

WEATHER AND CIRCULATION OF FEBRUARY 1980 California Floods

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1. Mean circulation

The trend toward amplified waves in the mean 700 mb flow at middle and high latitudes together with fast and southward displaced westerlies, which was noted in January (Wagner, 1980), continued this month (Figs. 1, 2 and 3). During February, however, cold air was advected to and off the east coasts of both Asia and North America. This contributed to longitudinally extensive belts of enhanced baroclinicity at relatively low latitudes (Fig.

4), intense cyclogenesis over both oceans, and a further strengthening of the subtropical westerlies. The latter effect was especially notable over the eastern Pacific where mean wind speeds were more than twice normal along the wind speed axis and along the southeast coast of the United States. The intensifying oceanic lows supported strong ridges downstream—over northwestern Canada and western Europe. As was the case in January, the Pacific subtropical westerlies were so strong and extensive that upper level troughs were driven

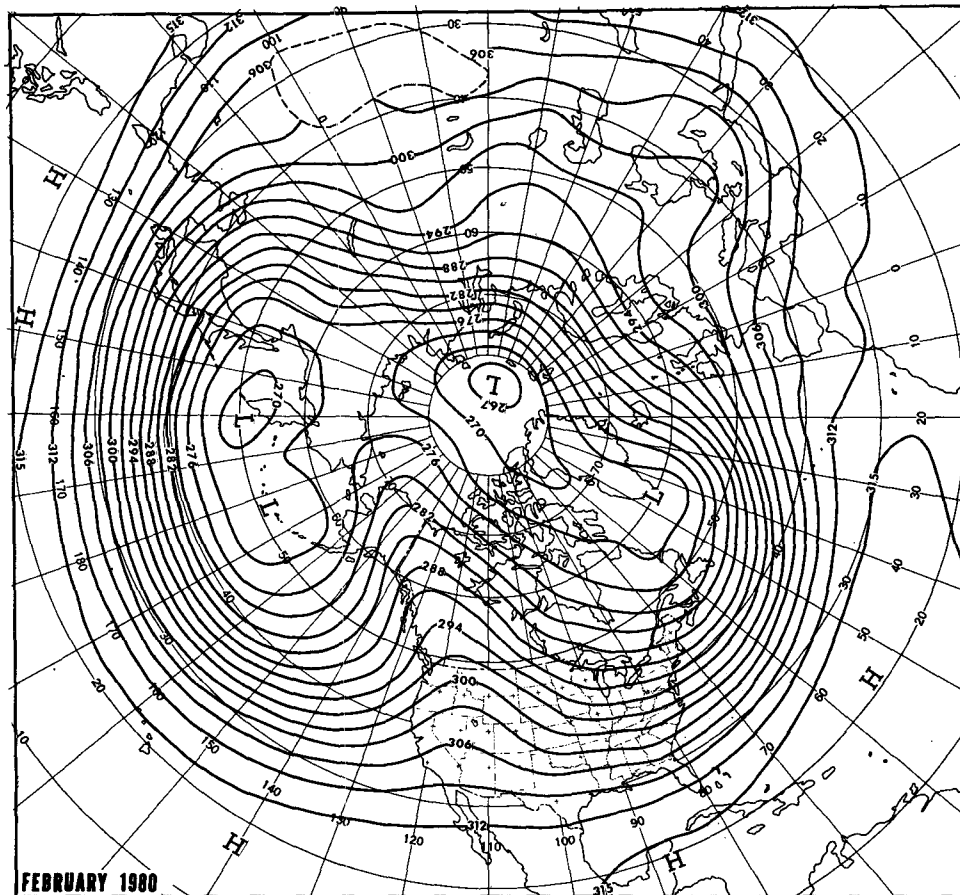


FIG. 1. Mean 700 mb height contours (dam) for February 1980.

