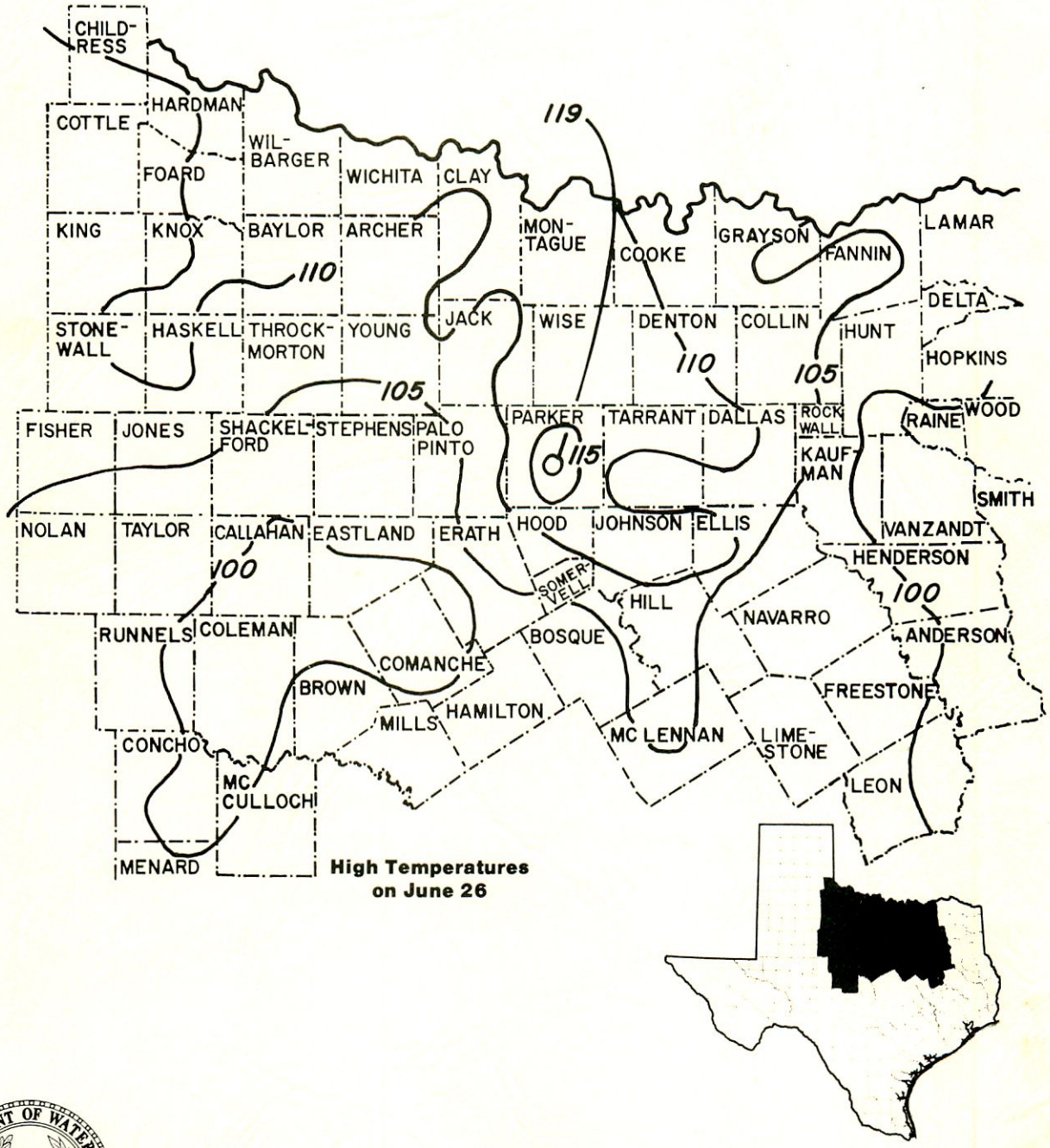
1980: WHEN SCORCHING HEAT GRIPPED TEXAS

A Review of Texas' Weather During the Year



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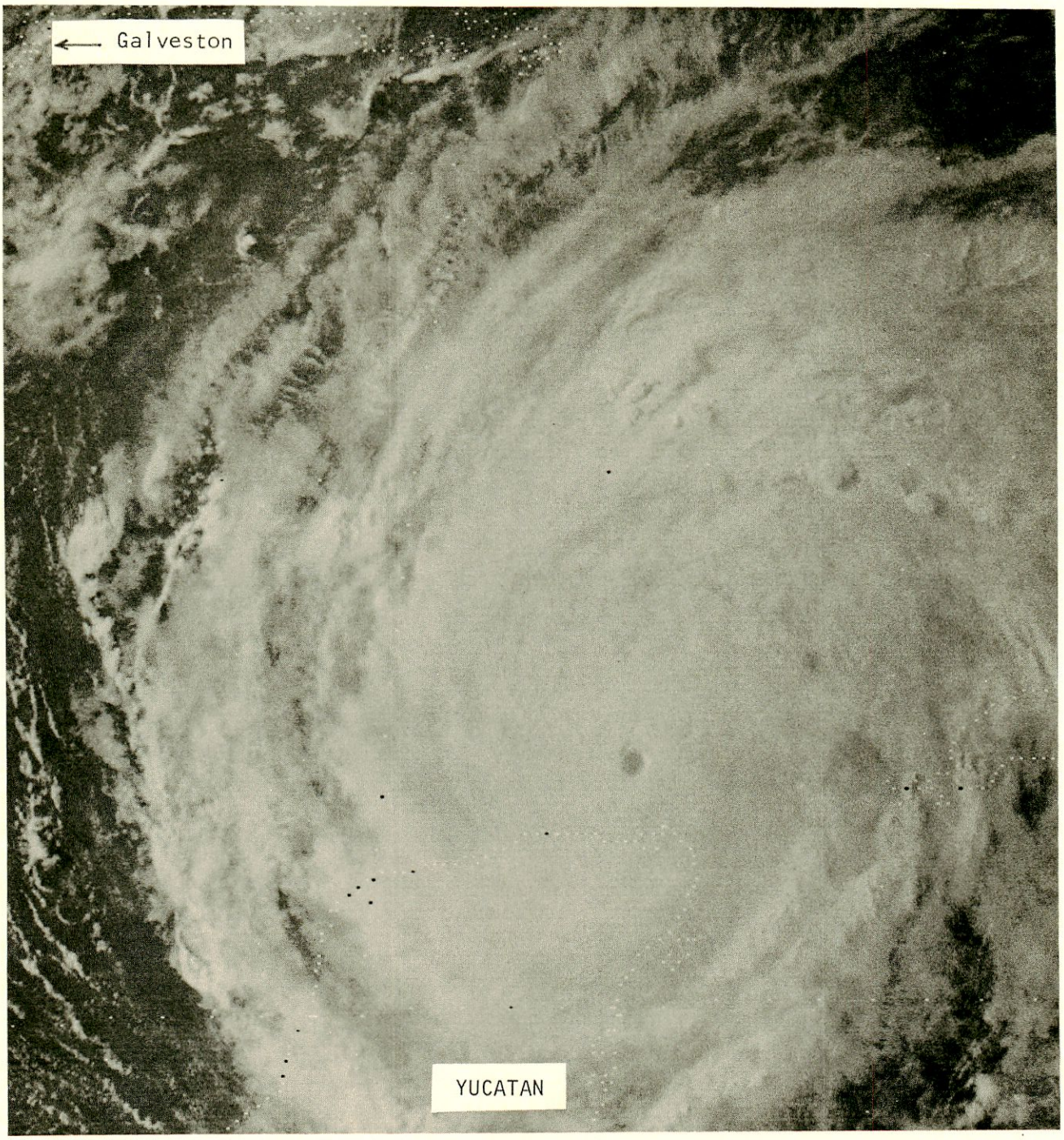

The huge "eye" of Hurricane Allen is prominent in this visible satellite photograph of the massive storm as it moved from off the northern tip of Yucatan northwestward toward the lower Texas coast on the afternoon of August 7, 1980; for a time the second most dangerous hurricane in Atlantic weather history, Allen crashed ashore over south Padre Island 54 hours later, causing 3 deaths, 7 injuries, and $650-750 million in property losses.

1980: WHEN SCORCHING HEAT GRIPPED TEXAS

A Review of Texas' Weather During the Year

by

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PREFACE

Voluminous amounts of meteorological data are routinely collected each day of the year at more than 600 points in Texas. Yet, it often is difficult--if not impossible--to glean from these vast arrays of numbers information on how various aspects of the State's weather--from drought to flash-flooding downpours--have impacted the people and the economy of Texas. This report is an attempt to describe the most significant weather developments of the year 1980 and to relate the ways in which those events affected the State.

Meteorological data used in this report consist of: official rainfall, snowfall, temperature, and wind data as provided by the National Oceanic and Atmospheric Administration (NOAA) in the publications, "Climatological Data: Texas," "Local Climatological Data" (for selected cities), "Storm Data," and "Daily Weather Maps;" weather teletype reports (circuits "A" and "C") from the National Weather Service surface and upper-air observing network; surface and upper-air facsimile charts provided by the National Meteorological Center of NOAA; newspaper accounts; and photographs obtained by the author from NOAA's orbiting meteorological satellites. The belatedness of the date of issuance of this report is due to the unavailability of hourly precipitation data for the months of May-December 1980. As of this writing, all of those data had not been released by the National Climatic Center in Asheville, North Carolina.

Maps depicting precipitation and temperature data are based upon all available data from the National Weather Service's first, second, and third-order (cooperative observer) networks in Texas. Normals of monthly and annual precipitation and temperature are derived from averages of precipitation and temperature data for the period 1941-70. For snowfall, freeze-day and 100°-day data, normals are based upon observations for the period 1951-80.

The author extends appreciation to Dave Owens and the staff of the Austin office of the National Weather Service for the use of surface and upper-air weather data collected routinely by the NWS. Gratitude is expressed to the Weather & Climate Section staff of the Texas Department of Water Resources for helpful review and comments. A special thanks is given to the Weather & Climate Section's William Hanshaw, who plotted all of the data for the author's analysis, and to Wanda Ferris, who typed the manuscript. Garry Goerdel of the Department staff prepared the cover.

ABSTRACT

All of the notable aspects of Texas' weather during 1980 are described, along with accounts of how those varied elements impacted the people and economy of the State. Descriptions of a wide assortment of weather phenomena---such as heat and cold waves, killing freezes, drought, tornadoes, hailstorms, hurricanes, wind and duststorms, flash floods, and snowstorms--are provided along with supporting pictoral, numeric, and graphical data.

Texas suffered in 1980 through one of the longest and most intensely hot summer seasons ever. A record-setting heat wave that got underway in late May gripped the State for much of four months and produced some of the hottest single-day temperature readings ever. Scores of people died from the extraordinary heat, the peak period of which occurred in late June, or when daytime readings climbed to 115°F or more in parts of the northern half of the State. More uncommon heat recurred on numerous occasions in July and August, giving areas as diverse as the southern High Plains, the Red River valley, the Upper Coast, and the Lower Valley the hottest overall summer temperatures in recorded weather history. Strangely, the torrid temperatures of summer followed by only a few weeks some of the coldest weather ever seen so late in spring. Belated cold snaps sent temperatures to record-low levels in much of Texas in early-March and mid-April, and killing freezes on both occasions caused extensive and severe agricultural losses.

On either side of the killer heat wave of summer were spells of very substantial rains that fell in record amounts in some sections of Texas. A rash of late-spring thunderstorms soaked parts of Southern Texas with record rainfall totals of 10 inches or more in the month of May. Then, in early-August the first hurricane to cross the Texas coastline in nine years--Hurricane Allen--caused more than $650 million in damages to property and crops in the southern quarter of the State. Allen and its remnants helped produce record rainfall of 12 inches or more for the month of August in much of Southern and South Central Texas and the Lower Valley. Allen's impact, however, was not felt in most of the northern half of the State, where scanty rainfall totals of one inch or less for the 3-month period ending in August marked the summer as the driest of the 20th century.

A second major tropical disturbance--Tropical Storm Danielle--generated very appreciable rainfall that erased a moderate drought in the northeastern quarter of Texas in September. Combined with torrential rainfall of 6 to 8 inches generated by an early-autumn cold front, rains from Danielle's residue helped make September 1980 the wettest first month of Autumn in recorded history in parts of the High and Low Rolling Plains. A year to be categorized as one of the most bizarre periods in Texas' weather history neared an end with a pair of winterlike snowstorms that yielded in November the heaviest snow in history in parts of western Texas. Equally unlikely was the movement of another hurricane within striking distance of the Texas coast in that same

month; what could have been the latest such tropical cyclone to ever hit Texas was forced away by a fast-moving cold front entering the Gulf of Mexico from the west.

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INTRODUCTION

When leaden skies finally parted to let in sunlight one day in late May of 1980, the transition was heartily welcomed by many Texans grown weary of persistent and bountiful spring rains. The time had arrived for summer's sunshine to restore some semblance of normalcy by drying out an earth saturated by a 5-day siege of some of the most torrential rains ever witnessed in Texas in springtime. However, it took only a few weeks of sunny and virtually rainless weather to erase the memories of spring deluges and to supplant them with the vision of an impending drought. Coupled with the scourge of a rapidly spreading and intensifying drought was a debilitating heat wave that swelled to killer dimensions. Day after day the incandescent rays of a broiling sun beat down upon the Lone Star State, forcing temperatures to skyrocket to seldom-seen levels. An occasional, spotty, and short-lived burst of rain dampened a small segment of the landscape and momentarily chilled the air, but those signatures of a too-infrequent thundershower quickly vanished when the searing rays of the sun were restored. The fleeting shower merely teased the earth and its inhabitants, who soon realized the siege of torrid heat and scanty rain was to become one of the most calamitous weather events in Texas history.

The smoldering atmosphere terminated the lives of dozens of residents and made life miserable for millions more. Elderly people by the scores, holed up in unairconditioned houses, apartment buildings, and mobile homes, succumbed from the oppressive heat or from a deterioration in their general health aggravated by the onerous burden of too much heat. Untold numbers of people, whose heat-induced maladies ranged from cramps and light-headedness to exhaustion and stroke, had to be cared for in hospitals and clinics. Multitudes experienced breathing difficulties not only because of the stifling heat but also due to the pronounced presence of air pollutants that stemmed from a sluggish atmosphere unable to ventilate itself. Other animal life suffered greatly as well. Hundreds of thousands of chickens and turkeys died from suffocation, and remaining egg-laying fowl suffered serious declines in productivity. Hundreds of cattle and other livestock perished from exposure and the inability to get enough water. The production of dairy herds dropped off dramatically, and in some parts of the State ranchers had to burn cactus for cattle food. The wild deer population in Southern Texas was largely killed off. High evaporation rates and a virtual stillness of the air prevented windmills from supplying enough water to sustain livestock.

In urban areas streets cracked and buckled under the relentless heat. Record power consumption was reported in hosts of cities and communities, and overtaxed municipal water pumps either failed or necessitated major maintenance. The fracturing of concrete and asphalt sections of highways, including a stretch of Interstate 45 in Galveston County, posed traffic problems, as did thousands of disabled automobiles whose cooling systems were overextended by the heat. Dry shifting ground broke subterranean natural gas lines in some locales.

Six weeks of unbearable heat exacted an awesome toll in crop losses as well. The heat combined with very spotty and mostly inconsequential rainfall and very high evaporation rates to cause parched and cracked soils, plunging levels in rivers and reservoirs, and rapidly diminishing ground-water supplies. In Brazoria County, where flood waters had stood two feet deep just one year earlier, cracks in the soil were observed to be at least of the same depth. All unirrigated crops suffered extensively, and in some areas failed to survive. The cotton crop in the southern half of the State was reduced by at least one-fourth, and grain sorghum amounted to only about 75 percent of the normal production--or the lowest yield in 24 years. Crop and livestock losses in the southern half of Texas alone amounted to nearly $500 million.

To many Texans the deadly heat was reminiscient of the searing temperatures that accompanied the century's worst drought in the early and mid 1950s. For a few days near the end of June, however, the killer heat wave of 1980 attained an intensity unmatched at any other time since at least the Civil War. The heat grew so fierce on several afternoons that the mercury in thermometers within and near the Red River valley eased to within a few degrees of the upper limit of the ability of those instruments to gage the heat. Maximum readings peaked not far below 120°F on one or several afternoons in the last week of June in communiites such as Weatherford (119°), Wichita Falls (117°), Vernon (116°), and Bowie, Bridgeport, Henrietta, and Lake Kemp (all at 115°). The high of 119°F at Weatherford on June 26 was not only the most torrid temperature measured anywhere in Texas during the summer but was just 1° shy of tying the record for the hottest reading (120°F at Seymour on August 12, 1936) in Texas' weather history. Even though the sizzling heat abated a little in the early half of July, the modest slackening in afternoon maximum temperatures was hardly noticeable. Nights continued to be uncomfortably warm and muggy, and daytime readings consistently shot up above 100°F in much of the State. Scores of cities recorded 100° temperatures on every day for periods lasting many weeks. One of every four communities in North Central Texas endured 100-degree heat on every day in July, and some cities suffered through at least 60 consecutive days when temperatures soared into the triple-digit category.

Its protracted and extraordinarily intense nature was not the only reason for designating the killer heat wave of the summer as the foremost weather development of the year of 1980. The toll in human fatalities and sickness wrought by the torrid summer far overshadowed the total number of casualties resulting from all other weather events during the year. Unlike its immediate predecessor, a year highlighted by the monumental tornado that decimated Wichita Falls and cost over 50 lives, the year of 1980 was marked by a "spell" of distinctly insidious weather that gradually but unfalteringly evolved into a phenomenon that debilitated a largely helpless populace. The Wichita Falls tornado assessed its vengeance in less than one hour, whereas the deadly heat wave of 1980 consumed many hours in building itself into an enigma. While

the destruction levied by the April 1979 twister was confined to parts of three Red River valley counties, the impact of the lethal summer heat was felt statewide. The deaths of more than 60 people were traced directly to the excessive heat, with nearly all of them occurring in the Dallas-Fort Worth area, where the temperature soared above 110°F on three straight days. At least that many more died from various medical complications exacerbated by the intense heat.

Interestingly, the virulent siege of heat began manifesting itself little more than a month after the second in a pair of extremely belated cold snaps gripped Texas during the spring. A surge of record-setting Arctic air smothered the State with a chill that forced temperatures to the lowest levels ever observed in April in some sections along with heavy frost that exacted a huge toll in agricultural losses. That phenomenal chill was overshadowed, however, by an even colder and more costly wintry wave that encased Texas at the beginning of March. Arctic air on March 2 drove the temperature far below the freezing level and caused the most severe freeze ever witnessed so late in spring in central and southern sectors of Texas. Losses to fruit and garden crops, as well as to herds of livestock, amounted to several million dollars in the Hill Country, Winter Garden and coastal prairie sections of the State. Rarely has the vagarious and perplexing essence of Texas weather been so forcefully attested as by the extraordinarily frigid spring that gave way most improbably to a summer season distinguished throughout by a protracted siege of sultry and sweltering heat.

In addition to the crippling heat wave and drought that dominated the summer and the belated cold snaps that punctuated the preceding winter and spring, numerous other extraordinary weather happenings highlighted the year of 1980 in Texas:

- The first hurricane to enter Texas in nine years--named Hurricane Allen--slammed into the southern portion of Padre Island early in August, and the 100-mile-per-hour winds and tidal action generated by the mammoth cyclone caused damages in excess of $650 million; remnants of Allen, which for much of its journey through the Caribbean Sea and Gulf of Mexico was the second strongest hurricane of record in the Atlantic Ocean, spilled torrential rains that amounted to the most substantial in history for the month of August in large portions of southern and southwestern Texas.

- Tropical Storm Danielle entered the Upper Coast in early September and furnished heavy rains that obliterated a moderate drought in the State's eastern extremity.

- Autumn's first major cold front instigated numerous waves of heavy thunderstorms that drenched most of the northern half of Texas with record-setting rainfall in late-September; rains of 6-12 inches brought welcome relief to a drought-plagued northeastern quarter of the State.

- The only major snowfall early in the year fell, not during the winter, but in mid-spring and gave parts of the Trans Pecos the thickest snow cover ever so late in the spring; the same westernmost sector of Texas witnessed the earliest autumnal snowstorm of the century when a late-October wintry spell produced a 1 to 3-inch snow cover.

- The most treacherous wintry weather of 1980 came in two doses during November, when a pair of late-autumnal storms cumulatively generated more than a foot of snow in the southern High and Low Rolling Plains--the most snow accumulation in November in that area's history.

- The year's most notable "near-miss" occurred when Hurricane Jeanne moved to within a few hundred miles of the Texas coastline before being shunted away by an approaching cold front early in November. The belated cyclone, which did cause extensive erosion on Texas beaches, would have been the only hurricane ever to strike Texas during November had its movement toward the State not been altered.

- Only one of the above-average number of 151 tornadoes spotted in Texas in 1980 caused human fatalities, and the toll assigned to that twister--the one that struck Round Rock and nearby communities on April 7 and caused more than $2.5 million in property losses--was limited to one.

- The most pernicious localized severe storm of the year consisted of a concentration of thunderstorms that unleashed hail up to the size of grapefruits, costing property owners $60 million in Fort Worth and adjacent parts of Tarrant County on April 2.

TEMPERATURE

Near-normal temperatures for the whole of the year, as well as seasonally mild readings at both the beginning and end of the year, belie the fact that 1980 featured hot and cold-weather extremes of a magnitude rarely witnessed in Texas. Summer furnished not only the hottest single-day temperatures ever recorded in some parts of the State but one of the most protracted spells of intense heat in memory. Yet, the crippling heat wave was book-ended by uncommonly chilly weather in both the Spring and Autumn. Indeed, the extended heat wave got underway only a few weeks after some exceptionally cool weather marked April as one of the most abnormally-cool mid-months of Spring in history, and the heat wave five months later abruptly eased and gave way to an uncommonly nippy Autumn.

Average Annual Temperature

With the magnitude of the killer heat wave in Summer numerically negated by the inordinately chilly conditions so prevalent in Spring and Autumn, average annual temperatures were uncharacteristically near normal throughout Texas in 1980 (Table 1). Yearly averages in more than nine-tenths of the State were within 1°F of normal. Generally, annual readings were a bit cooler than normal in that portion of Texas east of a Paris-San Antonio-Laredo line, as well as the upper Pecos River valley and adjacent areas in the southern High Plains and northwestern Edwards Plateau (Figure 1). The greatest negative departures from normal occurred in small segments of the Upper Coast at Liberty (-1.9°F), the southern High Plains at Midland-Odessa (-1.8°F), northern South Central Texas at New Braunfels (-1.8°F), and in the northeastern corner of the State at Clarksville (-1.6°F) and Marshall (-1.6°F). On the other hand, the most unusually warm weather for the year as a whole was enjoyed in scattered portions of the northern High Plains, the westernmost Trans Pecos, and North Central Texas. Greatest positive departures from normal were registered in these sectors at Spearman, Ysleta and Cleburne (all with readings +2.0°F above normal). True to tradition, the lowest average annual temperatures were registered in the northernmost fringe of Texas, where Vega and Dalhart observed readings of 55.5°F and 55.9°F, respectively. Moreover, the extreme southern tip of the State not surprisingly sustained the mildest temperatures, with McAllen (75.2°F) and Mercedes (74.7°F) recording the highest mean yearly temperatures of any stations in the State.

Table 1. Mean and extreme temperatures (°F) for selected cities in Texas during 1980.

CLIMATIC DIVISION/city	Annual Average	Departure from Normal (1941-70)	Extremes Low	Extremes High
HIGH PLAINS				
Amarillo	56.8	-0.6	3 Nov 26	106 Jun 27
Big Spring	64.1	-0.3	13 Mar 2	109 Jun 25
Dalhart	55.9	0.7	5 Mar 1	105 Jun 27
Hereford	57.0	0.2	7 Feb 10	106 Jun 07
Lipscomb	57.3		-2 Mar 2	113 Jun 28
Lubbock	61.3	1.6	8 Nov 26	108 Jun 28
Midland-Odessa	62.1	-1.8	9 Mar 2	106 Jun 27
Pampa	58.1		5 Mar 2	111 Jun 25
Plainview	60.0	1.1	8 Mar 2	109 Jun 29
LOW ROLLING PLAINS				
Abilene	65.7	1.2	10 Mar 2	109 Jun 28
Paducah	62.1		7 Mar 3	110 Jun 29
Snyder	61.5	-0.9	9 Mar 2	108 Jun 29
Wichita Falls	64.3	0.2	5 Feb 10	117 Jun 28
NORTH CENTRAL				
Dallas-Ft. Worth	66.8	1.3	15 Mar 2	113 Jun 27
Gainesville	64.1	0.5	10 Feb 10	111 Jun 28
Mineral Wells	66.6		8 Feb 10	114 Jun 28
Paris	64.0	0.9	12 Mar 3	106 Jul 18
Waco	67.0	-0.1	17 Mar 2	109 Jun 27
EAST				
Athens	66.0		15 Mar 2	106 Aug 22
College Station	67.7	-0.6	19 Mar 2	106 Aug 22
Longview	66.1	0.6	17 Mar 2	104 Jul 17
Lufkin	66.1	-0.6	18 Mar 2	104 Aug 22
Texarkana	62.8		15 Mar 2	105 Aug 22
TRANS-PECOS				
Alpine	62.2	-0.4	10 Mar 2	104 Jun 19
Chisos Basin	62.1		18 Feb 9	98 Jun 07
El Paso	64.3	1.0	16 Feb 9	109 Jun 28
Pecos	65.0	-0.2	17 Mar 3	112 Jun 08
EDWARDS PLATEAU				
Del Rio	70.9	0.9	21 Mar 2	108 Jul 02
Llano	66.4	-0.2	14 Mar 2	112 Jun 28
Ozona	64.1		8 Mar 2	106 Jun 29
San Angelo	65.4	-0.8	8 Mar 2	105 Jun 28
SOUTH CENTRAL				
Austin	68.9	0.8	19 Mar 2	105 Jun 27
Columbus	67.7		18 Mar 2	107 Aug 24
Corpus Christi	71.4	-0.5	24 Mar 2	101 Jun 27
Goliad	70.7	-0.6	21 Mar 2	106 Jul 21
San Antonio	69.8	1.0	19 Mar 2	105 Jun 27
UPPER COAST				
Beaumont-Pt. Arthur	68.8	0.4	25 Mar 3	103 Jul 17
Galveston	69.2	-0.6	26 Mar 2	96 Aug 23
Houston	69.7	0.8	22 Mar 2	107 Aug 23
Victoria	69.9	-0.3	21 Mar 2	100 Jul 17
SOUTHERN				
Alice	72.1	0.0	23 Mar 2	107 Jun 28
Laredo	73.8	-0.1	26 Feb 10	110 Jun 28
Rio Grande City	73.7		29 Mar 4	109 Jun 29
LOWER VALLEY				
Brownsville	74.2	0.4	32 Mar 2	100 Jul 20
McAllen	75.2	1.5	31 Mar 2	107 Jun 27

*Same temperature also occurred on earlier date(s).

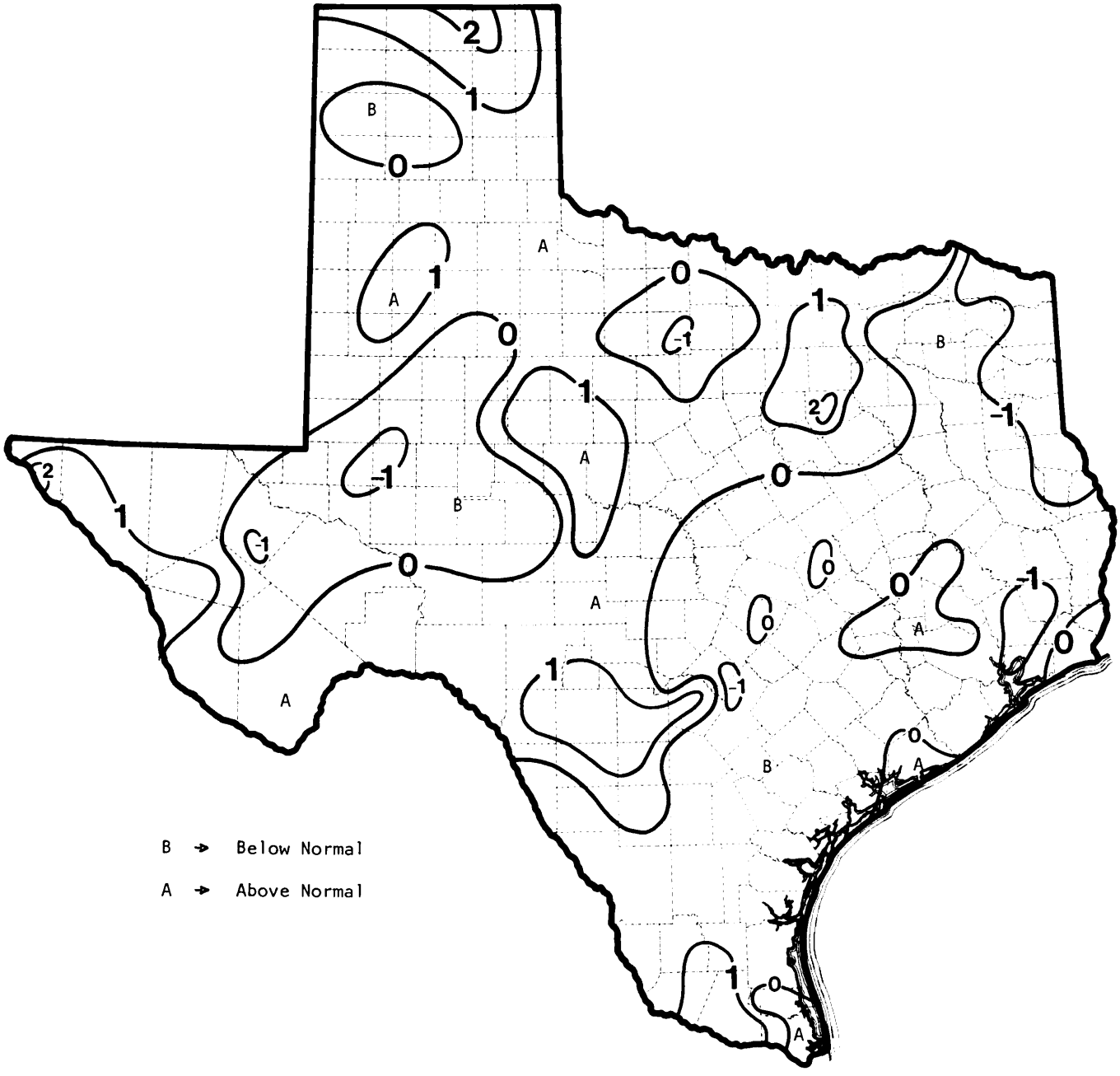


Figure 1. Departure (°F) of average annual 1980 temperature from normal.

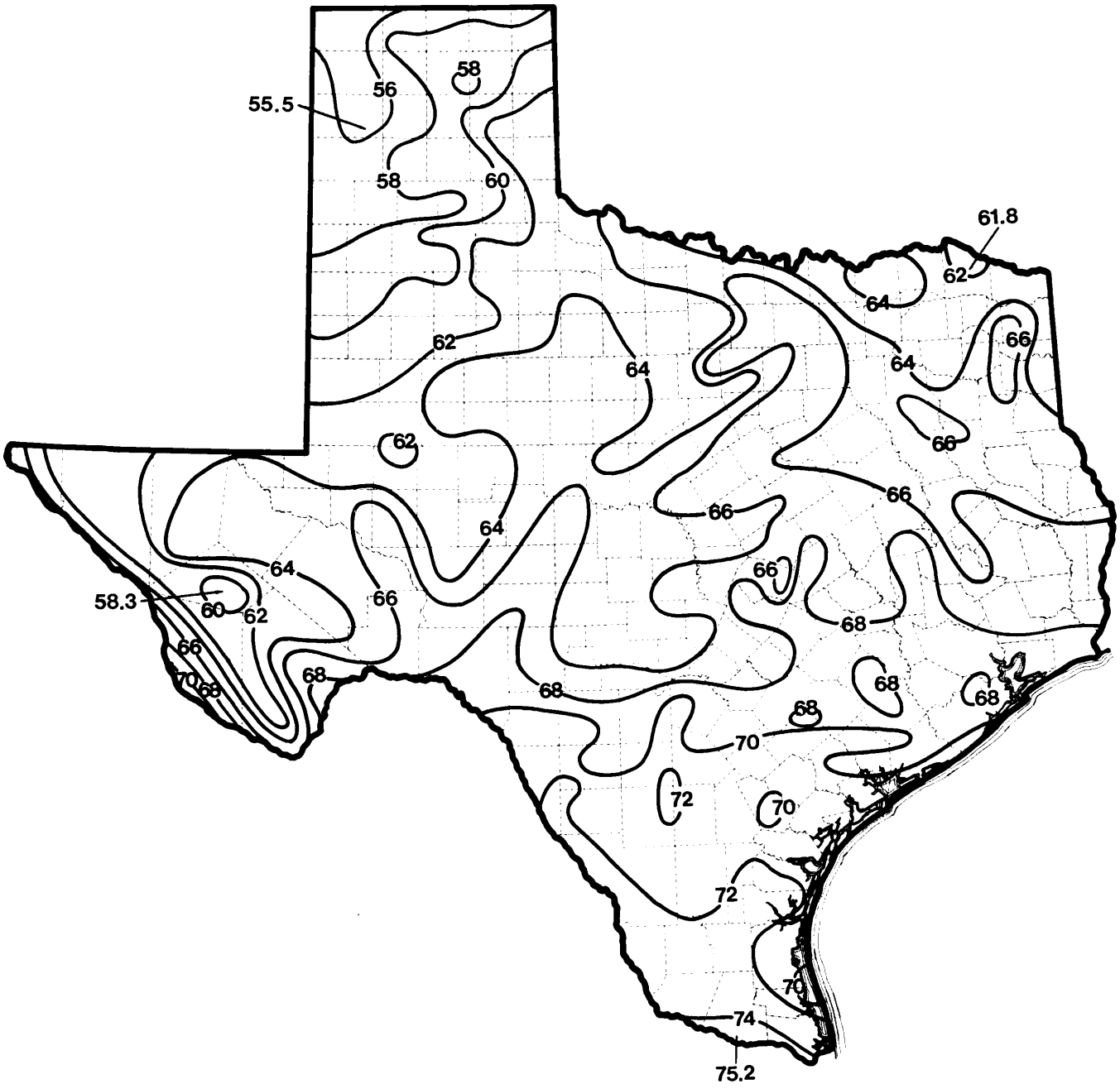


Figure 2. Average annual temperature (°F) for 1980.

The Winter-Spring Period

In a year that featured a heat wave of extraordinary length, areal extent, and intensity, it is significant that Summer's counterpart also was highlighted by temperatures of unthinkable extremes. While Winter furnished several strong outbreaks of bitterly cold air, none was as hurtful and extensive as the severe cold snap that permeated all of Texas as the "official" winter season drew to a close. What was unquestionably the year's harshest cold wave to most Texans struck at least a month later than usual, and consequently huge crop losses were inflicted on growers in the southern half of the State. More wintry weather six weeks later in mid-April wrought still more misery upon farmers in the same areas. Then, about one month later, the surges of cold air from the polar region abruptly ceased and the latter half of May fostered the incipient stage of a most unforgettable killer drought and heat wave.

Except for an unusually mild January, the Winter-Spring period (January-May) in Texas was uncharacteristically chilly. With a record-setting cold spell at mid-month, April was substantially colder than normal throughout the State. February was modestly colder than usual in all but the western extremity of Texas, while March was just slightly cooler than normal in all but that portion of the State within 100 miles of the Rio Grande. Without the sweltering heat in early May that marked the incipiency of the killer heat wave of summer, May would also have been noted as a month of cooler-than-normal weather.

Most areas of the Lone Star State received a near-normal number of freeze occurrences during the Winter-early Spring period (Table 2). A few areas in the High Plains and the Trans Pecos registered an abnormally large number of freeze days, however. Alpine had almost double the usual number of freezes in January-May, with the 5-month total of 56 establishing a new seasonal high for that mountainous community. Amarillo's sum of 79 freezes was within one of tying the record for most freeze days in a Winter-Spring period. The longest string of freeze days in the northern half of Texas ran from late January into the first or second week of February. The city with the lengthiest spell of consecutive freeze days early in 1980 was Perryton, where temperatures dropped to freezing or below on 35 straight days beginning on January 16 and ending on February 19. Perryton also recorded the greatest number of freeze days--94--of any Texas locality during the first several months of the year, while nearby Stratford had 92.

Due to the bitter cold snap that chilled all of Texas in the first week of March, the last freeze occurrence in the Winter-Spring period in most of the southern half of Texas came from two weeks to more than a month later than usual. A hard freeze was recorded on the morning of March 2 at Laredo, where Winter's freeze normally occurs around February 1.

Table 2. Number of freeze days during January-May 1980 as compared with the recent past (1949-1979).

Locale	Number of Freeze Days: Jan-May 1980	Mean (1949-78)	Greatest in Any Jan-May	Greatest Number of Consecutive Freeze Days
HIGH PLAINS				
Amarillo	79	67	80 (1959/64)	32 Jan 19-Feb 18
Dalhart	86	83	97 (1964)	19 Jan 16-Feb 03
Lubbock	51	58	72 (1964)	19 Jan 19-Feb 03
Muleshoe	86	77	93 (1951)	26 Jan 20-Feb 14
Seminole	65	58	75 (1955)	26 Jan 20-Feb 14
Spearman	66	74	88 (1964)	17 Jan 19-Feb 04
LOW ROLLING PLAINS				
Abilene	29	34	54 (1978)	9 Jan 26-Feb 03
Wichita Falls	40	42	63 (1978)	7 Jan 26-Feb 01
NORTH CENTRAL				
Dallas-Ft. Worth	28	27	51 (1978)	8 Jan 27-Feb 03
Paris	43	37	58 (1978)	18 Jan 27-Feb 13
Waco	25	21	39 (1978)	3 Mar 01-03
EAST				
Longview	26	26	50 (1978)	7 Jan 29-Feb 04
Lufkin	17	22	49 (1978)	4 Jan 31-Feb 03
TRANS-PECOS				
Alpine	56	32	55 (1960)	9 Jan 26-Feb 03
El Paso	27	33	51 (1964)	5 Feb 08-12
Wink	44	44	56 (1964)	12 Jan 26-Feb 06
EDWARDS PLATEAU				
Del Rio	15	10	20 (1964)	3 Feb 08-10
San Angelo	35	31	43 (1978)	9 Jan 26-Feb 03
SOUTH CENTRAL				
Austin	11	14	32 (1978)	3 Mar 01-03
UPPER COAST				
Houston	13	10	34 (1978)	3 Mar 01-03
Victoria	8	7	17 (1963)	3 Mar 01-03
SOUTHERN				
Laredo	3	5	14 (1973)	1
LOWER VALLEY				
Brownsville	1	2	8 (1973)	1

Wintry weather--if gaged by the occurrence of freezing temperatures--was not so slow to exit other sections of Texas, however. In North Central Texas and in much of the Low Rolling Plains and Edwards Plateau, the last freeze of the Spring took place on or about March 18 (Figure 3), or a few days to a week sooner than normal. In East Texas the latest freeze arrived almost two weeks ahead of schedule. The season's last freeze in the Panhandle was observed in mid-April, or about one week earlier than usual. That freeze was extraordinary in that it extended throughout the Trans Pecos as well, where the last Spring freeze usually occurs in mid or late March. Among the 350 locations in Texas where temperatures are recorded on a daily basis by the cooperative-observer network of the National Weather Service, Rankin (Edwards Plateau) registered the last freeze of the Spring with a low temperature of 30°F on April 28. Freezing weather did not threaten any of the State in May, although morning readings dipped into the mid 30's in the extreme northern fringe of the Panhandle on May 9.

