WEATHER AND CIRCULATION OF JANUARY 1978
Cold with Record Snowfall in the Midwest and Northeast,
Mild and Wet in the West

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1. Mean circulation

The January mean 700 mb circulation was characterized by vigorous cyclonic activity across the Pacific Ocean (Figs. 1 and 2). The marked strengthening of the Pacific westerlies over the previous month’s values to as much as 10 m s\(^{-1}\) above normal (cf. Figs. 1, 2 and 3 with the same in Taubensee, 1978) drove the high-latitude ridge component from the Bering Sea inland to the Yukon area, where it phased with the amplifying quasi-stationary ridge over the western United States and British Columbia. The downstream trough progressed slightly to a position a short distance inland from the east coast of North America.

The low-latitude ridge over the Atlantic moved eastward and amplified west of Europe, maintaining a strong trough over the Mediterranean Sea somewhat west of its December position. The remnant of the strong ridge that had been over Europe in December

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![](image.png)

**Fig. 1.** Mean 700 mb contours (dam) for January 1978.
was flattened by the general troughing over the area, although 700 mb heights were slightly above normal over western Russia (Figs. 1 and 2).

Thermal contrast between the warm Atlantic ridge and cold air over eastern North America (Fig. 4) contributed to unusually strong southwesterly flow across the Atlantic. Mean 700 mb wind speeds of 21 m s$^{-1}$ east of Newfoundland were 11 m s$^{-1}$ stronger than normal (Figs. 1 and 3). Arctic air moving south-eastward from the weak ridge over Greenland helped generate the vigorous cold low east of Spitzbergen and helped provide a cold air supply over northeast Asia for storms moving into the Pacific, where rapid deepening occurred repeatedly over the relatively warm water.

2. Temperature

Temperatures averaged well below normal in most areas east of the Continental Divide, while rather mild conditions prevailed in the West (Fig. 5). The cold weather east of the Rocky Mountains was due to frequent southward-moving polar highs steered by the strong ridge over northwest Canada (Fig. 1). The mild conditions in the West resulted from a relatively uninterrupted flow of maritime air crossing the Pacific from low latitudes and penetrating that area (Fig. 1). The cold areas bore a good relationship with the mean thickness anomaly, but the warmth west of the Con-
continental Divide was due largely to lack of radiational cooling near the surface at night with the frequent storms and excess cloudiness (Fig. 4). Temperatures over Alaska were generally several degrees warmer than normal in southerly flow aloft (Fig. 1), except at Fairbanks, which was near enough to the ridge to have strong radiational cooling from time to time. Hawaii was generally warmer than normal.

The cold weather over the eastern United States was, for the most part, much less severe than during the previous January (Wagner, 1977), but January 1978 was a few degrees colder over much of the Great Plains and western Gulf States, where it generally ranked as the third or fourth coldest on record (Table 1). Overall, the temperature anomaly pattern was quite similar to that of the previous January.

3. Precipitation

In sharp contrast with the dry January a year ago (Wagner, 1977), nearly the entire conterminous United States had above normal precipitation (Fig. 6). Only portions of the southern Great Plains and upper Mississippi River Valley had substantially less than normal amounts. There were two principal causes of the much wetter conditions in 1978. The subtropical westerlies were stronger this year, and in particular, they were able to break through the southern portion of the western ridge (Figs. 1 and 2), bringing frequent storms carrying large quantities of moisture from the

![Fig. 6. Percentage of normal precipitation for January 1978 from National Oceanic and Atmospheric Administration and Economics, Statistics, and Cooperative Service, 1978.)](image_url)
The disturbances moving in the subtropical westerlies picked up additional moisture when they reached the vicinity of the Gulf of Mexico. It was there that the second factor came into play to give a wet month to the eastern third of the country. The mean trough over eastern North America was noticeably further west in 1978 than in 1977, when cyclonic activity was mainly well off the coast. The trough position fluctuated across the Pacific into the Southwest. Extensive areas had more than three times the normal precipitation (Fig. 6), and several localities had a record wet January (Table 2).

