WEATHER AND CIRCULATION OF JANUARY 1974

Another January with Rapid Midmonth Warming

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1. Mean circulation

The mean 700-mb circulation during January 1974 was dominated by an extremely deep Icelandic Low (227 meters below normal) and a vigorous Pacific Low displaced well southwest of its normal position by a strong blocking ridge over Alaska and northeast Siberia (Figs. 1 and 2). The subtropical ridge over the western and central Atlantic was stronger than normal, with 700-mb heights averaging 100 m above normal east of Cape Hatteras.

As a consequence, the 700-mb westerlies were much stronger than normal at middle latitudes over the Western Hemisphere, while the westerlies were weaker than normal over polar areas and at low latitudes. This characteristic was similar to January 1972 (Wagner, 1972). The axis of maximum 700-mb wind speed was displaced south of normal over the western and central Pacific but was near its normal location over the Atlantic, where a peak monthly mean value of 32 m sec^{-1} was observed southeast of Newfoundland (Fig. 3). This was 15 m sec^{-1} stronger than normal for that

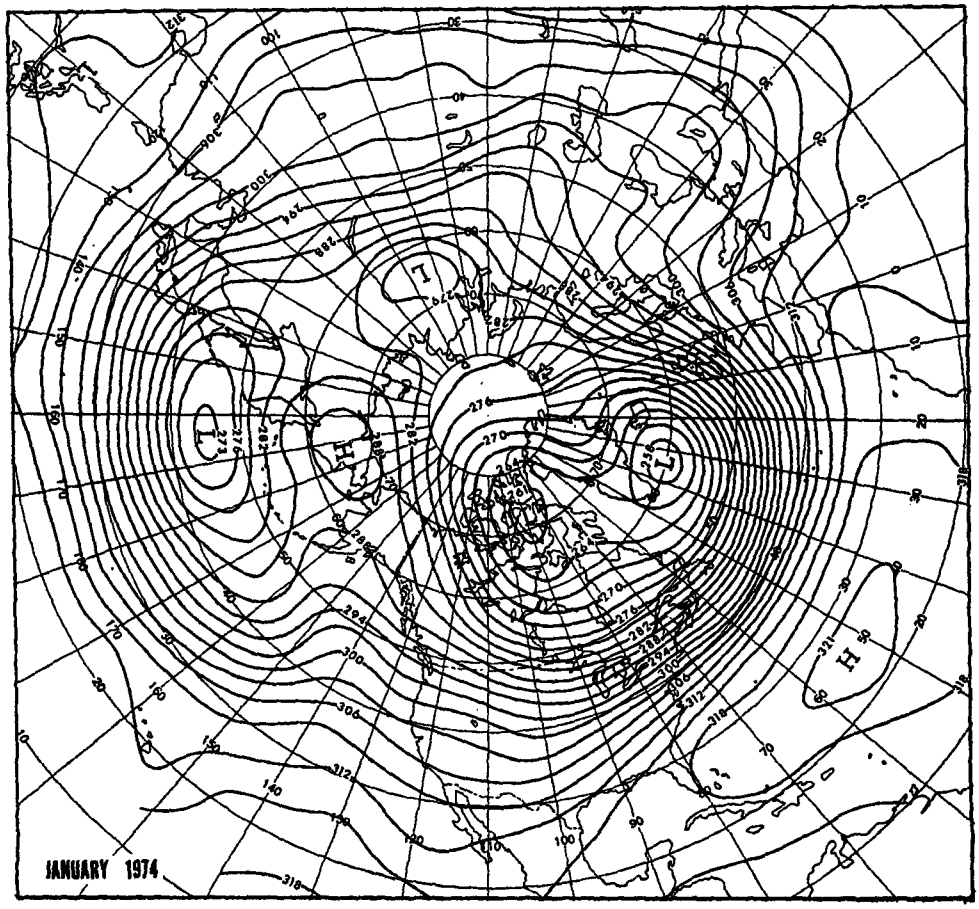

FIG. 1. Mean 700-mb height contours (dam) for January 1974.

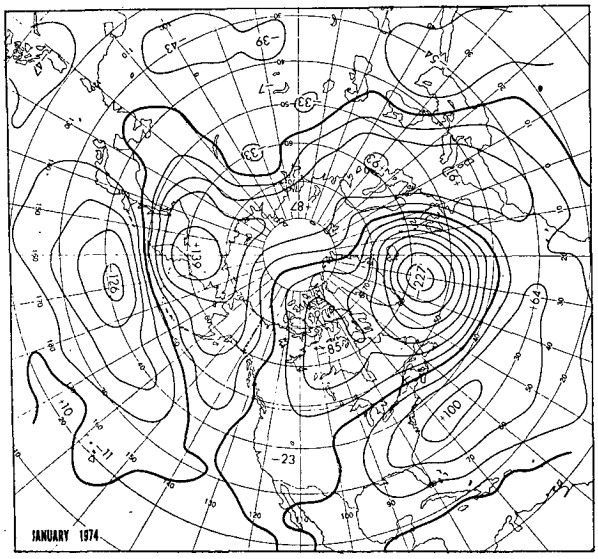

FIG. 2. Departure from normal of mean 700-mb height (m) for January 1974.