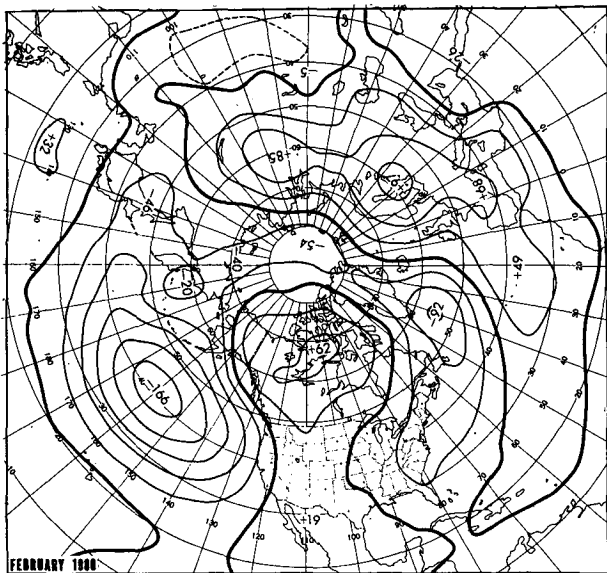


FIG. 2. Departure from normal of mean 700 mb height (m) for February 1980.

across the western United States weakening the normal mean ridge there. The multiple positive anomaly centers over northern Europe and Asia represent successive locations of blocking in the two halves of the month. North of these ridges an Arctic low deepened.

2. Temperature

Enhanced southerly wind components, coupled with cloudy conditions, produced above-normal

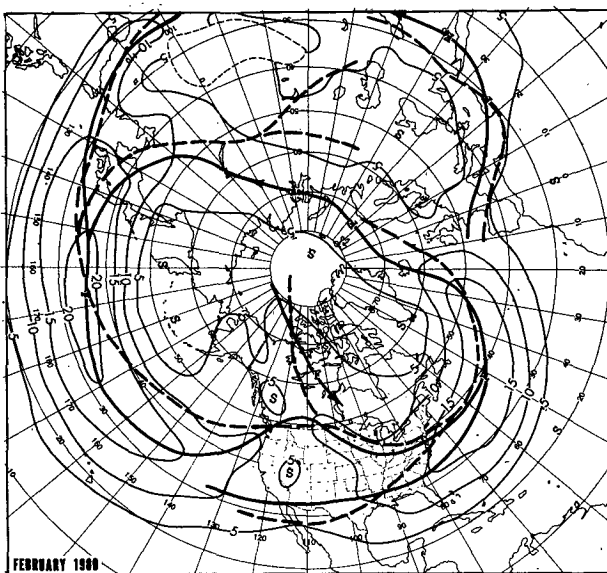


FIG. 3. Mean 700 mb geostrophic wind speed ($m s^{-1}$) for February 1980. Solid arrows indicate observed axes of maximum wind speed and dashed lines, the normal.

mean temperatures over much of the West as well as in Alaska (Fig. 5). A notable exception was the area of near to below-normal temperatures in the Pacific Northwest where easterly components in the anomalous flow are symptomatic of the influx of cold, continental air from time to time. Temperatures averaged near to above normal in Hawaii to the south of the central Pacific wind maximum.

The combination of a strong western Canada ridge and a deep East Coast trough brought cold weather to most areas east of the Continental Divide.

3. Precipitation

Storm systems and upper level troughs, travelling in the strong and southward displaced Pacific westerlies, moved across the West bringing above-normal precipitation to a large area (Fig. 6). From time to time southwesterly flow associated with such systems overran cold air east of the Rocky Mountains and extended the relatively wet area eastward.

