WEATHER AND CIRCULATION OF FEBRUARY 1977
Widespread Drought

ROBERT R. DICKSON

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

1. Mean circulation

The monthly mean 700 mb circulation through much of the western half of the Northern Hemisphere during February was quite similar to that of the preceding four months (Wagner, 1977). Throughout this period, deep mean troughs were located over the mid-Pacific and near the east coast of the United States, while a strong mean ridge persisted near the west coast of North America (Figs. 1 and 2). Over most of the Hemisphere major height anomaly centers decreased in magnitude from the extreme values of January. The decline of the Arctic high and the reestablishment of an Arctic low were especially notable.

Wind speed maxima at 700 mb increased and progressed over both the Atlantic and Pacific Oceans (Fig. 3). The Pacific maximum also moved a bit northward and was associated with the progression and flattening of the western North American ridge. As the Atlantic maximum moved eastward a mean 700 mb low moved from eastern Canada to just south of the tip of Greenland. Mean 700 mb wind speeds also

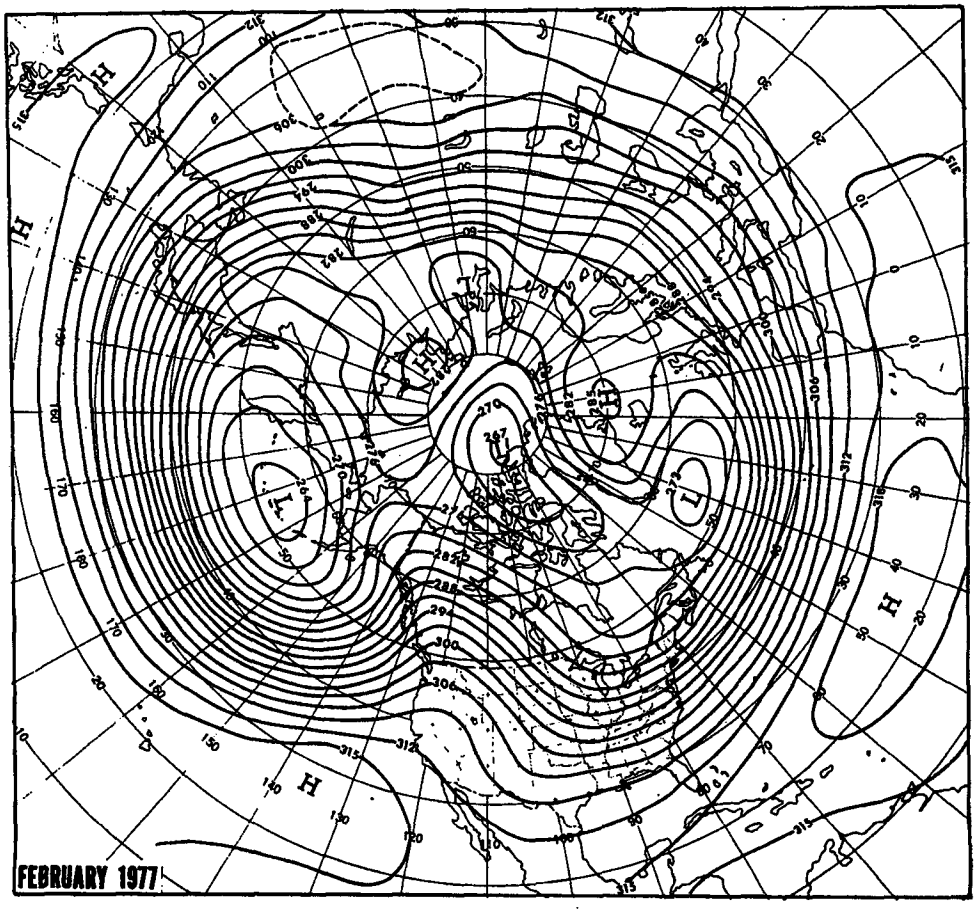


FIG. 1. Mean 700 mb height contours (dam) for February 1977.

