WEATHER AND CIRCULATION OF APRIL 1980
Heavy Precipitation in the South but Developing Drought in the Northern Great Plains

A. JAMES WAGNER

Climate Analysis Center, NMC, NWS, NOAA, Washington, DC 20233

1. Mean circulation

Unusually fast westerly flow continued to prevail at middle latitudes over the Pacific between a deep Aleutian low and a strong subtropical ridge spanning nearly the entire ocean from the Philippines to well east of Hawaii (Figs. 1–3). The 700 mb height anomaly center associated with the deep mean low was greater than two and a half standard deviations below the mean, while the central anomaly in the ridge to the south was about two standard deviations above the mean. The fast westerly flow between these features averaged as high as 24 m s^{-1}, which was 13 m s^{-1} stronger than normal and represented a speed of more than twice normal.

The unusually fast Pacific circulation led to progression of the Aleutian low from its mean position over the Bering Sea during the previous month (Livezey, 1980) and progression of the eastern Pacific 700 mb ridge into western North America, where it joined with a strong retrograding high-latitude block to produce a monthly mean anomaly

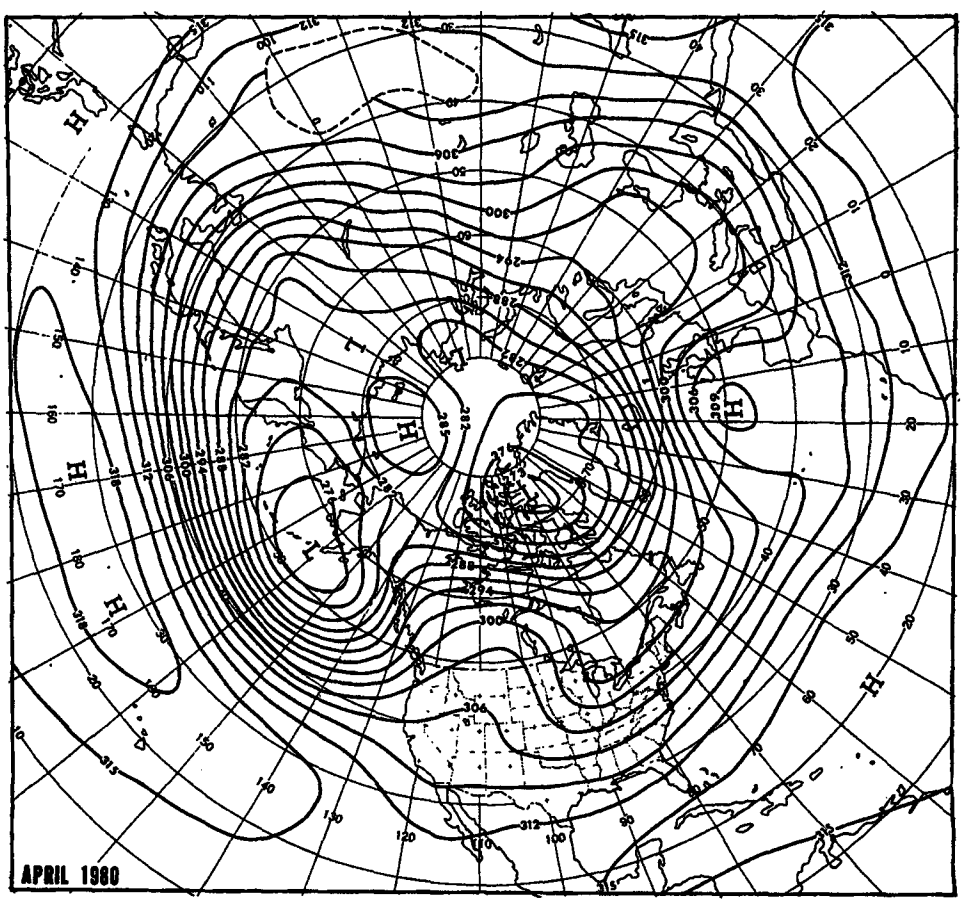


FIG. 1. Mean 700 mb height contours (dam) for April 1980.

of +82 m over south central Canada during April, a value that was a full three standard deviations above the mean.

From North America eastward to central Asia, the westerlies were split into two branches in connection with a belt of strong positive height anomalies extending from central Canada to western Europe. Monthly mean troughs and ridges progressed slowly eastward from their March positions in these sectors. The trough over the Mediterranean and the ridge over central Asia remained quasi-stationary, however, while blocking over northern Siberia contributed to the development of a new mean trough over Manchuria during April.

