WEATHER AND CIRCULATION OF JANUARY 1979
Widespread Record Cold with Heavy Snowfall in the Midwest

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1. Mean circulation

The fast midlatitude zonal flow of the previous month (Taubensee, 1979) continued through January in the sector from central Asia to the central Pacific, but the westerlies moved south of their normal position over much of the Northern Hemisphere between the eastern Pacific and eastern Europe. Strongly amplified mean troughs were located over the western Pacific and central North America (Fig. 1), representing some progression from the previous month's positions.

An extensive area of positive height anomaly extending from Alaska across northern portions of Canada and the Atlantic into northern Europe and western Russia reflected the westward movement of two separate major high-latitude blocking surges during the month (Fig. 2). The 700 mb polar westerlies continued weak over the western half of the Northern Hemisphere at 0.8 m s^{-1}, 2.4 m s^{-1} below normal, while the midlatitude westerlies decreased by 4.1 m s^{-1} from their fast December value to 8.7 m s^{-1} in January, which is 1.3 m s^{-1} below normal. The subtropical westerlies increased to 7.8 m s^{-1}, only 0.4 m s^{-1} above normal, but January was the first month with stronger than normal subtropical westerlies since May 1978.

The strong 700 mb wind maximum near the southern border of the United States (Fig. 3) was accompanied by an extremely pronounced monthly mean jet stream at the 200 mb level (not shown). Wind speeds averaged more than 10 m s^{-1} above the long-term mean from north of Hawaii to Texas, with peak values of 35 to 42 m s^{-1}, as much as 15 m s^{-1} stronger than the long-term mean. Daily values of winds near the tropopause were frequently in excess of 70 m s^{-1}.

At low latitudes of the western Pacific, the westerlies averaged weaker than normal throughout much of the troposphere, as reflected by the strong 700 mb positive height anomaly near Japan (Fig. 2). This may have been a factor contributing to the formation of an unusually long-lived winter typhoon over the southwestern Pacific. Tropical Storm Alice formed near the Marshall Islands on 4 January and became a typhoon two days later. Moving slowly on a west-northwest trajectory, the storm did not lose typhoon intensity until 14 January near 16°N, 137°E, after which it dissipated rapidly within the following 24 h.

Enhanced thermal gradients in the lower troposphere over the southern United States, southern Europe and central Asia stimulated frequent and often intense cyclonic activity in those areas (Fig. 4), while the effects of the high-latitude blocking led to diminished cyclonic activity in the eastern Gulf of Alaska and the Davis Strait.

2. Temperature

In response to the amplified mean ridge over northwestern Canada and the southward movement of the westerlies, colder than normal weather covered nearly the entire lower 48 states, with the exception of California and New England (Fig. 5). This pattern is also implied by the extensive area of below normal monthly mean thickness anomaly centered over the United States (Fig. 4). Only Alaska, where strong southerly anomalous components to the flow prevailed (Figs. 1 and 2), had substantially warmer than normal conditions. Temperatures averaged within a few degrees of normal over Hawaii.

The cold was noteworthy not only for its geographical extent but for its severity. A large area extending from the northern Rocky Mountains to the central Mississippi Valley averaged between 12 and 16°F below normal. Several cities in the central part of the country between the Rocky Mountains and the Mississippi Valley reported the coldest January on record. Topeka, KS reported a record total of 14 days with subzero minimum temperatures. Dozens of additional localities from the Pacific Northwest through the Rockies as far south as the interior of the Gulf Coast states and east to the Ohio Valley reported a near-record cold January (Table 1). It was the third consecutive record or near-record cold January over much of the central

