WEATHER AND CIRCULATION OF APRIL 1976

Unprecedented Spring Heat Wave in the Northeast and Record Drought in the Southeast

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1. Mean circulation

Although flat, faster than normal flow continued across the Pacific, the 700 mb circulation became more amplified during April over North America and the Atlantic than it had been in March. [Compare Figs. 1 and 2 with the corresponding charts in Taubensee (1976).] A strong, negatively-tilted mean ridge extended from northwest Canada to the central Gulf Coast, with a deeper than normal full-latitude trough immediately downstream extending southward from the Davis Strait to the western Atlantic. This feature in turn helped to build a strong ridge over the North

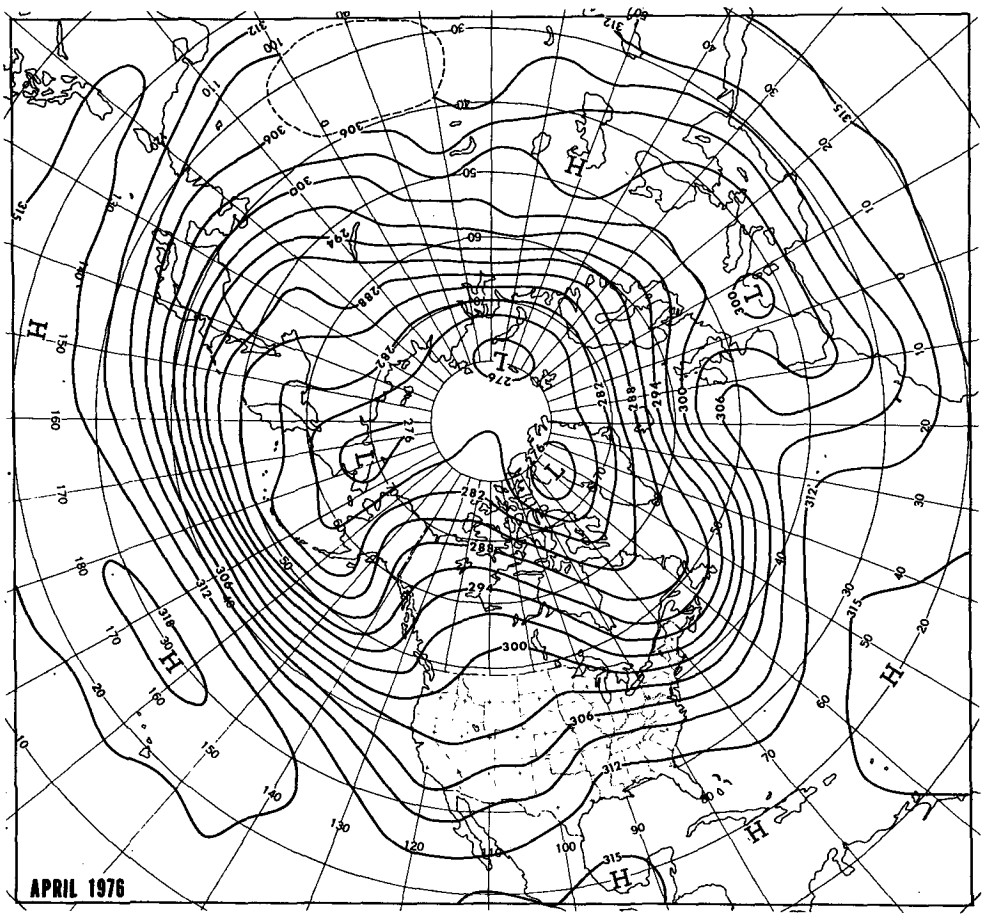


FIG. 1. Mean 700 mb height contours (dekameters) for April 1976.

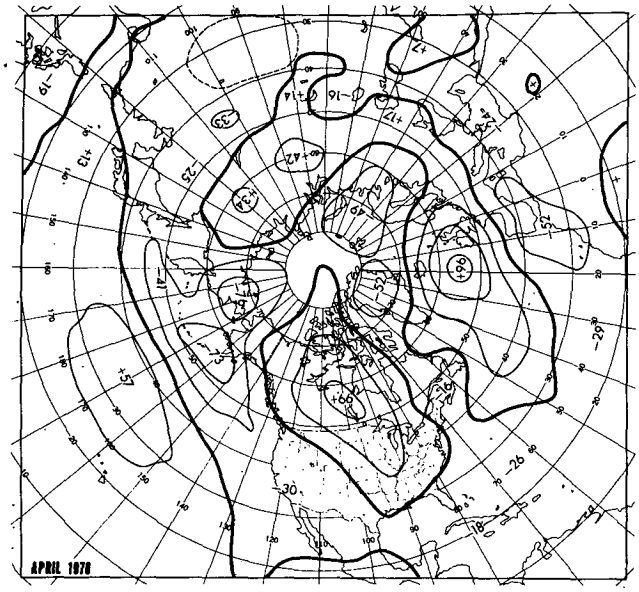


FIG. 2. Departure from normal of mean 700 mb height (m) for April 1976.

