

## WEATHER AND CIRCULATION OF FEBRUARY 1978

### Record or Near-Record Cold East of the Continental Divide with a Major Blizzard in the Northeast

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#### 1. Mean circulation

During February, the monthly mean 700 mb circulation was very anomalous over much of the Northern Hemisphere. Deep mean troughs with accompanying fast westerlies centered south of normal dominated the flow over both the Atlantic and the Pacific, while a massive mean ridge overlaid western and central Canada (Figs. 1, 2 and 3). This represented an eastward

motion of most circulation features from their January locations (Wagner, 1978) and a marked intensification of the Atlantic trough. As the Atlantic trough deepened at mid and low latitudes, the Greenland ridge intensified, producing a reversal of the previous month's height anomaly pattern over much of the Atlantic.

The excess of kinetic energy above normal at low latitudes and the deficit from 45° to 60°N is well illustrated by the mean wind profile for the Western

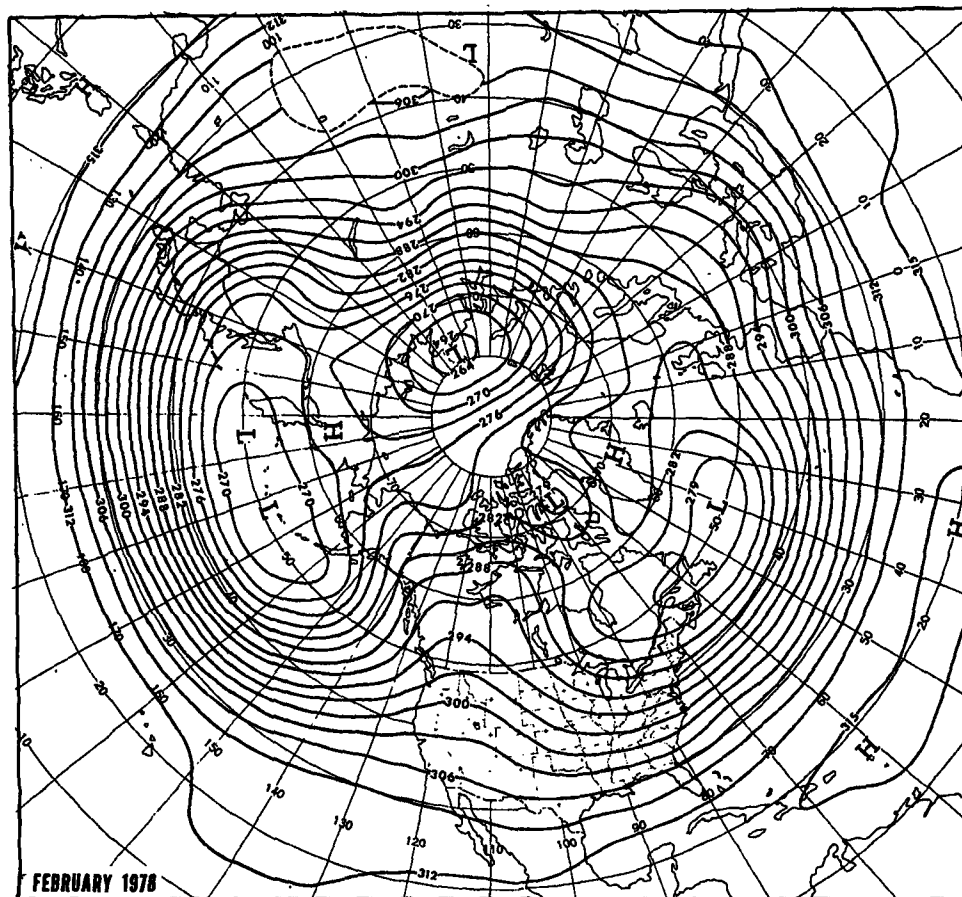


FIG. 1. Mean 700 mb height contours (dam) for February 1978.

