WEATHER AND CIRCULATION OF MARCH 1980

Record Precipitation in the South and Central High Plains

ROBERT E. LIVEZEY

National Meteorological Center, National Weather Service, Washington, DC 20233

1. Mean circulation

Two upper air features common in the previous two months (Wagner, 1980; Dickson, 1980) were largely missing from March's circulation. Much of the broad troughing at 700 mb over both oceans that led to anomalously strong subtropical westerlies was displaced by strong ridging (Fig. 1), while positive height anomalies disappeared completely from North America (Fig. 2). Other important changes from February included the northwestward displacement of the main Eurasian block, troughing over western Europe, and the retreat of the Pacific low center of action to the Bering Sea. The latter, assisted by enhanced baroclinity along the coast of eastern Asia, was accompanied by increased midlatitude westerlies (from 6 to 8 m s^{-1} above normal at 700 mb) across most of the North Pacific (Figs. 3 and 4). This was offset over the Atlantic by northward deflection of the main westerly current in the presence of the strong midlatitude Atlantic ridge. Elsewhere, greater than normal thickness gradients extended across the southeastern United States and off the northeast coast.

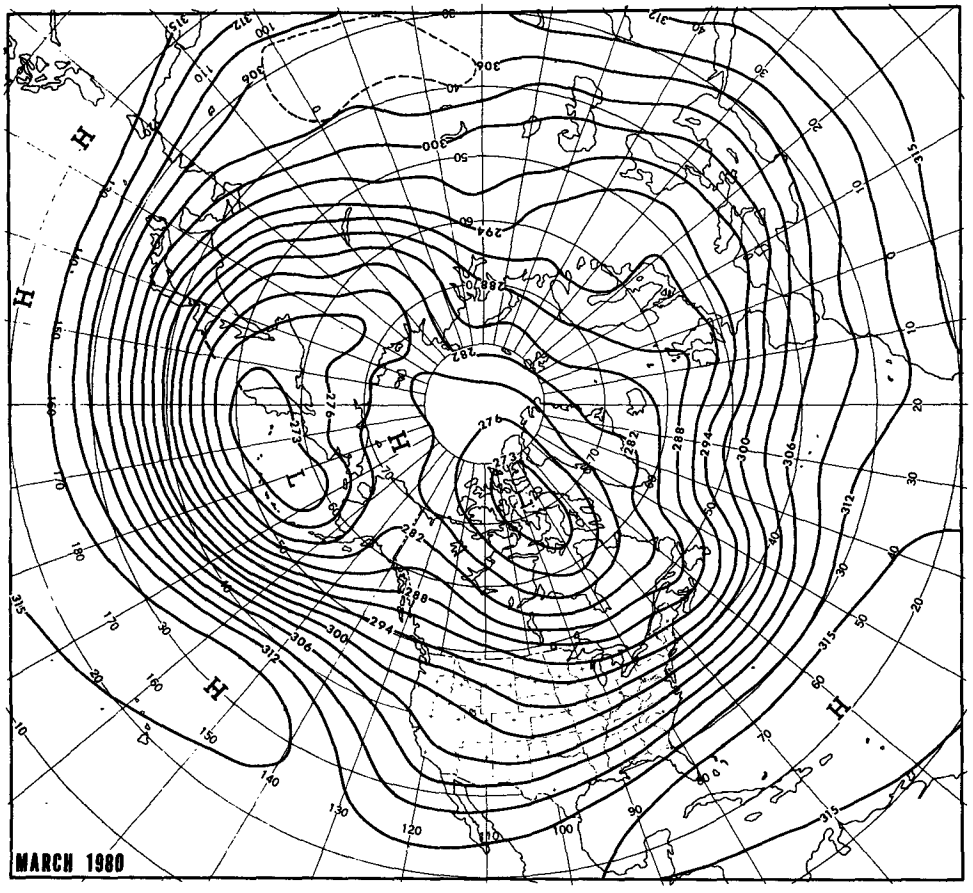


FIG. 1. Mean 700 mb height contours (dam) for March 1980.

