

WEATHER AND CIRCULATION OF MAY 1978

Record Wet Month in Parts of the Northern Great Plains and the East Gulf Coast

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1. Mean circulation

The normal seasonal decline of the midlatitude westerlies over Asia and the Pacific Ocean during May was accompanied by the retrogression of the Asiatic coastal trough to the Sea of Japan and an increase in the number of waves in the mean 700 mb circulation over the Pacific (Figs. 1, 2 and 3). The latter development resulted in the progression of wave features over the

east Pacific and North America, bringing mean ridges to the east Pacific and mid-continent (south of 60°N) and a mean trough to just east of the Continental Divide. The ridge over south-central Canada took on the characteristics of a blocking ridge, with weak *in situ* westerlies, while the belt of strongest westerlies was displaced well to the south, passing through two rather closely spaced troughs (Figs. 1 and 3). Although low-

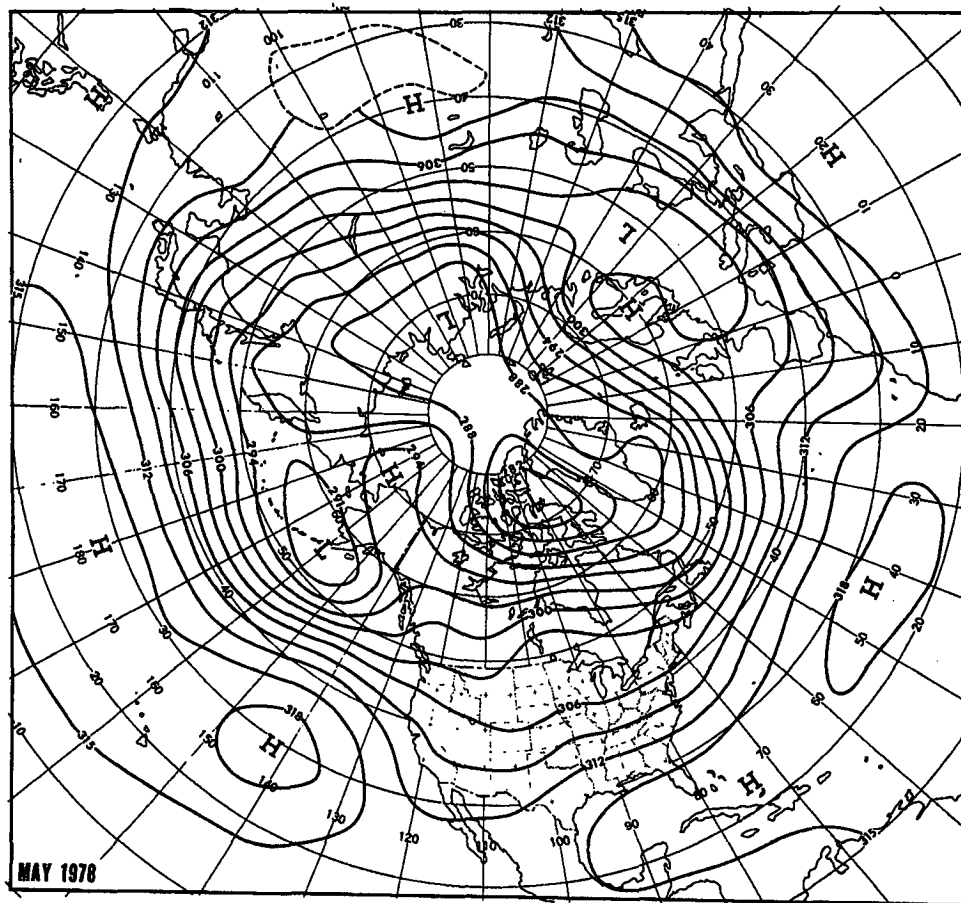


FIG. 1. Mean 700 mb height contours (dam) for May 1978.