The Western Hemisphere polar westerlies increased to greater than normal strength for the first time in several months, mainly due to the deeper than normal mean low centered over northern Baffin Island and the area of higher than normal heights to the south. The mean wind speed was 7 m s^{-1} above normal near the northwest shore of Hudson Bay. Unusually active storm tracks for the season prevailed over northwestern Canada and off the east coast of Greenland, where the monthly mean thickness anomaly indicated strongly enhanced baroclinic zones (Fig. 4). The large area of positive thickness anomaly over central Canada was associated with unusual early spring warmth and loss of snow cover about two weeks early in some places by the end of the month.

A strengthened baroclinic zone favorable for vigorous cyclonic activity also prevailed across much of the North Pacific, but in most middle latitude areas over the Northern Hemisphere the thickness anomaly pattern represented a weakening of the normal north-south temperature gradient.

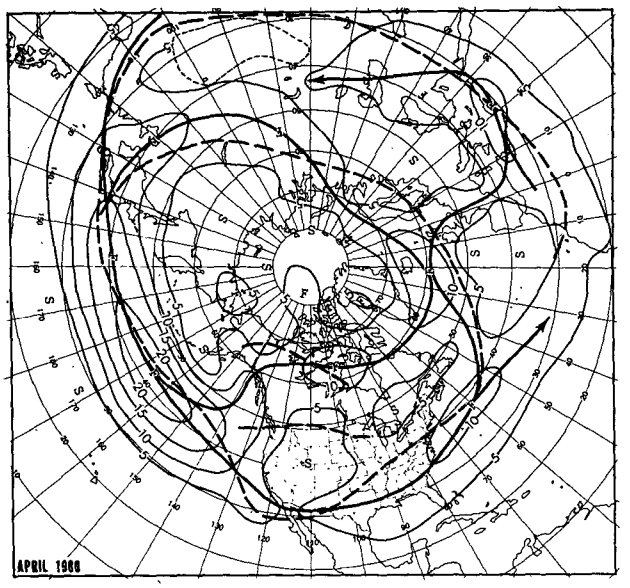


FIG. 3. Mean 700 mb geostrophic wind speed (m s^{-1}) for April 1980. Solid arrows indicate observed axes of maximum wind speed and dashed lines, the normal.

2. Temperature

The temperature anomaly pattern over the United States was in generally good agreement with the mean thickness anomaly (cf. Figs. 4 and 5) with the greatest anomalous warmth along the Canadian border with the northern Great Plains. Several cities

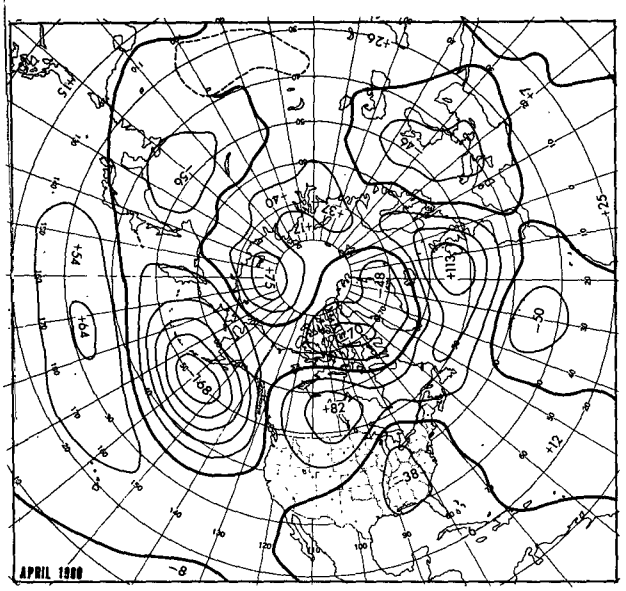


FIG. 2. Departure from normal of mean 700 mb height (m) for April 1980.

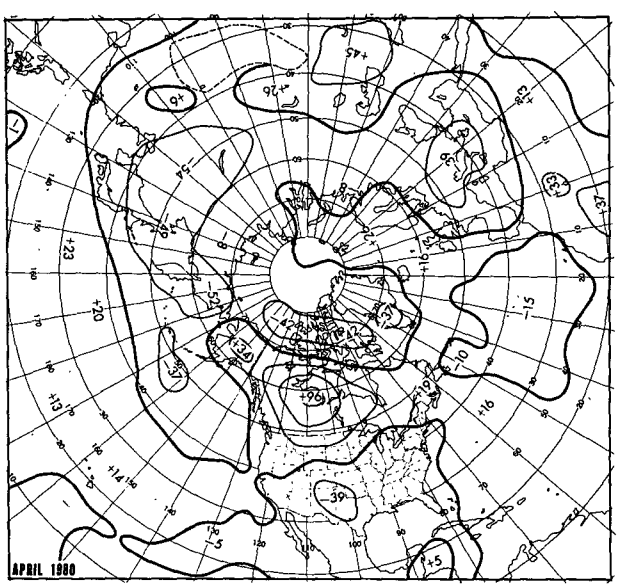


FIG. 4. Departure from normal of mean 1000–700 mb thickness (m) for April 1980.