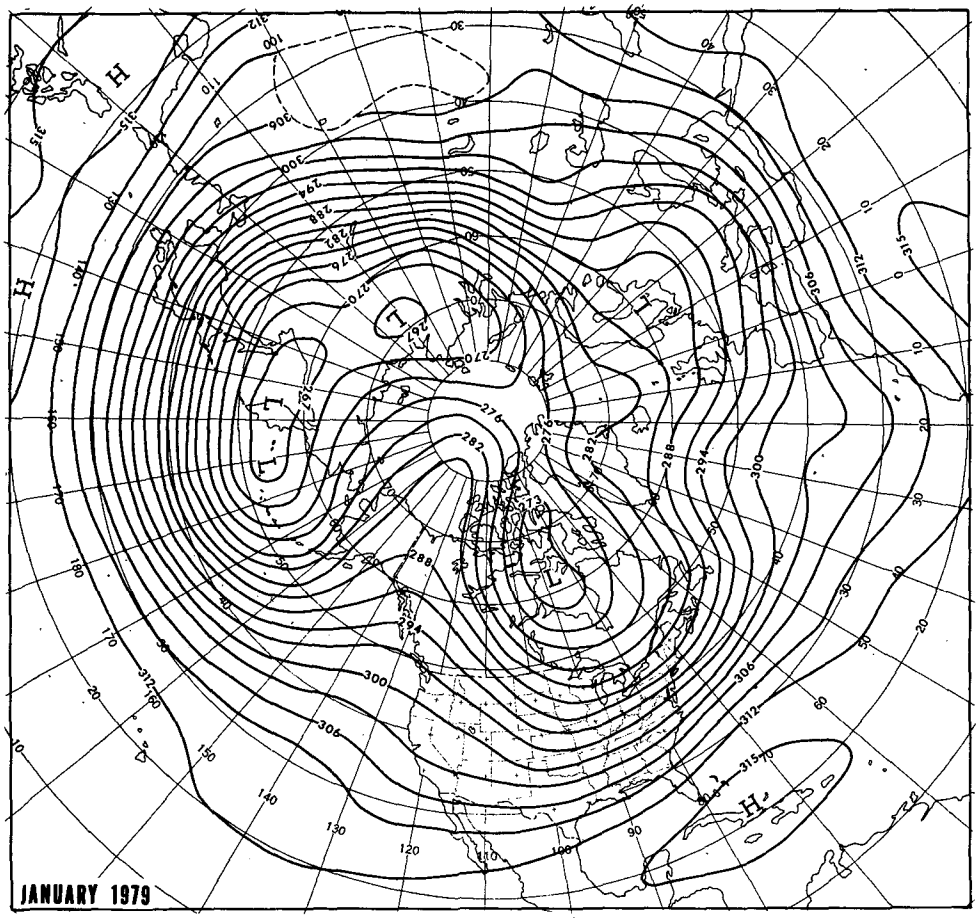

FIG. 1. Mean 700 mb contours (dam) for January 1979.

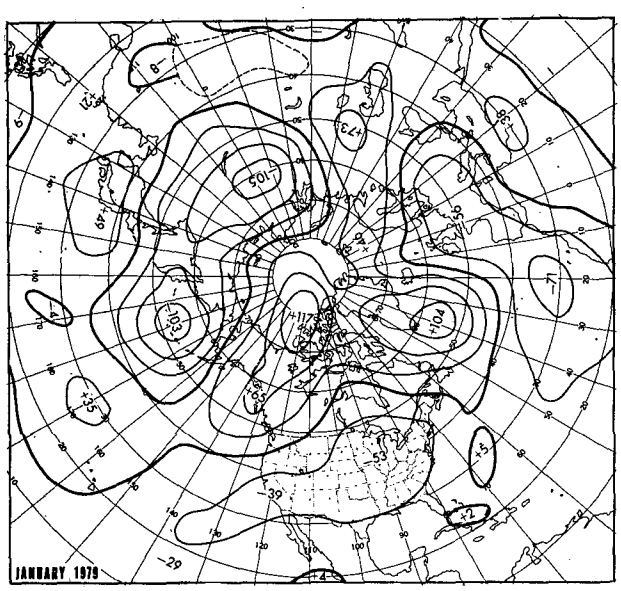

FIG. 2. Departure from normal of mean 700 mb height (m) for January 1979.

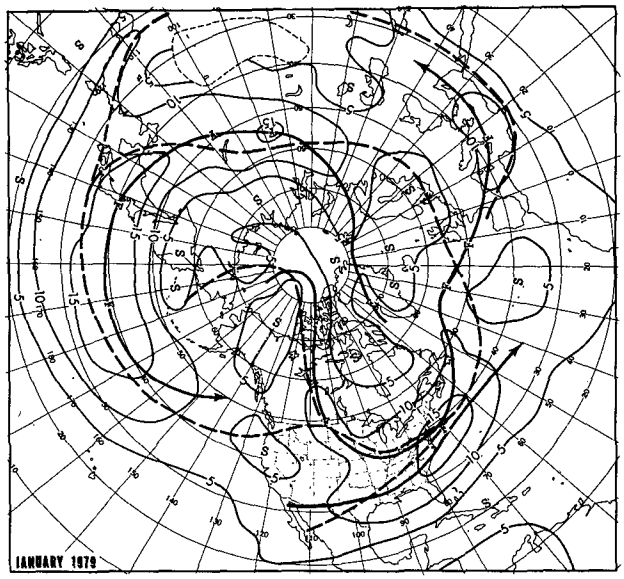

FIG. 3. Mean 700 mb geostrophic wind speed (m s^{-1}) for January 1979. Solid arrows indicate observed axes of maximum wind speed; dashed lines show the normal.

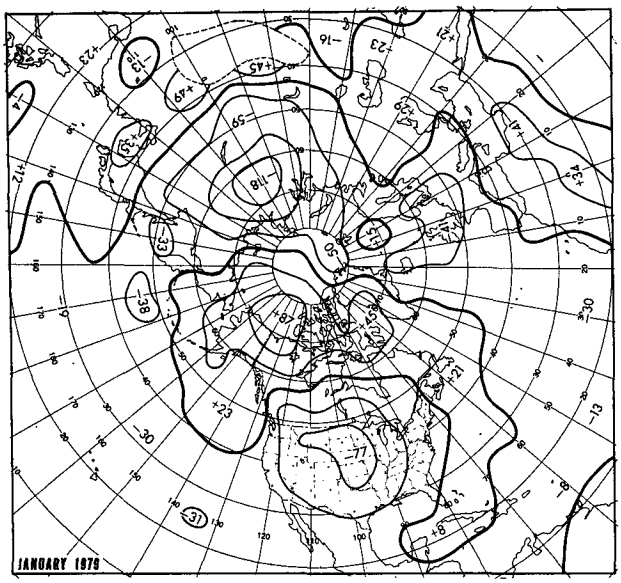

FIG. 4. Departure form normal of mean 1000–700 mb thickness (m) for January 1979.

