end of the week, the Arctic low over Canada plunged bodily southward bringing a second, even colder Arctic air mass into the middle of the country by the end of the week.

b. 10–16 January

Although in the mean, the Arctic low remained over Northern Canada, the southward plunge referred to in the preceding paragraph is reflected in the separate mean trough extending southward from Ontario to the eastern Gulf of Mexico (Fig. 8A). The eastern Pacific ridge remained quasi-stationary but amplified and joined with a ridge north of the Bering Straits, increasing the northerly component of the flow from the Arctic across Canada into the United States and bringing a record cold wave to much of the central and southeastern part of the United States (Fig. 8B and Table 3). Temperatures over the entire country east of the Continental Divide averaged far below normal for the week, and favorable radiation conditions over the snow cover in the northern Great Basin kept temperatures below normal there as well, even though Arctic air did not cross west of the Rocky Mountains during the second full week of January. The mean trough in the East extended southward to the Gulf of Mexico, driving cold air into Florida where a damaging freeze occurred.

Precipitation was generally light across the country due to the low moisture content of Arctic air, but heavier amounts fell near the path of a disturbance along the Gulf Coast States (Fig. 8C). Unseasonably heavy snows and severe icing spread across parts of the South as well as over the Ohio Valley and the middle Atlantic States. Locally heavy snows of record proportions hit Buffalo, NY and Muskegon, MI from the combined destabilizing effects of Arctic air crossing the open waters of the Great Lakes and strong, cyclonicly curved flow aloft due to the southward plunge of the Arctic low (Table 4).

c. 17–23 January

During the latter part of January, there was a tendency for the westerlies to move northward over most of the Northern Hemisphere as 70 kPa heights fell at high latitudes except for over the Canadian Archipelago (Fig. 9). The result was progression of most of the 5-day mean 70 kPa troughs and ridges except for the ridge that had been a short distance off the West Coast. This feature retrograded, allowing for development of a new trough along the West Coast. The downstream trough that had been over the eastern United States moved rapidly out into the Atlantic, and a ridge developed over the southeastern

TABLE 3. Record and near-record temperatures observed during January 1982.*

Station	Temperature	Date	Remarks
Bishop, CA	−21.7 (−7)	7	Equaled all-time lowest (1947)
Rockford, IL	−32.8 (−27)	10	Exceeded all-time lowest
Chicago, IL (O'Hare)	−32.2 (−26)	10	Exceeded all-time lowest
Sault Ste. Marie, MI	−37.8 (−36)	10	Lowest for month
San Angelo, TX	−15.0 (5)	11	Lowest for month
Austin, TX	−11.7 (11)	11	Lowest in 31 years
Montgomery, AL	−15.6 (4)	11	Lowest for month
Atlanta, GA	−20.6 (−5)	11	2nd lowest ever recorded
Augusta, GA	−17.2 (1)	11	Exceeded all-time lowest
West Palm Beach, FL	−1.7 (29)	12	2nd lowest ever recorded
Norfolk, VA	−10.0 (14)	11	2nd lowest daily mean in January
International Falls, MN	−42.8 (−45)	17	2nd lowest ever recorded
Milwaukee, WI	−32.2 (−26)	17	Exceeded all-time lowest
Cairo, IL	−21.7 (−7)	17	Lowest January temperature since 1930
Beckley, WV	−28.9 (−20)	17	Exceeded all-time lowest
Charleston, WV	−25.0 (−13)	17	Equaled lowest for month
Toledo, OH	−27.2 (−17)	17	Equaled all-time lowest
Mansfield, OH	−29.4 (−21)	17	Exceeded all-time lowest
Cleveland, OH	−19.4 (−3)	17	Lowest daily max. in January
Youngstown, OH	−28.3 (−19)	17	2nd lowest ever recorded
Buffalo, NY	−26.7 (−16)	17	Exceeded lowest for month
	−18.9 (−2)	17	First subzero max. since 1934
Erie, PA	−26.1 (−15)	17	Equaled all-time lowest
Philadelphia, PA	−21.7 (−7)	17	Lowest for month
Baltimore, MD	−21.7 (−7)	17	Equaled all-time lowest
Wilmington, DE	−23.3 (−10)	17	Lowest for month
Newark, NJ	−21.7 (−7)	17, 18	Lowest for month
Salt Lake City, UT	16.7 (62)	26	Highest for month
Cheyenne, WY	18.9 (66)	26	Highest for month
Denver, CO	22.8 (73)	26	Highest for month
Scottsbluff, NE	23.3 (74)	26	Highest for month

