WEATHER AND CIRCULATION OF JUNE 1979— Record Cold in the Southeast

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1. Mean circulation

The mean 700 mb circulation over the Pacific Ocean for June 1979 (Figs. 1 and 2) was significantly different from the pattern of May (Dickson, 1979). The primary Pacific trough was positioned along the east coast of Asia as opposed to its May location over the central Pacific. Cyclogenesis associated with the contrast between cool air from eastern Siberia and warm air across Japan (Fig. 3) provided baroclinic support for the trough. Midlatitude westerly flow slowed and shifted poleward across the ocean from May to June to a position well north of normal (Fig. 4) in response to expanded subtropical ridges. The prominent ridge southward from the Aleutian Islands essentially replaced the strong central Pacific trough of May.

Lows near the Pole and over Baffin Island gave strength to a broad mean trough that dominated the circulation across much of Canada. This trough and the stronger than normal wind flow associated with it generally replaced the blocking and weak flow pattern of May. A remnant of the May block contributed to a ridge over Alaska.

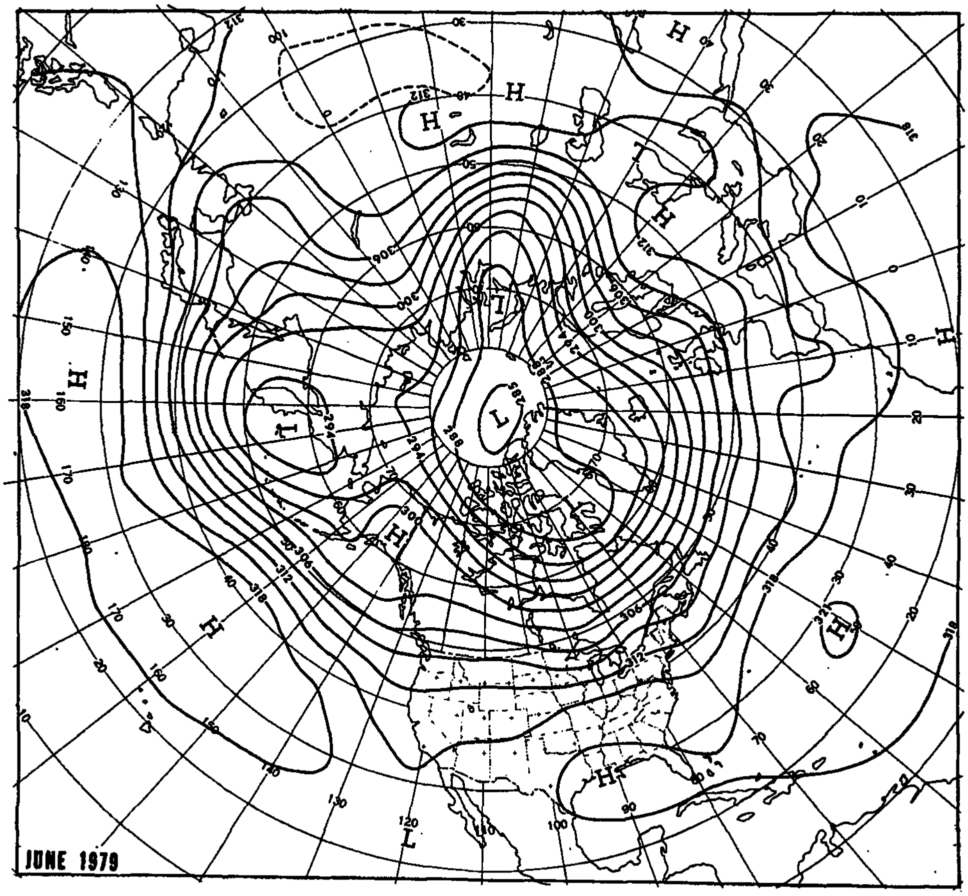

FIG. 1. Mean 700 mb contours (dam) for June 1979.

