WEATHER AND CIRCULATION OF NOVEMBER 1980
A Late Heat Wave and Hurricane and Early Snow

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1. Mean circulation

At 700 mb the pattern of mean heights (Fig. 1) over the Northern Hemisphere underwent a number of alterations from October (described by Dickson, 1980) that resulted in an increase in its zonal symmetry. This change was attended by the confinement of much of the anomalously cold lower tropospheric air (Fig. 2) to high latitudes and by the maintenance of relatively fast midlatitude westerly winds in all quadrants (Fig. 3).

In effecting these changes, the diminution of high-latitude blocking ridges in both hemispheres played a key role. The ridge over the Canadian Archipelago retrograded to the Arctic Ocean, separating itself from the western North American ridge and the ridge near Iceland. In the advance of this retrogression a low moved southward to north-central Asia, leading to a strong negative height anomaly center (Fig. 4) focused just southwest of Novaya Zemlya.

The intensity of this center can partially be attributed to the strengthening of the upstream ridge near Iceland. Whatever the case it supplanted a major October ridge at 700 mb over the central Soviet Union which faded to the south and east. Additionally, the low developed a lobe (both on height and height anomaly charts) extending far to the east between 60 and 70°N latitudes.

Prior to the appearance of this eastward extension of cyclonic activity, the usual snow cover at this time of year between the 100 and 140°E meridians south of 60°N latitude was largely missing. This may have been a contributing factor to the trough's development, as well as to the appearance of intense baroclinity along 60°N latitude, and the acceleration of westerlies further north than usual in east Asia. To the south, the Asian coastal trough substantially filled in the face of an upstream source of anticyclonic vorticity and increased westerlies from the continent.

On the opposite side of the hemisphere the removal of the block from northern Canada allowed deepening of a low over the Archipelago. This represented a split in the trough over eastern North America with the southern part moving well out over the western Atlantic. Its progression was accompanied by frequent and major storm development over the western and central Atlantic, transport of cold air from the continent, and a large increase in mid-ocean westerly wind strength. Because the mid-Pacific trough remained in its October position, the progression of the Atlantic trough permitted the maintenance of a separate trough over Texas. Also, ridges swelled off both the southeast and southwest coasts of the United States resulting in a bridge of positive height anomalies across most of the Nation.

2. Temperatures

Most of the prominent features in the November temperature anomaly pattern (Fig. 5) can be easily associated with the mean flow conditions during November (Figs. 1–4). The large positive departures from normal over the northern Great Plains and the Pacific Northwest are related to higher-than-normal heights aloft and in the case of the latter, mean southwesterly and maritime flow. In contrast, the cold conditions in the Northeast occurred with mean negative height anomalies and southeastward transport of Canadian air aloft.

Less obvious is the genesis of the large temperature gradient anomaly between west Texas and northwest Arizona, especially in the context of the modest scale and magnitude of the negative height anomaly over Texas. The entire region participated in a heat wave early in the month that produced a number of new high-temperature records (Table 1) across the Southwest and central northern plains. In the latter half of the month, however, two major early season snowfalls undoubtedly played a role in producing the sharply focused cold anomaly in western Texas. On 8 November, Abilene, TX reported a new record-high temperature for November of 92°F—only nine days later (November 17) the same observing facility noted a record-low maximum temperature of 35°F for the date. Both the snow and the changing weather conditions in the Southwest will be discussed in more detail in Sections 3 and 4.