* Temperatures are in °C; numbers in parentheses are in °F. Year of beginning of period of record is shown in parentheses when known.

United States (Fig. 10A). The ridge resisted the southward penetration of Arctic air, and in marked contrast to the previous week, the Gulf Coast States enjoyed a warm week, with some localities observing record daily maximum temperatures. In sharp contrast, areas to the north suffered through a second record-breaking cold wave (Fig. 10B). Additional all-time and January minimum temperatures were set over a wide area encompassing the Midwest, the middle Atlantic States and the Northeast (Table 3).

TABLE 4. Record and near-record 24 h snowfall totals observed during January 1982.*

Station	Total	Date(s)	Remarks
Muskegon, MI	55.9 (22.0)	10	Greatest in 24 h
Buffalo, NY	64.3 (25.3)	10–11	Greatest in 24 h
Jackson, MS	15.2 (6.0)	13–14	5th greatest on record
Houston, TX	T (T)	13	Rare snowfall
Norfolk, NE	32.5 (12.8)	22	Greatest in 24 h
Huron, SD	31.2 (12.3)	22–23	Greatest in 24 h
Fargo, ND	44.2 (17.4)	22–23	2nd greatest in 24 h
Rochester, MN	39.1 (15.4)	22	Greatest in 24 h
Minneapolis, MN	43.4 (17.1)	20–21	Greatest in 24 h
	43.9 (17.3)	20–21	Greatest single storm
	47.0 (18.5)	22–23	Greatest in 24 h
	50.6 (19.9)	22–23	Greatest single storm

* Precipitation totals are in cm; number in parentheses are in inches.

The introduction of a trough along the West Coast and development of a ridge over the Southeast increased the southerly component of flow over the United States and brought an increased supply of moisture to most of the country (Fig. 10C). Several minor waves crossed the country early in the week carrying mainly Pacific moisture, but the main precipitation producer developed on Friday as an intense Colorado low and moved rapidly northeastward to the Great Lakes, while the 70 kPa flow underwent strong amplification. Several localities near the path of the storm center set new records for 24 h or single-storm snowfall totals, and Minneapolis, MN had the dubious distinction of breaking the record twice in the same week (Table 4). Severe weather occurred in the warm sector in parts of the South and a damaging glaze built up in parts of the middle Atlantic Coast States as the moisture-laden tropical air

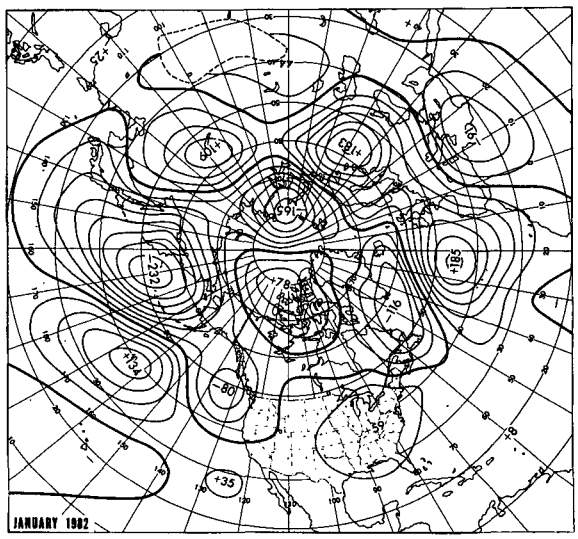

FIG. 9. Mean 70 kPa height change from first half to second half of January 1982.

