

WEATHER AND CIRCULATION OF JUNE 1980 Inception of a Heat Wave and Drought over the Central and Southern Great Plains

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1. Mean circulation

After a long period with enhanced 700 mb ridges in the Arctic (Taubensee, 1980) a deep and cold mean low returned to that area in June (Figs. 1 and 2). This was accompanied by the emergence of a strong baroclinic field on the fringes of the Arctic, increased cyclogenesis and augmented circumpolar flow (Figs. 3 and 4).

The Pacific westerlies continued their decline from the extremely strong values of April and the long-wave pattern over the Pacific retrograded and amplified. This brought a deep trough to the west Pacific and strong ridge to the east Pacific. The latter feature phased with a retrogressive ridge at high latitudes.

The trend toward retrogression and amplification of long waves in the westerlies extended around much of the Northern Hemisphere. Over the United States this involved the retrogression of troughs near both coasts and the retrogression and pronounced amplification of a ridge over the central and southern Great Plains. This ridge amplification from the south proceeded as the retrogression of the long-wave pattern over Canada led to the weakening (in an anomaly sense) of the previously strong northern Great Plains blocking ridge.

Retrogression and amplification of the Atlantic ridge led to the development of a cold mean trough over Great Britain ending a lengthy spell of quiescent weather there which had accompanied a blocking ridge. Remnants of the blocking ridge moved eastward to Finland and a trough progressed to east of the Ural Mountains.

The long-wave pattern which evolved this month—with amplified upper level ridges over the northern central Pacific, central United States and the central Atlantic—was a close match to that described by Namias (1955) as associated with extensive summer-time drought over the United States. The emergence of an extreme heat wave over the central and southern Great Plains, accompanied by de-

veloping drought is described in the next two sections.

2. Temperature

The long-standing warm spell in the north-central states was considerably ameliorated this month (Fig. 5) as the overlying blocking ridge weakened. Amplification of the ridge over the central and southern Great Plains, however, shifted the focus of unusually hot weather to that area. During the last half of the month, temperatures of 100°F or greater were common over the central and southern Great Plains and several June and all-time temperature records were set (Table 1). The most notable of these was 117°F at Wichita Falls, TX, an all-time high for that location. By the end of the month, protracted hot and dry weather has caused several deaths, had placed crops and livestock under severe stress and was showing no signs of ending.

Strong northwesterly flow over central Canada deployed cold air masses over the northeastern quarter of the United States, to the west of a deep coastal trough. Subnormal temperatures also were observed over much of the far West where increased southwesterly flow spread maritime influences inland. It was the coldest June of record at Pendleton, OR and the third coldest at Medford, OR.

Temperatures were subnormal over most of interior Alaska where the strong southwesterly flow produced more than usual cloudiness and precipitation. To the north and the south, however, warm weather prevailed. Temperatures over the Hawaiian Islands ranged from near normal in the north to above normal in the south.

3. Precipitation

Emergence of the southern ridge coupled with the decline of the previous blocking ridge over the northern Great Plains produced a northward jump in the westerlies and significant changes in the pre-