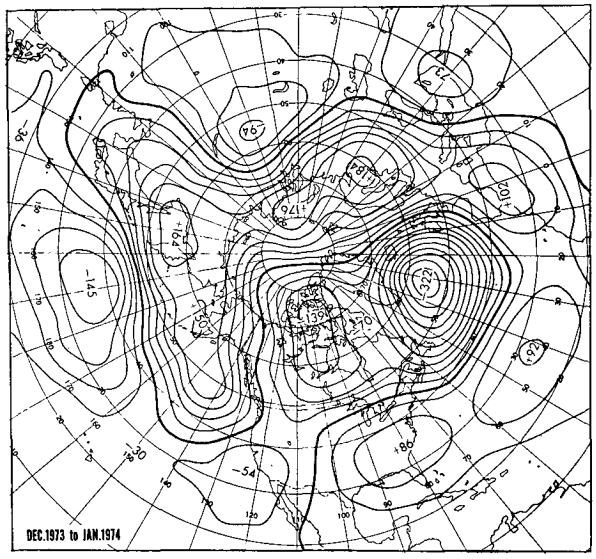

FIG. 4. Mean 700-mb height anomaly change (m) from December 1973 to January 1974.

area. The two branches of the 700-mb wind maximum over the United States were associated with Alberta-type Lows and storms moving northeastward from the lower Mississippi Valley toward the Great Lakes and New England.

The January circulation represents a considerable change from that of December (Taubensee, 1974). Retrogression of the 700-mb ridge near the West Coast of North America accompanied the merger of the Asiatic coastal trough with the central Pacific trough into the intense cyclonic system located south of Kamchatka. Height anomalies fell by as much as 145 m from December to January over the west central Pacific (Fig. 4) Monthly mean height anomalies fell by as much as 139 m over Canada due to retrogression of the western Canada ridge and further deepening of the Baffin Low.

This, coupled with rising 700-mb heights over the Southeast, greatly increased the zonal westerlies over North America and propelled cold, Canadian air out over the Atlantic. The interaction of this Arctic air with unusually warm air and water over the North Atlantic that had been built up over the past two months by an anomalously strong 700-mb ridge (Taubensee, 1974) created a large source of available potential energy. As a result, several cyclones deepened to well below 950 mb at sea level over the North Atlantic during January, and the monthly mean 700-mb height anomaly decreased by as much as 322 m from December to January (Fig. 4). The January mean 700-mb height anomaly of 227 m below normal (Fig. 2) was in excess of two and a half standard deviations.

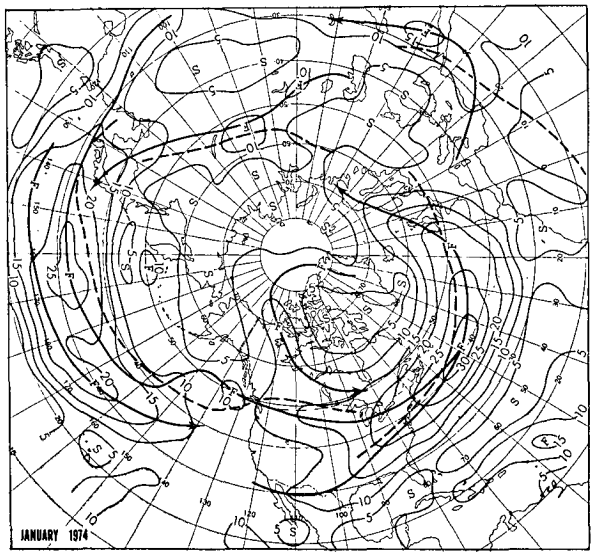

FIG. 3. Mean 700-mb geostrophic wind (m sec^{-1}) for January 1974. Solid arrows show the observed axes of maximum wind speed, and dashed lines show the normal.

2. Temperature

As is usually the case during winter, the monthly mean temperature anomaly pattern was well correlated with the height anomaly (Figs. 5 and 2, respectively). The strong westward extension of the Bermuda High kept polar air out of the Southeast practically the whole month, and a nearly continuous flow of maritime tropical air kept temperatures well above normal. A large portion of the Southeast experienced record high January mean temperatures more than 10F above normal (Table 1 and Fig. 5) with daily records for warmth too numerous to list. For example, three new daily records for warmth were set at Appalachicola,

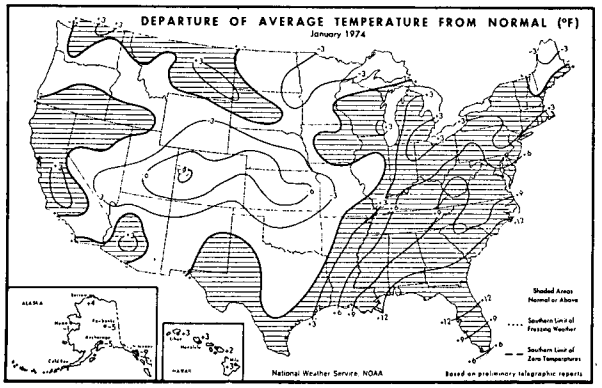

FIG. 5. Departure from normal of average surface temperature (°F) for January 1974 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service, 1974).