January: An Uncharacteristic Mildness

Given the fact that some areas in the southern quarter of the State escaped a freeze for the first time in a decade, and that all of the Panhandle avoided sub-zero temperatures for the first time in eleven years, it is no wonder that the first month of 1980 turned out to be atypically mild. Furthermore, at no time during the month did temperatures fall to record-setting levels, and some parts of the Texas coastal plain on or near the coastline failed to register a freezing temperature during the month for the first time in January in at least ten years. All but one of the six cold fronts that traversed the State in January produced a drop in average daily temperature of no more than 10-15°F. Average January temperatures were near or just above normal in the northern half of the State, while elsewhere mean readings were 1-3°F above normal. A short-lived "heat" wave that pumped temperatures far into the 70s and low 80s in much of Texas just before mid-January was partially responsible for the uncharacteristically mild monthly readings statewide.

February: Ample Doses of Arctic Air

Very cold polar and Arctic air, pent up in the polar region during January, gushed into Texas on several occasions during the year's shortest month and gave nearly every locale in the State colder-than-normal temperatures. With a large ridge of high pressure over the southwestern U. S. providing strong northwesterly winds in the upper atmosphere over Texas for much of February, a series of cold airmasses frequently enveloped Texas and contributed to

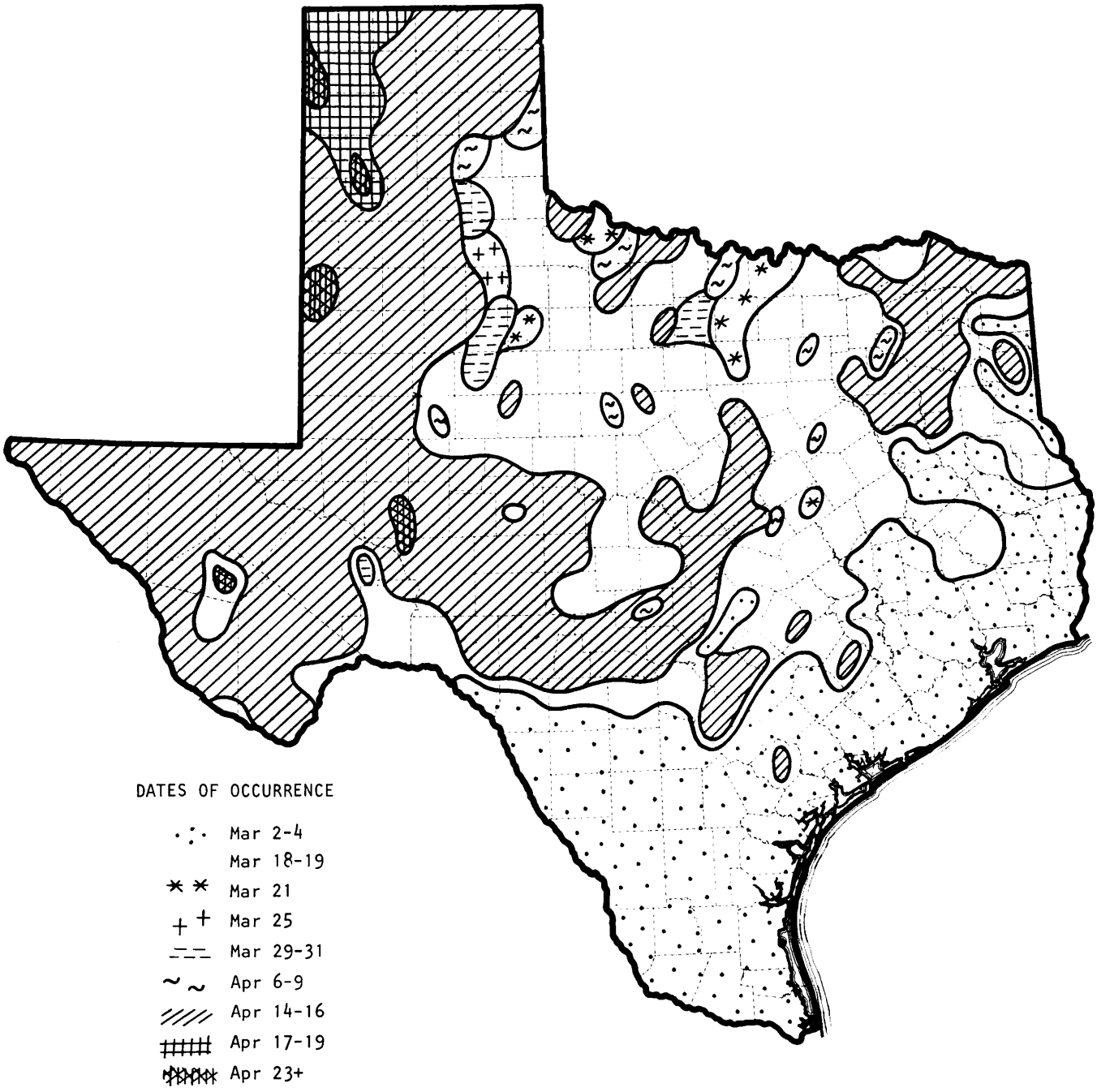


Figure 3 . Time of occurrence of the last freeze in the winter-spring period of 1980.

average monthly temperatures 1°-3° below normal in the eastern two thirds of the State. Some areas in the Trans Pecos and High Plains were spared some of the abnormally chilly weather when the cores of several of the polar and Arctic airmasses poured in from the north and settled over central or eastern sections.

The intensity of the cold air masses that enveloped Texas, rather than the frequency with which they crossed the State, was primarily responsible for the colder-than-normal conditions that prevailed in eastern Texas. The number of days on which temperatures dropped to the freeze level was no greater than usual in North Central and East Texas, as well as other regions to the south and immediately westward of them. Where mean readings were appreciably warmer-than-usual--particularly in the Trans-Pecos--the number of freeze days was considerably less than expected for the late-Winter period. The Arctic airmass that accompanied the snowstorm of February 7-8 shoved the freeze line to its farthest equatorward points during the month. Still, some parts of the Lower Valley escaped a freeze when the center of the very cold air settled over the State on the morning of February 10. The southernmost extension of the freeze line reached just north of McAllen, Brownsville, and Port Isabel at that time. A second infusion of Arctic air almost one week later again dipped morning readings to just one or two degrees above freezing in the Lower Valley.

Of the three Arctic and four polar air masses that extended into Texas during February, only the first Arctic front--the one which traversed all of the State on February 7 and 8--plunged temperatures to record-low levels. On the morning of February 10, temperatures bottomed out between 0 and 10 degrees from the High Plains to the Red River valley, where both Wichita Falls (5°F) and Dallas-Fort Worth (18°F) set new daily low temperature marks. That Arctic airmass produced the lowest temperatures of the season at several points in the mountains of the Trans Pecos, in the western High Plains, and in scattered portions of North Central Texas and the Low Rolling Plains (Figure 4).

March: A Belated and Disastrous Hard Freeze

Wintry weather often persists in brief spells well into the Spring in Texas, but rarely does an extremely hard freeze capture as much of the State as happened on the first two days of March 1980. From the Edwards Plateau to the Upper Coast and South Central Texas, the freeze that occurred on the morning of March 2 was the hardest ever in March in this century. Even the Lower Valley felt the impact of the huge dome of Arctic air that settled in over Texas two days after its leading edge first penetrated the State's northern border. A mild freeze lasting from 3 to 5 hours on the morning of March 2 was followed on March 3 by a light frost in almost all of the Lower

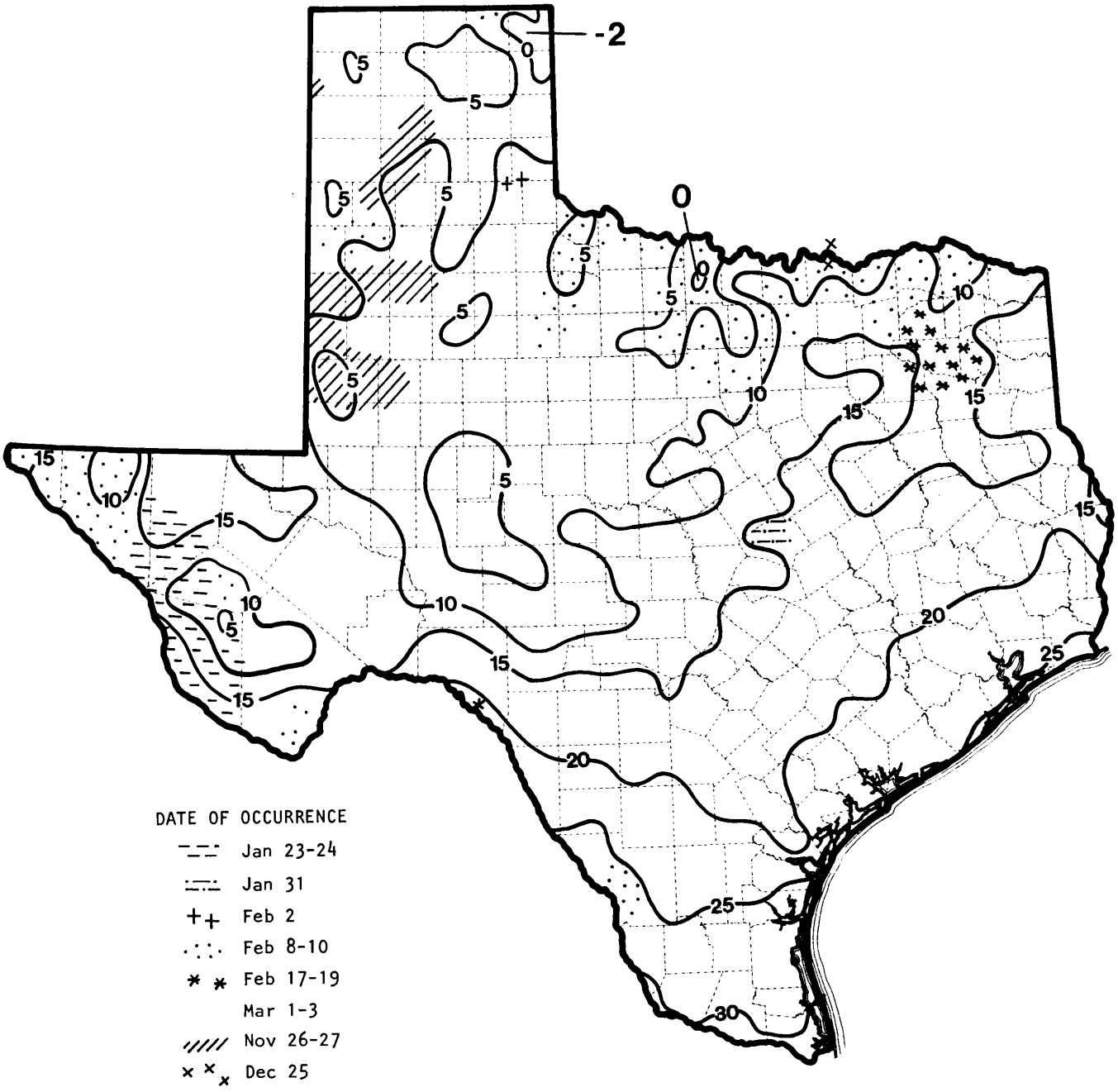


Figure 4. Extreme minimum temperatures (°F) of 1980.

Valley, where slight damage to cucumber, melon, and cantaloupe crops was sustained and where hardier crops and citrus were injured by wind burn.

Farther north thousands of people who had invested in early Spring garden crops paid dearly. So did livestock owners. The March 2 hard freeze cost many sheep and goat ranchers as much as 60-80 percent of their herds in a large part of the Hill Country. In anticipation of balmy Spring weather, stockmen had sheared their animals, who were then lost to exposure to the wind and cold when the Arctic blast hit on the first day of March. Summerlike heat during the last week in February had encouraged fruit trees in the Hill Country to bud, but then the cold snap led to losses of 40-60 percent of the potential for the season. Hardest hit were orchards in Gillespie, Blanco and adjacent counties, where the peach crop alone brings in revenue of more than $3 million. Growers of cotton, grain sorghum, and vegetables in the Coastal Bend section had to replant after the cold siege destroyed their initial crops.

The Arctic air produced, in addition to numerous daily record-low temperatures in almost every region of Texas on one or more of the month's first few days, the coldest readings ever gaged on any day in the month of March in the State's southeastern quarter. Some of these new all-time March temperature records included:

Coldest March Temperature Ever	°F	Date	Previous Record
San Angelo	8°	Mar 2	09° March 2, 1922
Midland-Odessa	9°	Mar 2	10° March 11, 1948
San Antonio	19°	Mar 2	21° March 11, 1948
Del Rio	21°	Mar 2	24° March 11, 1948
Victoria	21°	Mar 2	23° March 3, 1943
Corpus Christi	24°	Mar 2	28° March 13, 1951
Galveston	26°	Mar 2	27° March 3, 1943
Laredo	27°	Mar 2	28° March 11, 1948

Numerous other places, including Houston (22°), Tyler (13°), McAllen (31°), Longview (17°), Harlingen (29°), Temple (15°), and Kingsville (24°) tied alltime low-temperature marks, which in most instances were established in the 1940s. Furthermore, nearly all of the readings cited above also constituted the lowest ever observed so late in the Winter-Spring period. Every portion of the southern quadrant of Texas except for the southernmost tip of Padre Island sustained freezing weather on the morning of March 2, while temperatures plunged into the teens as far south as Charlotte (Southern) and Sinton (South Central) and into the 20s in such locales as Rio Grande City (Southern) and Harlingen and Port Mansfield (Lower Valley).

Barely two weeks after the historic freeze that coincided with Texas' Independence Day, another uncommonly late surge of Arctic air produced more record cold temperatures in the southern half of Texas. Orchards in the Texas Hill Country that had been harmed by the bitter cold spell of March 2 were finished off by sub-freezing weather that hit on March 18; buds that somehow survived the earlier freeze in March were in full bloom when the subsequent freeze hit, and as a consequence, losses to peaches and plums amounted to 90 to 95 percent of the potential crop for 1980. Moreover, thousands of small home gardens and much larger commercial truck gardens had to be replanted. Temperatures bottomed out in the mid teens as far south as Menard and in the low 20s at Fredericksburg and Kerrville, while lows in the mid 20s were registered at Boerne and Blanco. Freezes were observed as far south as Floresville, Columbus, and San Antonio on the morning of March 18.

In spite of the two Arctic cold waves at the beginning and in the middle of March, the month as a whole was neither unusually warm or cold. Temperatures averaged over the whole of March generally were within 2 degrees of normal, with the majority of locales registering slightly below-normal readings for Spring's first month. Greatest negative (colder) departures from normal were measured in the Red River valley, where mean temperatures were 2 to 3 degrees below normal, while the coastal bend portion of the coastal plain sustained mean monthly temperatures nearly 3 degrees above normal.

April: Another Untimely and Hurtful Cold Wave

Still another extraordinarily massive mound of Arctic air poured into Texas and produced another round of record-shattering cold weather midway through spring. The frigid airmass, which instigated an unusually late and severe icestorm in the western tip of Texas and promoted snowflakes deep into the Hill Country, plunged morning temperatures to the lowest levels ever observed in April in the southeastern quarter of the State. New alltime low temperatures were recorded at the following cities:

Coldest April Temperature Ever	°F	Date	Previous Record
Corpus Christi	33°	April 14	39° April 7, 1971
Kingsville	34°	April 14	36° April 10, 1973
Victoria	35°	April 14	36° April 7, 1971
Brownsville	38°	April 14	39° April 14, 1915

Lows on the same morning of 33° at San Antonio and 36° at Beaumont-Port Arthur tied the record for the coldest-ever temperature recorded in April. With a minimum of 40°, Harlingen joined the cities mentioned above in registering the coldest readings ever so late in the Spring; Bryan-College Station's minimum of just a couple of degrees above freezing matched the 34°-reading of April 14, 1928 for the lowest ever so late in the Spring. A freeze on the morning of April 14 occurred deep into South Central Texas at scattered spots such as Columbus, Floresville, Goliad, and New Braunfels, where freezing weather had never occurred so late in the Spring. Freezing temperatures in parts of the Hill Country at locales like Kerrville had not occurred so late in the Spring in almost 20 years.

A heavy frost that accompanied the record-setting cold wave exacted a massive toll on agriculture in South Central and Southern Texas. The drainage of sub-freezing air into low-lying areas resulted in heavy crop losses, particularly in river and creek-bottom portions of the blacklands and gently rolling prairies. Almost all of the corn crop was lost in Dewitt and Goliad Counties, while "heavy" corn losses were sustained in the northern part of Live Oak County and in Karnes County. Newly-sheared and newborn goats and sheep died in the Hill Country from exposure to the severe chill, while emerging rice crops in the coastal plain were damaged.

Due largely to the mid-April Arctic surge and a less-influential but nonetheless significant outpouring of polar air near the end of the month, average April temperatures were substantially colder than normal statewide. Indeed, every one of the several hundred temperature-observing stations within the State measured subpar temperatures over the course of the month, and at least half of them reported temperature departures from normal of at least 3°F. Readings were most abnormally cold in East Texas, where the region as a whole observed an average April temperature 4.4°F below normal and where at least half of the stations registered mean readings of 5°-6°F under normal.

May: A Rapid Warm-up

The frequency of occurrence of cool fronts traditionally drops off appreciably as Spring wanes and Summer approaches, and sure enough May 1980 offered only a trio of polar fronts that reduced temperatures only moderately.

The first of the three cold fronts gave a momentary chill of record-setting dimensions by dropping morning temperatures deep into the 40s in the Red River valley and the mid 50s in the Upper Coast on May 9. No portion of the High Plains was ever seriously threatened by a freeze during May, although

the first two cold fronts of the month did force readings on a few mornings in the northern fringe of the Panhandle into the upper 30s.

The warmup that followed the last major frontal passage of May marked the incipient stage of the monumental summer heat wave. The large subtropical high-pressure cell responsible for the intense and prolonged heat moved north out of the tropics and fastened its grip on Texas not long after the middle of May. Texans, while unaware that the evolution of a massive heat wave was imminent, welcomed the arrival of sunny skies and dry southwesterly winds that signalled the end of a 5-day siege of heavy thunderstorms in mid-May that left more than half of the State with more rain in any May in almost 25 years. Quickly, however daytime temperatures in the last week of May shot to record levels in the upper 90s in the Low Rolling Plains and North Central Texas. Such lofty temperature readings, along with uncomfortably high humidities, turned out to be an omen of the misery that Texans would endure in the following months.

Summer

The huge mound of high pressure that began asserting itself on Texas in late May tightened its grip in June to the extent that much of the State saw the killer heat wave at its worst as June drew to a close. While it eased off slightly and intermittently in July and August, the oppressive high nonetheless fostered several more spells of extraordinarily intense heat. Average temperatures for each of the three summer months were hotter than normal in nearly all of Texas; only the southern quarter of the State experienced subpar readings, and they were confined to the month of August, when Hurricane Allen furnished a dense cloud cover and cooling rains. Temperatures averaged over the whole summer (June-August) were the highest ever registered in some locales, as listed below:

Hottest Summer in History	Summer Avg.	Temperature Departure from Normal Jun	Jul	Aug	Summer
Dallas-Fort Worth	89.2	6.4	7.2	3.6	5.8
Wichita Falls	88.5	3.5	6.1	3.3	4.3
Abilene	86.6	4.1	5.5	2.5	4.0
Houston	86.4	4.0	4.2	3.2	3.8
Brownsville	86.4	4.1	3.1	0.5	2.5
Austin	86.2	3.0	3.3	1.3	2.6
San Antonio	86.2	2.9	3.4	0.6	2.3
Lubbock	82.7	6.0	4.6	2.2	4.3

The Summer of 1980 would have been the hottest in the 96-year weather history of El Paso except that the average temperature for the months of June-August 1884 was 0.06°F than that registered in 1980! Waco and Abilene suffered the hottest Summer since 1934, whereas Amarillo experienced the hottest Summer since 1953.

June: The Killer Heat Wave At Its Worst

The large upper-atmospheric high pressure cell retreated enough to allow a lone cool front to penetrate through Texas at the end of June's first week, and that was the only brief respite that Texas enjoyed from the scorching heat wave at any time in Summer's first month. By the time of the Summer Solstice, the vast "bubble" of high pressure hovering over Texas had allowed enough compression of the surface layer of air and a virtual peak in daytime solar radiation that temperatures shot to historic levels in a broad expanse of the Low Rolling Plains and North Central Texas. Near the end of June, with ample sunshine and searing desert winds forcing temperatures to skyrocket during the daytime, locales along and up to 100 miles south of the Red River saw the mercury in official thermometers climb to levels never-before registered. Among the all-time high-temperature records established were:

Hottest Temperature Ever	Date	Previous Record
Wichita Falls	117° Jun 28	113° Aug 6, 1964
Dallas-Fort Worth	113° Jun 26	112° Aug 11, 1936
Pampa	111° Jun 25	109° Jun 15, 1939
Plainview	109° Jun 29	107° Jul 7, 1971
		Jun 19, 1960
		Aug 3, 1944
Houston	107° Aug 23	106° Aug 13, 1962
		Aug 14, 1962

Others of the State's 100 largest cities that registered record-tying temperatures included: Laredo (110°), Denison Dam (109°), Huntsville (107°), and Tyler (107°).

In addition to almost tying the all-time statewide record-high temperature of 120°F recorded at Seymour 44 years earlier, the high of 119°F registered at Weatherford on June 26 was distinguished as the hottest temperature anywhere in Texas during 1980 (Figure 5).

The extraordinarily intense heat during the last week of June culminated a month that was noted as the hottest June of the 20th century in such diverse areas as the Trans Pecos and Lower Valley. Of Texas' 50 largest cities, those

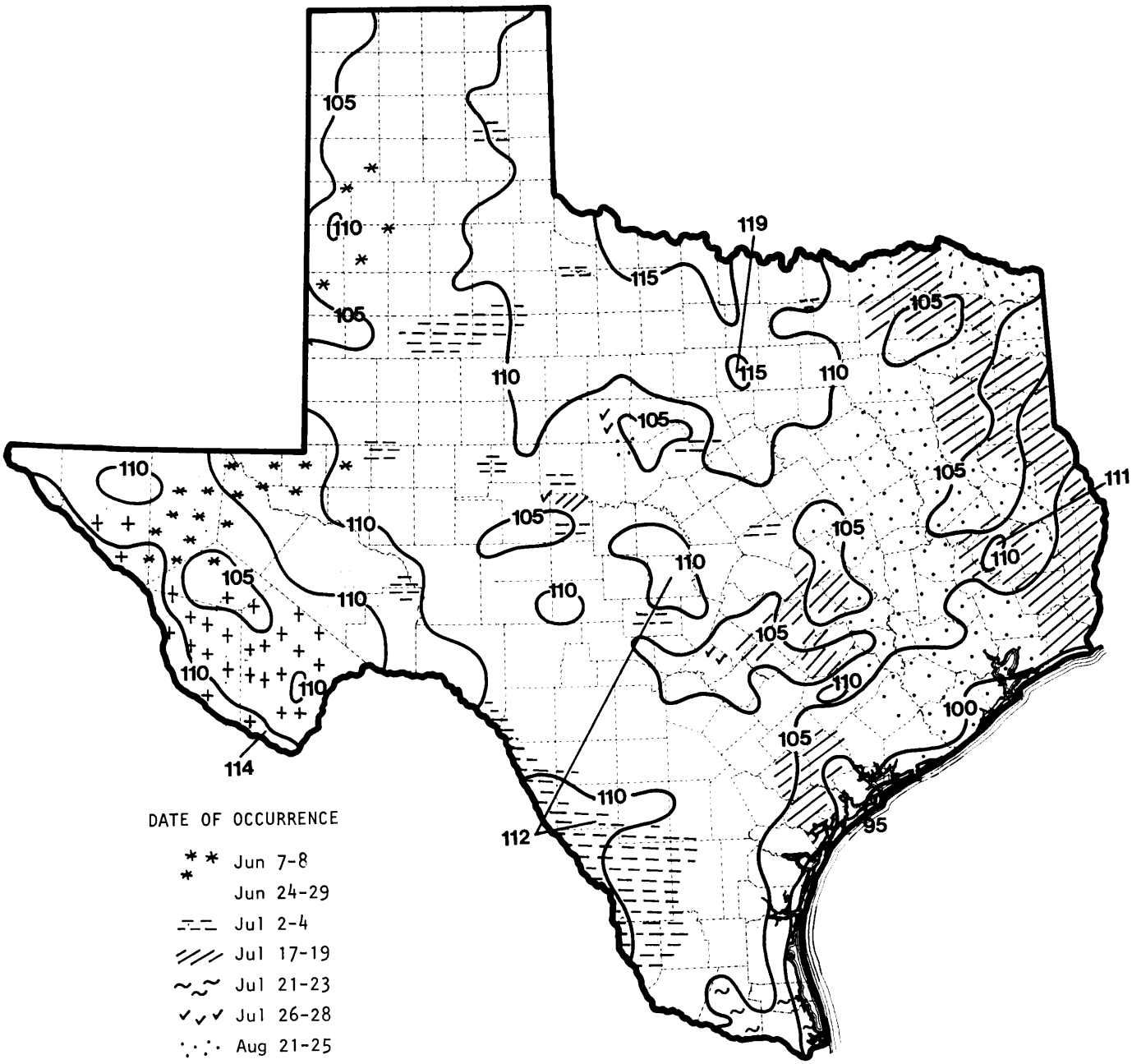


Figure 5. Extreme maximum temperatures (°F) of 1980.

which sustained the hottest weather in the month of June in recorded weather history are listed below:

Hottest Average Monthly Temperature Ever in June	°F	Previous Record
Laredo	90.5	89.9 (1953)
Brownsville	86.9	86.4 (1900)
El Paso	86.3	85.0 (1960)

Houston's average June temperature of 85.1°F was the hottest of any June in 74 years, while San Antonio's mean of 85.1°F was the highest June average since the drought of the 1930s. Cities having the hottest June weather since the century's worst drought in the mid-1950s include: Dallas-Fort Worth (87.5°), Del Rio (87.2°), Wichita Falls (84.8°), Abilene (84.4°), Waco (85.2°), Amarillo (78.3°). Lubbock (83.1°), Austin (84.6°), McAllen (86.4°), Denton (84.6°), Harlingen (85.3°), Sherman (83.5°), and Kingsville (86.6°).

Average June readings were more than 2°F above normal at 80 percent of all temperature-observing stations in Texas; only one station (Marshall) registered average June readings that were below normal (only -0.3°F), while more than half of all stations in the Trans Pecos reported departures from normal of at least 5°F.

Understandably, it was exorbitant afternoon maximum temperatures moreso than high morning minimum readings that contributed to the inordinately high mean June temperatures in most areas. With the majority of stations in Texas reporting afternoon highs of 100°F or higher on more than one-half of June's days, the mean maximum temperature for the month in many areas broke all-time records, as evidenced below:

Hottest Average June Maximum Temperature Ever	°F	Previous Record
El Paso	103.9	99.8 (1960)
Dallas-Fort Worth	99.5	98.5 (1953)
Houston	96.3	96.2 (1902)

The early arrival of the phenominal heat was responsible for the establishment of a variety of other temperature records as well. Daily and monthly record high temperatures were set in almost every region of Texas by one or several of the peak periods of intense heat that extended throughout most of June. The high temperatures listed below were the hottest readings ever measured for any day during the month of June:

Hottest June Temperature Ever	°F	Previous Record
Wichita Falls	117° June 28	111° June 25, 1972
Dallas-Fort Worth	113° June 27	107° June 21, 1936
Laredo	110° June 28	109° June 24, 1949
Sherman	110° June 28	106° June 21, 1936
Waco	109° June 27	107° June 21, 1936
Denton	108° June 26	106° June 21, 1936
Kingsville	107° June 28	104° June 14, 1967
Tyler	104° June 28	101° June 15, 1963
Houston	103° June 30	102° June 18, 1934

McAllen's high of 104° on June 28 tied the all-time highest June temperature set 38 years earlier. Actually, the record readings listed above culminated a weeklong siege of deadly heat that repeatedly forced temperatures on successive days to new heights for so early in the summer season. For example, Dallas-Fort Worth's previous record-high temperature for June (107° on June 21, 1936) was initially shattered on June 25 by an afternoon maximum of 109°. The high of 113° recorded the next day erased that short-lived new record, however, and the maximum of 113° registered on June 27 matched the new record high set the day before. Soft southwesterly winds that transported desertlike air into the area, along with a total absence of clouds that maximized the amount of solar insolation reaching the surface, were the primary culprits responsible for the phenomenal heat (Figure 6). The high of 105° measured at El Paso on June was the first time in the 94-year weather history of that far western city that the temperature reached the 105° level so early in the summer, but then that new record was obliterated three other times later in the month. The same is true of the 112° reading observed at Wichita Falls on June 24, because the temperature on following days climbed still higher: to 114° on June 25, 116° on June 27 and ultimately to the all-time maximum of 117° on June 28.

Moreover, with the State inextricably gripped by the huge high-pressure cell for nearly all of June, many areas registered individual record-breaking temperatures on about half of June's 30 days. Most of the record-setting heat was confined to the Trans-Pecos during the first half of June, although parts of the High Plains, North Central Texas, and the Upper Coast sustained high temperatures that broke daily records on either June 6 or 7. Of the State's 15 largest metropolitan areas, El Paso saw the greatest number--16--of record-setting daily high temperatures; of those 16, eight occurred in succession during the period of June 11-18. While afternoon readings in the far western sector of Texas did not appreciably cool down later in June, temperature records were broken day after day in a large expanse of Texas from the High Plains to North Central Texas, the Upper Coast and South Central Texas on June's last eight days. Dallas-Fort Worth and Houston both recorded new record highs eight days in succession.

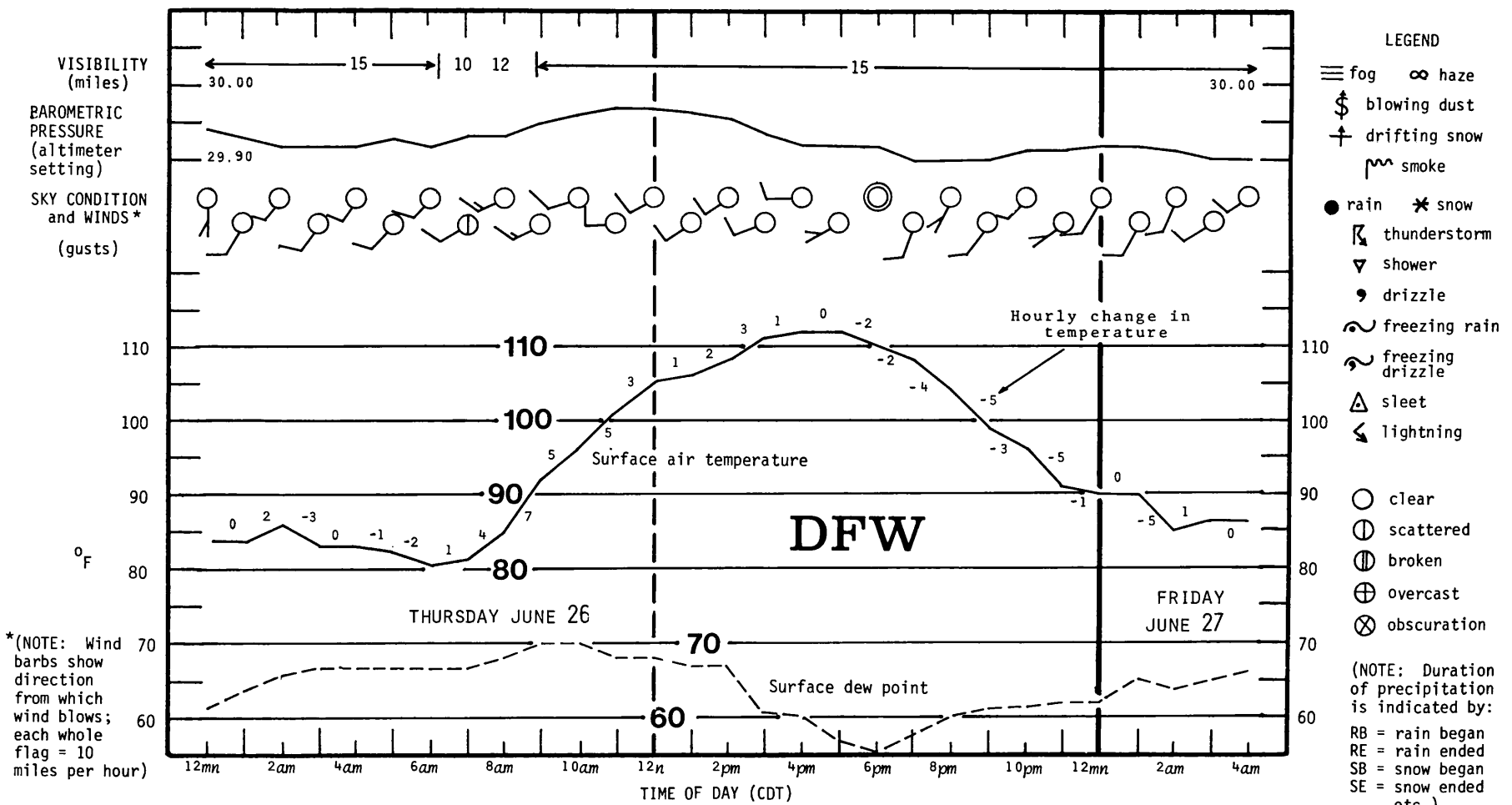


Figure 6. Hourly surface weather conditions at the Dallas-Fort Worth Regional Airport (DFW) during the record-breaking heat wave that gave the area the hottest temperature (113°) ever recorded: from 12 mn (CDT), June 25 to 4 a.m. (CDT), June 27, 1980.

July: Continued Record Warmth

With Texas already seared from a devastating heat wave that peaked in the northwestern half of the State in late June, July compounded the misery by providing little else than a continuation of scorching temperatures. In the absence of any meaningful developments in the Gulf of Mexico and with only a couple of weak cool-air infusions late in the month, conditions in most regions of the State were consistently hot throughout the month. With a superabundance of sunshine and the prevalence of dry southerly winds, most areas wilted as temperatures shot up on numerous occasions throughout the month to record levels in every sector of the State; a large number of locales in the northern quarter of the State suffered through a sequence of 100-degree temperatures that spanned the entire month.

The same phenomenon--a massive mound of subtropical air that extended high into the atmosphere--that introduced the killer heat wave of late June maintained its presence in Texas for much of July. On numerous occasions during the month the weight of this huge high fomented daytime temperatures that soared well beyond the 100-degree level in every section of the State except for the immediate coastal area and the highest elevations of the Trans-Pecos. In fact, the sun beat down with such an intensity early in the month that one major metropolitan area registered the hottest temperature ever observed in July:

Hottest July Temperature Ever	°F	Date	Previous Record
Dallas-Fort Worth	110°	July 2, 18	109° July 25, 1954 July 29, 1912

In addition, high temperatures of 114° at Wichita Falls and 103° at Beaumont-Port Arthur tied all-time record highs for the month of July. Numerous other cities in North Central and East Texas, and in Southern Texas and the Lower Valley, observed temperatures within one or two degrees of the all-time July record. As attested by the monthly maximum of 110° at Dallas-Fort Worth registered on both July 2 and July 18, several spells of uncommonly intense heat forced readings within proximity of record levels at mid-month and again at the end of July.

The fact that the incredibly torrid wave hardly relaxed its grip at any time during July resulted in temperatures averaged over the whole of the month that were the hottest ever in **any** summer month in some parts of the State. As shown below, cities in almost every section of Texas sustained the hottest cumulative temperatures for the whole of July in history:

Hottest Average Monthly Temperature Ever in July	Average July Temperature	Previous Record
Dallas-Fort Worth	92.0	90.5 (1954)
Wichita Falls	91.9	89.9 (1978)
Del Rio	90.1	89.7 (1953)
Abilene	89.4	89.0 (1978)
San Antonio	88.1	86.9 (1962)
McAllen	88.0	86.8 (1969)
Austin	87.9	87.5 (1925)
College Station	87.5	87.2 (1934)

Houston missed by 0.1° tying the all-time highest average July temperature of 87.6 set in 1888. Brownsville, with an average July temperature of 87.5°, endured the hottest July since 1876 and the second hottest of any summer month since records were started there in 1850! El Paso's average of 87.2° was the hottest in 96 years. An average of 84.3° made July the second hottest July in history at Lubbock.

Mean temperatures for the month of July were above normal at every one of the more than 300 temperature-observing stations in the State. Highest average values occurred in parts of the Low Rolling Plains and North Central Texas, where monthly readings exceeded the normal by 5-6 degrees! Readings for the whole of July were nearest normal levels in a narrow band extending from the coastal bend northeastward along the coastline through the Upper Coast, where the sea breeze played its usual moderating role in keeping afternoon maximum temperatures well below 100 degrees on most days; indeed, on Galveston Island, the mercury in the official thermometer climbed no higher than 95 degrees at anytime during July.

While morning low readings were most often at their usually balmy levels, the extent to which temperatures soared beyond normal levels in the afternoon explains in part why July 1980 was exceedingly hot. Numerous points in the Low Rolling Plains and North Central Texas registered maximum temperatures of at least 100 degrees on every one of July's 31 days—a feat never-before observed in some locales. When collectively examined, these maximum temperatures easily broke all-time records in some of the State's largest cities:

Hottest Average July Maximum Temperature Ever	°F	Previous Record
Wichita Falls	107.3	104.3 (1978)
Dallas-Fort Worth	105.3	101.9 (1954)
Laredo	104.0	102.7 (1957)
El Paso	101.8	100.1 (1979)
Austin	100.1	99.4 (1956)
San Antonio	99.9	98.5 (1962)
Houston	99.4	95.8 (1971)
Brownsville	97.5	96.6 (1978)

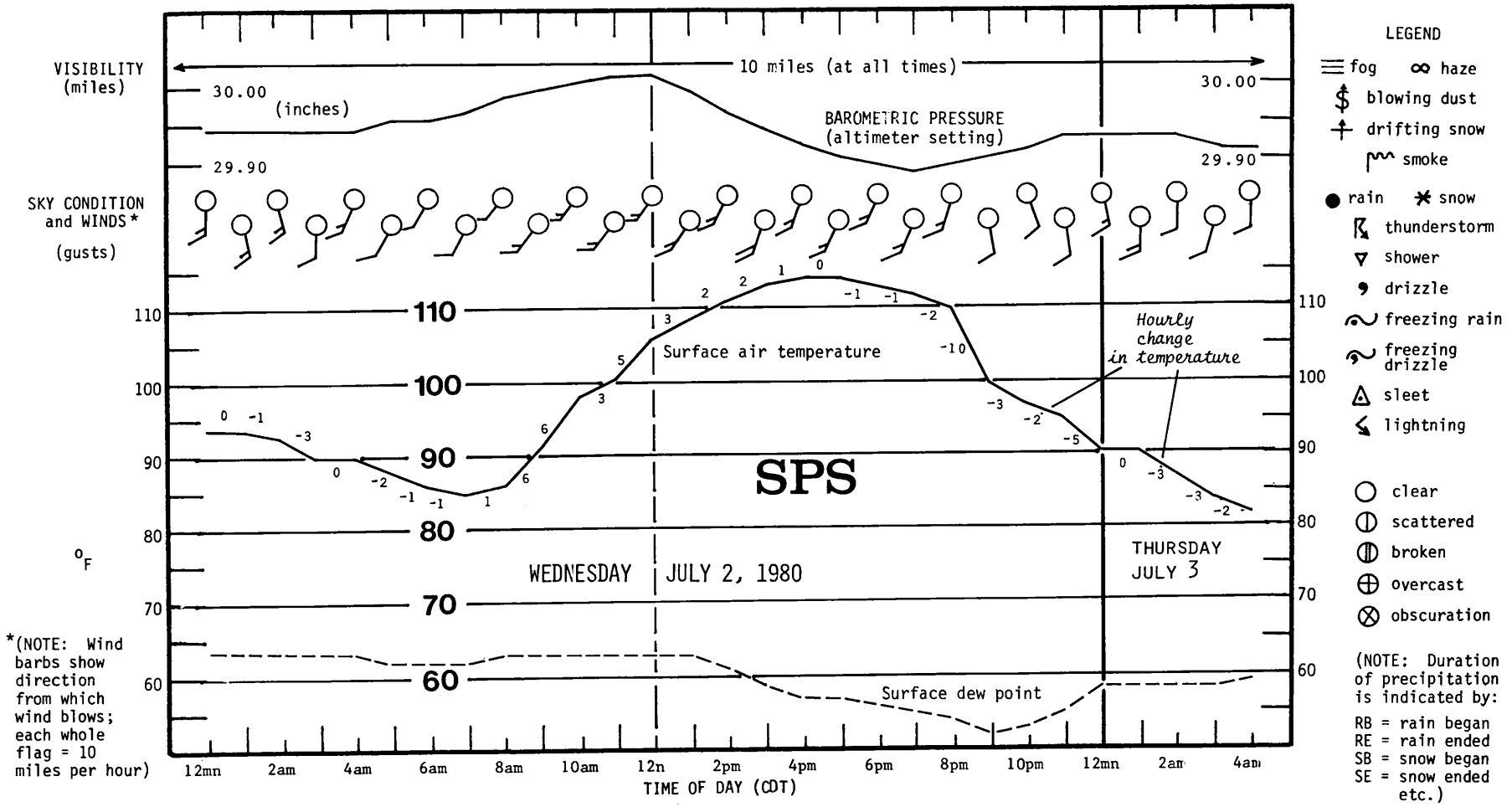


Figure 7. Hourly surface weather conditions at Wichita Falls (SPS) during the record-setting heat wave that gave the city the hottest temperature (114°) ever recorded in the month of July: from 12 mn (CDT), July 1 to 4 a.m. (CDT), July 3, 1980.