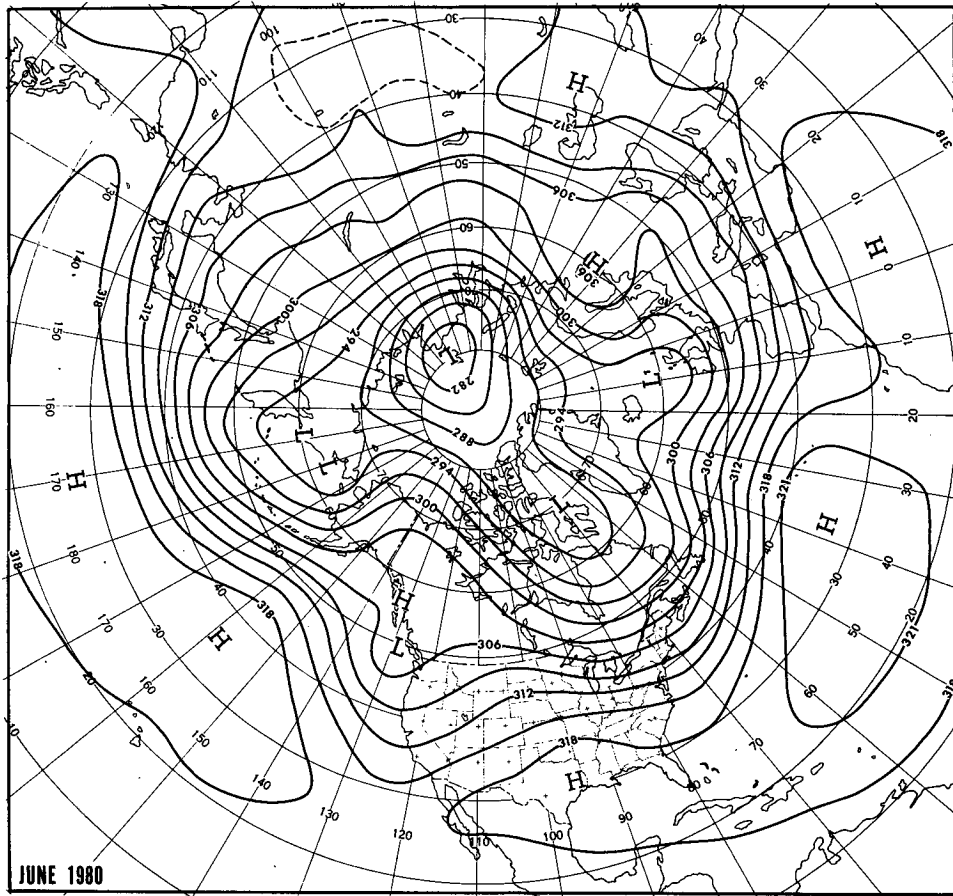


FIG. 1. Mean 700 mb height contours (dam) for June 1980.

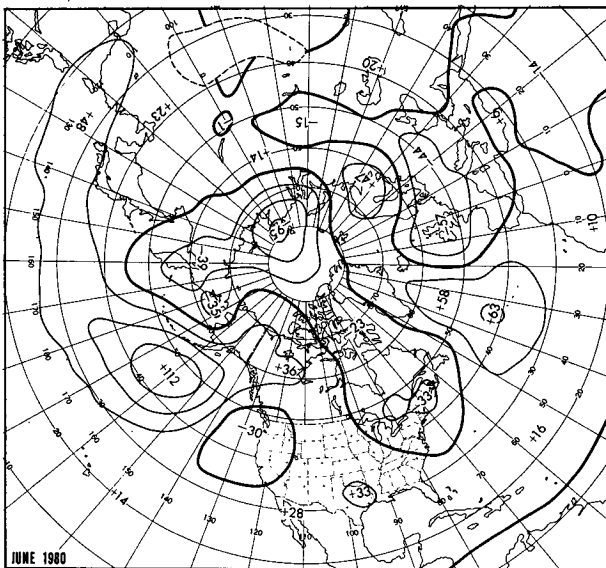


FIG. 2. Departure from normal of mean 700 mb height (m) for June 1980.

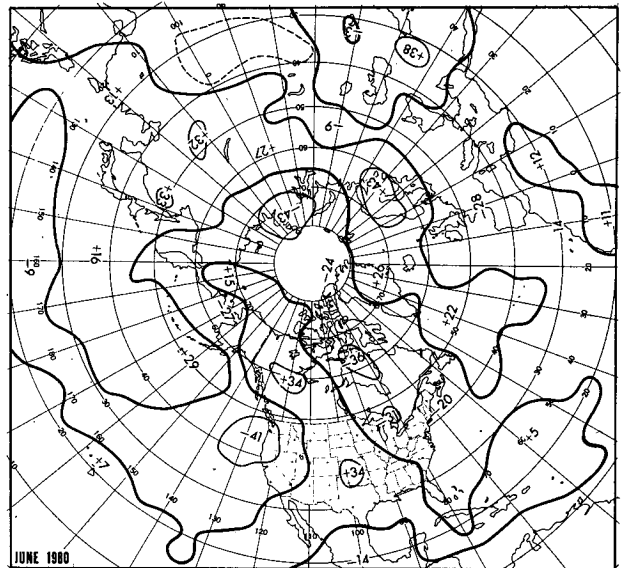


FIG. 3. Departure from normal of mean 1000-700 mb thickness (m) for June 1980.