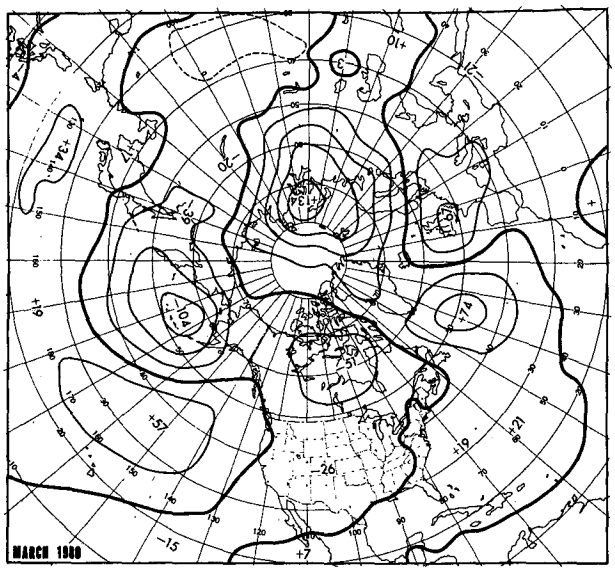


FIG. 2. Departure from normal of mean 700 mb height (m) for March 1980.

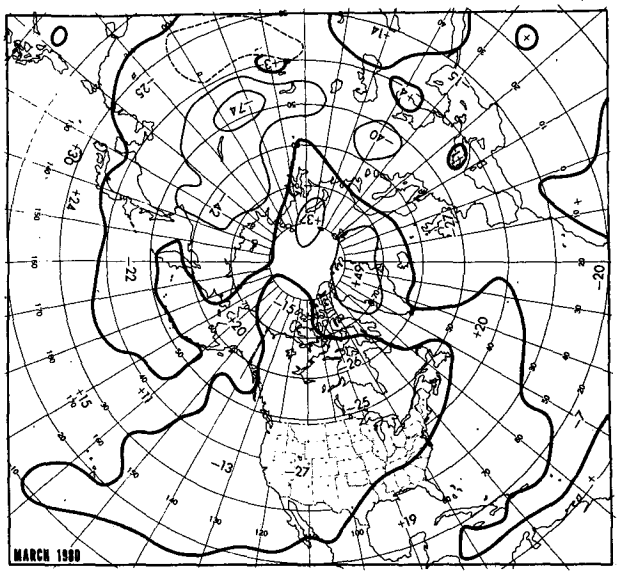


FIG. 4. Departure from normal of mean 1000–700 mb thickness (m) for March 1980.

2. Temperature

Because anomalous 700 mb flow over the country was generally zonal and quite weak (Fig. 2), most of the United States enjoyed near normal temperatures in March (Fig. 5). Cold outbreaks associated with deepening of the upper air trough into southeastern Canada and the northeastern United States during the first half of the month, and cloudiness in the second half substantially account for the cold weather in the lower Mississippi and Ohio Valleys and around the Great Lakes. Along the southeastern coast these effects were enhanced by a record-breaking late season snowstorm (see Section 3) early in the month. In the Pacific the establishment of the deep trough northwest of the Aleutians brought anomalous advection of relatively warm oceanic air to all of Alaska.

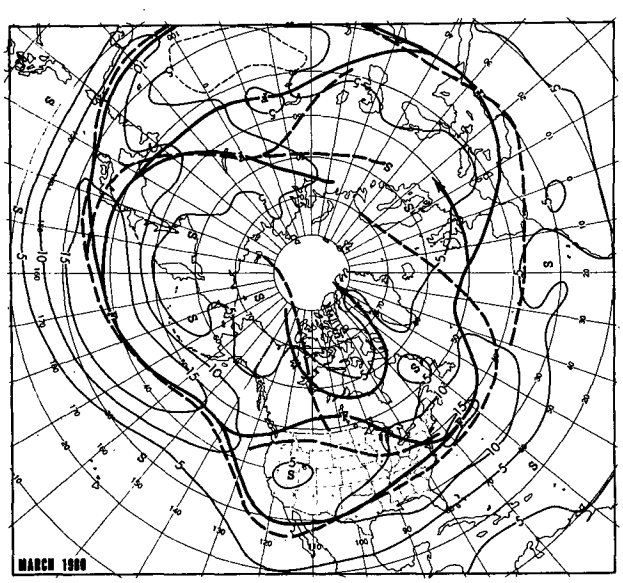


FIG. 3. Mean 700 mb geostrophic wind speed (m s^{-1}) for March 1980. Solid arrows indicate observed axes of maximum wind speed and dashed lines, the normal.

