

# WEATHER AND CIRCULATION OF AUGUST 1978

## Texas Floods

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### 1. Mean circulation

Relatively fast westerlies near their normal location at midlatitudes were associated with progression of long-wave features over much of the Northern Hemisphere this month (Figs. 1, 2 and 3). This brought mean ridges to the east Atlantic, eastern Asia and the central Pacific, and mean troughs to central Asia, the west Pacific, the east Pacific and eastern Canada.

The previous trough over the northwestern United States (Wagner, 1978) filled as southwest flow pattern developed over that area and formed a confluent pattern with the strong northwesterly flow from central Canada. Both the thermal gradient and the 700 mb winds were strong over south central and southeastern Canada (Figs. 3 and 4). Strong subtropical highs overlay the southeastern and southwestern United States, separated by a mean trough just east of the southern Rocky Mountains.

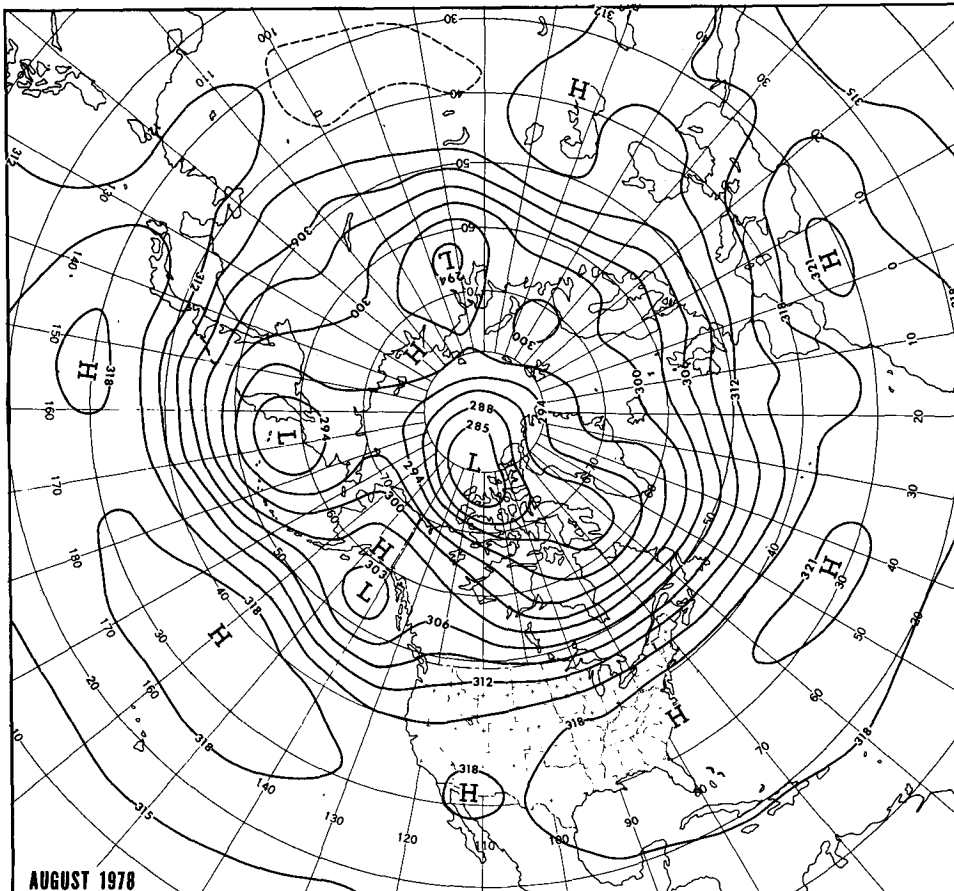


FIG. 1. Mean 700 mb height contours (dam) for August 1978.