Mississippi Valley, eastern portions of the Great Plains, and western portions of the Great Lakes area and the Ohio Valley (Wagner, 1977, 1978). The core of the most extreme cold has been a little farther west in each successive year.

3. Precipitation

Precipitation was well above normal over most of the country, with only limited areas of the Pacific Northwest, northern Great Plains and Rio Grande Valley reporting substantially subnormal totals (Fig. 6). Note that the area of less than 50% normal precipitation along the Pacific Northwest Coast should not be shaded. The overall distribution of precipitation was quite similar to that of the previous January (Wagner, 1979) except that much heavier amounts occurred over the central Great Plains and central Mississippi Valley during January 1978.

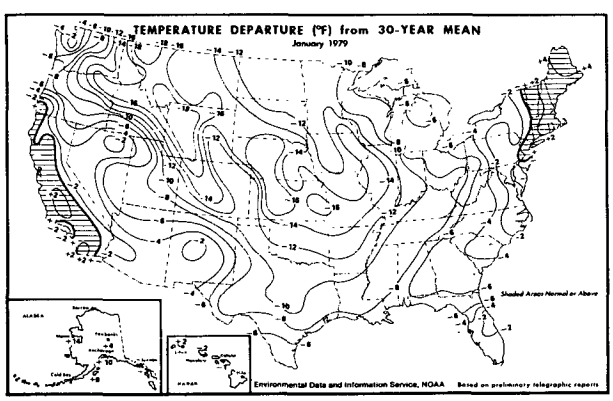

FIG. 5. Departure from normal of average surface temperature (°F) for January 1979 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1979).

TABLE 1. Record and near-record monthly mean temperatures observed during January 1979.

Station	Temperature (°F)	Anomaly (°F)	Remarks
Spokane, WA	10.5	−14.9	4th coldest January
Walla Walla, WA	18.5	−14.9	5th coldest January; coldest November–January on record
Pendleton, OR	15.3	−16.7	2nd coldest January
Lewiston, ID	16.9	−14.3	5th coldest January
Pocatello, ID	10.7	−12.5	3rd coldest January
Kalispell, MT	−0.2	−19.3	Coldest January
Helena, MT	1.1	−17.0	5th coldest month
Lander, WY	1.3	−18.3	2nd coldest January
Sheridan, WY	3.4	−17.6	3rd coldest January; coldest November–January on record
Casper, WY	8.8	−14.4	2nd coldest January; coldest since 1949
Colorado Springs, CO	16.9	−11.7	Coldest January
Denver, CO	18.0	−11.9	2nd coldest January
Pueblo, CO	16.1	−14.0	Coldest month
Alamosa, CO	6.0	−11.2	2nd coldest January since 1946
Clayton, NM	23.2	−9.8	Coldest January since 1930
Rapid City, SD	7.4	−14.5	Coldest month in 42 years; 3rd coldest month on record
Huron, SD	0.3	−12.2	5th coldest January
Sioux Falls, SD	1.8	−12.4	Coldest January
Sioux City, IA	3.9	−14.1	Coldest January
Des Moines, IA	7.5	−11.9	3rd coldest January
Waterloo, IA	3.6	−12.7	4th coldest January
Scottsbluff, NE	10.4	−14.5	2nd coldest January
Valentine, NE	4.1	−16.3	Coldest January
North Platte, NE	6.0	−17.4	Coldest January
Grand Island, NE	7.5	−14.8	Coldest month
Norfolk, NE	5.7	−13.2	Coldest January
Lincoln, NE	7.2	−15.0	Coldest January
Omaha, NE	7.9	−12.3	Coldest January
Dodge City, KS	14.8	−16.0	Coldest January
Concordia, KS	12.7	−13.7	3rd coldest January
Wichita, KS	16.7	−14.4	2nd coldest January
Topeka, KS	11.8	−16.2	Coldest January
St. Joseph, MO	10.7	−15.5	Coldest month
Kansas, City, MO	12.5	−14.6	Coldest January
Columbia, MO	15.9	−13.4	4th coldest January
St. Louis, MO	16.6	−14.7	3rd coldest January
Springfield, MO	17.6	−15.3	Coldest month
Amarillo, TX	24.9	−11.1	Coldest January
Wichita Falls, TX	30.7	−10.8	2nd coldest January
Austin, TX	40.4	−9.3	2nd coldest January
Ft. Smith, AR	25.6	−13.4	Coldest January
Little Rock, AR	27.5	−13.8	Coldest January
Shreveport, LA	37.4	−9.8	4th coldest January
Jackson, MS	38.3	−8.8	4th coldest month
International Falls, MN	−8.7	−10.6	3rd coldest January
St. Cloud, MN	−2.5	−11.4	3rd coldest January
Minneapolis, MN	3.2	−9.0	5th coldest January
Rochester, MN	−1.5	−14.4	4th coldest month
Green Bay, WI	5.9	−9.5	5th coldest January
Houghton Lake, MI	11.5	−5.9	4th coldest January
Muskegon, MI	17.0	−7.0	2nd coldest January
Rockford, IL	7.7	−12.5	3rd coldest January
Moline, IL	6.3	−15.2	Coldest month
Peoria, IL	9.4	−14.4	2nd coldest January
Springfield, IL	12.4	−14.3	2nd coldest January
Chicago, IL (Midway)	12.5	−11.8	3rd coldest January
Cairo, IL	24.6	−11.7	4th coldest January
Evansville, IN	20.9	−11.7	5th coldest January
Louisville, KY	24.6	−8.7	5th coldest January