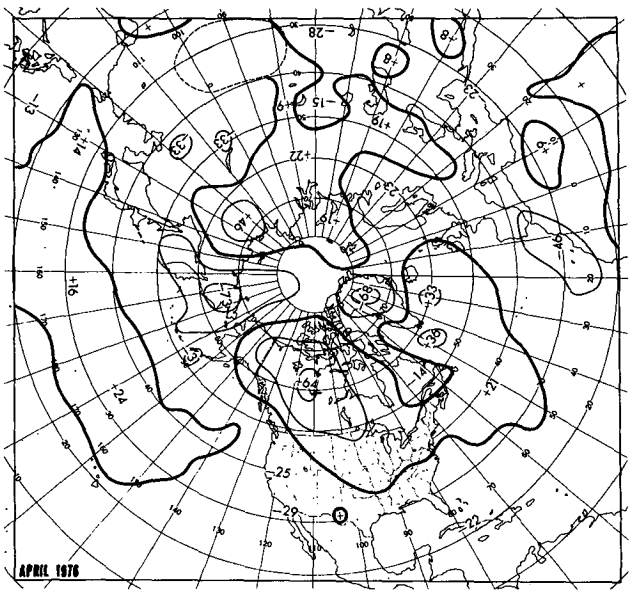


FIG. 4. Departure from normal of mean 1000–700 mb thickness (m) for April 1976.

Atlantic just west of the British Isles and a deepening trough over Finland. The strong block over western Russia during March weakened and its remnants were displaced southeastward by the Scandinavian trough.

Unusually strong westerly flow, up to 20 m s^{-1} (9 m s^{-1} stronger than normal), in the monthly mean continued across the Pacific (Fig. 3). The remains of the Asian block over central Siberia helped to transport arctic air southward over eastern Siberia and the Bering Sea. The juxtaposition of this cold air with mild air circulating around the strong Pacific subtropical high led to formation of a strong baroclinic zone (Fig. 4) and an active Pacific storm track.

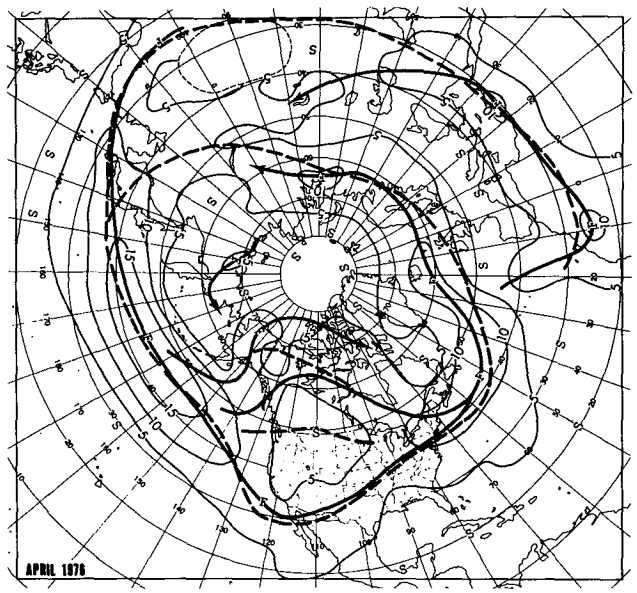


FIG. 3. Mean 700 mb geostrophic wind speed (m s^{-1}) for April 1976. Solid arrows indicate observed axes of maximum wind speed; dashed lines show the normal.

Approaching North America, the mean flow split into two branches: one looping northeastward over central Canada and the other dropping southeastward to Baja California, close to its normal position. The two 700 mb maximum wind axes rejoined in the deep trough south of Newfoundland and the single maximum was displaced north of normal by the strong ridge as it crossed the Atlantic to Scandinavia (Fig. 3). The normal late winter-spring secondary 700 mb wind maximum was located close to its normal position across North Africa.

On the average, over the western part of the Northern Hemisphere the mean 700 mb mid-latitude zonal westerlies decreased to near-normal values, following record high values during March (Taubensee, 1976) and generally above normal values throughout the preceding winter.

2. Temperature

Temperatures averaged above normal in most areas east of the Continental Divide except for the lower Rio Grande Valley and the Southeast (Fig. 5). This anomaly pattern, which agreed quite well with the mean thickness anomaly (Fig. 4), was rather similar to April two years ago (Wagner, 1974), even though the corresponding circulation anomalies were quite different. The rather strong warmth of 3–6°F above normal from the

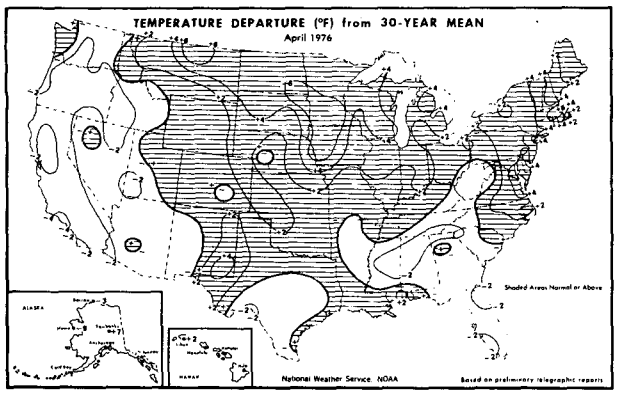


FIG. 5. Departure from normal of average surface temperature (°F) for April 1976 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service, 1976).