All of Southern California's precipitation this month occurred during the 13–21 February period when a series of storms moving in from the Pacific brought daily and substantial amounts. Nine-day totals along the coast ranged from about 4.5 inches at San Diego in the south to over 9 inches at both Los Angeles and Long Beach and then dropped off to about 5.5 inches at Santa Maria to the north. The resulting extensive flooding and mudslides caused the loss of at least 36 lives and an estimated one-half billion dollars damage. Six California counties, from Ventura County just north

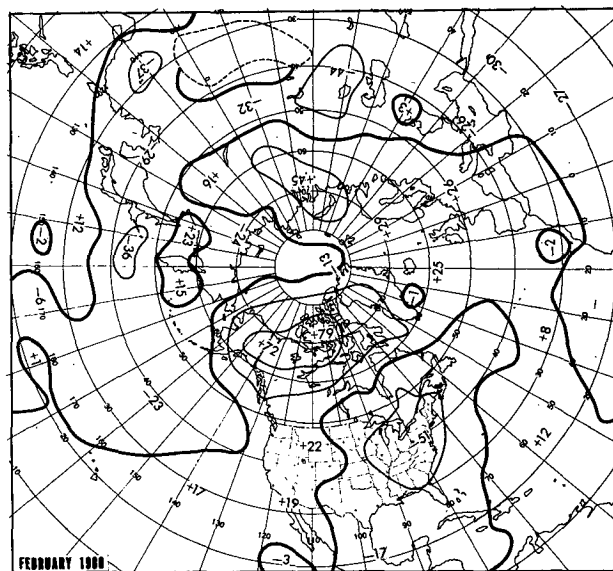


FIG. 4. Departure from normal of mean 1000–700 mb thickness (m) for February 1980.

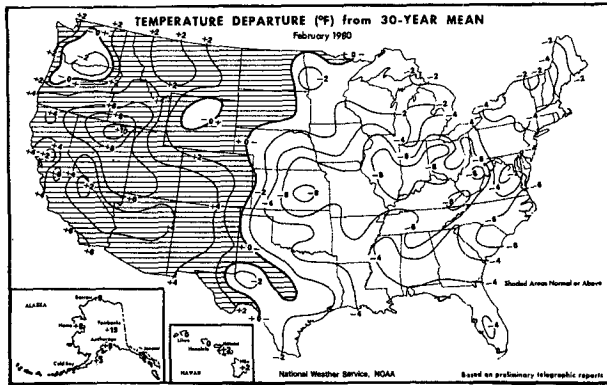


FIG. 5. Departure from normal of average surface air temperature (°F) for February 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1980).

of Los Angeles to San Diego County on the Mexican border, were declared national disaster areas. Thousands of persons were evacuated from Palm Springs, San Diego, Riverside County, Los Angeles County and Point Mugu Naval Air Station as residences were flooded or destroyed by mudslides. Six major San Diego reservoirs reached the highest levels since 1941. Agricultural damage was extensive and included the loss of much of the strawberry crop.

Beyond California, flooding from the storms caused an estimated 90 million dollars damage in the vicinity of Phoenix, AZ where 400 houses, hundreds of streets and several bridges were destroyed, and an estimated two million dollars damage in Cache County in northern Utah. It was the second wettest February of record at Salt Lake City, UT.

Except as noted earlier, precipitation east of the Continental Divide was generally subnormal as east coast storms generally deepened well off the coast and the Alberta storm track was inactive. This was

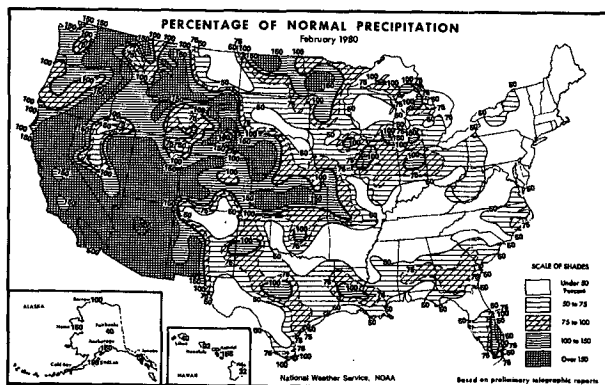


FIG. 6. Percentage of normal precipitation for February 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1980).