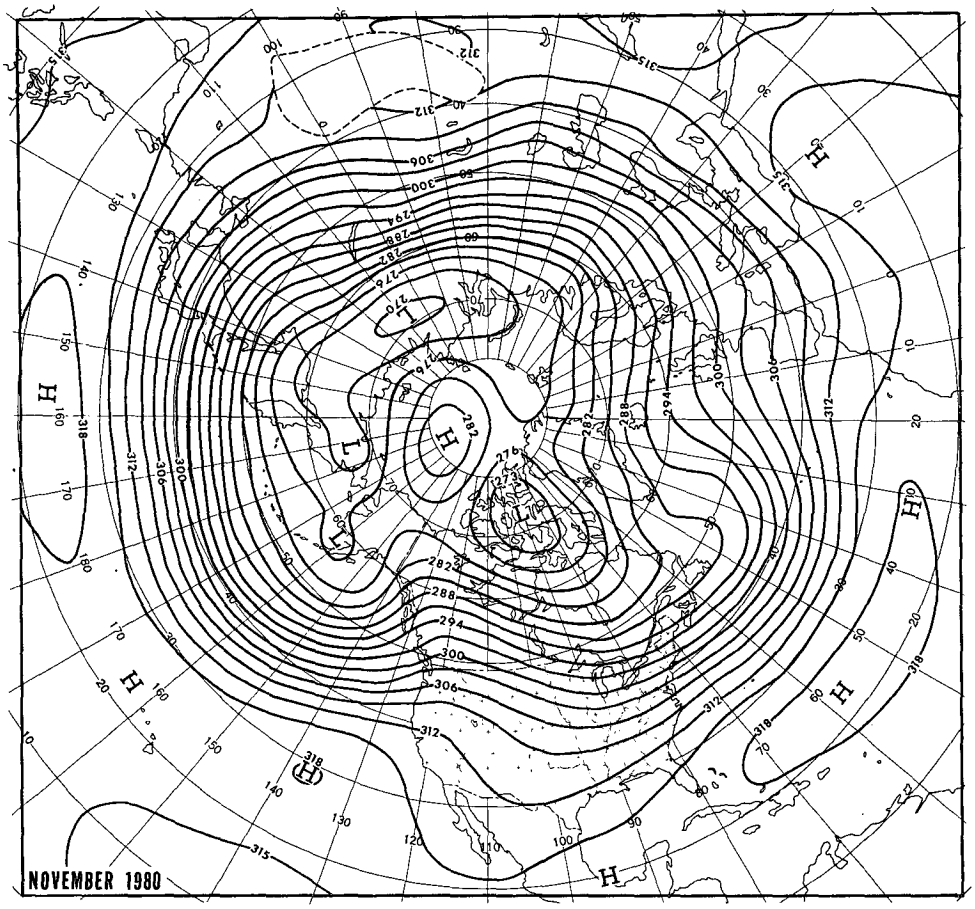


FIG. 1. Mean 700 mb height contours (dam) for November 1980.

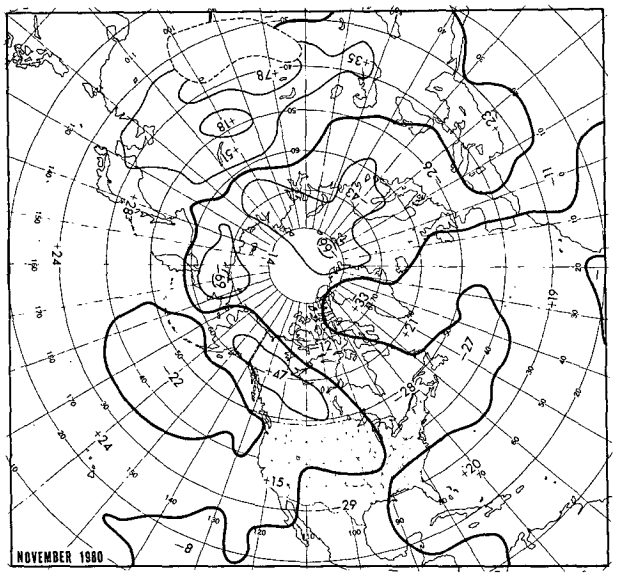


FIG. 2. Departure from normal of mean 1000–700 mb thickness (m) for November 1980.

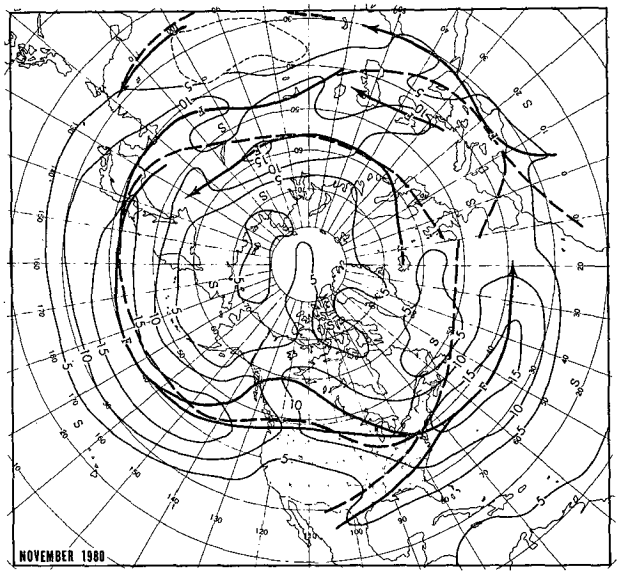


FIG. 3. Mean 700 mb geostrophic wind speed (m s^{-1}) for November 1980. Solid arrows indicate observed axes of maximum wind speed and dashed lines, the normal.