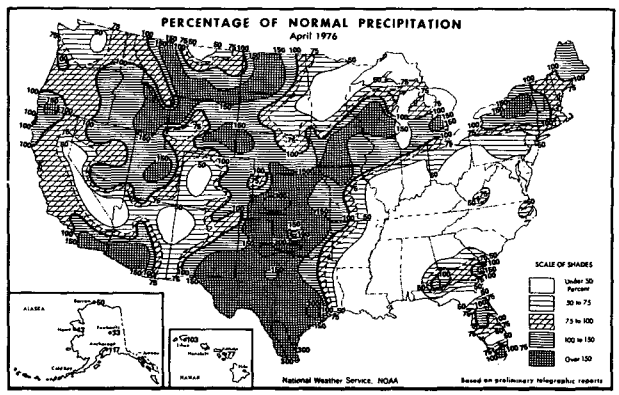


FIG. 6. Percentage of normal precipitation for April 1976 (from National Oceanic and Atmospheric Administration and Statistical Reporting Service, 1976).

northern Great Plains to New England in 1976 stands in stark contrast to the widespread record cold of April 1975 (Wagner, 1975).

Considerable variation of regimes from week to week prevented the establishment of any monthly mean records in 1976, even though a record heat wave developed over the Northeast just after the middle of the month. This extreme warm regime may explain why temperatures averaged above normal in an area with mean northerly anomalous flow for the month as a whole (Fig. 2).

Temperatures were generally above normal in Hawaii under the stronger than normal subtropical ridge. Southerly anomalous flow brought warmer than normal readings to eastern Alaska, but the deep Bering Sea trough was associated with colder than normal Arctic air over the Aleutians and the western part of the state.

3. Precipitation

The mean ridge axis extending northward from the Mississippi Delta neatly defined the boundary separating an area of record drought in the Southeast from heavy rains (at times of record value) extending northeastward from Texas to the western Great Lakes (Figs. 1 and 6, Table 1). The rains in the Great Plains, as much as 8 inches in some places, were too late to be of much help to the winter wheat crop, but greatly improved prospects for spring and summer planting and lessened the danger of another "dust bowl" this year.

Precipitation was also generally heavier than normal over the Plateau and Rocky Mountains, where a mean trough prevailed, and in the 700 mb confluence zone from the Great Lakes to New England.

Rainfall was close to normal in Hawaii and precipitation was lighter than normal over most of Alaska except for the south coast, where the southerly flow had an upslope component.

4. Weekly variability

a. 29 March–4 April

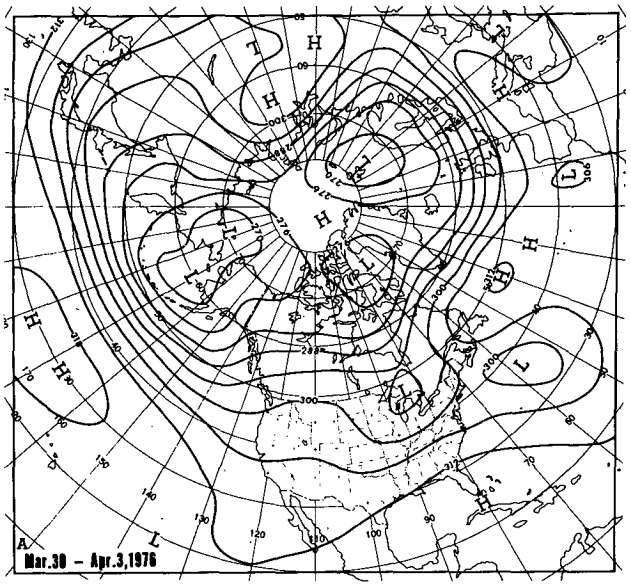
The strong subtropical Pacific ridge and the low near the west coast of Alaska (Fig. 7A) both retrograded somewhat from their locations the previous week (Taubensee, 1976). A weak trough persisted just off the west coast of North America, while the United States portion of the flat ridge over the Rocky Mountains amplified somewhat as the trough extending southwestward from the Great Lakes to the southern Great Plains became more pronounced.

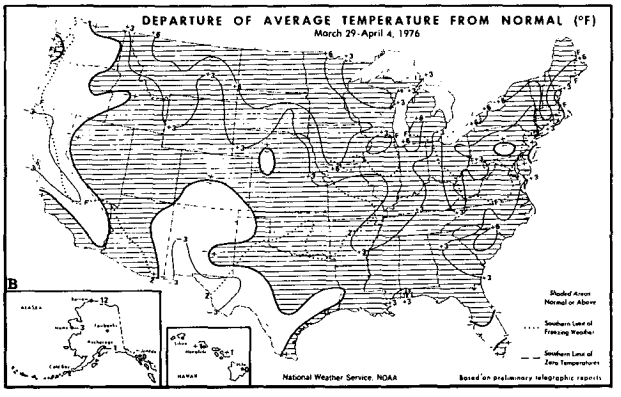
The generally mild temperatures of the previous week also persisted, as there was no pronounced advection of cold air from the north. Greatest positive temperature anomalies of 6°F or more above normal were observed over the northern Great Plains and over northern New England (Fig. 7B).