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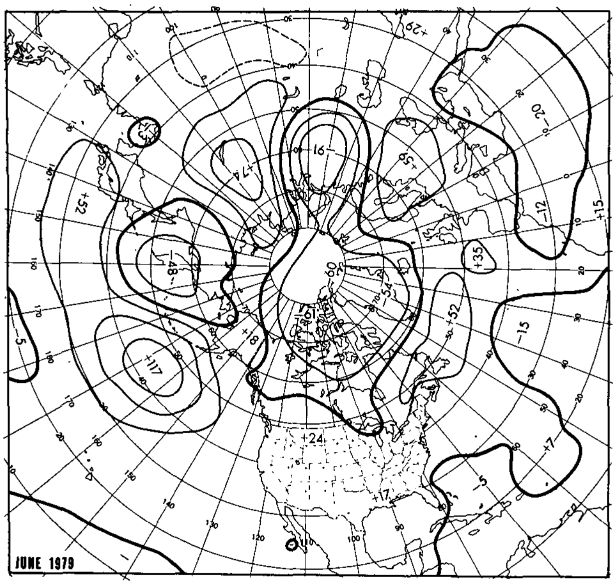

FIG. 2. Departure from normal of mean 700 mb heights (m) for June 1979.

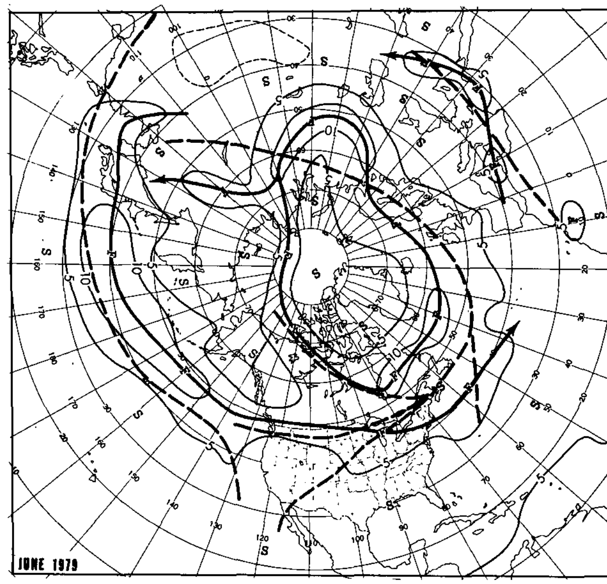

FIG. 4. Mean 700 mb geostrophic wind speed (m s^{-1}) for June 1979. Solid arrows indicate observed axes of maximum wind speed and dashed lines, the normal.

The flow across the United States was rather flat and wavelengths were generally short, especially over the North. The eastern Canadian trough dipped southward over the Great Lakes and relatively weak troughs were situated along the East and West Coasts. Stronger than normal ridges prevailed over the Rocky Mountains, the southern half of the Mississippi Valley and the Northeast.

Mean ridges were more prominent than usual at midlatitudes across the Atlantic Ocean, particularly near 50°N. A maximum wind speed axis over the North Atlantic Ocean occurred along a zone of thermal contrast between cool air associated with the polar trough and warm air to the south. Across the South Atlantic, troughs east of Florida and along 35 and 10°W interrupted the east-west extension of subtropical ridges.

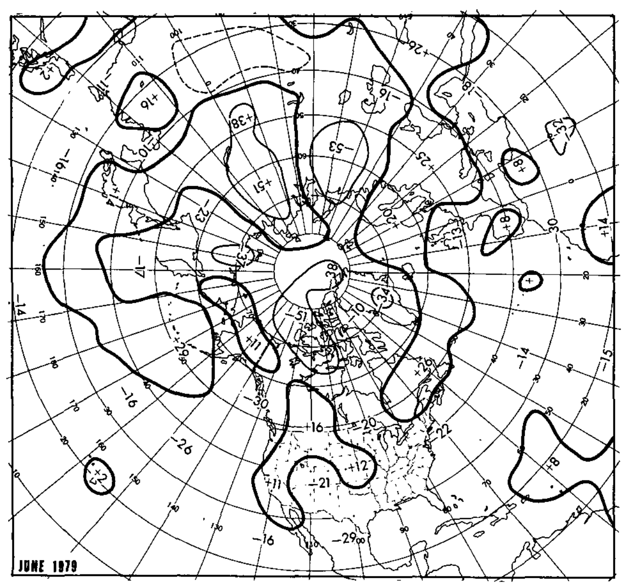

FIG. 3. Departure from normal of mean 1000–700 mb thickness (m) for June 1979.

Little remained of the active trough that existed north of Great Britain in May. Excessively long wavelengths associated with the loss of this trough induced retrogression of the downstream wave train. A strong May ridge weakened somewhat as it moved westward to Scandinavia and central Europe. Downstream, a cold trough intensified as it retrograded to the vicinity of the Ural Mountains, while a strongly amplified warm ridge became entrenched over central Asia.