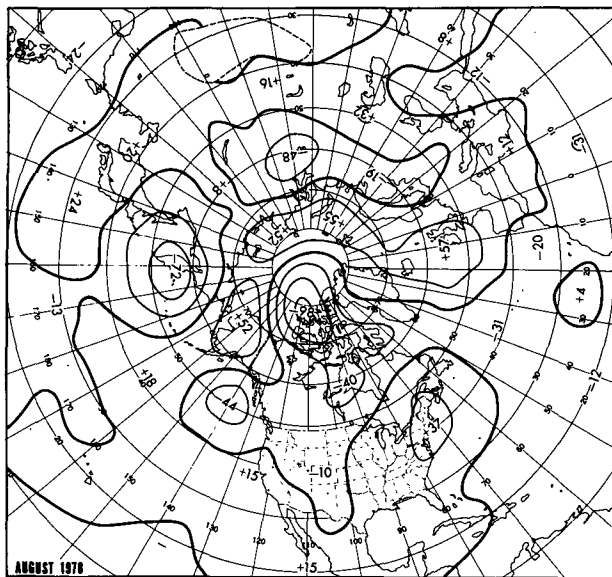


FIG. 2. Departure from normal of mean 700 mb height (m) for August 1978.

At high latitudes, the increasing thermal contrast between the polar cap and peripheral areas was accompanied by a rather remarkable deepening of the polar low. The greatest departure from normal in that area is estimated to be about two times the local standard deviation of August monthly mean 700 mb heights.

Stronger than normal easterly flow over the subtropics (20–35°N) was accompanied by a substantial number of tropical storms over both the Pacific and the Atlantic–Gulf of Mexico.

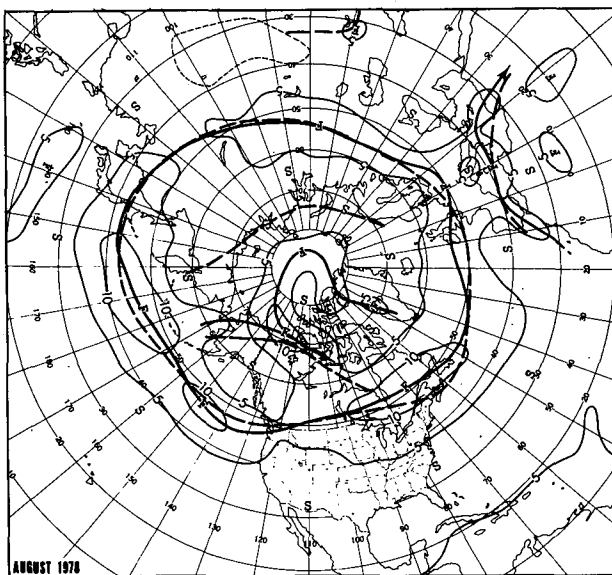


FIG. 3. Mean geostrophic wind speed ( $\text{m s}^{-1}$ ) for August 1978. Solid arrows indicate observed axes of maximum wind speed and dashed lines, the normal.

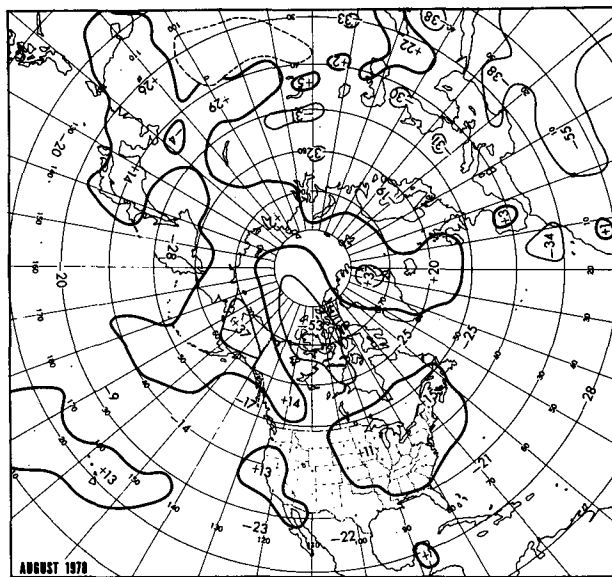


FIG. 4. Departure from normal of mean 1000–700 mb thickness (m) for August 1978.