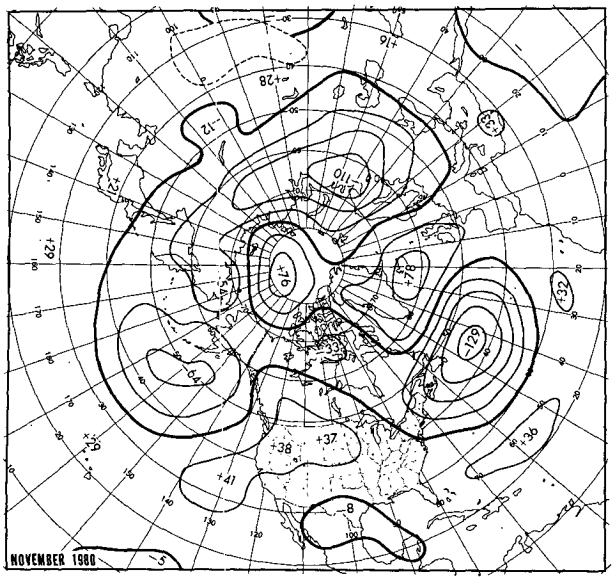


FIG. 4. Departure from normal of mean 700 mb height (m) for November 1980.

Mean temperatures averaged generally near normal over the Hawaiian Islands during November and mostly above normal in Alaska (especially in south coastal and central areas). The latter occurred with the stronger than usual southerly flow at 700 mb off of a warmer than usual eastern Gulf of Alaska.

3. Precipitation

The two Texas snowstorms mentioned in Section 2 were largely responsible for the noteworthy maximum over the region in November precipitation departures (Fig. 6). One of the hardest hit localities was Lubbock, TX, where the daily snowfall exceeded 10 inches twice during the month. The same two storms contributed greatly to the zone of moderate precipitation totals that extended northeast from Louisiana to Maine. Much of this activity was in response to the steady advancement of the mean trough from the east Pacific over the southern half of the United States.

Elsewhere the Pacific Northwest, the eastern Intermountain region, the eastern slopes of the Rocky Mountains, and an area near the central U.S.-Canadian border all received significant amounts of precipitation mostly associated with disturbances from the Pacific and lee developments. A large portion of south Florida's impressive totals—e.g., 22.5 inches at Key West on 11 November—is directly attributable to Hurricane Jeanne (see Section 5).

The central plains and southwest were quite dry in November, but a region of developing water shortages, the coastal Northeast, received enough rain to bring partial relief. Alaskan precipitation amounts

TABLE 1. Temperature records equaled or exceeded in November 1980.

Station	Date	Temperature (°F)	Remarks
San Angelo, TX	8	93	Highest for November
Abilene, TX	8	92	Highest so late Highest for November
Dodge City, KS	6	91	Highest so late Highest for November
Phoenix, AZ	7	89	Highest so late
	10	88	Equaled highest so late
Amarillo, TX	8	87	Highest so late Highest for November
Oklahoma City, OK	6	85	Equaled highest so late
	7	86	Highest so late
	8	87	Highest so late Equaled highest for November
Las Vegas, NV	4	85	Equaled highest for November
Topeka, KS	8	85	Highest so late Highest for November
Witchita, KS	7	81	Highest so late
	8	85	Highest so late Highest for November
Concordia, KS	6	84	Highest so late Highest for November
Pueblo, CO	6	83	Equaled highest so late Equaled highest for November
	7	84	Highest so late Highest for November
North Platte, NE	6	82	Highest so late
Asheville, NC	9	78	Highest so late
Reno, NV	5	77	Highest so late
Albuquerque, NM	8	76	Highest so late
	9	75	Highest so late
	10	73	Highest so late
Ely, NV	5	74	Highest so late
Concord, NH	3	13	Equaled lowest so early

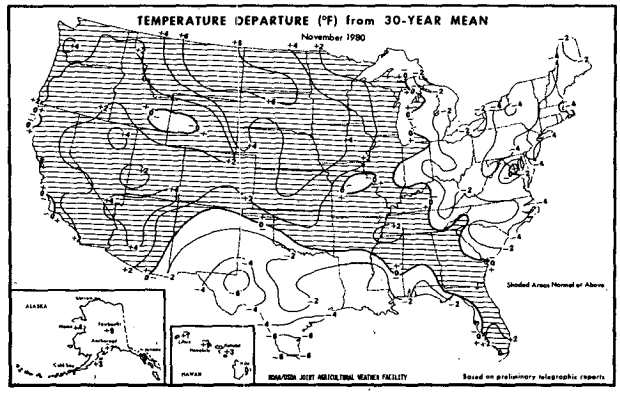


FIG. 5. Departure from normal of average surface air temperature (°F) for November 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperative Service, 1980).

were mostly near normal. Hawaii, under the influence of a well-developed subtropical ridge, had less rain than usual.