2. Temperature

The broad 700 mb ridge over the Rocky Mountains together with strong westerly flow near the northern border contributed to higher than normal temperatures across the northern half of the country westward from the Mississippi River (Fig. 5). This warmth extended into part of the Southwest where the 700 mb flow was southwesterly. Several strong and persistent cold air outbreaks during June led to lower than normal temperatures across much of the remainder of the country despite monthly mean 700 mb ridges over the Mississippi River Valley and the Northeast. The availability of extremely cold air over northern Canada during June (Fig. 3) contributed to the unusual extent and

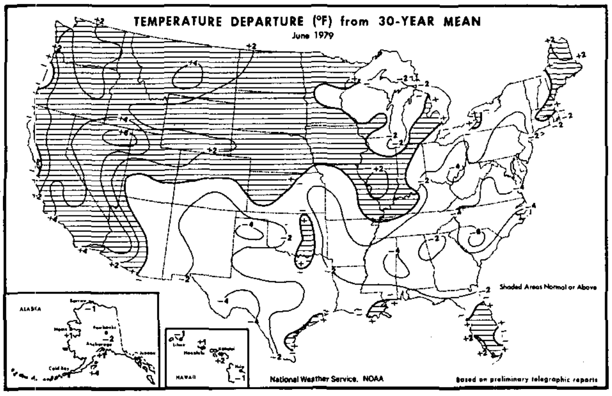

FIG. 5. Departure from normal of average surface air temperature (°F) for June 1979 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1979).

strength of the negative temperature anomalies. In the Southeast, Raleigh, NC and Columbia, SC both experienced their coldest June on record with mean temperatures of 69.8 and 73.0°F, respectively.

Alaskan temperatures tended to be higher than normal beneath southerly flow to the west of a ridge but were generally lower than normal elsewhere across the state. Readily available data at four stations in Hawaii indicated that the temperature anomalies may have been influenced by the observed precipitation (Fig. 6) as well as by the subtropical ridge to the north of the islands. Temperatures averaged higher than normal at the two drier stations but were below normal at the stations which had heavier than normal precipitation.

3. Precipitation

The mean 700 mb ridge over the West contributed to a significantly drier than normal June across most of the region upstream from the axis of the ridge (Fig. 6). Subnormal precipitation over Montana brought the second driest June on record to Glasgow, which received only 0.48 inch of precipitation, and the fourth driest to Missoula where precipitation totaled 0.67 inch. Elsewhere, a subtropical high and northwesterly flow were coupled with less than normal precipitation along the Gulf Coast. Significantly lighter than normal precipitation also was observed beneath ridges in the middle Mississippi Valley and in the Northeast. Concord, NH received only 0.64 inch of precipitation during the station's third driest June and Worcester, MA had only 0.79 inch for the driest June since 1912.

Heavier than normal precipitation was observed eastward and north-eastward from a trough over the southern Rocky Mountains. Much of this precipitation occurred during periods when the trough deepened as short wave troughs moved across the north and phased with the monthly mean trough. Above normal precipitation also occurred in the vicinity of the trough over the Great Lakes and from the Ohio Valley into the middle Atlantic states.

Storminess emanating from the western Pacific trough gave heavier than usual precipitation to virtually all of Alaska. Easterly flow to the south of a subtropical ridge led to above normal precipitation at two Hawaiian stations situated on windward sides of the islands. Precipitation at the two non-windward stations ranged from near to below normal.

4. Weekly variability

a. 4–10 June

A mean 700 mb trough over central North America contributed to lower than normal temperatures across a wide area of the United States from the Rocky Mountains to the Great Plains early in June (Figs. 7A and 7B). Several record-low daily minima were observed in the area during the last half of the week. Upstream, a ridge near the West Coast was linked with higher than normal temperatures westward from the Rocky Mountains. The ridge moved inland at the end of the week and daily maxima reached or exceeded 100°F at many stations in California on the 10th. Southwesterly flow and a ridge over the East Coast supported higher than normal temperatures across most of the country eastward from the Great Plains.

Precipitation was widespread across the country eastward from the vicinity of the trough (Fig. 7C). Heaviest precipitation occurred in the central and southern Great Plains where short wave cyclonic activity and moisture were shunted northeastward around the eastern ridge. The ridge curtailed precipitation along the Atlantic Seaboard and the Gulf Coast. Northerly flow in advance of the ridge near the West coast inhibited precipitation development upstream from the Rocky Mountains.

