UDC 551.506.1:551.513(73)"1973.07"

WEATHER AND CIRCULATION OF JULY 1973

Cool and Wet in the Middle Third of the Country But Increasing Drought in the Northwest

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1. MEAN CIRCULATION

The middle-latitude 700-mb zonal westerlies remained stronger than normal during July, but both their absolute value and the magnitude of the anomaly decreased in July. This change was due mainly to weakening of both the Aleutian and Icelandic Lows, which had been unusually strong during June (Taubensee 1973).

The subtropical ridge over the Pacific remained stronger than normal, while the Bermuda-Azores ridge amplified to as much as 70 m above normal over the central Atlantic (figs. 1, 2). Over North America, the middle latitude portions of the trough, which in June had extended from the Davis Strait to Texas, advanced to a position near the 70°W meridian (fig. 1). Remains of the lower portion of the trough were reflected in a break between the two subtropical ridges and a weak negative anomaly over west Texas.

At high latitudes, the intense polar vortex progressed 90° of longitude from its location near the Taymyr Peninsula to about 170°W, accompanied by a fall of 88 m in the mean 700-mb height anomaly from June to July north of the Bering Strait (fig. 3). Blocking remained over northwest Canada, although it became less pronounced

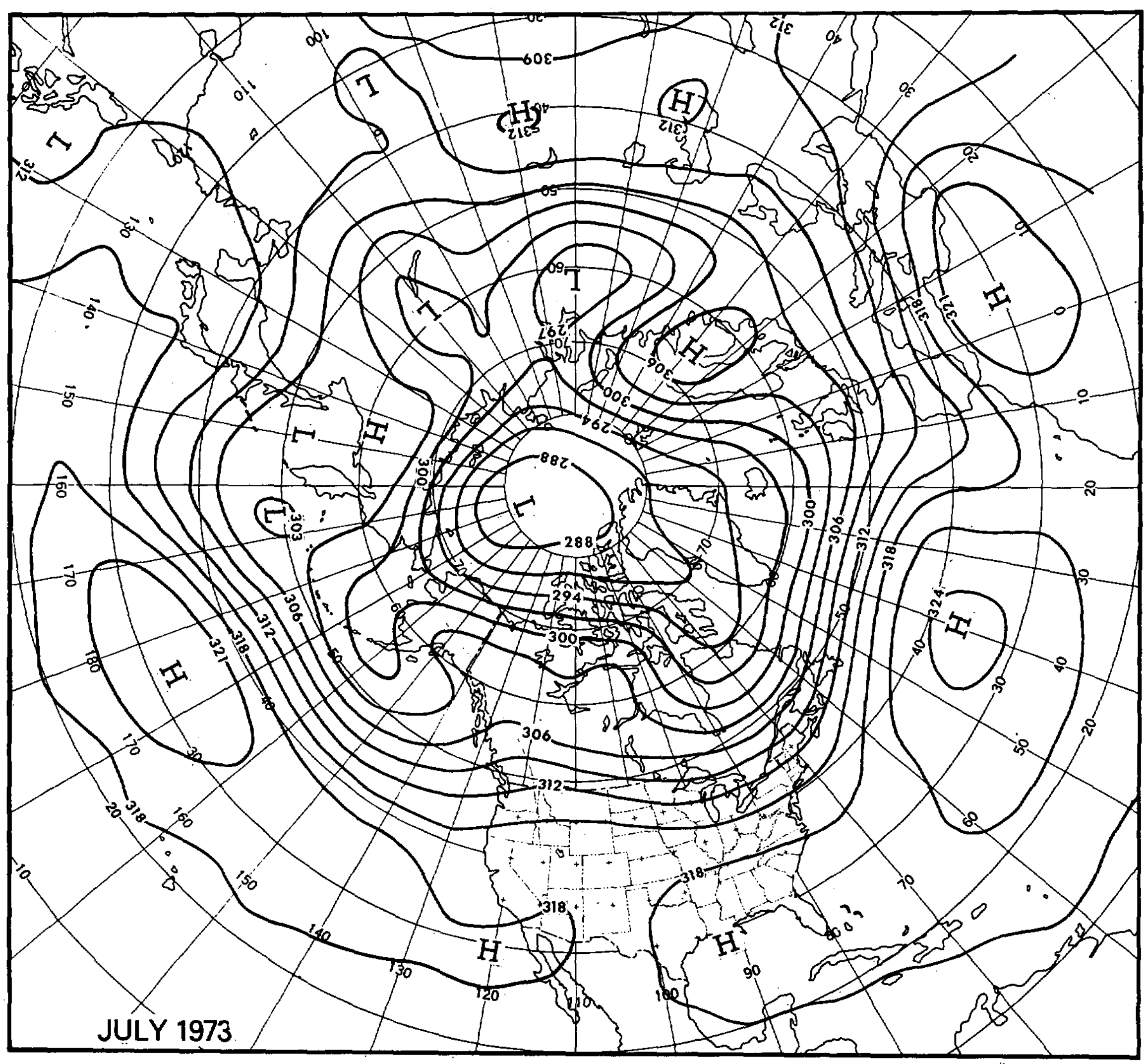

FIGURE 1.—Mean 700-mb height contours in dekameters (dam) for July 1973.