4. Variability within the month

a. 3–9 November

For the second week in a row (Fig. 11a from Dickson, 1980, and Fig. 7a here), the upper air long-wave pattern over North America was somewhat in phase between middle and high latitudes. However, despite substantial deepening of a low south of Baffin Island, the northerly component of the 700 mb flow over the United States decreased as the trough at 150°W longitude deepened and the strong ridge over western North America flattened north of the U.S. border. As a result almost the entire country benefited from a combination of clear skies and a mild air mass of Pacific origin.

All of this manifests itself in Figs. 7b and 7c as widespread large positive temperature departures from normal and dryness, respectively. In an area-weighted integral sense, Fig. 7b is even more impressive than its counterpart for the climax week of the 1980 summer heat wave (Fig. 9b from Livezey, 1980). High-temperature records for November or for so late in the season were equaled or set at numerous locations over the Great Plains and the Southwest (Table 1). Substantially cooler air than normal was strictly limited to New England, parts of New York and Pennsylvania, and coastal points in the Florida Panhandle. Interestingly, the only entry on Table 1 not related to the early November heat event is for a record low temperature equaled so early in the season at Concord, NH, in this same week.

The changes at 700 mb that allowed moderate temperatures to develop across the country increased the vulnerability of the Northwest to Pacific disturbances. Most of the other precipitation shown in Fig. 7c is related to an east-west stationary front near the U.S.-Canadian border and developments on the front in the latter part of the week. Hawaii, except to the windward, was mostly dry near the mean subtropical

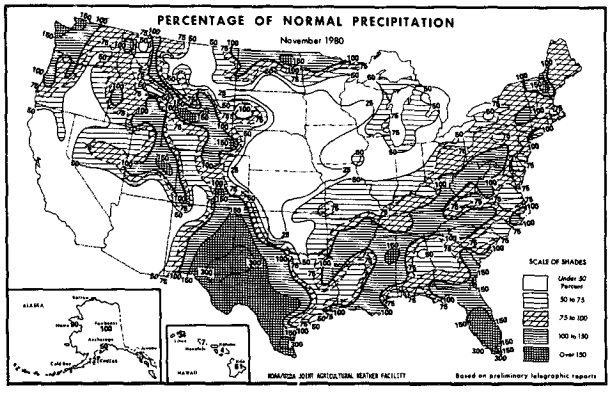
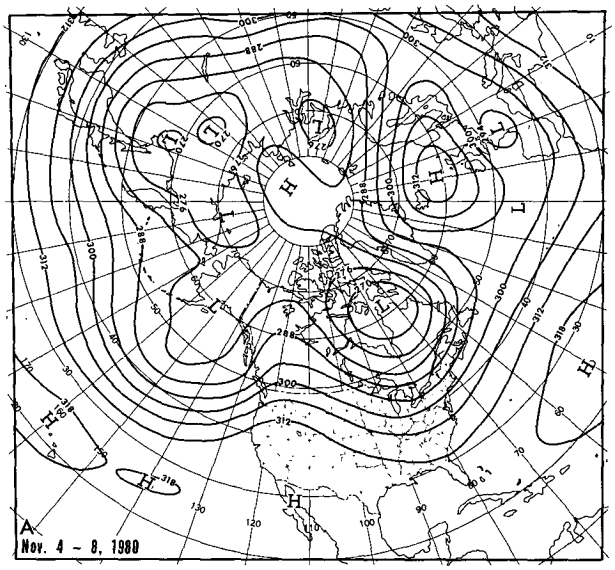
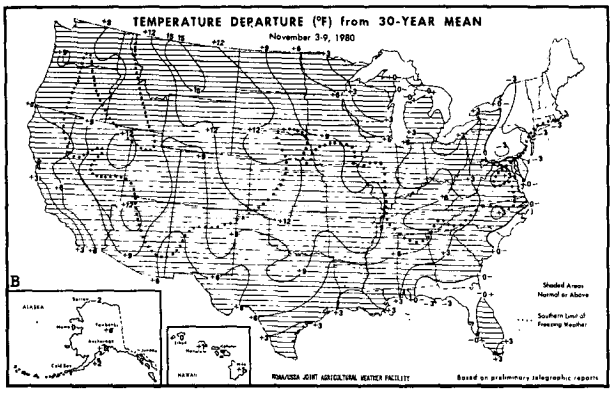


FIG. 6. Percentage of normal precipitation for November 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperative Service, 1980).