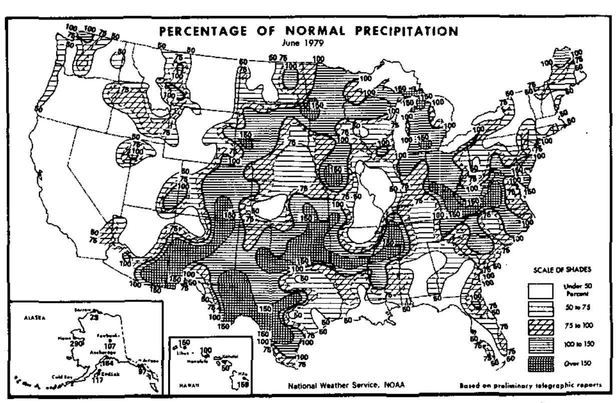

FIG. 6. Percentage of normal precipitation for June 1979 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1979).

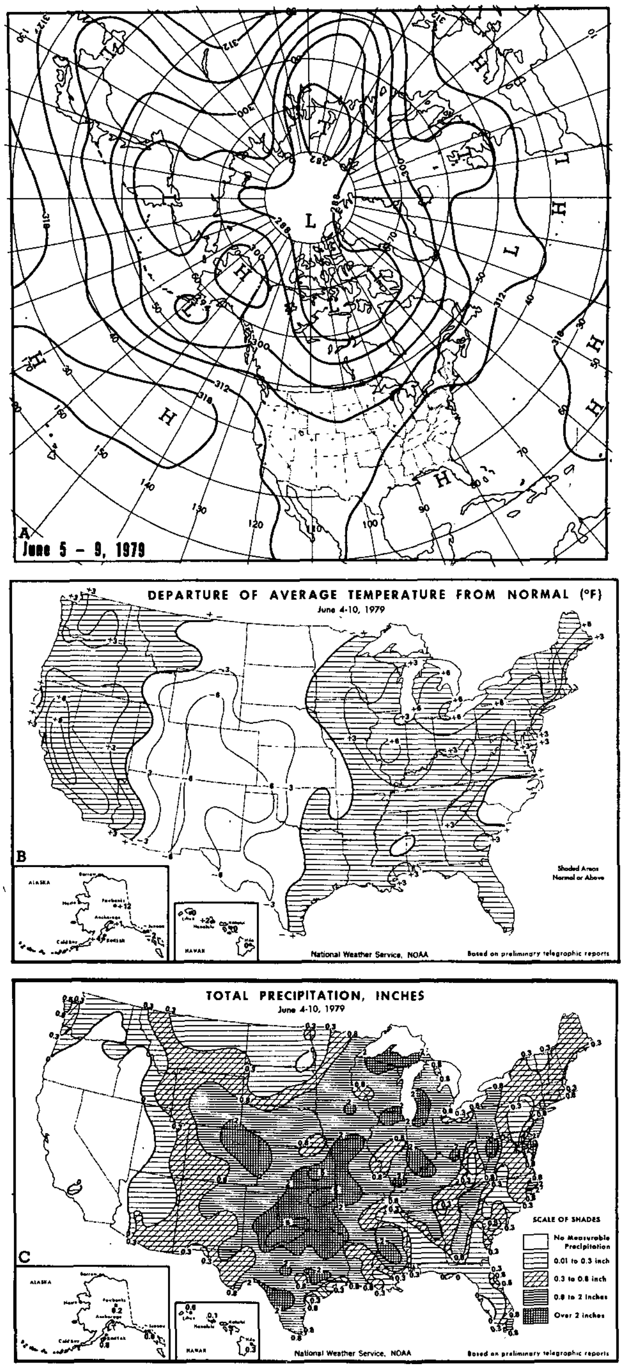

FIG. 7. (A) Mean 700 mb contours (dam) for 5–9 June 1979; (B) departure from normal of average surface air temperature (°F); and (C) total precipitation (inches) for week of 4–10 June 1979 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1979).