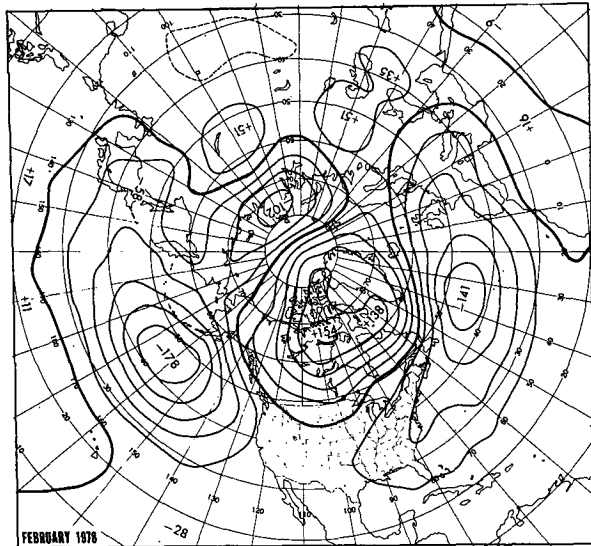


FIG. 2. Departure from normal of mean 700 mb height for February 1978.

Hemisphere (Fig. 4). This profile is quite similar to that of January 1977 (Wagner, 1977). The advection of cold air off the southeast coasts of both continents enhanced baroclinic fields and associated energy transformations over western portions of the Atlantic and Pacific (Fig. 5).

The fast Atlantic flow continued across southern Spain and south of the rather deep trough over Europe before the wind maximum became diffuse. At high latitudes, strong northerly winds between the deep Tamyr Peninsula low and the strong Greenland ridge advected quite cold air over Scandinavia and the northeast Atlantic. Confluence of this flow and a warm

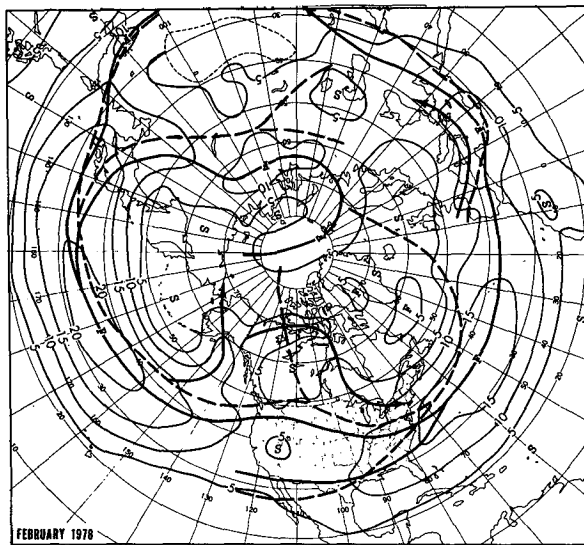


FIG. 3. Mean 700 mb geostrophic wind speed ( $m s^{-1}$ ) for February 1978. Solid arrows indicate observed axes of maximum wind speed and dashed lines, the normal.

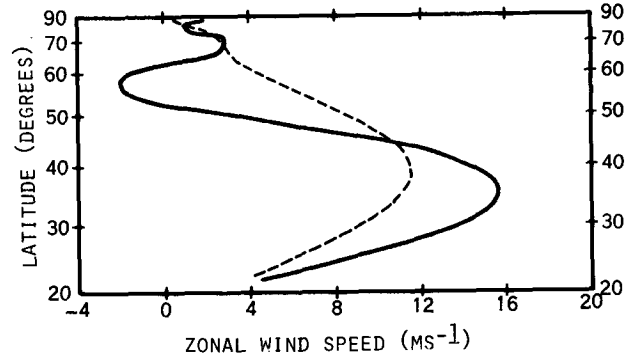


FIG. 4. Mean 700 mb zonal wind speed profile for the western half of the Northern Hemisphere during February 1978 (solid line); dashed line is the normal.

southeasterly current, however, largely confined the cold advection to high latitudes.