## 2. Temperatures

Enhanced influx of maritime air together with the tapping of the extensive Canadian cold air supply brought subnormal mean temperatures to much of the northern and central portions of both the Intermountain Region and the Great Plains this month (Fig. 5). Below normal temperatures also were observed with the cloudy, rainy regime near the west Texas trough. Warm weather accompanied the above normal mean heights along the West Coast and the strong ridge over the eastern half of the country. The largest temperature anomalies were found near where the eastern ridge had its greatest strength relative to normal. Both a record high August mean temperature (81.3°F) and an all-time record high mean minimum temperature (73.8°F) were observed at Washington, DC. The latter was 6.2°F above normal. It was the third warmest August of record at Norfolk, VA.

Temperatures averaged above normal over most of Alaska under a strong mean ridge, and near normal at most locations in Hawaii.

## 3. Precipitation

An active storm track near the northern border, coupled with an increased transport of moisture from the Gulf of Mexico, gave above normal precipitation to much of the contiguous United States this month (Fig. 6). A large part of the rainfall in the south came from two tropical storms, one in its dying stages over Texas at the beginning of the month, and the other over the lower Mississippi Valley at the end of the month. The effects of these storms are discussed in Section 4. It was the second

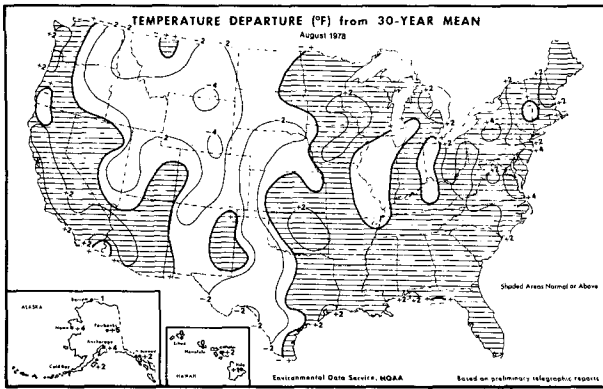


FIG. 5. Departure from normal of average surface air temperature (°F) for August 1978 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1978).

wettest August of record at Pendleton, OR and Cairo, IL and the third wettest at Medford, OR. On the other hand, it was the third driest August of record at Oklahoma City.

Rainfall was subnormal along most of the middle and south Atlantic Coast under the strong upper level ridge. Although tongues of moist air occasionally reached the normally dry Southwest, their northward penetration was limited.

The strong upper level ridge over Alaska produced dry conditions there. To the south, monthly rainfall totals were quite variable over the Hawaiian Islands.

4. Variability Within the month

a. 31 July–6 August

Early in the month the mean 700 mb wave pattern in the vicinity of North America was highly amplified (Fig. 7). Strong ridges were located near the West Coast and off the East Coast while a deep

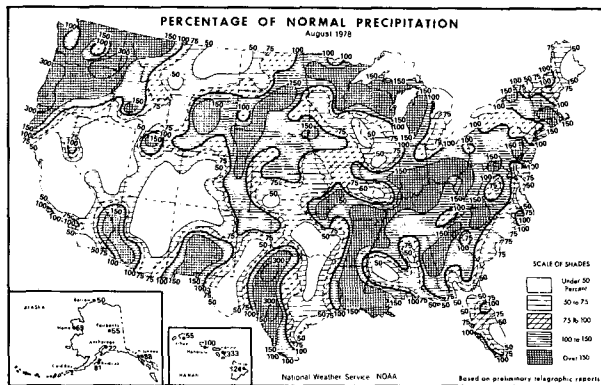


FIG. 6. Percentage of normal precipitation for August 1978 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1978).