Fig. 7. (A) Mean 700 mb contours (dam) for 3–7 January 1978; (B) departure from normal of average surface temperature (°F), and (C) total precipitation (inches) for week of 2–8 January 1978 (from National Oceanic and Atmospheric Administration and Economics, Statistics, and Cooperative Service, 1978).

Fig. 8. As in Fig. 7 except (A) 10–14 January 1978 and (B) and (C) week of 9–15 January 1978.
in January 1978 between the Mississippi Valley and the Atlantic Coast. When the trough was in the more western position, storms were steered northeastward through the Ohio Valley, and when it was near the Appalachians, storms moved along or just off the coast. As a result, precipitation was heavy over a wide area, and numerous snowfall and precipitation records were broken in a large area encompassing the northeastern quadrant of the country (Table 2).

Portions of the south coast of Alaska were again wet, similar to last year, and Hawaii was extremely dry, since intense cyclonic activity over the central Pacific suppressed the trade winds but did not dip far enough south to provide Kona type precipitation.

4. Weekly variability

a. 2–8 January

The amplified ridge over eastern Alaska the previous week (Taubensee, 1978) was undercut by strong westerlies crossing the Pacific, leaving a closed blocking high over Alaska (Fig. 7A). The northern portion of the eastern North America trough progressed to the Labrador coast, while the downstream ridge also advanced from the eastern Atlantic to the British Isles. Overall the circulation features became less amplified and moved eastward from the previous week’s positions.

In agreement with the generally flat pattern, temperatures were near normal over most of the eastern and central part of the United States. This was the mildest week of the month east of the Continental Divide, and contained the only days of January in which the temperature was above normal over much of the middle of the country. Cold air moving southward east of the Alaskan block filtered into the northern Great Plains, and to a lesser extent, into the interior Columbia River Valley (Fig. 7B). It was generally quite mild over the Great Basin under the influence of Pacific air masses.

The maritime air in the West also brought copious rains along the entire Pacific coast, most of which received more than 2 inches for the week (Fig. 7C). The rains were accompanied by a thunderstorm with

Fig. 9. Mean 700 mb height change (m) from first half to second half of January 1978.

Fig. 10. As in Fig. 7 except (A) 17–21 January 1978 and (B) and (C) week of 16–22 January 1978.
hail at San Francisco, and a tornado in southern California. Tornadoes and severe thunderstorms also occurred in the South in advance of a sharp cold front marking the leading edge of a strong Arctic outbreak at the end of the week.

b. 9–15 January

The circulation amplified from the eastern Pacific to western Europe, and shortening wavelengths were brought about by progression over the eastern Pacific and retrogression over the Atlantic. Cold air covered the entire United States east of the Continental Divide as Arctic highs moved southeastward in the strong flow between the full-latitude ridge over the West and the sharp trough near the Atlantic coast (Figs. 8A and 8B).

The cold air was ushered into the East by an intense storm at the beginning of the week, which brought heavy rains to the Northeast ahead of the cold front (Fig. 8C). At the end of the week another storm produced heavy snow over a wide area from the central Mississippi Valley to New England. Frequent storms brought moisture-laden subtropical air into the Southwest. Parts of California had more than 5 inches of rain for the week, while record high temperatures were observed in the Great Basin.

Over the Pacific, tropical storm Nadine formed on 10 January from a weak tropical depression. The unusual off-season storm passed within 100 km of Wake Island on the 12th and 13th, before weakening as it turned northeastward in the vicinity of a polar front.

c. 16–22 January

During the latter part of the month, the westerlies moved northward over the eastern Pacific accompanying 700 mb height rises off the west coast (Fig. 9). Large height falls occurred over the British Isles as strong cyclonic activity moved into the area and the Atlantic midlatitude westerlies moved southward, suppressing part of the previously strong ridge to lower latitudes off Africa. The midlatitude portion of the ridge moved eastward into Europe (Fig. 10A) and then northward, where it contributed to the strong height rises over the polar basin. Other contributions to the polar blocking surge came from the northern part of the western North American ridge.