## 2. Temperature

Despite the eastward motion of circulation features, the mean temperature anomaly pattern over the United States during February was very similar to that of the previous month. The combined influence of the strong ridge over western Canada and the deep trough along the east coast brought colder than normal mean temperatures to all locations east of the Continental Divide (Fig. 6). This was the coldest February of record in parts of the Midwest and the Great Plains and one of the coldest in most locations east of the Continental Divide (Table 1).

West of the Divide relatively warm conditions prevailed as the longitudinally extensive southwesterly flow over the east Pacific advected both warm air and frequent cloud-producing storms into the West.

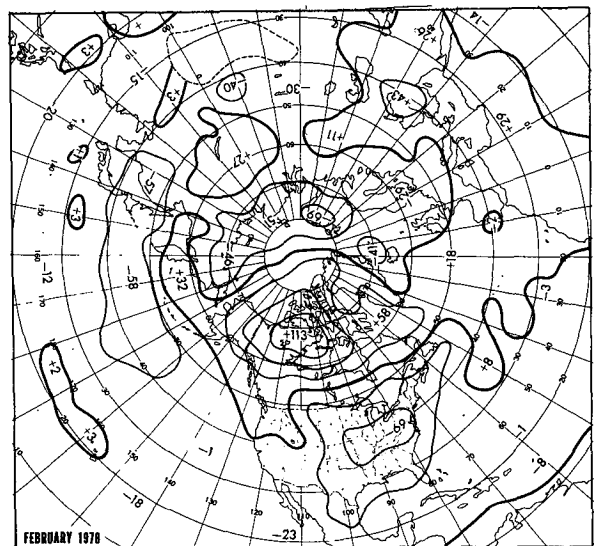


FIG. 5. Departure from normal of mean 1000-700 mb thickness (m) for February 1978.

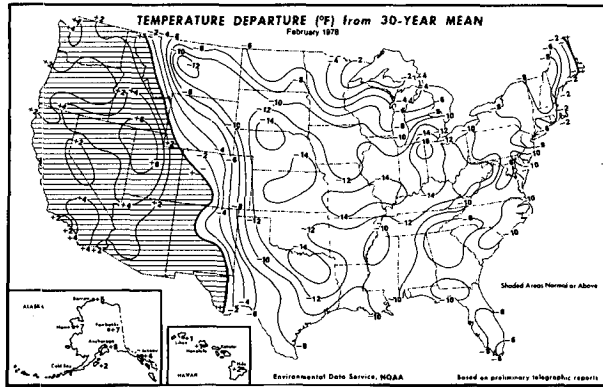


FIG. 6. Departure from normal of average surface air temperature for February 1978 (from National Oceanic and Atmospheric Administration & Economics, Statistics and Cooperatives Service, 1978).

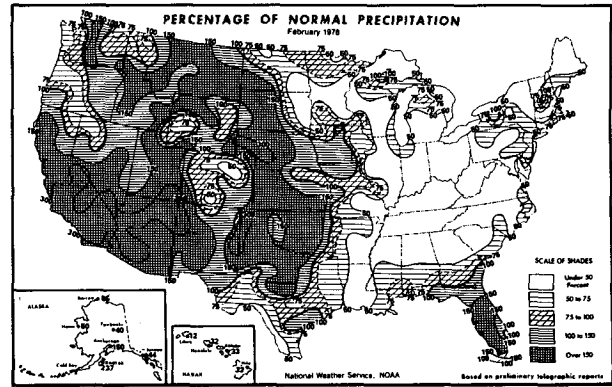


FIG. 7. Percentage of normal precipitation for February 1978 (from National Oceanic and Atmospheric Administration & Economics, Statistics and Cooperatives Service, 1978).

TABLE 1. Record and near-record monthly mean temperatures observed during February 1978.

