WEATHER AND CIRCULATION OF JANUARY 1976

Increasing Drought in California and the Southern Great Plains

A. JAMES WAGNER

National Meteorological Center, National Weather Service, NOAA, Washington, D. C. 20233

1. Mean circulation

Fast mid-latitude westerlies and a pronounced 3-wave pattern with broad troughs over eastern North America, eastern Europe, and the western Pacific were outstanding features of the Northern Hemisphere 700 mb circulation during January 1976 (Fig. 1). Locations of the principal troughs and ridges did not change appreciably from the previous month (Taubensee, 1976), although the record 700 mb polar westerlies observed in December weakened while the mid-latitude westerlies in-

creased, mainly as a result of southward motion of the anomalously strong eastern Atlantic ridge and deepening of the trough over eastern North America (Figs. 1 and 2).

The anomalously strong subtropical highs over the eastern Atlantic and eastern Pacific were still displaced well north of normal, with the result that the axis of maximum winds was likewise located north of normal in these areas (Figs. 2 and 3). Wind speeds across the eastern Pacific and the entire Atlantic averaged 6 to 9

FIG. 1. Mean 700 mb height contours (dekameters) for January 1976.

FIG. 2. Departure from normal of mean 700 mb height (m) for January 1976.

m s^{-1} stronger than normal near the maximum axis. The subtropical westerlies averaged more than 3 m s^{-1} weaker than normal over the Western Hemisphere, declining by more than 1 m s^{-1} from the December value at a time when speeds are normally increasing.

The areas of strong mean wind over the eastern Pacific and Atlantic were also areas, in the lower troposphere, of enhanced baroclinic contrast and available potential energy for cyclogenesis (Fig. 4). The strong ridge over Asia continued northerly anomalous flow over China, contributing cold air to stimulate cyclo-

FIG. 3. Mean 700 mb geostrophic wind speed (m s^{-1}) for January 1976. Solid arrows indicate observed axes of maximum wind speed; dashed lines show the normal.

FIG. 4. Departure from normal of mean 1000 to 700 mb thickness (m) for January 1976.

genesis in the deep trough over the western and central Pacific.

The anomalously strong westerlies and baroclinic zone, a feature persisting over 2 months across the North Atlantic (see also Taubensee, 1976), contributed to the development of a violent gale affecting the British Isles, North Sea, lower Scandinavia and central Europe on 2 and 3 January. Peak gusts of over hurricane force caused considerable damage and numerous casualties in several countries.

Around the middle of the month, deepening of the trough in the central Pacific led to an extensive downstream amplification of the planetary waves. The ridge near the West Coast of North America amplified, the trough deepened over the eastern United States, and a new ridge amplified over the central Atlantic west of the initial mean ridge, causing retrogression. After being absent most of the season, cold air from the North Atlantic and Greenland was brought south-eastward into Europe, and the lower part of the eastern European trough retrograded from the Black Sea to the eastern Mediterranean Sea from the first half to the second half of the month.

2. Temperature

For the first time in 5 years (Posey, 1971), January was predominantly warm in the West and cold in the East (Fig. 5). The overall temperature anomaly pattern agreed well with the thickness anomaly pattern (Fig. 4), except for a small area of warmer than normal temperature over the central Great Plains.

Large departures from normal were observed at opposite ends of the country. Concord, N. H., had the coldest January on record, averaging 10.9°F , which was

FIG. 5. Departure from normal of average surface temperature (°F) for January 1976 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service 1976).

9.7°F below normal. Los Angeles, Cal. (International Apt.), and Sacramento, Cal. (city office), both averaged more than 5°F above normal, and the latter reported the 2nd warmest January on record. The strong ridge near the West Coast with northeasterly anomalous flow in the lower troposphere over California (Figs. 1 and 2) contributed to the unusual warmth. Santa Ana conditions were observed at times along the southern California coast.

Greatest anomalous warmth in an absolute sense occurred over western Montana, where frequent Chinook winds caused by the strong western 700 mb ridge and northward displaced wind maximum (Fig. 3) led to monthly mean temperatures of 5°F to 10°F above normal.