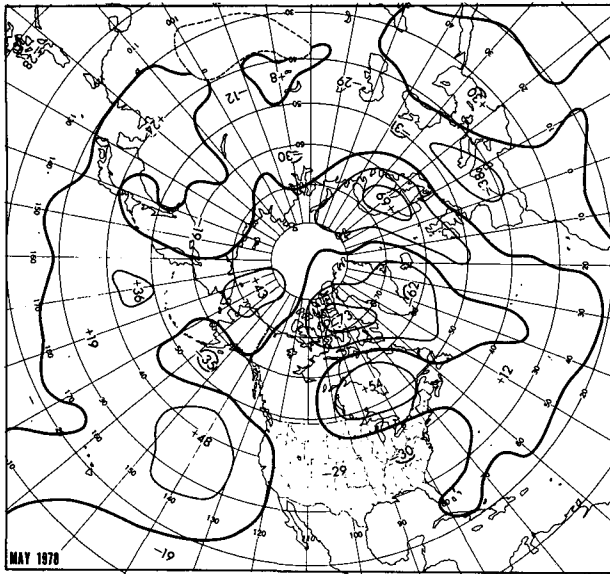


FIG. 2. Departure from normal of mean 700 mb height (m) for May 1978.

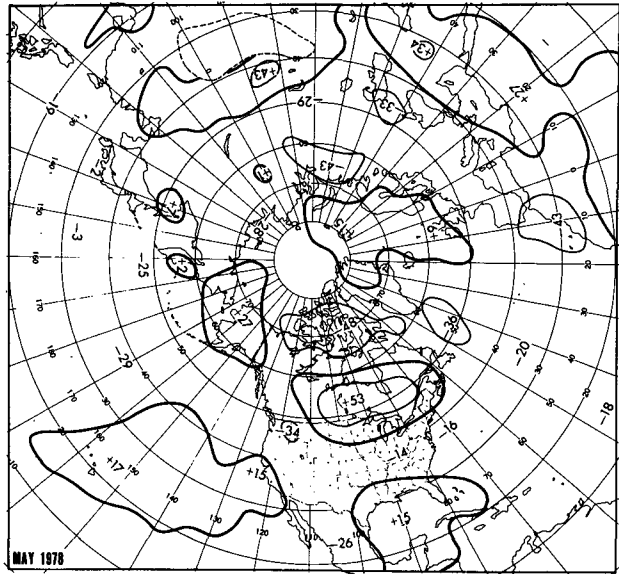


FIG. 4. Departure from normal of mean 1000-700 mb thickness (m) for May 1978.

latitude portions of the western Atlantic trough retrograded to the east coast of the United States, the eastern Atlantic ridge and the strong trough over Europe persisted near their April positions (Wagner, 1978), as did the ridge over central Asia.

At higher latitudes, mean troughs persisted over Baffin Island and the Tamyr Peninsula and a mean ridge

continued north of the Bering Straits. Emergence of the strong ridge over south-central Canada together with the persistence of the Baffin Island low brought an increase of both the thermal gradient and the wind in central Canada (Figs. 3 and 4). The fast westerlies drove vorticity maxima strongly off the coast, forming a mean trough near the tip of Greenland and displacing the northern part of the Atlantic mean ridge to Scandinavia.

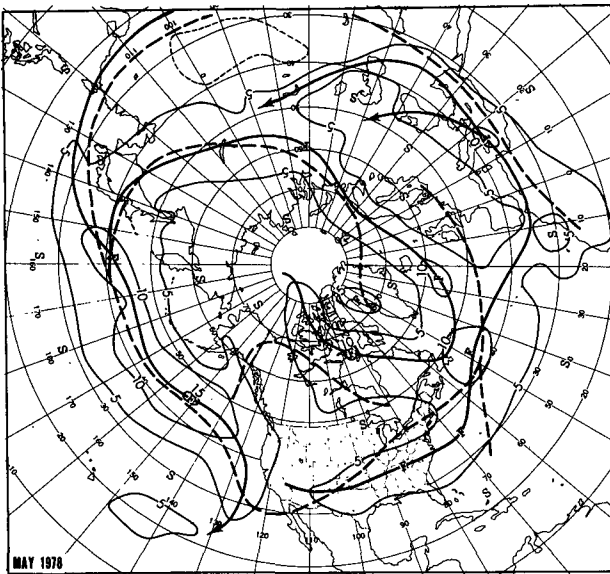


FIG. 3. Mean 700 mb geostrophic wind speed ($m s^{-1}$) for May 1978. Solid arrows indicate observed axes of maximum wind speed and dashed lines, the normals.