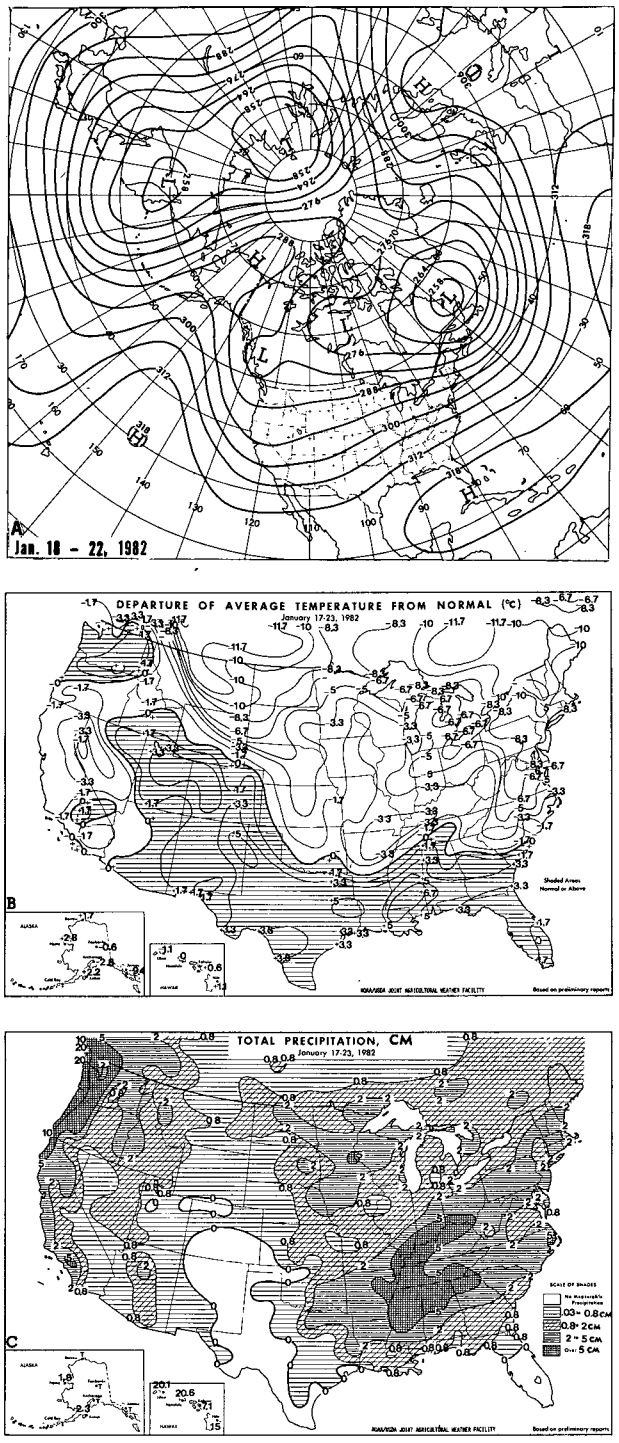

FIG. 10. As in Fig. 7 except for (A) 18–22 January 1982 and (B) and (C) week of 17–23 January 1982.