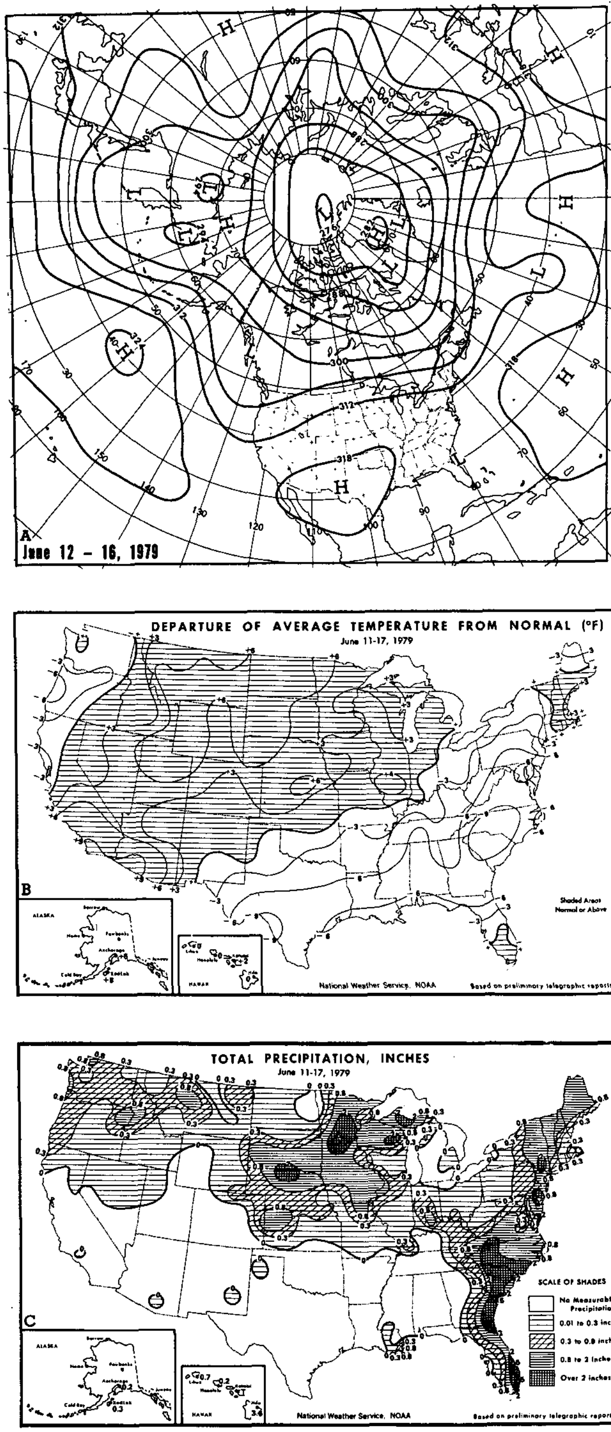

FIG. 8. As in Fig. 7 except (A) 12–16 June 1979 and (B) and (C) week of 11–17 June 1979.

b. 11–17 June

A blocking high dropped southward from Alaska and became part of an amplified ridge along 160°W (Fig. 8A). Downstream, the wave phase reversed over the United States as progression of the pre-existing wave train brought troughs to the vicinity of the East and West Coasts and a broad ridge to the Great Plains.

Temperatures dropped to below normal northward from San Francisco as a trough approached the West Coast. Meanwhile, warm air associated with a ridge spread higher than normal temperatures across the West and eastward to the Great Lakes. Record high daily maxima occurred beneath the ridge on 14 June when temperatures reached as high as 106°F in the eastern Great Plains and upper Mississippi Valley.

Temperatures averaged considerably lower than normal across extensive parts of the East and South in response to the trough near the East Coast and to enhanced northerly flow in advance of the Great Plains ridge. Nighttime radiative cooling of dry air also contributed to coolness across the South. Record-equaling low minimum temperatures for June occurred at Binghamton, NY (35°F) and at Lake Charles, LA (58°F) on the 12th.

Short wave cyclonic activity from the West Coast trough produced varying amounts of precipitation across the North (Fig. 8C). In addition, a tropical low associated with the upper level low near Jacksonville generated rather heavy precipitation along the East Coast. Most of the remainder of the country was dry in response to the well-developed subtropical high centered over southwestern Texas.

c. 18–24 June

The mean flow flattened and weakened across the eastern Pacific Ocean and into the western United States (Fig. 9A). As the downstream ridge moved eastward, a trough became established from Minnesota to the southern Rocky Mountains. A low near Nova Scotia sharpened the trough off the East Coast.