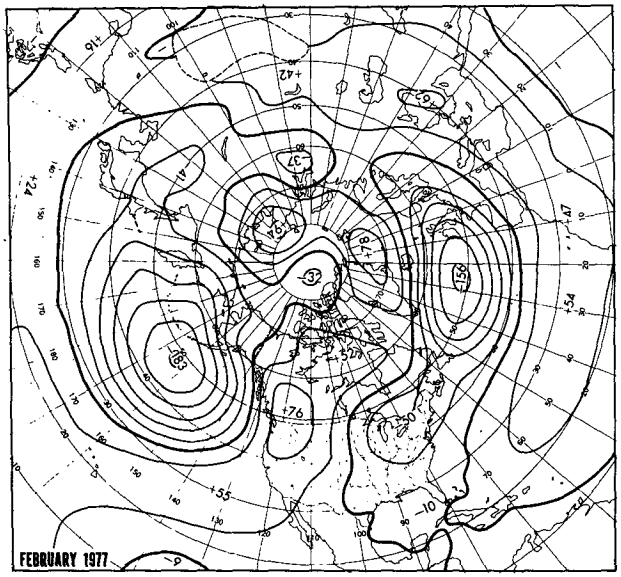


FIG. 2. Departure from normal of mean 700 mb height (m) for February 1977.

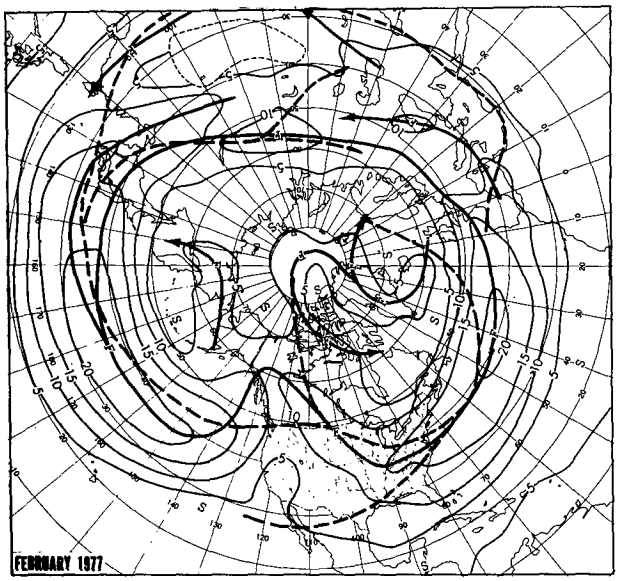


FIG. 3. Mean 700 mb geostrophic wind speed (m s^{-1}) for February 1977. Solid arrows indicate observed axes of maximum wind speed and dashed lines, the normal.

increased in mid-latitudes of Eurasia. Enhanced baroclinic fields were observed near the circumhemispheric wind speed maximum (Fig. 4).

2. Temperature

In view of the general persistence of the mean circulation in the vicinity of the United States, the marked change in temperature regime from January to February (Fig. 5) is surprising. The record breaking low mean temperatures of January east of the Divide gave way to above normal means over most of the Great Plains, Mississippi Valley and Northeast in February.

Although gross aspects of the monthly mean circulation pattern near the United States persisted from January to February, significant changes did occur which affected the temperature distribution. These changes are elucidated to some extent by application of unpublished temperature specification equations, used at the National Meteorological Center, which relate the mean temperature at locations in the United States to the regional field of mean 700 mb height. Such an application indicates that progression of the mean ridge over the Pacific Northwest in February, together with the flattening of both the eastern trough and the ridge over northwest Canada, all contributed to the pronounced warming from January to February. However, the magnitude of this warming was greatly underestimated by the specification equations. At Minneapolis, for example, the specification accounted for only about one-half of the observed warming from 12°F below normal to 6°F above normal. It seems likely that the extreme degree of observed warming was due in part to the spreading eastward of the warm air that had accumulated in the persistent western ridge (Fig. 4).

Mean temperatures remained below normal over most of the eastern quarter of the contiguous United States, near or west of the still-strong mean trough. Stronger than normal southerly flow persisted warm conditions over Alaska, while Hawaii continued warm under a strong subtropical ridge.

