

WEATHER AND CIRCULATION OF AUGUST 1977

Record or Near Record Rainfall in the Midwest

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1. Mean circulation

The mean 700 mb circulation this month consisted of a highly amplified wave pattern at middle and high latitudes surmounting a belt of moderately strong subtropical highs (Figs. 1 and 2). Anomaly extremes connected with the central Pacific trough, the Alaska ridge and the central Canada trough were all at least two standard deviations removed from normal, as was the negative anomaly center near Japan.

Middle and high latitude waves were largely in phase this month over the Pacific and North America, in contrast to July, and were generally west of their July locations (Wagner, 1977). As was the case in July, the main advection of warm air to high latitudes was west of the Alaskan ridge (Fig. 3). To the east of this ridge, cold air advection to the south strengthened the thermal gradient near the northern border of the United States which enhanced storm development and

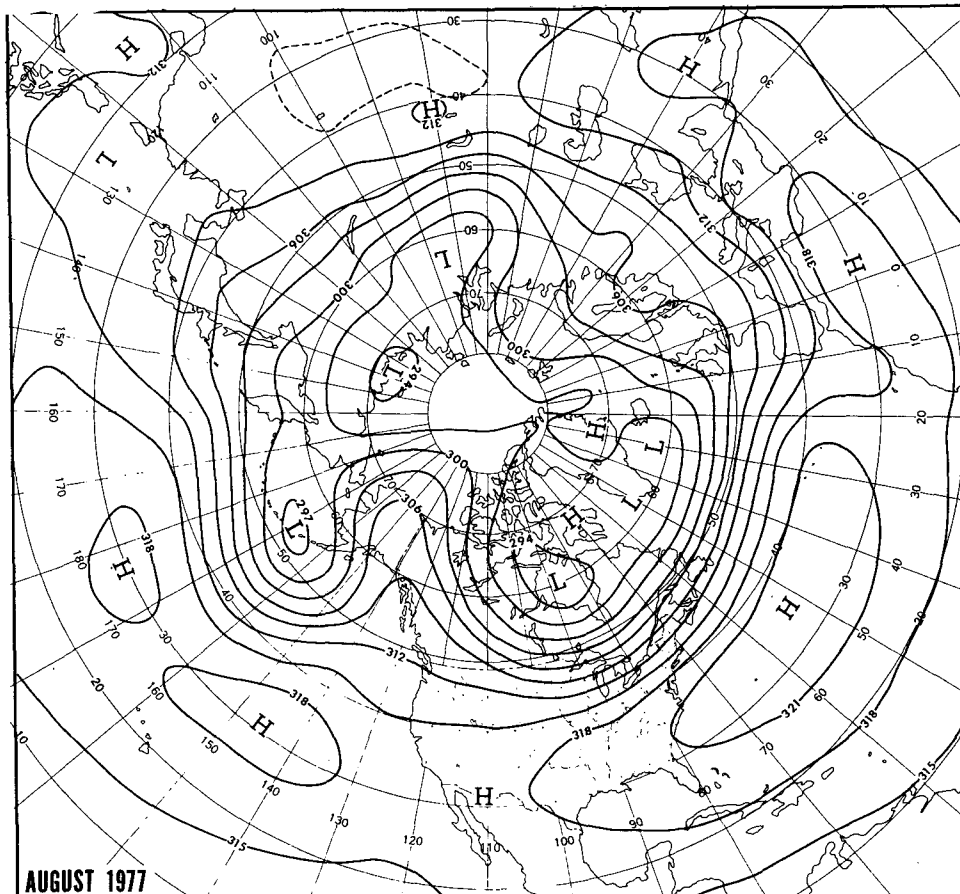


FIG. 1. Mean 700 mb contours (dam) for August 1977.