2. Temperature

Both advective and radiative processes appear to have been important in producing cool weather over much of the United States this month (Fig. 5). Cold air masses entered the country to the east of both the amplified east Pacific ridge and the Canadian blocking ridge in early stages of its development. In both instances passage over late season snow fields helped maintain low temperatures in the overlying air mass. In addition, storm systems traveling in the westerlies south of the blocking ridge were generally slow moving and produced extensive cloud covers which limited insolation at the ground. Above-normal temperatures were generally limited to the southern and western fringe of the country, south of the prevailing storm track, and to areas along the northern border in the vicinity of the blocking ridge. It was the warmest May of record at San Diego, CA, and the second warmest at Duluth, MN.

Mean 700 mb ridges with above-normal average

heights were associated with above-normal temperatures over most of both Alaska and Hawaii.

3. Precipitation

Slowly moving storm systems, traveling in the westerlies south and west of the blocking ridge, produced greater than normal precipitation amounts over most of the country this month (Fig. 6). It was one of the wettest Mays of record in parts of Montana and Wyoming as well as in Mississippi and Alabama (Table 1). The monthly precipitation total at Casper, WY, was, in addition, a record high for any month. The combination of cold and wet weather this month produced record May snowfall at some locations in the western Great Plains (Table 1).

Subnormal precipitation amounts were confined largely to a few areas near the blocking ridge, portions of the West under enhanced northerly flow, and parts of Texas. The latter was an area of diminished low-level moisture advection from the Gulf of Mexico and also the locus of a rain shadow effect east of the mountains (Figs. 2 and 3). It was the driest May of record at Port Arthur, TX.

Precipitation in Alaska, under a mean 700 mb ridge, was generally subnormal. Greater than normal amounts were found, however, near the moderately strong Aleutian low. With the exception of the windward station Hilo, precipitation was substantially above normal at the readily available reporting locations in the Hawaiian Islands (Fig. 6) for the first time in several months. The area of below normal mean 700 mb heights west of Hawaii (Fig. 2) hints at the brief regimes during the month when precipitation was concentrated. These occurred on 4 June when a deep upper trough was located just west of the Islands and from 19–23 June when heights were well below normal north of the islands with a low center aloft observed near 30°N on several days.

TABLE 1. Record and near-record total monthly precipitation and snowfall observed in May 1978.

Station	Amount (inches)	Anomaly* (inches)	Remarks
Casper, WY	6.59	+4.65	Wettest any month; 340% of May normal
Sheridan, WY	6.80	+4.35	2nd wettest May; 3rd wettest any month
Billings, MT	6.97	+4.89	Wettest May
Montgomery, AL	12.01	+8.54	Wettest May
Jackson, MS	10.48	+6.10	2nd wettest May since 1909
Port Arthur, TX	0.10	-4.84	Driest May
Colorado Springs, CO	19.4	+18.3	Snowiest May
Missoula, MT	8.1	+7.3	Snowiest May
Clayton, NM	8.0	+8.0	Snowiest May

* Departure from long-term mean for snowfall.

4. Weekly Variability

a. 1-7 May

During the first week of the month, the mean 700 mb circulation was quite similar to that of the month as a whole (Figs. 1 and 7). Strong mean ridges off the West Coast and over southern Canada coupled with deep troughs east of the Divide and off the northeast coast drove quite cold air over most of the country. The effects of late-season snowfields over southwest Canada, the Rocky Mountains and the area from north of the Great Lakes to northern New England helped make this the coldest week of the month in much of the United States.

The deep mean trough and southward displaced westerlies over the United States brought storm systems and substantial precipitation amounts to a large area east of the Continental Divide. A surface low-pressure area which moved from the northern Gulf of Mexico, across southeastern Louisiana, and thence eastward and northeastward on 3 and 4 May was a major contributor to the heavy rainfall observed from Louisiana to southern Georgia this week. This storm also produced several tornadoes in Florida and South Carolina.