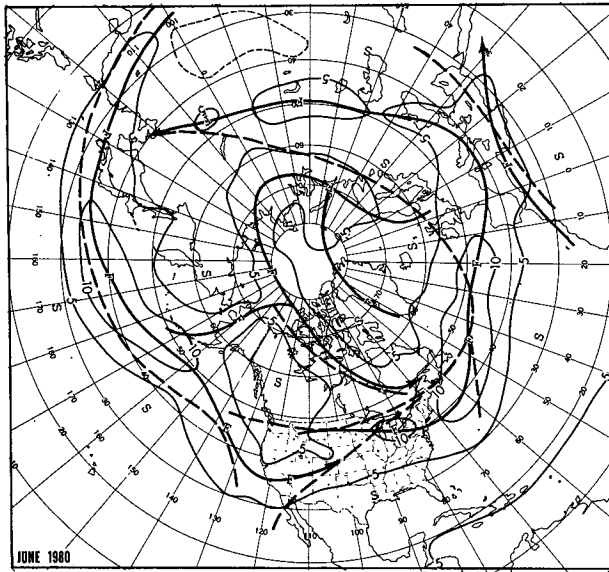


FIG. 4. Mean 700 mb geostrophic wind speed ($m s^{-1}$) for June 1980. Solid arrows indicate observed axes of maximum wind speed and dashed lines, the normal.

precipitation distribution over the United States. Re-institution of a major storm track from the northern and central Great Plains to New England produced greater-than-normal rainfall over much of the area from the Dakotas to New England (Fig. 6), providing some slight relief to a severe drought in progress in the former area. To the south, in the vicinity of the building upper level ridge, generally dry weather replaced the previous wet regime. In conjunction with the previously discussed hot spell, this produced crop moisture shortages over Texas and parts of Kansas and Missouri by the end of the month.

It was also quite dry at scattered locations about the country (Table 2). These included Norfolk and Lynchburg, VA, located between two storm tracks,

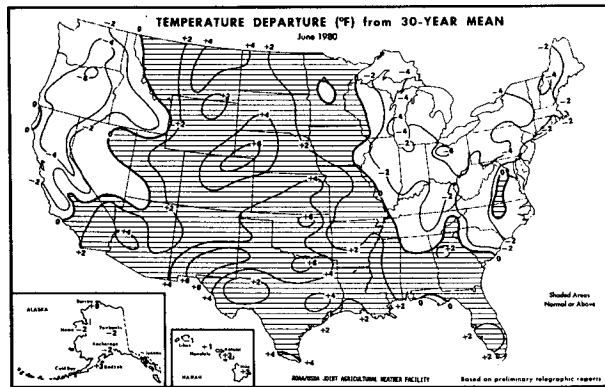


FIG. 5. Departure from normal of average surface air temperature ($^{\circ}F$) for June 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1980).

TABLE 1. Record temperatures observed in June 1980.

Station	Date	Temperature ($^{\circ}F$)	Remarks
Wichita Falls, TX	24	112	Highest for month
	25	114	Highest for month; equaled all-time high
	27	116	Highest for month; highest all-time
	28	117	Highest for month; highest all-time
Dallas, TX	25	109	Highest for month
	26	113	Highest all time
	27	113	Equaled highest all time
Waco, TX	25	109	Equaled highest all time
Wichita, KS	26	109	Highest for month
	27	109	Equaled highest for month
	30	110	Highest for month
Pueblo, CO	26	106	Highest for month
Albuquerque, NM	2	40	Lowest for month
	29	105	Equaled all time high
Duluth, MN	25	93	Equaled highest for month
Astoria, WA	4	37	Lowest for month; lowest for so late
Burns, OR	3	23	Lowest for month
Sault S. Marie, MI	10	28	Equaled lowest for month
Lansing, MI	10	35	Lowest for so late
	11	35	Equaled lowest for so late
Binghamton, NY	9	33	Lowest for month

where record low precipitation for June was recorded.