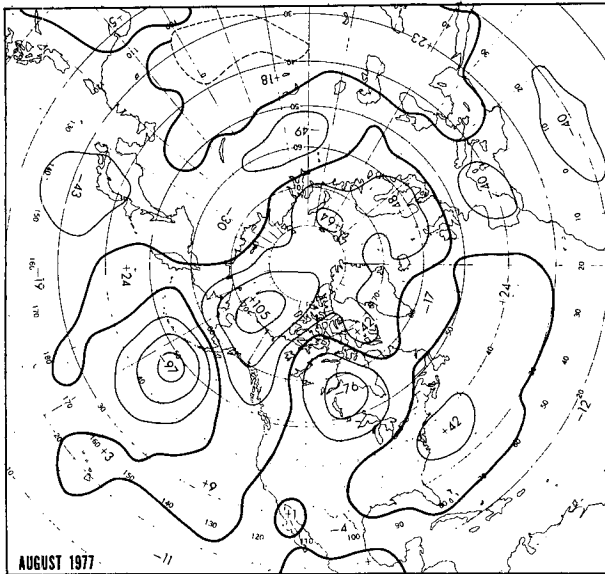


FIG. 2. Departure from normal of mean 700 mb height (m) for August 1977.

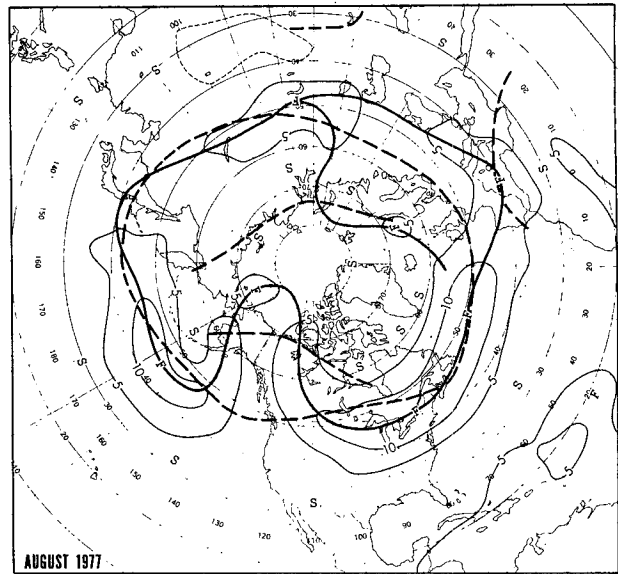


FIG. 4. Mean geostrophic wind speed ($m s^{-1}$) for August 1977. Solid arrows indicate observed axes of maximum wind speed and dashed lines, the normal.

contributed to increasing upper level winds in that area. The 700 mb wind maximum extending from the Great Lakes to the central Atlantic was the strongest in the Northern Hemisphere (Fig. 4).

The westerly flow over the Atlantic split into north and south segments as it traveled around the strong Scandinavian blocking ridge (Figs. 1 and 4). Deep troughs were maintained to the south and to the east of this ridge. Between the central Asia trough and the intense Asiatic coastal trough, generally westerly flow prevailed.

2. Temperature

Enhanced northerly and northwesterly flow between the deep Hudson Bay low and the strong ridge to its west drove cool air over the north central portion of the United States this month (Figs. 1, 2 and 5); several stations in this area reported record or near record low August mean temperature (Table 1). Southward penetration of the cool air was limited by the relatively strong subtropical ridge over the Southeast and by the fact that the motivating northerly flow was well to the north in western Canada (Figs. 1 and 2). The strong subtropical ridge which protruded across the South continued warm conditions in that area. Considerable warming took place this month in the Pacific Northwest as a moderately strong ridge built along the coast

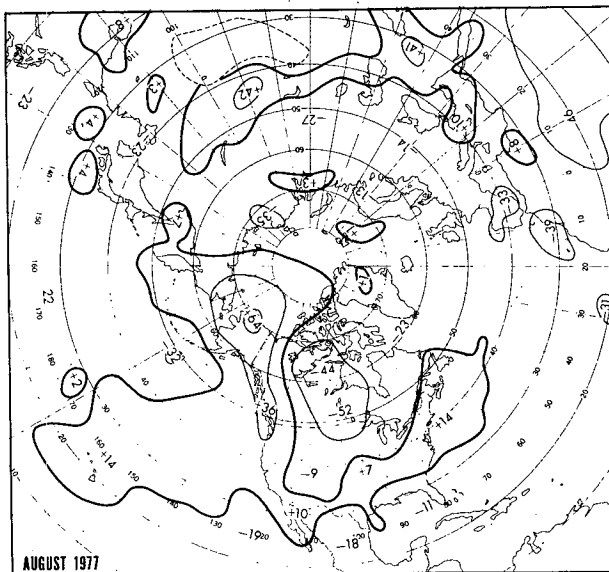


FIG. 3. Departure from normal of mean 1000-700 mb thickness (m) for August 1977.