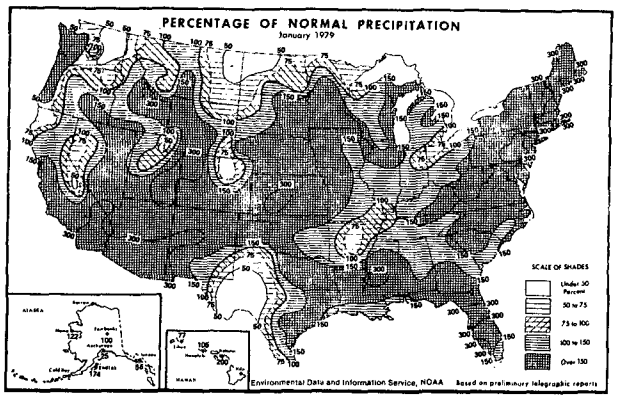

FIG. 6. Percentage of normal precipitation for January 1979 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1979).

Record and near record totals were observed over widely scattered areas, but the greatest concentration was in the Middle Atlantic and New England States, where several cities reported the wettest January on record (Table 2). Some of these localities had just set a new record in January 1978.

At the opposite end of the country, Hilo, HA was deluged with 32.24 inches, also a new January record for this normally wet city. An observing site located 30 mi north of Hilo was reported to have had almost 93 inches of rain during January. The heavy rains which covered parts of Hawaii were due to a cut-off Kona-type low which prevailed in the area for several days before the middle of the month. The enhanced northeasterly anomalous mean flow generated by stronger than normal high pressure over the central Pacific (Figs. 1 and 2) usually favors heavier than normal rainfall at windward exposures such as Hilo.

The stronger than normal southerly flow covering Alaska was associated with heavier than normal precipitation over all but the southeastern coastal areas, near the amplified mean ridge.

There were records for heavy snow set during January 1979, mainly over the central Great Plains and central Mississippi Valley (Table 2). The area of records was centered slightly west of the area of record heavy snow in the previous January (Wagner, 1978), in good agreement with the westward shift of the mean North American trough and the axis of coldest temperatures relative to normal. Several cities in lower Michigan, southern Wisconsin and northern Illinois reported the greatest depth of snow on the ground on record sometime during the month. The snow was especially paralyzing in the Chicago area, where O'Hare Airport, the world's busiest, is located. Thousands of travelers were stranded for days while the runways had to be closed for snow removal.

TABLE 2. Record and near-record precipitation and snowfall observed during January 1979.

Station	Amount (inches)	Anomaly (inches)	Remarks
Hilo, HA	32.24	+23.17	Wettest January
Long Beach, CA	8.41	+6.15	3rd wettest January since 1942
Flagstaff, AZ	5.54	+3.65	4th wettest January;
	59.4	—	2nd snowiest January
Casper, WY	0.81	+0.31	3rd wettest January;
	16.3	—	4th snowiest January
Shreveport, LA	9.22	+5.18	5th wettest January
Jackson, MS	14.10	+9.57	Wettest January; 5th wettest month
Cape Hatteras, NC	9.72	+5.46	Wettest for any winter or spring month
Norfolk, VA	6.47	+3.12	4th wettest January
Richmond, VA	6.16	+3.30	3rd wettest January
Washington, DC	6.64	+4.02	3rd wettest January
Harrisburg, PA	8.01	+5.44	Wettest January
Philadelphia, PA	8.74	+5.93	Wettest January
Avoca, PA	6.48	+4.44	Wettest January
Allentown, PA	8.47	+5.40	Wettest January
Trenton, NJ	8.99	+6.23	Wettest January
New York, NY (Central Park)	10.52	+7.81	Wettest January
Albany, NY	6.37	+4.17	3rd wettest January
Hartford, CT	9.12	+5.84	Wettest January
Providence, RI	11.66	+8.14	Wettest January; 3rd wettest month
Worcester, MA	11.16	+7.81	Wettest January
Milton, MA (Blue Hill Observatory)	11.61	+7.49	Wettest January
Boston, MA	10.55	+6.86	Wettest January
Concord, NH	8.09	+5.42	Wettest January; 2nd
	42.3	—	snowiest January
Portland, ME	11.92	+8.54	2nd wettest January;
	62.4	—	snowiest month
Buffalo, NY	42.6	—	6th snowiest January
Huron, SD	23.8	—	3rd snowiest January
Waterloo, IA	17.2	—	3rd snowiest January
Goodland, KS	18.1	—	Snowiest January
Concordia, KS	13.7	—	3rd snowiest January
Topeka, KS	20.1	—	Snowiest January
Springfield, MO	23.1	—	Snowiest January
Moline, IL	26.7	—	Snowiest month
Peoria, IL	24.7	—	Snowiest January
Chicago, IL (Midway)	40.4	—	2nd snowiest month
Muskegon, MI	65.7	—	2nd snowiest January
Evansville, IN	15.0	—	6th snowiest January