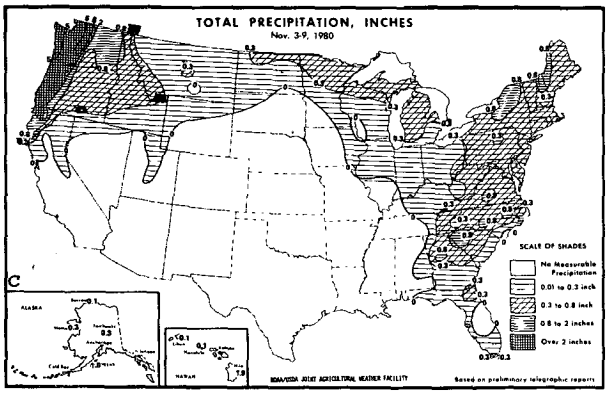


FIG. 7. (A) Mean 700 mb contours (dam) for 4–8 November 1980; (B) departure from normal of average surface air temperature (°F) and (C) total precipitation (inches) for week of 3–9 November 1980 (from National Oceanic and Atmospheric Administration and Economics, Statistics and Cooperative Service, 1980).

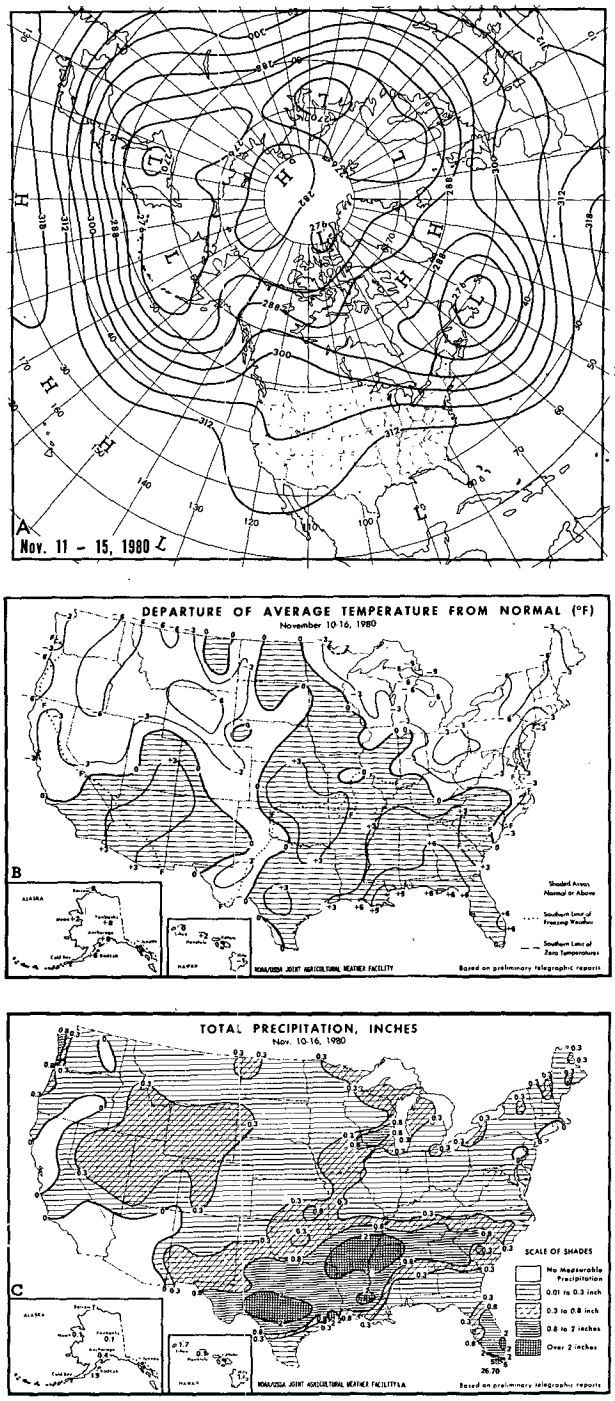


FIG. 8. As in Fig. 7 except for (A) 11–15 November 1980, and (B) and (C) week of 10–16 November 1980.

ridge, while the south coast and interior of Alaska were warmer than usual.

b. 10–16 November

The largest changes during November in the upper-air circulation over North America (Fig. 8a), and consequently the largest changes in the associated weather for the United States (Figs. 8b and 8c), took place in the second full week of the month.