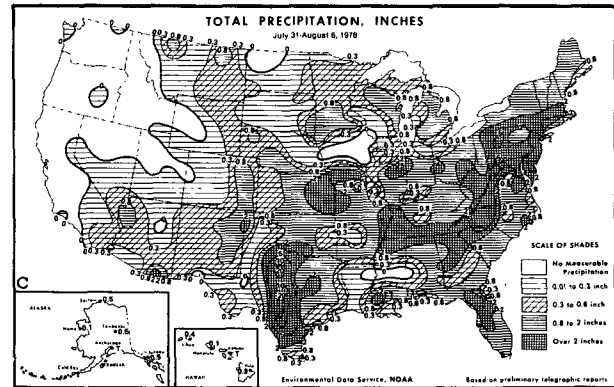
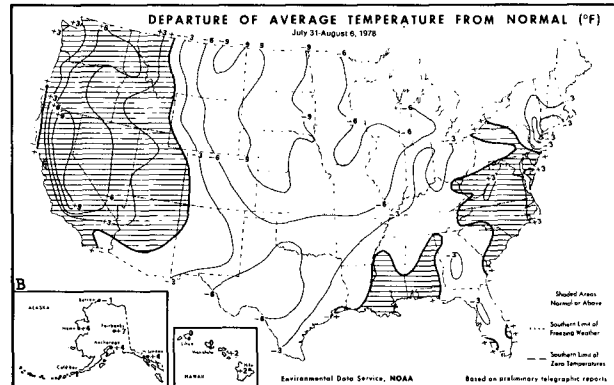
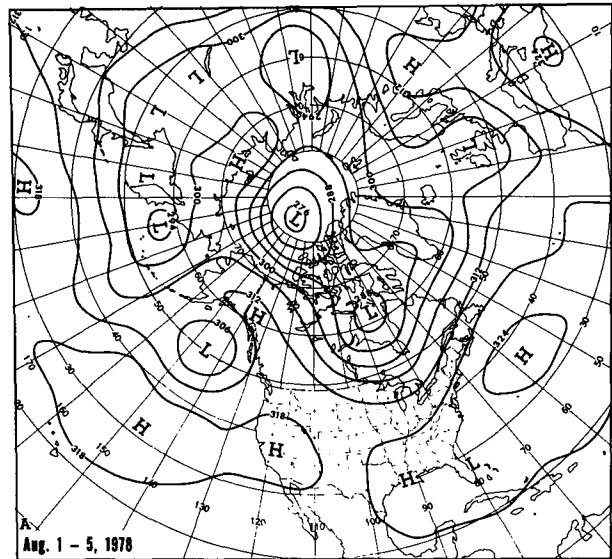


FIG. 7. (A) Mean 700 mb contours (dam) for 1–5 August; (B) departure from normal of average surface air temperature (°F); and (C) total precipitation (inches) for week of 31 July–6 August 1978 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperatives Service, 1978).

mean trough extended southward from Hudson Bay. The polar low was at maximum intensity this week.

Temperatures averaged well above normal in the vicinity of the western ridge while enhanced

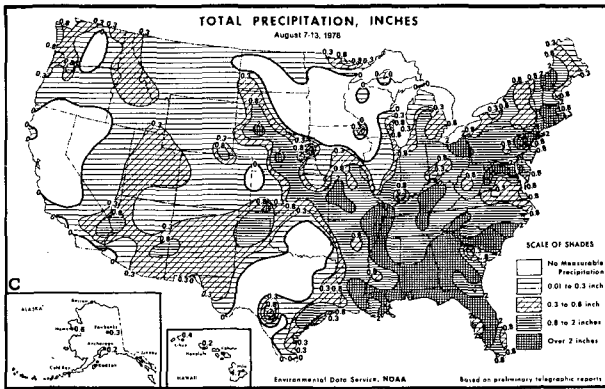
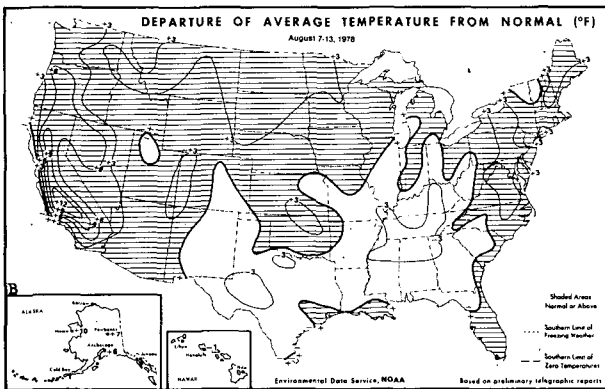
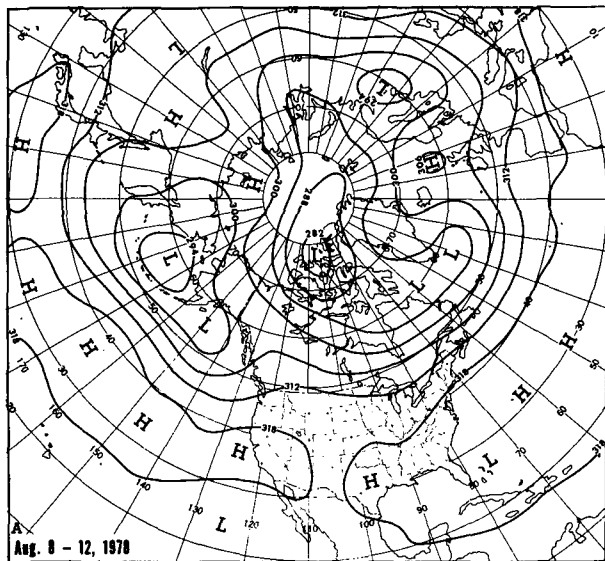