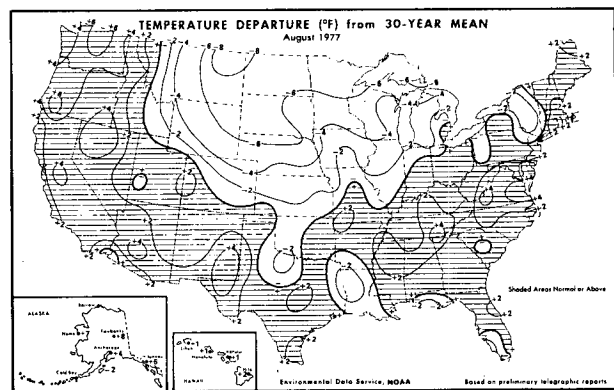


FIG. 5. Departure from normal of average surface air temperature ($^{\circ}F$) for August 1977 (from National Oceanic & Atmospheric Administration & Statistical Reporting Service, 1977).

TABLE 1. Record and near-record monthly mean temperatures observed during August 1977.

Station	Temperature (°F)	Anomaly (°F)	Remarks
Bismarck, N. D.	62.0	-7.2	Coldest August
Sault St. Marie	57.3	-5.9	Coldest August
Casper, Wyo.	66.1	-3.5	Tied coldest August
Rapid City, S. D.	66.0	-5.6	2nd coldest August at Airport
Waterloo, Iowa	65.9	-4.9	2nd coldest August (tied)
Fargo, N. D.	62.7	-6.5	3rd coldest August (tied)
			Coldest August since 1888
Madison, Wisc.	65.9	-4.9	2nd coldest August (tied)
Duluth, Minn.	58.6	-5.5	2nd coldest August
Phoenix, Ariz.	94.1	+5.0	2nd warmest August
Medford, Ore.	76.0	+5.6	2nd warmest August

TABLE 2. Record and near-record precipitation totals observed in August 1977.

Station	Amount (inches)	Anomaly (inches)	Remarks
Tallahassee, Fla.	15.73	+8.84	Wettest August
Des Moines, Iowa	13.68	+10.38	Wettest August
Concordia, Kan.	10.72	+7.57	Wettest August
Erie, Pa.	10.67	+7.14	Wettest August
Minneapolis, Minn.	9.31	+6.26	Wettest August
Grand Island, Neb.	8.73	+6.19	Wettest August
Walla Walla, Wash.	2.94	+2.49	Wettest August
Pendleton, Ore.	2.58	+2.24	Wettest August
Baton Rouge, La.	13.31	+8.64	2nd wettest August
Kansas City, Mo.	11.18	+7.00	2nd wettest August
Evansville, Ind.	8.43	+5.48	2nd wettest August
Fort Wayne, Ind.	7.26	+4.36	3rd wettest August
Chicago, Ill.	9.68	+6.54	Wettest August since 1885

effecting a reduction in the advection of cool, maritime air over that region.

Temperatures averaged above normal in Alaska under a strong mean 700 mb ridge. Departures from normal ranged up to +7.2°F at Fairbanks and +8.2°F at Kotzebue. In Hawaii, near a somewhat stronger than normal upper level ridge, temperatures averaged above normal.

3. Precipitation

The combined effects of a deep upper level trough over the north-central states and a strong moisture-advecting high off the east coast brought greater than normal precipitation totals to most areas east of the Continental Divide (Fig. 6). Record or near record August precipitation amounts were observed at several locations in the Midwest as well as a few stations along the Gulf Coast and in the Northwest (Table 2). Widespread and substantial rainfall in parts of the drought-stricken Southeast and Northwest helped replenish depleted soil moisture storage.

In the region of usually light summer precipitation west of the Divide, the above normal August precipitation mainly occurred with transient rain-producing

systems that were not very recognizable in the monthly mean 700 mb height distribution; these will be discussed in the next section.