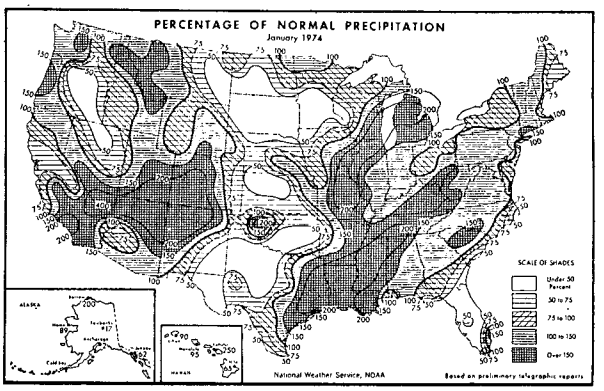

FIG. 6. Percentage of normal precipitation for January 1974 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service, 1974).

Fla. Every day of the month was at least 7F above normal at Orlando, Fla. and 8F above normal at Daytona Beach, Fla. At Charleston, S. C., the temperature hit 80F three times during the month. Even several stations which did not set new records had the warmest January since 1950 (Table 1).

Temperatures averaged more than 6F below normal from the eastern Plateau through the central Rocky Mountains to the central Great Plains (Fig. 5). No monthly records were established in this area as the cold did not persist all month in most places, but was due mainly to an intense cold wave which gripped the area the first two weeks of the year. The greatest monthly mean negative temperature anomaly over the conterminous United States was −9.7F at Grand Junction, Colo., far short of the previous year's record January cold at that station (Wagner, 1973).

3. Precipitation

As might be expected during a month with below normal heights in the West and a strong ridge off the East Coast (Figs. 1 and 2), precipitation was heavier than normal over much of the country (Fig. 6). More than twice the normal amount fell over much of the Southwest, mainly in connection with storms early in the month. It was the second snowiest January on record at Sandberg, Calif., and Albuquerque, N. Mex. (Table 2).

Another swath of heavy precipitation occurred from

TABLE 1. Record and near-record monthly mean temperatures observed in January 1974.

Station	Temperature (°F)	Anomaly (°F)	Remarks
Key West, Fla.	76.8	+ 6.1	Warmest Jan. on record
Miami Beach, Fla.	74.2	+ 5.7	Warmest Jan. on record
West Palm Beach, Fla.	73.2	+ 7.7	Warmest Jan. on record
Lakeland, Fla.	71.0	+10.2	2nd warmest Jan. since 1915 1st Jan. with no heating degree days
Fort Meyers, Fla.	73.0	+ 9.5	2nd warmest Jan. on record
Tampa, Fla.	71.1	+10.7	2nd warmest Jan. on record
Pensacola, Fla.	65.7	+13.6	2nd warmest Jan. on record
Jacksonville, Fla.	66.7	+12.1	3rd warmest Jan. on record
Tallahassee, Fla.	66.6	+14.0	Warmest Jan. on record
Mobile, Ala.	64.0	+12.8	2nd warmest Jan. on record
Columbus, Ga.	59.6	+12.7	2nd warmest Jan. on record
Augusta, Ga.	56.8	+11.0	Warmest Jan. on record
Charleston, S. C.	61.8	+13.2	Warmest Jan. on record
Columbia, S.C.	59.2	+13.8	Warmest Jan. on record
Wilmington, S. C.	58.8	+12.4	Equaled 2nd warmest Jan.
Greensboro, N. C.	45.8	+ 7.1	Warmest Jan. since 1950
Charlotte, N. C.	49.8	+ 7.7	Warmest Jan. since 1950
Bristol, Tenn.	47.0	+10.6	Warmest Jan. since 1950
Norfolk, Va.	48.6	+ 8.1	Warmest Jan. since 1950
Richmond, Va.	45.8	+ 8.3	Warmest Jan. since 1950, also 4th warmest Jan. on record
Beckley, W. Va.	41.4	+10.0	Warmest Jan. since 1950
Cleveland, Ohio	32.0	+ 5.1	Warmest Jan. since 1953
Cairo, Ill.	38.0	+ 1.7	Warmest Jan. since 1937

TABLE 2. Record and near-record precipitation totals observed during January 1974.

Station	Amount (inches)	Anomaly or date	Remarks
Oklahoma City, Okla.	0.10	−1.21	Driest Jan. since 1943
Jacksonville, Fla.	0.28	−2.50	2nd driest Jan. on record
Tampa, Fla.	0.17	−2.16	3rd driest Jan. on record
West Palm Beach, Fla.	8.30	+5.82	Wettest Jan. on record
Albuquerque, N. Mex.	9.3	—	2nd snowiest Jan. on record
Sandberg, Calif.	55.1	—	2nd snowiest Jan. on record, also 3rd snowiest month on record
Mount Shasta, Calif.	6.97	15–16	Greatest 24-hour precip. any month on record, also
	42.35	from July 1	2nd greatest seasonal precip. on record
Sexton Summit, Oreg.	5.98	14–15	Greatest 24-hour precip. any month on record
Houghton Lake, Mich.	3.13	+1.67	2nd wettest Jan. on record
	1.39	26–27	Greatest 24-hour precip. in Jan.
Port Arthur, Tex.	8.81	+4.75	3rd wettest Jan. on record
Alexandria, La.	11.93	+7.25	2nd wettest Jan. on record
Lake Charles, La.	12.69	+8.65	Wettest Jan. on record
Shreveport, La.	10.09	+6.05	4th wettest Jan. on record

the central Gulf Coast northeastward to the Great Lakes in connection with several lows moving between the very warm air over the Southeast and the cold air over the Rocky Mountains and Great Plains. Several stations in Louisiana reported one of the wettest Januarys on record (Table 2).