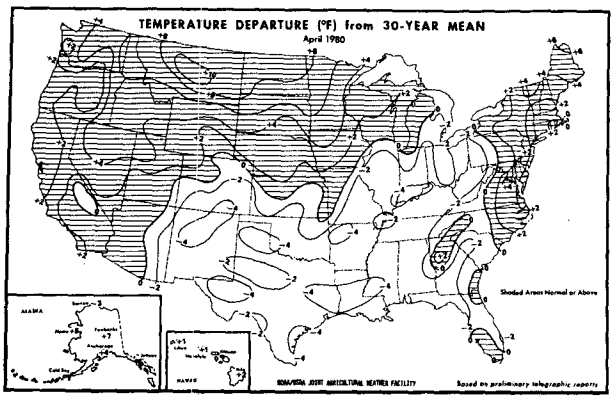


FIG. 5. Departure from normal of average surface air temperature (°F) for April 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1980).

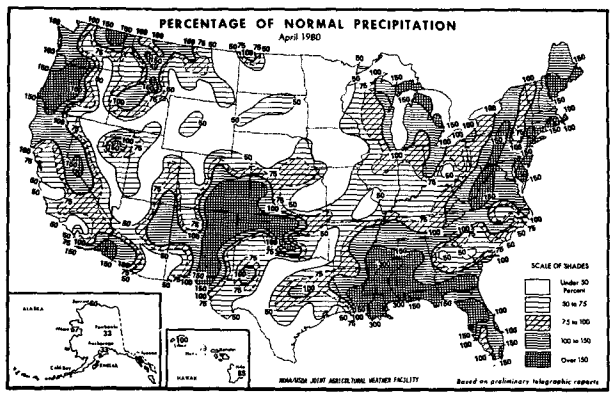


FIG. 6. Percentage of normal precipitation for April 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1980).

in Montana reported one of the warmest Aprils on record. Below normal temperatures were confined primarily to the southern third of the Nation and the Ohio Valley, where monthly mean 700 mb heights and thicknesses were below normal. The northeastern part of the country east of the Appalachian Mountains also had above normal temperatures even though the thickness was near or slightly below normal. This may have been due in part to the early retreat of snow and unusually warm air over southern Canada, that when advected into the area would be less cool than usual, especially at lower levels. Indeed, there were several instances throughout the month in which warm air moved southward or southeastward from Canada into the United States.

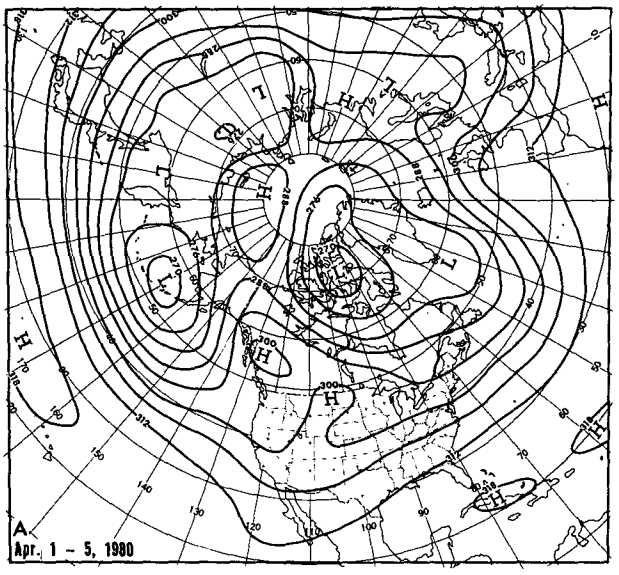
Temperatures were also well above normal over the interior of Alaska in the anomalously strong southeasterly flow between the Aleutian low and the North American block. The north coast of Alaska remained colder than normal, however, under the influences of Arctic air circulating around the strong mean polar high related to the areas of blocking over northern Siberia. Temperatures were slightly above normal in Hawaii, south of the strong subtropical high.