3. Precipitation

In sharp contrast to a rather unexceptional temperature anomaly pattern, most of the country received excessive amounts of precipitation in March 1980 (Fig. 6). A region of heavy rainfall extensive in both time and space was bracketed by two small areas with record-breaking snowstorms separated by almost 1500 mi and a month.

Heavy precipitation fell over a broad area in the South in every week of the month. Both the areal extent of the heaviest amounts and the frequency of tornado sightings increased from week to week as the month progressed, substantially curtailing agricultural field operations and leading to frequent flooding. Several March precipitation records fell (Table 1), the most noteworthy at Chattanooga, where the most rain (16.32 inches) fell in a month of record.

In a monthly mean sense the stage was well set for these widespread rains: Stronger than normal baroclinity extending across the South and up the Atlantic coast depressing the prevalent storm track south and east to the Ohio Valley (Fig. 4), anomalous southerly flow (Fig. 2) supplying warm moist Gulf air, and broad troughing over the continent providing ready access to Pacific disturbances. In the latter half of the month a reversal in the circulation over eastern North America (Fig. 7) substantially in-

creased the anomalous southerly flow over the South. Many of these factors also favored ample precipitation in the Northeast where several storms in middle to late March effectively ended the several month drought. However, dry weather continued through a third month in West Texas and northern Mexico where as little as 35% of normal rain had fallen since 1 January.

March began with an extreme weekend snowstorm in the Virginia Tidewater area and in northeastern North Carolina and ended with a second record breaker in western Nebraska and northwest Kansas (Table 1). Norfolk, VA, was virtually paralyzed by a storm which almost doubled the March snowfall record and occurred hard on the heels of the snowiest month of record (Dickson, 1980). Mail delivery in Norfolk was absent on 3 March for the first time in operational history. As many as 36 deaths in 10 states were attributed to the storm by news reports. In the high plains storm, seasonal snowfall records were set with at least one month remaining in the snow season.

Elsewhere the developing upper level height pattern in the Pacific led to strengthening trade winds bringing record rains to the windward slopes of the island of Hawaii, while the same anomalous southerly flow that warmed Alaska brought heavier than normal rain to Kodiak, but lighter than normal amounts to interior and sheltered locations.

4. Variability within the month

March decidedly lacked constancy this year, especially aloft in the western part of the Northern Hemisphere, but contrary to tradition its weather was "lion-like" for the entire month over the United States (see Section 3). At 700 mb an amplified high-latitude wave pattern accompanied by fast subtropical westerlies had been dominant since January. In late February, this flow regime began to decline (Dickson, 1980), and by the beginning of March its disappearance was substantially complete (Fig. 8a). Over the North Pacific this was followed by slow progression and growth of the long waves (Figs. 9a, 10a and 11a) but over North America and the North Atlantic a second major circulation reversal, dramatically illustrated in Fig. 7, took place in the latter half of the month.

Early in the month, with the retrogression and erosion of the western Canadian ridge, an upper level trough over North America dug south and east, bringing cold air to the coast and enhancing the midlatitude westerlies across the North Atlantic. Downstream, apparently assisted by further retrogression of the Eurasian block, a ridge reponsively swelled northwestward during the course of the month, completely supplanting the trough over eastern North America by the last week.

Meanwhile with cold air driving into much of

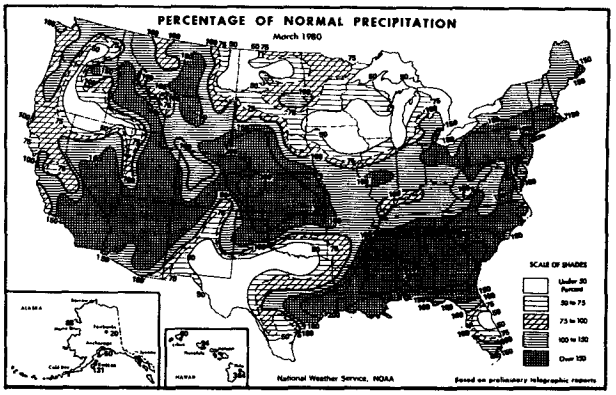


FIG. 6. Percentage of normal precipitation for March 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1980).