4. Weekly variability

a. 1–7 January

A highly amplified pattern prevailed over North America during the first week of 1979 (Fig. 7A). The anomalously strong ridge centered over the Yukon area was an amalgamation of an amplifying ridge moving northward from the Gulf of Alaska and a continued rapid retrogression of blocking centered over the David Strait during the last week of December (Taubensee, 1979).

The temperature anomaly pattern was very simi-

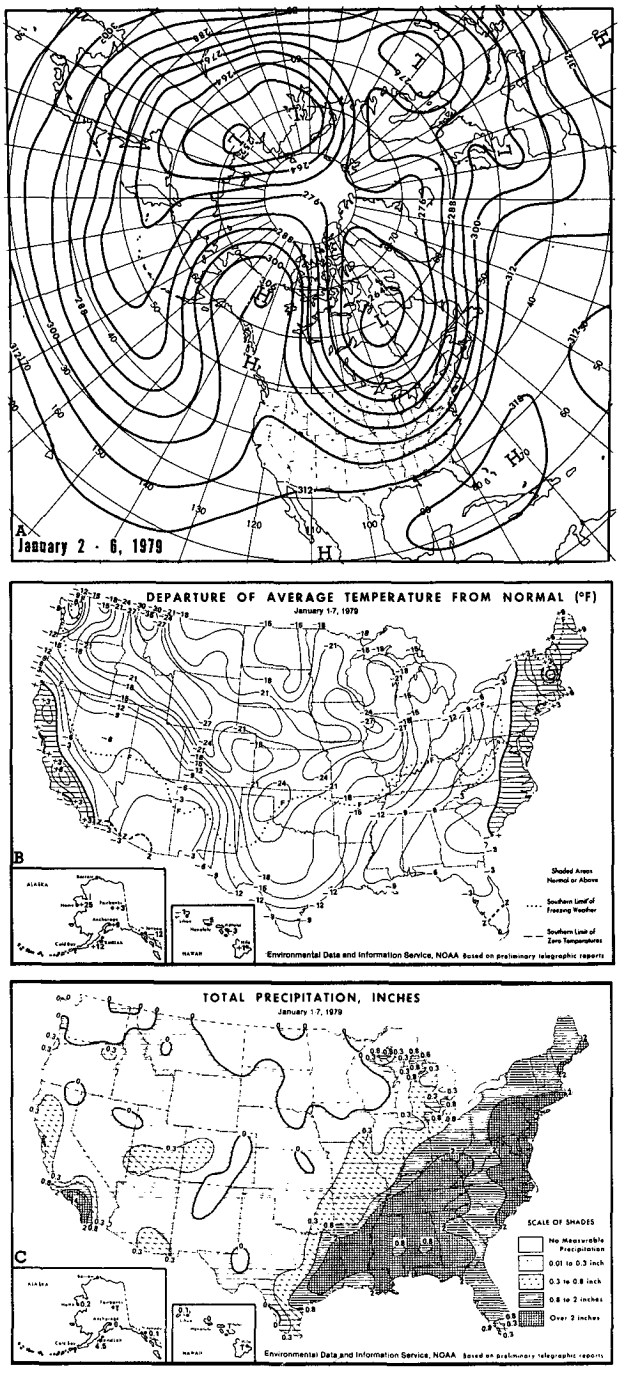

FIG. 7. (A) Mean 700 mb contours (dam) for 2–6 January 1979; (B) departure from normal of average surface temperature (°F) and (C) total precipitation (inches) for week of 1–7 January 1979 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1979).

lar to the monthly mean (cf. Figs. 5 and 7B), only of greater magnitude, ranging down to 35°F below normal over the northern Rocky Mountains and 24°F below normal over the Texas and Oklahoma Panhandle area. A huge Arctic high produced a record-high sea level pressure of 31.08 inches at Pendleton, OR on 1 January and set daily low temperature records from there through the Great Plains south to the Rio Grande Valley and east to Mississippi on the first three days of the month. Severe frost and freeze damage occurred to winter vegetables in the lower Rio Grande Valley.