3. Precipitation

The wind field about the strong western ridge steered most eastern Pacific storms into the Gulf of

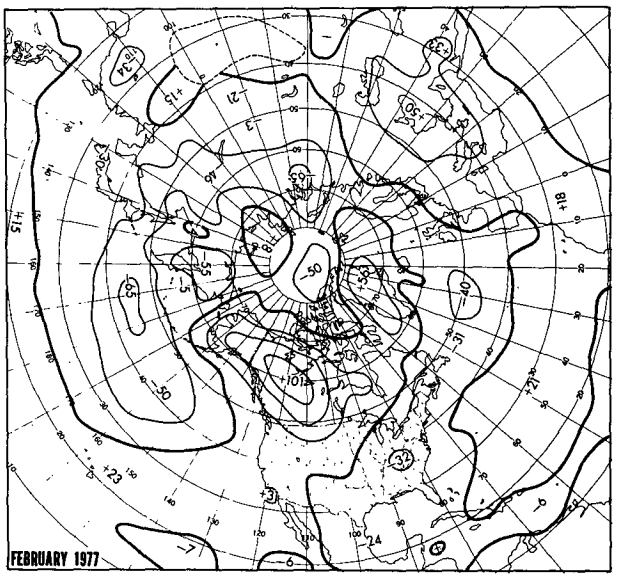


FIG. 4. Departure from normal of mean 1000–700 mb thickness (m) for February 1977.

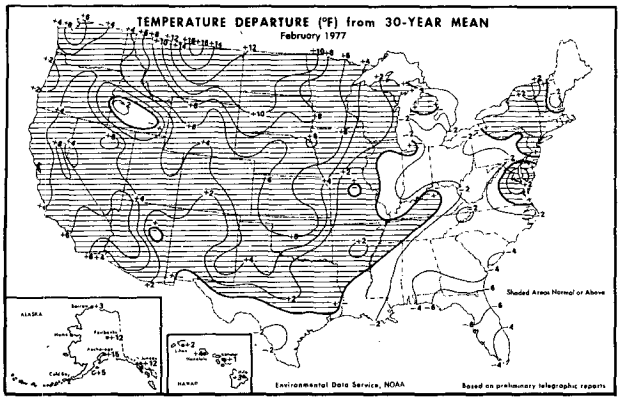


FIG. 5. Departure from normal of average surface air temperature (°F) for February, 1977 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service, 1977).

Alaska, effectively shielding the western states from their effects (Fig. 6). In addition, enhanced northerly wind components helped keep precipitation totals below normal at most locations between the western ridge and the still-deep eastern trough. It was the driest February of record at Sheridan, Wyo., (0.08 inch) and Billings, Mont. (0.05 inch), second driest at Milford, Utah (0.10 inch), and Wilmington, Del. (1.09 inches), and tied for the third driest at Havre, Mont. (0.07 inch). Precipitation was also well below normal in Hawaii, located under a strong subtropical ridge.

Above-normal precipitation amounts in the contiguous United States were largely limited to north central portions of the country together with the southern Great Plains and the Northeast. Most of the precipitation in the first of these areas occurred during the final week of the month when the circulation regime had decisively changed. Precipitation also continued above normal along the south coast of Alaska, an area of strong southerly flow in advance of the deep central Pacific trough.