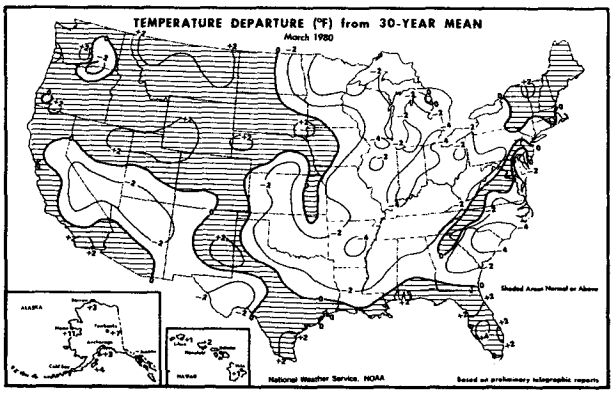


FIG. 5. Departure from normal of average surface air temperature (°F) for March 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1980).

TABLE 1. Precipitation records set during March 1980.

Station	Amount (inches)	Anomaly (inches)	Remark
		Rain	
Augusta, GA	11.92	+7.25	Wettest March
Charlotte, NC	8.76	+4.24	Wettest March
Chattanooga, TN	16.32	+10.69	Wettest month
Hilo, HI	49.93	+36.24	Wettest March
Huntsville, AL	17.00	+11.24	Wettest March
Newark, NJ	9.13	+5.20	Wettest March
		Snow	
Cheyenne, WY	114.1	+75.6 (thru March)	Snowiest season
Goodland, KS	79.3	+48.7 (thru March)	Snowiest season
Norfolk, VA	13.7	+12.8	Snowiest March*
	41.9	+34.9	Snowiest season
North Platte, NE	15.1		Snowiest 24 h
Scottsbluff, NE	64.0	+31.5 (thru March)	Snowiest season

* Second consecutive record month. February 1980 (18.9 inches) was snowiest month on record.

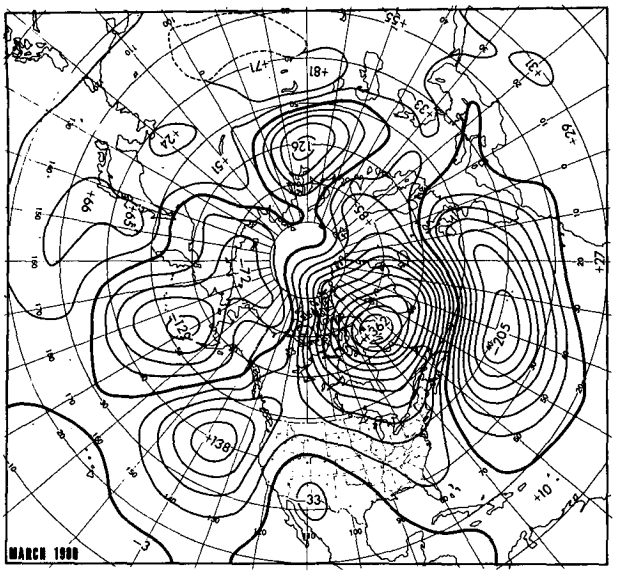


FIG. 7. Mean 700 mb height change (m) from first half to second half of March 1980.