Unusually mild and moist air streaming northward ahead of the sharp front marking the leading edge of the Arctic air mass produced record warmth at several eastern cities the first two days of the month. The first of several heavy rainstorms this month producing 2 inches or more precipitation accompanied the front ushering in the Arctic air (Fig. 7C). Following the frontal passage, temperatures plunged rapidly from record high values to near zero readings. At Beckley, WV the temperature plummeted 67°F within 48 h, from 63°F on 1 January to −4°F on 3 January. Similar rapid temperature changes were observed at other cities in the middle Atlantic and Appalachian areas.

On its way to the Atlantic, the Arctic high set another new record high sea level pressure value of 30.74 inches at Jacksonville, FL on the 4th.

b. 8–14 January

The intense elongated cyclonic center that had been over northern Siberia moved to a position over the Sea of Okhotsk, contributing to fast mid-latitude westerlies across the Pacific. A second trough extended southward from the Aleutians, while a ridge remained near the west coast of North America (Fig. 8A). The top portion of the ridge developed into a closed high that moved northward over the Beaufort Sea, allowing increased westerly flow from the Pacific to enter the United States.

As a result, temperatures moderated somewhat over the southwestern portion of the Nation to as much as 9°F above normal (Fig. 8B). The rest of the country remained colder than normal, although the cold was not quite as severe as during the previous week. Below-normal temperatures pushed eastward to the Atlantic Coast, with the exception of southern Florida.

Precipitation fell across most of the country with heaviest amounts along the West Coast in response to the increased maritime flow from the Pacific (Fig. 8C). Portland, OR and vicinity had a severe ice storm on 9–10 January when over an inch of rain froze due to cold air still trapped in the Columbia River Basin.

The short wave that produced the ice storm combined with a second, more intense impulse that amplified over the southern Great Plains to produce an intense storm in the Midwest on 13 January. Chicago had its second heaviest snowstorm in his-

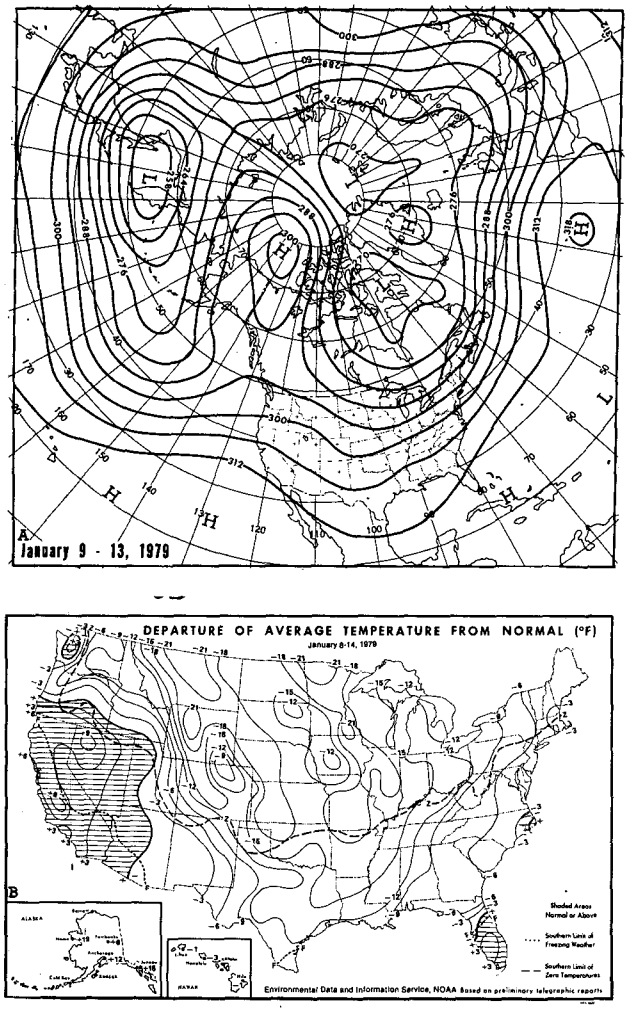

FIG. 8. As in Fig. 7 except (A) 9–13 January 1979 and (B) and (C) week of 8–14 January 1979.

tory with 21 inches within a two-day period. As the system moved east, it combined with a second storm that developed in the Gulf of Mexico to give the third heavy rainstorm of the month to much of the Northeast.

c. 15–21 January

The weakening of the first blocking surge which had been over northwestern Canada and the Beaufort Sea area and the development and movement of the second blocking surge from eastern Europe to southern Greenland is clearly demonstrated by the height change between the first and second half of January (Fig. 9). Westerlies increased markedly across the north Pacific but decreased strongly across the North Atlantic while increasing over the subtropical Atlantic.

During the third week of the month, the low over the north Pacific moved east of Kamchutka while the subtropical ridge built at lower latitudes (Fig. 10A). The increased westerly flow helped to push the trough that had been over the east-central Pacific into the western United States, where it became oriented along a northeast–southwest axis from the northern Mississippi Valley to southern California. A ridge built over the southeastern states, and a deepening, negatively tilted trough moved into the western Atlantic as the westerlies began to undercut the new blocking high extending from western Russia back to Iceland. Severe winter weather with heavy snowstorms occurred over the normally milder maritime areas of western Europe and the southern British Isles with this pattern.