Station	Temperature (°F)	Anomaly (°F)	Remarks
Ft. Wayne, IN	11.3	-16.3	Coldest February
Toledo, OH	11.8	-15.3	Coldest February
Evansville, IL	21.0	-14.9	Coldest February
Springfield, MO	22.9	-14.1	Coldest February
Lexington, KY	21.3	-14.0	Coldest February
Columbus, OH	16.6	-13.7	Coldest February
Indianapolis, IN	17.8	-12.9	Coldest February
Wichita Falls, TX	33.3	-12.6	Coldest February
Parkersburg, WV	22.4	-12.3	Coldest February
Louisville, KY	23.8	-12.0	Coldest February
Goodland, KS	19.7	-11.8	Coldest February
Youngstown, OH	15.6	-11.1	Coldest February
Grand Rapids, MI	14.4	-10.1	Coldest February
Tallahassee, FL	45.2	- 9.6	Coldest February
Muskegon, MI	15.7	- 8.9	Coldest February
Port Arthur, TX	47.2	- 7.9	Coldest February
Waterloo, IA	7.4	-13.4	2nd coldest February
Sioux City, IA	10.1	-13.3	2nd coldest February
Grand Island, NB	15.0	-12.7	2nd coldest February
Cairo, IL	27.5	-12.2	2nd coldest February
Omaha, NB	13.5	-12.0	2nd coldest February
Tulsa, OK	29.4	-11.8	2nd coldest February
Rockford, IL	12.3	-11.7	2nd coldest February
Erie, PA	14.5	-10.7	2nd coldest February
Jackson, MS	39.6	-10.2	2nd coldest February
Wilmington, NC	38.5	- 9.6	2nd coldest February
Columbia, SC	38.4	- 9.2	2nd coldest February
Richmond, VA	30.3	- 9.1	2nd coldest February
Concord, NH	13.5	- 9.1	2nd coldest February
Austin, TX	45.0	- 8.3	2nd coldest February
Fort Myers, FL	57.2	- 7.5	2nd coldest February
Topeka, KS	20.4	-13.0	3rd coldest February
Peoria, IL	15.4	-12.3	3rd coldest February
Norfolk, NB	12.1	-11.8	3rd coldest February
Cleveland, OH	16.7	-11.2	3rd coldest February
Chicago, IL	16.8	-10.6	3rd coldest February
Norfolk, VA	32.6	- 8.8	3rd coldest February

Strong southerly flow between the Aleutian low and the western Canada ridge brought above normal mean temperatures to Alaska. Temperatures in Hawaii, south of the fast westerlies, were also warmer than normal.

### 3. Precipitation

Storm systems advected into the West by the fast and southward displaced Pacific westerlies brought above normal precipitation to most locations west of the Continental Divide this month (Fig. 7). The north Pacific Coast, under relatively weak westerly flow, was an exception.

East of the Divide above normal precipitation was largely confined to the Great Plains when frequent troughs crossing the mountains impinged on the persistent cold air mass to the east. With a deep mean trough off the East Coast, deepening storm systems were generally kept far enough to the east that precipitation totals north of Florida were less than normal for the month as a whole. This was one of the driest Februaries of record at several locations east of the Mississippi River (Table 2). However, December through February snowfall was the greatest of record at Chicago (77.5 inches). It is perhaps surprising that the major East Coast blizzard during the first week of the month occurred in an otherwise relatively dry month.

TABLE 2. Record and near-record total monthly precipitation observed in February 1978.

Station	Amount (inches)	Anomaly (inches)	Remarks
Parkersburg, WV	0.48	-2.29	Driest February
Columbus, OH	0.29	-2.03	Driest February
Washington, DC	0.42	-2.03	Driest February
Youngstown, OH	0.60	-1.82	Driest February
Erie, PA	0.57	-1.55	3rd Driest February
Indianapolis, IN	0.36	-2.00	4th Driest February
Concord, NH	0.67	-1.78	4th Driest February
Cairo, IL	1.08	-2.69	Driest since Feb. 1918