FIG. 8. As in Fig. 7 except for (A) 8-12 August 1978 and (B) and (C) 7-13 August 1978.

northerly flow between that ridge and the Hudson Bay trough drove quite cool air to central portions of the United States. Cool weather over Texas was largely the result of a persistent cloudy, rainy regime as was the case in parts of the Southeast and Northeast.

Rainfall was concentrated near and east of the mid-continent and Florida mean troughs. Although the surface circulation of Tropical Storm Amelia had vanished by 1 August, residual moisture and instability from that storm contributed to the 20 or more inches of rain which fell in parts of central Texas this week. Persistent and enhanced low-level flow of moist air from the southeast against the central Texas hills, together with an anticyclonic circulation in the upper troposphere over Texas, were probably important components of this deluge. Flooding along the Guadalupe and Medina Rivers in Texas on 1 and 2 August devastated nine hill country communities 40 or 50 miles northwest of San Antonio killing at least 16 persons. Subsequent flash flooding 250 miles to the north at Albany, TX caused 9 additional deaths on the 4th.

*b. 7-13 August*

Increasing westerlies across the North Pacific, coupled with the southward movement of the polar low flattened the flow pattern across western Canada this week (Fig. 8). This continued the warm regime in the western United States and spread warm air across most of the rest of the country. On 8 August all-time record high temperatures were observed at Medford, OR (110°F) and Blue Canyon, CA (97°F) and equalled at Red Bluff, CA (119°F). Record high August temperatures were recorded at Salem, OR (106°F) on the 8th and at Astoria, OR (94°F) on the 7th. Cool air continued over most of the South as frequent but weak upper level troughs produced cloudy, wet weather. Elsewhere precipitation was widespread but generally not heavy.

*c. 14-20 August*

The flow pattern over the Pacific and North America amplified this week as a strong ridge built over the east Pacific driving a deep mean trough to the Great Plains (Fig. 9). Ridge and trough were both latitudinally extensive due to the phasing of middle and high latitude wave features. This resulted in the advection of cool air over most of the western half of the country and warm air to the East.

The area of greatest precipitation shifted to the north-central part of the country as the mean trough moved to the Great Plains. The combination of cold and wet weather in the northern Rocky Mountains produced snow at high elevations in Idaho, Montana and Wyoming with up to a foot reported in Yellowstone Park.

*d. 21-27 August*

Long-wave features near North America remained highly amplified this week, and retrograded (Fig. 10). The mean temperature pattern over the