Although it did not have a record cold January, northern Florida had persistently colder than normal temperatures, especially the daily minima. Tallahassee, Fla., tied the 1940 record of 19 days with minimum temperatures at or below freezing, and Jacksonville, Fla., had a record 26 days with minima of 32°F or lower.

FIG. 6. Percentage of normal precipitation for January 1976 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service 1976).

Strong maritime flow from the south led to a mild January along the south coast of Alaska, but northern and western sections were colder than normal. Temperatures averaged near to above normal in Hawaii, near the western lobe of the strong eastern Pacific ridge (Fig. 1).

3. Precipitation

Most of the southwestern quarter of the Nation had less than half the normal precipitation, and extensive areas reported less than one-tenth the normal amount (Fig. 6). Several cities in California and in the Great Plains reported one of the driest Januarys on record (Table 1), somewhat similar to the pattern 4 years ago (Wagner, 1972). Agricultural consequences of the long drought, which had been developing since late fall in some places, were becoming increasingly severe in the important winter produce areas of California, as well as in the Great Plains where the lack of precipitation meant inadequate snow cover protection for winter wheat and left soils in "ready to blow" condition.

TABLE 1. Record and near-record dry monthly and seasonal precipitation totals observed during January 1976.

Station	Amount (inches)	Anomaly (inches)	Remarks
San Diego, Calif.	T	-1.88	Tied with Jan 1948 for driest
San Francisco, Calif.	0.31	-4.20	2nd driest Jan in 127-yr record
	0.92	—	Driest Nov-Jan on record
Sacramento, Calif.	0.37	-3.58	3rd driest Jan
Fresno, Calif.	0.04	-1.80	3rd driest Jan
Mount Shasta, Calif.	0.48	-6.17	3rd driest Jan, driest since 1920
Stockton, Calif.	0.14	-2.77	Driest Jan
Grand Junction, Colo.	0.13	-0.51	4th driest Jan
Albuquerque, N. M.	0.00	-0.30	Tied with Jan 1928 for driest
Oklahoma City, OK.	T	-1.11	Driest Jan
Eureka, Calif.	1.88	-5.13	3rd driest Jan
Wichita, Kans.	0.04	-0.81	Driest since 1961
Sioux City, Iowa	1.1	—	Least Dec-Jan snowfall
	0.43	—	4th driest Dec-Jan

cold front moved off the Atlantic Coast over the weekend, additional precipitation fell over much of the East.

b. 5-11 January

While blocking developed over northeast Siberia and the Bering Straits, the westerlies moved southward over

FIG. 8. Same as Fig. 7; (A) for 6-10 January 1976, (B) and (C) for week of 5-11 January 1976.

FIG. 9. Same as Fig. 7; (A) for 13-17 January 1976, (B) and (C) for week of 12-18 January 1976.

the Pacific with decreasing amplitude in the perturbations (Fig. 8A). The flow pattern also flattened over the United States, with the sharp mean trough over the Great Plains the previous week moving eastward into a broad trough over the eastern part of the country.

FIG. 10. Same as Fig. 7; (A) for 20-24 January 1976, (B) and (C) for week of 19-25 January 1976.

Increased northerly flow from Canada, however, helped bring temperatures below normal over the entire eastern three-fourths of the United States, as it reinforced the eastward-moving cold air which had affected the West the previous week (Fig. 8B). Temperatures averaged more than 12°F below normal over

portions of the northern Great Plains and Mississippi Valley, the western slopes of the Appalachians, and northern New England. Fast flow from the Pacific moderated conditions over much of the West, particularly in the upper Columbia River Valley, where temperatures averaged over 9°F above normal.

Precipitation was heaviest along the north Pacific Coast in the region of strong onshore flow affected by several storm systems, while considerable rain, some due to convective activity, fell over the Southeast (Fig. 8C). It remained rainless over most of the southwestern states. The combination of cyclonic flow and cold air over the Great Lakes led to severe snow squalls in some areas, with as much as 4½ feet falling in New York State.

c. 12-18 January

Deepening of a broad trough over the central Pacific led to amplification of the ridge over western North America and downstream deepening of the southern portion of the full latitude trough over the eastern United States (Fig. 9A).