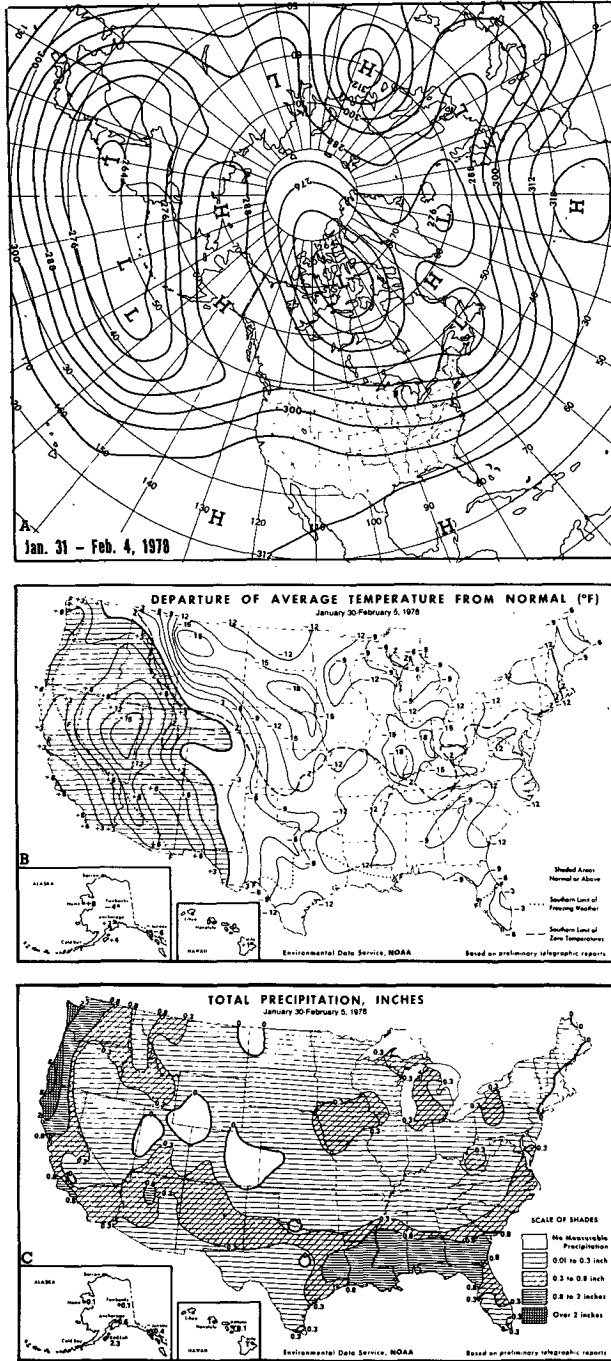


FIG. 8. (A) Mean 700 mb contours (dam) for 31 January–4 February 1978, (B) departure of normal of average surface air temperature (°F) and (C) total precipitation (inches) for week of 30 January–5 February 1978 (from National Oceanic and Atmospheric Administration & Economics, Statistics and Cooperatives Service, 1978).

Dry weather prevailed in both Alaska and Hawaii this month as storm systems moving in the fast and southward displaced westerlies were generally well removed from both areas. This continued a long-standing dry spell in Hawaii.

4. Variability within the month

a. 30 January–5 February

Early in the month progression of a deep upper low to south of the Aleutians was associated with the retrogression of a high-latitude ridge to an Alaska-northeast Siberia axis and the development of a deep trough over