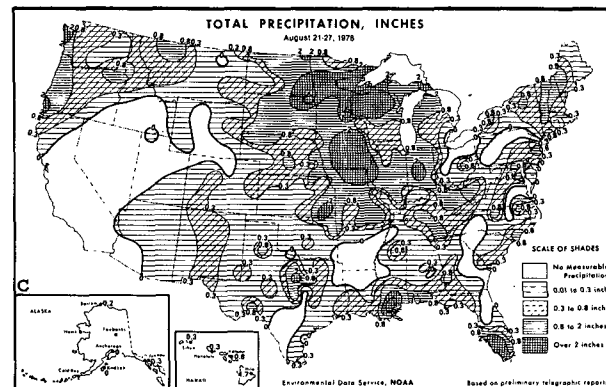
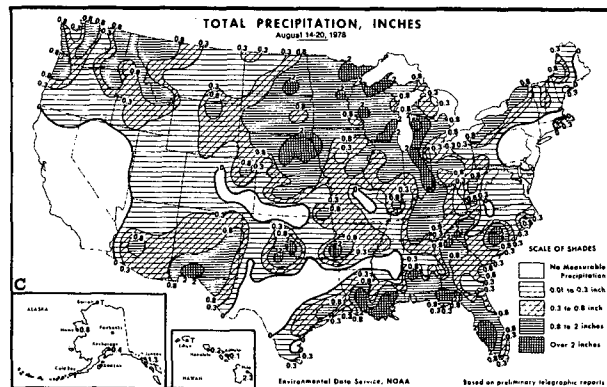
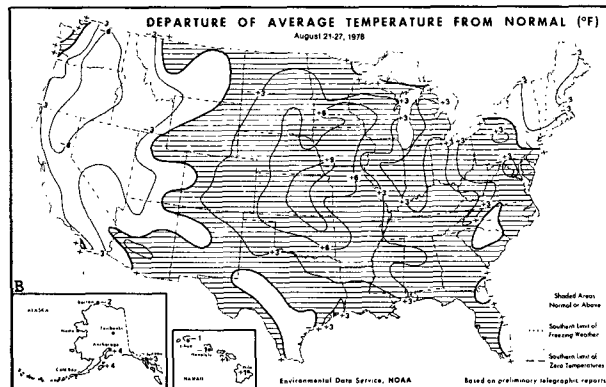
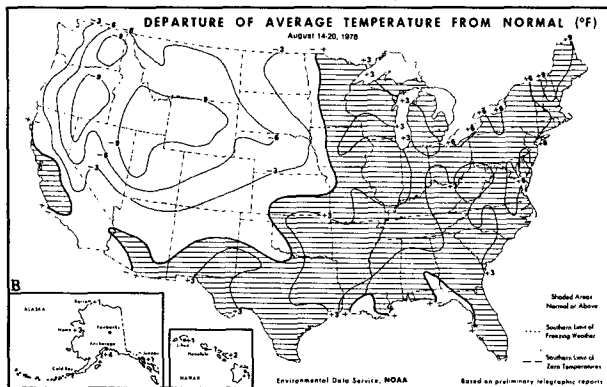
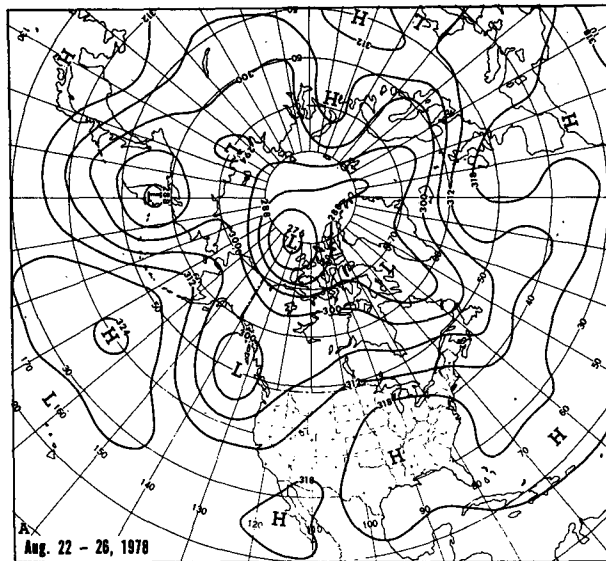
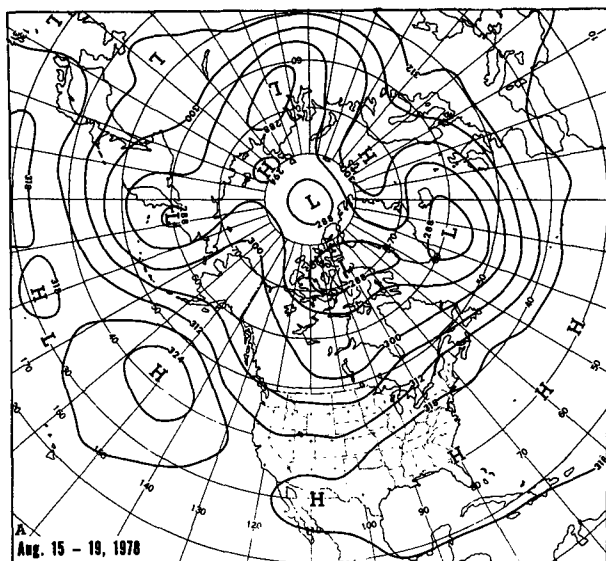
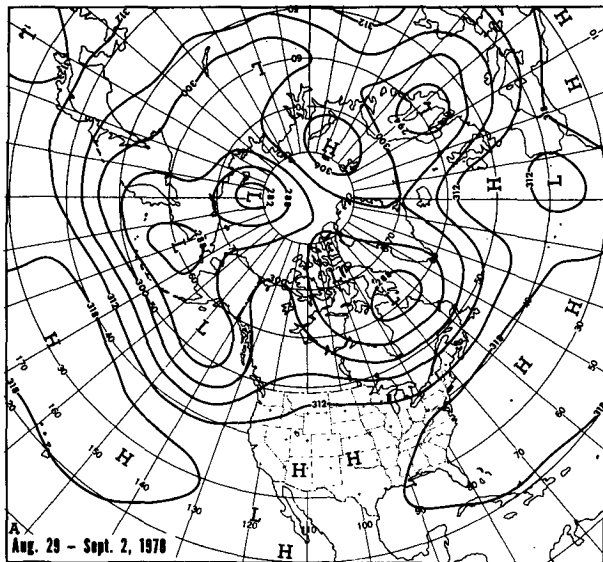