In western portions of the contiguous United States, retrogression of the west coast trough was accompanied by a westward shift and diminution

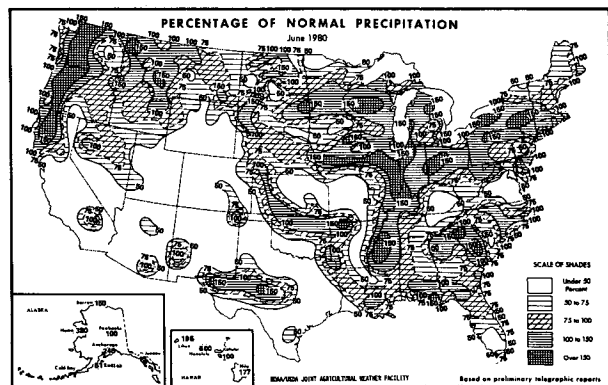


FIG. 6. Percentage of normal precipitation for June 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1980).

of the area of relatively wet weather. To the north, strong southwesterly flow over Alaska produced greater than normal precipitation over most of the state. Southern Alaska, however, was dry under a fairly strong upper level ridge and Annette recorded its driest June of record.

Most of the Hawaiian Islands, located south of a strong mean ridge, received greater-than-normal rainfall. This was concentrated near 15 June when an upper low passed over the Islands.

4. Variability within the month

a. 2-8 June

Decline of the previous south-central Canada blocking ridge, which began in late May, was essentially completed by early June (Fig. 7). During this week storm systems moving in the northward displaced westerlies spread substantial rainfall and widespread severe storms from the eastern Dakotas across the Midwest to the Appalachian Mountains. This was the second consecutive week of helpful rainfall in the north-central drought area.

Although temperatures remained above normal at most locations east of the Continental Divide, there was substantial cooling over the northern Great Plains as westerlies returned to that area. It was the coldest week of the month near the western trough where some record low temperatures for the month were observed (Table 1).

b. 9-15 June

The west coast trough weakened and downstream wave features retrograded this week (Fig. 8). This, together with the progression of a highly amplified wave-train at higher latitudes resulted in a phasing of middle- and high-latitude ridge components over central North America and trough components near the East Coast, producing an extensive and far-southward penetrating outflow of very cold air over the eastern third of the United States. Several locations in the vicinity of the eastern Great Lakes reported record-low June temperatures or lowest

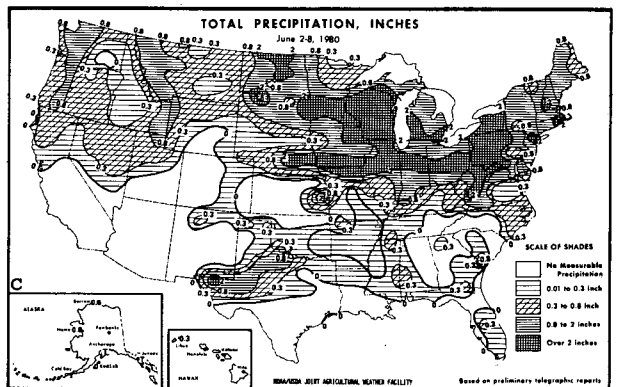
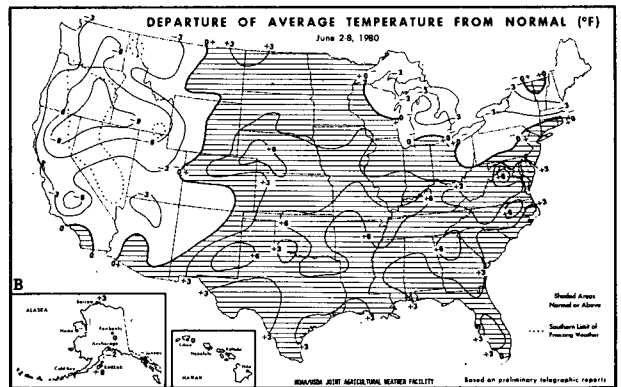
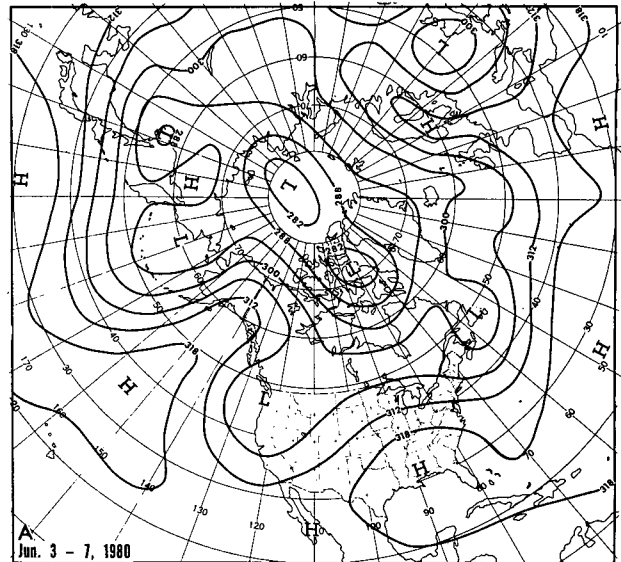