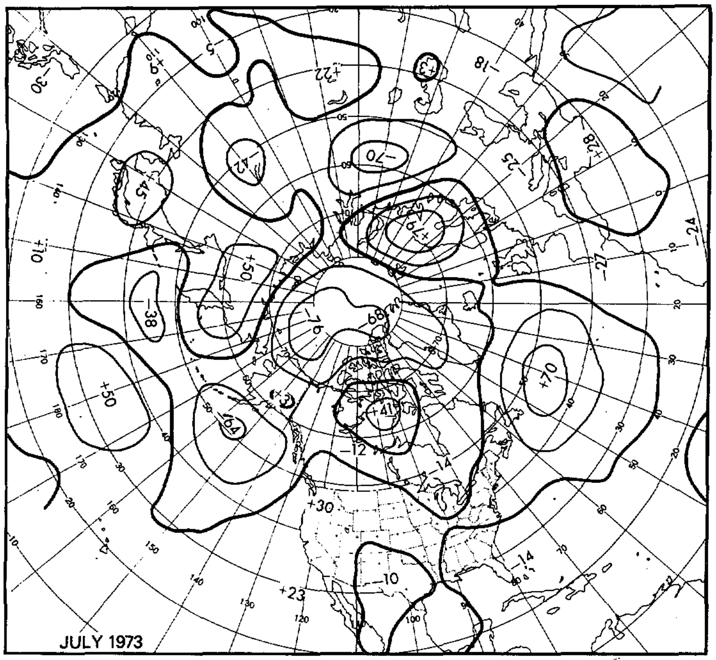

FIGURE 2.—Departure from normal of mean 700-mb height in meters (m) for July 1973.

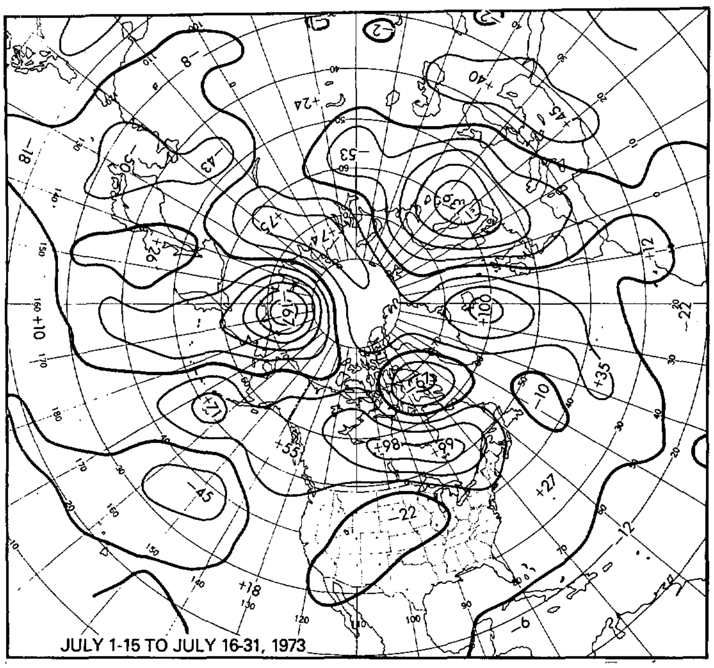

FIGURE 3.—Mean 700-mb height anomaly change (m) from June 1973 to July 1973.

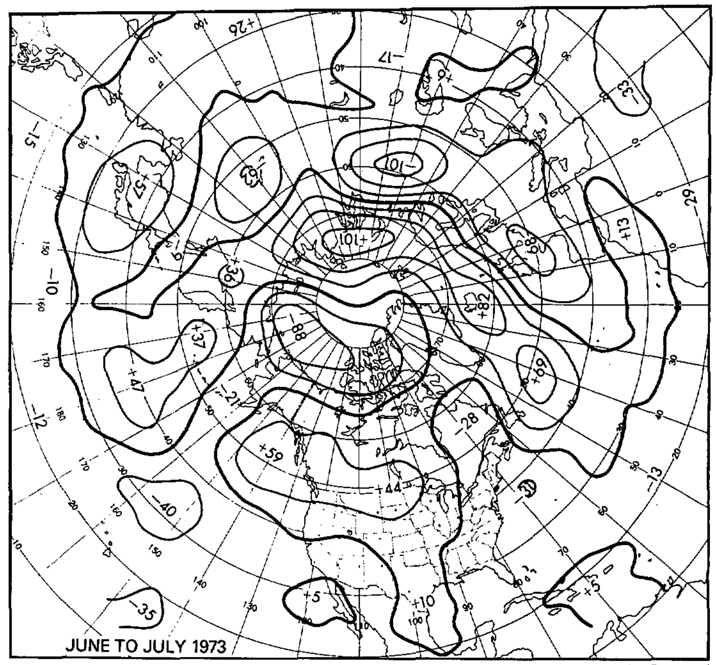

FIGURE 4.—Mean 700-mb height change (m) from July 1–15 to July 16–31, 1973.