Frequent overrunning of cold air in the Northeast by the flow of warm, moist tropical air results in an unusually large number of occurrences of freezing rain and drizzle. Worcester, Mass., and Newark, N. J., reported 7 days of glazing and New York's LaGuardia Airport and Philadelphia both reported these conditions on 5 days during January.

The strongly persistent flow of moist tropical air from the Gulf of Mexico into the Southeast contributed to an unusual amount of cloudiness and fog in that area. Port Arthur, Tex., and Alexandria, Bootheville, Lake Charles, and Shreveport, La., all reported 25 or more days with fog during January. At the latter station, it was the foggiest month on record. Even as far inland as Columbus, Ga., there were 15 mornings with heavy fog.

Notably dry conditions were observed only over portions of the Great Plains and central Florida, where a few localities reported one of the driest Januarys on record (Table 2).

4. Variability within the month

The monthly mean 700-mb circulation pattern (Fig. 1) barely hints at the strongly contrasting regimes which made it up. Retrogression of the northern part of the eastern Pacific 700-mb ridge throughout January led to sudden cyclogenesis in the Gulf of Alaska just before the middle of the month when Arctic air from Alaska began moving out over the relatively warm water. The 700-mb height fell nearly 300 m near the Alaskan coast between the first and second halves of the month (Fig. 7) and rising heights to the south led to a rapid increase in the westerlies in that sector.

The downstream response of the temperature and precipitation over the United States and southwestern Canada also occurred with dramatic rapidity. Temperature rises of as much as 70F in 36 hours at Sheridan, Wyo., were similar to those observed two years previously at a number of localities (Wagner, 1972). Strong Chinook winds melted and evaporated 8 inches of snow within 24 hours at Walla Walla, Wash., and 10 inches of snow in less than 3 days at Great Falls, Mont. Many stations, particularly in the Pacific Northwest and over the northern and central Rocky Moun-

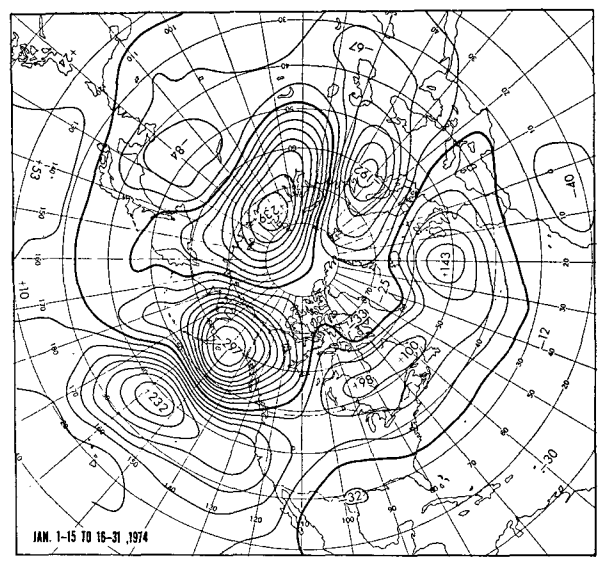

FIG. 7. Change in 700-mb height (m) between the first and second halves of January 1974.

tains and Great Plains reported every day colder than normal through the 12th and every day milder than normal thereafter. The overall weekly temperature anomaly patterns, to be discussed next, bore an amazingly close correspondence on a week-to-week basis with those of January a year before (Wagner, 1973).