Precipitation fell over most of the Nation with the exception of portions of the Southwest and Great Plains. A rather slowly moving 700 mb trough triggered two waves as it moved eastward in the rather weak mean flow over North America. Heavy convective rains of as much as 5 inches fell over the Southeast and

TABLE 1. Record and near-record monthly precipitation totals observed during April 1976.

Station	Amount (inches)	Anomaly (inches)	Remarks
Columbia, S. C.	0.18	−2.70	Driest April
Raleigh, N. C.	0.23	−2.84	Driest April
Charlotte, N. C.	0.30	−3.10	Driest April
Asheville, N. C.	0.25	−3.28	Driest April
Beckley, W. Va.	0.28	−3.03	Driest April
Charleston, W. Va.	0.50	−2.83	Driest April
Parkersburg, W. Va.	0.96	−2.49	Driest April since 1900
Nashville, Tenn.	1.53	−2.58	Driest April since 1948
Baton, Rouge, La.	0.38	−4.72	2nd driest April, driest since 1915
New Orleans, La.	0.28	−3.87	Driest April since 1915
Dodge City, Kans.	6.26	+4.55	Wettest April
Des Moines, Ia.	7.76	+4.82	Wettest April





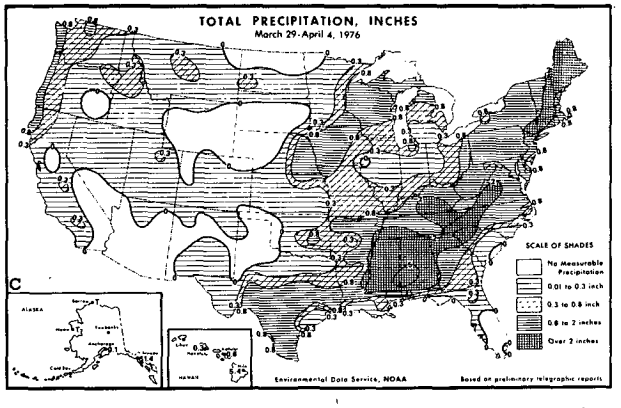
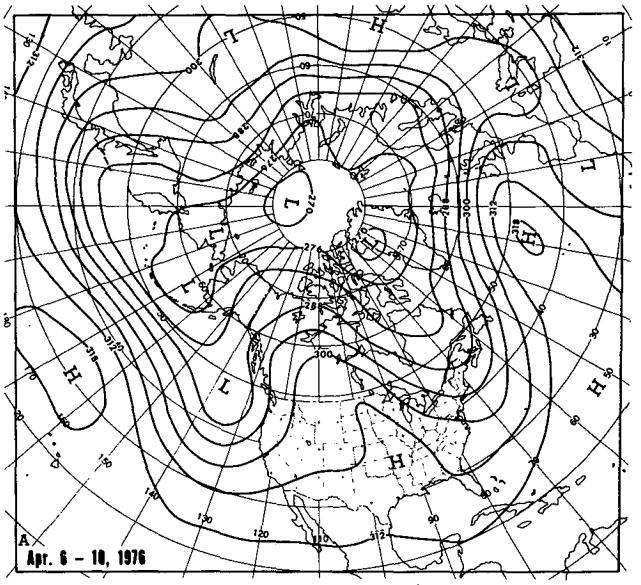


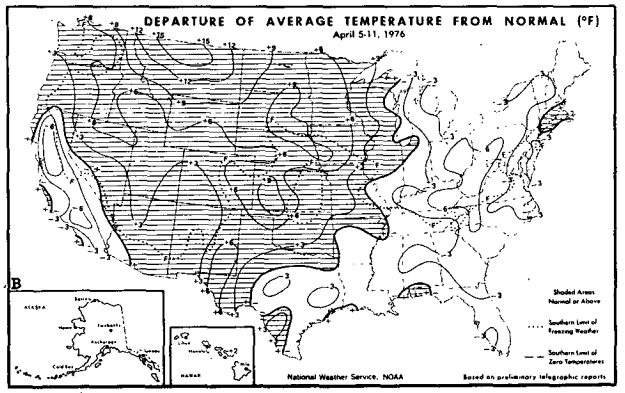
FIG. 7. (A) Mean 700 mb contours (dam) for 30 March–3 April 1976; (B) departure from normal of average surface temperature (°F); and (C) total precipitation (inches) for week of 29 March–4 April 1976.

blocking by a strong ridge over Newfoundland slowed the second wave as it approached the Northeast, leading to over 2 inches of rain and minor flooding in parts of New England (Figs. 7A and 7C).