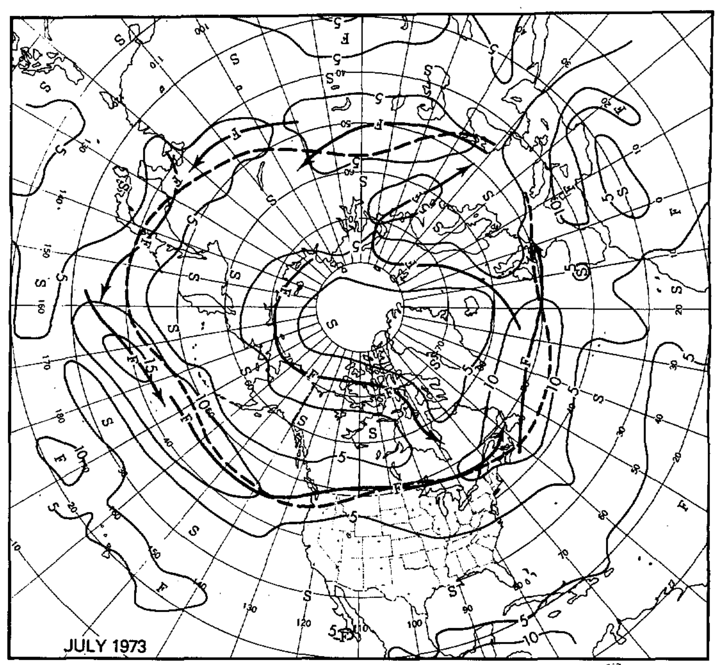

FIGURE 5.—Mean 700-mb geostrophic wind speed (m/s) for July 1973. Solid arrows show the observed axes of maximum wind speed, and dashed lines show the normal.

because of the height falls over the Beaufort Sea and rises over southwest Canada (figs. 1–3).

Another area of blocking, which had been zonally oriented in June across north-central Europe, moved northward and consolidated into a strong blocking High over Scandinavia (figs. 1–3). Under the influence of the fast zonal westerlies (14 m/s, 6 m/s above normal) over the North Atlantic and progession of the upstream trough, the deep trough that had been just west of the British Isles was driven into Europe around the middle of July, where it undercut and weakened the block and established a broad band of westerlies across the continent (figs. 4, 5). The northern branch of the 700-mb wind maximum in the area was mainly characteristic of the first half of the month, while the southern branch reflected mostly the circulation prevalent in the second half of July. The weakening and displacement of the block is shown by mid-month height falls of as much as 139 m.

The other large intramonthly height-fall center of 167 m off the coast of northeastern Siberia was related to continued displacement of the polar vortex toward the

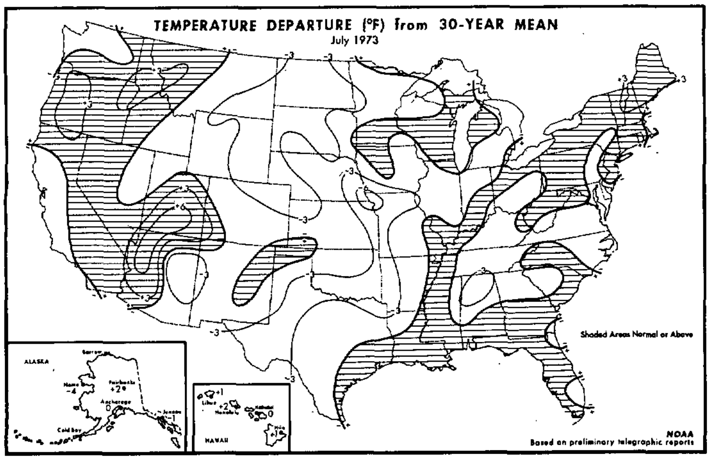

FIGURE 6.—Departure from normal of average surface temperature (°F) for July 1973 (from Environmental Data Service and Statistical Reporting Service 1973).

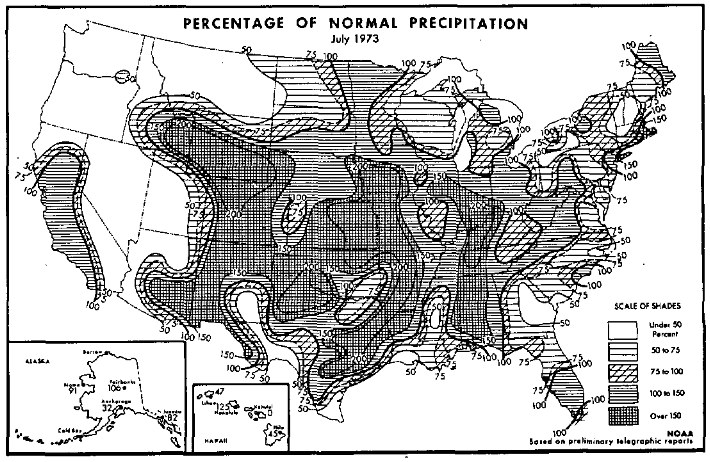

FIGURE 7.—Percentage of normal precipitation for July 1973 (from Environmental Data Service and Statistical Reporting Service 1973).