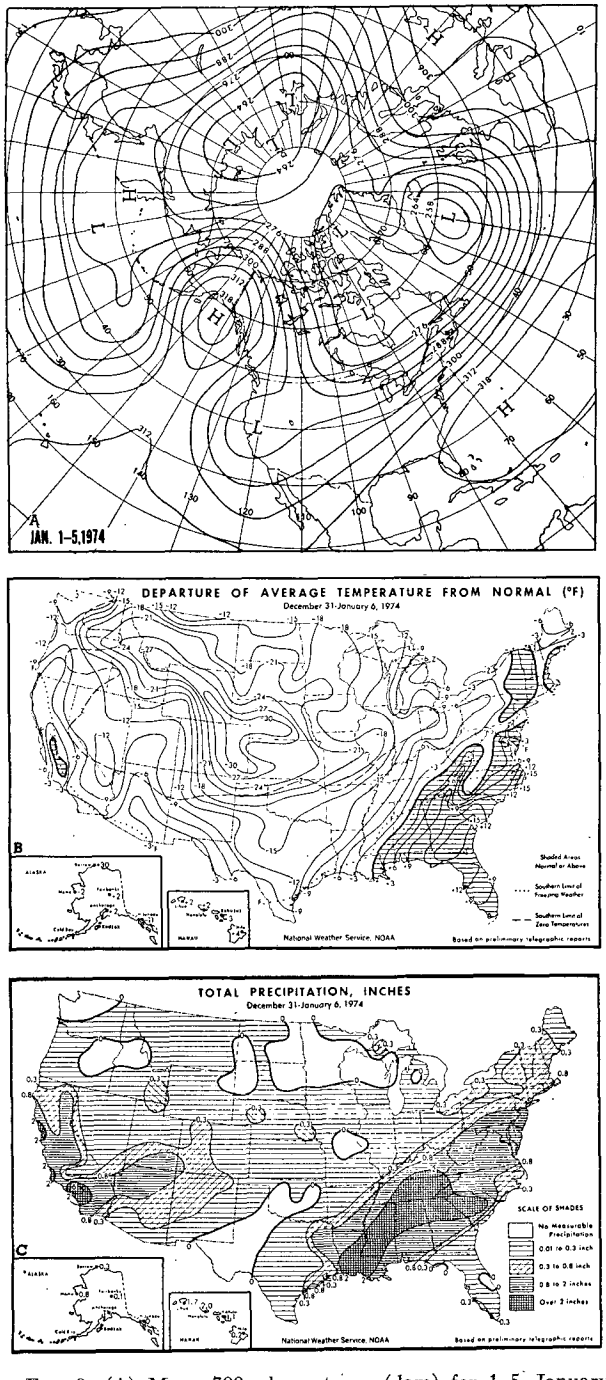

FIG. 8. (A) Mean 700-mb contours (dam) for 1–5 January 1974; (B) departure from normal of average surface temperature (°F) and (C) total precipitation (inches) for week of 31 December 1973–6 January 1974 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service, 1974).

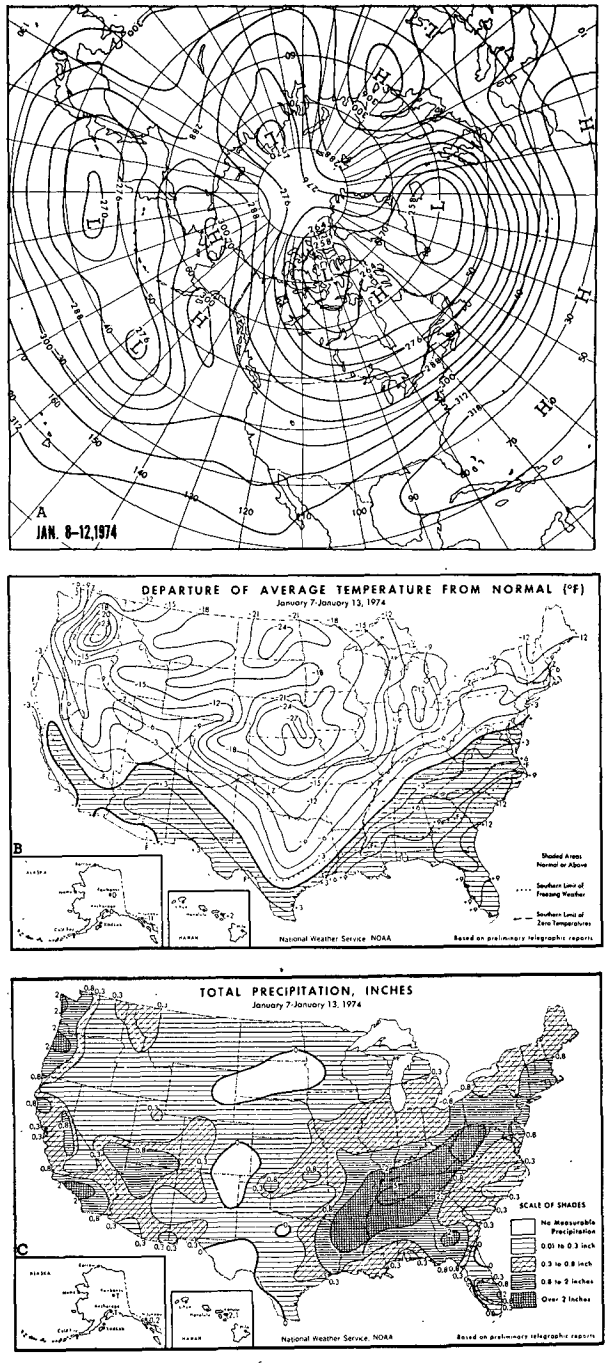

FIG. 9. Same as Fig. 8, (A) for 8–12 January 1974, (B) and (C) for week of 7–13 January 1974.

a. December 31–January 6

The maximum amplification of the eastern Pacific 700-mb ridge occurred during the first week of the new year, as a closed high center just south of Alaska was flanked by strong cyclonic areas to the southwest and southeast, the classic omega-blocking pattern (Fig. 8A).