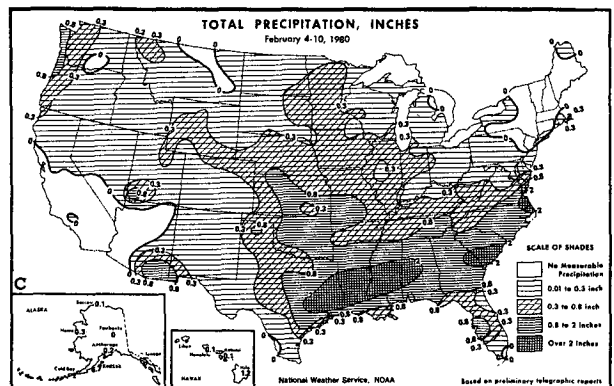
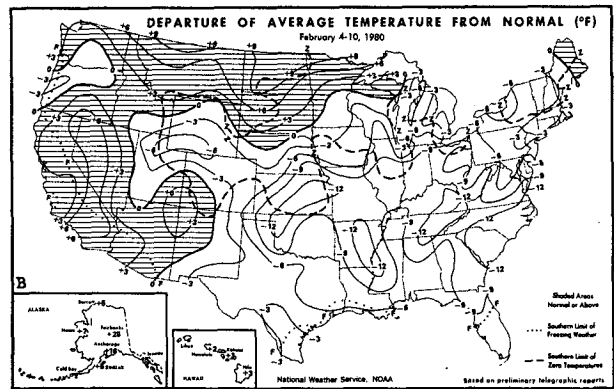
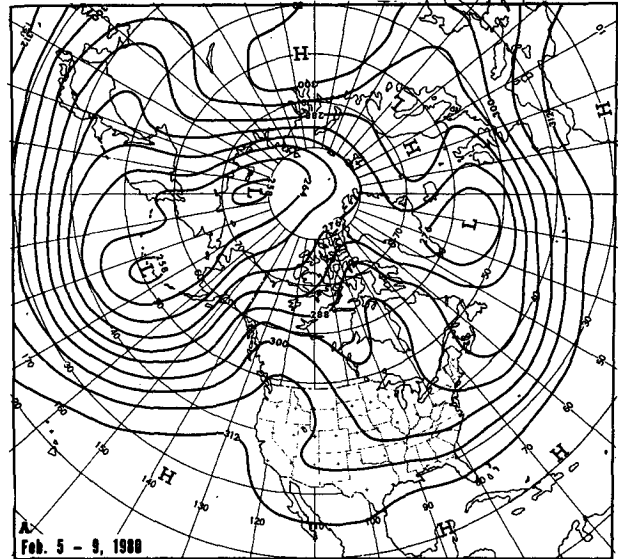


FIG. 7. (A) Mean 700 mb contours (dam) for 5-9 February 1980; (B) departure from normal of average surface air temperature (°F) and (C) total precipitation (inches) for week of 4-10 February, 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1980).

the third consecutive month with subnormal precipitation in the Northeast. It was the second driest February on record at Avoca, PA (Wilkes-Barre Scranton Airport). Although occurring in a month