b. 5–11 April

Progression of a strong blocking ridge to eastern Siberia led to amplification of the flow across the Pacific and North America (Fig. 8A). The temperature anomaly





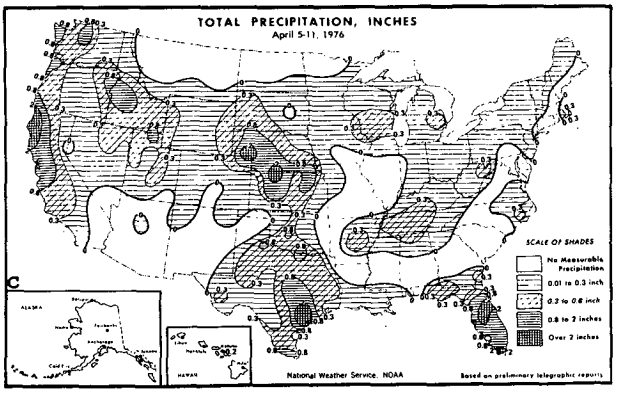


FIG. 8. As in Fig. 7 except for (A) 6–10 April 1976 and (B) and (C) week of 5–11 April 1976.

pattern also amplified, with most of the western two-thirds of the United States averaging from 3 to 15°F above normal (Fig. 8B). Strong northwesterly flow from Canada cooled the eastern United States to as much as 6°F below normal. Frost, which damaged fruit trees brought into bloom by unseasonably mild weather earlier in the spring (Taubensee, 1976), was noted as far south as northern Georgia.

Strong southerly flow east of the amplified trough just off the West Coast brought substantial welcome rains to California, which had suffered a serious winter drought (Wagner, 1976). Relatively heavy precipitation, accompanied by severe weather in Texas, also helped agricultural prospects in the southern and central Great Plains (Fig. 8C). Other heavy showers and thundershowers occurred over Florida near the bottom of the sharp Atlantic coast trough (Fig. 8A). Precipitation was generally light over the rest of the country.

An unusual off-season typhoon, Marie, moved slowly northwestward east of the Philippines. The persistent, anomalously strong subtropical ridge extending across most of the Pacific for several months may have been a factor in its formation, as lower troposphere circulation patterns more typical of the warm part of the year had prevailed in that area.

c. 12–18 April

Between the first and second halves of April, a large and significant redistribution of mass occurred over the Northern Hemisphere. The 700 mb heights increased by more than 100 m over a wide area at high latitudes, while generally decreasing over middle and low latitudes (Fig. 9). This change, though in consonance with the normal change in April, was much stronger than normal

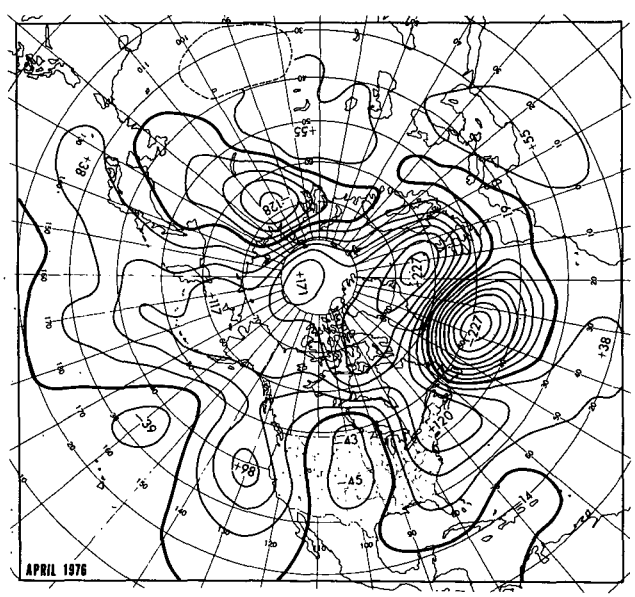


FIG. 9. Mean 700 mb height change (m) from first half to second half of April 1976.

TABLE 2. Record seasonal and monthly extreme temperatures observed during April 1976.

Station	Temperature (°F)	Date	Remarks*
Great Falls, Mont.	77	11	
Albuquerque, N. M.	24	17	Lowest so late in season
Binghamton, N. Y.	14	12	Lowest so late in season
	83	17	
	85	18	
Bridgeport, Conn.	25	12	Lowest so late in season
	84	18	Equaled highest so early
Providence, R. I.	19	12	Lowest so late in season
	93	17	
	98	19	
Richmond, Va.	25	13	Lowest so late in season
	96	17	
Roanoke, Va.	91	17	
Hatteras, N. C.	27	13	Lowest so late in season
Muskegon, Mich.	81	16	
Sault Ste. Marie, Mich.	83	18	
Youngstown, Ohio	87	18	Also highest for month
Burlington, Vt.	91	18, 19	Also highest for month
Concord, N. H.	92	18	
	95	19	
Boston, Mass.	94	18	Also highest for month
Hartford, Conn.	92	17	Equaled highest so early
	95	18	
	96	19	
Albany, N. Y.	90	18	
	92	19	
Trenton, N. J.	93	18	Also highest for month
Avoca, Penn.	92	18	Also highest for month
Allentown, Penn.	88	17	
	93	18	Also highest for month
Philadelphia, Penn.	92	17	
	94	18	
Baltimore, Md.	90	17	
	93	18	
Washington, D. C.	95	18	
St. Louis, Mo.	30	27	Lowest so late in season
Seattle, Wash.	85	30	