Southward transport of Arctic air from Alaska and northwestern Canada led to extremely cold tempera-

TABLE 3. Record monthly extreme temperatures observed during January 1974.

Station	Temperature (°F)	Date	Remarks
Topeka, Kans.	—	1–13	Longest cold spell of such severity (23.4° below normal)
			Min. below 0° 12 consecutive days
Grand Island, Neb.	—	Dec. 23–Jan. 12	Below freezing continuously for 21 consecutive days
Lincoln, Neb.	−33	12	Lowest ever observed
Columbia, Mo.	−17	12	Lowest ever observed
Pendleton, Oreg.	68	15	Highest observed in Jan.
Portland, Oreg.	62	18	Equaled Jan. highest
Fresno, Calif.	75	15	Highest observed in Jan.
Bakersfield, Calif.	79	15	Highest observed in Jan.
Pocatello, Ida.	57	16	Equaled Jan. highest
Valentine, Neb.	70	16	Highest observed in Jan.
Midland, Tex.	84	17	Highest observed in Jan.
	84	21	Equaled Jan. highest
Jackson, Miss.	70	10	Highest Jan. min.
	75	10	Highest Jan. mean
Columbia, S. C.	84	24	Highest observed in Jan.
Bridgeport, Conn.	65	27	Highest observed in Jan.
New York, N. Y. (Central Park)	—	21–31	Longest Jan. mild spell, with mean above 40° on 11 consecutive days

tures over much of the western two-thirds of the conterminous United States (Fig. 8B). Temperatures averaged as much as 30F below normal for the week over parts of the central Great Plains.

Under the influence of the strong Bermuda High, weekly temperatures averaged as much as 15F above normal in parts of the Southeast. Storms generated along the sharply contrasting air masses produced more than 2 inches of rainfall over the interior of the Southeast (Fig. 8C).

A storm which moved toward the southern California Coast produced heavy rains and mudslides at low elevations with near-record heavy snows in the mountains and some of the normally dry and mild interior desert areas. Here the Pacific moisture interacted with the unusually cold air brought down from Canada in a region where the mean flow had strong cyclonic curvature (Fig. 8A).

b. January 7–13

The westerlies moved southward around the deepening centers of cyclonic activity over the western and central Pacific, while the northern part of the eastern Pacific 700-mb ridge moved westward to the Bering Strait as a separate blocking high. Middle latitude portions of the ridge weakened somewhat, but the westerlies did not break through strongly from the central Pacific (Fig. 9A).

Most of North America was dominated by the effects of an intense northwesterly flow around the deep 700-mb Arctic Low over northern Canada. As consequence, bitter cold temperatures continued their grip over all but the extreme southwestern and southeastern portions of the United States, where the week averaged as much as 12F above normal along the South Atlantic Coast (Fig. 9B). Coldest temperatures of more than 20F below normal were found over the northern and central Great Plains and in the upper Columbia River Basin. In all these areas good radiation conditions prevailed with generally clear skies and an anomalously deep snow cover. Lincoln, Neb., and Columbia, Mo., set all-time record minimum temperatures on the 12th as a severe cold spell of near-record duration and severity drew to a close (Table 3).

As with the circulation and temperature patterns, the precipitation distributions were quite similar in the first and second weeks of January (Figs. 8C and 9C). Most of the precipitation along the northwest coast occurred on the 12th, as Pacific moisture began to reach the mainland again.

c. January 14–20

Continued retrogression of the blocking high from the Bering Strait to northeast Siberia led to rapid cyclogenesis over the Gulf of Alaska (Fig. 10A). Strong westerlies extended in a continuous band from Japan all the way across the Pacific, North America, and the Atlantic to Western Europe.

Amplification of a low-latitude ridge over the eastern Pacific helped to drive large quantities of mild, maritime air across the West Coast and well into the United States. The entire country, except for Alaska and New England, was much warmer than normal. Portions of the Ohio Valley and Northern Plains averaged more than 20F above normal for the week (Fig. 10B). Record high temperatures for January were observed at several cities from the far West to the Great Plains (Table 3).

Anomalously deep snow cover over the Central Plains and the eastern Great Basin retarded the warming somewhat in those areas. A northwesterly component