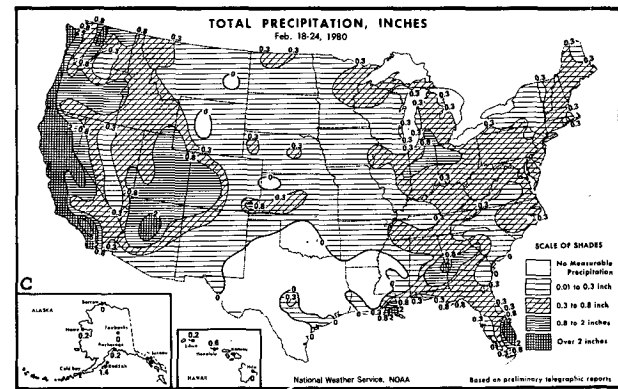
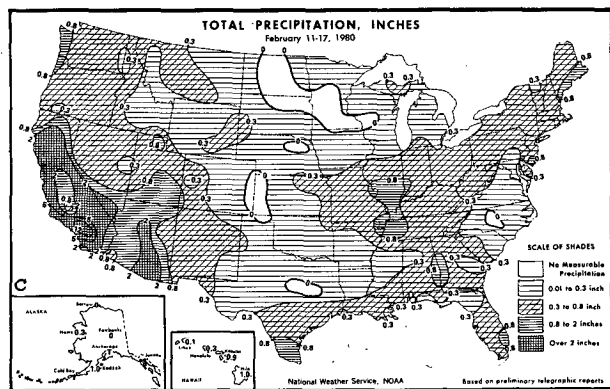
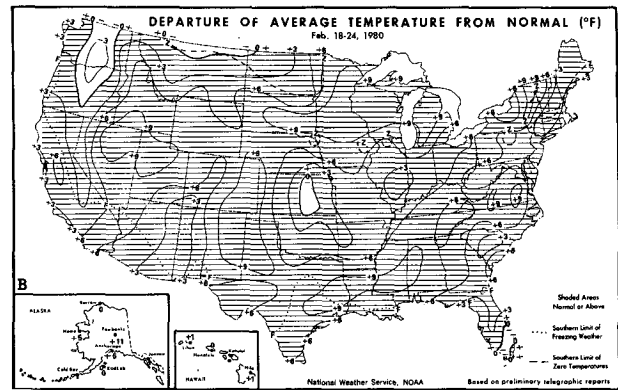
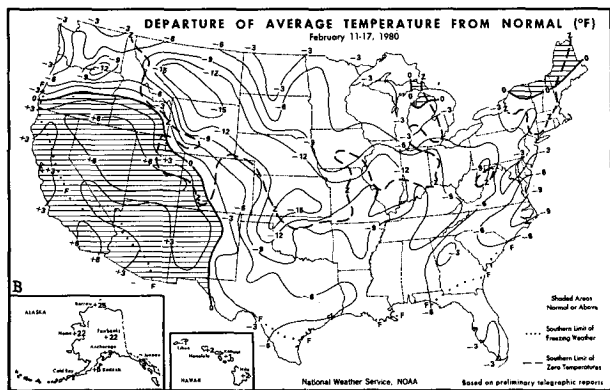
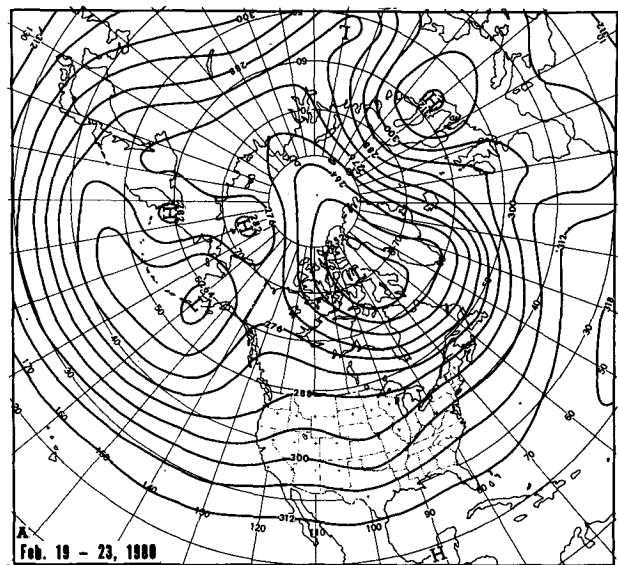
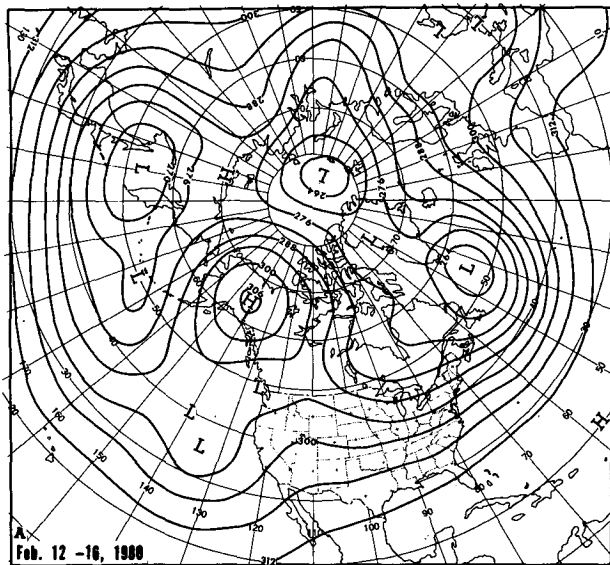