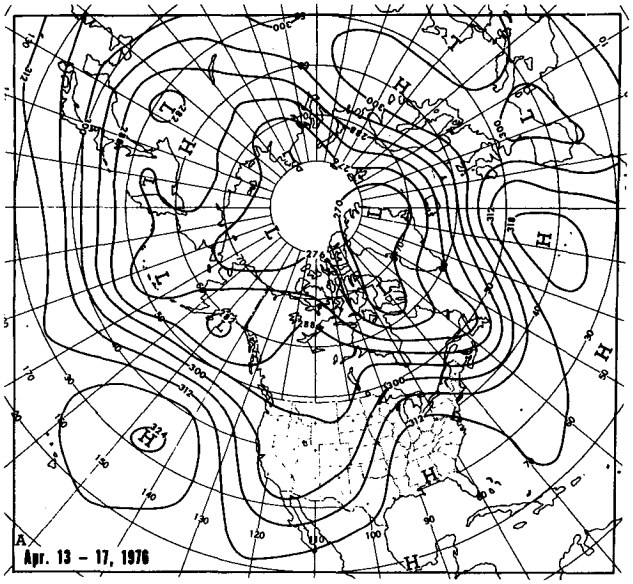
* All are highest so early in the season except as otherwise indicated.

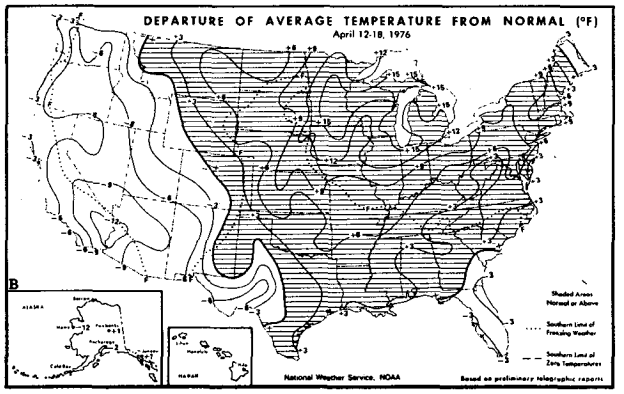
and represented the first really significant blocking trend in the western part of the Northern Hemisphere for several months.

In a weekly sense, the western Pacific trough progressed to the central part of the ocean, resulting in progression and amplification of the eastern Pacific ridge and the 700 mb circulation features over North America. An amplified ridge remained over the eastern Atlantic (Fig. 10A).

Progression of the strongly amplified 700 mb ridge from the Great Plains to the Ohio Valley set the stage for a week which saw many new temperature records established, mainly in the Northeast (Table 2). Of special interest is the fact that several places (Binghampton, Bridgeport, Providence and Richmond) had record low temperatures for so late in the season, followed by record high temperatures for so early in the season within the same week, as an arctic high which plunged southward from Hudson Bay was rapidly transformed into a warm high by strong ridging aloft. The temperature at Concord, N. H., rose from a wintry 11°F on the 13th to a summery 90°F on the 17th—a total increase of 79°F within 5 days.

Numerous daily records were also broken, at some stations for 4 or 5 days in a row. The extreme nature of the Easter weekend heat wave is further attested by the fact that some daily records that had stood since before 1900 were surpassed by 10°F or more in the great 1976 heat wave. The highest temperature officially observed