TABLE 1.—*Record temperatures for the month set or equaled during July 1973*

Station	Temperature (°F)	Date	Remarks
Eugene, Oreg.	39	1	Equaled lowest for month
Phoenix, Ariz.	91	4	Equaled all-time high minimum temperature
Flagstaff, Ariz.	97	5	Highest ever recorded
Rapid City, S. Dak.	110	6	Do.
Denver, Colo.	103	6	Highest for month
Pueblo, Colo.	105	6	Equaled all-time high
Missoula, Mont.	105	10	Do.
Great Falls, Mont.	105	10	Highest for month
Medford, Oreg.	–	–	Record 13 days with maximum temperature 100 or higher
Tucson, Ariz.	63	22	Equaled lowest for month

TABLE 2.—*Record and near-record monthly and seasonal precipitation totals observed during July 1973*

Station	Amount (in.)	Anomaly (in.)	Remarks
Helena, Mont.	0.08	−0.95	Driest July
	4.30	−2.95	Driest Jan.–July
Billings, Mont.	1.10	–	Equaled driest Jan.–July
Kalispell, Mont.	0.05	−0.99	4th driest July
	4.74	−4.55	2d driest Jan.–July: driest since 1931
Missoula, Mont.	0.09	−0.76	4th driest July
	3.37	−4.75	Driest Jan.–July
			First July with no thunderstorms
Great Falls, Mont.	0.13	−1.15	4th driest July
Aderbeen, S. Dak.	6.81	−6.23	Driest Jan.–July
Mount Shasta, Calif.	0.75	−5.50	Driest Apr.–July since 1909
Yuma, Ariz.	trace	−0.23	139 consecutive days no measurable rain through July
Cheyenne, Wyo.	5.01	+3.19	2d wettest July
Lander, Wyo.	2.10	+1.33	4th wettest July; wettest since 1937
Topeka, Kans.	10.16	+7.56	4th wettest July
Louisville, Ky	9.38	+5.60	4th wettest July; wettest since 1940
Cincinnati, Ohio	8.47	+4.88	4th wettest July
Nashville, Tenn.	7.67	+3.95	Wettest July since 1950

Pacific quadrant as the month progressed. The band of height rises across the northeastern Pacific and southern Canada was associated with a decrease of the middle-latitude wind maximum and gradual weakening of the Aleutian Low (figs. 4, 5). At the same time, the high-latitude wind maximum along the North American Arctic coast strengthened because of the combined effects of displacement of the polar Low toward that sector and the normal rapid seasonal heating of the high-latitude continental areas after the snow had melted.

2. TEMPERATURE

Monthly mean surface temperatures for July were predominantly lower than normal over the middle third of the United States, with the strongest positive anomalies located over the southern Great Basin, the Northern Rocky Mountains, and northern New England (fig. 6). Although the previous month's pattern had been classified as warm in the north and cool in the south (Taubensee 1973), there was relatively high persistence from June to July, with 42 out of 100 stations remaining within the same anomaly category and only 14 stations changing by more than one out of the five temperature anomaly classes used by the Long Range Prediction Group.

The temperature anomaly pattern was not especially well correlated with the height anomaly pattern (fig. 2) because of a variety of weekly regimes to be discussed later. Nevertheless, the strong ridge in the West was persistent, and most of the month was hot in that area. No monthly mean temperature records were established, but Medford, Oreg., did have a record 13 days with maximum temperatures of 100°F or higher, and several stations reported record-high July maxima (table 1). Much of the coolness in the middle of the country, where heights averaged near or slightly above normal, was related to heavy precipitation.

3. PRECIPITATION

Precipitation was generally heavy from the Mississippi Valley westward to the Central Rocky Mountains, where several stations reported one of the wettest Julys on record (fig. 7, table 2). Extensive areas of the South received over 8 in. of rain. A small area in the Ohio Valley also experienced near-record precipitation totals during July.

Most of the West remained dry, with some areas having no rain at all. The situation was not bad in the Southern Plateau, which had received above-normal precipitation during most months since last summer. However, drought worsened over large portions of the Northwest and Northern Rocky Mountains and Northern Great Plains. Several stations in Montana had one of the driest Julys and one of the driest January–July periods on record (table 2). Crops and orchards were beginning to be hurt, and ranges were drying up. Fire danger was becoming critical in some areas by the end of the month.

Precipitation averaged slightly on the dry side east of the Appalachian Mountains, with some areas receiving only about half the normal amount. Nevertheless, rather heavy amounts were recorded in portions of the Carolinas and along the New England coast.