FIG. 8. As in Fig. 7 except for (A) 12-16 February 1980, and (B) and (C) week of 11-17 February 1980.

FIG. 9. As in Fig. 7 except for (A) 19-23 February 1980, and (B) and (C) week of 18-24 February 1980.

with subnormal precipitation, a pair of storms in the 6-10 February period produced 18.9 inches of snow at Norfolk, VA, the heaviest monthly total of record.

Strong southerly wind components brought heavier than normal precipitation to most of south and west Alaska. The interior and the north, sheltered by mountain ranges, were somewhat

drier than normal. Precipitation in Hawaii was quite variable.

4. Variability within the month

a. 4-10 February

Early in the month strong blocking ridges were located over both continents and deep troughs and

fast westerlies were situated over both oceans (Fig. 7A). A strong ridge over western North America, together with a deep trough off the east coast, brought cold weather to much of the United States east of the Continental Divide and warm weather to the West (Fig. 7B).

Upper troughs traversing the country south of the blocking ridge spread precipitation over much of the country (Fig. 7C). With a blocking ridge over eastern Canada, the westerlies were displaced southward over the eastern United States and heaviest precipitation was found in the Southeast. A storm system moving up the East Coast gave heavy snowfall to southeastern Virginia and northeastern North Carolina on 6 and 7 February. Norfolk recorded 12.4 inches of snow, second heaviest storm total of record, while Elizabeth City, NC received 20 inches. A second storm on 9–10 February added another 6.5 inches to Norfolk's total, making it the snowiest month of record there.

b. 11–17 February

Blocking over North America retrograded and consolidated into a single massive high near the Canada-Alaska border (Fig. 8A). Strong Pacific westerlies undercut this high driving a deep trough to the east Pacific, and a ridge to the great basin. Relaxation of blocking in eastern Canada was accompanied by the retrogression of the Atlantic low to south of Greenland. As the strong blocking ridge moved northwestward cold air was driven over parts of the Pacific Northwest as well as most areas east of the Divide (Fig. 8B). Warm weather persisted, however, over the remainder of the West to the east of the deep mean trough.

The deep east Pacific mean trough and associated fast subtropical westerlies brought a succession of rain producing systems into the west yielding heavy precipitation over a large area (Fig. 8C). Effects of this wet regime are discussed in Section 3. Elsewhere over the country, between the western ridge and the east coast trough, precipitation was relatively light.

c. 18–24 February

The North American blocking ridge further retrograded and weakened and the multiple Pacific lows of the previous week consolidated into a single, deep Aleutian low (Fig. 9A). Fast subtropical westerlies continued across the Pacific. As blocking relaxed over Canada a mean low was established near Baffin Island and the westerlies increased over southern Canada and the Atlantic.