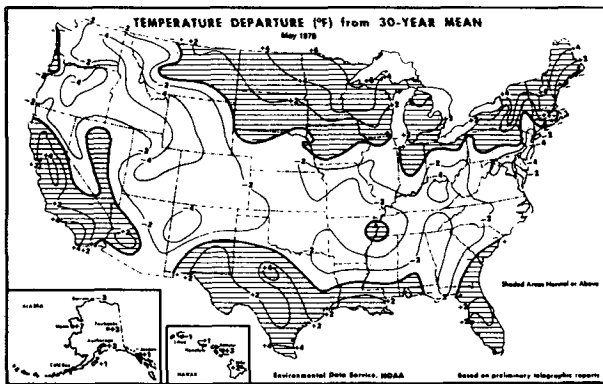


FIG. 5. Departure from normal of average surface air temperature (°F) for May 1978 (from National Oceanic and Atmospheric Administration & Economics, Statistics and Cooperatives Service, 1978).

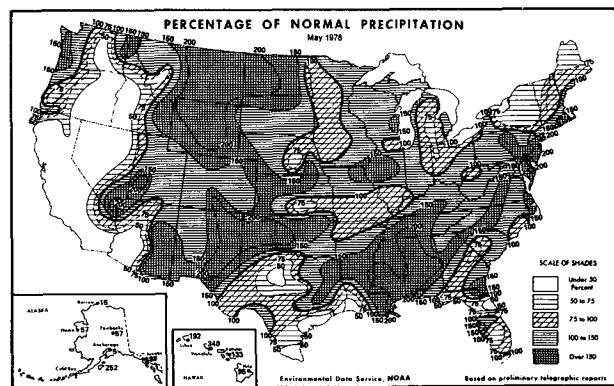


FIG. 6. Percentage of normal precipitation for May 1978 (from National Oceanic and Atmospheric Administration & Economics, Statistics and Cooperatives Service, 1978).

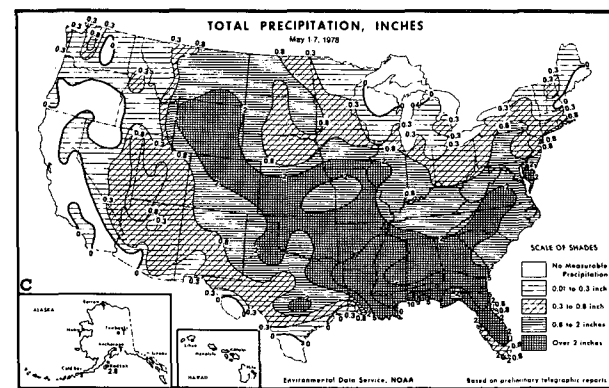
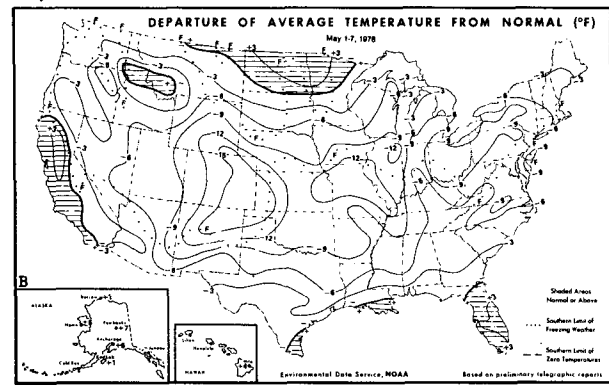
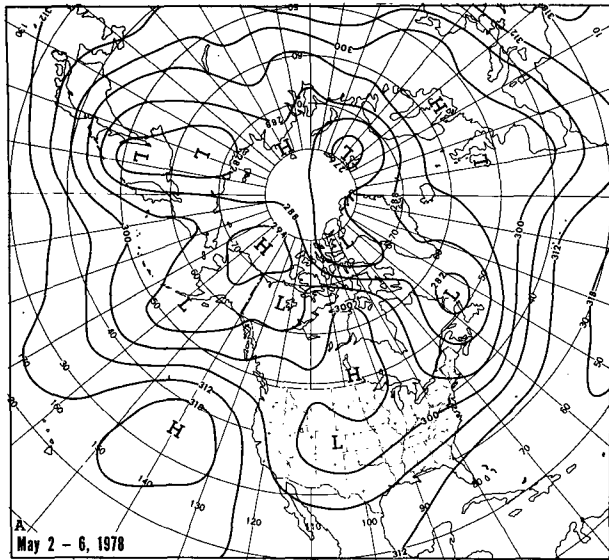


FIG. 7. (A) Mean 700 mb contours (dam) for 2-6 May 1978; (B) departure from normal of average surface air temperature (°F); and (C) total precipitation (inches) for week of 1-7 May 1978 (from National Oceanic and Atmospheric Administration & Economics Statistics and Cooperatives Service, 1978).