Not surprisingly, hardly a day in July passed on which at least one of the State's largest 16 cities registered a new, daily record high temperature. Daily, record-setting high temperatures were most numerous and widespread at month's beginning and again for about one week around mid-month. Most of the western third of the State registered such records during those two periods, although the western tip of Texas saw temperatures climb on several occasions to new levels during July's last week. Much of the remainder of the State measured record highs on an intermittent basis throughout most of July. Of the State's 15 largest metropolitan areas, Houston gaged the greatest number--17--of daily, record-high temperatures, while Dallas-Fort Worth was a close second with 14. Houston also sustained the longest string--9--of days of record-high readings.

August: A Gradual Diminution of Torrid Temperatures

The huge oppressive mound of hot subtropical air eased off slowly during August, and record-breaking daily temperatures above 100° were much less numerous than during Summer's first two months. Still, high pressure gripped Texas enough of the time to promote an almost uninterrupted spell of seasonably hot weather. As during the two previous months, parts of the State experienced some of the hottest weather of the century. Houston's average temperature of 86.6° was the highest since 1902 and the second highest since records were begun 98 years ago.

In much of the northern half of Texas, mean August temperatures of 2°-4°F above normal were the warmest for the month since the drought-ravaged mid-1950s. August 1980 was the hottest last month of summer since 1952 at Lubbock (80.6°), Wichita Falls (88.8°), and Dallas-Fort Worth (88.5°), while Abilene (86.1°) and Sherman (87.2°) had the hottest monthly average temperatures since 1954 and 1956, respectively. However, for the first time in four months, some parts of the southern half of the State sustained slightly below-normal temperatures, a major reason for which was the cooling rains generated by Hurricane Allen.

Most of the State's ten climatic divisions sustained hot-enough temperatures on one or more days in August to shatter all-time temperature records for those days. Some locales in the Upper Coast and Trans-Pecos recorded afternoon high temperatures that not only shattered daily records but also established new temperature marks for the whole month as well:

Hottest August Temperature Ever	°F	Date	Previous Record
Houston	107°	Aug 23	106° Aug 14, 1962
El Paso	108°	Aug 2	105° Aug 17, 1969

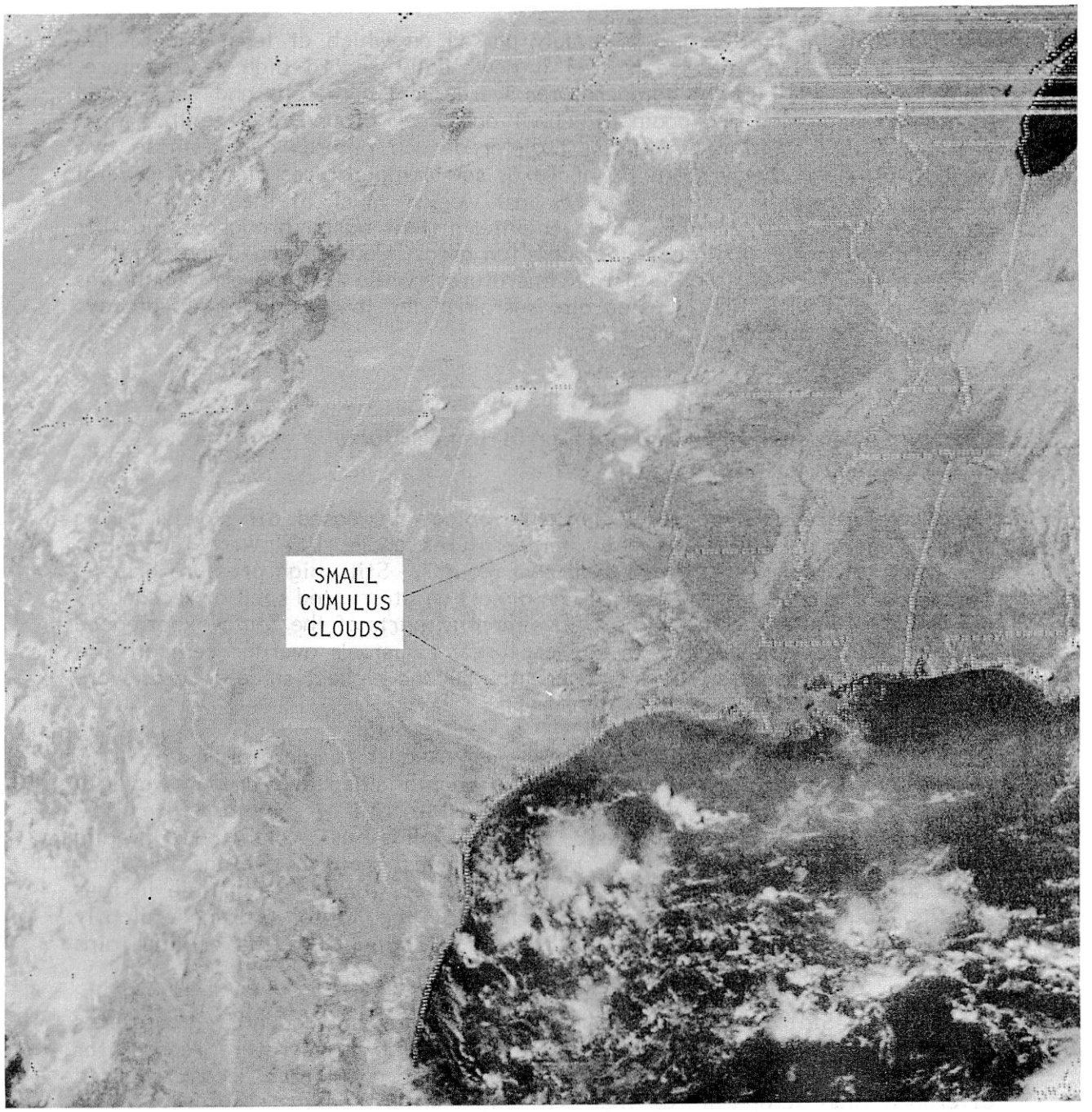


Figure 8. A scene much too common during the summer of 1980: clear skies marred in only a few areas by patches of mostly small cumulus clouds, as seen by this visible satellite photograph taken on the afternoon of August 22, 1980.

Almost all of the daily record highs set during August took place on either the month's first 2-3 days or near the end of the month. The most widespread outbreak of record-breaking heat engulfed most of the northeastern half of the State on August 22-24, when highs soared to near 110 degrees along the Red River and surpassed 105 degrees in the northern reaches of the Upper Coast. At least one record daily high temperature was established in such diverse areas as El Paso, Brownsville, Galveston, and Wichita Falls. Of the State's 15 largest metropolitan areas, Houston gaged the greatest number--4--of daily record high temperatures, all of which were on four consecutive days from August 22-25; on two of those occasions, the maximum exceeded the previous all-time high by 9 degrees!

The Autumn of 1980

Summer's sweltering heat gave little heed to the calendar, for extraordinarily hot weather extended far into the month of September before a slow-moving cool front mercifully brought most-welcome relief to Texas on September 22. The first bonafide "norther" of the Autumn broke the back of the killer heat wave, however, as modestly cooler-than-normal temperatures persisted for much of October. Then, a mid-Winter chill encased Texas on several occasions in November, but not before yet another hot-weather siege led to some of the hottest temperatures ever observed so late in the year in some portions of the State.

Autumn's first freeze came much earlier than usual in virtually every sector of Texas. Thanks to the influx of uncommonly cold Arctic air during October's last week, nearly all of the northern half of Texas had sustained its first freeze by October 30. That meant the initial fall freeze arrived nearly three weeks earlier than normal in southern North Central Texas and at least two weeks prematurely in the Trans Pecos, the southern High and Low Rolling Plains, and much of the Edwards Plateau and North Central and East Texas. Even in the Texas Panhandle Autumn's inaugural freeze was about one week earlier than usual. The extraordinarily cold blast of Arctic air that plunged through Texas a couple of days before Thanksgiving was responsible for the season's first freeze in most of the southern half of the State. The frigid airmass furnished an initial freeze from two to three weeks early in much of South Central and Southern Texas as well as the Upper Coast.

Although freezing weather hit uncommonly early, and while a cold snap later in November set new record-low readings in much of the State, the trailing end of 1980 featured a customary number of freeze days in most sections of Texas (Table 3). Only in the extreme west--at El Paso--and in the east--in the piney woods around Lufkin--was the number of freeze days in November and December substantially above normal. At least one freeze hit in every

Table 3. The number of freeze days during the months of November-December of 1980 at selected cities as compared with the recent past (1949-1978)

CLIMATIC	Number of Freeze Days: Nov-Dec 1980	Mean (1949-78)	Greatest in Any Nov-Dec	Greatest Number of Consecutive Freeze Days
HIGH PLAINS				
Amarillo	42	40	51 (1972)	20 Nov 14-Dec 3
Dalhart	45	49	56 (1972)	16 Nov 14-29
Lubbock	31	35	48 (1940)	08 Dec 19-26
Muleshoe	48	47	56 (1972)	24 Dec 8-31
Seminole	33	34	50 (1972)	09 Dec 19-27
Spearman	39	44	53 (1951)¢	09 Nov 14-22+
LOW ROLLING PLAINS				
Abilene	19	19	35 (1972/76)	05 Nov 16-20
Childress	27	29	40 (1976)	08 Dec 19-26
Wichita Falls	22	24	38 (1976)	09 Dec 19-27
NORTH CENTRAL				
Dallas-Ft. Worth	14	13	22 (1963/76)	04 Dec 24-27
Paris	22	20	32 (1951)	05 Dec 19-23
Waco	11	11	24 (1976)	04 Dec 24-27
EAST				
Longview	13	15	28 (1963)	04 Dec 25-28
Lufkin	19	14	23 (1950)	07 Dec 25-31
TRANS-PECOS				
Alpine	23	20	37 (1976)	06 Nov 24-29
El Paso	32	24	37 (1975)	06 Nov 15-20+
Wink	33	28	41 (1972)	10 Dec 19-28
EDWARDS PLATEAU				
Del Rio	4	6	13 (1953/66/76	02 Dec 25-26
San Angelo	19	18	31 (1950)	04 Nov 17-20
SOUTH CENTRAL				
Austin	6	6	15 (1976)	02 Dec 20-21
UPPER COAST				
Beaumont-Pt. Arthur	2	5	12 (1963)	01 Nov 27+
Houston	7	5	15 (1976)	03 Nov 26-28
Victoria	6	3	8 (1966)	02 Nov 27-28
SOUTHERN				
Laredo	3	*	9 (1973)	01 Nov 28+
LOWER VALLEY				
Brownsville	0	#	2 (1978)¢	0

* At least one freeze day in two out of every three years.
\# No freeze days in November since 1948; at least one freeze day in one out of every four years in December.
\+ At later time(s) during the November-December period also.
¢ Also in earlier years.

area except on Galveston Island, in the Lower Valley, and at two isolated locations--at Falcon Dam (Southern) and Chapman Ranch (South Central)--elsewhere in the southern extremity of the State. The earliest freeze in Autumn was registered on October 17 at three spots in the northern fringe of the Texas Panhandle: Gruver, Perryton, and Stratford. The lengthiest spell of freezing weather covered much of the week of Christmas in the northern half of Texas, while the most consecutive number of freeze days in the southern portion occurred around Thanksgiving. The longest spell of consecutive days of freezing temperatuers during Autumn and early Winter of 1980 was recorded at Claude and Gruver (High Plains), where 21 days of freezing weather occurred from November 14 through December 4. Muleshoe recorded the greatest number of freeze days (57) during the last quarter of 1980.

September: A Prolongation of Intense Heat

The first half of September featured the last vestige or two of torrid heat that marked the Summer of 1980 as the hottest of this century in parts of Texas. Readings during the month's first 2-3 weeks resembled those ever present since the summerlike weather got underway in late-May, with 100-degree weather common in much of the northern half of the State. The heat was particularly intense in the State's northeastern quarter, where afternoon temperatures as high as 105 degrees or more persisted until mid-month. Thick cloud cover delivered by Tropical Storm Danielle gave the coastal plain temporary relief from the heat early in the month, but temperatures climbed back to levels usually reserved for the warmest portion of the Summer once skies cleared shortly before mid-month. At last the intense heat spell broke at the beginning of September's last week for most Texans, when the first major cool front of the Autumn slipped gently through much of the State.

The predominance of uncommonly warm tropical air during the first 3 of September's 4 weeks was the reason for abnormally high mean temperatures for the month in almost all of Texas. In fact, practically all of the southeastern half of the State registered mean September temperatures that were significantly warmer than normal. Within this vast area, positive (warmer) departures from normal were as much as 4 degrees in parts of East and South Central Texas. On the other hand, mean September readings in the southern High and Low Rolling Plains failed by as much as 3 degrees to reach normal early-Autumn levels. This discrepancy from the overall statewide temperature pattern stemmed mostly from a spell of unusual chill that accompanied a protracted siege of rainy weather near the end of the month. An inordiantely great amount of cloud cover--and hence reduced sunshine--was a prime factor in keeping the temperature at sub-normal levels for a good portion of the month in this section of Texas.

One peculiar feature of Texas' weather in September was the occurrence of at least one 100-degree temperature in all of the State's ten climatic divisions.

That oddity (for so late in the warm season) underscored the atypically warm weather that gripped Texas for most of September. Another incongruity was the intense heat in the northeastern corner of the State that shoved temperatures well beyond 100 degrees on 8 or more days during September's early half. It is seldom that this sector of Texas registers **any** 100-degree highs as late as September. Similar readings easily exceeded the normal in North Central Texas and the Low Rolling Plains as well.

Understandably, with summerlike heat enveloping Texas for much of the month, temperatures of record-making proportions were quite common, especially in the Upper Coast and East Texas. Among the State's 16 largest metropolitan areas, at least one record-breaking or record-tying temperature was measured on nearly half of the month's 30 days. The city of Houston suffered through eight such days, varying from as early as September 3 to as late as September 29. Houston also had the distinction of suffering through the longest string of such record-establishing temperatures: 4, or from September 22 to September 25. The most widespread spate of record-high temperatures occurred on September 17, when highs of near or above 100 degrees were recorded all along the coastal plain and as far inland as Del Rio; the 101-degree maximum at Del Rio tied a record set back in 1912.

October: An Early Killing Frost

After many months of phenominal warmth, Nature reversed itself in October by providing a lengthy chill of record-setting dimensions. Not since April 1980 had all of Texas sustained appreciably cooler-than-normal temperatures over the course of a whole month, but the infusion of a pair of uncommonly cold airmasses near the end of October was largely responsible for unusually low monthly average temperatures in all sections of the State. Both generated a freeze, though the one that followed in the wake of the passage of the Arctic front on October 27-28 was much more widespread, more intense, and longer-lasting. Both produced record-low temperatures, though the magnitude and extent of new records were much greater with the settling of the Arctic air over Texas at month's end. The first widespread freeze to hit the Panhandle sector came on October 24 after abnormally cold polar air poured through the region on the previous day. In fact, that polar air mass not only gave a hard freeze--as well as record-low temperatures--to the northern Panhandle around dawn on October 24 but also led to a light freeze in the northern reaches of North Central and East Texas and to record-low temperatures as far south as the Upper Coast. The polar air was easily outdone, however, by the Arctic air that knifed rapidly through Texas on October 28. A hard freeze followed on the mornings of October 30 and 31 in much of the northern half of the State once the center of the Arctic air mass settled in over the Lone Star State (Figure 9). A killing frost gripped all of Texas generally north of a line from Del Rio to San Antonio to College Station to Lufkin on one or both of October's last two days. Record-low temperatures on the mornings

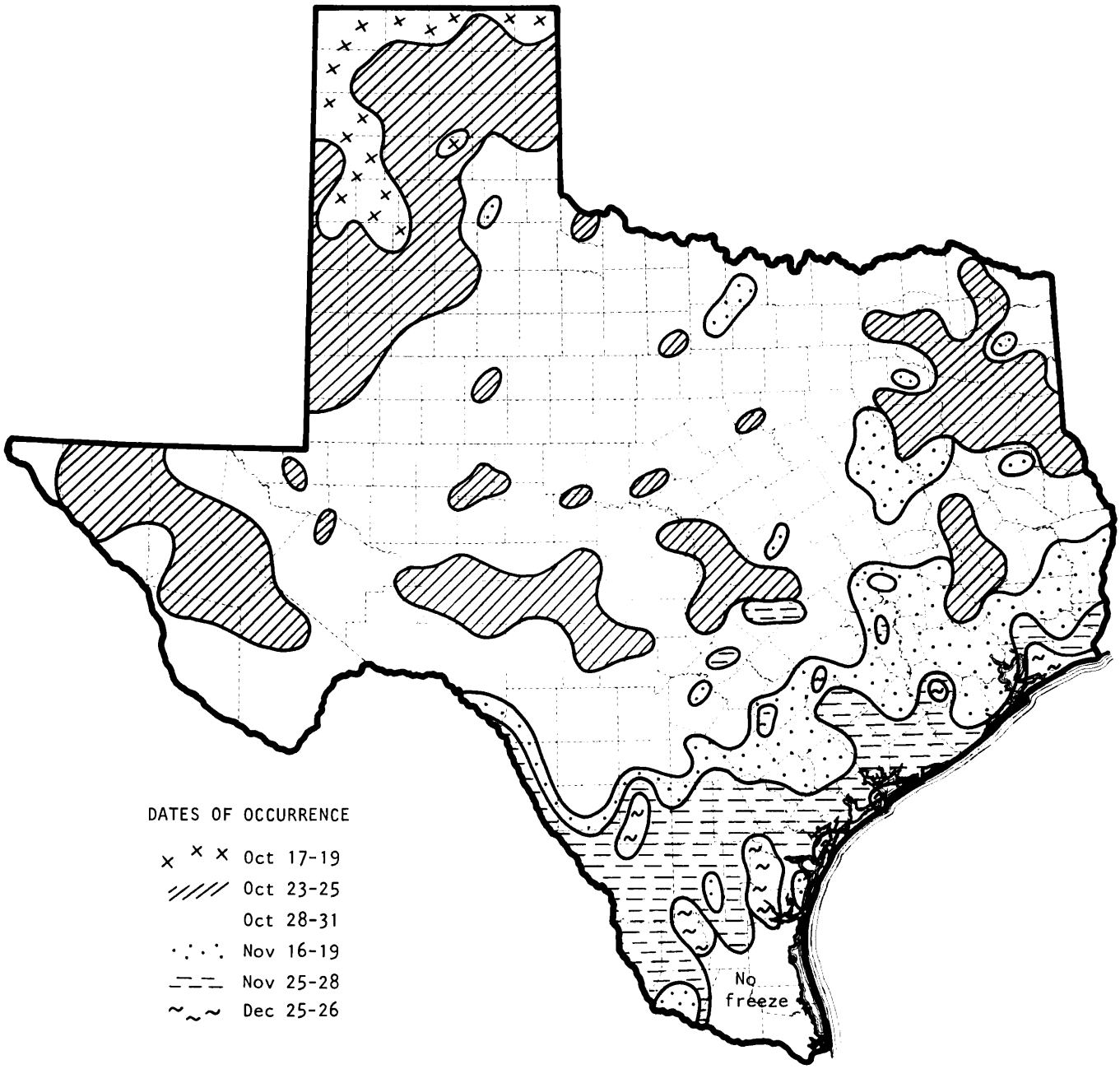


Figure 9. Time of occurrence of the first freeze in the autumn-winter period of 1980.

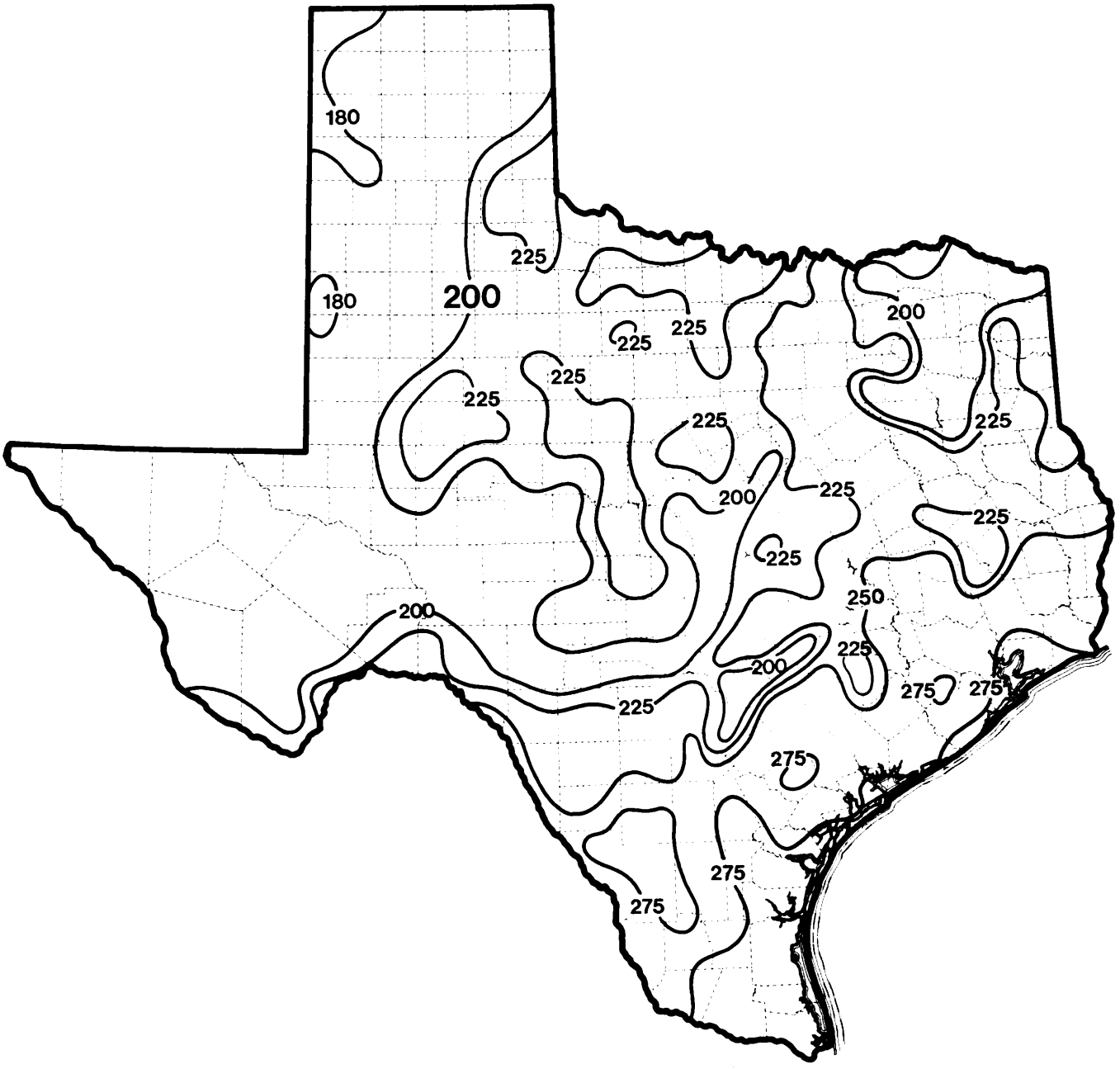


Figure 10. Number of days in 1980 between the dates of the last freeze in the winter-spring and the first freeze in the autumn-winter

of October 30 and 31 were common in such diverse regions of the State as the Low Rolling Plains--where lows dipped into the 20's--the Upper Coast and coastal section of South Central Texas.

The invasion of the Arctic air at month's end shoved the freeze line southward to an extent seldom seen in October. At least one morning at the end of October brought a freeze as far south as Junction, Temple, and Lufkin. Autumn's first freeze struck the Red River valley of North Central and East Texas on October 30, or 2 to 3 weeks sooner than normal. The first freeze was ahead of schedule by about 2 weeks in the southern Low Rolling Plains and northern Edwards Plateau. In southern East Texas, where temperatures dipped below the freeze level on October 30, Autumn's first freeze was no more than 1 week ahead of the historical norm. The polar air that rushed through Texas on October 23-24 gave an earlier-than-normal freeze to the High Plains and Trans-Pecos; the first freeze of Fall in the northern High Plains—on October 24—was about 4 to 7 days ahead of schedule, while in the northern Trans-Pecos, the freeze was about 2 weeks earlier than usual.

One of the most remarkable reversals in temperature variations occurred during the interim between the polar and Arctic air infusions near the end of the month. Two days after the polar air dropped morning temperatures into the high 30's and 40's in South Central Texas, a warm front that surged northward through the region on October 26 led to record heat in most of the southern quarter of the State on the following afternoon. Afternoon readings soared into the low 90's in South Central Texas on October 27, only to give way to record low temperatures again three days later after the arrival of the Arctic air mass at month's end. Other notable heat waves during October included a brief spell of record-setting warmth in the southern High Plains on October 22, when highs in the low 90's preceded the arrival of the abnormally cold polar air a day later. Before the slow-moving Pacific front penetrated the regions at mid-month, the Red River valley of the Low Rolling Plains sustained record-tying heat in the mid-90's on October 15, while much of the southeastern quarter of the State saw readings almost as high two days later.

November: Record Warmth and Record Chill

No other month epitomizes the erratic behavior of Texas' weather that marked 1980 as a most bizarre year than the month of November. The last month of Autumn brought some of the hottest temperatures ever seen in parts of Texas so late in the year, as well as two infusions of Arctic air that plummeted temperatures to record levels later in the month. In spite of the fact that the number of cold frontal passages during November fell short of the normal (4 compared to the usual November total of 6), temperatures averaged over all of the month were significantly colder than normal statewide. Indeed, several areas of Texas sustained mean November readings substantially below

normal, or as much as 7 degrees colder than usual. These sizable negative departures from normal were due almost exclusively to the two invasions of Arctic air at mid-month and again near month's end. The Arctic fronts produced drops of 25 to 40 degrees in one day's time and then maintained overnight and daytime extremes well below seasonal levels for several days.

The mid-November infusion of Arctic air was preceded by the reassertion of the subtropical ridge--the upper-atmospheric high pressure cell so common during the Summer--that produced summerlike temperatures during November's first ten days. Dry desert air pushing eastward into the State's midsection encouraged temperatures to shoot to phenominal levels on November's second weekend. When afternoon highs climbed well into the 80's and low 90's, new maximum temperature marks for the month of November were established:

Hottest November Temperature Ever	°F	Date	Previous Record
San Angelo	93°	Nov 8	91° November 1, 1945
Abilene	92°	Nov 8	91° November 1, 1945
Amarillo	87°	Nov 8	86° November 7, 1934

Numerous other locales in many parts of the State measured highs within one or a few degrees of the all-time monthly maximum. Midland-Odessa's high of 87° on November 7 was the warmest temperature ever observed so late in the autumn.

The coldest outbreak in the waning months of 1980 came long before Winter "officially" arrived. In fact, the bitterly cold snap that produced morning readings near 0°F in the Panhandle struck a couple of days before Thanksgiving, not Christmas. The same Arctic airmass plunged temperatures far into the teens on Thanksgiving morning as far south as Post and Snyder. Another siege of phenominally cold air that penetrated the State a week earlier caused morning lows to dip to 9°F at Marathon in the Trans Pecos and into the low teens in the Davis Mountains. Practically everywhere in Texas, extreme minimum temperatures for November were no higher, and in many instances lower, than extremes gaged in the year's final month. The lowest temperature observed in Texas during the Autumn-early Winter period of 1980 was -2°F at Boys Ranch in the northwestern Panhandle on November 26. That reading tied the minimum of -2°F registered back on March 2 at Lipscomb in the northeastern Panhandle and thus shared the distinction as the State's coldest spot in 1980.

More than the usual amount of sunshine combined with frequent, mild and dry southwesterly winds to force temperatures to uncommonly high levels on numerous occasions during December. Because intrusions of unseasonably cold air during the month numbered only a few, most of the High and Low Rolling Plains, as well as the Trans-Pecos, sustained temperatures averaged over the whole of December that were substantially (3 to 6 degrees) above normal. The most pronounced positive (warmer) departures from normal occurred in

the northern and western tips of the State, where average December temperatures were nearly 6 degrees above normal. Only the southern half of the coastal plain--including the coastal bend section--and Galveston Island received temperatures that averaged out below normal, and those negative departures from the norm were not significant.

The warmth that prevailed for much of the month in the western half of Texas led to average monthly temperatures that were the highest for any December in at least ten years. Indeed, mean December readings in the upper 40's in the northern Low Rolling Plains were the highest for any December since the mid-1950's drought. Wichita Fall's average of 47.2 was the highest December value since 1955, while Lubbock's 45.7 was the warmest for December in 15 years. Although the mean December temperature of 48.9 degrees at El Paso exceeded the normal by almost 6 degrees, the month was not quite as warm as the December of 1977, but it was nonetheless one of the warmest Decembers of this century.

Practically all of the Lone Star State was chilled to the greatest extent in December on Christmas Day, or a few days before or after that holiday. The infusion of Arctic air on Christmas Eve quickly settled in over Texas, plummeting temperatures into the teens as far south as near San Angelo and Waco, while readings in the 20's were registered as far equatorward as Alice and Victoria.

The extraordinary chill produced new record lows in the mid 20s at Austin and Victoria on Christmas Day and a record-tying 17°F at Dallas-Fort Worth that same morning.

PRECIPITATION

Without the cloudbursts generated by the dying remnants of Hurricane Allen, Tropical Storm Danielle, and Autumn's first bonafide "norther," the year of 1980 would have been a very lean one in terms of rainfall for most of Texas, particularly the western half of the State. In spite of record snowfalls in western Texas in November, even with the excessive rains of late Summer and early Autumn, most locales collected subpar amounts of precipitation for 1980 as a whole.

Rainfall

Meaningful rain was scanty not only during the historic killer heat wave of Summer but in much of the Spring and Autumn as well. Moreover, substantial rainfall was largely confined to those few periods lasting several days in late Summer or early Autumn when tropical cyclones or strong cold fronts instigated large concentrations of heavy thunderstorms. Nonetheless, it was during those relatively brief and scarce spells of wet weather that copious quantities of rainfall were dumped on areas scattered throughout the State. Cloudbursts were responsible for rains of 8-10 inches in only one or a few days in such disparate sections of Texas as the mouth of the Sabine River in extreme east Texas, the southern Low Rolling Plains out west, and the Lower Valley in far southern Texas.

The Annual Distribution

The year 1980 as a whole was appreciably drier than normal in more than two-thirds of Texas (Figure 11). The most inordinately "dry" weather was sustained in parts of southern East Texas and in some sections of North Central Texas, where yearly sums amounted to less than 65 percent of normal. It was uncommonly dry in some areas farther west, too. A mere 7.51 inches fell during the year at Boquillas in the east edge of Big Bend National Park; that amount translates into just over one-half of the nearly 13 inches that falls there in an "average" year. For portions of the High Plains, including locales such as Amarillo and Littlefield, the year was the second driest (only 1970 was drier) since the end of the century's worst drought early in 1957. The annual total of 28.30 inches at Huntsville was the least rainfall in any year since World War I and the second driest of the 20th century. Much of Southern Texas garnered less than 20 inches throughout the year, and totals less than 25 inches were collected in some parts of northern South Central Texas (Figure 12).

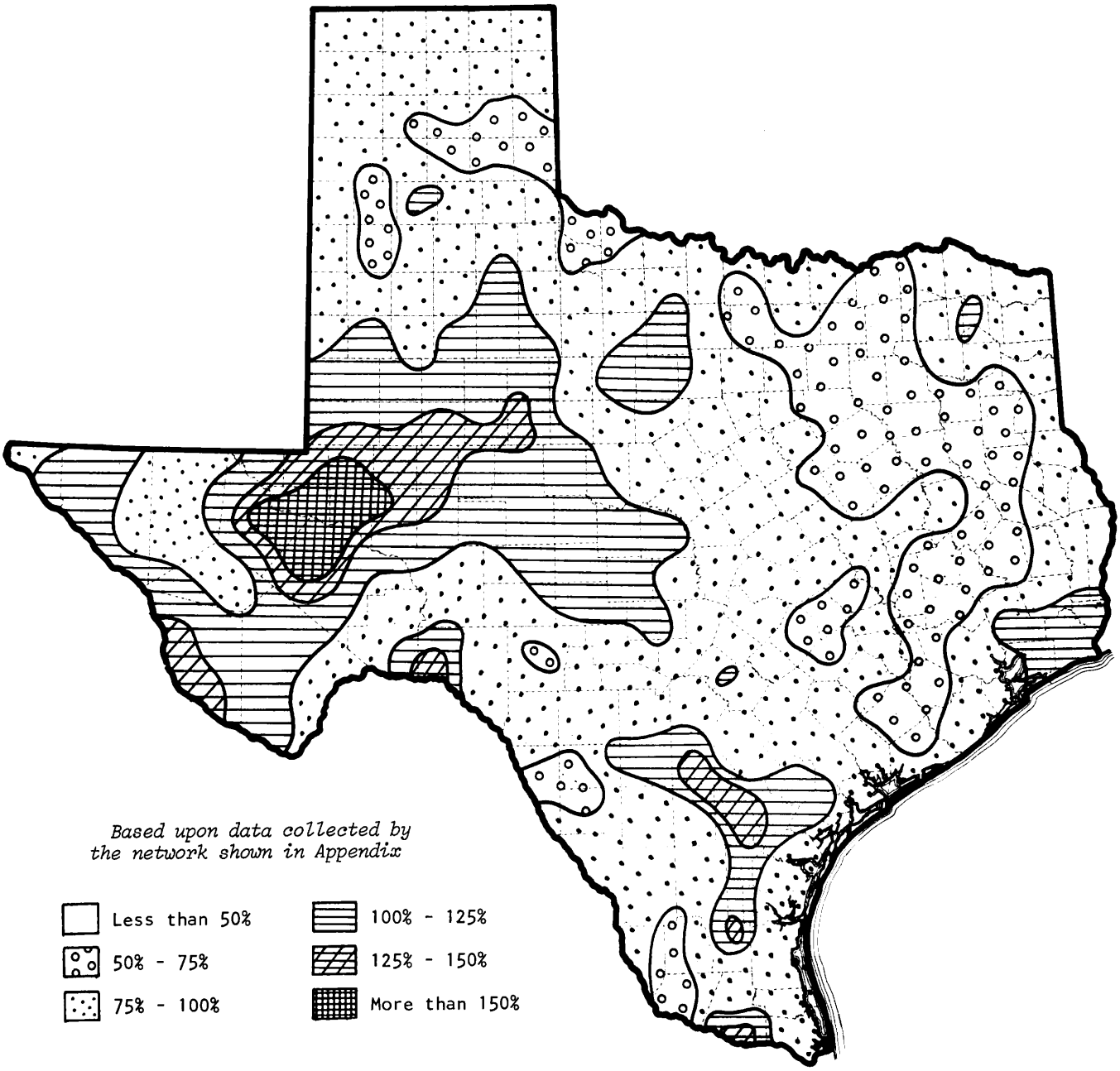


Figure 11. Total precipitation in 1980 as a percentage of the normal amount.

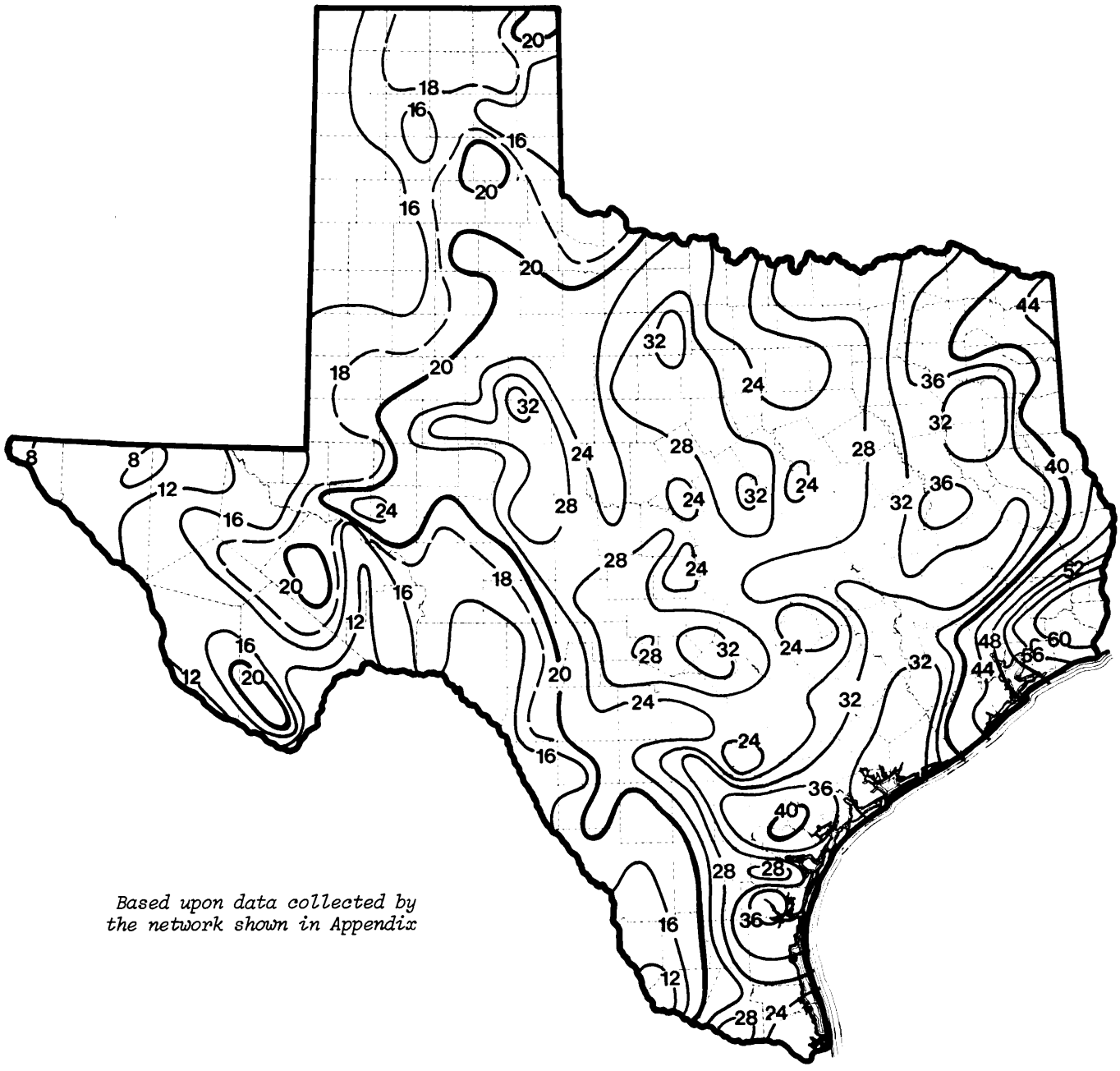


Figure 12. Total precipitation (inches) in 1980.