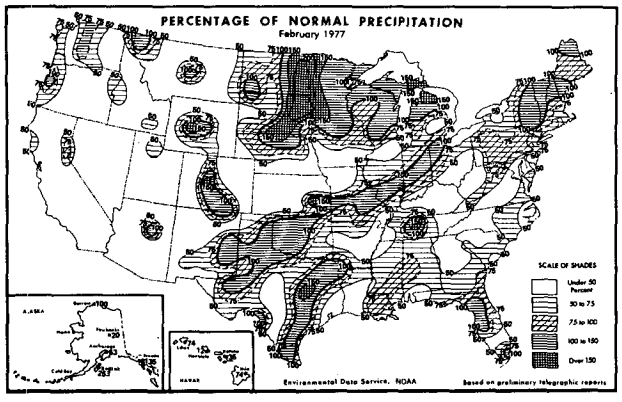
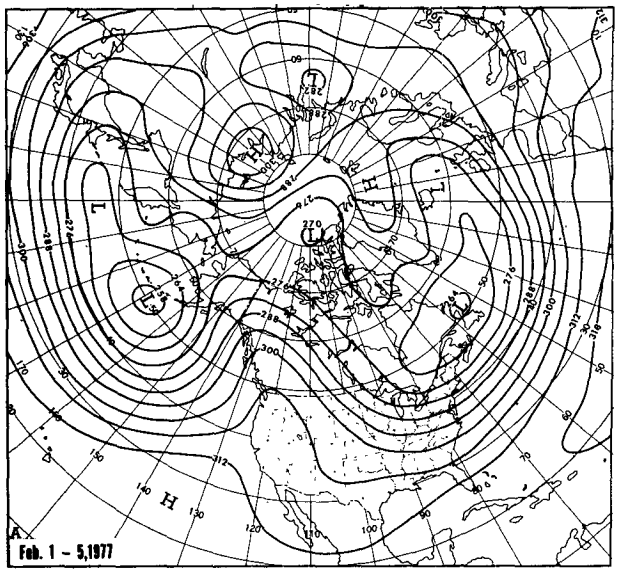
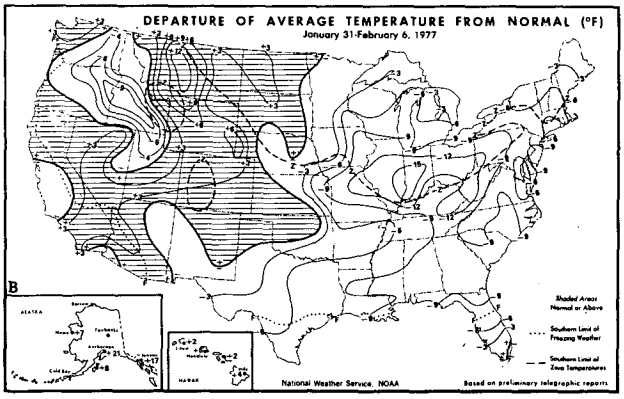


FIG. 6. Percentage of normal precipitation for February 1977 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service, 1977).





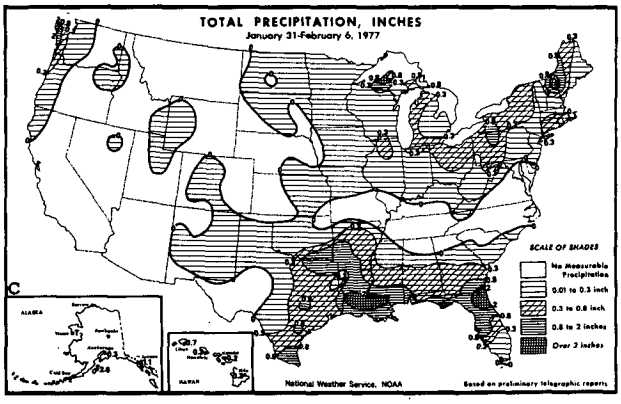


FIG. 7. (A) Mean 700 mb contours (dam) for 1–5 February 1977; (B) departure from normal of average surface air temperature (°F) and (C) total precipitation (inches) for week of 31 January–6 February 1977 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service, 1977).