General retrogression of waves at high latitudes and advancement at low converted a formerly in-phase pattern to an out-of-phase one. Weakening of the Asiatic coastal trough and the collapse of the northwest Pacific ridge attended the shearing of both the North American ridge and the Pacific trough, the northern parts retrograding to Alaska and the Bering Sea, respectively, and the southern parts moving over the central and western United States. Similarly, the retrogression of the blocking high near Iceland to the Davis Strait was coincidental with the splitting of the North American low, which in the north retrograded to the Canadian Archipelago and in the south advanced to the east of Newfoundland.

One of the consequences of these changes was to shut off the supply of mild Pacific air to all but the Southwest. Arizona and southern California, however, continued to be quite dry and near the end of the week the latter was plagued by Santa Ana winds that fanned damaging brush fires. Otherwise, relatively warm temperatures were confined to the central plains states and the Southeast in the vicinity of the strengthened mean ridge. In the case of the Northeast and the Great Lakes region increased northwesterly flow permitted cold air to drive further south and east, noticeably enlarging the area covered by cold anomalies the previous week. Over much of the Northwest a mean trough, cloudiness, and frequent precipitation depressed temperatures considerably. Lastly, the south coast and interior of Alaska remained quite mild as the maritime flow from the relatively warm eastern Gulf of Alaska increased.

The sequence of events that accounts for most of the precipitation shown in Fig. 8c was associated with the drive of the Pacific trough into the country during the week. By mid-week a disturbance in the western states had organized itself into a long northeast to southwest frontal system that pushed steadily to the southeast to finally interact with the remnants of Hurricane Jeanne (see Section 5) on 16 November, the day of Lubbock's first 10-inch snow accumulation. Earlier in the week Jeanne had been responsible for the heavy rainfall in the south Florida peninsula (Section 3).

c. 17–23 November

In sharp contrast to the week before, systems at 700 mb near North America at both high as well as low latitudes generally translated eastward (Fig. 9a). One exception was the ridge in western Canada which stayed in place but weakened. Its stationarity and the general progression elsewhere combined to reduce phase differences between latitudes. The deepening of the low near the mouth of Hudson Bay and the

relaxation of ridging in western Canada and its reestablishment just to the south all contributed to enhanced upper air flow from the Pacific across the northernmost states, moderating temperatures considerably as far east as the upper Great Lakes (Fig. 9b).

As the major trough in the western part of the country continued to advance through the Southwest, the incipient storm associated with the interaction of Jeanne's remnants and the front at the end of the previous week (Section 4b) became a major and complex system. Substantial quantities of precipitation fell over the Southeast, the Ohio Valley, and the Northeast, with much of the latter two areas receiving snow (Fig. 9c). Behind the front a major cold outbreak took place by Wednesday and the juxtaposition of the two events largely accounts for most of the colder than normal temperatures experienced from Texas to Maine. Note additionally in Fig. 9b the centers of large negative departures near Midland, TX, and southwest Wyoming. The former can be associated with the snow cover laid down at the end of the previous week, while the latter is symptomatic of cold air trapped in a basin beneath relatively warm air and ridging aloft.

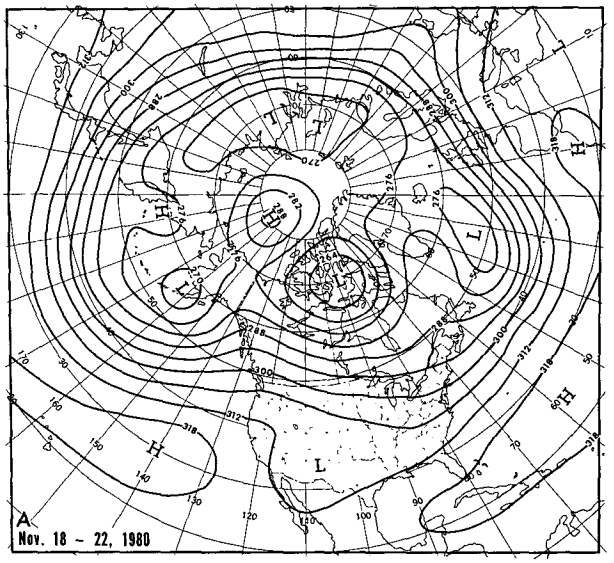
Positive temperature anomalies at Fairbanks and Anchorage again increased from the previous week along with the southerly winds from the Gulf of Alaska. An increase in the easterlies over Hawaii is reflected in the increase in windward precipitation.