Table 4. Precipitation totals (inches) for 1980 at selected Texas cities.

DIVISION/City	Total for 1979		Monthly Extremes				# of Months	
			Driest		Wettest		Below	Above
	Amount	Percent of Normal	Month	Amt	Month	Amt	Normal	Normal
HIGH PLAINS								
Amarillo	13.39	66	Dec	0.35	May	2.88	8	4
Big Spring	29.34	185	Sep	14.22	Oct	0.00	5	7
Dalhart	16.06	92	Sep	0.22	May	3.95	7	5
Hereford	12.98	75	Dec	0.00	Aug	3.50	9	3
Lubbock	15.86	86	Sep	3.55	Oct	0.19	8	4
Midland/Odessa	17.76	131	Jul	Trace	Sep	9.70	7	5
Pampa	16.03	80	Jun	0.52	May	3.90	6	6
Plainview	15.62	81	Dec	0.45	May	3.58	7	5
LOW ROLLING PLAINS								
Abilene	20.67	88	Apr	0.17	Sep	6.30	8	4
Paducah	18.98	86	Jul	0.01	May	4.41	6	6
Shamrock	15.55	66	Oct	0.25	May	4.35	7	5
Snyder	26.75	138	Oct	0.34	Sep	12.91	8	4
Wichita Falls	25.92	95	Jul	0.03	Sep	10.23	7	5
NORTH CENTRAL								
Brownwood	26.25	96	Jul	Trace	May	7.79	7	5
Dallas-Ft. Worth	22.08	68	Aug	Trace	Sep	6.54	10	2
Mineral Wells	28.00	102	Jun	0.10	Sep	8.57	6	6
Paris	34.99	77	Jul	0.26	Sep	9.28	10	2
Waco	23.01	74	Jul	0.01	May	4.47	8	4
EAST								
College Station	29.04	74	Jun	0.09	Mar	6.07	7	5
Lufkin	31.28	73	Aug	0.36	May	6.63	9	3
Sulphur Springs	37.20	82	Aug	0.73	Jan	5.95	9	3
Texarkana	46.49	98	Aug	0.85	Sep	8.83	7	5
Tyler	30.45	67	Dec	0.78	Sep	5.22	10	2
TRANS-PECOS								
Alpine	15.45	99	Mar	0.00	Sep	6.90	7	5
Chisos Basin	21.27	164	Apr	0.02	Aug	10.71	7	5
El Paso	7.31	94	Jun	Trace	Sep	1.90	5	7
Pecos	15.74	172	Mar	0.00	Sep	5.24	5	6
EDWARDS PLATEAU								
Del Rio	14.15	84	Oct	0.06	May	5.15	8	4
Llano	23.60	90	Jul	0.15	May	7.40	10	2
Ozona	17.14	109	Jul	0.00	Sep	5.61	6	6
San Angelo	30.09	172	Oct	0.01	Sep	11.00	4	8
SOUTH CENTRAL								
Austin	27.38	84	Jul	0.28	Sep	5.66	8	4
Columbus	30.21	73	Jun	0.54	May	6.39	6	6
Corpus Christi	32.69	115	Jun	0.03	Aug	14.79	9	3
Goliad	35.59	105	Jun	0.00	Aug	10.63	6	6
San Antonio	24.23	88	Jul	0.26	May	6.42	8	4
UPPER COAST								
Beau/Port Arthur	62.55	114	Jun	0.76	Sep	21.96	6	6
Galveston	34.58	82	Oct	0.28	May	7.44	9	3
Houston	38.99	81	Jun	0.92	Jan	6.09	8	4
Victoria	32.54	95	Jun	Trace	May	8.16	7	5
SOUTHERN								
Alice	28.21	104	Jun	Trace	Aug	13.89	10	2
Laredo	16.02	90	Jun	0.00	Aug	4.72	9	3
Rio Grande City	11.97	63	Jun	0.00	May	2.90	9	3
LOWER VALLEY								
Brownsville	21.77	87	Apr	0.01	Aug	7.29	7	5
McAllen	30.37	1.49	Apr	0.02	Aug	12.62	5	7

Because of Danielle and the cold front that ushered in Autumn, monthly sums of 8 to 12 inches in large portions of the Edwards Plateau, Trans Pecos, and southern High and Low Rolling Plains made September 1980 one of the wettest Septembers on record. The upper Pecos River valley was blessed with the greatest rainfall "surpluses" of any region of the State. Crane collected 24.55 inches during the year, or more than double its normal annual amount and the most ever gaged there; of that total, two-thirds (or more than 16 inches) was dumped on the locale in September. Almost half of the rainfall total of 29.34 inches for all of 1980 at Big Spring occurred in the month of September, making the year the wettest of any since 1919. The yearly sum of 22.68 inches, 10 inches of which fell in September, was the most at Fort Stockton in 39 years. Until 1980, which supplied 30.09 inches of rain, residents of San Angelo had not seen a year's worth of rain in excess of 30 inches since 1959. A few other scattered sectors of Texas also received much more than the usual amount of rain during the year, including bits of South Central and Southern Texas and the extreme southeastern corner of the State.

Rainfall sums for the year varied from as little as 7.08 inches at Salt Flat to 62.55 inches at Port Arthur municipal airport. The most uncommonly wet spot among 260 rainfall-gaging stations in Texas was Paint Rock (in Concho County of the Edwards Plateau), where the year's total of 47.32 inches of precipitation was slightly more than 25 inches above normal. By contrast, the greatest negative rainfall departure from normal occurred at Huntsville (East Texas), whose 1980 sum of 28.30 inches of rain was almost 17 inches less than usual. Paint Rock also held the distinction of having the greatest monthly precipitation total during 1980: 24.66 inches of rain in September, or more than eight times the normal amount for early Autumn in that centrally-located community. On the other hand, more than half of the Trans Pecos went without even a trace of precipitation during March, and in June a quarter of all observing stations in South Central Texas and more than half of those in Southern Texas collected no rain at all. All but four months furnished the High Plains with substantially higher precipitation than normal, while nine of the year's twelve months were notably drier than usual for Southern Texas. Unquestionably, June and July were the most unusually dry months of 1980; in both of those months each of the State's ten climatic divisions sustained appreciable rainfall deficits. On a statewide basis, September provided the most unusually wet weather; only the southern extremity of Texas collected subpar rainfall in that month.

Winter

In spite of a February noted for an unusual scarcity of precipitation, the Winter of 1979-80 (December 1979-February 1980) on the whole supplied most sections of Texas with near or slightly above-normal precipitation. February's meager totals were offset by ample precipitation earlier in the Winter, in-

cluding general, appreciable rains that covered nearly all of the State in December 1979. Actually, excepting a significant snowfall in the Panhandle sector and a spell of very substantial rains along the upper Texas coast, January 1980 was barely more generous in supplying meaningful precipitation than its successor. For parts of the Upper Coast, however, January 1980 was a most unusually wet first month of the year, with 1-month totals of 3 to 7 inches common in most of that region (Figure 13); in fact, the 6.85 inches of rain gaged at Galveston was the heaviest total observed on the island in January in 36 years.

Spring

Were it not for the bountiful rains that doused most of Texas in mid-May, the Spring of 1980 would have been nearly as rain deficient as the scorching Summer that followed. This was due to sparse rainfall in March in all but the northern and eastern extremities of Texas, while April was nearly devoid of significant rain almost everywhere. Barely measurable rainfall in much of the central third of Texas during April capped a first third of 1980 that was the driest such interval of time in nearly a decade. In fact, in parts of the Edwards Plateau, little more than 1 inch collected since the beginning of 1980 was the least in any January-April period since 1933, the year that marked the incipient stage of the next-to-worst drought of the 20th century in all of Texas. March, on the other hand, was most noted for its unusual disparity in rainfall from west to east across Texas; while many points in the far western Trans Pecos failed to see even a trace of rain, the Sabine River valley of East Texas was deluged by torrential rains that totalled more than 1 foot in some locales. Much of the Upper Coast also collected substantial rains (from 3 to 7 inches generally) in March, but in most other sections rainfall was not appreciable.

In the wake of spotty and negligible rains in much of Texas earlier in the Spring, and in advance of a rainless, killer heat wave that dominated for most of the Summer, it was fortuitous for most Texans that very heavy rains accompanied a slow-moving cool front in mid-May. The plentiful deluges, whose cumulative monthly sums amounted to 3-8 inches in at least three-fourths of Texas, essentially made up for too little rain earlier in the year and apparently delayed the onset of drought brought about by the mammoth heat wave a month later. Mostly as a result of a protracted siege of widespread--and at times violent--thunderstorms lasting nearly a week around mid-month (Figure 14), a huge share of the State received more rain than in any May since the end of the great drought of the early and mid-1950's. In fact, some spots in Southern Texas collected a record amount of rainfall over the course of the month; for example, Jourdanton's monthly sum of 11.56 inches was the greatest May total since weather records were begun there in 1940. That sumptuous

Figure 13. Four-day percipitation totals (inches) as observed by the cooperative-observer network of the Natonal Weather Service for the period beginning about 7 a.m. (CDT), January 19 and ending about 7 a.m. (CDT), January 23, 1980.

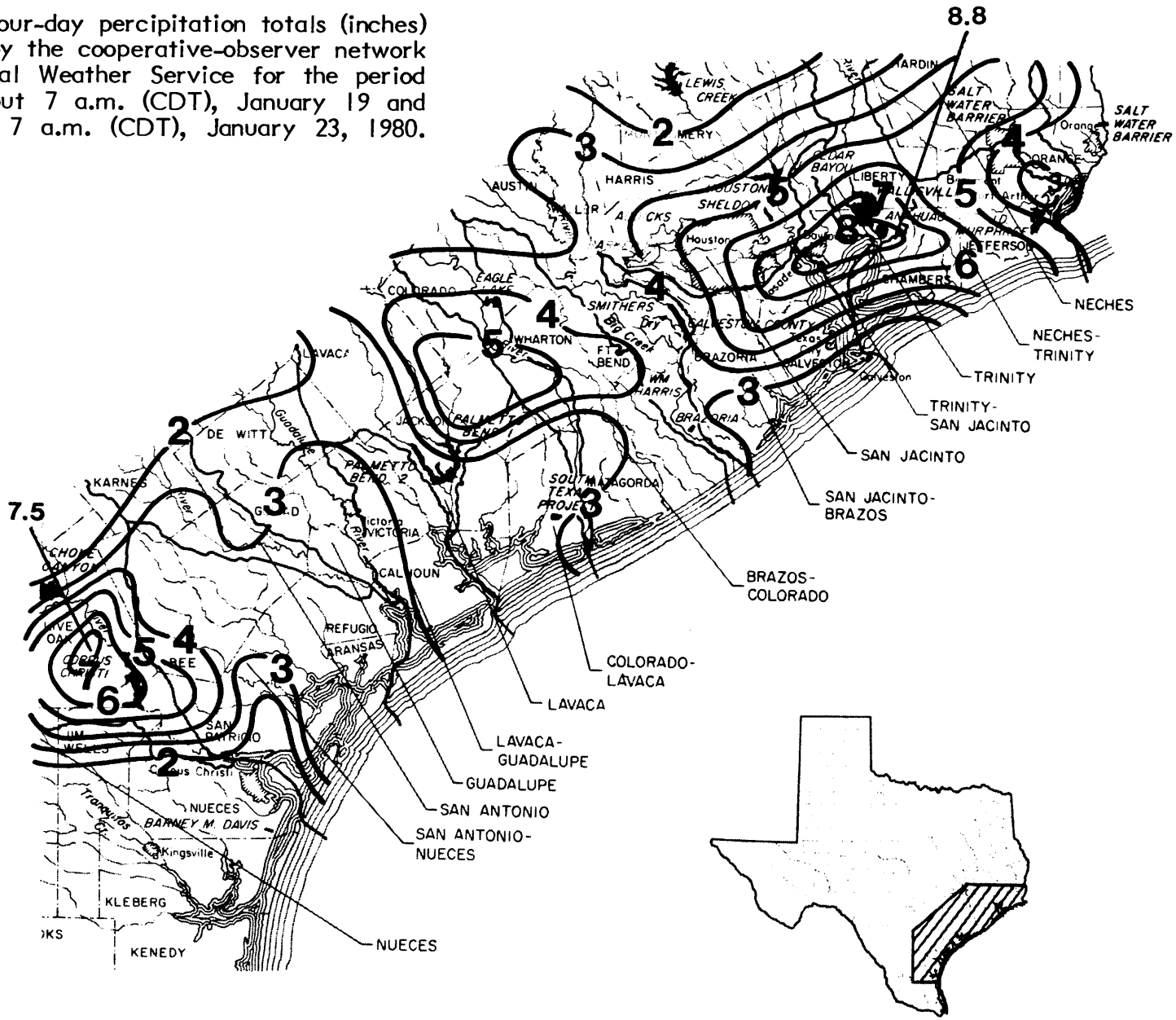
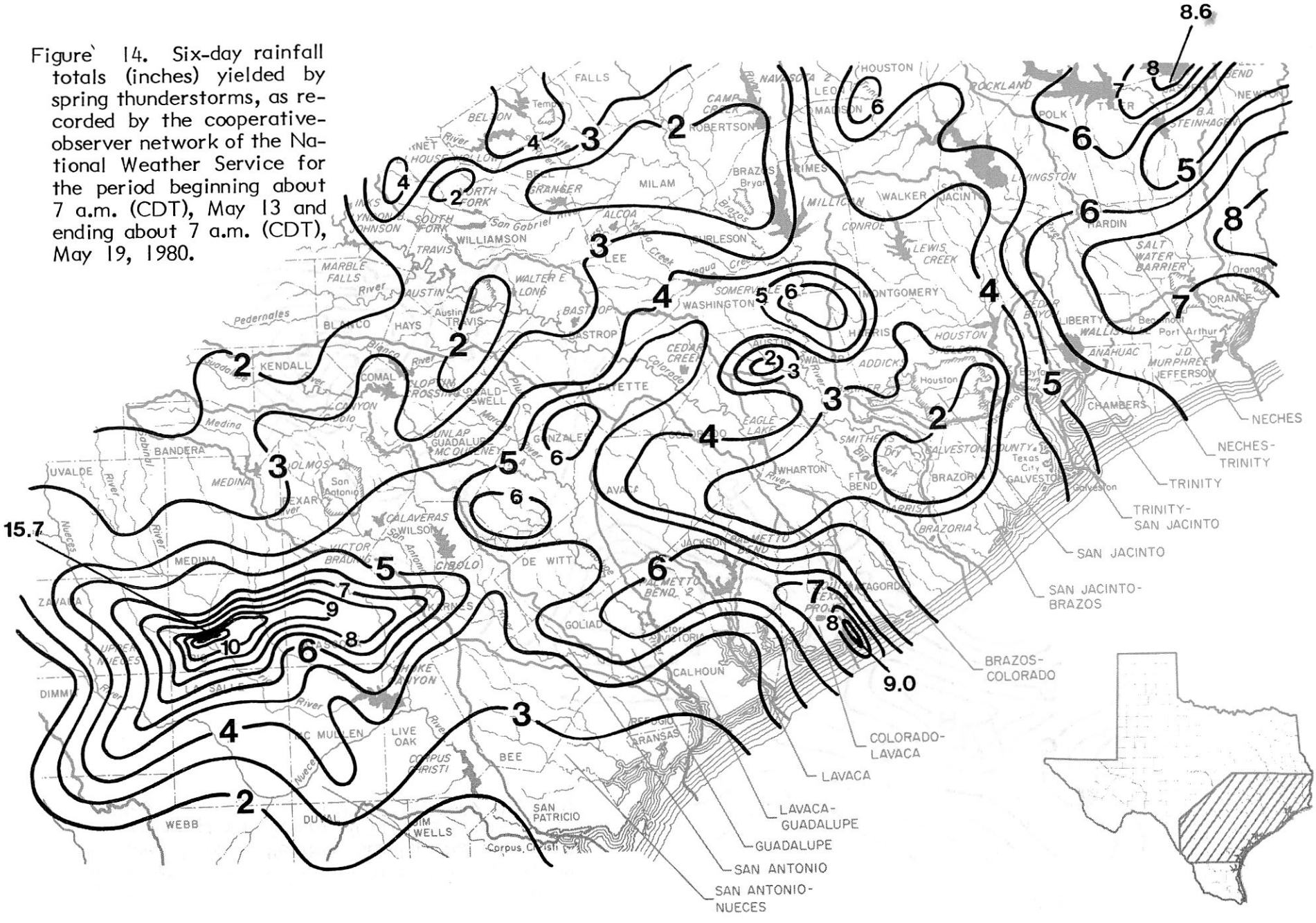


Figure 14. Six-day rainfall totals (inches) yielded by spring thunderstorms, as recorded by the cooperative-observer network of the National Weather Service for the period beginning about 7 a.m. (CDT), May 13 and ending about 7 a.m. (CDT), May 19, 1980.



total was dwarfed, however, by the 18.60 inches registered at Derby, which had nearly 15 inches of rain cascade on that small town in less than 48 hours on July 14-15.

Numerous other scattered points stretching from the Low Rolling Plains and the Edwards Plateau across North and South Central Texas to East Texas and the Upper Coast received uncommonly heavy rainfall during Spring's last full month. Some of the most phenominal monthly sums (inches) registered in these regions are listed below:

	May '80 total	Greatest 1 Day Total	Percentage of Monthly Total Collected During May 13-16
LOW ROLLING PLAINS			%
Truscott	11.56	3.78	62
Wellington	10.44	5.60	54
Munday	10.25	4.25	32
NORTH CENTRAL			
Olney 5NNW	11.90	5.30	19
Proctor Reservoir	9.61	3.14	26
Antelope	9.38	2.79	6
Graham	9.27	4.40	26
Rising Star	8.83	2.11	19
EAST			
Sam Rayburn Dam	11.69	3.28	55
Evadale	11.46	4.25	74
Carthage	10.16	3.73	53
EDWARDS PLATEAU			
Kempner	10.52	2.03	48
Burnet	9.17	2.10	45
SOUTH CENTRAL			
Nixon	9.31	3.40	46
Schulenburg	9.07	2.40	38
UPPER COAST			
Matagorda	10.87	7.00	18
SOUTHERN			
Dilley	10.94	4.90	67
Charlotte	10.82	6.70	83
Big Wells	10.04	2.50	51
Poteet	9.78	4.62	62

Summer: One of the Driest Ever

The scorching Summer heat wave essentially got underway in much of Texas with the cessation of widespread, appreciable rains on May 21. The onset of the lengthy rainless period was delayed, however, in the High and Low Rolling Plains, where a 3-day spell of numerous thunderstorms dealt out noteworthy rainfall (from 1/2 to 2 inches generally) at month's end, and in Southern Texas, where scattered thunderstorms supplied similar rainfall amounts on May 26-27. June's meager rainfall, with few exceptions, came in two short spells at the beginning of the second week and again just after midmonth. Rainfall from widely scattered showers was barely measurable in much of the southern half of Texas, where monthly sums of 0.10 inch or less marked the month as the driest June since the severe drought of the mid 1930s. In some sections of the coastal plain, however, rainfall was so minuscule that all-time records were threatened. Only a "trace" of rain fell all month at Victoria, making it the driest June there since 1913, while Corpus Christi, measuring a monthly total of merely 0.03 inch, experienced the scantiest June in 65 years. While every spot in the State suffered from relentless and unbearable heat, not every locale went without meaningful rain. Although nearly all of it came with one or two thunderstorms, sizeable amounts of rain fell in scattered locales throughout the northern half of the State. Totals were especially hefty in the Edwards Plateau, with Paint Rock (7.00 inches) and Mason (5.72) collecting the greatest sums during June.

Subpar rainfall was the rule statewide during July. The paucity of rain was so prevalent, in fact, that less than 5 percent of all locales with weather stations collected rainfall amounts exceeding normal. Hard rains totalling a couple of inches or more in one day were extremely rare. As during June, monthly totals were so scanty in many areas as to approach--and match in some instances--all-time records. An unmeasurable amount (a "trace") for the whole month at Midland-Odessa spelled July as the driest since the extreme drought of 1954. Wichita Falls' paltry total of 0.03 inch was the least ever witnessed in July in that Red River city, while the barely-measurable amount of 0.01 inch gaged at Waco made the month the driest July in that city since 1963.

Hurricane Allen's arrival in early August spelled relief for most of the southern half of Texas. The season's first major tropical cyclone dumped rains of 5-10 inches on the Lower Valley and most of Southern Texas in one week ending on August 12. Equally substantial rainfall occurred in the coastal section of South Central Texas, while slightly lesser--but nonetheless heavy--rains drenched the arid Trans Pecos when Allen's residue drifted near the Big Bend just before mid-month. In fact, Allen was so prolific as a rainmaker that historic amounts of rainfall were registered all along the Rio Grande from its mouth at Brownsville to the Presidio Valley upstream from the Big Bend. The following is a partial tabulation of record August rainfall totals (in inches), much of which was provided by Allen and its remnants, for selected locales along and near the Rio Grande (with the number in parentheses representing the beginning year of rainfall records for each weather station):

Most Rainfall Ever Observed in August	Aug. Total	% of Monthly Total Due to Allen
LOWER VALLEY		
McAllen (1941)	12.62	99
SOUTHERN		
Alice (1911)	13.89	99
Falfurrias (1907)	12.87	97
SOUTH CENTRAL		
Beeville (1900)	13.55	100
Corpus Christi (1887)	14.79	92
Goliad (1913)	10.63	88
Kingsville (1900)	17.36	98
TRANS PECOS		
Chisos Basin (1943)	10.71	87
Presidio (1927)	5.24	92
Sanderson (1942)	5.15	99

The course taken by Allen and its residue lay too far south to supply badly-needed rain to the northern and central thirds of Texas scorched by the killer heat wave. August was much like its two immediate predecessors in that it furnished very scanty rainfall from the Low Rolling Plains across North Central Texas and the Edwards Plateau to East Texas and the Upper Coast. Indeed, rainfall throughout the 3-month period was so scarce as to constitute the driest Summer of the 20th century at numerous locations in this vast stretch of Texas. The deficiency was most acute in a swath extending southeastward from the upper Red River valley to southern East Texas; in this sector, Summer rainfall totals generally were less than one-tenth of normal! The following tabulation of Summer (June-August) rainfall totals illustrates the unique character of the nearly rainless season that afflicted the northeastern quarter of Texas:

Driest Summer of the 20th Century	Summer 1980 Total	Previous Driest Summer
LOW ROLLING PLAINS		
Wichita Falls	0.55	1902 (0.98)
NORTH CENTRAL		
Waco	0.51	1956 (0.85)
EAST		
Bryan-College Station	0.64	1970 (1.69)
UPPER COAST		
Beaumont-Port Arthur	4.18	1956 (4.99)

Autumn

Substantial drought-breaking rains eventually came to the State's mid-section early in September when Tropical Storm Danielle surged ashore near High Island on September 5. About the time it made landfall, Danielle sent torrents of rain on the city of Port Arthur, where a short-term rainfall record of more than 17 inches was received within one 24-hour period. After bestowing general rains of 4-10 inches in much of the Upper Coast and southern East Texas, remnants of the season's fourth major disturbance originating in the Atlantic drifted slowly westward through northern South Central Texas and the Edwards Plateau, shedding widespread rains over two days of 5-10 inches. Lesser but still very appreciable rains later fell in the Trans Pecos and High Plains before the last remains of Danielle perished just prior to mid-month.

Equally important as a donor of thirst-quenching rains was a slow-moving Canadian front--the first major cold front of the Autumn--that triggered more substantial rains in most of Texas near the end of September (Figure 15). Waves of thunderstorms generated by the front gave drought-stopping rains of 6-8 inches in parts of North Central Texas and the Low Rolling Plains, where drought persisted in spite of Danielle. Combining the plentiful rains of Danielle with those given later in September by the invading polar cold front, monthly rainfall totals set or nearly matched all-time September rainfall records at a number of locales in the western portion of Texas:

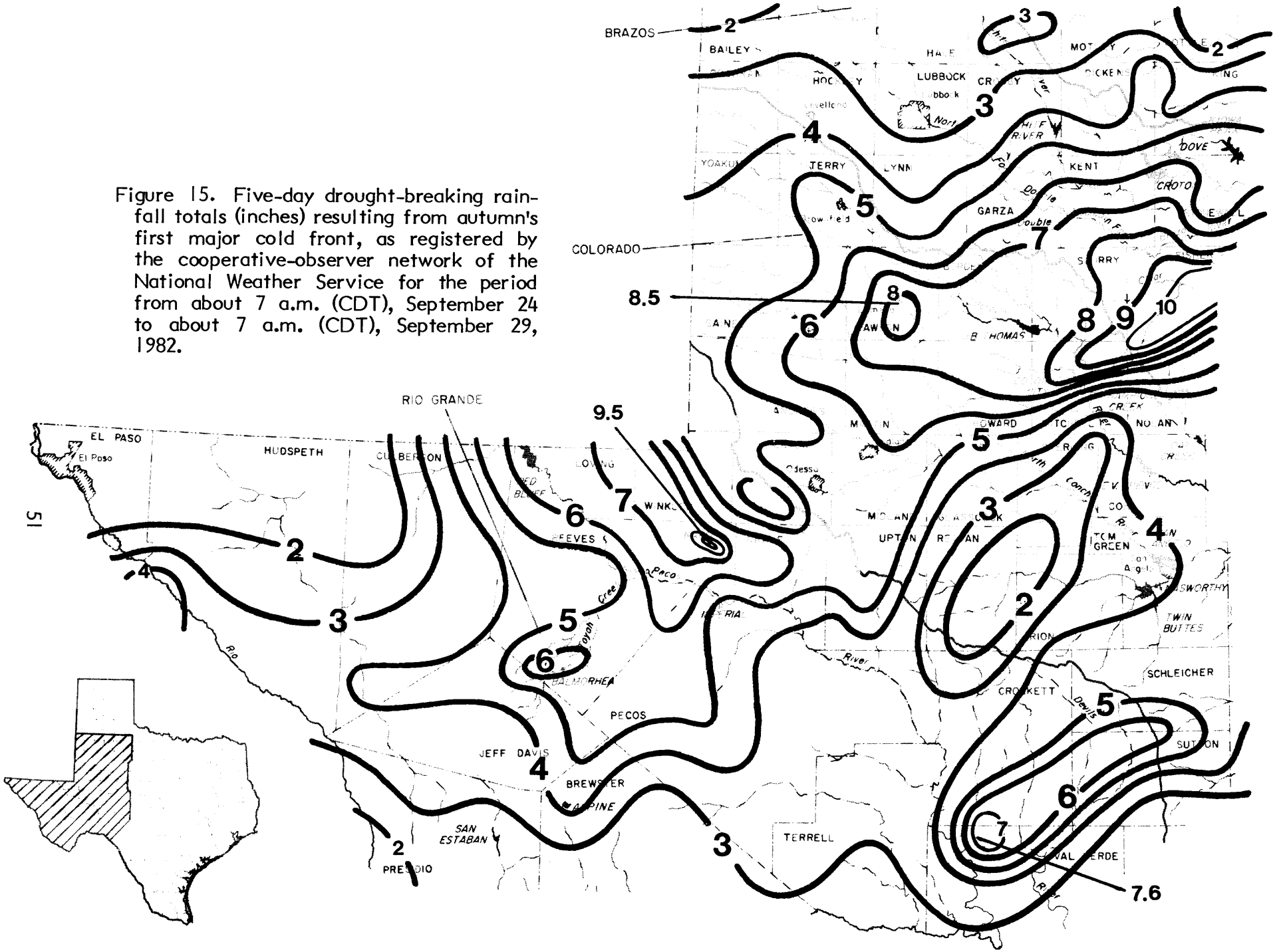


Figure 15. Five-day drought-breaking rainfall totals (inches) resulting from autumn's first major cold front, as registered by the cooperative-observer network of the National Weather Service for the period from about 7 a.m. (CDT), September 24 to about 7 a.m. (CDT), September 29, 1982.

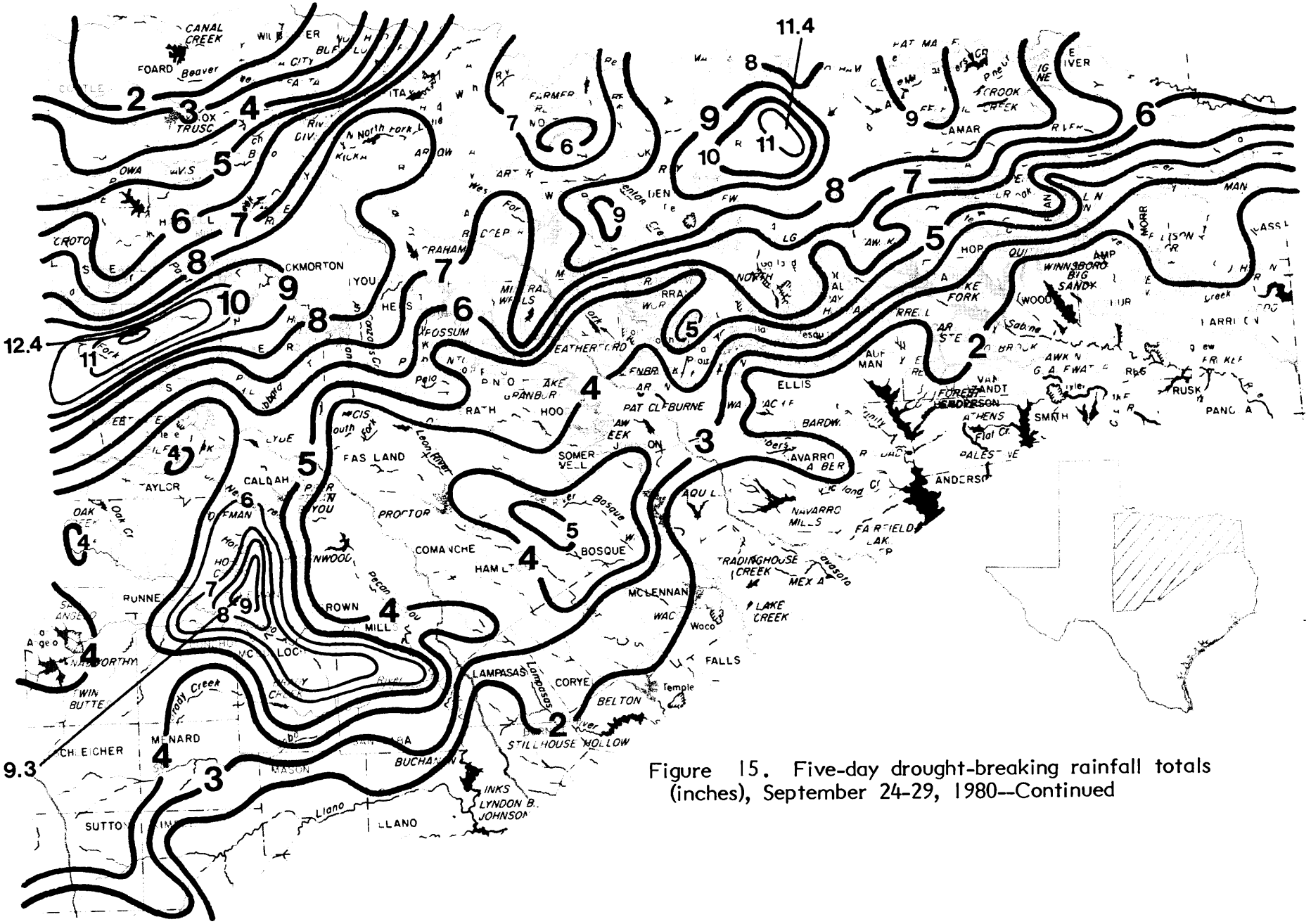


Figure 15. Five-day drought-breaking rainfall totals (inches), September 24-29, 1980--Continued

Wettest September in History	Monthly Total	% of Monthly Total Due To: Danielle	Cold Front
HIGH PLAINS			
Big Spring	14.22	27	70
Lamesa	9.78	12	88
Midland-Odessa	9.70	27	73
LOW ROLLING PLAINS			
Snyder	12.91	21	76
Wichita Falls	10.23	11	82

Subpar rainfall during October gave Texas an opportunity to dry out from September's copious rains and before sizeable rainfall came again in November. The former half of October was nearly void of significant rainfall, with only the western sector of Texas collecting any meaningful rain on a region-wide basis. Two rainy spells, one around mid-month and the other at month's end, brought modest amounts of 1/2-1 inch to most sections of the State. Only minuscule amounts of rain fell in the southern High Plains and northern Edwards Plateau, making the month the driest October in almost two decades. Only in the far eastern edge of Texas did rainfall exceed the normal for mid-October; a 2-day spell of thunderstorms left very substantial rains of 5 to 8 inches in the area bordered by Houston, Port Arthur, and Toledo Bend Reservoir (Figure 16). Due mostly to two snowstorms that produced record snowfall in the State's western sector, November was marked in that region by precipitation totals substantially above normal. Nearly all of the month's precipitation, which totalled 1 1/2-3 inches in the southern High and Low Rolling Plains and most of the Trans Pecos and Edwards Plateau, fell on a total of four or five days at the time of or just prior to the month's two big snowstorms. Lubbock's aggregate of 2.29 inches, or nearly five times the usual amount, was the second highest November precipitation total in 40 years; the same was true at San Angelo, where 2.53 inches was gaged. On the other hand, rainfall was notably lacking in most of the eastern half of Texas, where totals of less than 2 inches were common.

As if to epitomize a year chacterized by a killing wave of heat and drought sandwiched between Spring and Autumnal deluges, 1980 ended on a contrasting note. While rainfall was so scarce as to be almost immeasurable in much of the eastern portion of the State, a rare spate of nocturnal thunderstorms shed uncommonly substantial rains in parts of western Texas. Cumulative monthly totals of barely 1/4 inch in southern East Texas made December the driest last month of any year in several decades. That deficit, combined with a paucity of precipitation in the latter half of Autumn, left parts of East Texas as well as the Upper Coast with the driest weather for the year's last

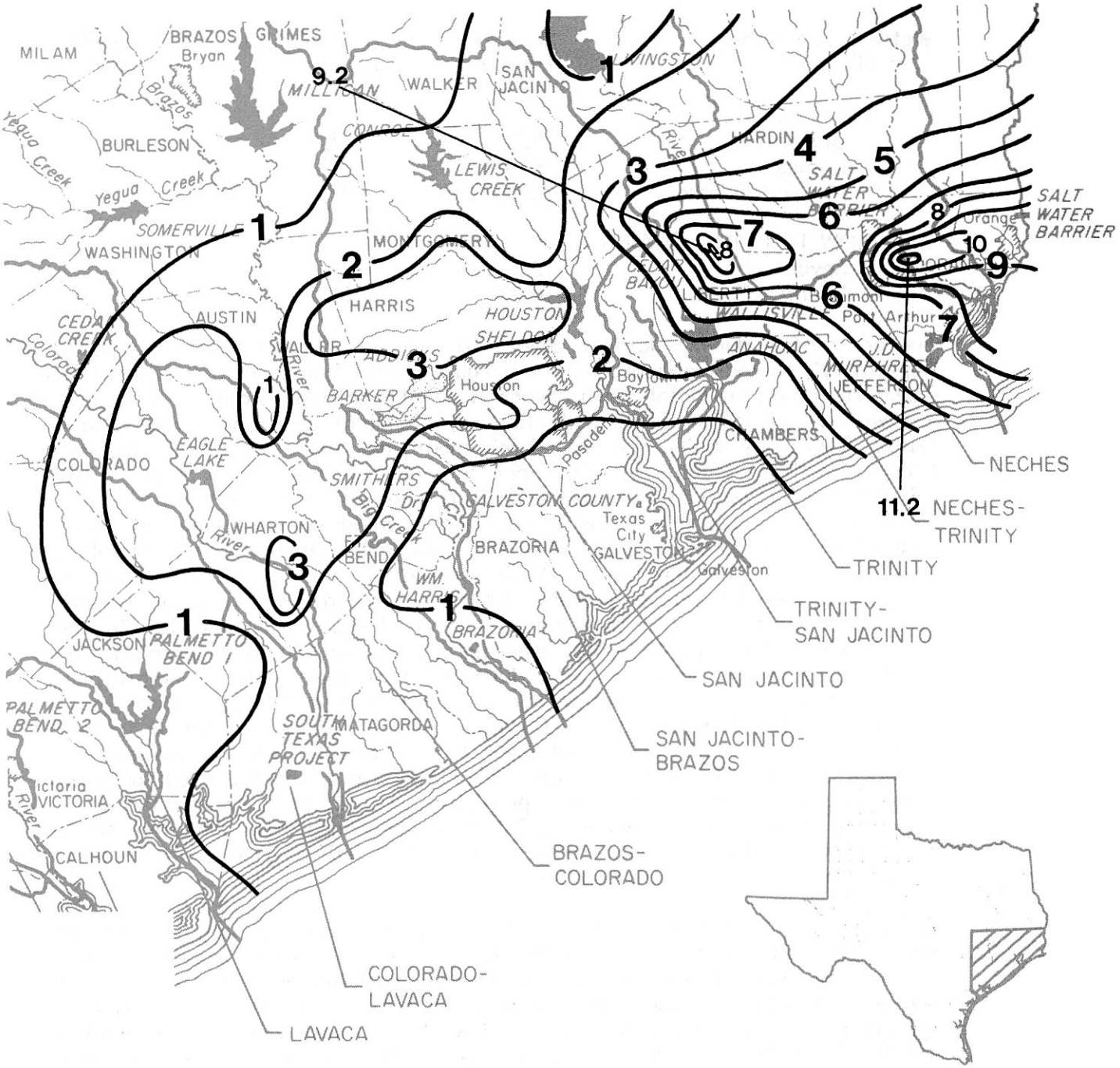


Figure 16. Two-day rainfall totals (inches) produced by frontal thunderstorms, as observed by the cooperative-observer network of the National Weather Service for the period beginning about 7 a.m. (CDT), October 17 and ending about 7 a.m. (CDT), October 19, 1980.

quarter in at least 15 years. Galveston's meager total of 3.37 inches was the lowest amount for the last three months of any year since 1950. However, springlike weather violence at the end of December's first week gave sections of the southern High Plains and Edwards Plateau some of the greatest rainfall observed in December in at least the past decade. Quantitatively, the aggregate monthly totals were meager by the standards of earlier, rainier months, but the 1.15 inches registered at Midland-Odessa was plentiful enough to constitute the most rainfall in December in 20 years.