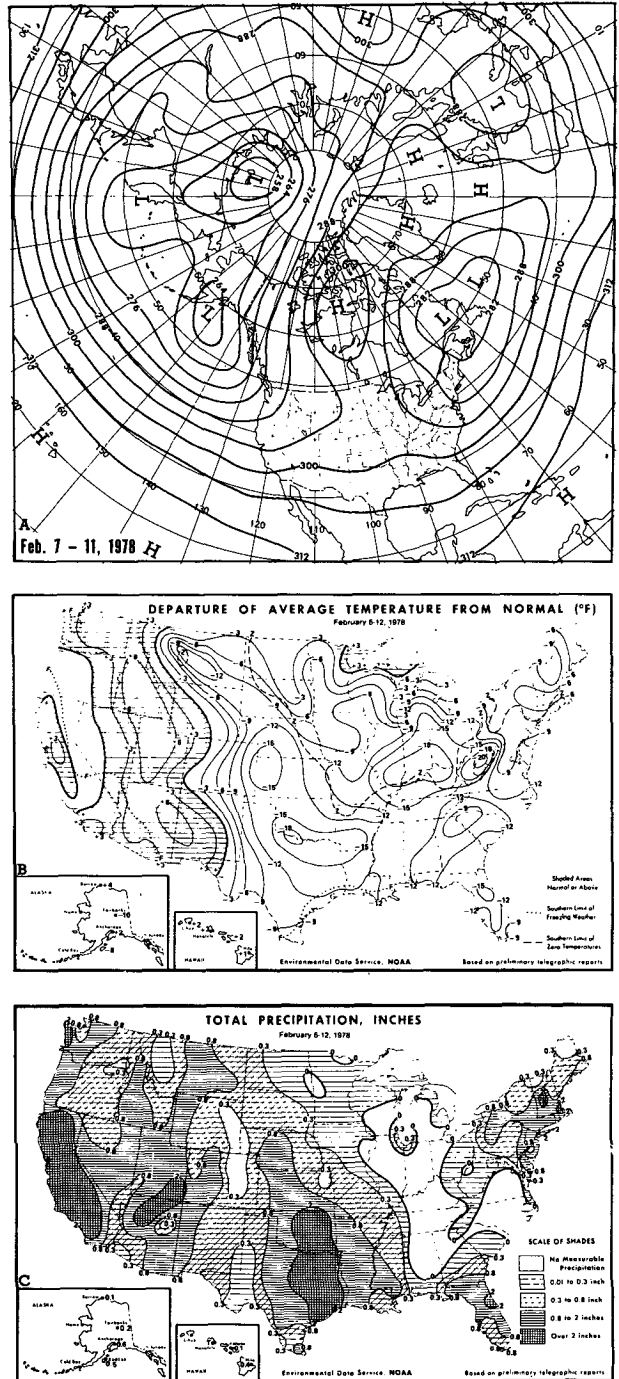


FIG. 9. As in Fig. 8 except (A) 7–11 February 1978 and (B) and (C) week of 6–12 February 1978.

north-central Canada (Fig. 8). The resulting strong northwesterly flow over northwest Canada drove very cold air over all of the United States east of the Continental Divide, while a strong mean ridge was accompanied by the warmest temperatures of the month in the West. Frequent storm systems steered to the northwest coast of the United States made this the

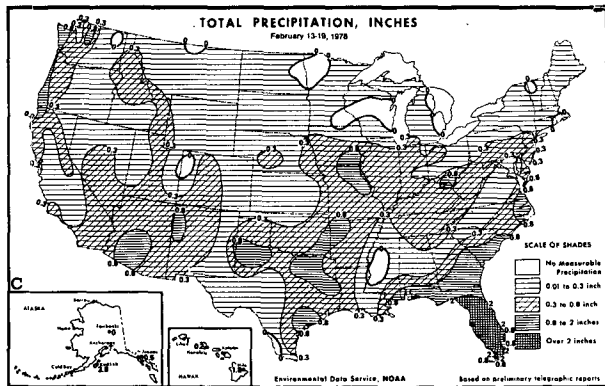
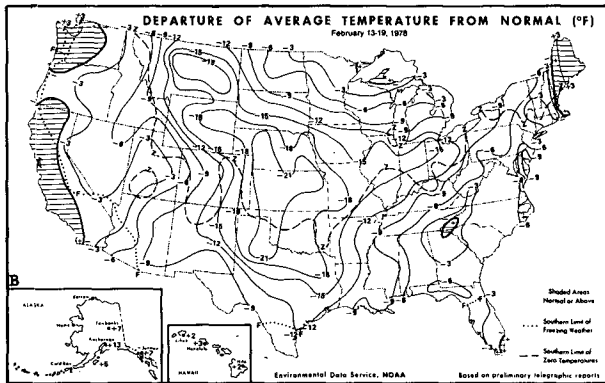
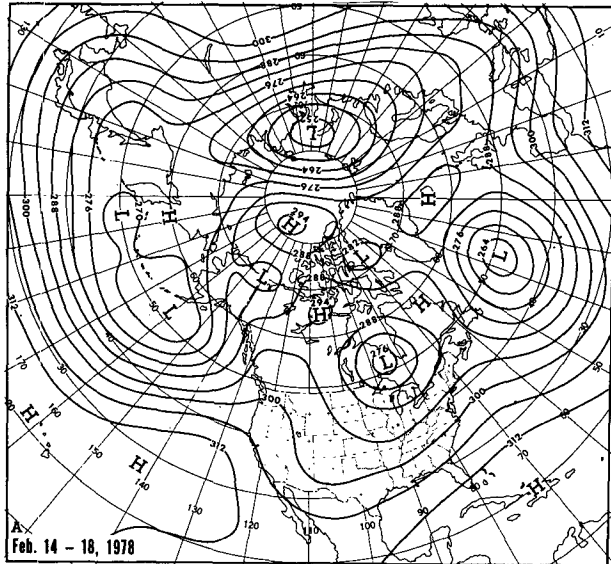