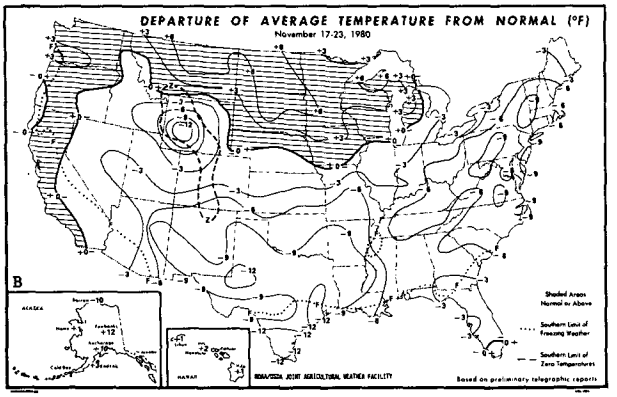
d. 24–30 November

Major ridges at 700 mb (Fig. 10a) built strongly across the Atlantic north of 60°N latitude, wedging between a retreating Canadian low and a southward-displaced Atlantic low. Similarly, in the Pacific the main trough advanced into the Gulf of Alaska as it was separated from its low-latitude extension by a wedge of anticyclonic vorticity. This, coupled with the advancement of the east Pacific high to the west coast of the United States, established the ridge line inland from Alaska to California, and generally kept temperatures over the northern Great Plains, the intermountain region and westward near or above normal (Fig. 10b). The exception to this over southern Idaho has the earmarks of the basin effect alluded to in the last section.

Downstream over the United States further advancement of the trough brought it into phase with the Canadian trough. With the swelling of the subtropical ridge along 65°W longitude, temperature extremes from the previous week were ameliorated everywhere east of the Mississippi River. Over Texas and New Mexico a second major snowfall and cold-air advection in its wake kept temperatures relatively cold.

The source of the snow was a storm that moved out of the southern Rockies on Tuesday, 25 November (Lubbock's second 10-inch snow day), and





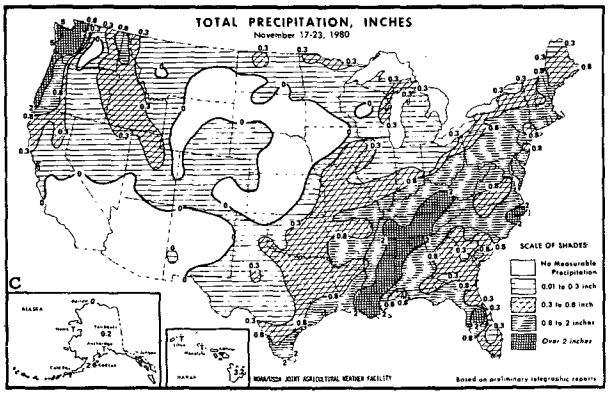
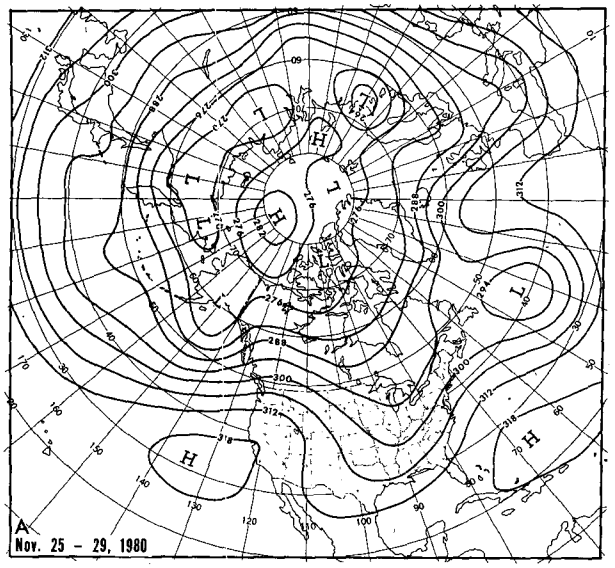
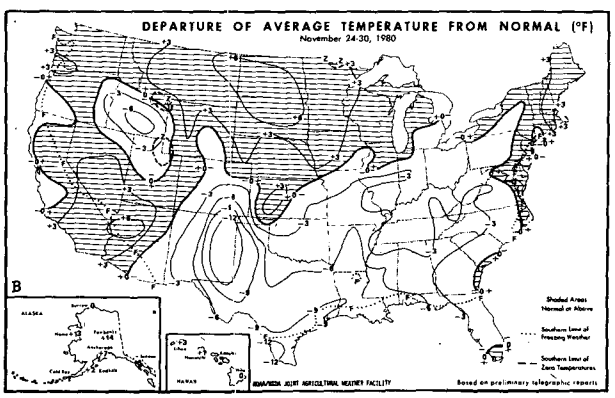