The massive upper level ridge over Alaska produced very dry conditions over most of that state. One of the driest locations was Fairbanks which received only 18% of the normal August precipitation. Rainfall was also mostly subnormal in Hawaii under a slightly stronger than normal upper ridge. Totals, however, were quite variable ranging from only 13% of normal at Honolulu to more than twice normal at Kahului.

4. Variability within the month

a. 1-7 August

The amplified wave pattern, characteristic of the monthly mean 700 mb flow, was already extant at the month's beginning (Fig. 7). Accordingly, both the temperature anomaly pattern for the whole country and the precipitation distribution east of the Divide were similar to their monthly means. West of the Divide, precipitation was scant as mean ridges over the Southwest and off the northwest coast dominated the circulation.

Record high temperatures for the month were established at Bishop, Colo., on 1 August (107°F), at Ely, Nev., on 2 August (97°F) and equaled at Winslow, Ariz., on 3 August (103°F).

b. 8-14 August

The long-wave pattern over and near North America and the associated distribution of temperature and precipitation in the United States persisted to a large extent this week (Fig. 8). Decreasing mean heights off the California coast had little effect on this week's weather but proved quite important during the following week.

c. 15-21 August

The mean trough progressed a bit this week, spreading cool temperatures throughout most of the East and

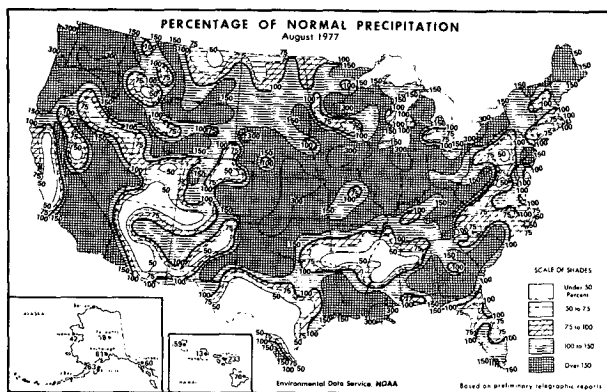


FIG. 6. Percentage of normal precipitation for August 1977 (from National Oceanic & Atmospheric Administration & Statistical Reporting Service, 1977).