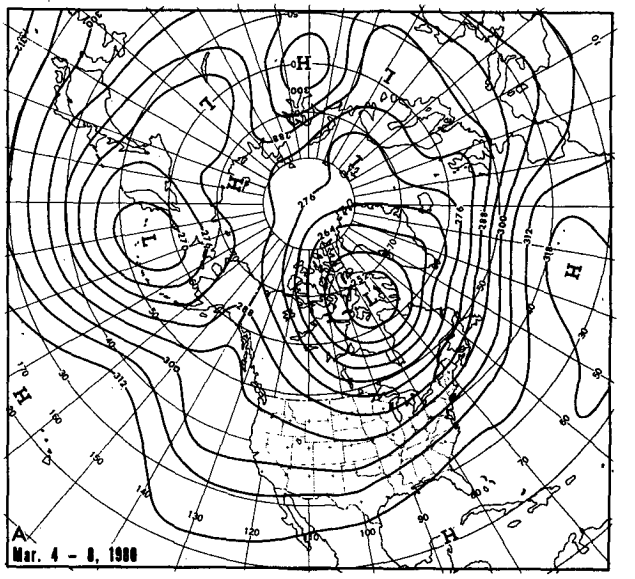
eastern Asia and enhanced coastal baroclinity, an upper level trough that had retrograded to just east of Kamchatka deepened and moved eastward, re-establishing itself near the Aleutians. This amplification and eastward advancement also characterized the mid-Pacific ridge and the trough that moved into the southwestern United States.

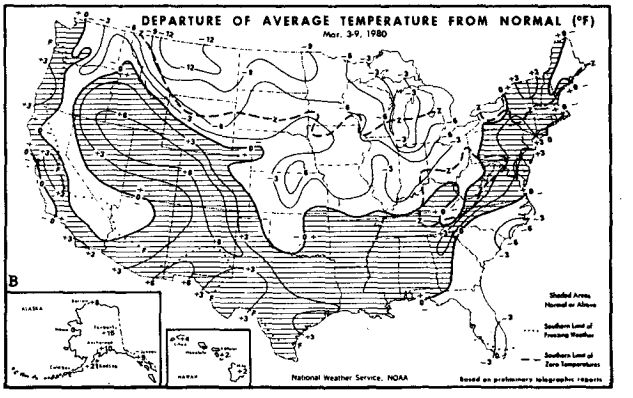
a. 3–9 March

With North American blocking virtually gone at the start of the month, only a remnant of the west coast ridge remained southeast of Alaska as a trough deepened strongly near the mouth of Hudson Bay (Fig. 8a). Above the Pacific a higher amplitude, shorter wavelength pattern emerged with subsequent weakening of the subtropical westerlies and advancement of the eastern Pacific trough to the west coast of the United States. In contrast, over the Atlantic the ridge west of Europe flattened somewhat and retrograded to mid-ocean.

These changes resulted in weak zonal upper air flow over the United States which mostly confined the coldest air to the north central region (Fig. 8b). One exception was the severe cold outbreak in the wake of the 1 and 2 March East Coast snowstorm (see Section 3). Record-low temperatures for the month of March or for so late in the season were set on 2 and 3 March at as many as 25 locations across Texas, the South and the Ohio Valley. Large snow accumulations were instrumental in depressing temperatures along the Carolina coast the balance of the week.

At least two upper level disturbances from the Pacific traversed the country during the week, and storms associated with them brought ample precipitation to the western third of the nation before





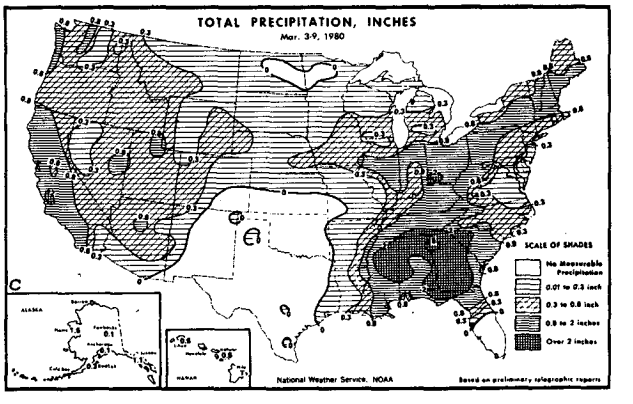


FIG. 8. (A) Mean 700 mb contours (dam) for 4–8 March 1980, (B) departure from normal of average surface air temperature (°F) and (C) total precipitation (inches) for week of 3–9 March 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1980).

weakening over the Plains (Fig. 8c). Subsequently, both reintensified and moved up the Ohio Valley bringing snow to the Midwest and Northeast and tornadoes and heavy showers to the South in advance of trailing cold fronts.