Somewhat lower 700 mb heights over northwest Canada reduced the southward plunge of cold air into the central United States; as a result, warmer than normal air masses prevailed as far eastward as the Mississippi River (Fig. 9B). Temperatures averaged as much as 18°F above normal in Montana, 12°F above normal over the central Great Plains, and 9°F above normal along the southern California coast. San Diego, Calif., set daily records for warmth on the 15th and 16th with 80°F and 86°F respectively.

The strong trough kept mild air from penetrating into the eastern part of the country, where temperatures averaged as much as 9°F below normal over northern New England with repeated cold outbreaks. Grand Rapids, Mich., set daily record low temperatures of -10°F and -13°F on the 17th and 18th, respectively, and -18°F on the 18th at Detroit, Mich., was the lowest ever observed in January. Unusually cold daily record low temperatures, as low as 5°F at Raleigh, N. C., and 28°F at Tampa, Fla., were noted in the Southeast the following day.

Precipitation was relatively light over most of the country, with the exception of the extreme northwest Pacific Coast and New England (Fig. 9C). The area of rainless conditions expanded northward to the central Rocky Mountains and eastward to the southern Mississippi Valley as the ridge strengthened in the West.

d. 19-25 January

Height rises over northwest Canada and a slight eastward progression of the North American trough to the Atlantic Coast moved the coldest air eastward to the East Coast States (Fig. 10A, B). Between 20 and

23 January, a large piece of the main Polar Low plunged bodily southeastward from the Canadian Archipelago to the Gulf of St. Lawrence, bringing bitterly cold temperatures to New York and New England, which averaged as much as 18°F below normal for the week. On the 22nd and 23rd, temperatures remained below zero over much of New England, with gale force winds gusting to over 50 mi h^{-1} contributing extreme wind-chill factors. Providence, R. I., reported a new all-time low temperature of -13°F on the 23rd. Mount Washington Observatory, N. H., lived up to its reputation, on the 23rd, for having the worst weather in the world: daily mean temperature -26°F , which was 31°F below normal, accompanied by winds averaging 63.4 mi h^{-1} with a peak gust of 130 mi h^{-1} .

There was little change in the generally mild conditions prevailing over the western two-thirds of the Nation. Greatest weekly anomalies were 12°F above normal in Montana and 9°F above normal over the desert Southwest (Fig. 10B). Record daily warm temperatures occurred at San Diego, Calif., and Havre, Mont.

Precipitation was again light over the country as a whole, as northwesterly flow prevailed in most areas (Fig. 10C). Only by the 25th, when a new daily trough, not included in the mean (Fig. 10A), deepened over the Rockies, did heavy precipitation break out in the lower Mississippi Valley area. Four tornadoes occurred in Louisiana, but there were no fatalities.

e. 26 January–1 February

Amplification of a full-latitude trough over the central Pacific led to further building of the ridge over California. Heights fell again over northwest Canada and a series of Alberta Lows moving southeastward to the Great Lakes area prevented much Arctic air from entering the United States (Fig. 11A, B). Gradual retrogression of the amplified Azores ridge for several weeks dumped colder air into Europe and activated the normal winter Mediterranean storm systems after an extended period of absence.

It was the mildest week of January over the United States, with weekly mean temperatures averaging as much as 24°F above normal over Montana (Fig. 11B). Daily records for warmth were set on the 27th with 55°F at Havre, Mont., and on the last day of the month the 74°F observed at Sacramento, Calif., was the warmest ever observed in January.

Retrogression of the eastern trough to the Great Lakes area allowed mild and wet conditions to extend northward along the Atlantic Coast (Fig. 11A, B, C). Most of the area east of the Appalachian Mountains had more than 2 inches of rain during the week. Ice jams aggravated flooding on several rivers in the Northeast, as a sudden thaw followed the bitter cold of the previous week. The rainless area over the Southwest expanded again under the influence of the amplified

FIG. 11. Same as Fig. 7; (A) for 27–31 January 1976, (B) and (C) for week of 26 January–1 February 1976.

ridge, extending northward to the Canadian border in Montana and eastward to portions of the Mississippi River Valley.

A final unusual event, a full-fledged typhoon (Kathy), developed over the western Pacific the last 2 days of

the month. It moved slowly northeastward east of the Philippines. The monthly mean circulation (Fig. 2) had stronger than normal easterlies in that area.

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