Heavy Short-Term Rainfall

The record-setting total of 13.40 inches of rain collected in the National Weather Service raingage at Port Arthur in one 24-hour period on September 5-6 as Tropical Storm Danielle pushed ashore was the most substantial 1-day rainfall total observed anywhere in Texas in 1980. More than a third of that total is believed to have fallen within a 2-hour period just before midnight on September 5. Yet, other short-term rainfall amounts measured in many sections of Texas were almost as inordinately bounteous as that which cascaded down on the State's eastern extremity. Many of the phenominally heavy 24-hour rainfall totals (in inches) gaged elsewhere also stemmed from Danielle's influence: 11.70 in the City of Beaumont and 10.28 at the Beaumont Research Center (both for the 24-hour period ending around daybreak on September 6), 8.28 at Roscoe in the Low Rolling Plains (September 9), 8.25 at Paint Rock (September 9), and 5.31 at Crane in the Trans Pecos (September 10). Likely the most substantive 1-day rain produced by Hurricane Allen fell at George West in Southern Texas, where 9.96 inches was measured on August 11, and at McAllen in the Lower Valley, where 9.42 inches fell the previous day. George West also received an extraordinarily torrential rain for so early in the year when a wave formed on a cold front that had stalled in the Gulf of Mexico just off the lower Texas coast on January 21; a total of 7.25 inches fell in a 24-hour period as that prolific rainmaker evolved in the lower atmosphere near that city. Thunderstorms induced by an intruding cold front dumped 12.80 inches of rain at Derby in Frio County of Southern Texas on May 16.

The Impact of Rainfall on Drought

It took only a few weeks of hot, rainless weather brought on by the killer heat wave of the Summer of 1980 to nullify substantial mid-Spring rains and produce a summer-long drought that attained severe intensity in North Central Texas in August. That drought was vanquished near Summer's end in the

southeastern quarter of Texas by torrential rains generated by two major tropical disturbances and then later in North Central Texas by numerous outbreaks of thunderstorms that accompanied the onset of Autumn. But moderate drought reappeared in the State's northeastern quadrant late in the year as the waning three months of 1980 furnished only modest amounts of precipitation. Few areas of the State managed to escape altogether drought of at least a moderate degree sometime during the year. On the other hand, most of Texas also enjoyed at least one lengthy spell of unusually wet-weather conditions in 1980. Indeed, for most Texans the year was one of oscillation between wetter-than-normal weather and drought of moderate intensity.

According to the Palmer Index--a credible criterion often used by climatologists to evaluate soil-moisture content across Texas--conditions seldom were any worse than moderate drought and hardly more desirable than moderately wetter-than-normal throughout the year. Only portions of North Central Texas and the Trans Pecos sustained drought of severe or extreme magnitude for awhile in the Summer. At the other extreme, much wetter than normal conditions developed only in the western, northern and eastern extremitites of Texas for short periods during the Spring or early Autumn. For a large portion of the year, conditions within the "normal" range prevailed across most of the Lone Star State.

To say that the year, by and large, was one of either modest blessing or suffering is not to deny that some parts of Texas endured lengthy and acute moisture shortages. None languished more than the northern half of North Central Texas, the Red River valley of which was stung by a drought that took hold in mid-June and worsened steadily until quenching rains came with the first genuine norther of the Autumn Figure 17c and 17g). Acutally a small portion of North Central Texas saw the drought reach extreme proportions early in September (Figure 17f). For sure, the late-September deluges quelled the drought but not for long. Virtually no rainfall in October and too-little precipitation the following month allowed moderate drought to encroach again as the year drew to a close (Figure 17h). Such a moisture problem had not been seen in North Central Texas since the massive, extreme drought of 1978 was abruptly eradicated by Tropical Storm Amelia's cloudbursts.

The worst drought since that of the mid-1950's afflicted the Trans Pecos region for about six weeks during the Summer of 1980. Unbearable heat and scanty rainfall during May and June led to the onset of moderate drought as June drew to a close. In fact, by the beginning of August the drought had attained severe status in almost all of the area west of the Pecos River (Figure 17d). That condition persisted until the bountiful rains from the remnants of Hurricane Allen brought sudden relief early in August. Then the region sustained wetter than normal conditions well into the last quarter of 1980, thanks to Allen's highly substantial rains and a much wetter-than-normal September and November.

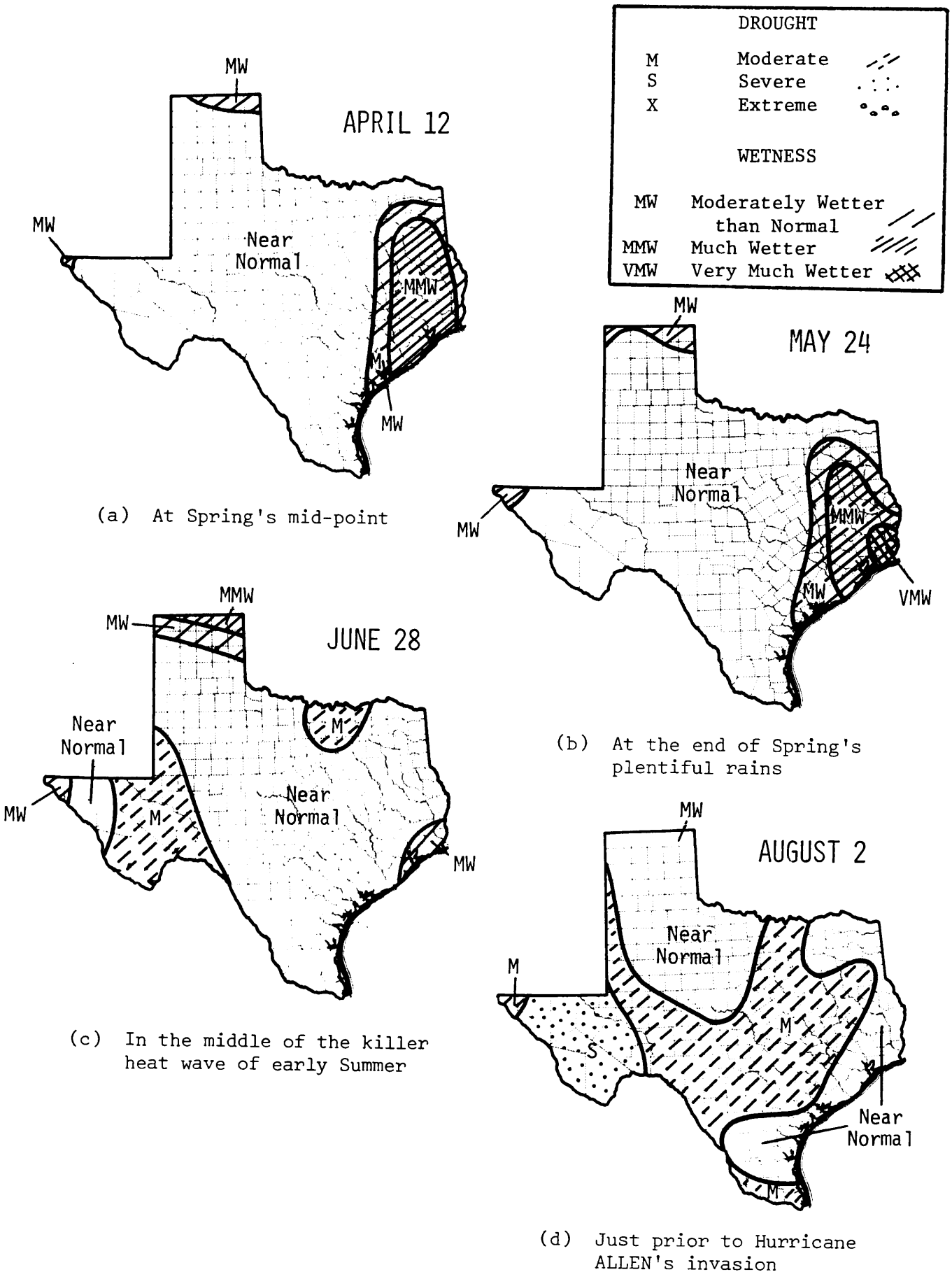
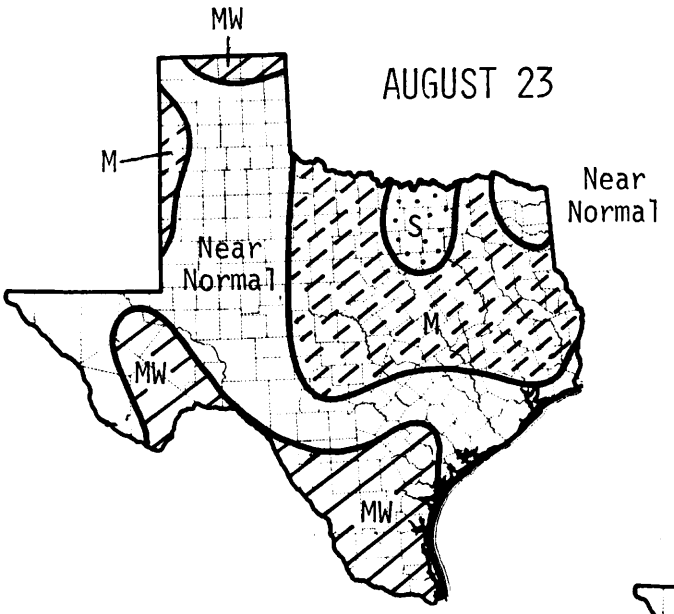
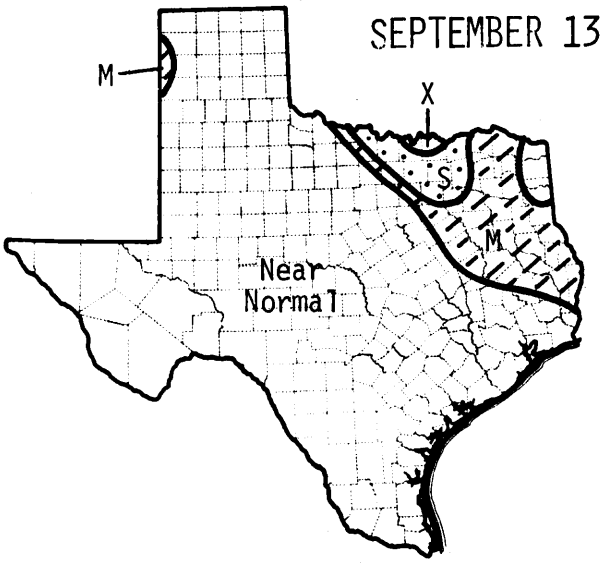


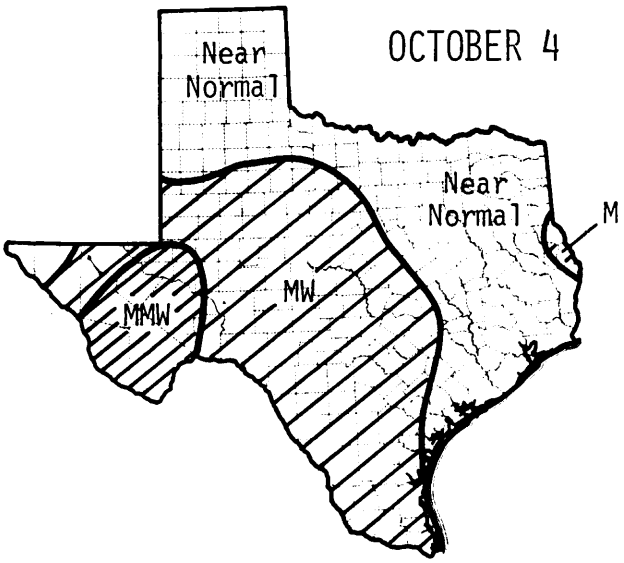
Figure 17. Drought and moist soil conditions in Texas at various times during 1980.



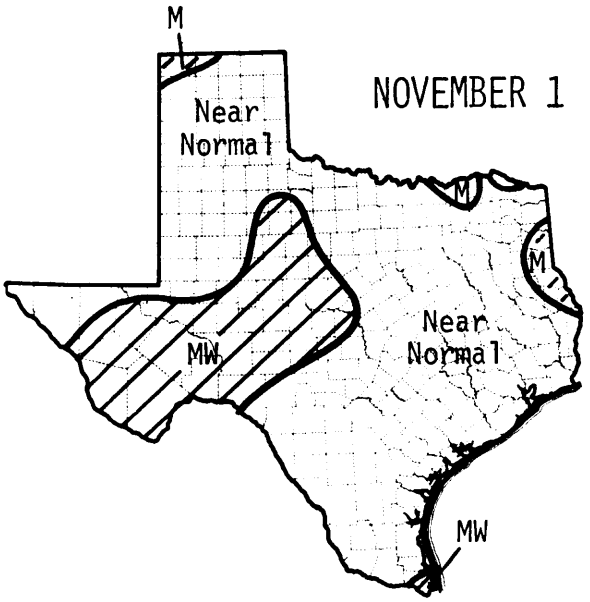
(e) In the wake of Hurricane ALLEN's deluges along the Rio Grande



(f) Just after Tropical Storm DANIELLE's trek across Texas



(g) Following early-Autumn deluges from frontal thunderstorms



(h) Midway through a dry Autumn

Figure 17. Drought and moist soil conditions in Texas at various times during 1980--Continued

The impact of the Summer's ferocious heat wave was felt acutely as well in the Edwards Plateau, where severe drought developed in July. Thanks to the superabundant rains from Allen in August and Tropical Storm Danielle a month later, drought ceased to be a concern to that region for the remainder of the year. Southern Texas fared in much the same way from Allen and Danielle, although the drought there never worsened beyond a "moderate" degree prior to the arrival of generally 4 to 8-inch rains from Allen on August 8-12. Still that moderate drought that dominated in July and early August was the most intense for Southern Texas in more than nine years.

Although moisture conditions in the Lower Valley remained within the "near-normal" range during the first half of 1980, a trend toward drought was established early in the year and culminated in a brief period of "moderate" drought that ended suddenly when Allen surged ashore on August 10. That 5-week spell of moderate drought was the worst in the Lower Valley since a drought of similar magnitude prevailed for more than three months in the Spring of 1971.

East Texas and the Upper Coast experienced the greatest fluctuations in moisture content during 1980. More than ample rainfall in March led to much wetter than normal conditions in much of both regions for the greater part of Spring. Sizable rainfall deficits in June and July, however, introduced an "incipient" drought by mid-Summer, and Allen failed to have enough of an effect on either of the two regions to stem the formation of "moderate drought" as Summer came to an end (Figure 17e). Rains of 5 to 10 inches from Danielle erased the drought in the Upper Coast early in September, whereas East Texas had to await the arrival of several outbreaks of heavy thunderstorms later in the same month to quash the drought there. Those thunderstorm rains, nevertheless, were not substantial enough to put East Texas in the wetter-than-normal category heading deeper into what turned out to be an Autumn of scanty precipitation. Consequently, moderate drought impinged upon the Sabine River valley again as Autumn ended (Figure 17h).

Snowstorms and Snowfall

A Winter-Spring period distinguished only by an uncommonly late and heavy snow in Texas' western extremity was overshadowed by record-breaking snowfalls in the northwestern quarter of the State near the end of 1980. The Autumn was one of the most extraordinary seasons in Texas' weather history not only because of the record amounts of snow that buried large sections of western Texas twice during November, but also because of a phenominally early snowstrom that glazed the Trans Pecos with snow and ice in late October.

Winter-Spring

The belated blast of wintry weather that culminated the snow season in Texas in mid-April unleashed most of its fury on the Trans Pecos, the region to be beleagured six months later by one of the earliest winter storms in history. Moreover, the late-Spring snow and icestorm was infamous for its severity as well as its tardiness. Freezing rain, followed by heavy snow accumulations of as much as 7 inches in the Franklin Mountains and up to 3 inches as far south as Big Bend National Park, caused damage of $1 million to the early pecan crop and an additional $500 thousand to cotton and other crops in the westernmost tip of the State. El Paso collected 2 inches from the storm on April 11-12, or the most ever for the month of April; in fact, it was only the second measurable snow accumulation of this century in April for that westernmost metropolitan area. A total of 3 inches of snow was deposited in Chisos Basin, the most ever observed within Big Bend National Park so late in the Spring. Farther north in the High Plains, the storm left only modest amounts of snow cover, ranging from a fraction of one inch up to 2 inches. However, the wintry cyclone was vigorous enough to give scattered areas elsewhere in Texas a thin coating of ice and snow, including a blanket of snow 2 inches thick at Mount Vernon in East Texas.

The sequence of events that accompanied the rare April snowstorm in far western Texas is depicted in Figure 18, a time-series plot of visibility, wind, pressure, temperature, and sky condition gaged hourly at Wink. Although only a trace of snow was measured in that small community, the weather scenario that characterized the wintry snowstorm in the Trans Pecos was monitored in its entirety at the weather-observing installation maintained by the Federal Aviation Agency a few miles outside of Wink. Arctic air surged into the Trans Pecos on the evening of April 11, plunging temperatures from the upper 60s into the low 40s in only three hours. Blustery northeast winds with gusts of 25-35 miles per hour raised enough dust to drop visibilities from 15 miles to 1 1/2 miles in less than one hour. Light rain began falling around daybreak

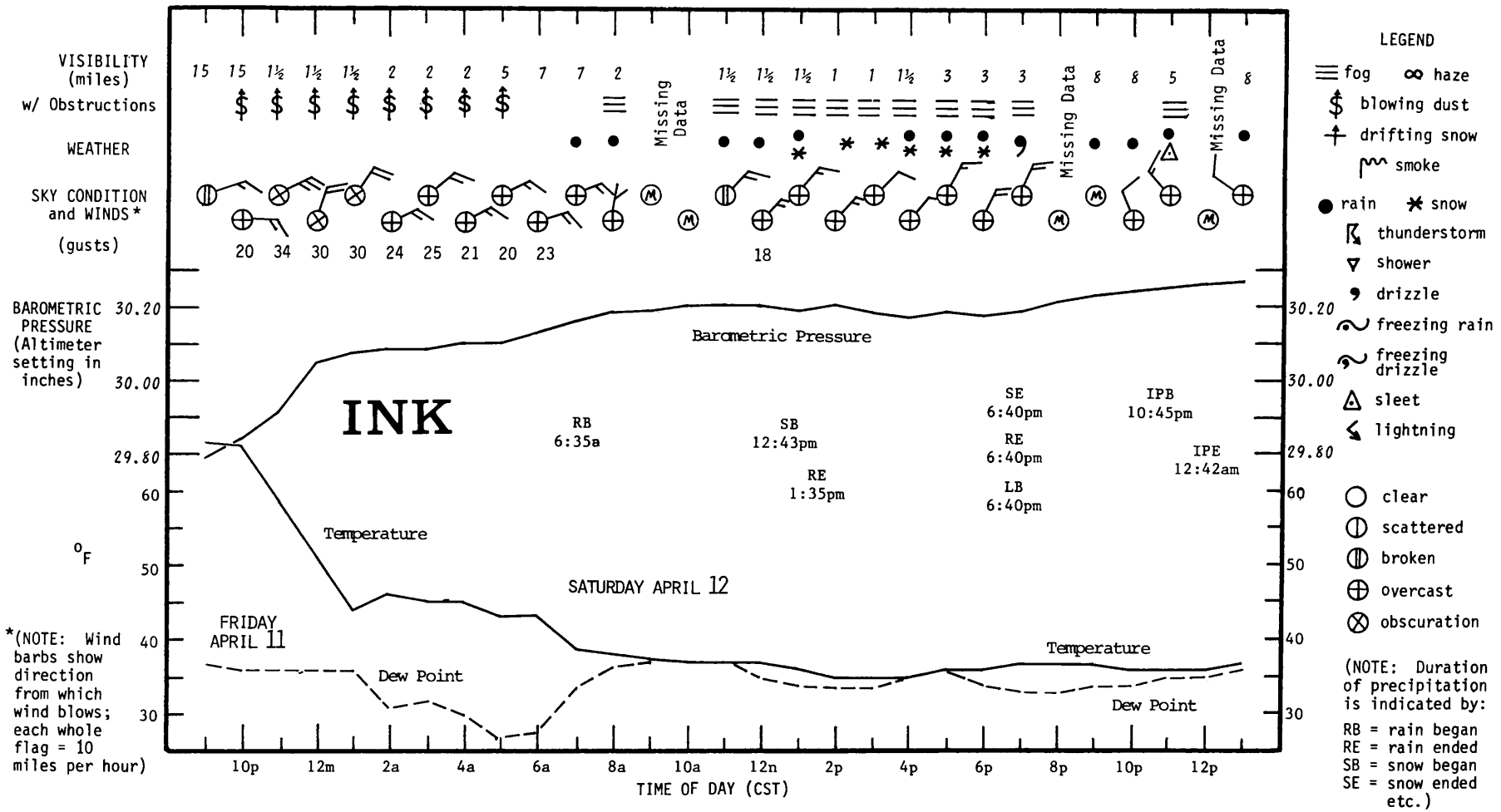


Figure 18. Hourly surface weather conditions at Wink (INK) in the northeastern Trans Pecos during the rare spring snowstorm that struck western Texas: from 9 p.m. (CST), April 11 through 1 a.m. (CST), April 13, 1980.

on April 12, and fog--rather than dust--reduced visibilities to only two miles; yet the air temperature remained a few degrees above freezing. Shortly after noon, leaden skies began yielding a mixture of rain and snow; the rain vanished within one hour, but light snow continued falling for another six hours. Because the air temperature never dipped lower than 35°F, the snow did not accumulate on the ground but instead melted and helped contribute to a precipitation water-equivalent of 0.36 inch for the day. While snowfall at Wink ended around dusk on April 12, a subsequent influx of slightly colder air that evening led to a spell of light rain interspersed with ice pellets (or sleet) that persisted for two hours into the early morning of April 13.

Other than the rare snowstorm in April in the Trans Pecos, snowfall occurrences during the Winter and Spring of 1980 were hardly significant. Seasonal totals were near or a bit above normal in the High Plains, while January-April sums were subpar in the Low Rolling Plains, North Central and East Texas (Table 5). For the seventh straight Winter-Spring period, measurable snowfall did not occur in South Central Texas, the Upper Coast, or other areas farther south. One surprising aspect was a significant snowfall that reached through East Texas into the northern periphery of the Upper Coast on February 2. For the first time since 1973, snowfall was reported on Galveston Island, though no measurable accumulations were observed. A snow cover of about one inch was measured at Houston and in several other locales in the northern extremity of the Upper Coast, as well as throughout much of East Texas.

Nearly equal amounts of snow during January and February made up the total snowfall for the Winter-Spring period in much of the High Plains. However, in the southern High Plains, where seasonal totals amounted to 3-8 inches (Figure 19), the bulk of that sum resulted from snowstorms on two separate occasions in February. Most of the season's snow in the Low Rolling Plains--which amounted generally to 3-6 inches--came in February, whereas in North Central Texas virtually all measurable snowfall during the year's first quarter occurred in early and mid-February. The same was true of the northern and central sections of the Trans Pecos, where seasonal totals of 1-3 inches were common.

During the Winter-Spring period, the snowline--the southern boundary of measurable snowfall accumulations--extended as far south and east as Chisos Basin (Trans Pecos), San Angelo, Temple, Houston, and Port Arthur. Traces of snow were observed as far south as Del Rio and Mathis (Southern), with those coming either at the end of the first week in February or shortly after the middle of that same month. McCook (Lower Valley) observed a trace of snow in early March.

Table 5. Snowfall totals (inches) for the first four months of 1980.

Region/City	Jan-Apr 1980 Total	Historical Record: Mean Jan-Apr	Greatest Total Amount	Year	Length of Record
HIGH PLAINS					
Amarillo	7.6	11.8	34.1	1905	1905-79
Dalhart	8.9	8.7	24.9	1978	1919-79
Lubbock	7.9	6.3	24.5	1961	1919-79
Midland-Odessa	3.3	2.5	12.8*	1929	1919-79
Muleshoe	9.0	7.1	22.3	1978	1924-79
Plainview	9.7	8.3	31.8	1956	1919-79
Spearman	18.0	12.0	31.1	1948	1921-79
LOW ROLLING PLAINS					
Abilene	2.2	3.0	16.5	1973	1905-79
Clarendon	3.5	5.0	17.8	1960	1919-79
Wichita Falls	3.6	3.9	13.7	1978	1931-79
NORTH CENTRAL					
Dallas-Ft. Worth	1.6	2.5	17.6	1978	1919-79
Waco	Trace	1.4	13.0*	1924	1905-79
EAST					
College Station	Trace	0.5	8.0	1973	1919-79
Lufkin	1.0	0.6	8.1*	1949	1919-79
Palestine	Trace	1.1	7.6	1978	1919-79
TRANS PECOS					
El Paso	5.6	1.9	9.9	1973	1905-79
Presidio	0.0	0.1#	2.5*	1947	1928-79
Sanderson	0.0	0.1	4.2*	1932	1929-35/ 1964-79
EDWARDS PLATEAU					
Del Rio	Trace	0.5¢	4.7*	1926	1919-79
Junction	0.0	2.0	24.2	1973	1919-79
SOUTH CENTRAL					
Austin	Trace	0.7¢	7.0*	1944	1926-79
San Antonio	Trace	0.5+	6.4*	1926	1919-79

* Amount collected in one month: January -Austin, Del Rio, Longview, Lufkin, Presidio, San Antonio
February - Midland-odessa, Waco
March - Sanderson

\# Only four measurable snowfalls in the past 51 years in the January-April period: January 1940 (2.0"), January 1947 (2.5"), January 1948 (0.7"), January 1951 (0.3")

¢ One measurable snowfall every four years.

\+ One measurable snowfall every five years.

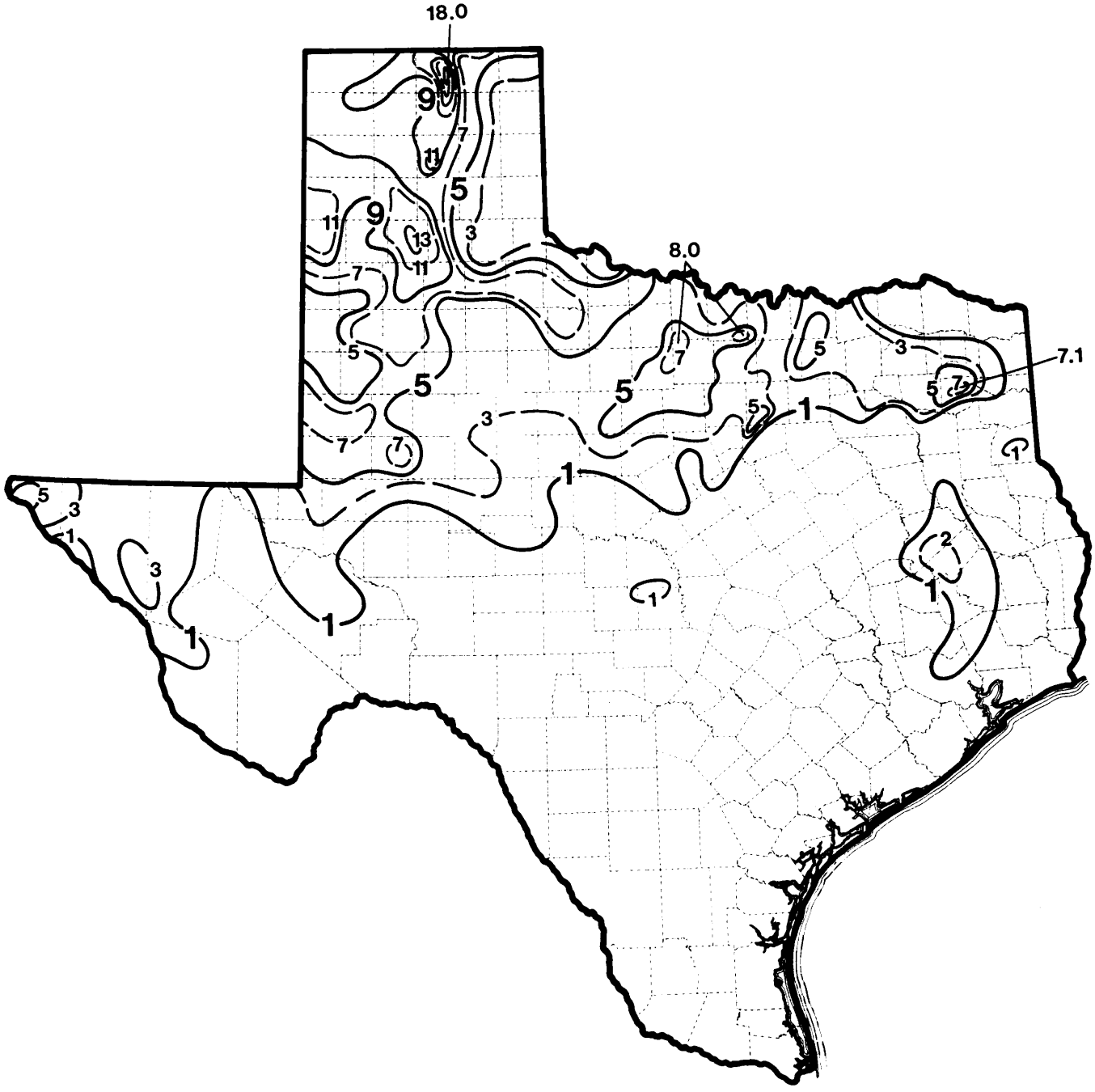


Figure 19. Cumulative snowfall totals (at 2-inch intervals) for January-April 1980.

Autumn-early Winter

Aside from the fact that snow on the ground rarely happens in Texas as early as October, such atypically early snowstorms almost always confine themselves to the northernmost periphery of the State. After all, a late-Autumn blizzard that struck the Panhandle on October 30, 1979 was only the fourth such wintry storm to hit anywhere in Texas in this century. Consequently, the snowstorm that roared across parts of Texas on October 27-28, 1980 was most eminent not only because of its precocity but also because it hit a most unlikely target. The snow spell lasted only a few hours during the morning of October 28, but snow deposits were measurable not only in the northern Trans Pecos but in the southernmost High Plains sector as well. The 1.0 inch of snow gaged at El Paso was the first measurable snow accumulation there in October in the 20th century. The thickest snow cover amounted to 3.0 inches at Cornudas Station in the northern Trans Pecos. Traces of snow were reported at several locales in the southern Low Rolling Plains and northern Edwards Plateau, and a measurable snow depth (0.5 inch) was noted at Forestburg in North Central Texas.

Perhaps the early nature of autumn's inaugural snowstorm could have been construed as a harbinger of plentiful snowfall to come. For sure, it was only about two weeks after the extraordinary snowstorm of October 28 that another wintry wave of treacherous weather gripped the western half of Texas. While the remains of Hurricane Jeanne languished in the western Gulf of Mexico, heavy snowfall plummeted from thick and chilled layers of moisture-rich clouds, leaving snow accumulations of unparalleled proportions in the higher elevations of the Trans Pecos and in parts of the southern High and Low Rolling Plains. The same mass of Arctic air that shunted Jeanne away from the Texas coastline was the catalyst for the huge snowfall amounts that totalled 10 inches in some parts of the southern High and Low Rolling Plains. Snowfall lasting barely 24 hours stacked up to 10 inches or more at Lubbock, Roscoe (Low Rolling Plains), and Water Valley (Edwards Plateau). Other very notable snowfall totals (in inches) in the High and Low Rolling Plains included: 8.3 at Dumont, 8.0 at Guthrie and Tulia, 7.1 at Seminole, 6.7 at Childress, 6.0 at Andrews, and 5.7 at Midland-Odessa. More modest amounts of 4-6 inches covered the northern High Plains, while sizeable accumulations--including 5.0 inches at McCamey and 4.0 inches at Ozona--were measured at a few locations in the western Edwards Plateau. Snow depths of 3-5 inches were common throughout most of the Trans Pecos, with 4 inches or more observed at such disparate places as El Paso in the west, Big Bend National Park in the south, and Pecos in the northeast. Even some locales in western North Central Texas were covered by a substantial snow blanket; 6.0 inches fell at Throckmorton, and 4.0 inches was noted at Albany, Archer City, and Putnam.

The mid-November snow cover had barely melted when a second wintry blast

deposited more heavy snowfall in much of Texas' northwestern quadrant. Another 10-inch snowfall smothered Lubbock, and at least a half-foot of snow was left on the ground throughout most of the Panhandle. Snow depths elsewhere in northwestern Texas were not nearly as substantial as those that occurred earlier in the month, but they were significant nonetheless. Two-day snow accumulations of 3-5 inches were common in much of the Low Rolling Plains, and one inch or more was measured at a few scattered locations in the northern Trans Pecos, the Edwards Plateau and North Central Texas. While most other cities in East Texas registered only a trace of snow, Center collected 2.0 inches. Moreover, for the first time in 21 years and only the third time in history, a measurable snow cover of 1.0 was gaged as far south as Austin.

The two spells of heavy snow combined to classify November 1980 as the snowiest November in the weather history of a number of communities in the High and Low Rolling Plains. Some examples of new snowfall records (inches) for the month of November are:

Snowiest November Ever	Nov. 1980	Previous Record
Lubbock	21.4	9.1 in 1976
Muleshoe	17.0	7.5 in 1961
Plainview	17.0	6.0 in 1931
Snyder	15.0	8.0 in 1923
Seminole	14.1	11.5 in 1976

In fact, some locations collected more snow during November 1980 than in any month of any year; until November 1980, for instance, the most that Lubbock had ever measured in any month was 14.3 inches in 1958. Other phenominally abundant monthly snowfall sums (inches) included: in the High Plains, 22.0 at Plains, 21.0 at Lorenzo and Floydada, 19.5 at Abernathy, 17.0 at Slaton, 16.5 at Tahoka, and 16.0 at Tulia; in the Low Rolling Plains, 22.0 at Post and 21.4 at Matador, in the Trans Pecos, 13.5 at Crane; and, in the Edwards Plateau, 16.0 at Water Valley.

Strangely, in the wake of record snowfall even before winter officially got underway, November's successor was accompanied by only a modicum of snowfall, and that was confined to the northern High Plains. Nearly a dozen communities, most of which were in the northern two tiers of Panhandle counties, collected a few inches of snow from a winter storm at the end of December's first week; heaviest snowfall totals for 1980's last month were gaged at Spearman (5.5 inches) and Stratford (5.0).

Table 6. Snowfall totals (inches) for the last two months of 1980.

Region/City	Nov-Dec 1980 Total	Historical Record: Mean Nov-Dec	Greatest Total Amount	Greatest Total Year	Length of Record
HIGH PLAINS					
Amarillo	8.6	3.0	31.3	1918	1904-79
Dalhart	7.4	2.3	20.0	1923	1919-79
Lubbock	21.4	1.2=	10.5	1942	1919-79
Midland-Odessa	7.2	0.4@	6.3	1943	1919-79
Plainview	17.0	1.6&	18.0	1931	1919-79
Spearman	13.0	2.4	25.8	1972	1921-79
LOW ROLLING PLAINS					
Abilene	3.7	0.5+	9.3	1918	1904-79
Childress	6.7	1.3+	24.0	1931	1925-79
Clarendon	9.0	1.2+	25.0	1931	1919-79
Wichita Falls	2.7	0.6+	8.0	1942	1931-79
NORTH CENTRAL					
Dallas-Ft. Worth	0.0	0.3%	5.0	1937/76	1919-79
Paris	0.0	0.2%	5.0	1976	1919-79
Waco	0.8	#	13.0	1929	1905-79
EAST					
College Station	Trace	#	5.5	1929	1919-79
Longview	Trace	#	14.0	1929	1919-79
Lufkin	Trace	#	10.5	1929	1919-79
Palestine	0.5	#	9.5	1929	1919-79
TRANS PECOS					
El Paso	4.0	0.9+	14.7	1976	1904-79
Presidio	0.0	#	12.0	1927	1928-79
EDWARDS PLATEAU					
Del Rio	0.0	#	2.8	1947	1919-79
Junction	0.0	#	14.0	1929	1919-79
SOUTH CENTRAL					
Austin	2.0	#	9.7	1937	1926-79
San Antonio	Trace	#	2.9	1929	1919-79

The total number of individual months (November or December) during the length of record when measurable snowfall occurred: 2 - Lufkin; 4 - College Station, Longview; 5 - Austin, Del Rio, San Antonio; 6 - Presidio; 8 - Junction; 9 - Palestine; 10 - Waco

+ One measurable snowfall every two years.

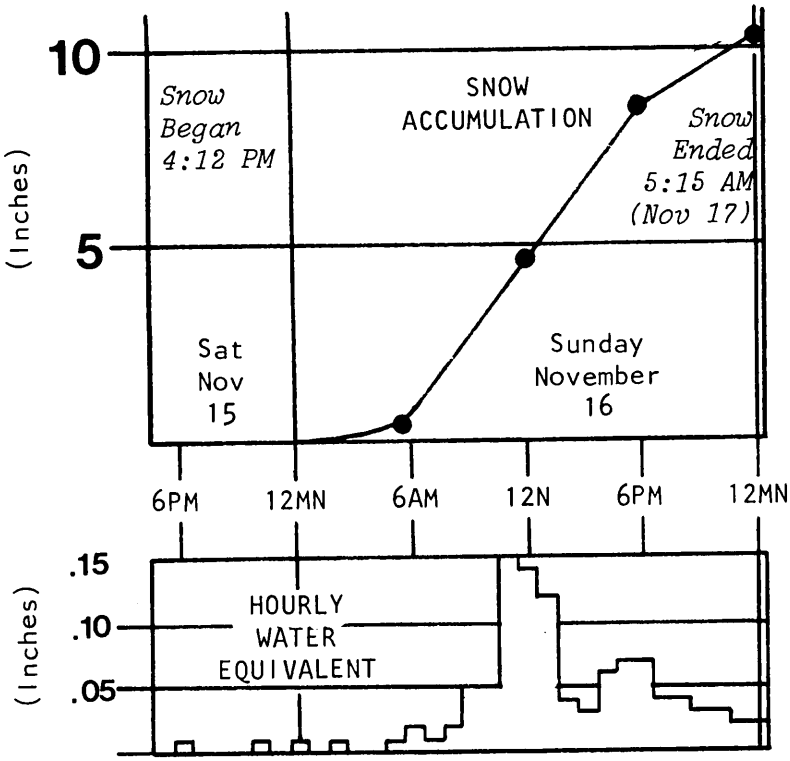
@ One measurable snowfall every three years.

% One measurable snowfall every four years.

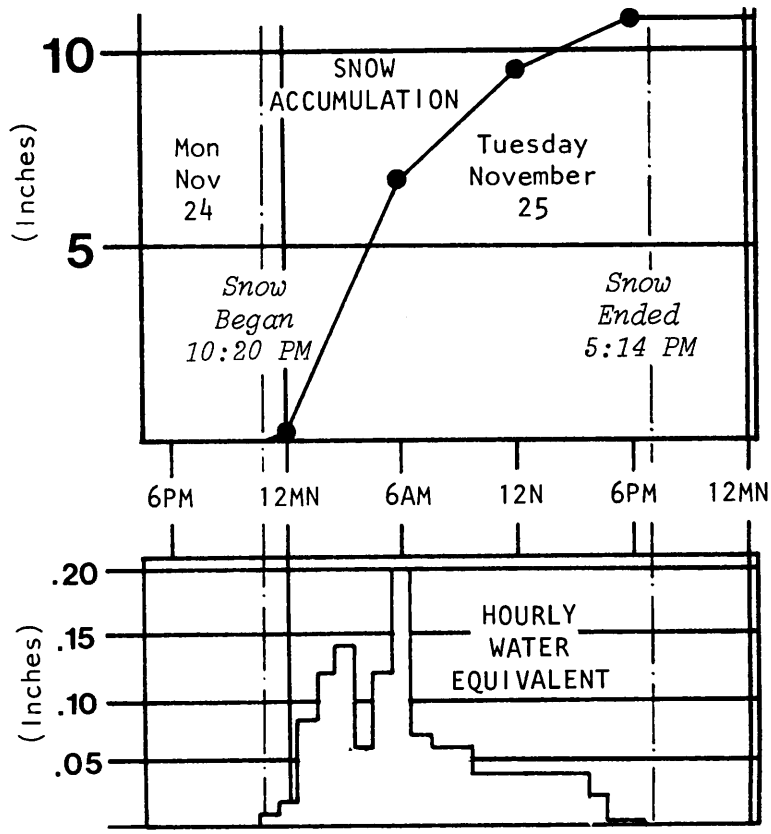
¢ One measurable snowfall every five years.