The unusually persistent circulation regime in the vicinity of the United States which dominated the fall and winter (including February) produced drought conditions in some parts of the country. One of the more serious of these is in the Pacific Northwest, where

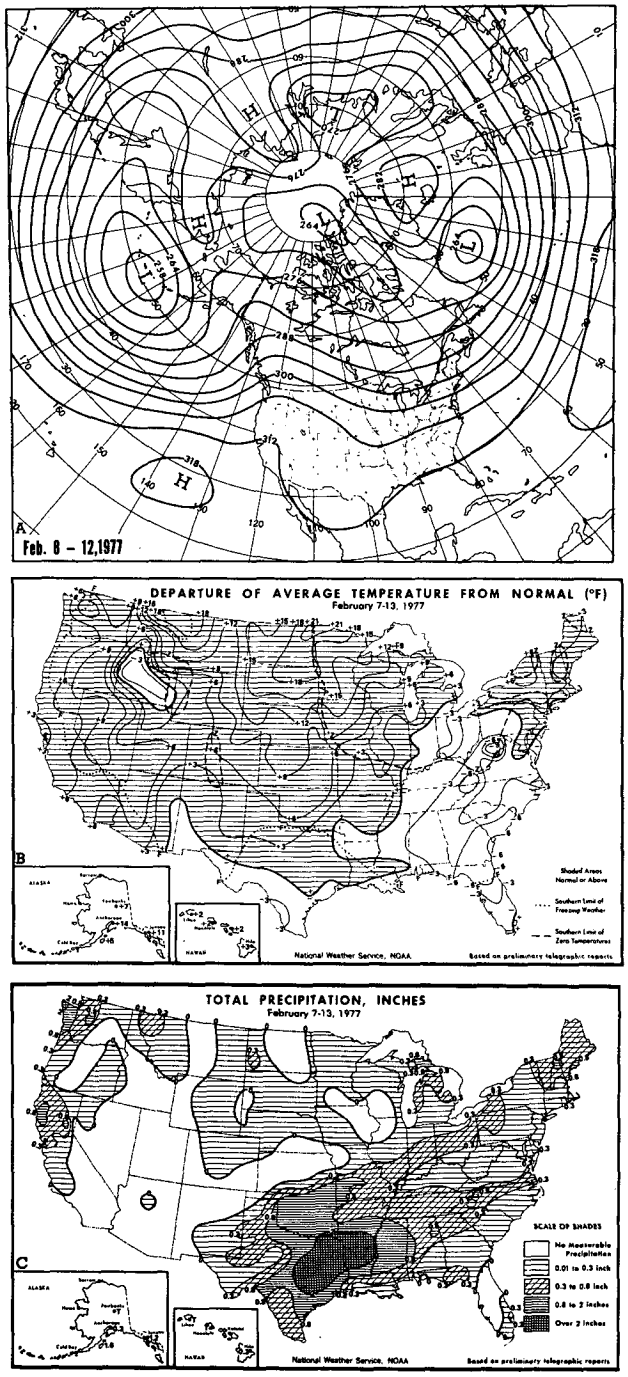


FIG. 8. As in Fig. 7 except for (A) 8–12 February 1977 and (B) and (C) week of 7–13 February 1977.

the colder half of the year is the time when most of the normal year's precipitation falls. Stations in the Northwest have had five to seven consecutive months of subnormal precipitation with September to February defecits of 5–20 inches developing over a large area. Both Spokane, Wash., and Medford, Oreg., experienced the driest fall–winter combination of record.

In an extensive area encompassing most of the Midwest and eastern portions of the northern and central Great Plains, fall and winter dryness followed a drier than normal summer and three season precipitation deficits of 5–14 inches are common. In this area Waterloo, Iowa, reported the tenth consecutive month with below normal precipitation and Moline, Ill.,