4. WEEKLY VARIABILITY

July 2–8

Under the influence of a strong ridge in the Southwest and fast westerly flow across southern Canada (fig. 8A), temperatures averaged above normal over most of the Conterminous United States (fig. 8B). Temperature departures exceeded 9°F in parts of Arizona, where both minimum and maximum values were unusually high. A large mass of hot, continental air moved from that area across the Rocky Mountains to the Northern and Central Great Plains during the week, giving several all-time and July record high temperatures (table 1) as well as daily record maxima too numerous to list.

Warm weather, averaging more than 6°F above normal, also prevailed in parts of the Great Lakes area and New England. Even though a shallow trough extended southward from a Low over Hudson Bay, the absence of a strong 700-mb ridge over western Canada prevented much cool air from entering the United States.

Much of the coolness in the South was due to extensive cloud cover accompanying heavy precipitation (fig. 8C). Heavy rains and much severe weather occurred in eastern Nebraska and Iowa, where hurricane-force squalls, hail, and rainfall totals in excess of 3 in. were reported.

Most of the western third of the Nation was rainless, although the fast westerlies near the northern border brought cool maritime air into the Pacific Northwest and produced a little rain in the coastal areas.

Alice, the first Atlantic hurricane of the season, passed a short distance west of Bermuda on her way north to landfall in Nova Scotia and Newfoundland, where she weakened rapidly because of the cold water.

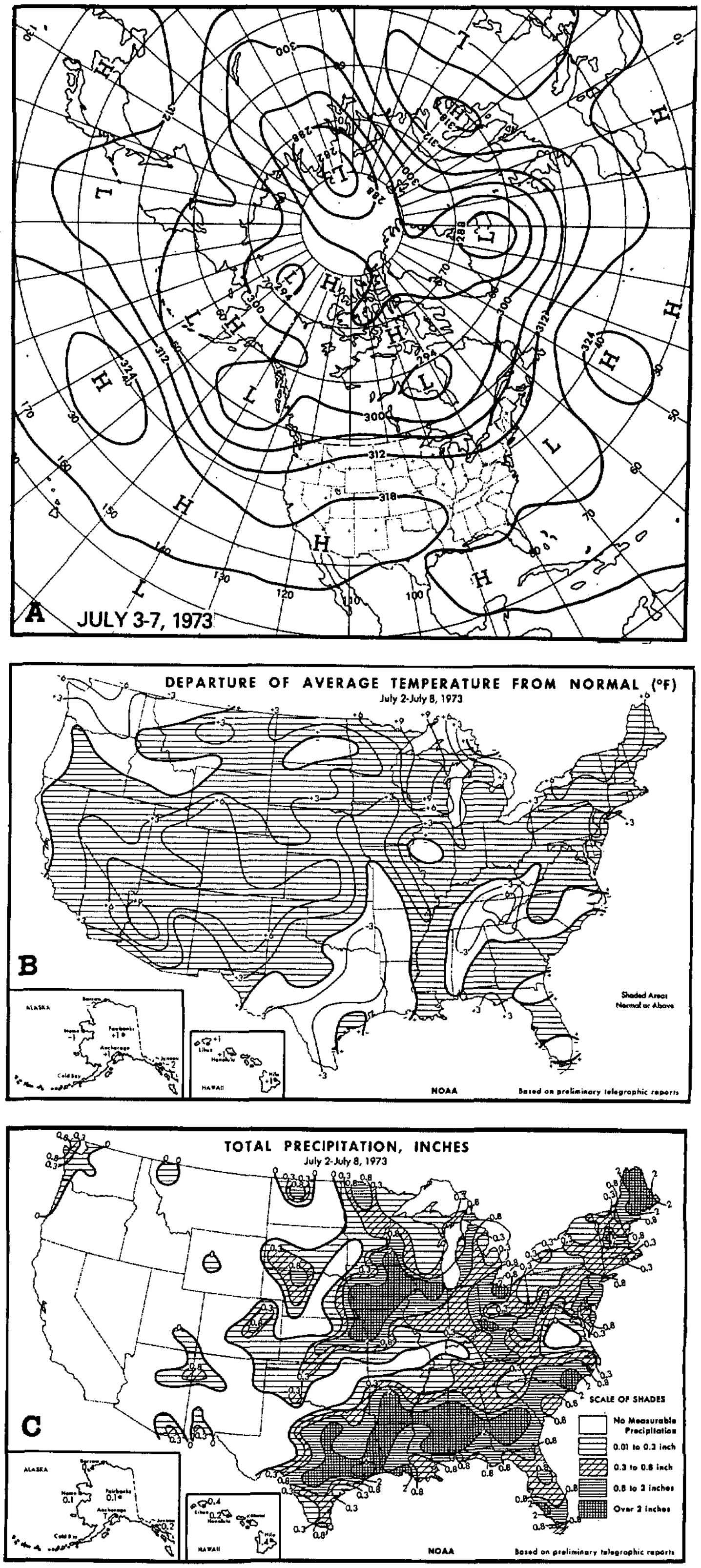

FIGURE 8.—(A) mean 700-mb contours (dam) for July 3–7, 1973; (B) departure from normal of average surface temperature (°F) and (C) total precipitation (in.) for week of July 2–8, 1973 (from Environmental Data Service and Statistical Reporting Service 1973).