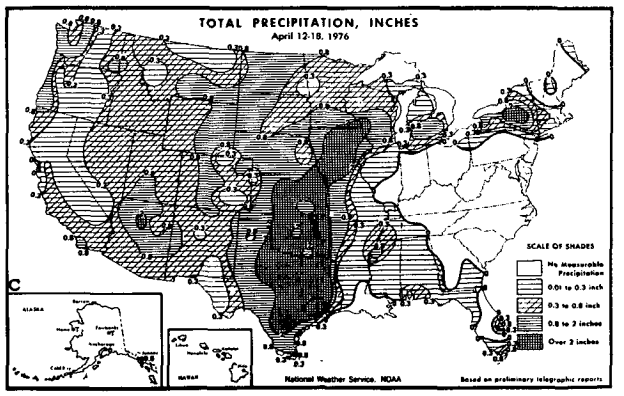
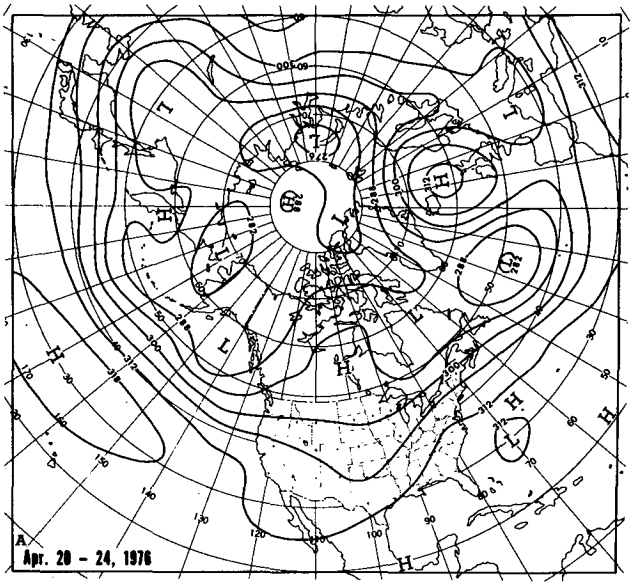
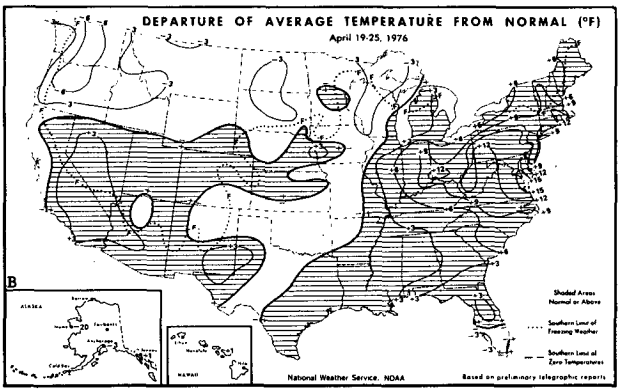


FIG. 10. As in Fig. 7 except for (A) 13–17 April 1976 and (B) and (C) week of 12–18 April 1976.

was a phenomenal 98°F at Providence, R. I., on the 19th, 40°F warmer than the normal maximum for that day. This was not only the highest temperature observed at a first-order station in the United States on that day; it also tied with Yuma, Ariz., for the second highest temperature observed anywhere in the country for the whole month. Only Thermal, Calif. reported a higher reading—100°F on the last day of April.





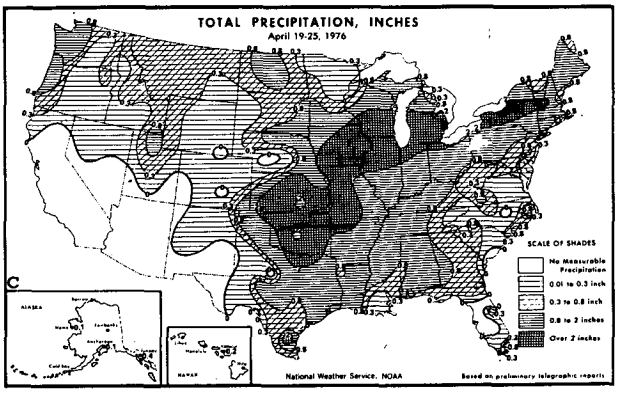


FIG. 11. As in Fig. 7 except for 20–24 April 1976 and (B) and (C) week of 19–25 April 1976.

The week as a whole averaged as much as 15°F above normal in the Great Lakes area. The record cool temperatures noted early in the week limited weekly means to 6–9°F above normal east of the Appalachian Mountains (Fig. 10B). West of the Continental Divide temperatures averaged well below normal, a common occurrence with record warmth in the East. Tucson reported 2 inches snow on the 16th, the latest measurable snow on record at a location where snow is rare. Albuquerque reported a record late-season low temperature of 24°F on the 17th.

Precipitation fell over most of the western three-quarters of the Nation, with heaviest amounts of over 2 inches occurring in the Great Plains, where strong southwesterly flow brought in copious supplies of moisture (Figs. 10A and 10C). There were numerous reports of severe weather, hail and tornadoes in this area, which was near the boundary between strongly contrasting air masses. Under the influence of the strong ridge and mean northwesterly flow, much of the East remained rainless, except for New York and parts of New England, where a quasi-stationary front moved back and forth several times.

d. 19–25 April

Flattening of the 700 mb flow across the Pacific and North America was accompanied by progression of the weakening trough from the Plateau to the Great Plains, while the ridge moved off the East Coast (Fig. 11A). The flow over the eastern Atlantic and Europe evolved into an omega block, with the amplified Azores ridge of the precious week moving northeastward as a strong high center between Iceland and Scotland.

Temperatures were above normal east of the Mississippi River as the heat wave slowly subsided, with averages as much as 12–15°F above normal in the mid-Atlantic states, where cold air did not really penetrate in force until the following week (Fig. 11B). A more zonal pattern was established in the west, with cool to the north and warm to the south.