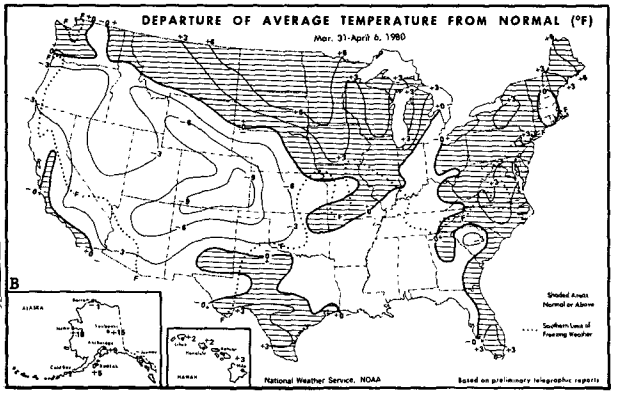
3. Precipitation

A large area centered over the northern Great Plains had less than half the normal April precipitation, due largely to the effects of the Canadian block and displacement of storm tracks away from that area (Fig. 6). Several stations over the north-central states reported record or near-record dryness (Table 1). Wetter than normal conditions continued from March over much of the South and East, although totals and percentage amounts were generally lower than the previous month (Livezey, 1980). Nevertheless, several cities in Louisiana and Mississippi reported record and near-record heavy

TABLE 1. Record and near-record monthly precipitation totals observed during April 1980.

Station	Amount (inches)	Anomaly (inches)	Remarks
Baton Rouge, LA	14.84	+9.74	Wettest April
Jackson, MS	14.33	+9.68	2nd wettest April
New York, NY (Central Park Observatory)	8.26	+4.96	2nd wettest April; wettest since 1874
Yakutat, AK	17.99	+10.34	2nd wettest April
Columbia, MO	7.1		Record April snowfall
Moline, IL	9.5		Record April snowfall
Waterloo, IA	1.22	−2.21	Driest April
Fargo, ND	0.02	−2.06	Tied 1949 for driest April
Duluth, NM	0.41	−2.14	3rd driest April
Des Moines, IA	0.86	−2.08	5th driest April; longest rainless period in April on record
Topeka, KA	1.03	−2.59	6th driest April
Billings, MT	0.46	−1.10	4th driest April





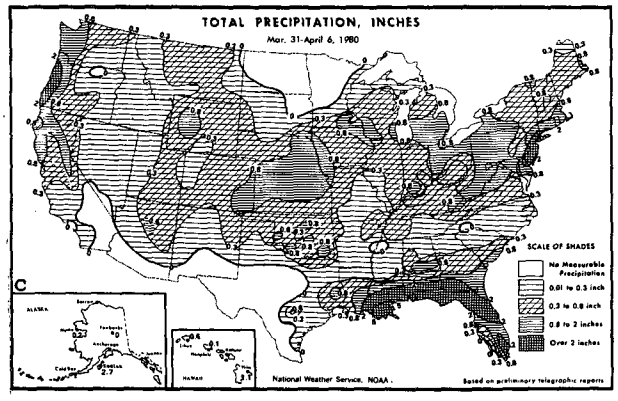
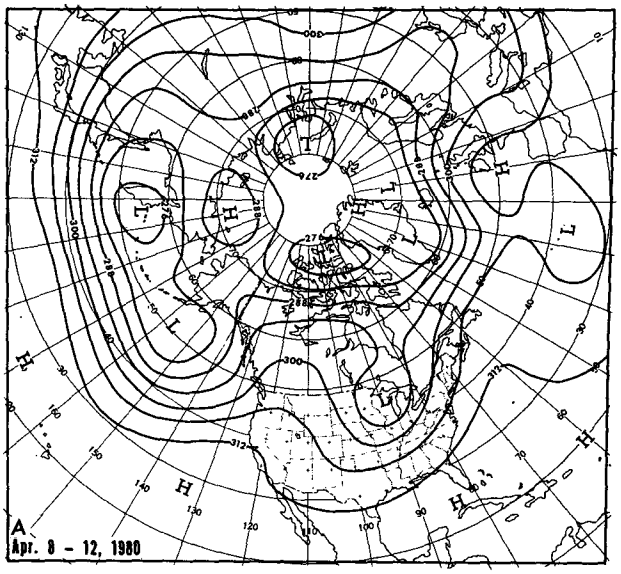
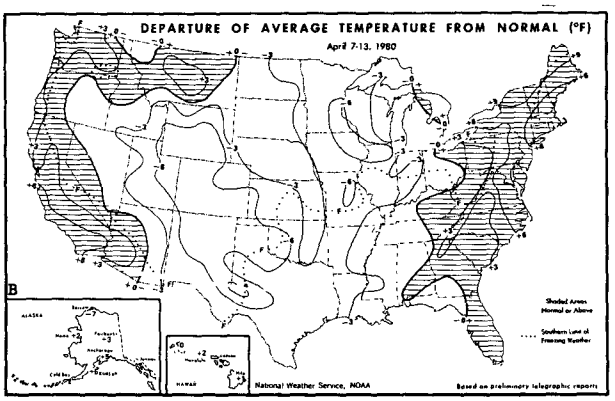


FIG. 7. (A) Mean 700 mb contours (dam) for 1–5 April 1980; (B) departure from normal of average surface air temperature (°F) and (C) total precipitation (inches) for week of 31 March 1980–6 April 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1980).