The east Pacific ridge amplified in two stages this week and each drove a deep upper level low over the western states, producing substantial late season snows. The first such low moved from southern California to Texas on 1 to 3 May causing 8.0 inches of snow at

Clayton, NM, a new record total for May at that location.

The second upper level low plunged rapidly from southwest Canada to the Great Basin on 5 May and then moved little for the rest of the week. It was associated with heavy snows over Wyoming, eastern Colorado and northern Utah. Some of the greatest storm totals were as follows: Lander, WY, 33.1 inches;

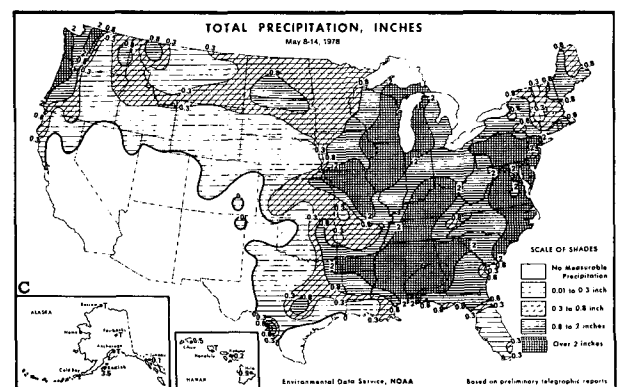
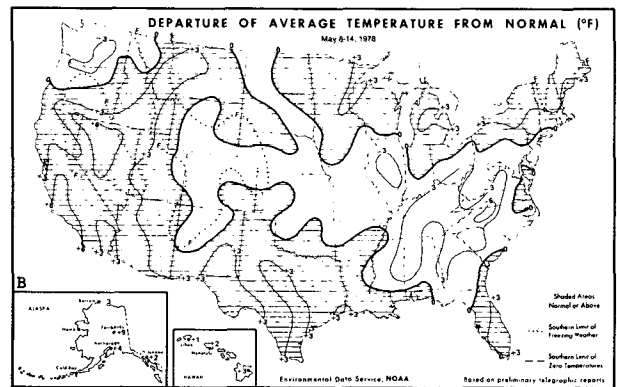
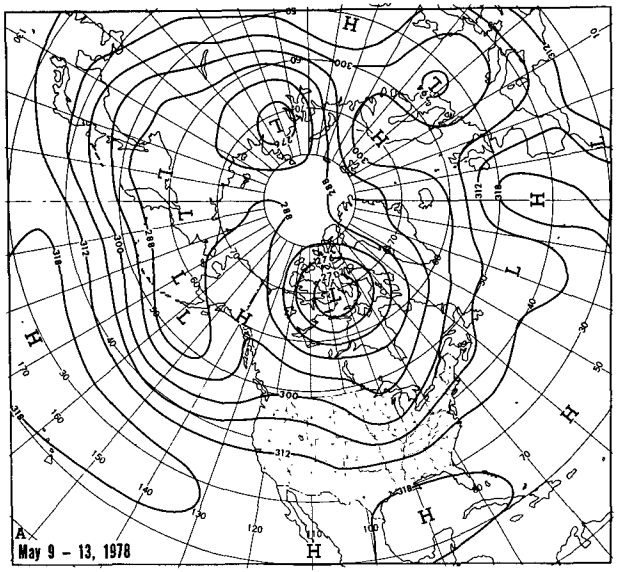


FIG. 8. As in Fig. 7 except (A) 9-13 May 1978 and (B) and (C) week of 8-14 May 1978.