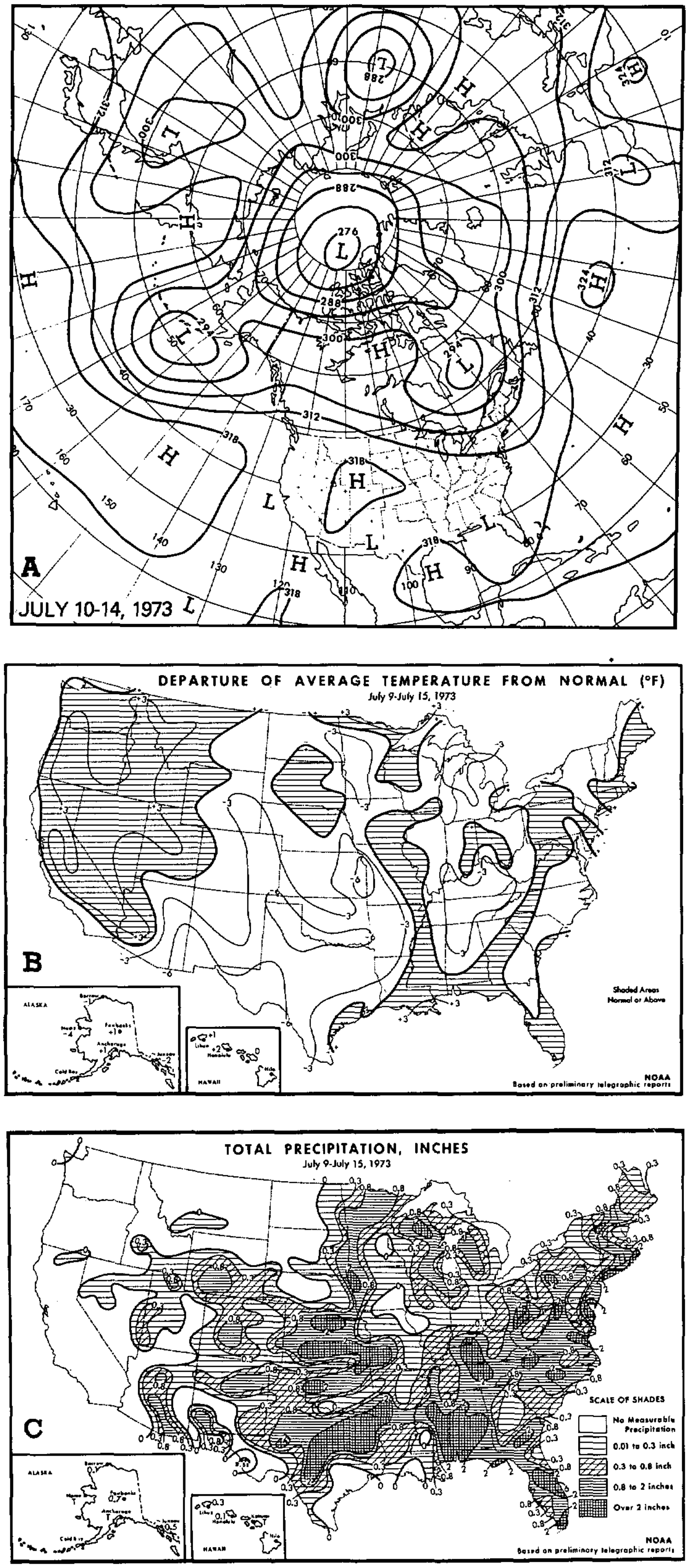

FIGURE 9.—Same as figure 8, (A) for July 10–14, 1973; (B) and (C) for week of July 9–15, 1973.