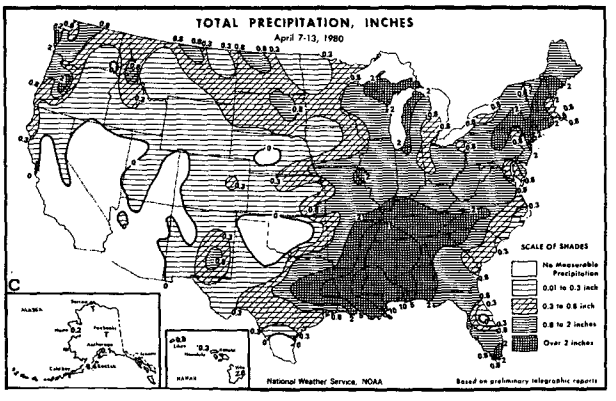


FIG. 8. As in Fig. 7 except for (A) 8–12 April 1980, and (B) and (C) week of 7–13 April 1980.

rains leading to considerable flooding (Table 1). Some of the same area suffered from even worse flooding just one year previous (Wagner, 1979).

Precipitation was lighter than normal over most of Alaska as southeasterly flow does not ordinarily carry moisture across the coastal ranges into the interior. However, several stations in coastal areas reported heavier than normal precipitation, notably Yakutat, with the second wettest April on record.

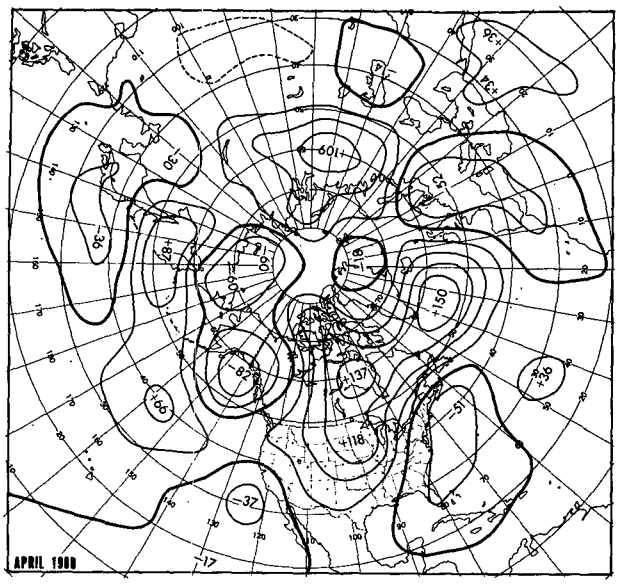


FIG. 9. Mean 700 mb height change (m) from first half to second half of April 1980.

Precipitation totals in Hawaii were generally close to normal.