Colorado Springs, CO, 19.4 inches; Casper, WY, 18.8 inches; and Cheyenne, WY, 18.3 inches.

b. 8-14 May

The mean circulation pattern changed rapidly this week as the westerlies shifted to higher latitudes over much of the Northern Hemisphere (Fig. 8). In the

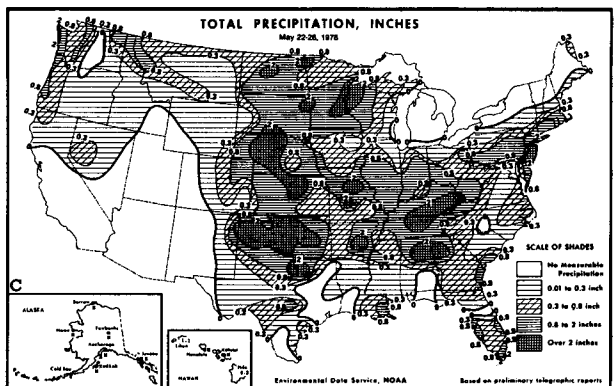
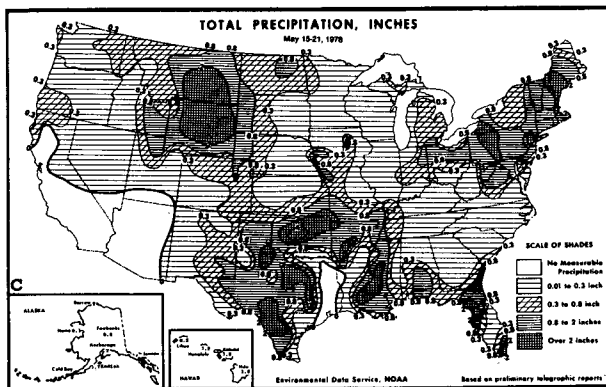
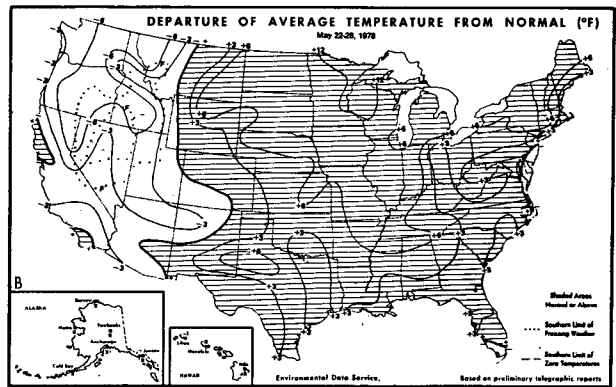
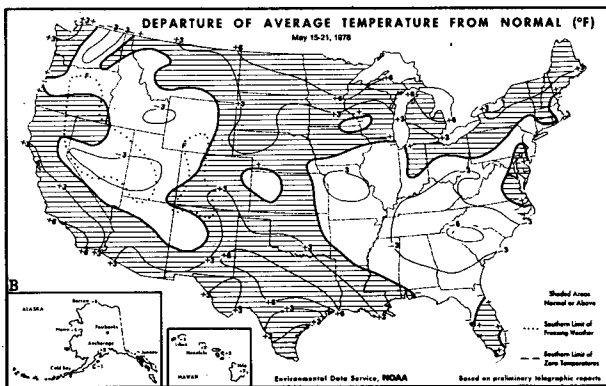
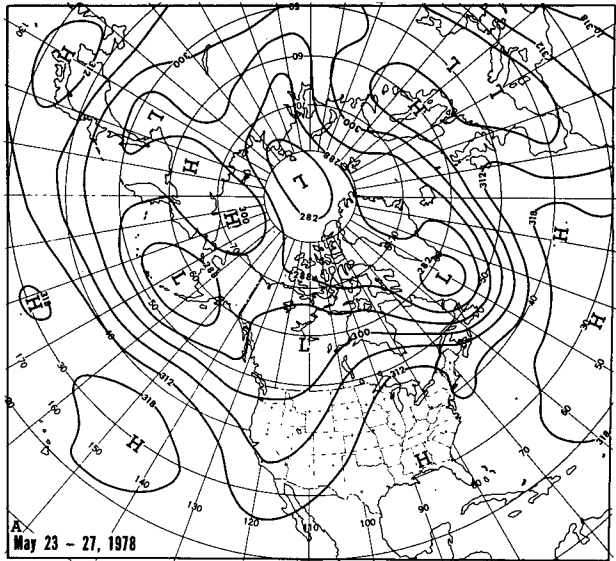
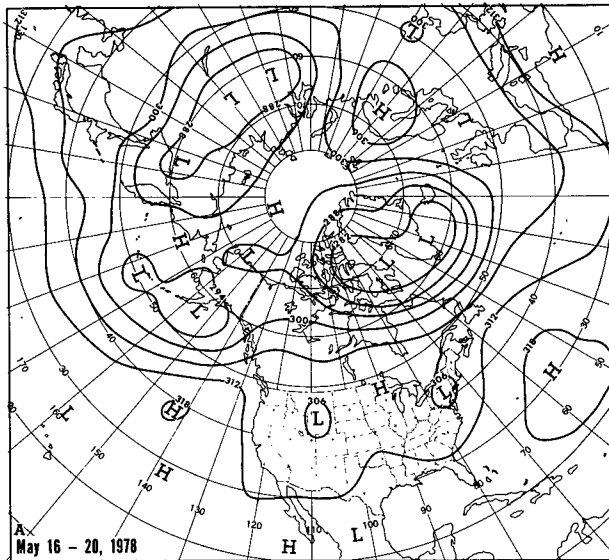