Cool air was reintroduced into much of the area to the rear of the trough that stretched across the Rocky Mountains (Fig. 9B). A southward shift of the westerlies led to lower than normal temperatures in the western Great Lakes. Cool air persisted along the Eastern Seaboard under northerly flow to the east of a ridge. Temperature departures rose considerably across parts of the South as warm air accompanying a ridge spread across the area.

Storminess associated with the trough over the Great Plains and Rocky Mountains spread precipitation across much of the country downstream from the Continental Divide (Fig. 9C). Some of this precipitation was produced by severe weather, especially during the first half of the week when a vigorous short wave system moved through the mean trough. The system reportedly spawned 35 tornadoes on the 19th and 28 more on the 20th in the region from the Great Plains eastward to the Ohio Valley where cool air displaced warm air. Precipitation decreased in the Pacific Northwest as the offshore trough weakened. Ridges were related to dry weather across much of the Southwest and in part of Texas.

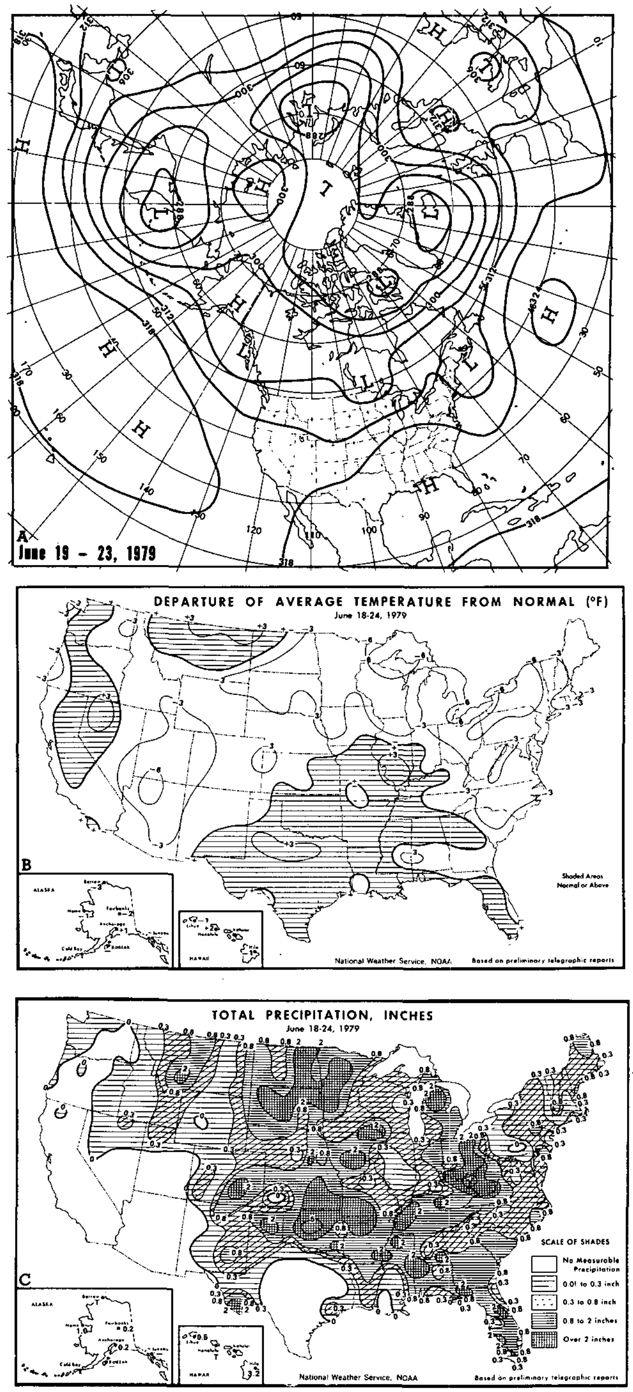

FIG. 9. As in Fig. 7 except (A) 19–23 June 1979 and (B) and (C) week of 18–24 June 1979.

d. 25 June–1 July

The mean 700 mb flow amplified across North America late in June in conjunction with a deepening trough over the eastern Pacific Ocean (Fig. 10A). While a well-developed ridge brought higher than normal temperatures to the western half of the