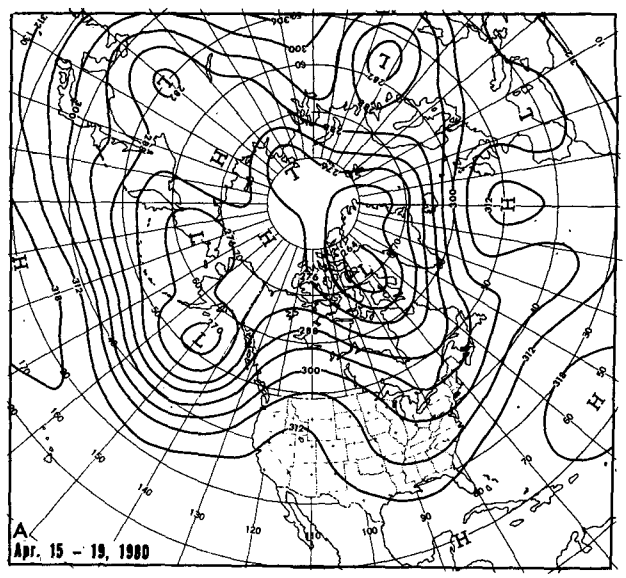
4. Variability within the month

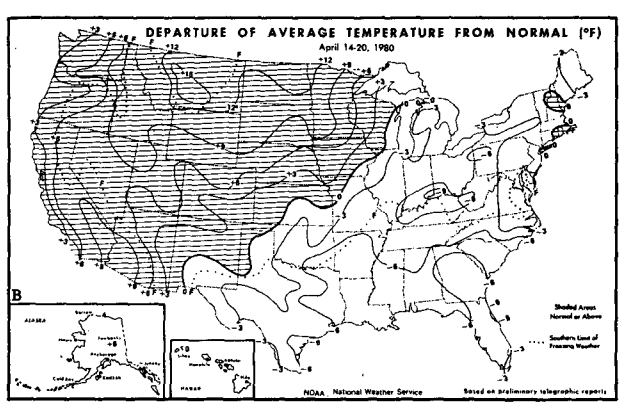
a. 31 March–6 April

The 700 mb circulation during the first week of April was marked by the development of a low centered over northern Canada and virtual disappearance of the strong blocking ridge that had been over Labrador and the Davis Strait during the last week of March (Livezey, 1980). Several components of blocking extended from the northern Great Plains northwestward through British Columbia to the Beaufort Sea, where the blocking joined with another area of positive height anomalies extending from the eastern Atlantic northeastward to Novaya Zemlya (Fig. 7A). Major troughs and ridges from the central Pacific to the central Atlantic showed little motion at middle and low latitudes, although the trough over the southwestern United States and northern Mexico lost amplitude.

Temperatures remained above normal across the northern border and east of the Appalachian mountains, while the greatest negative anomalies were over the central Rocky Mountains and adjacent areas (Figs. 7B). Alaska and Hawaii were both for the most part warmer than normal under the influence of ridges.

Early in the week, two cyclonic centers in rapid succession produced snow over the Rocky Mountains and central Great Plains. The first one dissipated over Indiana, but the second deepened as it moved eastward across the Great Lakes to





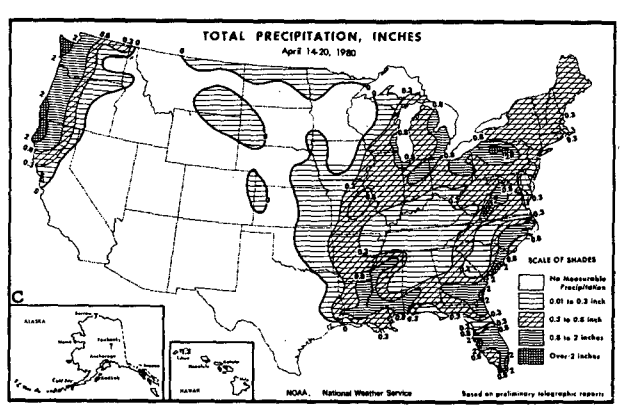


FIG. 10. As in Fig. 7 except for (A) 15–19 April 1980, and (B) and (C) week of 14–20 April 1980.

New England by the end of the week, spreading moderately heavy precipitation across much of the country (Fig. 7C). Most of the precipitation fell as snow over the Rockies and the Plains. Heavy convective activity produced nearly 6 inches of rain in New Orleans and triggered several tornadoes in

TABLE 2. Record seasonal and monthly extreme temperatures (°F) observed during April 1980.

Station	Temperature	Date	Remarks*
El Paso, TX	28	13	Lowest so late in season
Port Arthur, TX	36	14	Lowest so late in season
San Antonio, TX	33	14	Equaled lowest so late in season
Victoria, TX	35	14	Equaled lowest so late in season
Oklahoma City, OK	27	14	Lowest so late in season
Lake Charles, LA	39	14	Lowest so late in season
Salt Lake City, UT	85	20	Equaled highest for month
Casper, WY	81	20	Equaled highest so early in season
Sheridan, WY	85	20	Highest so early in season
Kalispell, MT	79	17	Equaled highest so early in season
Billings, MT	90	20	Highest so early in season
Great Falls, MT	89	20	Highest so early in season
Havre, MT	91	20	Highest so early in season
Glasgow, MT	91	20	Highest so early in season
Williston, ND	92	20, 21	Highest for month
Bismark, ND	93	21	Highest for month
Fargo, ND	94	20	Highest for month
	100	21	Highest for month
Pueblo, CO	89	21	Highest so early in season
Aberdeen, SD	97	21	Highest so early in season; equaled highest for month
Huron, SD	96	20	Highest for month
	97	21	Highest for month
Sioux Falls, SD	93	20, 21	Equaled highest so early in season
Valentine, NE	96	21	Highest for month
Norfolk, NE	95	21, 22	Highest for month
Sioux City, IA	94	21	Highest so early in season
	97	22	Highest so early in season
Des Moines, IA	93	22	Highest for month
Waterloo, IA	100	22	Highest for month
International Falls, MN	90	21	Highest so early in season
Minneapolis, MN	95	21	Highest for month
St. Cloud, MN	96	21	Highest for month
Rochester, MN	91	21, 22	Highest for month
Madison, WI	94	22	Highest for month
Milwaukee, WI	91	22	Highest for month
Green Bay, WI	89	22	Highest for month
Marquette, MI	92	22	Highest for month
Chicago, IL (O'Hare Airport)	91	22	Highest so early in season; equaled highest for month
Moline, IL	92	22	Highest for month
Cairo, IL	90	23	Highest for month
South Bend, IN	89	22	Highest so early in season
Nashville, TN	90	23	Highest so early in season