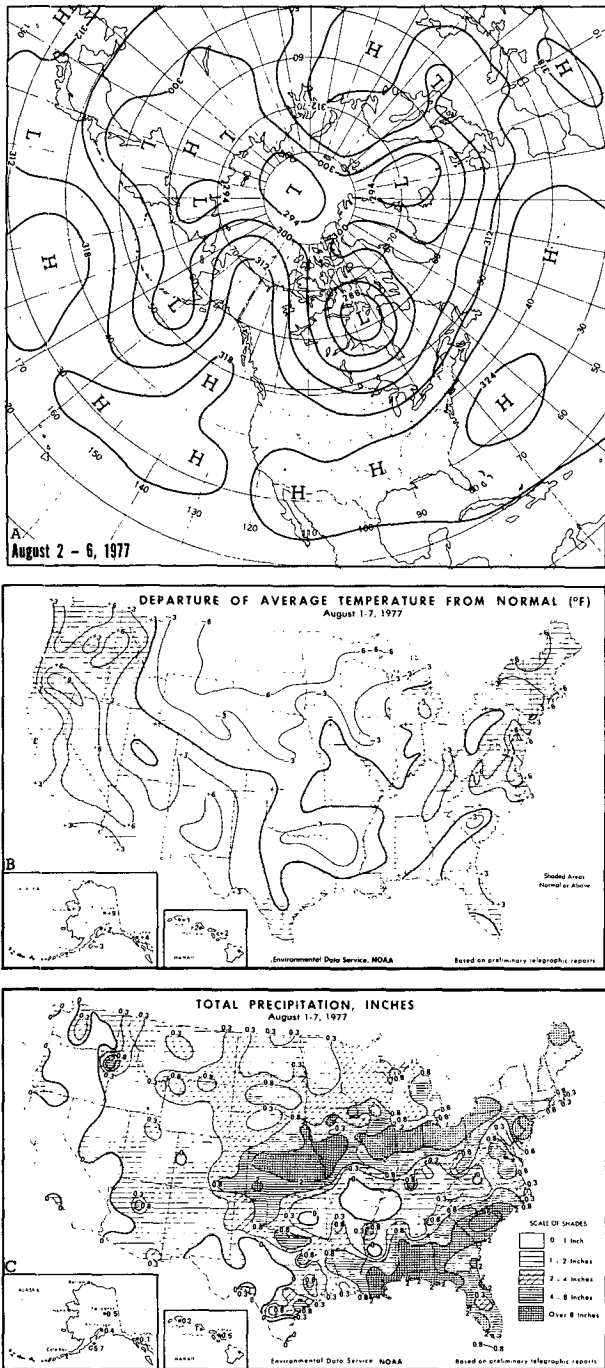


FIG. 7. (A) Mean 700 mb contours (dam) for 2-6 August 1977; (B) departure from normal of average surface air temperature (°F) and (C) total precipitation (inches) for week of 1-7 August 1977 (from National Oceanic & Atmospheric Administration & Statistical Reporting Service, 1977).

continuing widespread precipitation east of the Divide (Fig. 9).

The combined effects of the weak upper level low off California and a moderately strong ridge over the Southwest steered Hurricane Doreen northward along

the west coast of Baja, California. Although Doreen had been down graded to a low-pressure area off the southern California coast, more than 2 inches of rain fell at locations in southern California, Nevada and southwest Arizona. The rains produced some crop damage in southern California as well as flash floods and mud

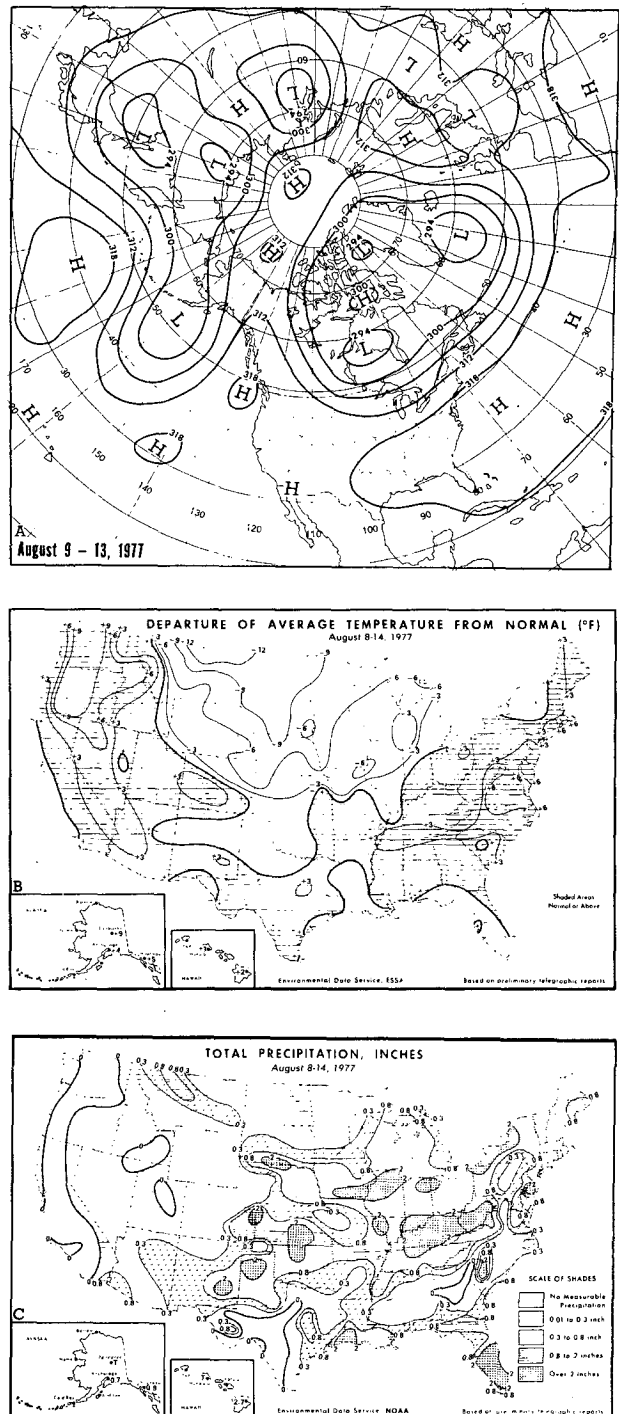


FIG. 8. As in Fig. 7 except for (A) 9-13 August 1977 and (B) and (C) week of 8-14 August 1977.

slides. Almost all of the month's precipitation in the far Southwest and the Great Basin fell during this week.