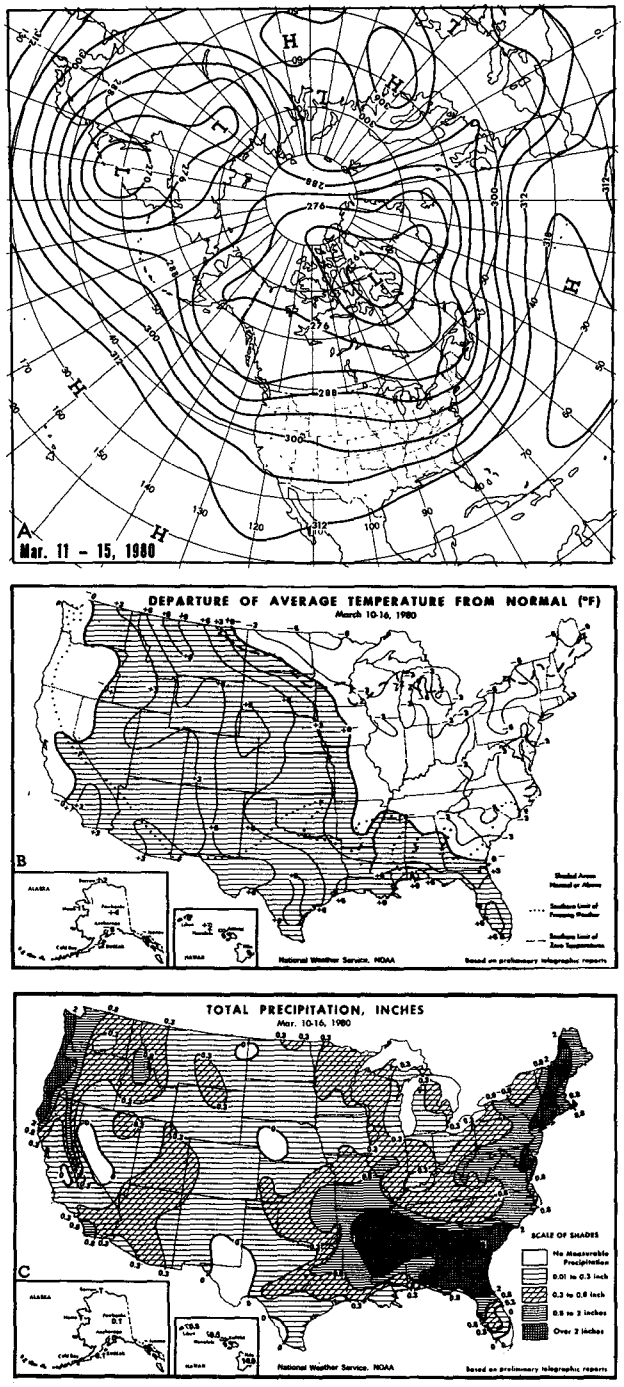


FIG. 9. As in Fig. 8 except for (A) 11–15 March 1980, and (B) and (C) week of 10–16 March 1980.