The low-latitude eastern Pacific trough moved eastward, where it contributed to the trough over the southern Mississippi Valley trough (Fig. 10A). Although the 700 mb flow pattern was considerably less amplified over the United States, the temperature anomaly for the week changed little (Fig. 10B). A decrease in the southerly component of the maritime air entering the Southwest resulted in some cooling there, although the sign of the temperature anomaly remained unchanged at most locations.

Precipitation was widespread across the entire country, with weekly totals of more than 2 inches again occurring along the Pacific Coast (Fig. 10c). Most of the East and portions of the Ohio Valley also received 2 inches or more, and nearly all of this was in the form of snow in the Midwest and Northeast. Two major winter storms struck these areas. The first one, on 16–17 January, produced record 24 h snowfall totals.
of 13.6 inches at Cairo, Ill., 14.1 inches at Louisville, Ky., and 11.3 inches at Cincinnati, Ohio. Following the storm, many places near the Ohio River reported their greatest snow depth of record on the ground. A second storm on 19–20 January moved up the East Coast giving a damaging ice storm to parts of North Carolina and Virginia, and near-record 24 h snowfall totals of 17.8 inches at Newark, N.J., and 21.0 inches at Boston, Mass. Albany, N.Y. reported a total of 31.9 inches of snow from three storms within a 9-day period.

A rather unusual, though not significant or severe, storm formed over the central Atlantic under the bottom of a polar trough cut off south of the strong ridge (Figs. 8A and 10A). It moved westward as far as the eastern Bahamas before losing its closed circulation on 24 January. Ship reports from its vicinity indicated considerable shower activity and some squally weather accompanied the storm.

d. 23–29 January

The circulation pattern again amplified, maintaining a flow of Arctic air into the central and southeastern part of the country (Figs. 11A and 11B). The cold air retrograded somewhat in response to the strong 700 mb ridge which built along the West Coast, where precipitation diminished considerably (Fig. 11C). Phasing of a sharp trough crossing the southern United States with a lobe of the polar low pushed southward by strong blocking in northern Canada resulted in the development of the worst blizzard on record in the Ohio Valley on 26 January. The southernmost trough helped to draw large quantities of moisture northward into close proximity with Arctic air.

The storm deepened 40 mb in 24 h, and dozens of cities with records going back a century or more reported the lowest sea level pressure on record. The lowest pressure reported in the United States during this storm was 28.28 inches, at Cleveland, Ohio. Stations as far south as Atlanta, Ga., and as far east as Wilmington, N.C., reported the lowest pressure ever observed during January.

Wind gusts approached hurricane force over a wide area and exceeded it near the storm center. Cleveland reported a record peak gust of 82 mph and Erie, Pa., had 78 mph. Even far to the east of the storm center, exposed locations such as Blue Hill Meteorological Observatory near Boston had gusts as high as 72 mph, and instruments on the Chesapeake Bay Bridge recorded 90 mph gusts. Damaging winds were reported as far south as Tallahassee, Fla. A freak tornado struck Quantico, Va., in the middle of the night. Most of the strong winds were in the warm sector over the East, but the strongest winds in the Ohio Valley were accompanied by temperatures between 0° and 10°F, giving severe wind chill factors and whipping the snow into mountainous drifts which paralyzed transportation for days.

The heaviest snowfall from the blizzard was observed just west of the storm center. Record 24 h totals were observed at several cities. Dayton, Ohio, had 12.2 inches, Grand Rapids, Mich., reported 16.1 inches and Houghton Lake, Mich., recorded 15.4 inches.

REFERENCES