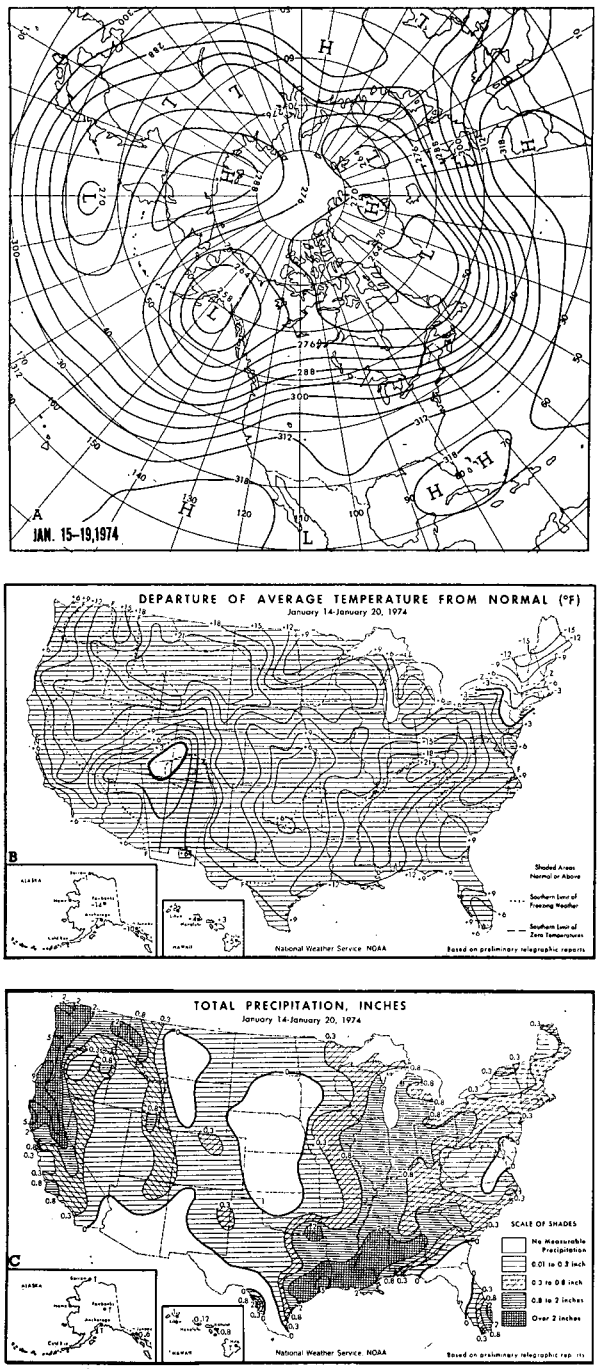

FIG. 10. Same as Fig. 8, (A) for 15–19 January 1974, (B) and (C) for week of 14–20 January 1974.

of flow from central Canada kept New York and New England cold, with temperatures averaging as much as 15F below normal for the week over northern Maine.

The onset of strong southwesterly flow from the Pacific led to heavy rains and flooding in the West, particularly in southwestern Oregon and northern California, where as much as 9 inches of precipitation fell during the week (Fig. 10C). The heavy rainfall and melting snow caused severe avalanches and floods in some areas. Record 24-hour totals were observed at the elevated stations, Mount Shasta, Calif., and Sexton Summit, Oreg. (Table 2).

Another area of heavy rainfall occurred along the central Gulf Coast. No precipitation at all fell over the southern Plateau and portions of the Great Plains, which were under the "rainshadow" effect due to the fast mid-latitude westerlies and anticyclonic flow.

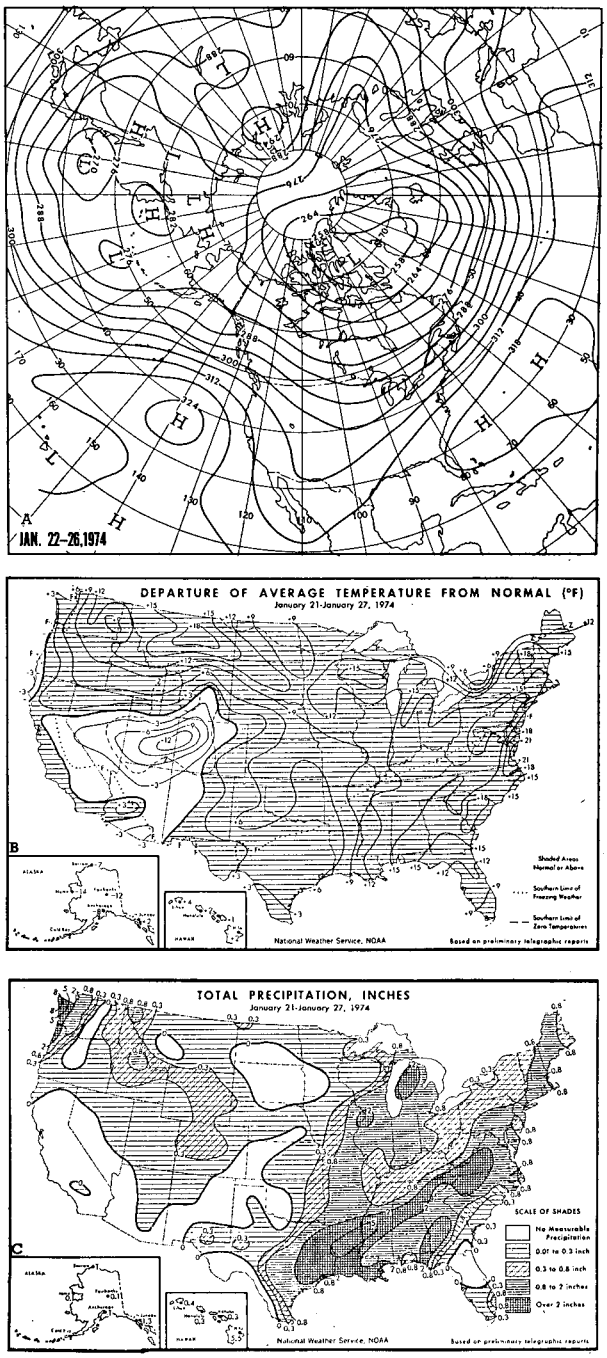

FIG. 11. Same as Fig. 8 (A) for 22–26 January 1974, (B) and (C) for week of 21–27 January 1974.