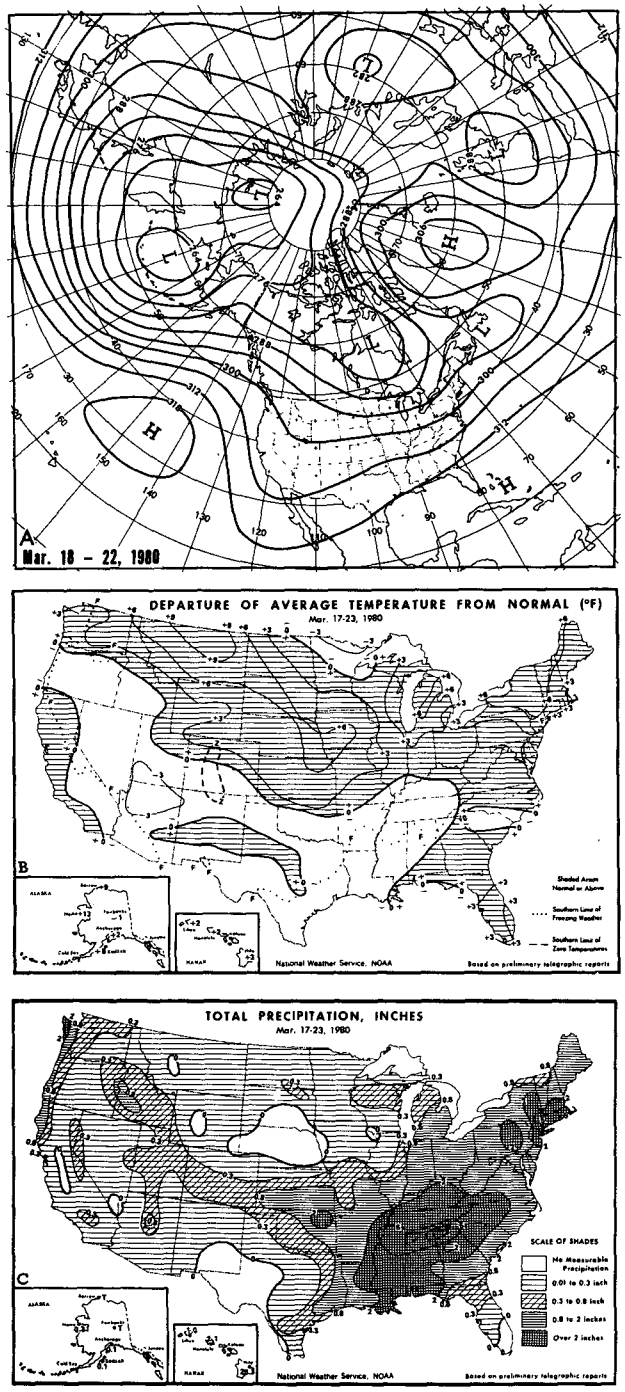


FIG. 10. As in Fig. 8 except for (A) 18–22 March 1980, and (B) and (C) week of 17–23 March 1980.

b. 10–16 March

Over both the Atlantic and Pacific, ridges swelled northward in response to deepening upstream troughs over southeastern Canada and the Sea of Okhotsk, respectively (Fig. 9a). In the case of the latter, amalgamation with the ridge that had retrograded from southeast of Alaska allowed establishment of the main West Coast trough further north, leading to slight ridging over the northern Great Plains and the advancement of cold air to the mid-Atlantic coast (Fig. 9b).

As the increased exposure to short-wave troughs from the Pacific shifted from California to the