FIG. 9. As in Fig. 7 except for (A) 18–22 November 1980, and (B) and (C) week of 17–23 November 1980.

reached the Gulf of Mexico by Wednesday. From there it turned to the north and split on either side of the Appalachians, before finally recombining over Quebec on the weekend. In addition to the aforementioned areas, snow was widespread from the Mississippi Valley to the eastern slopes of the Appalachians (Fig. 10c). Along the east coast the storm





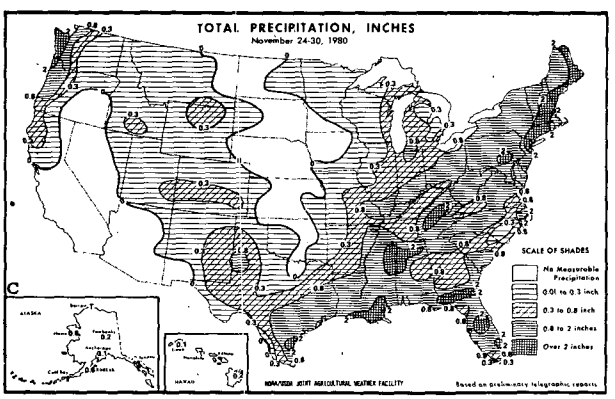


FIG. 10. As in Fig. 7 except for (A) 25–29 November 1980 and (B) and (C) week of 24–30 November 1980.

added rain to that already measured from a coastal low earlier in the week.

Meanwhile, precipitation amounts were unremarkable over Alaska and Hawaii, but for the fourth straight week several Alaskan stations reported temperatures well above normal.

5. Tropical activity

During November two storms were classified as Atlantic hurricanes, but only one threatened land. Tropical storm Jeanne entered the Gulf of Mexico through the Yucatan Channel on 9 November and moved slowly northwest, attaining hurricane strength on 11 November. Its westernmost advancement brought the storm to within 200 km of Brownsville, TX, on 14 November, but by then it had weakened considerably. Its subsequent motion was northeastward.

So-called Hurricane Karl can be traced to a baroclinic development off the northeast coast of the United States on 22 November. From there the low moved slowly southeastward to mid-ocean near 37°N latitude, resembling a slowly filling occlusion on synoptic charts. It was classified a hurricane from late on 25 to 27 November.

In the western Pacific three tropical systems were named during the month. Two of them had little effect: Cary was downgraded to a depression on 1 November and Typhoon Dinah stayed far from land over its life from 22 to 24 November. Betty, however, inflicted major damage to Luzon Island in the Phillipines on 4 and 5 November, where torrential rains and typhoon force winds (speeds of 125 kt were reported) destroyed crops and took many lives. The storm was already at typhoon strength on 1 November as it approached the Phillipines from the southeast. It rapidly diminished in strength and veered to the northeast after landfall.

REFERENCES

Dickson, Robert R., 1981: Weather and circulation of October 1980—A decisive end to the heat wave. *Mon. Wea. Rev.*, **109**, 205–211.

Livezey, Robert E., 1980: Weather and circulation of July 1980—Climax of a historic heat wave and drought over the United States. *Mon. Wea. Rev.*, **108**, 232–240.

National Oceanic and Atmospheric Administration, U.S. Department of Commerce, and Economics, Statistics and Cooperative Service, U.S. Department of Agriculture, 1980: *Weekly Weather and Crop Bulletin*, **67**, Nos. 46–50 (12, 18, 25 November, and 2 and 9 December 1980).