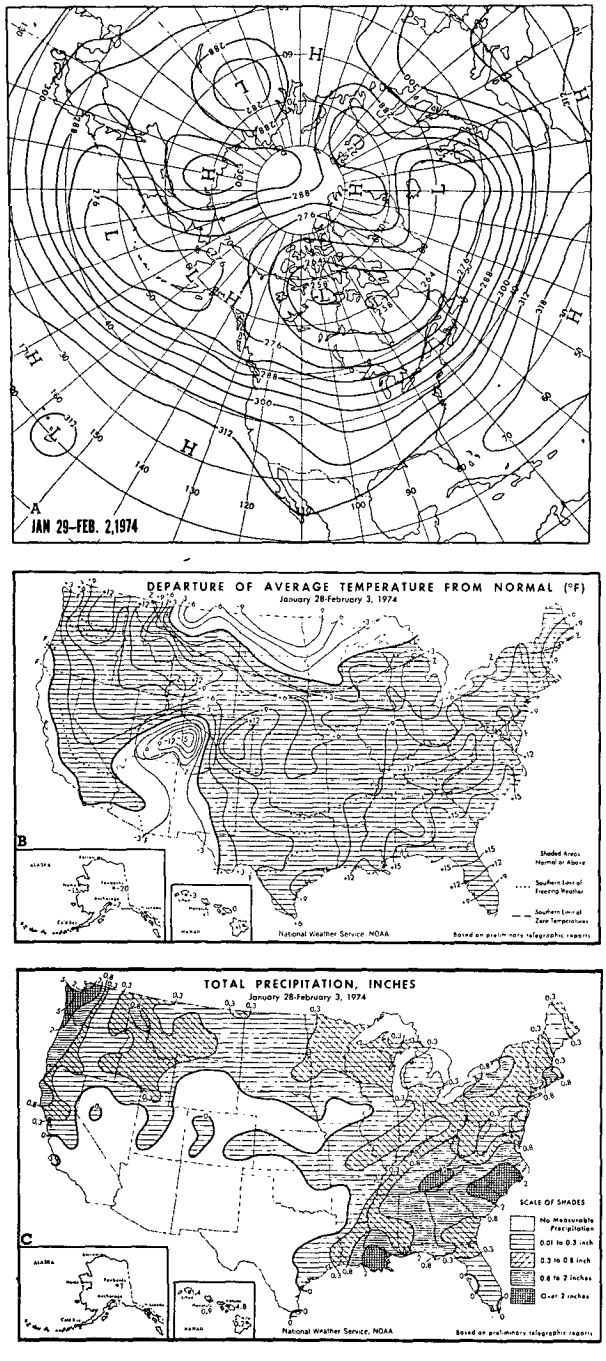

FIG. 12. Same as Fig. 8, (A) for 29 January–2 February 1974, (B) and (C) for week of 28 January–3 February 1974.

d. January 21–27

The Gulf of Alaska Low filled while the low-latitude portion of the eastern Pacific ridge amplified and built northward. This led to a continuation of westerly flow into North America, though at higher latitudes than during the previous week (Fig. 11A). A trough sloped southwestward from the upper Mississippi Valley to the southern Rocky Mountains.

Since there was no strong flow from the Arctic to any part of the country, most of the conterminous United States remained much milder than normal. Mild air moved into New England for the first time since the first few days of the year (Fig. 11B). The greatest positive temperature anomalies were located over the northern Great Plains and northern New England, where temperatures averaged 18F above normal for the week. Several cities in the East observed record high daily temperatures and a few had record maximum temperatures for January (Table 3).

Only Alaska and the central and southern Great Basin were substantially cooler than normal for the week. In the latter area, a northerly flow component and good radiation conditions over deep snow cover laid down earlier in the month helped to keep the temperature down to as much as 12F below normal around Grand Junction, Colo.

The northward movement of the westerlies in the eastern Pacific allowed the precipitation and floods to diminish in Oregon and California, with the heaviest weekly totals of over 8 inches occurring along the western slopes of Washington's Olympia Peninsula (Fig. 11C). The Southwest and much of the Great Plains were mostly rainless, and another swath of heavy precipitation was observed from eastern Texas to the central Appalachian Mountains. Unusually heavy precipitation for the winter season also occurred in Michigan, where Houghton Lake reported a record 24-hour January total (Table 2).

e. January 28–February 3

The eastern Pacific 700-mb ridge de-amplified and fast zonal westerlies again covered most of the Northern Hemisphere from Japan across the Pacific and North America to the eastern Atlantic (Fig. 12A).

The temperature pattern over the United States changed little from the previous week, except for a drop to as much as 10F below normal along the northern border states where shallow incursions of Arctic air from Canada occurred (Fig. 12B).

Heaviest precipitation again was along the northwest coast and over the Southeast (Fig. 12C). The entire southwest quarter of the country was practically rainless for the whole week.

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