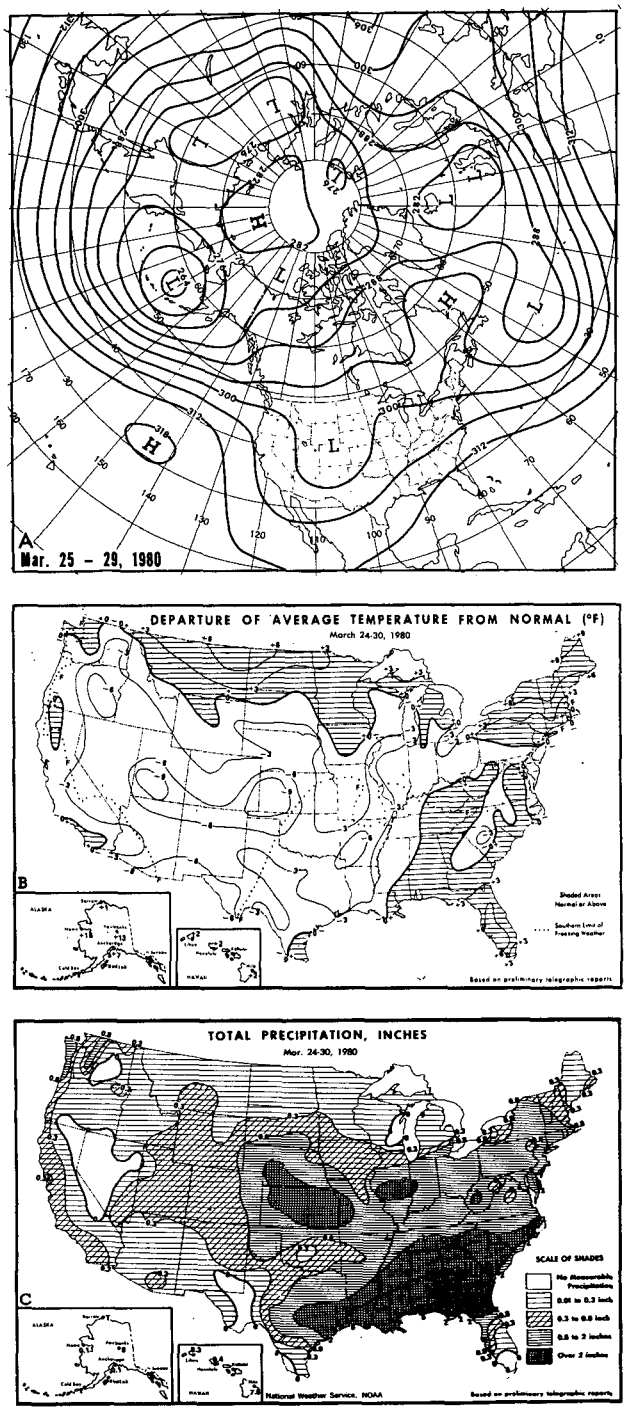


FIG. 11. As in Fig. 8 except for (A) 25–29 March 1980, and (B) and (C) week of 24–30 March, 1980.

Pacific Northwest, so did the West Coast precipitation maximum (Fig. 9c). The South received most of its weekly heavy rainfall allotment from overrunning of a stalled front early in the period and wave development on the same front in the middle of the week. An East Coast storm associated with this same system subsequently dropped moderate to heavy precipitation over much of the Northeast.

c. 17–23 March

Soon after the middle of the month a major adjustment began at 700 mb. Upstream of North America the long waves, continuing to amplify, advanced rapidly eastward, while downstream the growing Atlantic ridge moved quickly northward into a blocking position (Fig. 10a). At the beginning of the week the upper air pattern over the United States consisted of highly amplified, fast-moving short waves, but by the end had a long-wave trough anchored in the Southwest with a block south of Baffin Island and ridging in the east.

Across the southern half of the country mean temperatures for the week were unremarkable except for a cold pocket straddling the Arizona-Utah border under the upper air trough (Fig. 10b). Elsewhere temperatures were well above normal in Montana, assisted by plentiful sunshine and incursion of Pacific air, and in New York and New England which were dominated by maritime air most of the week.

Heavy rains and tornado sightings increased across the South in the strong southerly flow in advance of two extensive north-south frontal troughs that swept across the country (Fig. 10c). Flooding was reported in south central Tennessee near Chattanooga, which was experiencing its wettest month on record (Table 1). A storm that developed in the second frontal trough moved up the Ohio Valley, eventually bringing heavy rains to New York and New England—Tannersville, in the Catskills, received 9 inches of rain.

d. 24–30 March

The climax of the major reversal over the Atlantic and eastern North America reflected in Fig. 7 and discussed above is clearly evident in Fig. 11a. Toward the end of the week the block south of the Davis Strait began to relax as its focus shifted to the southeast. The establishment of a ridge along the east coast of the United States and higher than normal 700 mb heights over the north central states, combined with an eastward shift of the trough in the Southwest, effectively reversed the temperature pattern (Fig. 11b) from that of the first half of the month (Figs. 8b and 9b). Sunshine, maritime air, or anomalous southeasterly flow kept the northern tier of states well above normal in temperature while a deep trough and frequent cloudiness and precipitation (especially heavy snow) substantially depressed temperatures from Arkansas into the High Plains and the Plateau.

The same anomalous southerly and southeasterly flow between the advancing Southwest trough and

East Coast ridge spread moist Gulf air over much of the eastern two-thirds of the country and was a major factor in the frequent central High Plains snow and torrential Southland rain that finally toppled a number of seasonal snowfall and March precipitation records (Table 1). Snow, at times heavy, was common during the week from the Plateau to the western Plains as several weak disturbances moved across the region. Their interaction with a stationary front lying just south of the Gulf coast brought almost continual showers to states just to the north. The week culminated in major cyclogenesis that permitted a new 24 h snowfall record on 27–28 March at North Platte, NE (Table 1) and further exacerbated the excessive wetness to the south and east.

REFERENCES

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