Over the United States, temperatures remained below normal over the northern two-thirds of the country as Arctic highs continued to traverse an area of greater than normal snow cover. Milder than normal weather moved eastward as far as Florida across the southern part of the country in response

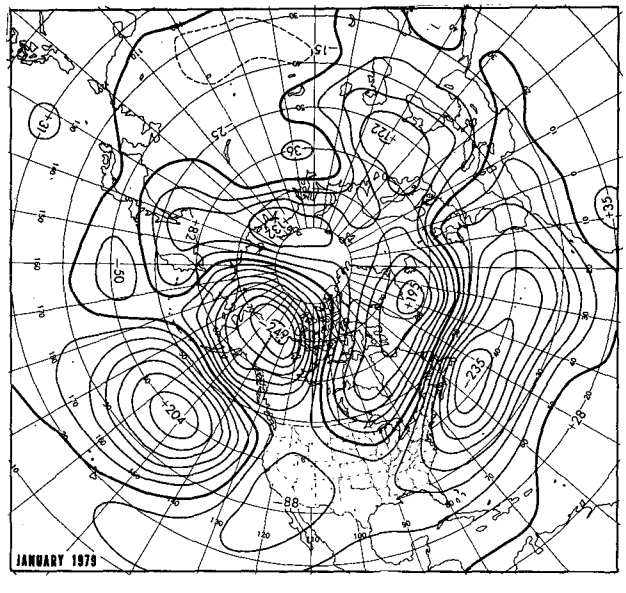

FIG. 9. Mean 700 mb height change (m) from first half to second half of January 1979.

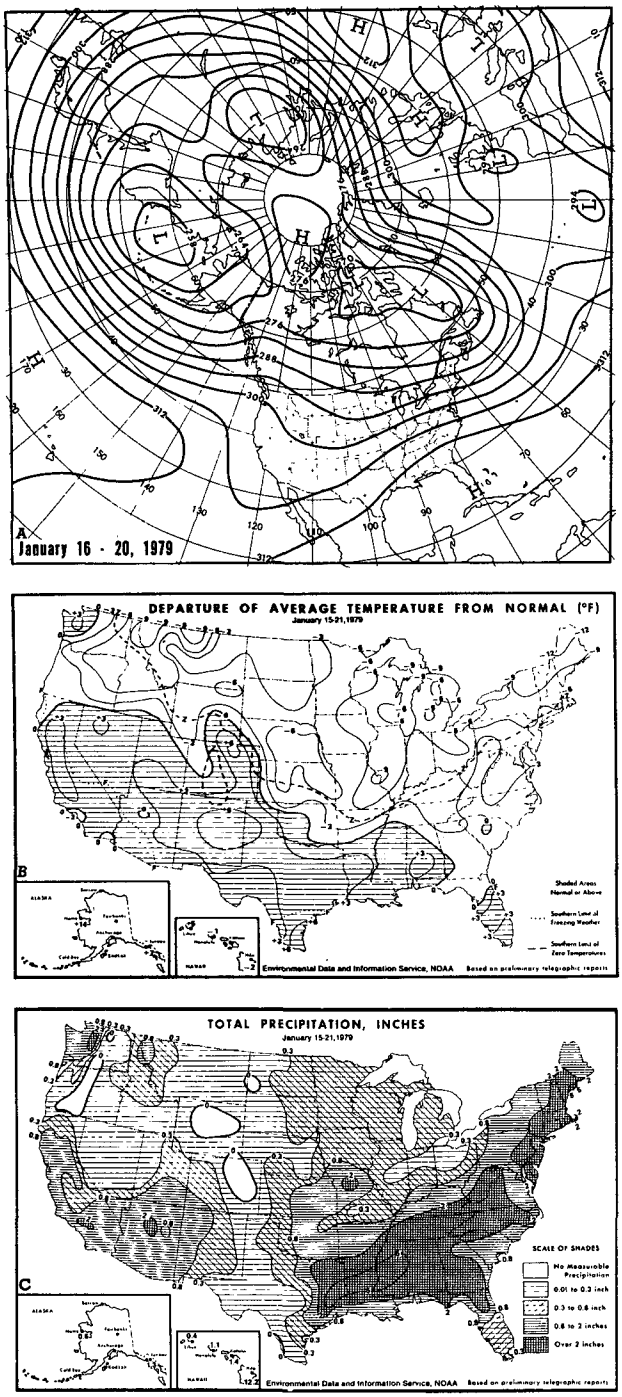

FIG. 10. As in Fig. 7 except (A) 16–20 January 1979 and (B) and (C) week of 15–21 January 1979.

to the ridging (Fig. 10B). Early in the week record daily temperatures as low as −19°F at Chicago, IL, −10°F at Kansas City, MO, and 18°F at Baton Rouge, LA were observed.