TABLE 2. Record or near-record low monthly precipitation totals observed in June 1980.

Station.	Amount (inches)	Anomaly (inches)	Remarks
Richmond, VA	0.38	-3.14	Driest June
Lynchburg, VA	0.65	-2.78	Driest June
Annette, AK	0.81	-4.24	Driest June
Cheyenne, WY	0.07	-2.34	Tied driest June
Port Arthur, TX	0.76	-4.05	2nd driest June
Topeka, KS	0.56	-5.24	2nd driest June
Casper, WY	0.10	-1.34	3rd driest June
Columbia, MO	0.35	-4.24	3rd driest June
Sioux City, IA	1.21	-3.38	3rd driest June

FIG. 7. (A) Mean 700 mb contours (dam) for 3-7 June 1980; (B) departure from normal of average surface air temperature (°F) and (°C) and total precipitation (inches) for week of 2-8 June 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1980).

temperatures for so late in the season (Table 1). Above normal temperatures persisted over most of the Great Plains and extended over the desert Southwest where maxima exceeding 100°F were

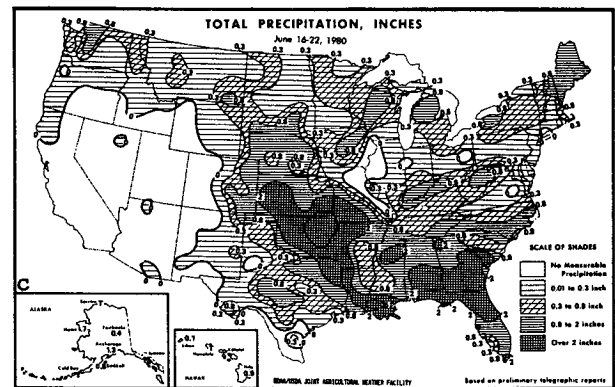
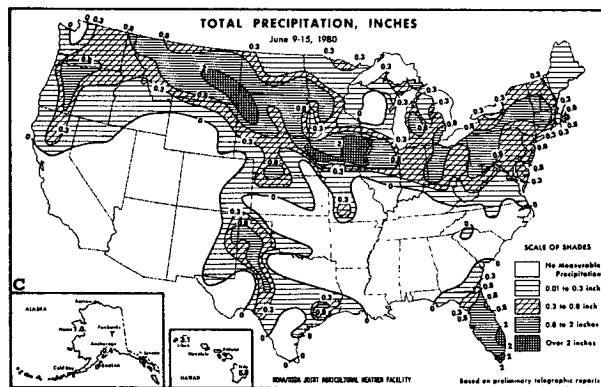
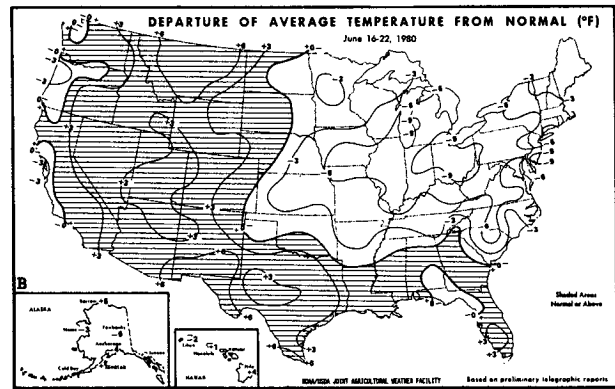
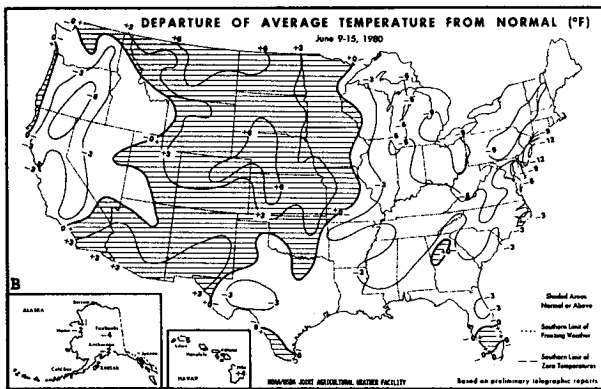
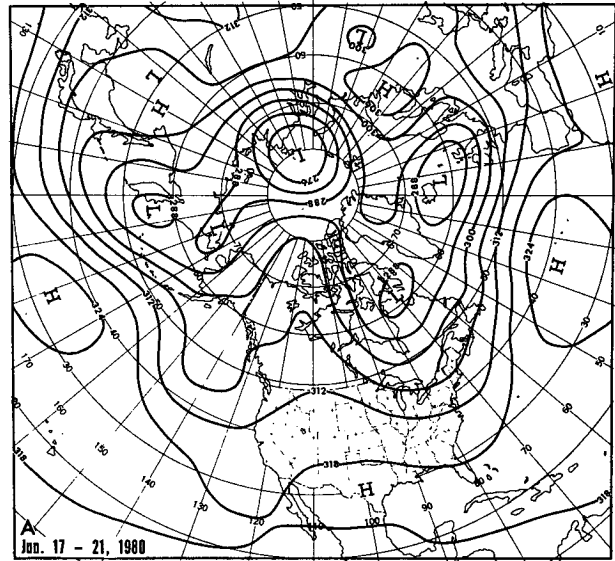
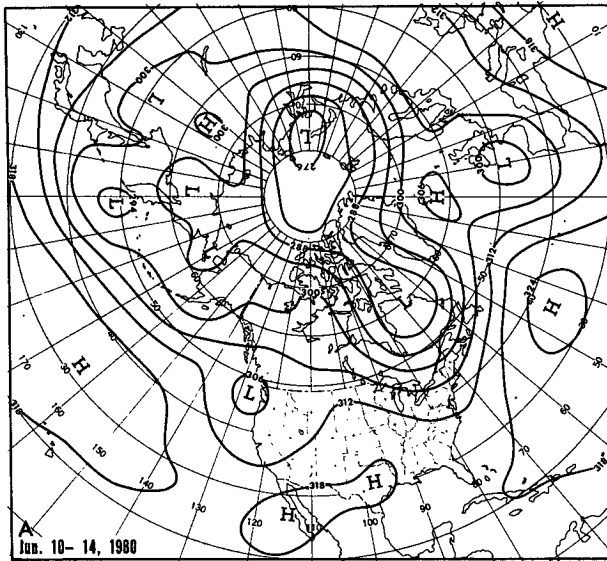


FIG. 8. As in Fig. 7 except for (A) 10-14 June 1980, and (B) and (C) week of 9-15 June 1980.

FIG. 9. As in Fig. 7 except for (A) 17-21 June 1980, and (B) and (C) week of 16-22 June 1980.

common. Elsewhere west of the Divide, the weakening coastal trough was accompanied by a moderation of the cool regime.