Two storms moving northeastward from the southern Great Plains toward the Great Lakes produced a swath of heavy precipitation (Fig. 11C). Again, numerous tornadoes and other severe weather occurred in the Great Plains. Record 5, 10 and 15 min rainfall totals of 1.29, 1.51 and 1.67 inches, respectively, were observed at Chicago's Midway Airport on the 24th, and on the same day, Milwaukee, Wisc. reported a record April 24 hr rainfall total of 3.01 inches.

e. 26 April–2 May

Amplification again occurred over the Pacific and North America with a strong blocking ridge building over the Canadian Rockies, while the trough over the Plains moved eastward to just off the Atlantic Coast and amplified (Fig. 12A). Part of the Atlantic block

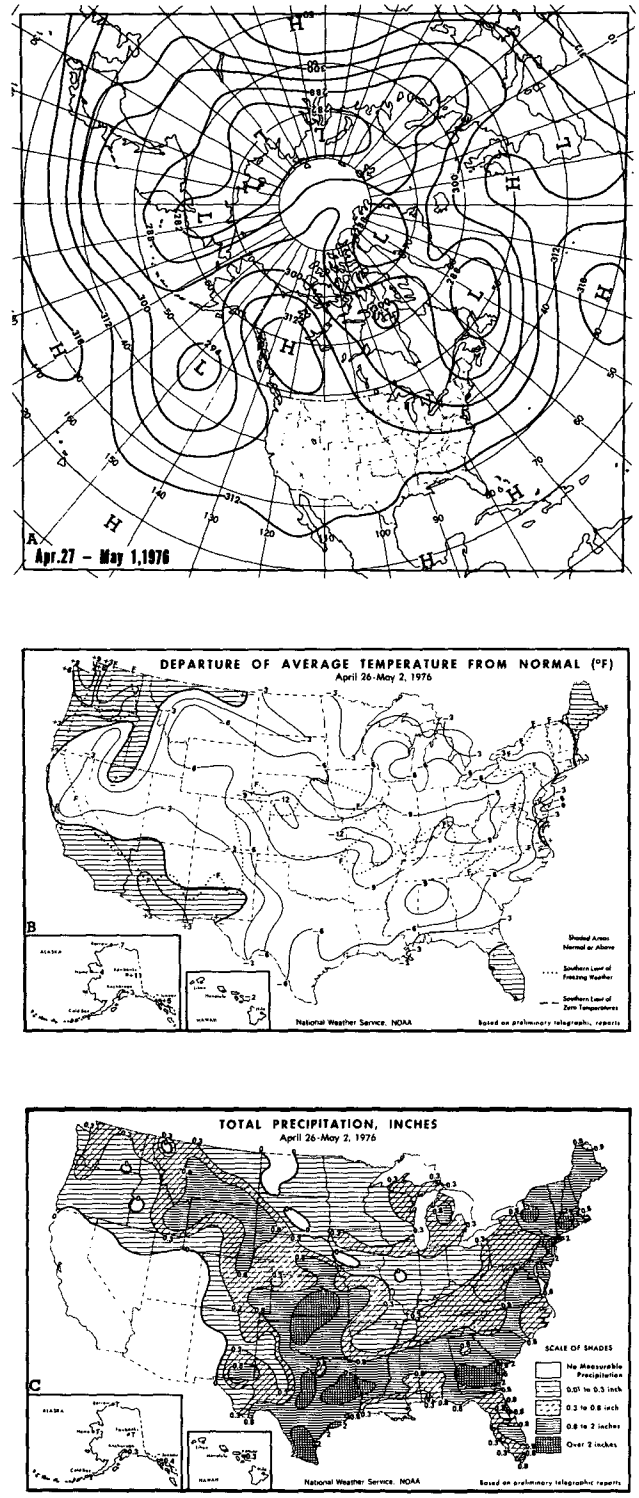


FIG. 12. As in Fig. 7 except for (A) 27 April–1 May 1976 and (B) and (C) week of 26 April–2 May 1976.

retrograded into northern Canada with the help of a cutoff low east of Newfoundland.

The strong northwest flow brought much colder Canadian air southward into the United States, where

temperatures averaged 6–12°F below normal over a wide area (Fig. 12B). St. Louis had a record late-season low of 30°F on the 27th, and frost occurred as far south as Arkansas.

Heavy precipitation was confined mainly to the South and New England by the southward push of cold air (Fig. 12C). Savannah, Ga., which had gone rainless all month except for two days with traces, recorded 5.62 inches of rain on the last day of April, to bring the monthly total to almost twice normal.

A second rare April tropical storm, Nancy, formed in the southwest Pacific and moved slowly westward south of the subtropical ridge before dissipating.

REFERENCES

National Oceanic and Atmospheric Administration, U. S. Department of Commerce, and Statistical Reporting Service, U. S. Department of Agriculture, 1976: *Weekly Weather and Crop Bulletin*, **63**, Nos. 14–19 (6, 13, 20 and 27 April, and 4 and 11 May 1976).

Taubensee, Robert E., 1976: Weather and circulation of March 1976—Record heavy precipitation around the Great Lakes. *Mon. Wea. Rev.* **104**, 809–814.

Wagner, A. James, 1974: Weather and circulation of April 1974—A generally mild but stormy month. *Mon. Wea. Rev.* **102**, 535–540.

——, 1975: Weather and Circulation of April 1975—Stormy with record cold. *Mon. Wea. Rev.*, **103**, 657–664.