= Two measurable snowfalls every three years.

& Three measurable snowfalls every four years.



(a) Snowfall accumulation and water equivalent for the snowstorm of November 15-17, 1980.



(b) Snowfall accumulation and water equivalent for the snowstorm of November 24-25, 1980.

Figure 20. Accumulation of snowfall at Lubbock Regional Airport and the hourly amounts of melted precipitation at that location during two separate snowstorms in November 1980 that furnished record amounts of snow.

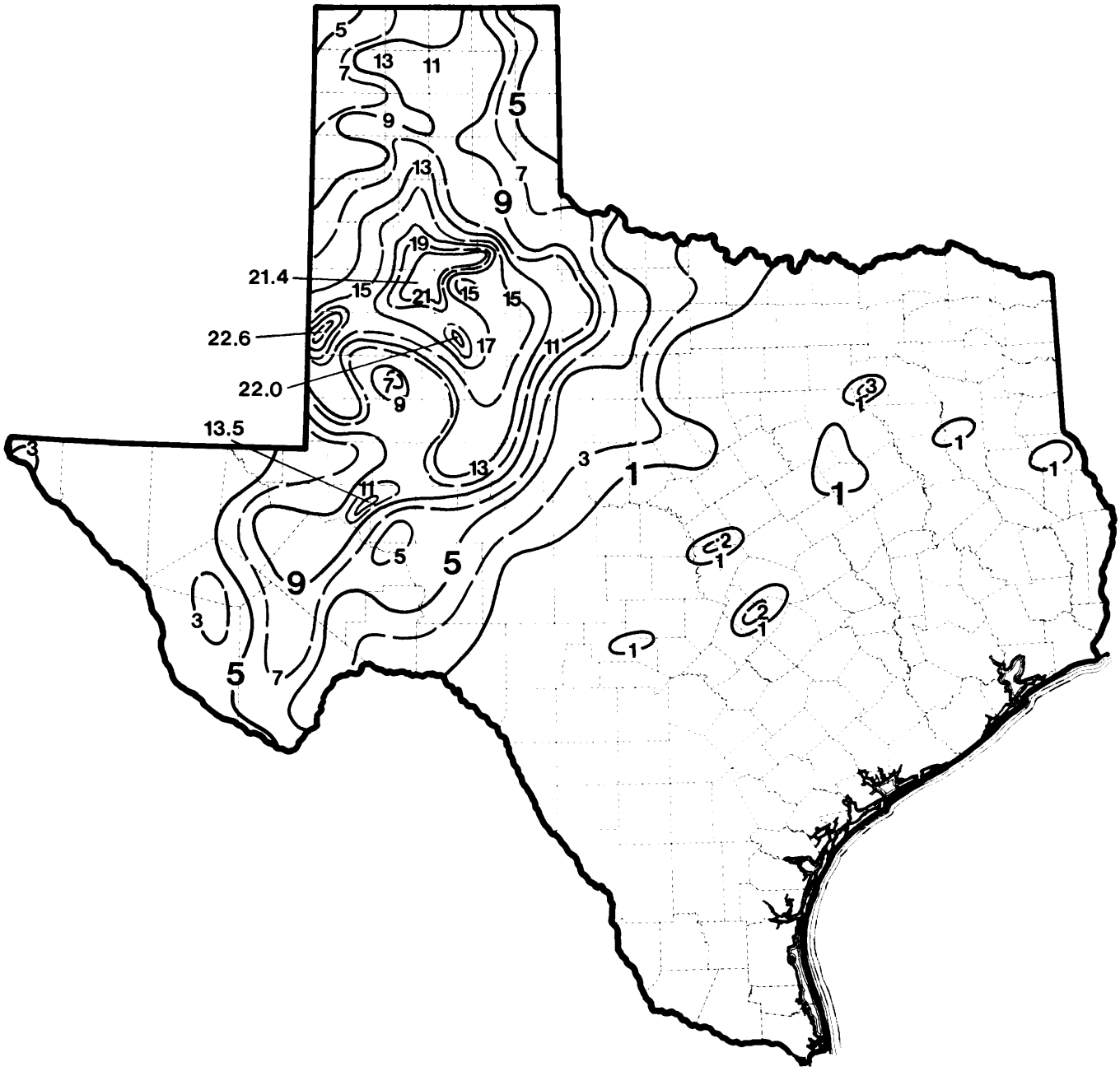


Figure 21. Cumulative snowfall totals (at 2-inch intervals) for November-December 1980.

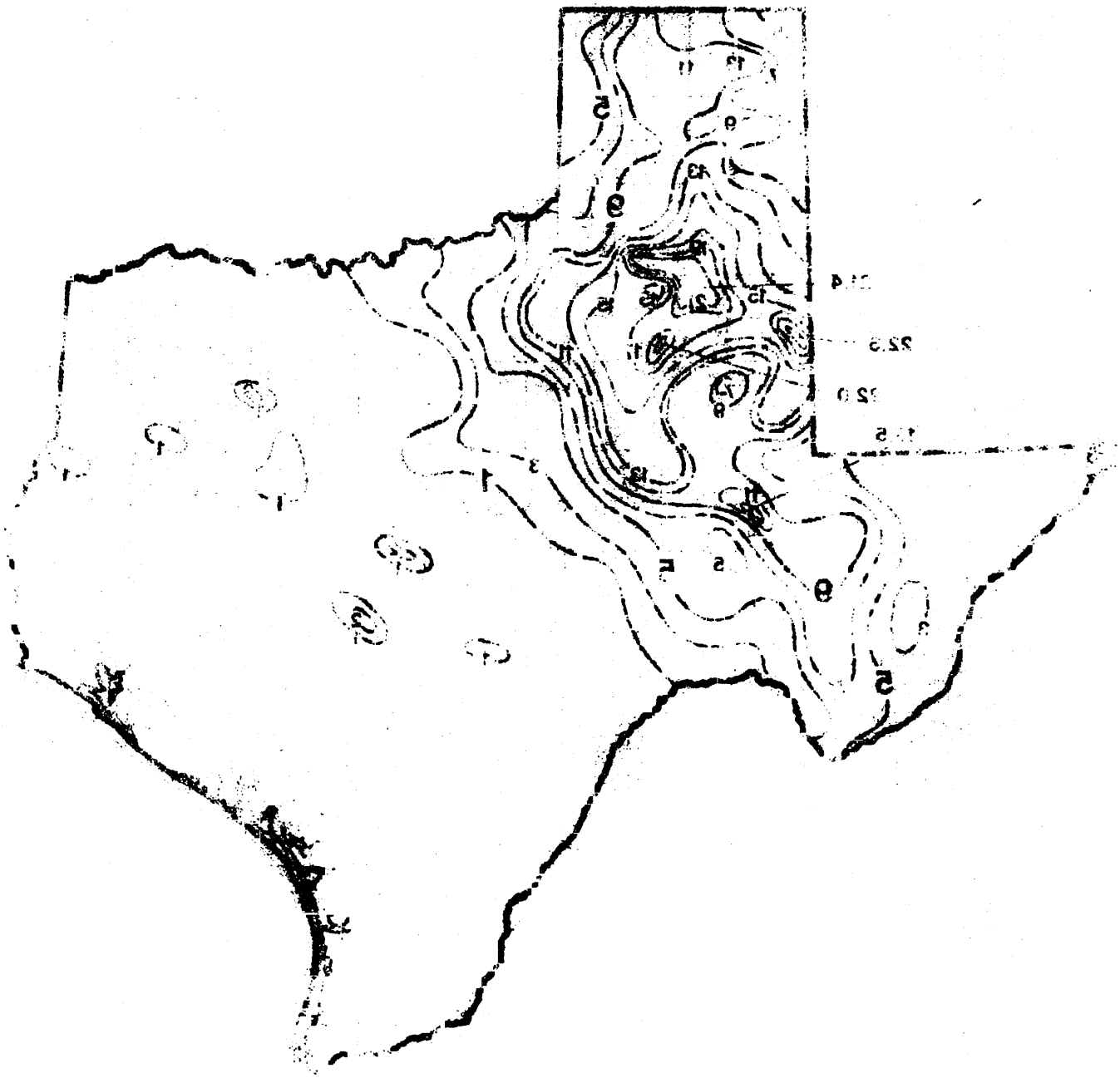


Figure 2b. Cumulative seasonal totals for Saint Johnsbury for November-December 1976.

HURRICANES AND OTHER TROPICAL DISTURBANCES

Oddly, of the ten hurricanes or tropical storms that formed in the Atlantic/Caribbean/Gulf of Mexico area during 1980, only three affected populated land areas, and each of them either perished within Texas or disintegrated in open water after threatening the Texas coastline. The other seven, six of which attained hurricane strength, remained far at sea throughout their lifetimes.1/ Hurricane Frances easily outlived all of the other Atlantic storms and consequently covered more territory than any of the others; Frances became a tropical storm while south of the Cape Verde Islands on September 7, grew into a hurricane within 48 hours, and trekked for 13 days across open seas before it finally disintegrated about 700 miles southeast of Greenland on September 20. Aside from Hurricane Allen, Frances was the strongest of the Atlantic storms, attaining a maximum sustained wind speed of 115 miles per hour at one point during its life cycle. Tropical Storm Danielle, with a lifetime of barely 24 hours, had the shortest lifetime of all of the major Atlantic storms.

Out of the Atlantic Ocean/Gulf of Mexico

A record string of eight consecutive years without a hurricane striking the Texas coastline was abruptly halted in the middle of Summer of 1980, when one of the Atlantic Ocean's most dangerous storms ever---Hurricane Allen--pushed inland across the southern end of Padre Island in the wee hours of the pre-dawn darkness of August 10.2/ Allen inexplicably but fortuitously weakened a few hours before it roared ashore just south of Port Mansfield, but the season's first hurricane nonetheless battered the lower half of the Texas coastline with extremely potent winds and instigated a near-record storm surge. Four weeks later, a second major tropical storm system struck the other end of Texas' coastal flank: Tropical Storm Danielle rushed ashore over High Island on September and dished out torrential rains that caused serious flooding in the southeastern extremity of Texas. Then, much later in the

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1/ The names of the Atlantic hurricanes/tropical storms during 1981, along with dates of occurrence, are: Allen (August 1-11), Bonnie (August 14-19), Charley (August 20-25), Danielle (September 4-7), Earl (September 4-10), Frances (September 6-20), Georges (September 1-8), Hermine (September 20-25), Ivan (October 1-11), Jeanne (November 7-16), and Karl (November 25-27).

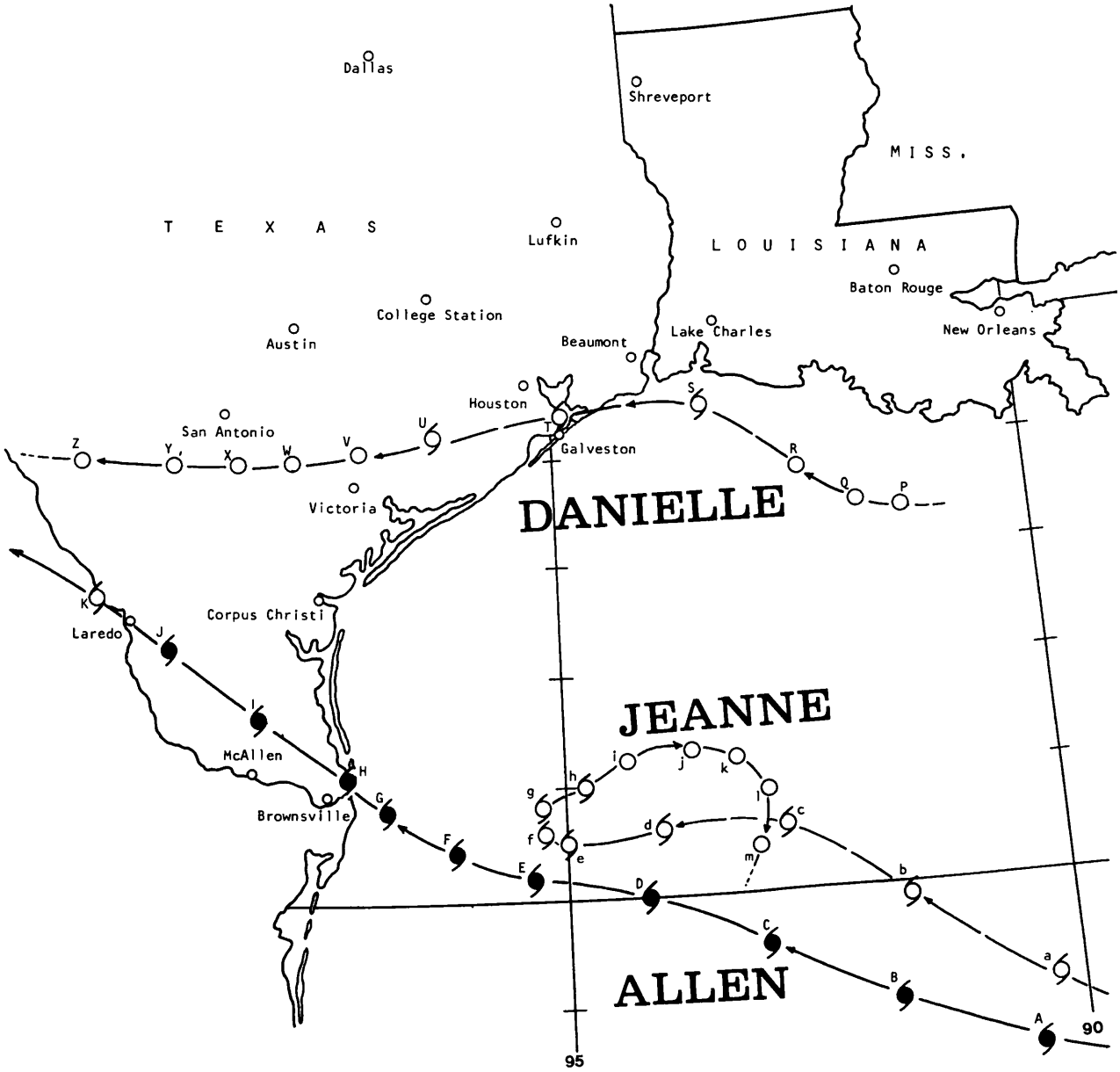
2/ Until Allen came on the scene, Hurricane FERN—a modest hurricane that hit near Matagorda on September 10, 1971 and stimulated extensive, flood-producing rains inland around Corpus Christi--was the most recent hurricane to punch across the State's coastline.

Autumn, yet another strong tropical disturbance--Hurricane Jeanne--entered the western Gulf headed for Texas' coastline. The State escaped the brunt of that minimal hurricane, however, when a Arctic front barged through Texas and into the Gulf on November 14, thereby deflecting Jeanne away from the coastline at the last instant.

Allen

From the time it began evolving from a tropical wave off the western coast of Africa on July 31 until it crashed into the southern tip of Texas nine days later, Hurricane Allen rarely deviated from a west-northwesterly course that took it from the eastern North Atlantic across the Caribbean Sea and Gulf of Mexico to the southern tip of Texas (Figure 22). Even more remarkable was the intensity which Allen acquired and sustained for over one week, even though the massive storm passed over Barbados and skirted Haiti, Jamaica, the Cayman Islands, and the Yucatan Peninsula. For most of its lifetime, Allen was the second strongest hurricane on record in the Atlantic Ocean/Gulf of Mexico. On three separate occasions--and for at least 12 hours each time--Allen mustered sustained winds of at least 170 miles per hour, qualifying the storm as a "5" on the Simpson scale of 1 to 5 (with the higher number denoting the greatest intensity). When Allen passed north of the Yucatan Peninsula on the morning of August 7, the mammoth storm's mass virtually covered all of the western half of the Gulf of Mexico (Figure 23a). What is more, its central pressure had bottomed out at an incredible 26.70 inches, and sustained winds near the center were gaged at an astounding 185 miles per hour. Indeed, Allen seemed on the verge of lashing the Texas coast with a ferocity that would more than compensate for eight years of relative tranquility.

Suddenly, late on August 9 with the hurricane's center a mere 50 miles from the Texas coastline, Allen for the first time began behaving mysteriously. It stalled, and for more than 12 hours, with winds of more than 100 miles per hour raking the lower Texas coastline, Allen weakened slowly but discernibly. When the still-dangerous hurricane began to move again, it veered slightly and moved ashore along a mostly isolated stretch of coastline about midway between Brownsville and Corpus Christi. That late-course maneuver doubtlessly spared Brownsville from what conceivably would have been a much greater disaster. As it turned out, wind damage to homes, trees, and other objects in that far southern city was superficial. Still, several million dollars in losses were incurred by fruit growers when citrus was knocked from trees. Parts of Cameron County east of Brownsville and fronting the Gulf suffered very extensive damage due to tidal flooding and surf action. The southern Laguna Madre, whose water level was actually higher than tides on the Gulf side of Padre Island, sustained $50 million in damages due to tidal action, while the city of South Padre Island incurred an estimated $30 million in damages from



ALLEN

	Day	Time (CDT)	Pressure (mb)	Max Winds (knots)
A	8	7 AM	960	115
B	8	1 PM	940	130
C	8	7 PM	912	145
D	9	1 AM	909	155
E	9	7 AM	916	140
F	9	1 PM	925	125
G	9	7 PM	935	110
H	10	1 AM	945	100
I	10	7 AM	960	85
J	10	1 PM	970	70
K	10	7 PM	990	60

DANIELLE

	Day	Time (CDT)	Pressure (mb)	Max Winds (knots)
P	4	7 PM	1010	25
Q	5	1 AM		25
R	5	7 AM	1008	30
S	5	1 PM	1004	50
T	5	7 PM		40
U	6	1 AM	1008	35
V	6	7 AM		30
W	6	1 PM		25
X	6	7 PM	1010	20
Y	7	1 AM		
Z	7	7 AM		

JEANNE

	Day	Time (CST)	Pressure (mb)	Max Winds (knots)
a	12	6 PM	999	55
b	12	12 MN	997	55
c	13	6 AM	993	60
d	13	12 N	994	60
e	13	6 PM	996	55
f	13	12 MN	998	50
g	14	6 AM	1002	50
h	14	12 N	1002	40
i	14	6 PM	1004	30
j	14	12 MN	1004	30
k	15	6 AM	1005	25
l	15	12 N	1006	20
m	15	6 PM	1007	20

STAGES : ○ Tropical Depression Tropical Storm Hurricane

Figure 22. Tracks of hurricanes and tropical storms from the Gulf of Mexico that affected Texas weather in 1980.

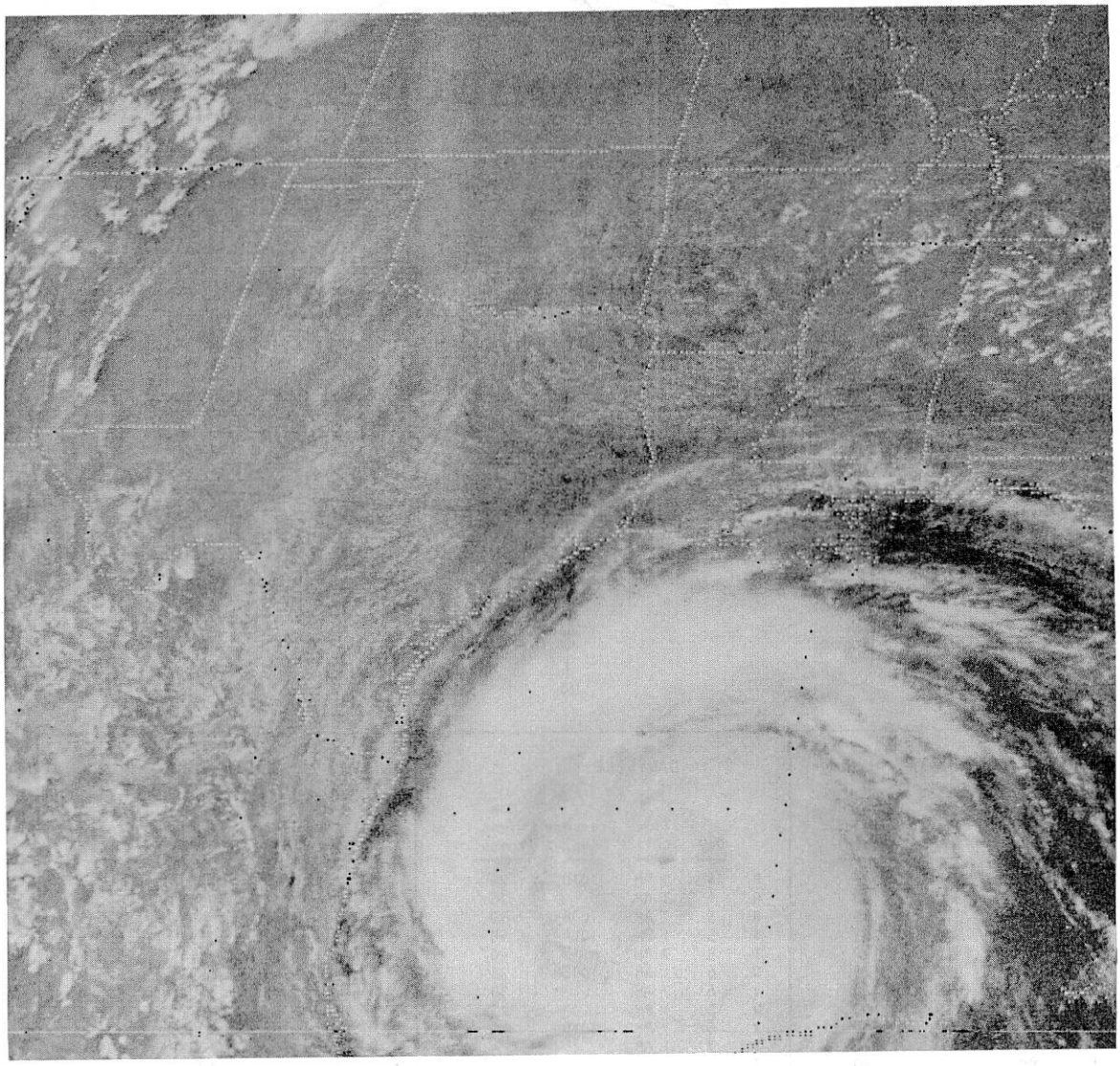


Figure 23. Hurricane Allen maintained a steady west-northwesterly course across the Caribbean Sea and Gulf of Mexico before stalling momentarily just off the lower Texas coast on the night of August 9, 1980 and then surging ashore near Port Mainsfield early the next day. (a) A visible satellite photograph of Allen around noon on August 8 reveals the massive cyclone consisted of very dense clouds that covered virtually all of the western half of the Gulf of Mexico.

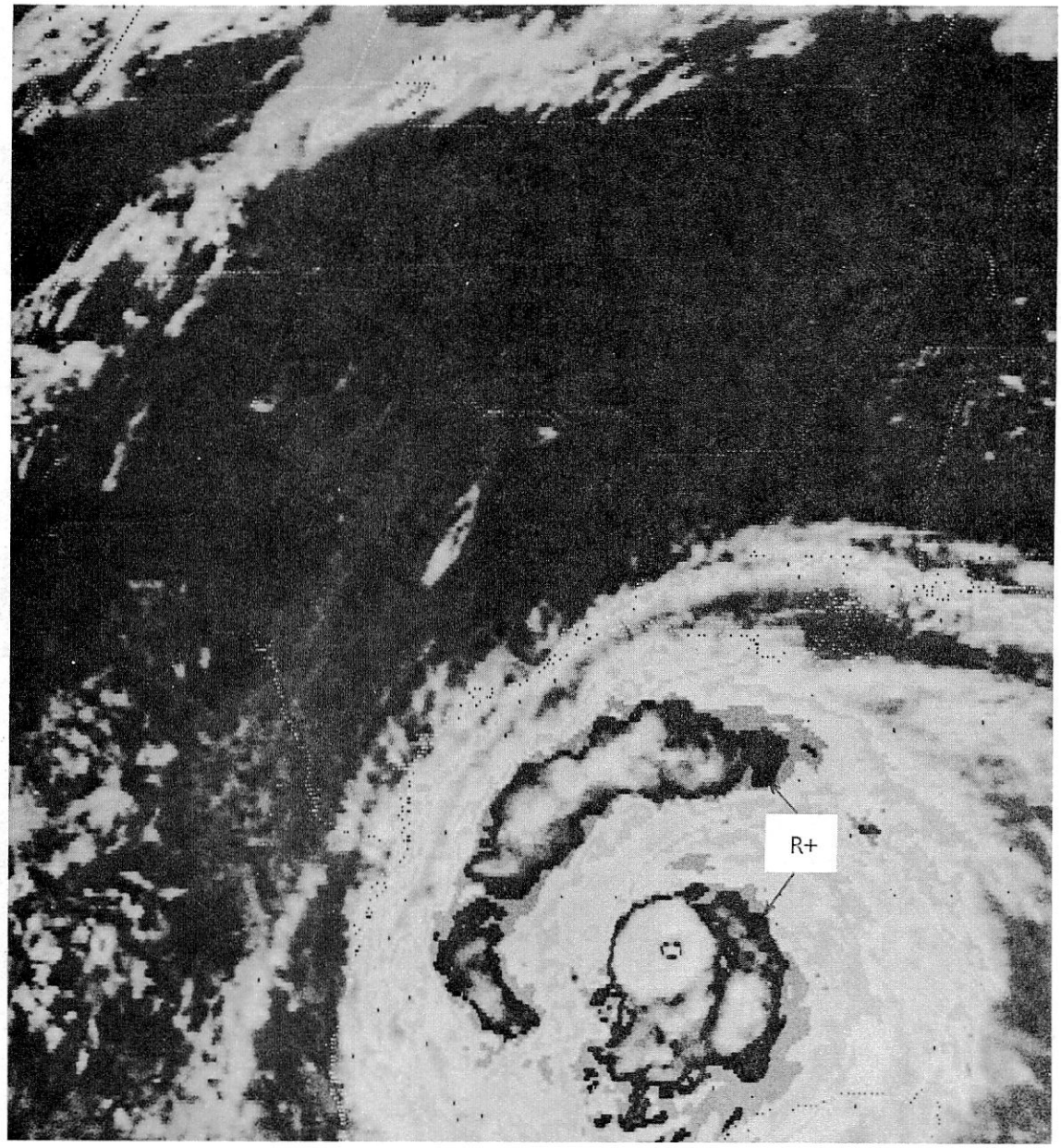


Figure 23b. An infrared satellite photograph at noon on August 8 shows the heaviest rain (the dark shaded parts (labeled R+) within the larger white areas) associated with Hurricane Allen is located near the eye of the storm and in a long arc extending 150-250 miles to the north and west of the storm center.

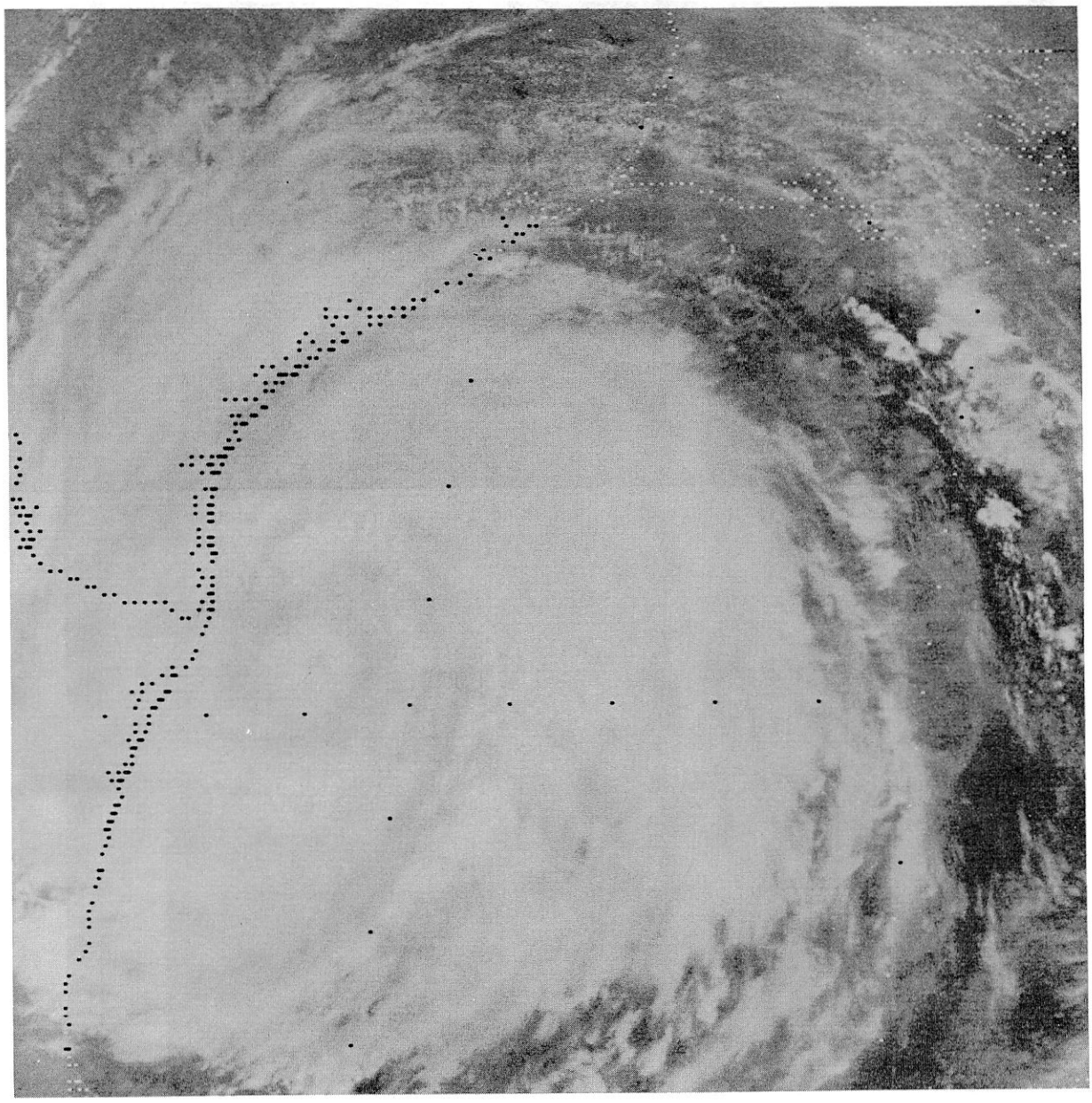


Figure 23c. Allen's eye, and the bands of intense convection spiraling around it, remain visible at noon on August 9, or when the storm center was barely 70 miles from the southern tip of Texas; although the cyclone was losing strength at this stage of its lifespan (with sustained winds near the center lowering to 145 mph), heavy rains in the northwestern quadrant of the storm were lashing the lower Texas coastline.

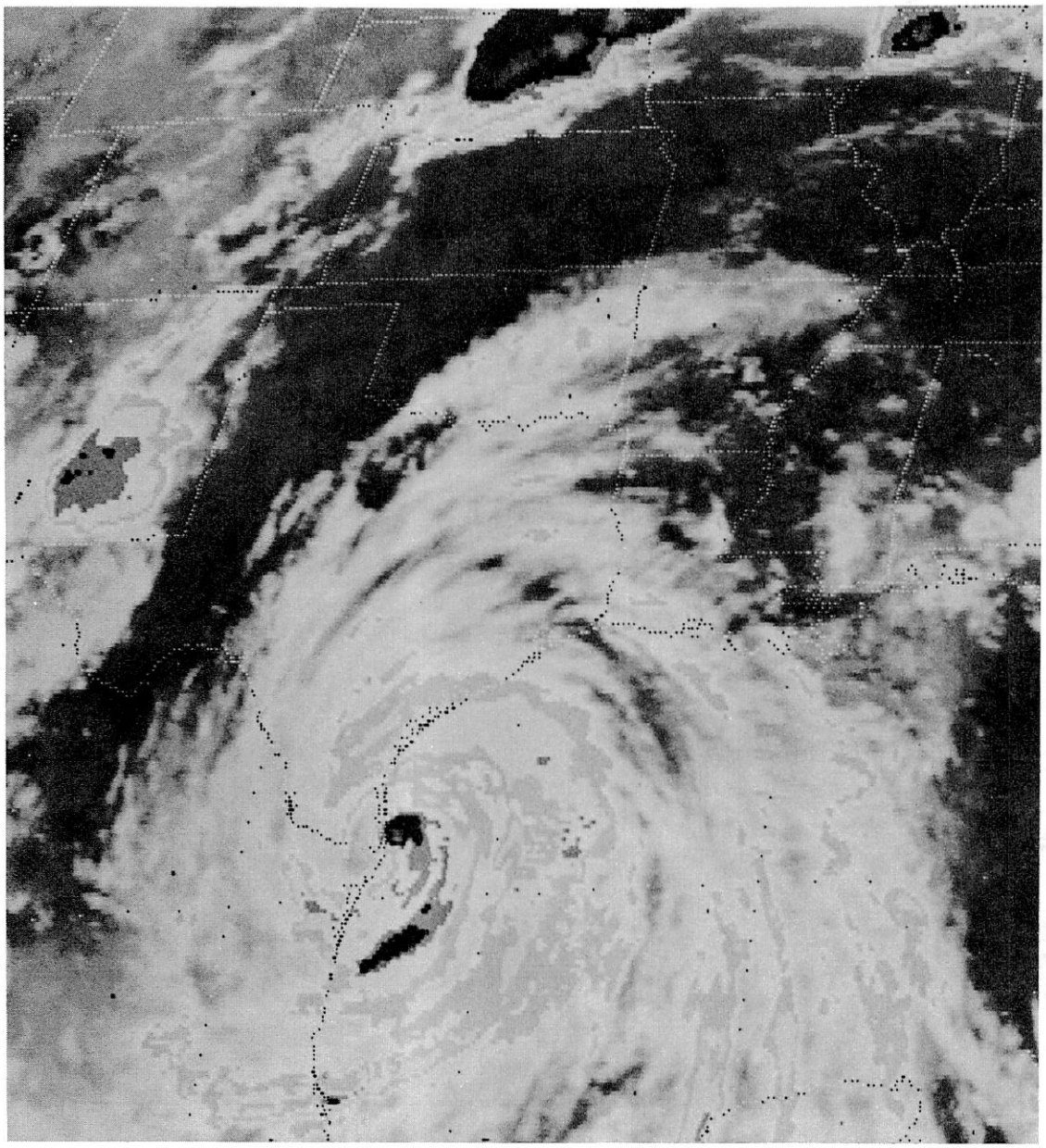


Figure 23d. This infrared photograph taken at midnight (CDT) on August 9 shows Allen's center moving ashore across south Padre Island, with the most intense rains (dark spots mingled among the gray and white areas) remaining offshore to the east and southeast of Brownsville; Allen had a central pressure of 945 mb (27.91 inches) and maximum sustained winds near the center of 115 mph at the time of landfall.

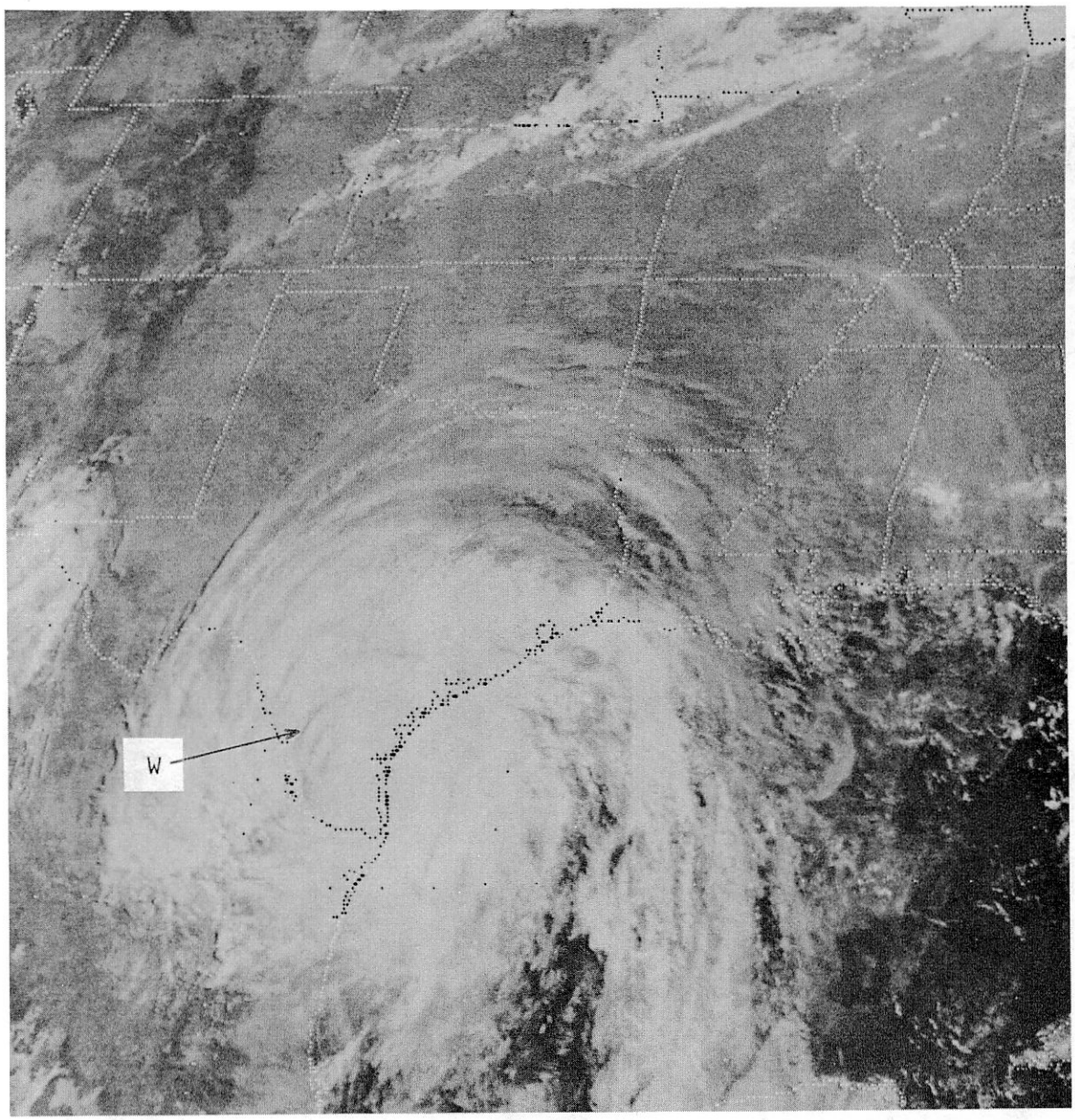


Figure 23e. The far-reaching impact of Allen is seen in this visible photo at 9:30 A.M. (CDT), August 10, when spiraling bands of middle and high clouds extended as far north as southern Oklahoma; also prominent in this photo are the shadows (labeled by "W") of several curling walls of very intense convection in Southern Texas that were furnishing torrential rainfall between Laredo and Corpus Christi.

Figure 23f. Twelve hours after Allen made landfall, the storm continued to provide hurricane-force winds near its dissolving center; this infrared photograph indicates the center of Allen near Laredo at 1 p.m. (CDT), August 10 with numerous very heavy rainstorms (dark spots) occurring in Southern Texas.