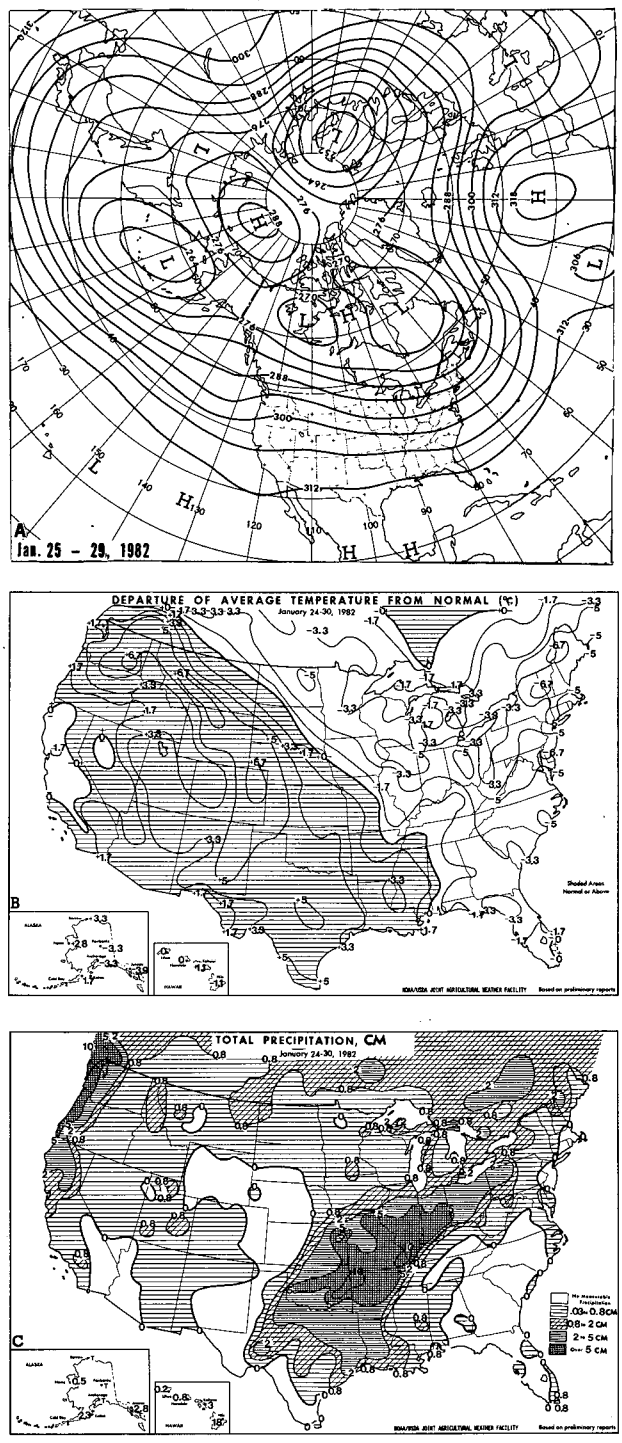

FIG. 11. As in Fig. 7 except for (A) 25–29 January 1982 and (B) and (C) week of 24–30 January 1982.

overran the remains of the entrenched Arctic air at the surface. Much of the heavy precipitation during January fell during individual storm events such as this one, which were associated with transient regimes that did not make much impression on the monthly mean pattern.

d. 24–30 January

Rapid deamplification and retrogression of the eastern Pacific ridge allowed the West Coast trough to weaken and retrograde slightly. The downstream ridge over the United States retrograded to its cli-

matological normal position near the Continental Divide, and the western Atlantic trough moved westward closer to the coast (Fig. 11A).

Temperatures rose rapidly to considerably above normal in most areas south and west of a line extending from Montana to the lower Mississippi Valley (Fig. 11B). Strong Chinook winds produced record maxima for January at some places over the High Plains (Table 4). In the southern part of this area the warmth continued from the previous week, but cooler than normal weather returned to Florida, though without a recurrence of the damaging freeze that accompanied the first cold wave earlier in the month. The Midwest and Northeast remained colder than normal, but not at the extreme levels of the previous two weeks.

Precipitation was again fairly widespread, and the heaviest amounts were concentrated in the central Mississippi Valley, as well as in the more normal locations along the northern Pacific coast (Fig. 11C). An amplifying trough that moved across the Southwest into the middle of the country the last three days of the month triggered the storm that was the week's major precipitation producer. Heavy rains led to rapid snowmelt and flooding in parts of the Ohio Valley and central Appalachians. A southward push of cold air on the last day of the month from another Arctic High located near the Great Lakes turned the rain, which was accompanied by thunderstorms in the St. Louis area, to heavy snow along a strip extending from Missouri across Illinois and Indiana to southern Michigan.

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