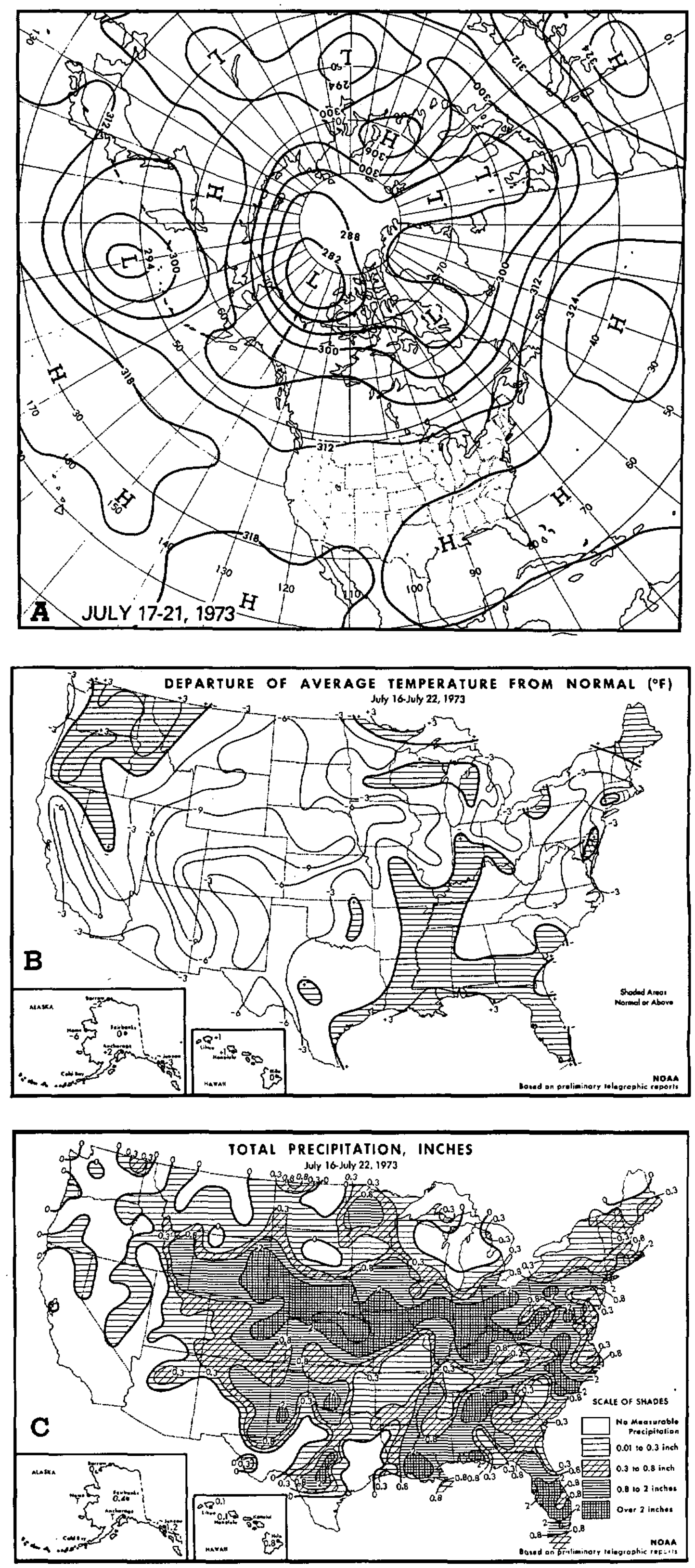

FIGURE 10.—Same as figure 8, (A) for July 17–21, 1973; (B) and (C) for week of July 16–22, 1973.

July 9–15

Circulation changes over eastern Asia and the Pacific resulted in retrogression of the trough that had been in the Gulf of Alaska to the Aleutian area (figs. 8A, 9A). As a result, 700-mb heights rose over the northwestern quarter of the United States and fell over the Northeast as the downstream trough amplified slightly and moved from the Great Lakes area to New England.

Temperatures averaged above normal over the western third, near normal over the eastern third, and below normal over the middle third of the country (fig. 9B). The anomaly pattern was quite similar to the monthly