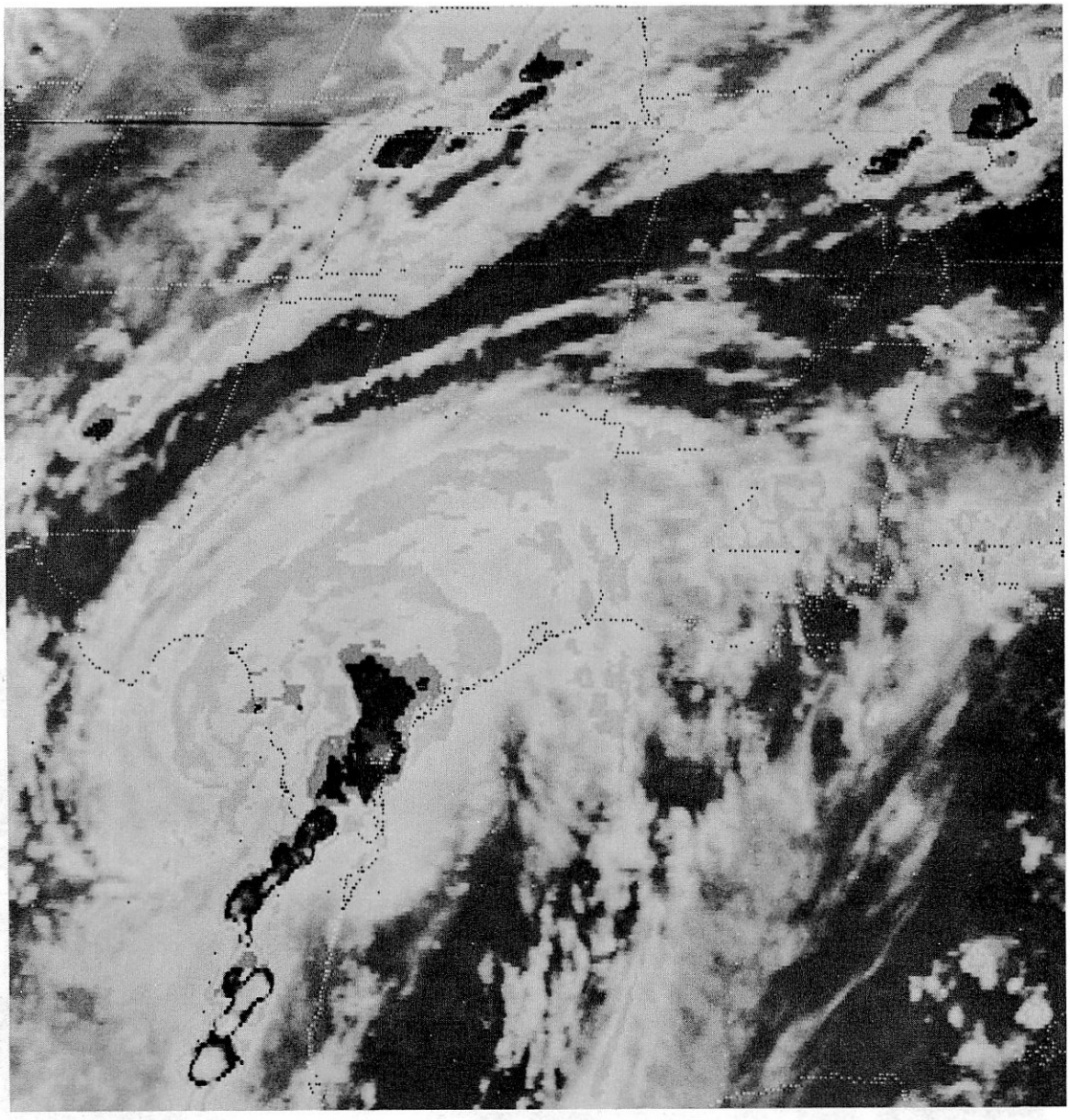


Figure 23g. Although it had been downgraded to a tropical storm by the time night fell on August 10, Allen continued to unleash very intense rainfall throughout much of the southern quarter of Texas, as seen by the preponderance of darkened areas in this 9:30 p.m. (CDT) infrared photograph.

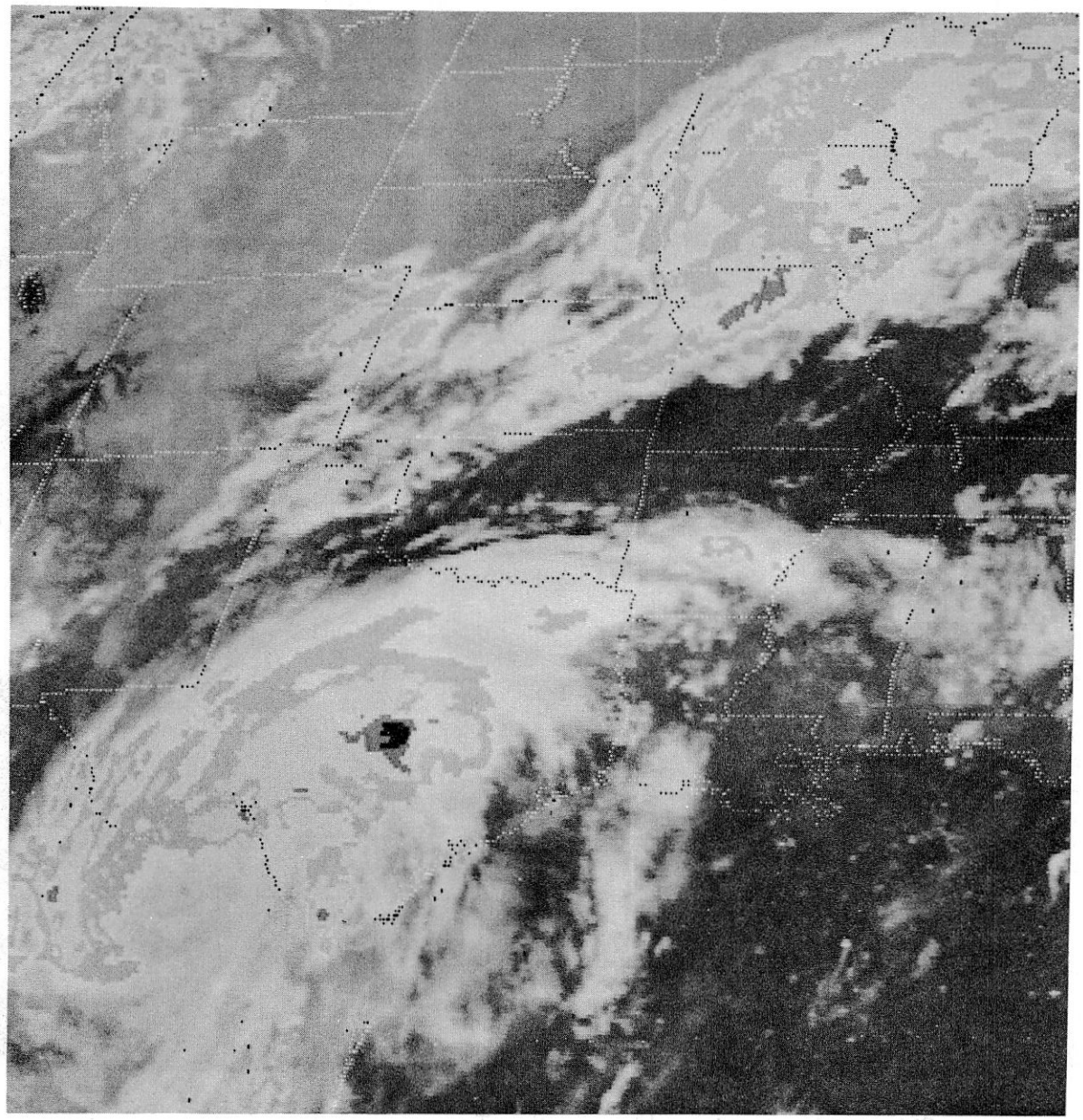


Figure 23h. As a tropical depression with a poorly defined center over extreme northeastern Mexico, Allen's residue continued to promote numerous bands of showers and a few thunderstorms that pushed westward across the Pecos River into the Trans Pecos before daybreak on August 11.

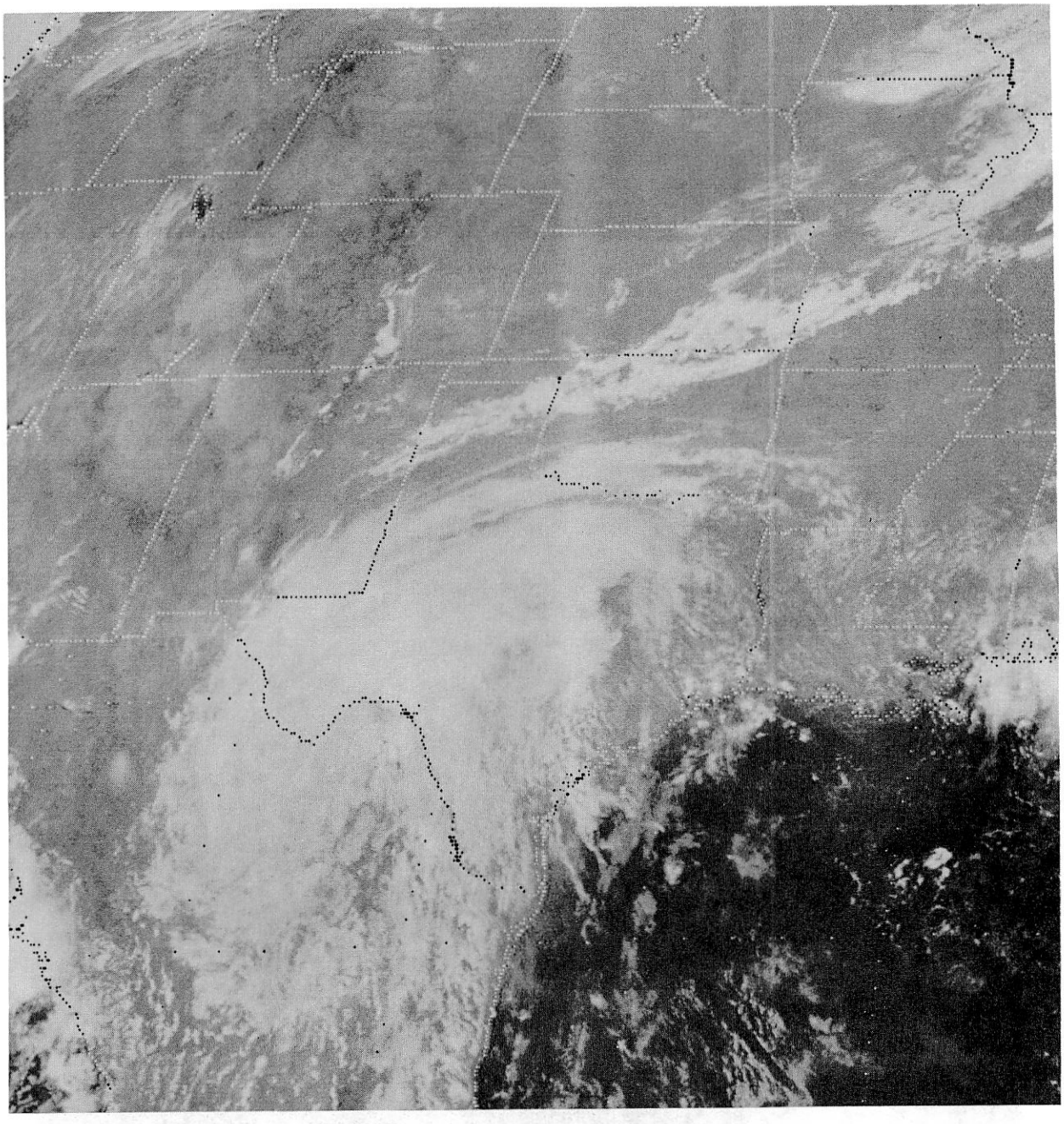


Figure 23i. With clearing skies in the Texas coastal plain around noon on August 11, Allen's remnants (centered near Big Bend National Park) persisted in giving most of western Texas a very dense cloud cover and intermittent rain squalls that produced 2-4 inches of rain on the ground in much of the Trans-Pecos.

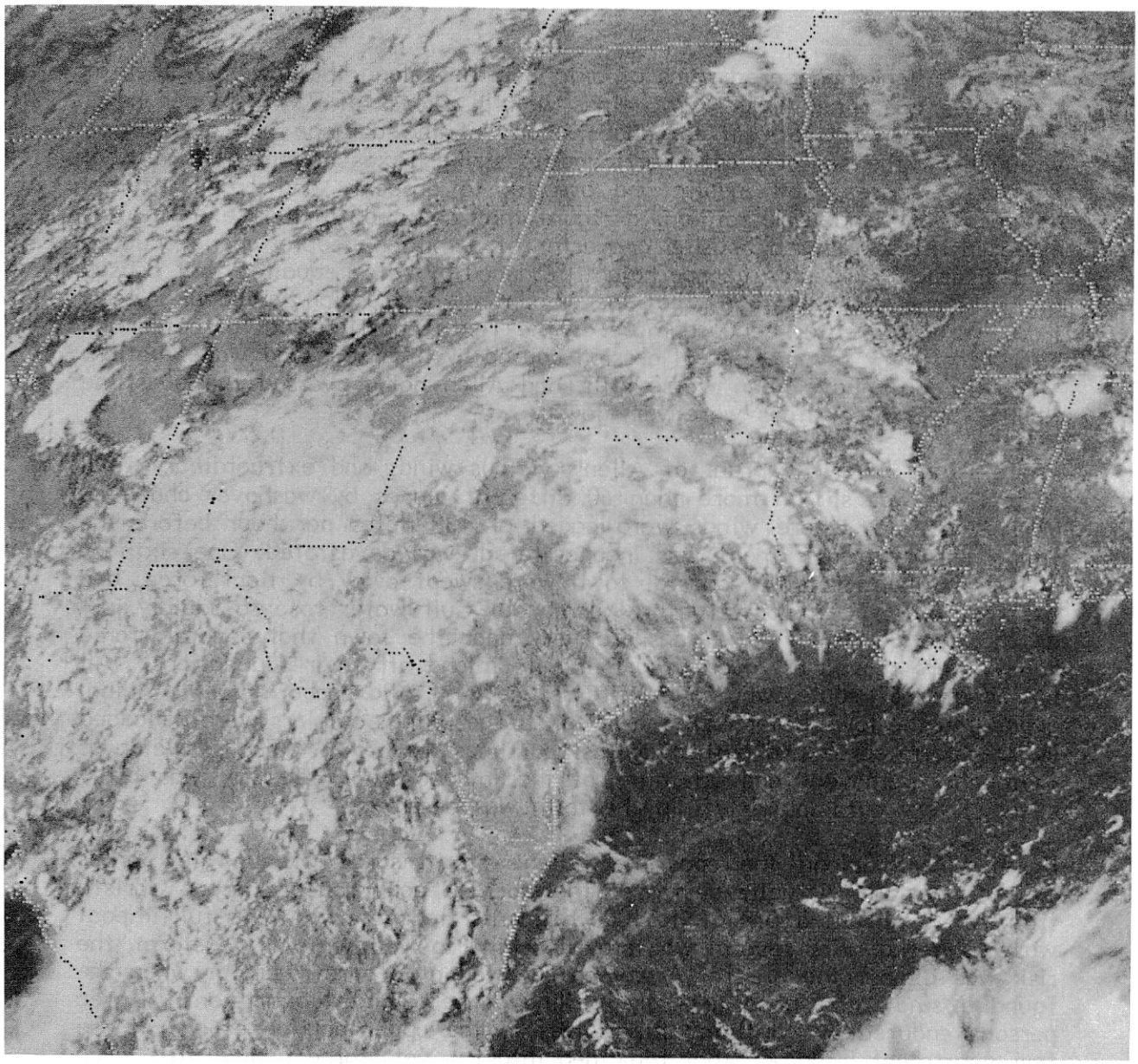


Figure 23j. Widespread cloudiness over much of Texas, as seen in this August 12 mid-afternoon photo, attests to the abundant moisture that lingered in the atmosphere several days after Allen entered The State.

high tides. On the mainland, Port Isabel suffered tidal damage estimated at $25 million.

Although Allen engendered rains of 5 to 8 inches along the lower quarter of the Texas coastline (Figure 24), winds well in excess of 75 miles per hour, and more than a score of tornadoes, much of the damage and destruction wrought by the season's only hurricane to strike Texas stemmed from tidal flooding. Losses, both public and private, to property and crops totalled between $650 and $700 million, a figure that does not include expenditures made in relocating and housing a quarter of a million people who evacuated coastal areas. The storm surge height produced by Allen equalled that caused by Hurricane Beulah in 1967, but the amount of destruction levied by Allen's tides was far greater because more of the Texas coastline was affected and because of very severe coastal erosion caused by high seas and wave motion. The toll could have been worse still, had Allen not traversed the coastline when astronomical tides were very low.

Padre Island bore the brunt of Allen's vicious winds and extraordinary tidal action. It was slit in more than 60 different places by washover channels. Port Mansfield, where winds were gaged at 138 miles per hour before the wind measuring instrument was incapacitated, was devastated. One sixth of all of the homes in the coastal town were swept away by tidal force, and the rest received major structural damage. Gulf water rose so rapidly just as the eye of Allen moved onshore very near the town that several frame houses were moved as much as a half-mile inland off their foundations. All but about 200 people, who found safe refuge in a solid harbormaster building, evacuated the town before Allen arrived. Large pilings of piers were dislodged by the storm surge and pushed against buildings downtown. The seawall was thoroughly removed, and 25 miles of the Intracoastal Waterway was badly silted. Every automobile left in the town was destroyed.

Farther north along the coastline, Allen's storm surge wrecked low areas around bays. It virtually destroyed the North Beach area of Corpus Christi, from which all but a few of its 1000 residents fled before Allen's full impact was registered. For several who stayed behind to weather out the storm, the risk was almost too great. A woman survived atop a refrigerator when she found a small air space near the ceiling of her flooded apartment. Three persons endured by confining themselves to the upper portion of one of the few apartment buildings that remained intact. Yet, three people died when they were swept away by the storm surge. Tidal flooding was the worst for the Corpus Christi area since the hurricane of 1919. Although the center of Allen was over 250 miles away, tidal flooding caused $1 million in damages on Galveston Island; tides of 5 feet rolled into the business district of the town of Kemah, flooding businesses and homes and destroying automobiles that were abandoned when residents fled to safe ground.

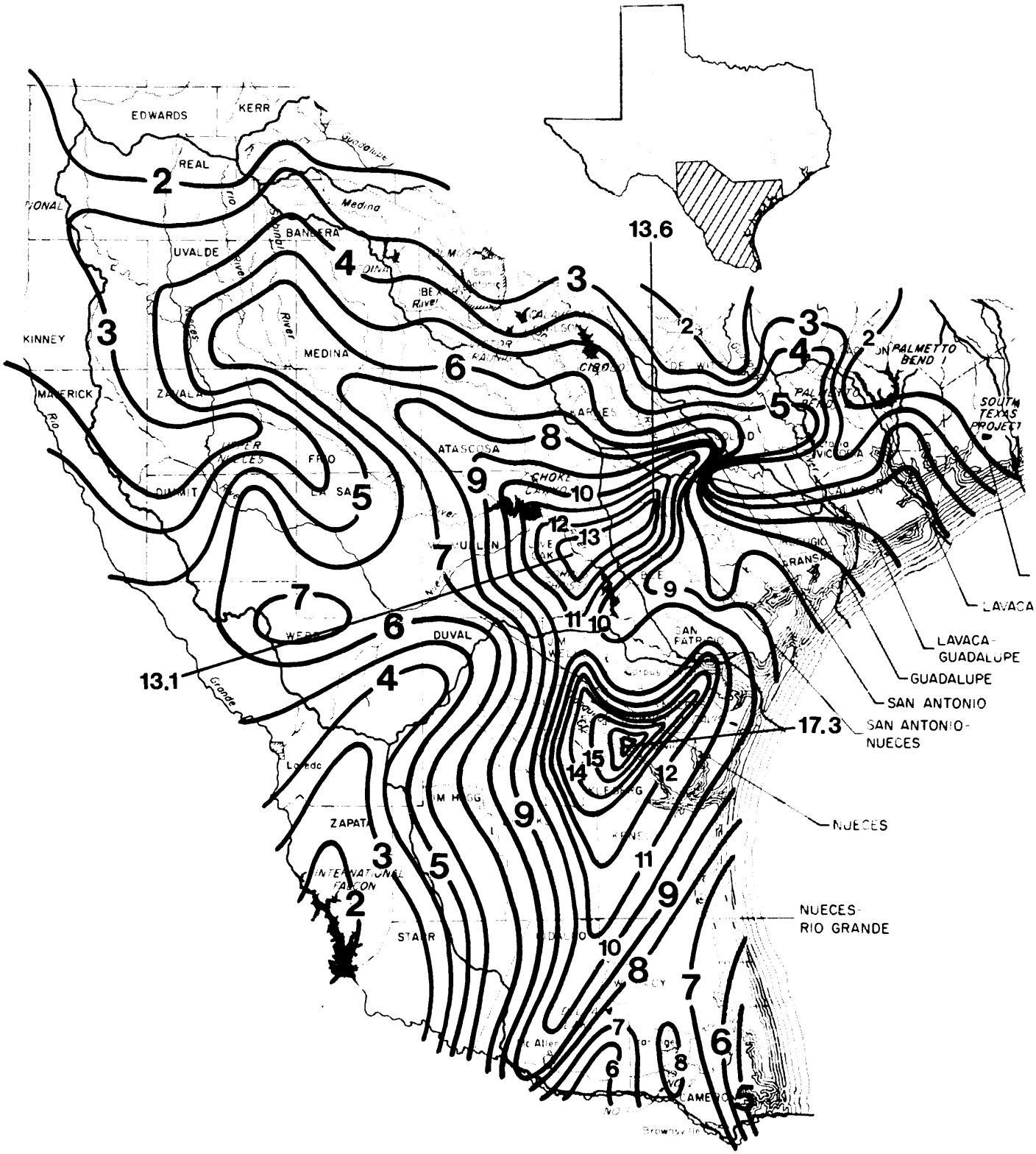


Figure 24. One-week rainfall totals (inches) resulting from Hurricane ALLEN and its remnants, as reported by the cooperative-observer network of the National Weather Service for the period from about 7 a.m. (CDT), August 5 to about 7 a.m. (CDT), August 12, 1980.

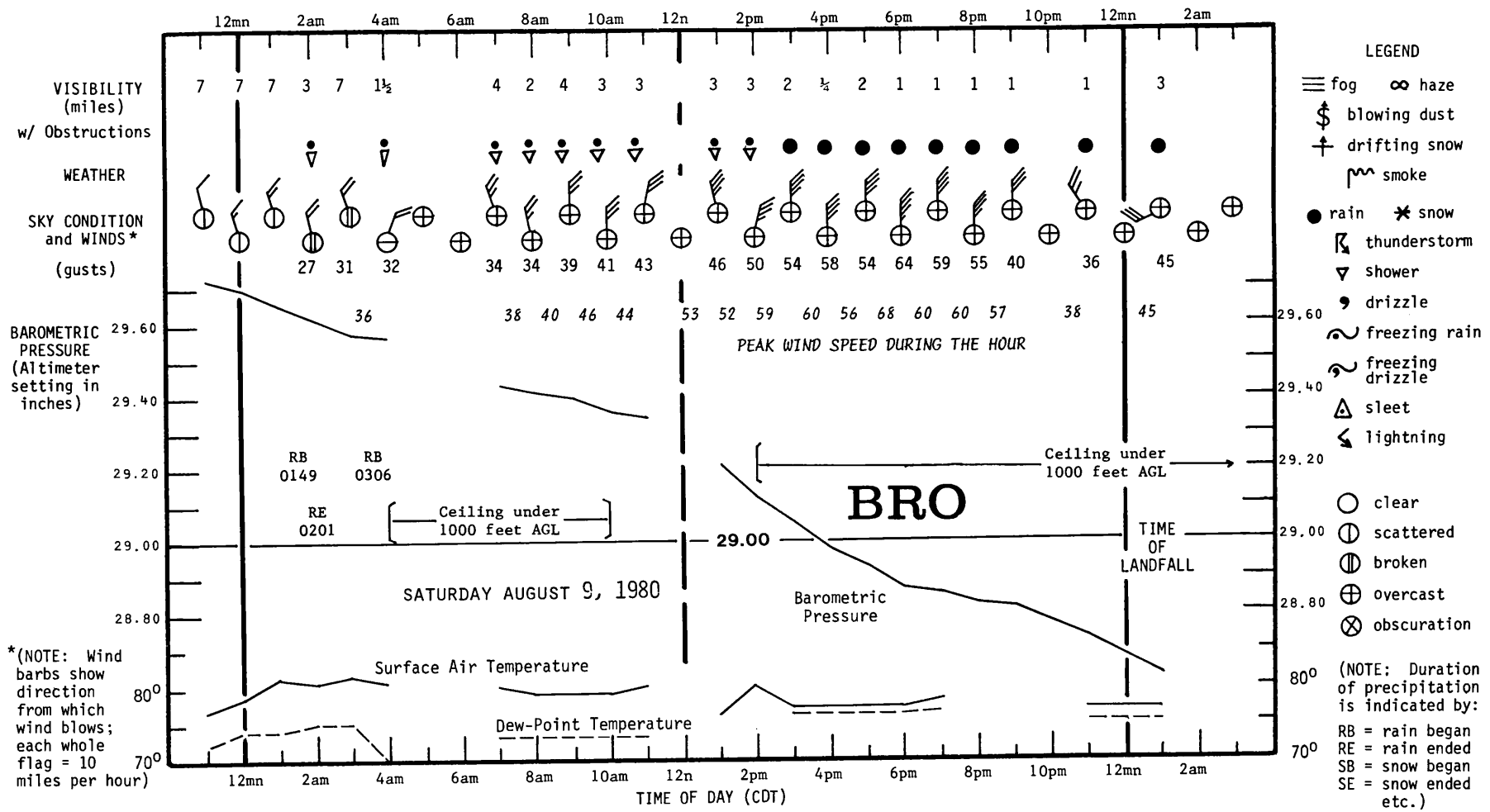


Figure 25. Hourly surface weather conditions at Brownsville (BRO) prior to, during, and following landfall of Hurricane Allen: from 11 p.m. (CDT), August 8 through 8 a.m. (CDT), August 11, 1980.

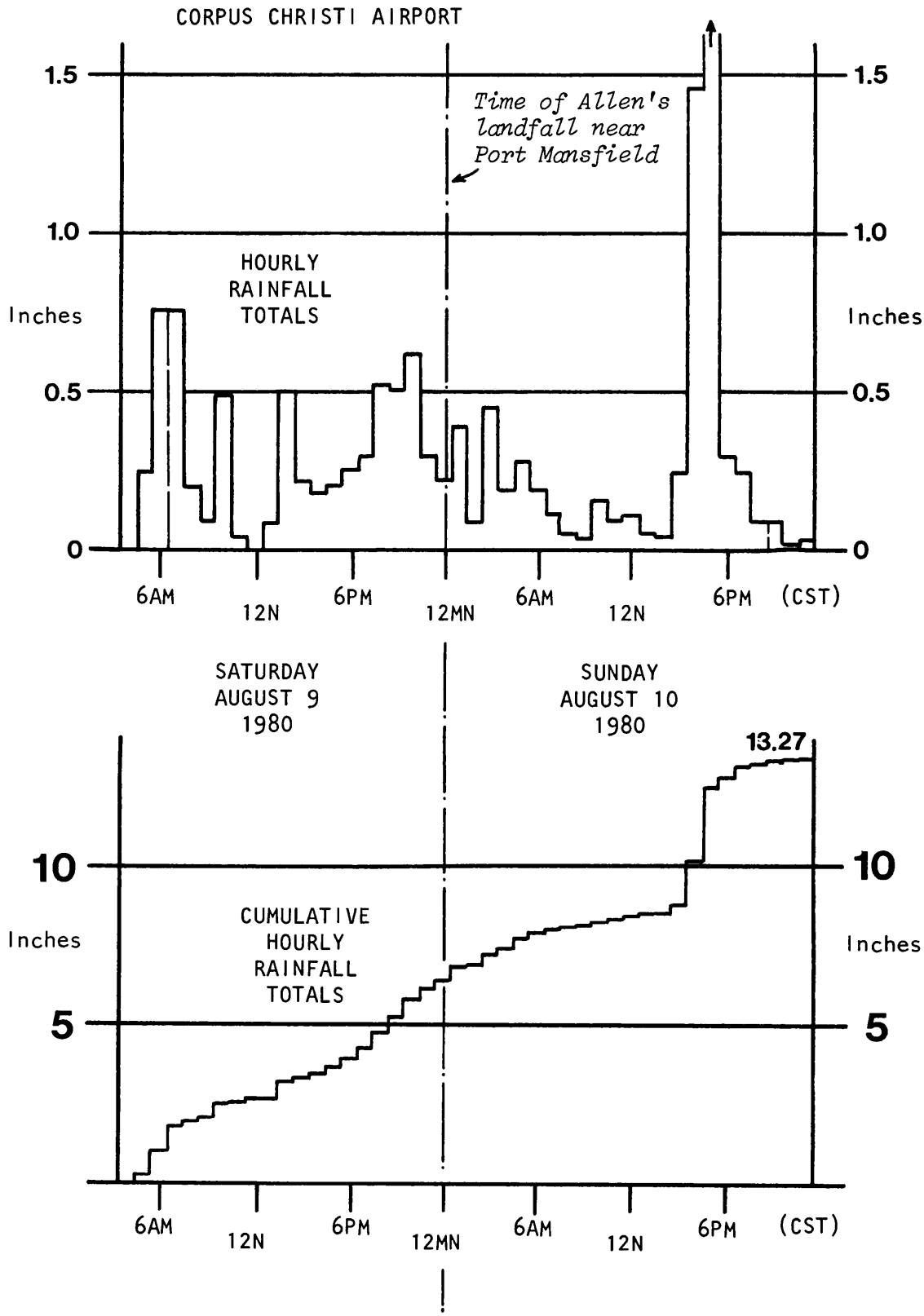


Figure 26. Hourly rainfall and cumulative hourly rainfall amounts (inches) observed at Corpus Christi (International Airport) prior to, at, and following the time of landfall of the center of Hurricane Allen, August 9-10, 1980.

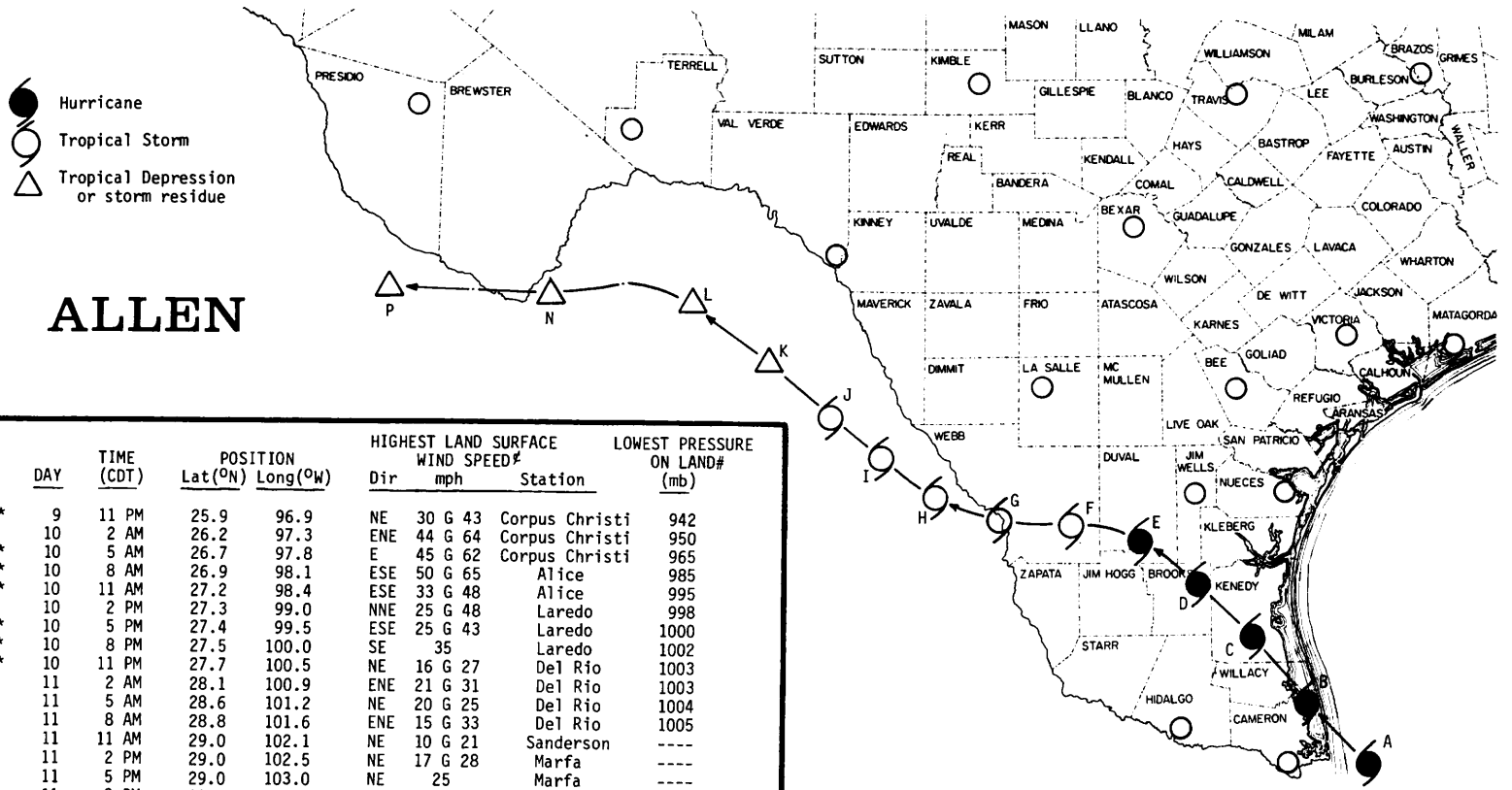
Nearly all of the southern quarter of Texas received at least 5 inches of rain from Allen. In fact, 3-day rainfall totals in excess of 15 inches were collected in parts of Jim Wells and Hidalgo Counties and around Aransas Pass. As Allen's residue trekked west-northwestward across the northern extremity of Mexico and toward the Big Bend area of Texas (Figure 27), rains of 5 inches or better were spilled in parts of the southern Edwards Plateau (Figure 28). Flash floods raged on the Pecos and Devils Rivers, causing some roads to be closed. As late as five days after Allen made landfall, thunderstorms continued to dump heavy rains in the southern Trans Pecos. More than six inches of rain fell in Chisos Basin of the Big Bend National Park (Figure 28), though flash flooding there was insignificant.

Danielle

Tropical Storm Danielle was almost impotent in comparison with Allen. When the season's fourth major Atlantic storm drifted onto land across High Island near dusk on September 5, it fostered sustained winds of only 55-60 miles per hour which caused only light damage in the eastern extremity of the Upper Coast. But Danielle was a noteworthy tropical system in that it dealt out enough torrential downpours to lead to serious flash flooding in a 5-county area of extreme southeastern Texas encompassing the Beaumont-Port Arthur area. Like Allen, Danielle furnished heavy rains for up to 72 hours after it made landfall in areas far inland from the coastline. Danielle was unlike its predecessor in that it lived as a tropical storm only about six hours before landfall, having been borne in the northwestern Gulf of Mexico no more than 125 miles east of the upper Texas coastline. Whereas Allen erased a severe drought in the Trans Pecos with its deluges, Danielle failed to send enough rain into North Central and northern East Texas to dent significantly a moderate to severe drought that gripped those areas.

The fact that the eastern extremity of Texas was exceedingly dry from a severe drought prior to Danielle's arrival helped reduce the extent of flooding that Danielle's 6 to 12-inch rains produced. Nonetheless, with Danielle surging ashore across High Island on the evening of September 5, the area north and east of the point of landfall--or in Jefferson and Orange Counties--suffered serious flooding in the coastal plain. Rainfall of 12 to 16 inches produced floodwaters that damaged about 900 homes, 175 businesses, and hundreds of automobiles at a cost of $3 million. One drowning death occurred when a woman drove her car around a barricade and into a flooded underpass in Beaumont, and an elderly man died of a heart attack while attempts were being made to rescue him from his capsized fishing boat on Lake Sabine.

Danielle's remnants attained even greater infamy when they produced torrential rains of 2-5 inches and more in the Texas Hill Country, the Edwards Plateau,



	DAY	TIME (CDT)	POSITION Lat(°N)	POSITION Long(°W)	HIGHEST LAND SURFACE WIND SPEED¢ Dir	mph	Station	LOWEST PRESSURE ON LAND# (mb)
A*	9	11 PM	25.9	96.9	NE	30 G 43	Corpus Christi	942
B	10	2 AM	26.2	97.3	ENE	44 G 64	Corpus Christi	950
C*	10	5 AM	26.7	97.8	E	45 G 62	Corpus Christi	965
D*	10	8 AM	26.9	98.1	ESE	50 G 65	Alice	985
E*	10	11 AM	27.2	98.4	ESE	33 G 48	Alice	995
F	10	2 PM	27.3	99.0	NNE	25 G 48	Laredo	998
G*	10	5 PM	27.4	99.5	ESE	25 G 43	Laredo	1000
H*	10	8 PM	27.5	100.0	SE	35	Laredo	1002
I*	10	11 PM	27.7	100.5	NE	16 G 27	Del Rio	1003
J	11	2 AM	28.1	100.9	ENE	21 G 31	Del Rio	1003
K	11	5 AM	28.6	101.2	NE	20 G 25	Del Rio	1004
L	11	8 AM	28.8	101.6	ENE	15 G 33	Del Rio	1005
M	11	11 AM	29.0	102.1	NE	10 G 21	Sanderson	----
N	11	2 PM	29.0	102.5	NE	17 G 28	Marfa	----
O	11	5 PM	29.0	103.0	NE	25	Marfa	----
P	11	8 PM	29.0	103.7	SE	13 G 18	El Paso	----

¢ as registered by the network of hourly weather-reporting stations depicted (with circles) on the map
estimated from sea-level pressure reports of the weather network depicted above
* positions obtained from National Weather Service advisories (other positions are estimates by the author using surface weather reports and satellite imagery)

Figure 27. Track of the center of Hurricane Allen and its remnants near and following the time of landfall, August 9-11, 1980.