FIG. 9. As in Fig. 7 except (A) 16-20 May 1978 and (B) and (C) week of 15-21 May 1978.

vicinity of North America, deep lows south of the Aleutians and over Baffin Island brought fast westerlies across southern Canada and northern United States, displacing the previous blocking ridge to the east and bringing a mean trough to the western Great Lakes.

The return to a more westerly flow regime resulted in moderating temperatures across the United States. Below-normal averages were mostly restricted to

interior areas east of the Mississippi River where cloudiness was persistent. Greatest precipitation amounts were observed near and east of the Mississippi Valley trough and in advance of the trough over the northeast Pacific.

Tornadoes were observed on six days this week as warmer and moister air spread over much of the country. These storms were concentrated in outbreaks on 11 and 12 May, when early reports indicated 42 tornadoes scattered from the west Gulf Coast to the Midwest.

c. 15–21 May

The mid-tropospheric circulation reverted to a state of highly amplified waves in the westerlies around most of the Northern Hemisphere this week (Fig. 9). Near North America, the previous high-index regime gave way to one similar to that of the first week of May. Strong mean ridges were located off the West Coast and over south-central Canada, while lows, secluded from the westerlies, were observed over Wyoming and eastern Pennsylvania. The flow over the northern and central latitudes of Canada, however, remained generally from the west and cold air advection into the United States was quite limited.

Below-normal temperatures were generally confined to areas near and west of the two mean troughs. Slow-moving weather systems in the vicinity of these troughs accounted for much of the precipitation observed in the country this week. In one such instance a deep upper low stalled over the northern Great Basin, bringing a prolonged wet spell to parts of Wyoming and Montana from 16–19 May. In Wyoming, storm precipitation totals ranged from near 4 inches at several locations to 7.52 inches at Story. Following the wet first week of the month, this produced one of the worst floods of record

in Wyoming, causing an estimated \$15.5 million damage.

d. 22–28 May

Both the east Pacific mean ridge and the trough over the western United States retrograded this week (Fig. 10). As the latter feature built northward into the westerlies, the downstream ridge built southward from the Great Lakes. This arrangement of long waves brought cool air to most areas west of the Continental Divide and above-normal temperatures to its east.

Much of the significant precipitation this week occurred near the western trough or over the Great Plains and the Mississippi Valley, where moisture was plentiful and precipitation-producing systems were frequent. A low-pressure area moving off the middle Atlantic Coast at mid-week in advance of the amplifying Great Lakes ridge gave over an inch of rain from the Delmarva Peninsula to southern New England. This low, south of the main belt of westerlies, milled about near the East Coast for several days. While tornadoes occurred in the United States on most days this week, they were concentrated in the Great Plains on 25 and 28 May.

The first tropical storm of the season over the eastern Pacific, Aletta, formed on 30 May south of Acapulco, Mexico, and intensified to hurricane strength that afternoon.

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