Rainfall was concentrated over the northern half of the country as weak storms traversed that area. A portion of the northern drought area again received substantial totals.

c. 16-22 June

The amplified upper level wave pattern over Canada persisted this week while that over the United States retrograded (Fig. 9). This resulted in the continued deployment of very cold air over much of the eastern United States coupled with a general

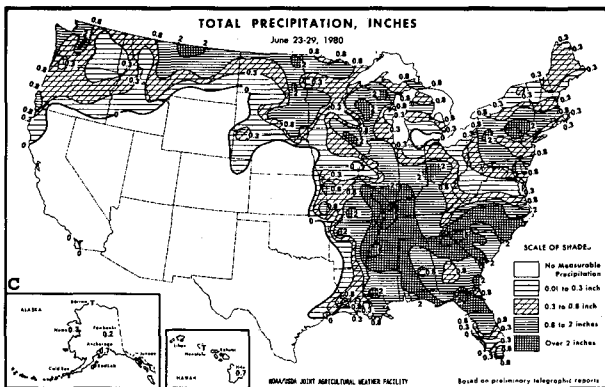
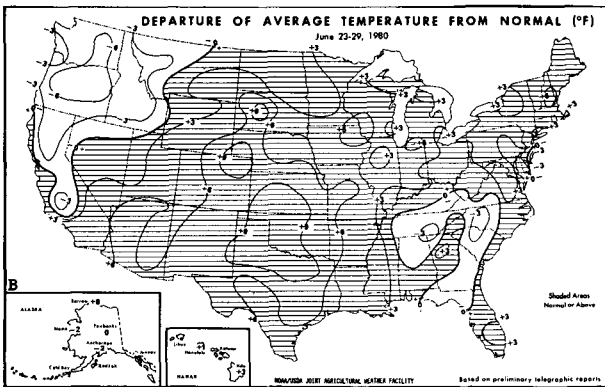
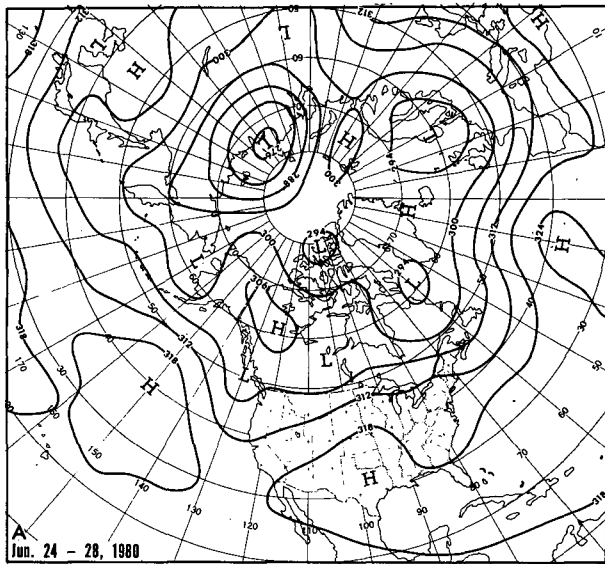


FIG. 10. As in Fig. 7 except for (A) 24–28 June 1980 and (B) and (C) week of 23–29 June 1980.

westward shift of the temperature anomaly pattern. Substantial precipitation amounts were concentrated near the mean frontal zone from the central Great Plains to the south Atlantic Coast.

d. 23–29 June

There was a general flattening and progression of the mean flow pattern over the United States while the ridge over northern Canada retrograded (Fig. 10). With the cessation of cold outflow from Canada above normal temperatures spread to most parts of the United States east of the Continental Divide and below-normal temperatures were largely limited to the Northwest where maritime flow increased.

The strengthening mean ridge over the central and southern Great Plains brought dry conditions and increasing temperatures to that area. Temperatures of 100°F or greater were observed over most of Texas from 23 June through the end of the month. From time to time the affected area expanded to include parts of the central and northern Great Plains. As noted in section 2, record-high temperatures for the month and for all-time were set at a number of locations (Table 1).

Storm systems and associated upper troughs and cold fronts produced substantial rainfall across the northern border states. Greatest amounts, however, were generally found in the Southeast, in connection with the passage of a closed low aloft which moved eastward in the southern fringe of the westerlies.

4. Tropical activity

Three tropical storms, Agatha, Blas and Celia, formed over the tropical east Pacific this month. Of these, Agatha and Celia were briefly of hurricane intensity. In the western Pacific, tropical storm Herbert formed over the South China Sea on 24 June and moved northwestward near Hainan prior to dissipating on 28 June as it moved inland.

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