FIG. 9. As in Fig. 7 except for (A) 15-19 August 1978 and (B) and (C) 14-20 August 1978.

FIG. 10. As in Fig. 7 except for (A) 22-26 August 1978 and (B) and (C) 21-27 August 1978.

United States likewise shifted westward with below normal temperatures confined to areas west of the Continental Divide while large positive anomalies developed under the strong central ridge. In New England the change from southwesterly to northwesterly mean flow brought an abrupt end to the

previous warm spell. At Caribou, ME the temperature fell to a new August low, 37°F, on the 25th. The deep trough off the West Coast made this a relatively wet week along the north Pacific Coast. Substantial precipitation continued over north-central portions of the country where moisture was



e. 28 August–3 September

The circulation pattern over the Pacific and North America flattened again (Fig. 11), becoming similar to that which existed during 8–12 August. As was the case earlier, this brought above normal temperatures to much of the country but cool weather to parts of the South where cloudy weather prevailed.

Precipitation was concentrated from Texas and Louisiana northeastward to the middle Atlantic States between the weak continental mean trough and the strong western Atlantic ridge. Heaviest rainfall totals accompanied Tropical Storm Debra which formed just south of the Texas–Louisiana border on 28 August, moved inland, and was downgraded the same day. By the end of the month the remnants of Debra were difficult to identify.

5. Tropical activity

West Atlantic–Gulf of Mexico tropical storms occurred during two intervals this month. Tropical Storm Bess formed in the Gulf of Mexico southeast of Brownsville, TX on 6 August, crossed the Mexican Coast near 20°N two days later, and dissipated as it moved inland. Hurricane Cora, following Bess by two days, formed rapidly in the south central Atlantic (near 14°N, 45°W), moved westward, and was downgraded to a low north of Venezuela by 12 August. After more than two weeks without a storm, another storm pair occurred at the month's end, and again consisted of a Gulf of Mexico storm followed two days later by a west Atlantic storm. Tropical Storm Debra formed just south of the Texas–Louisiana border on 28 August, moved inland, and was a frontal low by the next evening. Its effects are discussed in the preceding section on weekly variability. Tropical Storm Ella formed south of Bermuda (near 27°N, 64°W) on 30 August and was moving northwestward as a hurricane at the end of the month.