Retrogression of the western Canadian blocking ridge and the associated increase in the transport of maritime air across the west coast of North

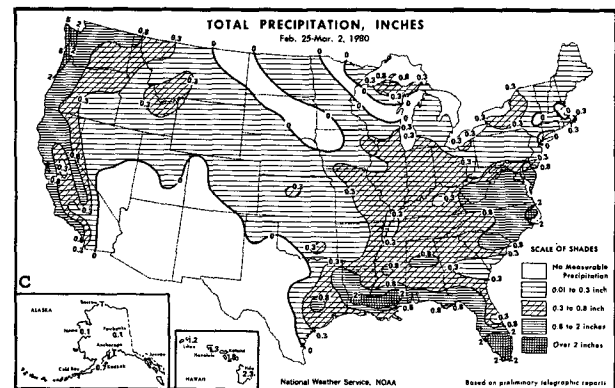
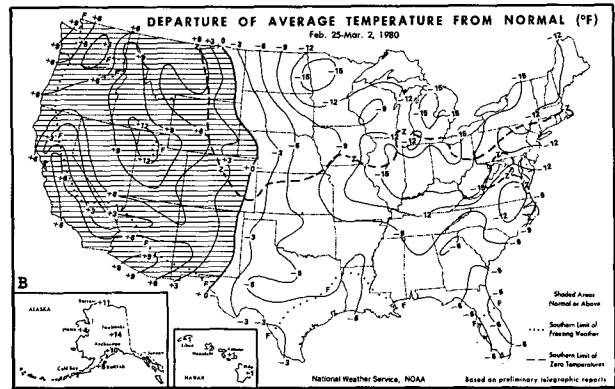
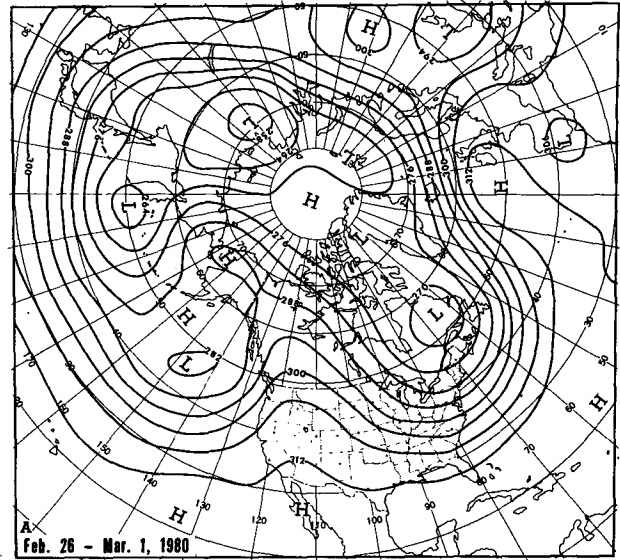


FIG. 10. As in Fig. 7 except for (A) 26 February–1 March 1980, and (B) and (C) week of 25 February–2 March 1980.

America brought above-normal mean temperatures to most of the country (Fig. 9B).

Despite the weakening of the east Pacific trough, the subtropical westerlies in that area remained strong enough to propel rain producing systems across the west for the second consecutive week, and rainfall totals there were again substantial (Fig.

9C). See Section 3 for a discussion of the effects of this wet regime. Several upper level troughs and associated surface lows crossed the country in the low-amplitude flow and produced widespread but generally light precipitation east of the Divide.

d. 25 February–2 March

The flow over the Pacific reverted to a double trough structure and the western North American ridge built strongly this week (Fig. 10A). East of this amplifying ridge the mean low was displaced southward to Labrador and a responsive ridge built strongly west of Great Britain.

While warm weather persisted under the building western ridge, extremely cold air was advected southward to its east (Fig. 10B) producing near-record low temperatures at scattered locations.

Substantial precipitation occurred in advance of

the east Pacific trough and along the Gulf and Southeast coasts, near the fringes of the cold air mass. A pair of storms on 1 and 2 March again produced heavy snowfall over portions of the middle Atlantic States (see also discussion for 4–10 February). As was the case with the earlier storm, some of the greatest storm totals were at Norfolk, VA (14 inches) and Elizabeth City, NC (25 inches); Cherry Point, NC recorded 30 inches.

REFERENCES

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- Wagner, A. James, 1980: Weather and circulation of January 1980—Commencement of a major index cycle. *Mon. Wea. Rev.*, 108, 531–538.