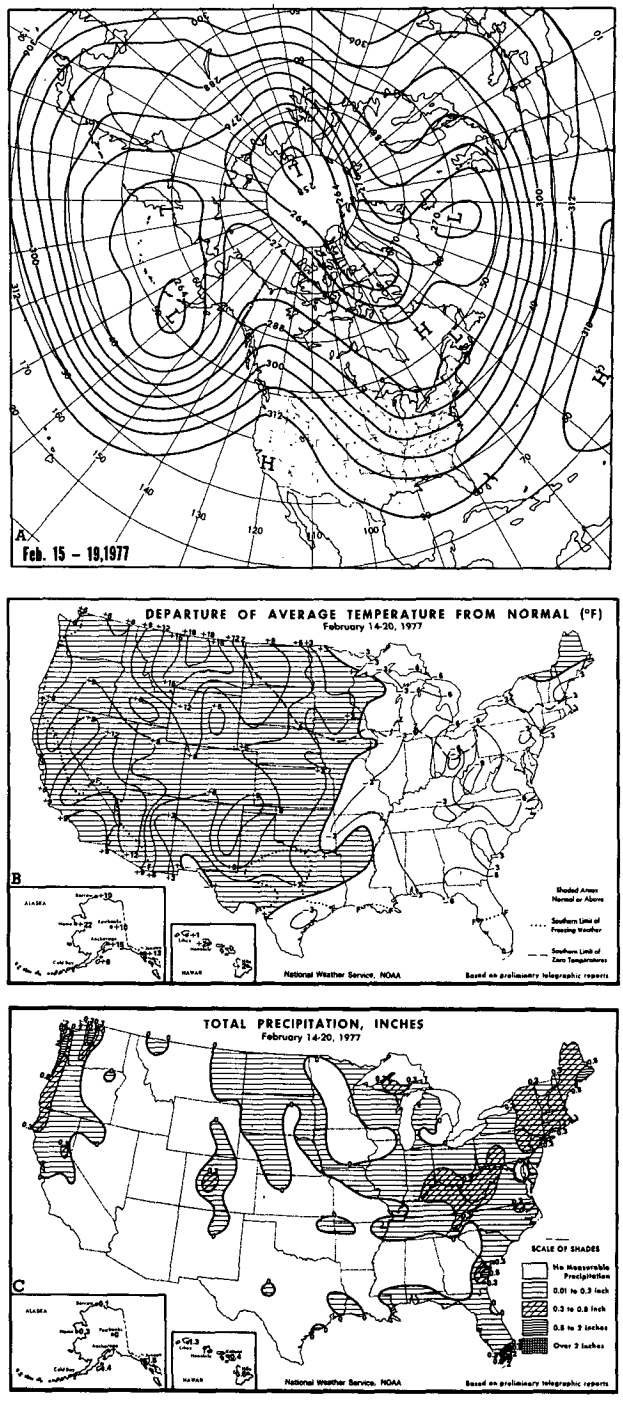


FIG. 9. As in Fig. 7 except for (A) 15–19 February 1977 and (B) and (C) week of 14–20 February 1977.