* All new records of highest for the month are also records for highest so early in season.

the south-central part of the United States. Only the far southwestern border and the northern Mississippi Valley remained completely dry.

b. 7–13 April

The deep low that had been over the Aleutians moved eastward to the Gulf of Alaska in response to the deepening of a second low center near Kamchatka (Fig. 8A). An amplifying ridge moved into the western United States and linked with the blocking over Canada. The low-latitude trough that had been over the Southwest deepened as it moved eastward to the Mississippi Valley and Great Lakes area, building a responsive ridge over the western Atlantic. A strong ridge remained poised over the Bay of Biscay, and the lower latitude remains of the central Atlantic trough sealed off a weak low center near the Azores.

Cooler than normal weather prevailed over much of the central part of the United States in response to eastward movement of the trough (Fig. 8B). Northerly flow to the rear of the trough brought record-low temperatures to several cities in the south central area late in the week. Temperatures were above normal in most areas under the strong western ridge and in the area of strong southwesterly flow east of the Appalachian Mountains.

Two major storms associated with the eastward-moving trough produced a variety of severe weather and extensive rainfall, some excessively heavy, over the eastern half of the Nation (Fig. 8C). More than

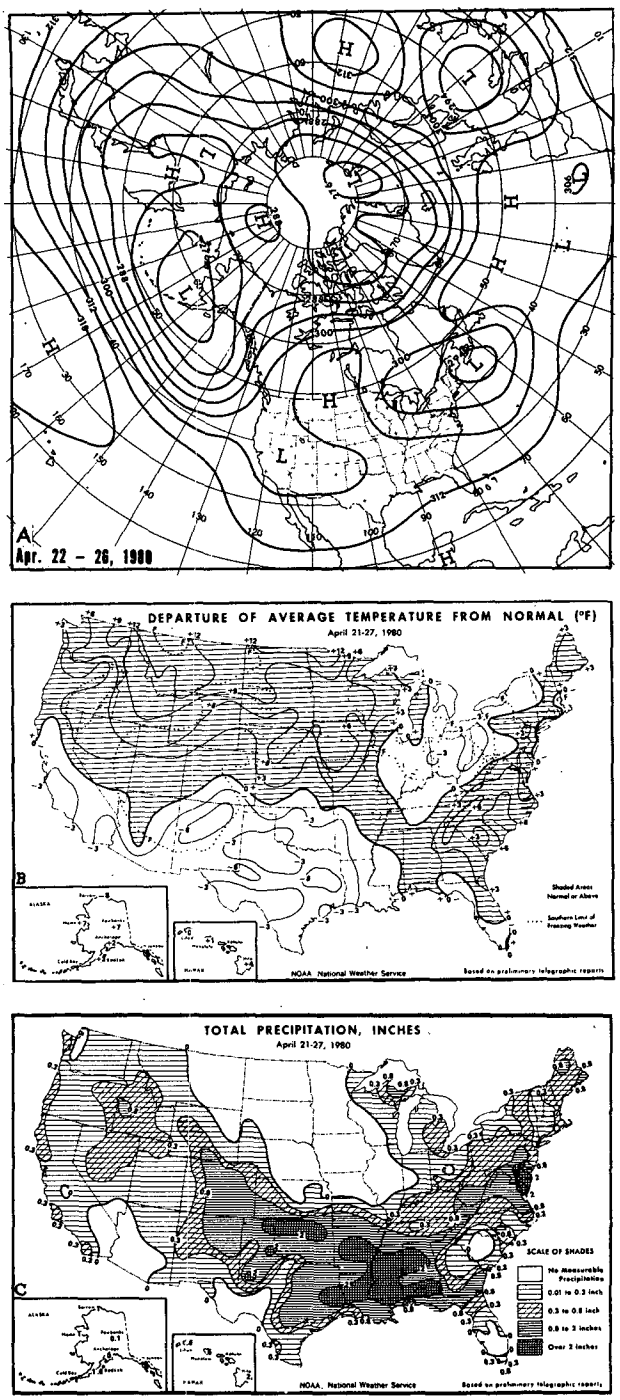


FIG. 11. As in Fig. 7 except for (A) 22–26 April 1980 and (B) and (C) week of 21–27 April 1980.

sixty tornadoes were reported within two days over the south-central area, the Midwest and Florida in connection with the first storm, while the trailing front from a second storm later in the week triggered torrential thunderstorms over the lower Mississippi River Valley in response to the approach of a third disturbance aloft. More than 8 inches of rain fell within 24 h at Jackson, MS and other localities in Louisiana and Mississippi received from 8 to 10 inches over the weekend. Two dozen more tornadoes were reported in the South and Southeast.

c. 14–20 April

A large area of 700 mb height rises over the North Atlantic and Canada represented the tendency for blocking to develop or strengthen in these areas during the latter part of April (Fig. 9). Over the central United States, the height rises represented the eastward motion of a strong ridge from the eastern Pacific and the movement of a trough from the Southwest to a position off the East Coast, where heights fell. Height changes over the Pacific indicated a northward displacement in the position of the main band of westerlies.