FIG. 10. As in Fig. 8 except (A) 14-18 February 1978 and (B) and (C) week of 13-19 February 1978.

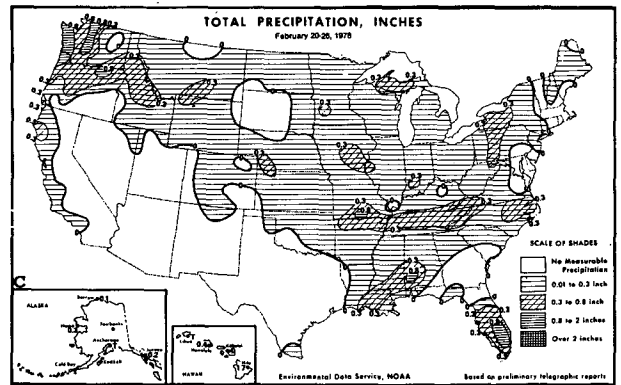
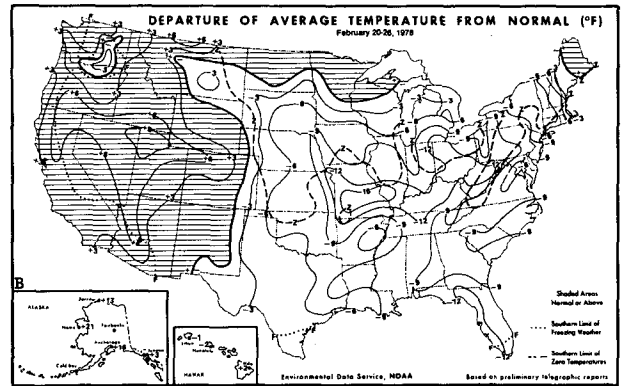
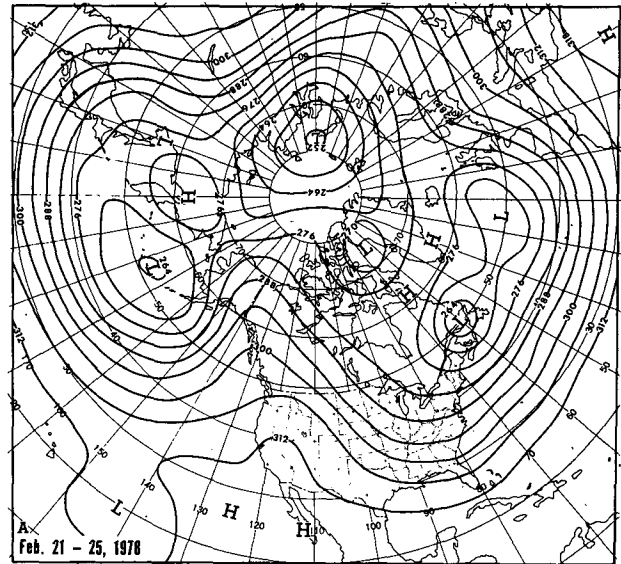


FIG. 11. As in Fig. 8 except (A) 21-25 February 1978 and (B) and (C) week of 20-26 February 1978.

wettest week of the month in that area. Elsewhere, significant precipitation was concentrated along the Gulf Coast, where a storm track continued to be active.