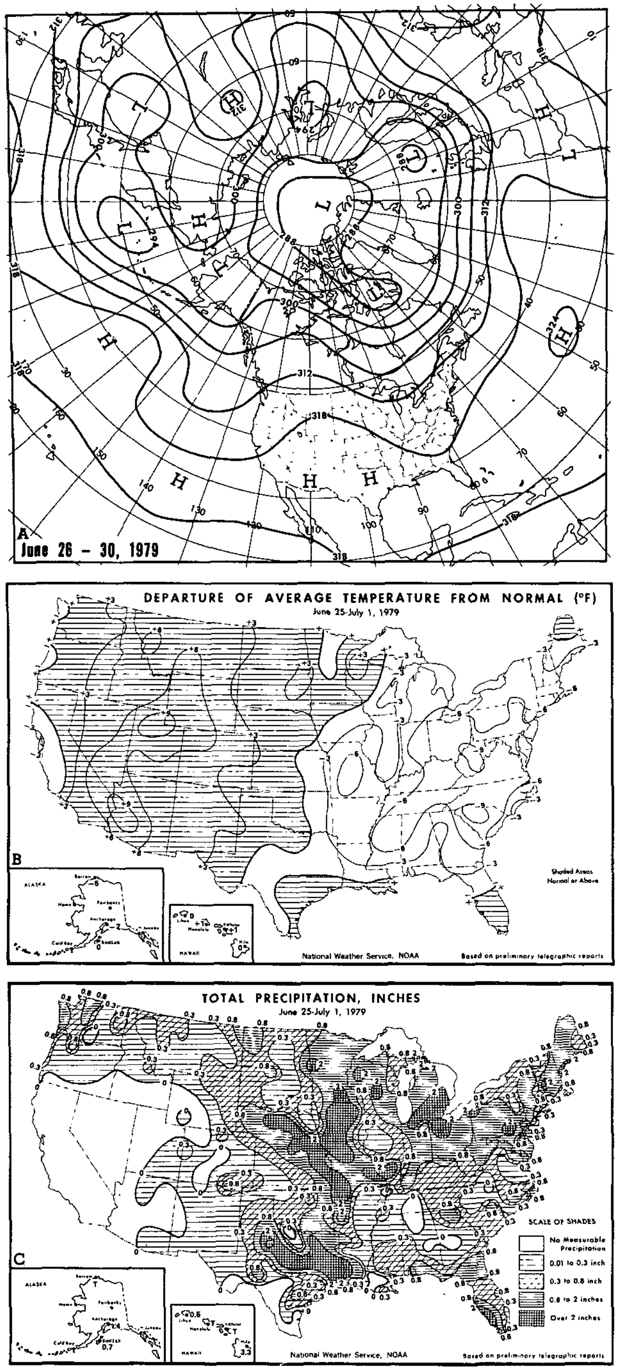

FIG. 10. As in Fig. 7 except (A) 26–30 June 1979 and (B) and (C) week of 25 June–1 July 1979.

country, northwesterly flow downstream from the ridge drove unusually cold air into an eastern trough (Fig. 10B). Many stations experienced record low daily minimum temperatures during 25–29 June as the cold air advanced eastward.

In spite of the change in circulation, the precipitation pattern (Fig. 10C) was not greatly different from that of the previous week (Fig. 9C). Much of the precipitation came from storminess associated with a 700 mb short wave and an accompanying cold front that were over the Great Plains on the 28th when 40 tornadoes were reported in Iowa and Minnesota. Precipitation across the Pacific Northwest occurred late in the month when the eastern Pacific trough moved to the coast but most of the Southwest remained dry.

5. *Tropical activity*

Short-lived tropical storm Ana was the first tropical storm or hurricane to develop over the Atlantic Ocean or adjacent waters in June since 1975. Ana developed on 22 June from a generally westward moving depression near 14°N, 58°W. The storm drifted across the Windward Islands and then weakened into a depression north of Venezuela by the 24th.

Andres became the first hurricane over the tropical eastern Pacific in 1979 on 3 June as it moved northward toward Mexico. The storm reached the Mexican coast near 102°W on the 4th, drifted northwestward and soon dissipated. Tropical storm Blanca's 4-day lifetime commenced on 22 June when the storm was positioned near 10°N, 109°W. Blanca followed a west-northwestward track and weakened to a tropical depression near 13°N, 125°W on the 25th.

Tropical storm Ellis was located well east of the Philippine Islands at 0000 GMT 1 July. The storm apparently formed during the last few hours of June.

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National Oceanic and Atmospheric Administration, U.S. Department of Commerce, and Economics, Statistics and Cooperatives Service, U.S. Department of Agriculture, 1979: *Weekly Weather and Crop Bull.*, **66**, Nos. 24–28 (12, 19 and 26 June and 3 and 10 July 1979).