Following this cold spell, a deepening low moved rapidly eastward from the Great Lakes across southern New England. It produced a record 24 h snowfall total of 27 inches at Portland, ME. Later in the week, an intensifying short wave triggered a rapidly deepening storm over the lower Mississippi Valley that subsequently moved northeastward along the Appalachian Mountains. This system produced the second lowest January sea level pressure on

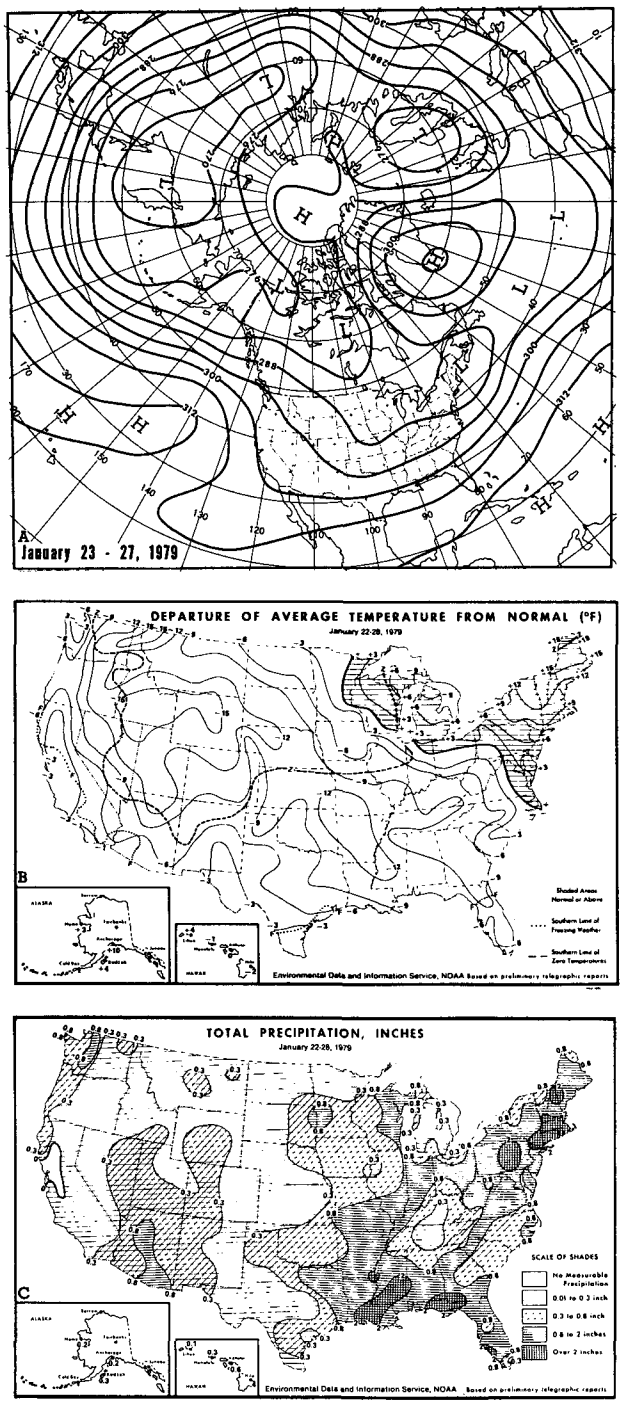

FIG. 11. As in Fig. 7 except (A) 23–27 January 1979 and (B) and (C) week of 22–28 January 1979.

record at Chattanooga, TN (29.05 inches) and Columbia, SC (29.13 inches). High winds were observed throughout the Southeast and the storm produced record wintertime 24 h rainfall totals in the New York City area and New England on 20 and 21 January. Trenton, NJ reported 3.16 inches, New York City area totals ranged from 3.25 inches at Kennedy International Airport to 3.92 inches at the Central Park Observatory, and Sikorsky Memorial Airport near Bridgeport, CT had 4.55 inches. Most of the rather heavy precipitation across the southern half of the country and over the Atlantic States was produced by this storm system (Fig. 10C).

d. 22–28 January

During the last week of the month, the North Atlantic block had retrograded to southern Greenland and the westerlies were far south of normal from the eastern Pacific to western Europe, where they were beginning to move north again with the removal of the block from Scandinavia (Fig. 11A).

Temperatures were well below normal over all but the northeastern United States, which was under the influence of mild maritime Atlantic air moving westward south of the block (Fig. 11B). Caribou, ME averaged 18°F above normal for the week, and the temperature there failed to go below freezing the last six days of the month. It averaged 28°F above normal on 30 January. Very cold air penetrated the Rocky Mountains and central portions of the country again behind two more eastward moving amplifying troughs. By the end of the month, several cities reported daily low temperature records.

Precipitation was widespread across the Nation in response to the two active storms (Fig. 11C). They gave several inches more snow to the Midwest. The first storm moved northeastward from the southern Great Plains to the Ohio Valley and then moved eastward as a cutoff low to the New England coast where it was quasi-stationary for three days under the influence of the block. The second storm moved eastward to the Tennessee Valley while a new center developed near Florida and moved northeastward along the Gulf Stream. Colder air returned to all but the New England area following this storm.

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