*b. 6-12 February*

By the first day of this week a high-latitude ridge had retrograded to northeastern Siberia and cold air

and cyclonic vorticity were strongly advected across Alaska to the vicinity of an already deep Pacific storm. The result was an explosive deepening over the northeast Pacific which is reflected in the mean circulation for the week (Fig. 9A). This was followed by the rapid building of a strong ridge over central Canada (replacing a deep mean trough), and the southward advection of a deep and cold upper low across the Great Lakes to the middle Atlantic Coast. As this vorticity maximum approached the coast, a storm formed east of Cape Hatteras on 6 February and deepened rapidly as it moved slowly northward on a near-coast trajectory, impeded in the movement by a strong surface pressure ridge over eastern Canada.

Heavy snowfall and strong winds accompanying this storm produced one of the worst winter storms of record in parts of the Northeast. Some of the greatest storm snowfall totals (6 and 7 February) were Blue Hills Observatory, MA, 30.1 inches, Providence, RI, 28.6 inches, Boston MA, 27.1 inches, Bridgeport, CT, 23.3 inches. Peak winds at Boston reached  $79 \text{ mi h}^{-1}$  on 6 February and  $60 \text{ mi h}^{-1}$  on 7 February; comparable speeds at Providence were  $67$  and  $35 \text{ mi h}^{-1}$ . Drifting snow closed highways and led to the declaration of a state of emergency in Connecticut and Rhode Island. In Massachusetts the emergency was compounded by flooding and wave action along the coast, where newspapers reported the highest tides of the century. The greatest damage due to flooding occurred at Revere, Hull, Scituate and the Houghs Neck section of Quincy, where an estimated 10 000 people were forced to evacuate their homes. There were reports of houses washed to sea and of at least two ships foundering off the Massachusetts Coast. Seventeen storm-related deaths were reported from the three affected New England states.

Elsewhere in the United States, temperatures continued below normal at most locations east of the Continental Divide and generally above normal to the West (Fig. 9B). The western warmth was considerably diminished, however, as the overlying ridge weakened.

Progression of the mean trough into the east Pacific, together with increasing westerlies along the southern border of the country, brought precipitation-producing storm systems to much of the western half of the

country and the Gulf of Mexico (Fig. 9C). Heavy rains over southern California produced flooding and mud slides, while severe blizzards were observed at Glasgow, MT, on 5–9 February and 11–12 February.

#### c. 13–19 February

Retrogression of midlatitude wave features in the vicinity of the United States brought a moderately strong mean ridge to the West Coast and a deep trough along a line from west Texas to James Bay (Fig. 10). While near to above normal temperatures prevailed near the western ridge, the retrograde position of that ridge produced the only cold week of the month in most areas west of the Divide. Elsewhere, cold weather prevailed except for parts of the East Coast well in advance of the mean trough. While proximity to the mean ridge kept precipitation relatively light along and near the West Coast this week, substantial amounts were recorded in the vicinity and to the east of the deep mean trough.

#### d. 20–26 February

The mean waves amplified and progressed over the United States this week, bringing a strong mean ridge to the Great Basin and the northern Rocky Mountains and a deep trough to the East Coast (Fig. 11). While average temperatures continued below normal in most areas east of the Divide, above normal temperatures returned to the West. Generally northerly wind components between the western ridge and the eastern trough made this the driest week of the month for the country as a whole.

#### REFERENCES

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- Wagner, A. James, 1977: Weather and circulation of January 1977—The coldest month on record in the Ohio Valley. *Mon. Wea. Rev.*, **105**, 553–560.
- Wagner, A. James, 1978: Weather and circulation of January 1978—Cold with record snowfall in the Midwest and Northeast; mild and wet in the West. *Mon. Wea. Rev.*, **106**, 579–585.