This was the warmest week of the month in the Northwest as a moderately strong 700 mb high built over the area.

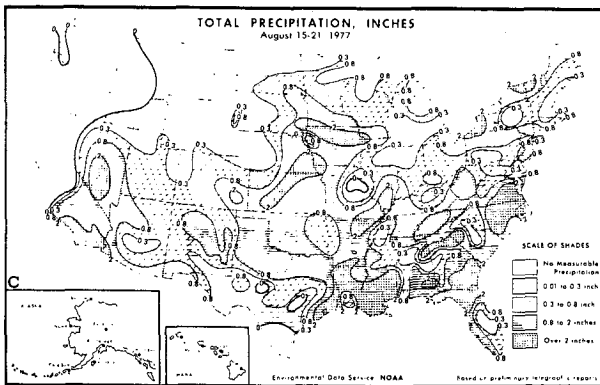
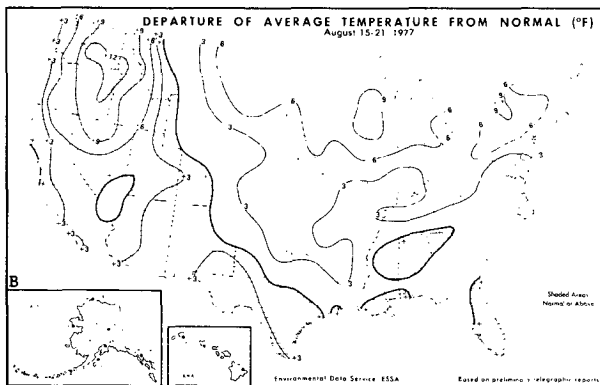
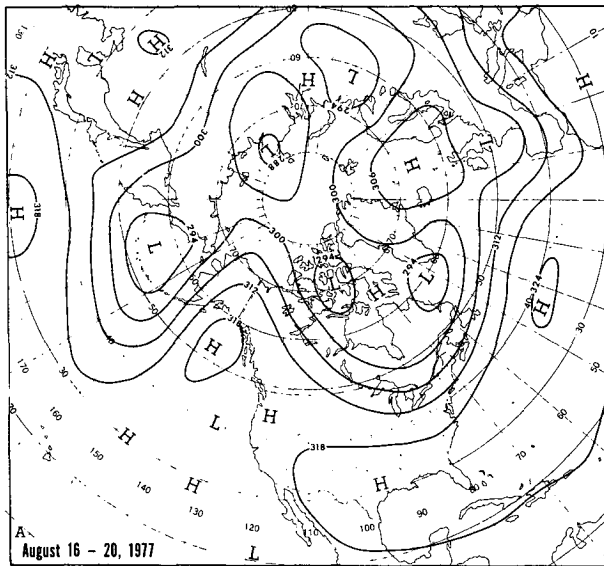


FIG. 9. As in Fig. 7 except for (A) 16-20 August 1977 and (B) and (C) week of 15-21 August 1977.