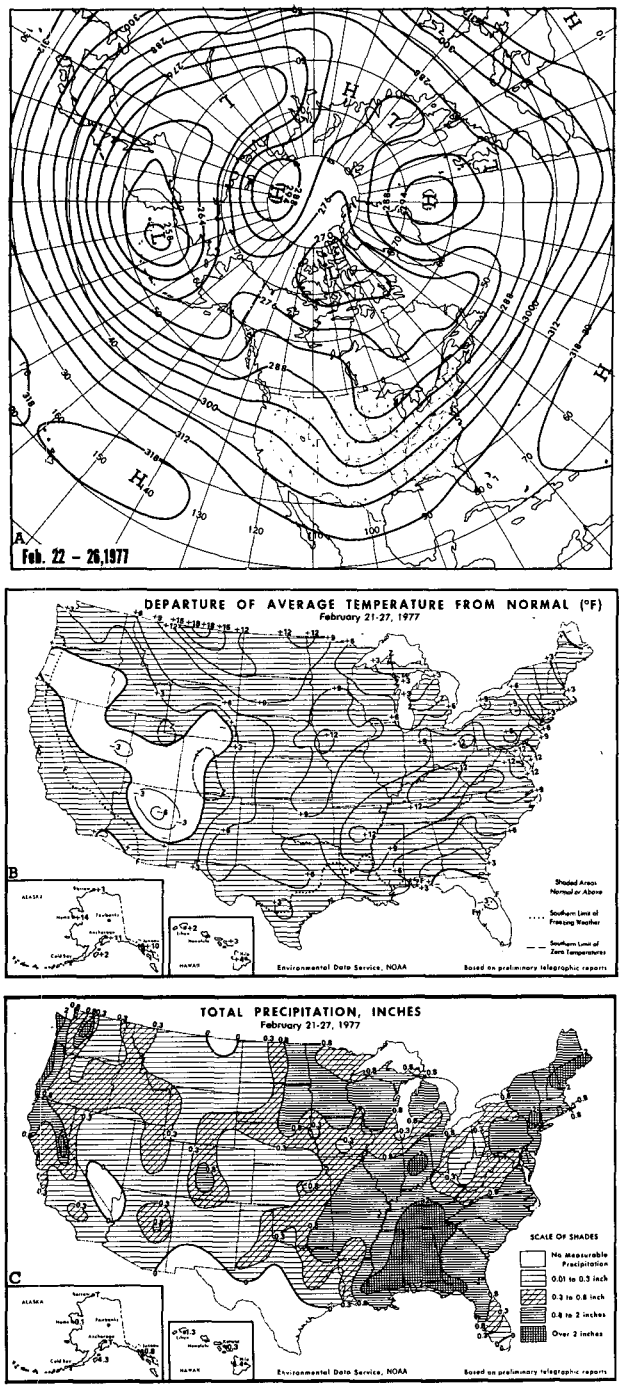


FIG. 10. As in Fig. 7 except for (A) 22–26 February 1977 and (B) and (C) week of 21–27 February 1977.

recorded its ninth consecutive dry month. To the west of this dry region Grand Junction, Colo., also reported the ninth consecutive month of subnormal precipitation.

The strong subtropical ridge which persisted over the Hawaiian Islands during the winter also produced very dry conditions in that state. Winter season precipitation varied from a scant 8% of normal at Kahului to less than 50% of normal elsewhere where data were readily available.

4. Variability within the month

a. 31 January–6 February

Already by the first few days of the month the mean wave features over and near the United States had progressed and temperatures had warmed to above normal over much of the Great Plains (Fig. 7). The still highly amplified wave pattern brought very cold temperatures to the eastern half of the country.

Weak storm systems moving across the northern Gulf of Mexico and more vigorous systems near the Great Lakes produced significant precipitation along the Gulf Coast and from the Great Lakes to the Northeast. The Pacific mean trough was far enough east to bring some precipitation to coastal portions of the Northwest.

b. 7–13 February

Continued progression and flattening of wave features over the United States furthered the spread of warm air across the nation (Fig. 8).

Heaviest precipitation occurred over the south-central states in advance of the Texas mean trough.

c. 14–20 February

The mean wave pattern over North America amplified this week, increasing both the extent and intensity of the cold air in the east, but continuing warm temperatures over the western half (Fig. 9). Record high temperatures for the month were equaled or exceeded this week at several stations west of the Continental Divide.

This was the driest week of the month; substantial precipitation amounts were confined to coastal areas in the Northwest and to the southern tip of Florida.

d. 21–27 February

The mid-tropospheric circulation near North America changed abruptly this week. The couplet of a strong western ridge and a deep eastern trough which had dominated the winter season gave way to fast westerlies with fast moving storm systems traversing the country (Fig. 10).

With the increasing westerly flow warm air masses spread across most of the United States. Weekly mean temperatures which had been 6–9°F below normal the previous week in parts of the eastern third of the country rose to 9° to 12°F above normal. Temperatures rose to the 70's and 80's in the Southeast on 25 and 26 February, equaling or exceeding record highs for the month at several locations.

The increased incidence of storm systems accompanying the breakdown of the western ridge made this the

wettest week of the month. This week accounted for most of the month's precipitation in parts of the Midwest and the northern Mississippi Valley as well as eastern portions of the Dakotas.

An intense low-pressure area moving out of the Great Basin and across the central Great Plains brought a severe dust storm to western portions of the central and southern Great Plains on 22 and 23 February. Dust, suspended in the atmosphere by this storm, moved across the South and passed off the southeast coast (Virginia to Florida) on 25 and 26 February. The storm center itself, on 23 February, brought a record low station pressure for the month to Sioux City, Iowa, and the third lowest pressure for any month to Grand Island, Nebr.

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