By the third week of April, the ridge extending from the Southwest to central Canada had become even stronger, while the trough progressed to the Appalachian mountains and became a strong full-latitude feature (Fig. 10A).

The temperature anomaly pattern reflected the circulation anomalies in the expected manner (Fig. 10B). The northwestern half of the Nation had warmer than normal weather, with temperatures as much as 15°F above normal for the week over Montana. Record early-season heat was noted at several localities at the end of the week, while by contrast, a few cities in the south-central area reported record late-season cold early in the week (Table 2). Most of the country south and east of a diagonal extending from the upper Great Lakes to the southern Rocky Mountains averaged below normal for the week under the influence of the eastern trough.

Precipitation was lighter nationwide than during either of the previous two weeks, with much of the western half of the country completely dry under the influence of the strong ridge (Fig. 10C). Only the northwest coast reported substantial precipitation, where there was an onshore component of flow east of the deep Gulf of Alaska low. At the beginning of the week, a storm moving north-northeastward from the Gulf Coast gave substantial precipitation to the Midwest and the Northeast. Several cities in the Midwest reported record late-season snowfalls from this storm (Table 1). Toward the end of the week a second disturbance moving southeastward from the Great Plains to the eastern Gulf of Mexico triggered scattered severe thunderstorms with hail over the Southeast and several tornadoes over northern Florida.

d. 21–27 April

Blocking built farther north into Canada again while a series of three slowly moving cutoff lows

affected the United States (Fig. 11A). Two separate short waves sheared off from the mean trough over the eastern Pacific early in the week. One slowly worked its way across the Southwest to the southern Great Plains by the end of the week, as reflected in the elongated mean low there. The other rode up over the top of the blocking ridge and then plunged southeastward, becoming a closed system over the Great Lakes area and showing as the western lobe of the elongated mean low centered off New England. The third low plunged almost due southward from eastern Canada across New England to the western Atlantic early in the week. An east-west blocking ridge became established to its north, south of a band of strong polar westerlies, giving a circulation pattern somewhat like that prevailing at the end of March (Livezey, 1980).

Temperatures were above normal over much of the country, due mainly to the unprecedented heat wave early in the week that produced record temperatures as high as 100°F over North Dakota and Iowa (Table 2). This unusually hot air moved into the Southeast by the middle of the week with somewhat reduced intensity, producing daily, but not seasonal or monthly, temperature records at a number of cities and contributing to a warm week (Fig. 11B). The overall situation was somewhat reminiscent of the record April heat wave over the Northeast four years ago (Wagner, 1976). Following the warm spell over the northern Mississippi Valley and upper Great Lakes, temperatures plunged rapidly back to levels more appropriate to winter. Just one day after Marquette, MI reported a record high of 92°F, the temperature fell to 21°F and several inches of snow fell. The temperature drop at Muskegon, MI was only slightly less spectacular, plunging from a record daily high of 79°F on 22 April to a record daily low of 27°F on 24 April, with over 3 inches of snow.

With the notable exception of the north-central area, precipitation fell across most of the country and heavy amounts returned to the South due to the influence of the slowly moving low that entered the country from the Southwest (Fig. 11C). Severe thunderstorms accompanied by hail and tornadoes again broke out across the South. As the storm center moved slowly northeastward near the Atlantic coast at the end of the month, heavy rains fell from eastern Maryland to New England, with local flooding in a few localities. Newark, NJ reported a new 24 h record heavy rainfall for April when 2.96 inches fell on the 28th and 29th.

REFERENCES

Livezey, Robert E., 1980: Weather and circulation of March 1980—Record precipitation in the South and central High Plains. *Mon. Wea. Rev.*, **108**, 833–839.

National Oceanic and Atmospheric Administration, U.S. Department of Commerce, and Economics, Statistics and Cooperatives Service, U.S. Department of Agriculture, 1980: *Weekly Weather and Crop Bulletin*, **67**, Nos. 15–19 (8, 15, 22 and 29 April and 6 May, 1980).

Wagner, A. James, 1976: Weather and circulation of April 1976—Unprecedented spring heat wave in the Northeast and record drought in the Southeast. *Mon. Wea. Rev.*, **104**, 975–982.

——, 1979: Weather and circulation of April 1979—Widespread heavy precipitation with floods in the South. *Mon. Wea. Rev.*, **107**, 948–954.