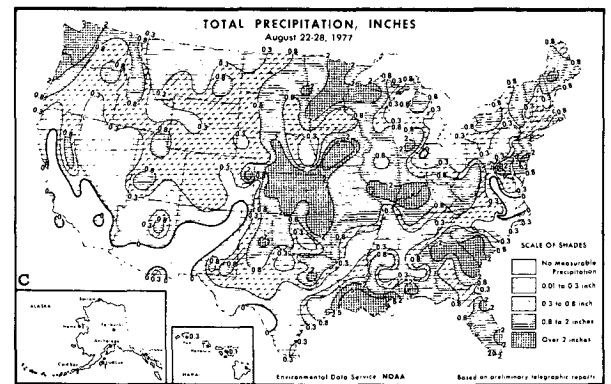
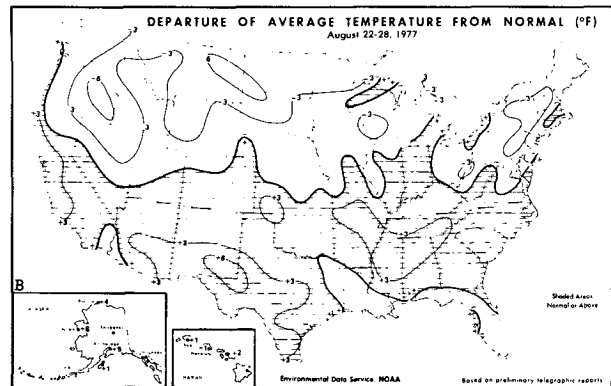
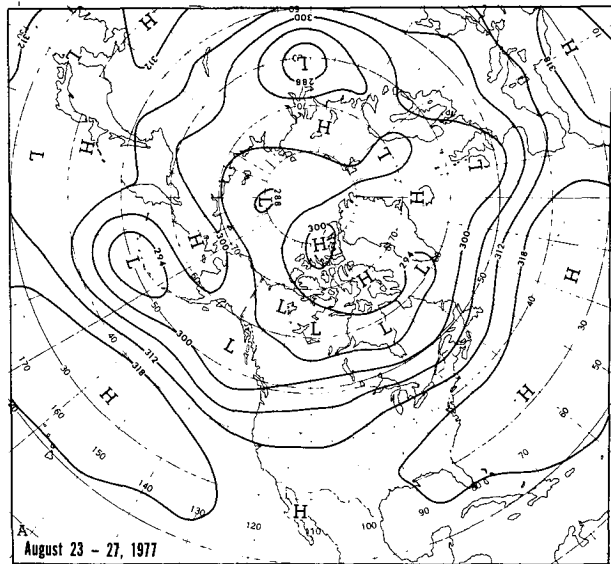


FIG. 10. As in Fig. 7 except for (A) 23-27 August 1977 and (B) and (C) week of 22-28 August 1977.

d. 22-28 August

The highly amplified mean circulation pattern which characterized the first three weeks of the month broke down this week as the Alaskan mean ridge retrograded to northeastern Siberia and a fairly deep low formed in the Gulf of Alaska (Fig. 10). The resultant increase in the westerlies over the Northwest brought cool, rainy

weather to that area. This end-of-the-month regime produced most of the month's precipitation in the Northwest.

Falling upper level heights in the Northwest were accompanied by rising heights and warming in the Southeast. Widespread precipitation continued east of the Divide with excessive amounts producing flooding in Iowa. Evansville, Ind., reported a record 3.33 inches of precipitation in one hour on 23 August.

5. Tropical activity

This was a slack month for tropical storms and hurricanes in both the Atlantic and Pacific. Anita, first Atlantic or Gulf tropical storm of the season, formed southwest of New Orleans on 30 August and rapidly became a hurricane. Anita had little effect on the weather in the United States during August.

Tropical storm Doreen formed south-southeast of the southern tip of Baja California on 14 August and became a hurricane the next day as it moved northward along the west coast of Baja California. Doreen was downgraded to a tropical storm on 16 August, to a tropical depression on 17 August and finally to a low on 18 August when located off southern California. Effects of Doreen are discussed in the section entitled Weekly Variability. Normally the month of most fre-

quent tropical storm and hurricane activity in the tropical east Pacific (Gunther, 1977), August had only one such storm this year compared to the 11-year average of 4.4.

Tropical storms and typhoons in the west Pacific were almost equally scarce. Two storms were in existence at the beginning of the month. Typhoon Vera made landfall on the China coast on 1 August and was rated a low the next day. Tropical Storm Wanda, south of Japan on 1 August, moved northward and then northeastward, losing its tropical characteristics on 4 August. The only tropical storm to form in the West Pacific in August was Amy, which was located north of the Philippines on 20 August and downgraded the next day.

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