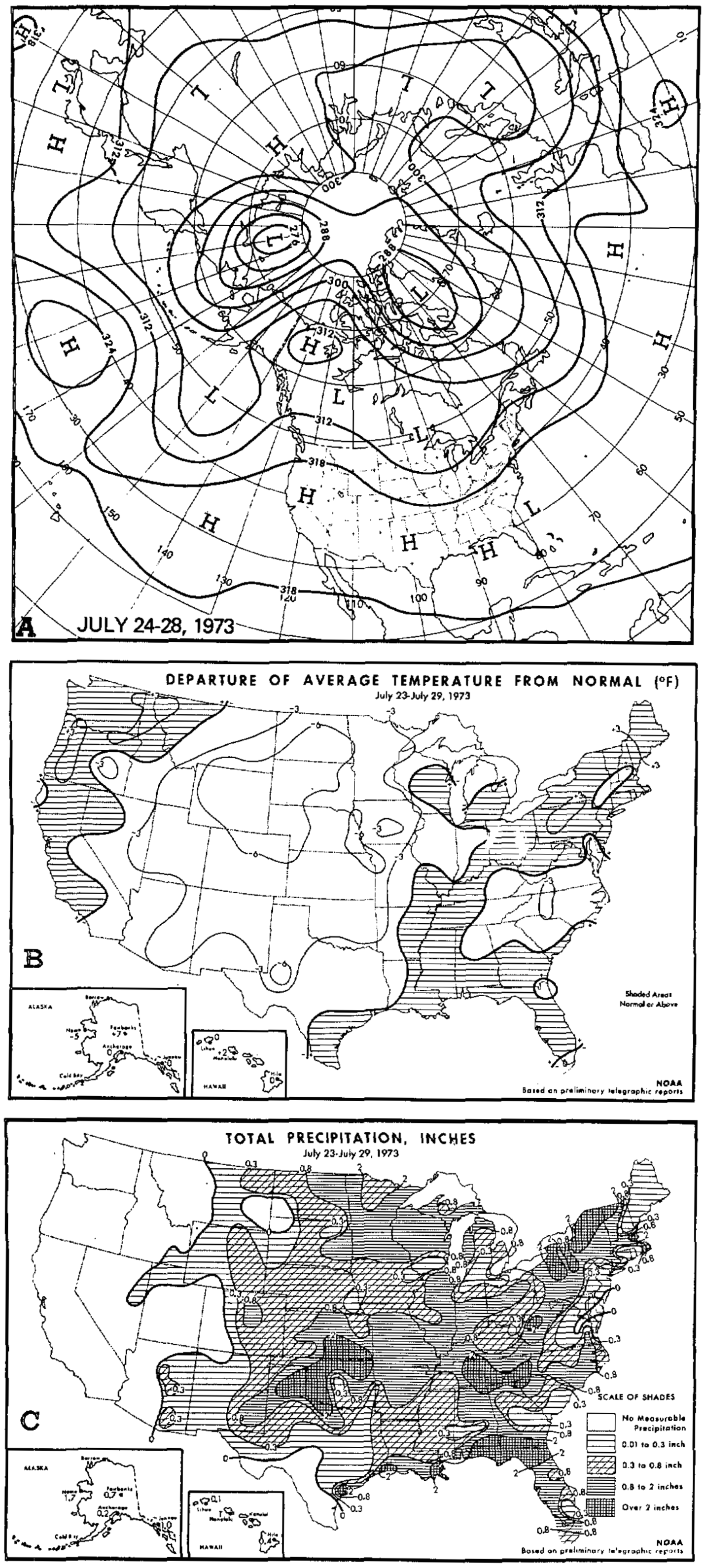

FIGURE 11.—Same as figure 8, (A) for July 24–28, 1973; (B) and (C) for week of July 23–29, 1973.

mean (fig. 6). Much of the coolness was again related to precipitation (fig. 9C), which was heavy in spots and accompanied by severe weather in the central part of the country.

Under the influence of ridging aloft, above-normal temperatures pushed all the way to the northern Pacific coast, and the rains ceased in the Pacific Northwest. Another heat wave moved eastward, this time across the Northern Rocky Mountains where Missoula and Great Falls, Mont., had record-high temperatures (table 1).

A front preceding a cool High moving from the Great Lakes to the mid-Atlantic States set off severe thunderstorms in the western suburbs of the Nation's Capital, where Annandale, Va., received about 4 in. of rain within 1 hr. Temperatures in the High fell to record lows for the date at several localities in Ohio and Pennsylvania, but rapid warming followed.

July 16–22

The 700-mb circulation was weak and flat across most of the United States and southern Canada (fig. 10A), while the ridge over the South built slightly. As a result, temperatures rose to near normal in that area, and as much as 3°F above normal along the central gulf coast (fig. 10B).

The lowest temperatures relative to normal coincided with a belt of heavy rain that moved along and north of a slowly moving cold front extending from the Central Rocky Mountains to New England (figs. 10B, 10C). Parts of northeastern Kansas received over 6 in. of rain, and this rain system gave the bulk of the month's precipitation to Wyoming and Kansas, where it was one of the wettest Julys on record (table 2). Weekly temperatures averaged more than 6°F below normal over an extensive area centered over the Rocky Mountains (fig. 10B). The coolness was due largely to low daytime temperatures associated with steady rains and persistent cloudiness, a rare occurrence in that part of the country during midsummer.

July 23–29

Amplification of the central Pacific 700-mb ridge and downstream deepening of a trough over the eastern Pacific led to building of a full-latitude ridge over western North America (fig. 11A). As a result, cool Canadian air penetrated as far south as central Texas and produced temperatures averaging more than 6°F below normal for the week over the Northern Plains (fig. 11B). Precipitation was not excessively heavy anywhere for the week as a whole (fig. 11C), while most of the area west of the Continental Divide was rainless.

Although the temperature anomaly patterns of the last 2 weeks of July were similar (figs. 10B, 11B), the coolness of the former week was due to cloudiness and rainfall depressing daytime temperatures, whereas the coolness of the last week of July was due primarily to nocturnal radiation in the dry, clear Canadian air. The coolness of the last half of the month was sufficiently strong and persistent to produce below-normal temperatures for the month as a whole, even at some of the stations that had record maxima early in July.

REFERENCES

Environmental Data Service, NOAA, U.S. Department of Commerce, and Statistical Reporting Service, U.S. Department of Agriculture, *Weekly Weather and Crop Bulletin*, Vol. 60, Nos. 28–31, July 9, 16, 23, and 30, and No. 33, Aug. 13, **1973**.

Taubensee, Robert E., "Weather and Circulation of June 1973—Warm in the North, Cool in the South," *Monthly Weather Review*, Vol. 101, No. 9, Sept. **1973**, pp. 712–717.