Six tropical storms, three of which became hurricanes, formed over southeastern portions of the North Pacific this month. This exceeds the comparable 1966–77 averages of 4.1 and 2.4 (Gunther, 1978) and tends to support an earlier study suggesting an association between frequent storm formation in this area in August, and the occurrence of a strong monthly mean 700 mb ridge from the Gulf of Mexico to Baja, California (Dickson, 1975).

Tropical Storm Iva formed south of the tip of Baja, California on 11 August, moved westward to become a hurricane two days later, and dissipated two days after that over cooler water to the west. Tropical Storms John, Kristy and Lane formed on 19 August from a trio of uniformly spaced waves on the ITCZ. John and Kristy reached hurricane intensity before dissipating south and east of Hawaii,

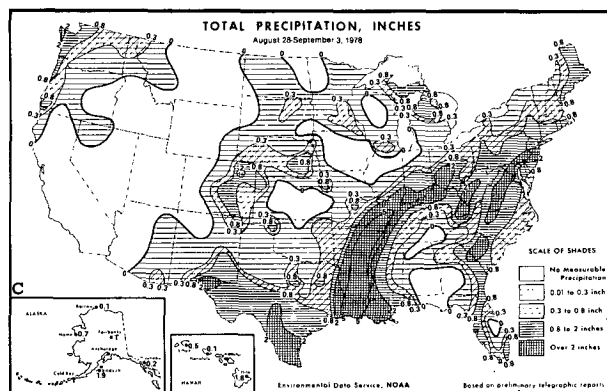
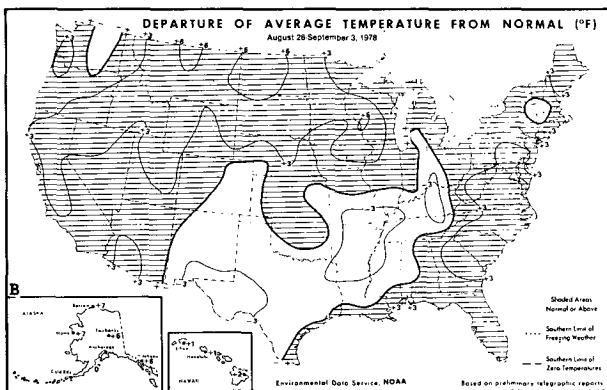


FIG. 11. As in Fig. 7 except for (A) 29 August–2 September 1978 and (B) and (C) 28 August–3 September 1978.

plentiful and surface fronts and traveling lows frequent. Several locations in this area received five or more inches of rain on the 23rd. The 5.79 inches which fell at Duluth, MN on the 22nd and 23rd were an all-time record 24-hour total for that location.

respectively. Lane, however, was a shortlived, weaker storm.

Tropical Storms Miriam and Norman formed during the last few days of the month and were south of Hawaii and Mexico, respectively, at the month's end.

Seven tropical storms, two of which became typhoons, formed south of the relatively strong west Pacific ridge this month. In addition, two typhoons, Virginia and Wendy, were in existence at the month's beginning. Virginia was a tropical depression east of Japan by 3 August while Wendy became a frontal low over the Sea of Japan on the same day.

Three tropical storms, Bonnie, Carmen and Della, formed during the 11-12 August period. Bonnie and Della both formed near the Asia coast and decreased in intensity while passing over North Vietnam and Taiwan, respectively. Carmen, on the other hand, formed well out to sea. After closely approaching the China coast (near 28°N) as a typhoon, Carmen became a tropical storm, changed its direction of motion, and dissipated near southwestern Korea on 20 August.

Tropical Storm Elaine formed just west of the Philippines on 24 August, became a typhoon a few days later, and was downgraded to a low as it crossed the coast just north of Hainan (21°N).

The final three tropical storms of the month, Faye, Gloria and Hester, formed during the 28-30 August period. While Gloria was very short-lived, Faye and Hester were still of tropical storm strength at the end of the month.

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