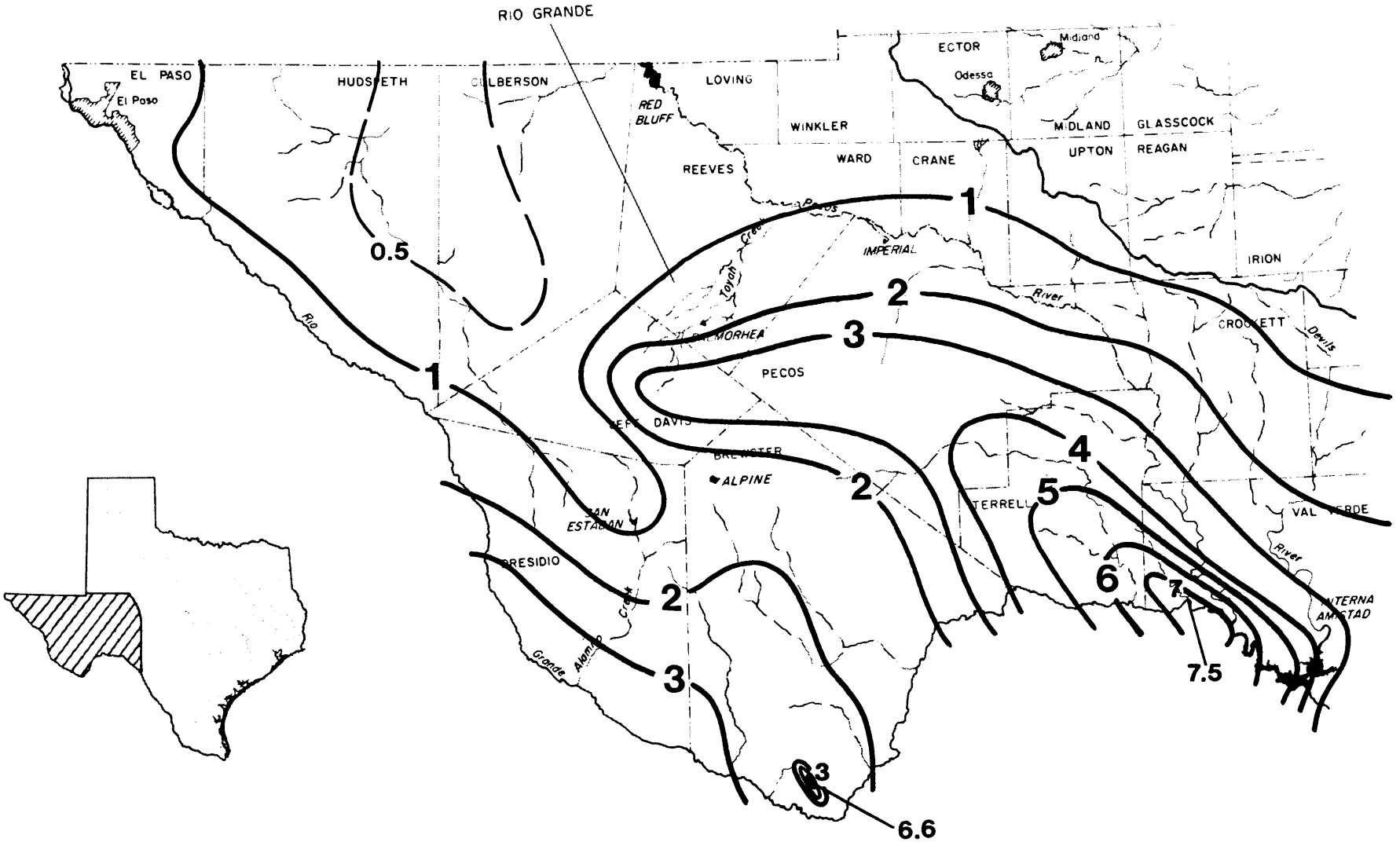
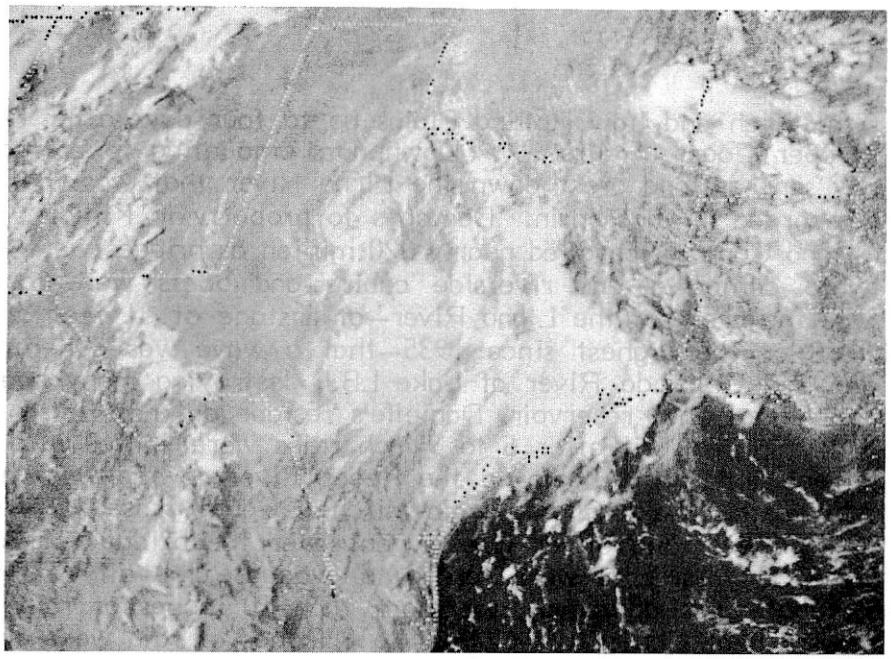
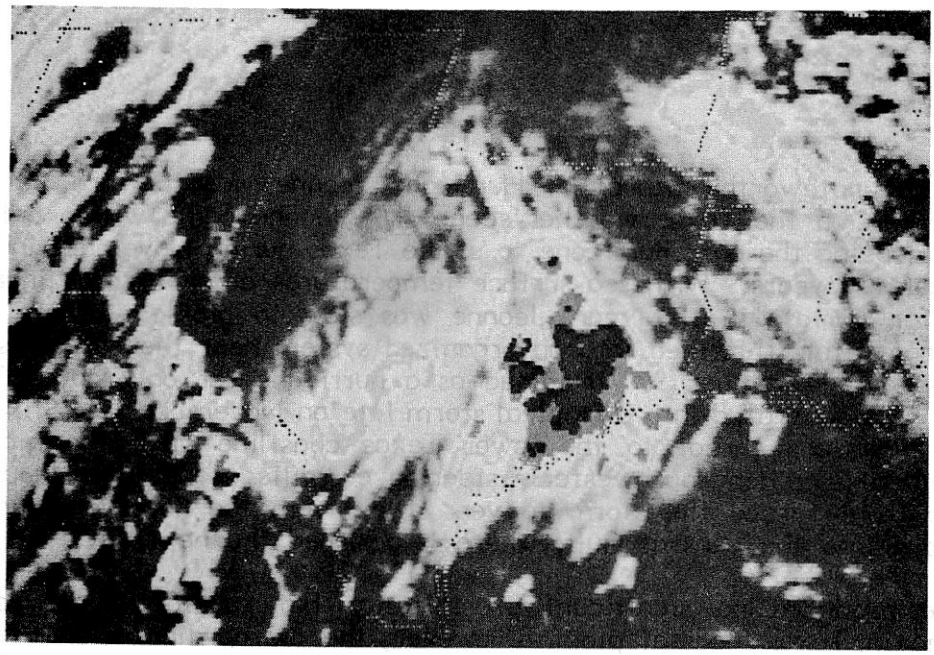


Figure 28. Five-day rainfall totals (inches) produced by the residue of Hurricane ALLEN, as reported by the cooperative-observer network of the National Weather Service for the period from about 7 a.m. (CDT), August 10 to about 7 a.m. (CDT), August 15, 1980.

(a)





(b)

Figure 29. The residue of Tropical Storm Danielle dumped torrential, flash-flooding rains in central and eastern sectors of Texas on September 8-9, 1980. (a) A visible satellite photograph depicts a dense mass of clouds covering most of central Texas on the afternoon of September 8, or just hours after a large portion of rains up to 25 inches in Kimble County caused the second highest flood crest ever on the Llano River. (b) While rainfall had diminished appreciably in the Edwards Plateau by this time, an infrared photograph taken at about the same time reveals very heavy rains (dark spots within white areas) occurring in the Upper Coast near Houston.

and parts of the High and Low Rolling Plains up to four days after Danielle entered the Upper Coast (Figure 30). Downpours amounting to 25 inches in Kimble County sent a flood crest down the Llano River that was the second highest ever recorded in that basin. Damages to property in Kimble, Mason, Menard, and Llano Counties totalled nearly $20 million as bridges were washed out, roads were damaged, and riverside cabins and boats were lost. So pronounced was the crest of the Llano River--at a stage of 31 feet at Llano on September 8 or the highest since 1935--that a wave was generated far downstream on the Colorado River at Lake LBJ, destroying many boats and docks on the banks of that reservoir. Danielle's residue did not finish meting out flash-flooding rains until after 5 to 9-inch rains were spilled in parts of a vast area from near San Angelo to the Pecos River to the west and the Caprock to the north. Lake Champion in Mitchell County rose 19 feet, and for the first time ever Big Silver Creek went over the bridge that crosses that lake. Some 300 residents were forced to evacuate the city of Roscoe, whose water supply was damaged, and more than 10 inches of rain caused severe soil erosion near Garden City. Four to 8 inches of rain were observed as far away as Big Bend National Park.

Jeanne

The most noteworthy aspect of Hurricane Jeanne was its rare, late-season appearance on the Texas weather scene. 1/ Jeanne came within only a few hours of being the only hurricane to strike Texas during November in at least the past 110 years. With sea-surface temperatures at an extraordinarily high level for so late in the year, Jeanne was slow to blossom into a minimal hurricane after it formed into an organized system near the southwestern tip of Cuba on November 9. It lasted as a hurricane for only about 36 hours before it degenerated into a tropical storm late on November 12. Still, Jeanne posed a serious threat to the lower Texas coastline until the morning of November 14, when southwesterly steering currents ahead of an approaching Arctic front forced the storm to veer away from the coast and move back eastward into the central Gulf, where it perished the next day.

Jeanne produced no significant precipitation but substantial environmental damage in Texas' coastal plain. However, the extraordinarily belated storm generated high swells and breakers and above-normal tides that led to severe beach erosion on barrier islands and at numerous points along the coastline. Since Allen had eliminated many of the protective dunes three months earlier, Jeanne's tidal action caused more serious flooding than would have occurred

1/ Amazingly, yet another Atlantic hurricane--named Karl--developed more than two weeks later, but it remained far at sea and lived only about 5 days.

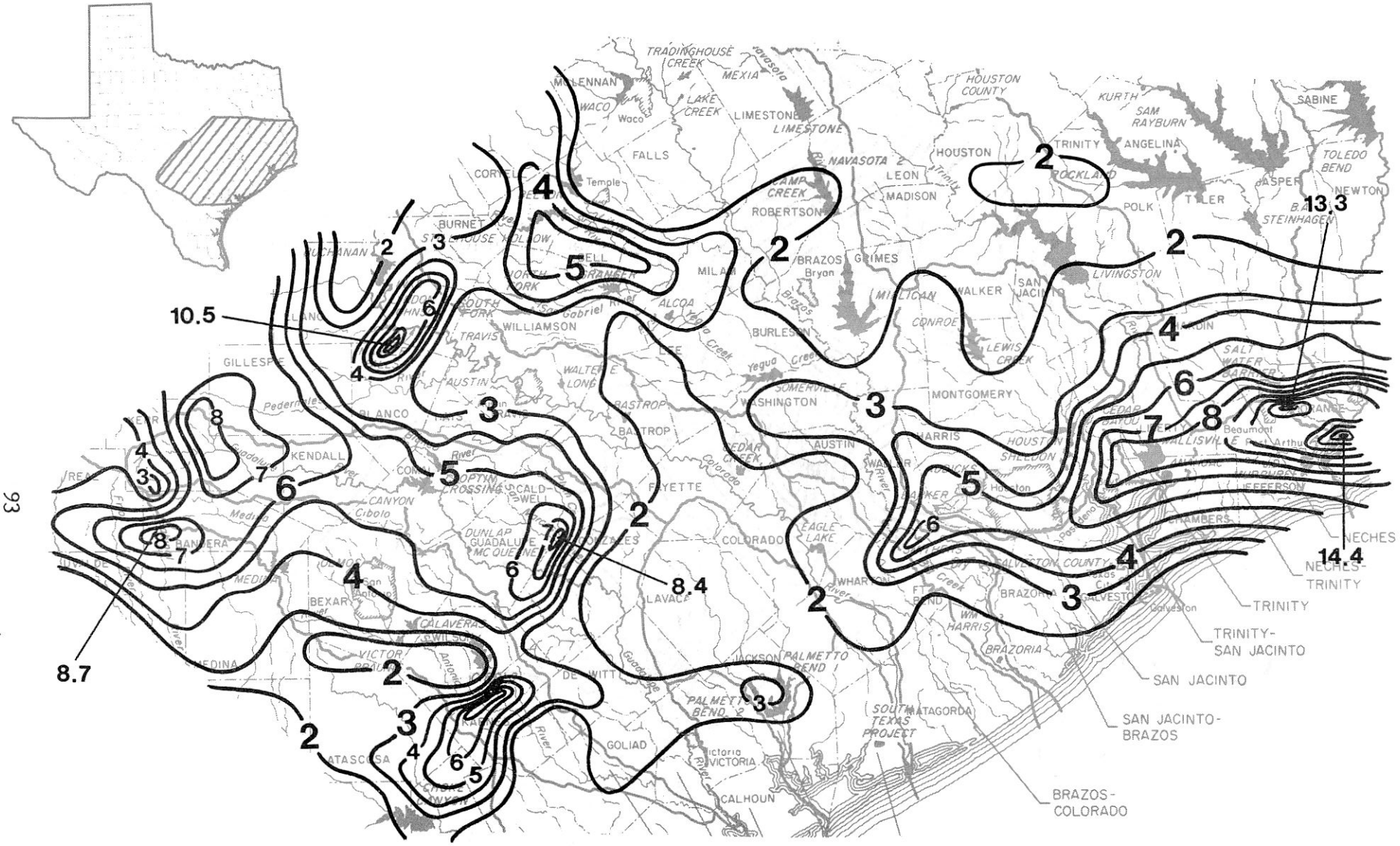


Figure 30. Five-day rainfall totals (inches) produced by Tropical Storm Danielle and its remnants, as detected by the cooperative-observer network of the National Weather Service during the period beginning about 7 a.m. (CDT), September 5 and ending about 7 a.m. (CDT), September 10, 1980.

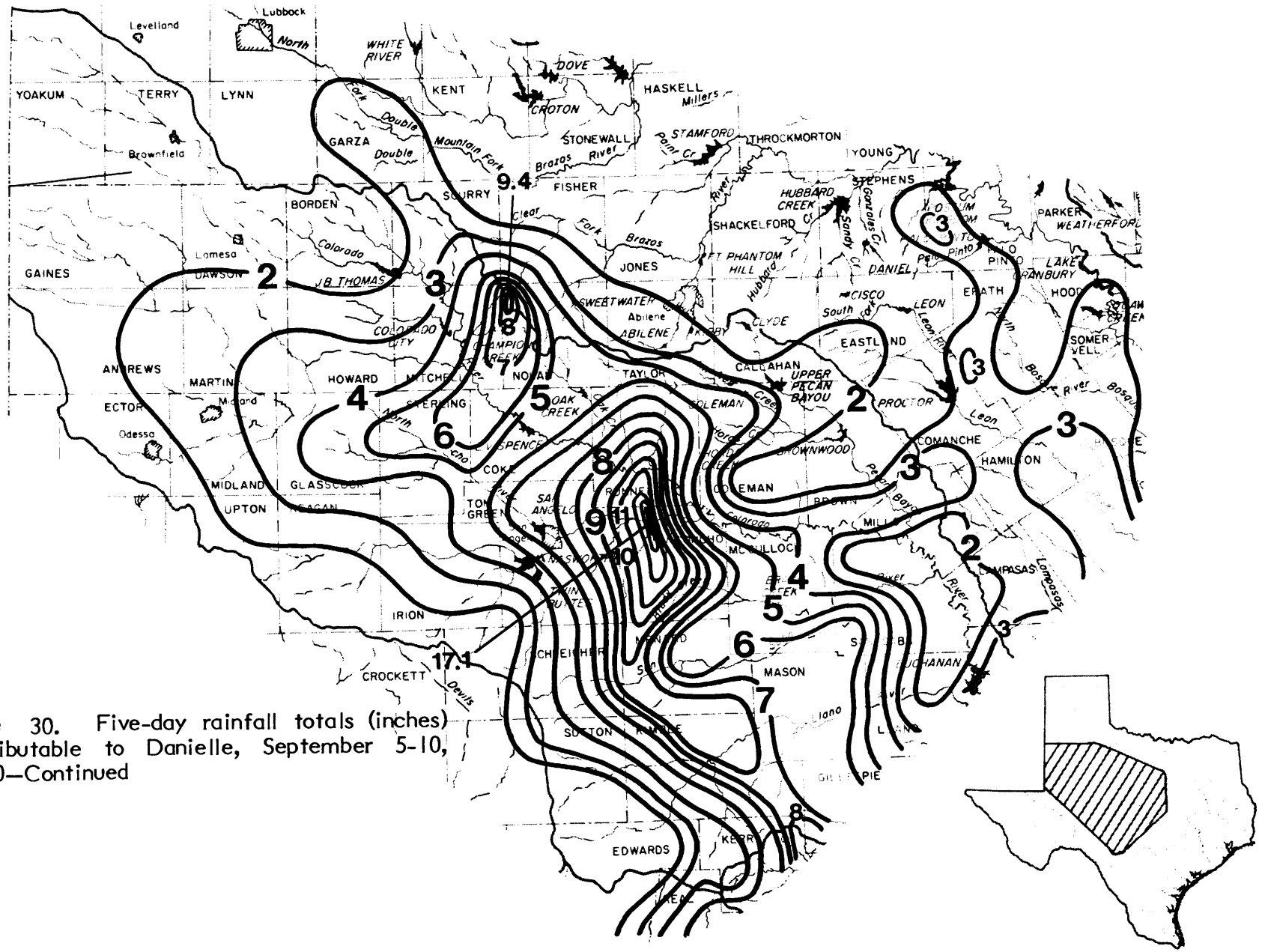


Figure 30. Five-day rainfall totals (inches) attributable to Danielle, September 5-10, 1980—Continued

otherwise. Several highways on South Padre Island were overwashed, while high tides forced residents of the communities of Surfside and Quintana in Brazoria County to evacuate their beachfront neighborhoods. Damage to homes was minimal, for the structures were elevated, but numerous automobiles sustained damage from saltwater flooding. Serious beach erosion resulted from tides 3 1/2 feet above normal on Galveston Island.

From the eastern North Pacific

Although the northeastern Pacific Ocean furnished an unusually large number of typhoons and tropical storms during the Summer and Autumn of 1981, none of them had a discernible effect on Texas weather.1/ All but one of the season's 14 major storms formed, drifted northwesterly, and died far at sea without affecting mainland Mexico. Tropical Storm Newton, the last of the season's 14 major storms in the eastern Pacific and one of nine tropical storms, behaved unlike its contemporaries in that it drifted northeastward toward mainland Mexico after forming in the warm water of the Pacific not far from the southwestern Mexican coastline. Even though Newton lost its identity as a tropical storm on October 29 while about 100 miles at sea, the storm's residue drifted inland near Mazatlan (Figure 31), and ultimately spread a band of high-altitude cirriform clouds within sight of the Big Bend area and Lower Valley of Texas.

1/ The names of the eastern Pacific's hurricanes/tropical storms during 1980, with dates of occurrence, are: Agatha (June 9-15), Blas (June 16-19), Celia (June 25-30), Darby (July 1-3), Estelle (July 12-13), Frank (July 18-22), Georgette (July 28-31), Howard (July 31-August 7), Isis (August 5-11), Javier (August 22-29), Kay (September 16-30), Lester (September 21-25), Madeline (October 11-12), and Newton (October 28-29).

	DAY	TIME (CST)	POSITION Lat(°N)	Long(°W)	WIND SPEED Max(kts)	MOVEMENT Dir	kts	GALES# n mi
A	27	9 PM	16.2	110.1	30 G 40	345	11	--
B¢	27	12 MN	17.0	109.8	35 G 45	010	12	40
C	28	6 AM	17.2	109.7	35 G 45	010	6	40
D	28	12 N	17.5	110.6	35 G 45	340	6	40
E	28	6 PM	19.0	118.4	35 G 45	035	9	40
F*	28	12 MN	19.8	107.9	30 G 40	040	9	--
G	29	6 AM	20.9	107.4				
H	30	6 AM	23.0	106.9				
I	31	6 AM	24.6	108.6				

NOTE: Positions A-F based on National Weather Service bulletins; positions G-I derived by the author using satellite and surface data

This is the distance that gale-force winds (28-47 knots) extend from the center of the storm system.

¢ The depression was upgraded to a tropical storm.

* The tropical storm was downgraded to a depression.

Figure 31. Track of the center of Tropical Storm Newton, October 27-31, 1980 (based on National Weather Service reports).

LOCAL SEVERE-STORM PHENOMENA

Although the historic heat wave that gripped Texas for several months in the Summer disallowed all but a few local severe storms, there was plenty of turbulence during the Spring and again during Autumn to categorize 1980 as a year of characteristic commotion. Tornadoes were as plentiful as usual, but only one caused death to humanity, and even in that lone instance in early April, the number of fatalities was limited to one. Several more people died from lightning and flash flooding, but the year was not without a few incidents of human heroics in which unfortunate victims were saved. Hail was a typical menace often in 1980 and pelted the ground in shapes and sizes from peas to saucers. Even the wind frequently tormented the citizenry, raising on one occasion in late March a massive duststorm that sandblasted much of western Texas.

Tornadoes

Unlike its immediate predecessor, a year always to be remembered for the mammoth tornado that killed 42 people in Wichita Falls, the year 1980 was without any major catastrophes attributable to tornadoes. That is not to say that the year was one of the more serene of the past several decades. Quite to the contrary, 1980 was somewhat more active than the typical year in that it furnished a total of 151 tornadoes, or about 20 percent more than usual, that were observed and reported by the National Weather Service. In spite of this abundance of "twisters," the number of fatalities resulting from them totalled only one, and the number of casualties amounted to only one-quarter of the normal annual injury toll. If 1980 was typical in any sense, it was in the number of "tornado days." At least one tornado was observed, on the average, on one out of every seven days, a rate coinciding precisely with that of a "normal" year. The year was noteworthy too in that a sizeable number of tornadoes came in the late Summer as a result of the invasion of the year's only hurricane to affect Texas.

More than half of the year's sum of tornadoes occurred during the late Spring and early Summer, or the months of April, May, and June (Table 7), a feature that is not at all uncommon. The fact that a total of 34 tornadoes--or about one-fifth of the year's total--came during August is not surprising either, for most of that number stemmed from the invasion of a hurricane, a phenomenon that often generates numerous tornadoes. Almost one out of every four twisters observed in Texas in 1980 hit in that portion of northern Texas containing the famed "tornado alley." On the other hand, no tornadoes were seen at anytime in the year in the semi-arid Trans Pecos region.

Table 7. Number of tornadoes, tornado days, and tornado-related casualties observed in Texas' ten climatic regions in 1980.

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
HIGH PLAINS													
Tornadoes		1	2	3	16	9	2		3				36
Tornado Days		1	1	2	4	5	2		1				16
Injuries					2	1	1						4
LOW ROLLING PLAINS													
Tornadoes			3	4	7							1	15
Tornado Days			1	2	4							1	8
Injuries				2	6								8
NORTH CENTRAL													
Tornadoes		1		10	10	2		1		2			26
Tornado Days		1		2	5	1		1		1			11
Injuries				5		1							6
EAST													
Tornadoes			2	7	2	2		2		2			17
Tornado Days			2	2	1	1		2		1			9
Injuries								1					1
TRANS PECOS													
Tornadoes													
Tornado Days													
Injuries													
EDWARDS PLATEAU													
Tornadoes				1	2	1							4
Tornado Days				1	2	1							4
Injuries													
SOUTH CENTRAL													
Tornadoes				1	2			22					25
Tornado Days				1	2			4					7
Injuries				2	1			29					32
UPPER COAST													
Tornadoes					1	7		2		7		1	18
Tornado Days					1	4		2		4		1	12
Injuries													
SOUTHERN/LOWER													
Tornadoes					4			7					11
Tornado Days					2			2					4
Injuries								1					1

Source: "Storm Data," U. S. Department of Commerce.

The year's only killer tornado cut a path across parts of four counties encompassing the Capital City on April 7, taking one life, injuring five others and exacting a toll in property damage of more than $2.5 million. A 51-year-old man living in Round Rock was killed when the tornado, seen by numerous persons for 10 or 15 minutes, struck his 2-story home in the middle of town. Tornadoes occurred as early as February 7, with the year's first reported near Dimmitt in the High Plains (Table 8). That twister, preceded by an outbreak of sleet and followed by a two to 3-inch snowfall, uprooted two 30-foot evergreen trees, removed a chicken house from its foundation, and caused the walls of a grain-storage tank to collapse inward in Castro County. The year's last tornado struck at Spur (in Dickens County of the Low Rolling Plains) on December 7, damaging several buildings and downing power lines. Fifty four persons, some of whom narrowly escaped death, were injured during the year by tornadoes. When a tornado struck a warehouse in Dimmitt (High Plains) on July 27, a watchman sustained cuts and a broken nose while jumping into a pickup truck, whereupon he was narrowly missed by a piece of 2' X 4' plank that was driven through the top of the vehicle into the floor of the cab. That same tornado drove a piece of 4" pipe 2 1/2 feet into concrete pavement. More than half of the year's tornado-associated injuries stemmed from the barrage of 29 tornadoes that accompanied Hurricane Allen on August 9-11.

The largest outbreak of tornadoes during 1980 was associated with the invasion and gradual demise of Hurricane Allen. Twenty-nine twisters were identified on the periphery of Allen's circulation center during August 9-11. The number is far from the record of tornadoes produced by Hurricane Buelah in 1967, but many of Allen's tornadoes were especially significant because of their strength, longevity, and movement through several heavily-populated areas of South Central Texas. The most injurious of the whole outbreak of tornadoes hit San Marcos and other communities along a 47-mile-long path that ended near Blanco. The twister caused 20 injuries and $18 million worth in damages, $15 million of which occurred in San Marcos. The most destructive of the bunch, however, was the tornado that touched down in the northeastern sector of Austin earlier the same afternoon. By exacting a toll of $50 million in damages to property, it was one of the most destructive hurricane-related tornadoes in Texas' weather history. Another noteworthy tornado outbreak, but not associated with a tropical cyclone, hit hard the southern portion of the Texas Panhandle on May 28. One of the seven tornadoes produced by a single "supercell" thunderstorm inflicted $1 million in damages in the center of Tulia, while a second twister lifted a pickup truck and virtually overturned it near Nazareth, injuring the driver. Likely the most destructive waterspout of the year struck a shrimp boat in San Antonio Bay on May 8. The tornado over water ripped off the cabin from the vessel, then overturned and sank the craft. Two of the three crew members were injured but rescued, while the third was never found.

Table 8. Tornadoes of significance in Texas in 1980.

Significance	Location	Date	Time (LST)	Deaths	Injuries	Path	
						Length (mi)	Width (ft)
First observed tornado of 1980	Southeastern Parmer County	February 7	6-7:30 p.m.	0	0	-	-
First tornado causing significant destruction	Southeastern Parmer	February 7	6-7:30 p.m.	0	0	-	-
First tornado causing injury	Northwestern Parker County	April 2	3:15 p.m.	0	1	3 1/2	725
First large outbreak (9)	Northern North Central Texas	April 2	12:10-4:30 p.m.	0	3	-	-
First killer tornado	Round Rock	April 7	4:48 p.m.	1	5	25	1200
Most destructive ($50 million)	Austin	August 10	1:40 p.m.	0	4	3 1/2	450
Day with greatest number (19)	Southern half of Texas	August 10	7:30 p.m.	0	27	-	-
Last large outbreak	Southern half of Texas	August 9-11	3:45 p.m. 12:30 a.m.	0	30	-	-
Last tornado causing injury	Near Palestine	October 16	8:00 a.m.	0	1	2	150
Last tornado causing major destruction	San Marcos	August 10	4:02-5:00 p.m.	0	20	47	600
Last observed tornado of 1980	Spur (Dickens County)	December 7	5:59 p.m.	0	0	5	90

Source: "Storm Data," U. S. Department of Commerce

Lightning

Nearly a score of people were hit by lightning during the year. Four of the six deaths that stemmed from lightning strikes occurred in May (Table 9), or during the peak period of thunderstorm activity in Texas. A consideration of the ways by which the six deaths took place serves as a reminder of the places and activities that should be avoided when turbulent weather is in progress. An 11-year-old youth died shortly after being hit by lightning on the evening of May 20 while she sat in a swing underneath a tree at her home in Keller (North Central). On May 8 a late-morning thunderstorm generated a lightning flash that felled a guard standing within a metal observation tower at Laredo and then, a half hour later, produced a second bolt that struck and killed a man as he was opening a metal gate near a mining site in Duval County. One week later lightning entered the home of a man living in the community of Cut-and-Shoot (in Montgomery County of the Upper Coast) and killed him as he watched

Table 9. Number of fatalities and injuries resulting from local severe storm phenomena in 1980.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TORNADOES													
Number		2	7	26	44	21	2	34	10	5		1	151
Days		2	3	5	12	9	2	8	5	3		1	49
Deaths				1									1
Injuries				10	8	2	1	31	1	1			54
HAILSTORMS													
Deaths													0
Injuries				5	5								10
LIGHTNING													
Deaths					4				1	1			6
Injuries		1			4	2			4	1			12
WINDSTORMS													
Deaths								1					1
Injuries				1	15	2	1	4				1	24

Source: "Storm Data," U. S. Department of Commerce

television. The man's wife was injured as the electrical charge, which entered through the television, leaped across the floor to where the couple was sitting. Then in October a young man was struck dead by lightning as he and a companion, who was injured by the same bolt, were working on a deer blind in a meadow in Caldwell County (South Central).

Twice as many victims survived as died from being hit by lightning. A young woman was hit in the head by a lightning flash as she walked at midday from her home near Tomball (Upper Coast) to a roadside mailbox; though she was discovered shortly thereafter to be in critical condition, cardio-pulmonary resuscitation administered by rescuers revived her. Lightning also started numerous fires, at least one of which led to the death of a person overcome by smoke inhalation. A bolt struck a restaurant in downtown Houston on May 16, and the ensuing fire not only destroyed the building but took the life of an employee. An uncommonly early lightning event occurred on January 22, when a bolt caused $5000 worth of damage to the water tower in Keene (in Johnson County of North Central Texas). Numerous incidences were reported of lightning hitting and consuming the contents of oil storage tanks and barns filled with hay.

Wind and Duststorms

Very blustery springtime winds raged as usual across the vast expanses of western Texas on several occasions. The most notable duststorm beleagured the High and Low Rolling Plains and northern Trans Pecos all day long on March 31, causing minor damage and considerable inconvenience, especially to motorists. Winds of near hurricane-force battered El Paso, while the visibility at Lubbock plunged to near zero for a few hours from dust-filled winds clocked at 60 miles per hour (Figure 32). The sandblasting effect of the harsh, dusty winds damaged winter wheat in the Panhandle. In much of the High Plains, glass in buildings was shattered, the roofs of carports were ripped off, trees were uprooted, and power lines were downed by the ferocious, unrelenting winds. A second major windstorm pounded the Texas Panhandle one week later, damaging roofs, trees, and outbuildings, and blowing over signs in places such as Perryton, Pampa, Childress, and Miami.

Potent, dust-filled wind on a different scale--in the form of dust devils—caused minor damage at a few locations scattered around the State during 1980. One interesting instance of damage wrought by a dust devil--a common phenomenon in Texas in Summer that seldom causes harm--occurred in Starr County on June 17: On a cloudless and very hot day with very little wind, a massive dust devil, producing a loud, deep roar, struck an auto repair shop in the Falcon Heights community, removing the doors, roof, and windows of the facility.

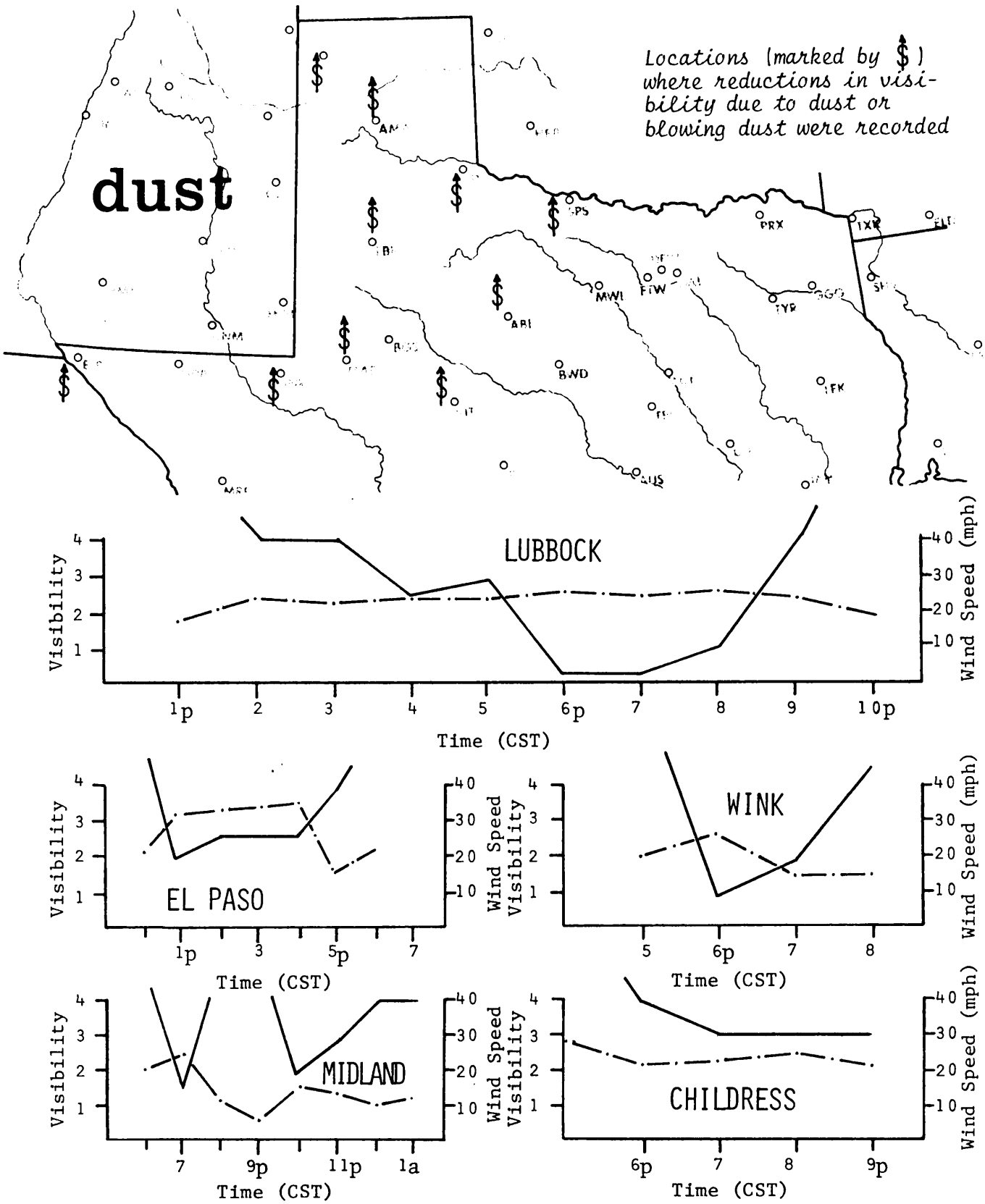


Figure 32. Visibilities (miles) and sustained wind speeds (miles per hour) at selected points in northwestern Texas during the duststorm of March 31, 1980. (Visibilities at hourly intervals are denoted by solid lines, and wind speeds by dashed-dotted lines.)

Hailstorms

Hail--a scourge to hundreds of farmers every Spring and Summer--pelted virtually every sector of Texas at least once in 1980. The most costly hailstorm of the year ravaged parts of Tarrant County on April 2, when a late-afternoon thunderstorm unleashed a barrage of hail the size of baseballs that caused property damage estimated at $60 million. The fury of the storm was felt especially in the Wedgwood area of Fort Worth, where damage to autos and roofs of homes was exceedingly extensive. At times the hailstorms were as large as softballs and grapefruits. One of them broke the hand of a woman leaving a shopping mall. As in every year, hailstorms were most prevalent in the High Plains. The same "supercell" thunderstorm that fomented seven tornadoes in the southern Panhandle on May 28 also unleashed a torrent of hail that pulverized the center of Castro County. Hail the size of marbles and golfballs--but with some stones as big as cantaloupes--battered Dimmitt, where $3 million in damage was done to automobiles and another $2 million to homes. On the same day near Miami, huge hailstones struck autos traveling on U. S. Highway 70 with such impact that numerous windshields were shattered! Perhaps the most unrelenting outbreak of hail tormented parts of Knox County (Low Rolling Plains) on May 25, an event hailed by long-time residents as the worst they had ever encountered. Hail up to the size of baseballs pounded some areas around Munday for periods lasting as long as 2 1/2 hours!

Likely the most unsightly hailstones of the year fell in northern Travis County (South Central) on April 7. The stones were reported by residents to be as big as "dinner plates," not round but flat, and they fell with such force as to sever the limbs from trees just as a power saw would do. Hail that fell for almost an hour in a strip of land near Dumas (High Plains) on August 21 covered the ground, forming a sheet of ice about two inches thick. One of the most inordinately large accumulations of hailstones was observed in the southern section of Arlington (North Central) on May 1, when hail drifts were observed to have heights of 18 to 24 inches. Hail piled up one to two feet high at Perryton (High Plains) on April 23 and as much as one foot deep in Carrollton (North Central) on April 24 and at Fargo in Wilbarger County (Low Rolling Plains) on the next day.

Flash Floods

Aside from the torrential rains generated in parts of Texas by Hurricane Allen and Tropical Storms Danielle and Jeanne, flash-flooding deluges produced by extratropical weather events struck from the Panhandle to East Texas at various other times of the year. Gigantic thunderstorms dumped 7 to 10 inches in and around Olney (Low Rolling Plains) on May 27, and the floodwaters

that ensued damaged up to 60 homes, the community hospital, the high school, and several businesses. The assessed damage due to the excessive rains amounted to $2.3 million. Just two weeks after heavy rains were produced by Danielle, torrents of rain lasting six days and produced by a slow-moving cool front led to extensive flooding in Fisher, Mitchell, Nolan, and Scurry Counties of west central Texas. Scores of homes were damaged, streets were inundated by high water, crops were damaged, and soil was eroded extensively. Damages in the 4-county area totalled just over $2.2 million. Rainfall of 6 to more than 11 inches caused heavy road damage and railroad washouts on April 11-12 in parts of Shelby and Panola Counties of East Texas. On May 27 a severe thunderstorm dealt, along with baseball-size hail, very excessive rains amounting in some places to 10 inches in Sherman and Moore Counties of the Texas Panhandle; raging floodwaters washed out part of Palo Duro Creek and nearly drowned a man driving a pick-up truck that was washed down South Palo Duro Creek. The driver escaped by kicking out the window of the vehicle.

Flash floods cost several people their lives, while others survived only after dramatic rescue attempts were successful. When tornado sirens were sounded in Wichita Falls early on the afternoon of April 2, several families sought refuge by getting into drainage ditches. That action led to the deaths of a woman and her infant granddaughter when flash floodwaters suddenly poured down the drainage canal in which they hovered. An 11-year-old Waco girl lost her life while attempting to foard a creek that had just flooded, while a companion preserved her life by clinging to tree branches. Probably the year's most courageous rescue took place one night in June near the town of Happy in Swisher County (High Plains), where a woman and her son riding in their auto were swept off the roadway by rising water produced by heavy, nightlong rains. Once they extricated themselves from the vehicle, they were carried downstream where, on several occasions, they secured mom ·tary refuge by clinging to fences and posts. When they eventually almost to safe ground, the mother, weak from recent surgery, was once more swept back into the raging water. Her son swam to her and pulled her back to safety. The ordeal for the pair had lasted seven hours! Almost as incredulous was the rescue by firemen of two brothers who got too close to a swollen drainage canal in San Antonio on May 13. After both boys had been swept into the swift current of water, they were carried through an underground drainage pipe for 1 1/2 miles before they were hauled to safety!

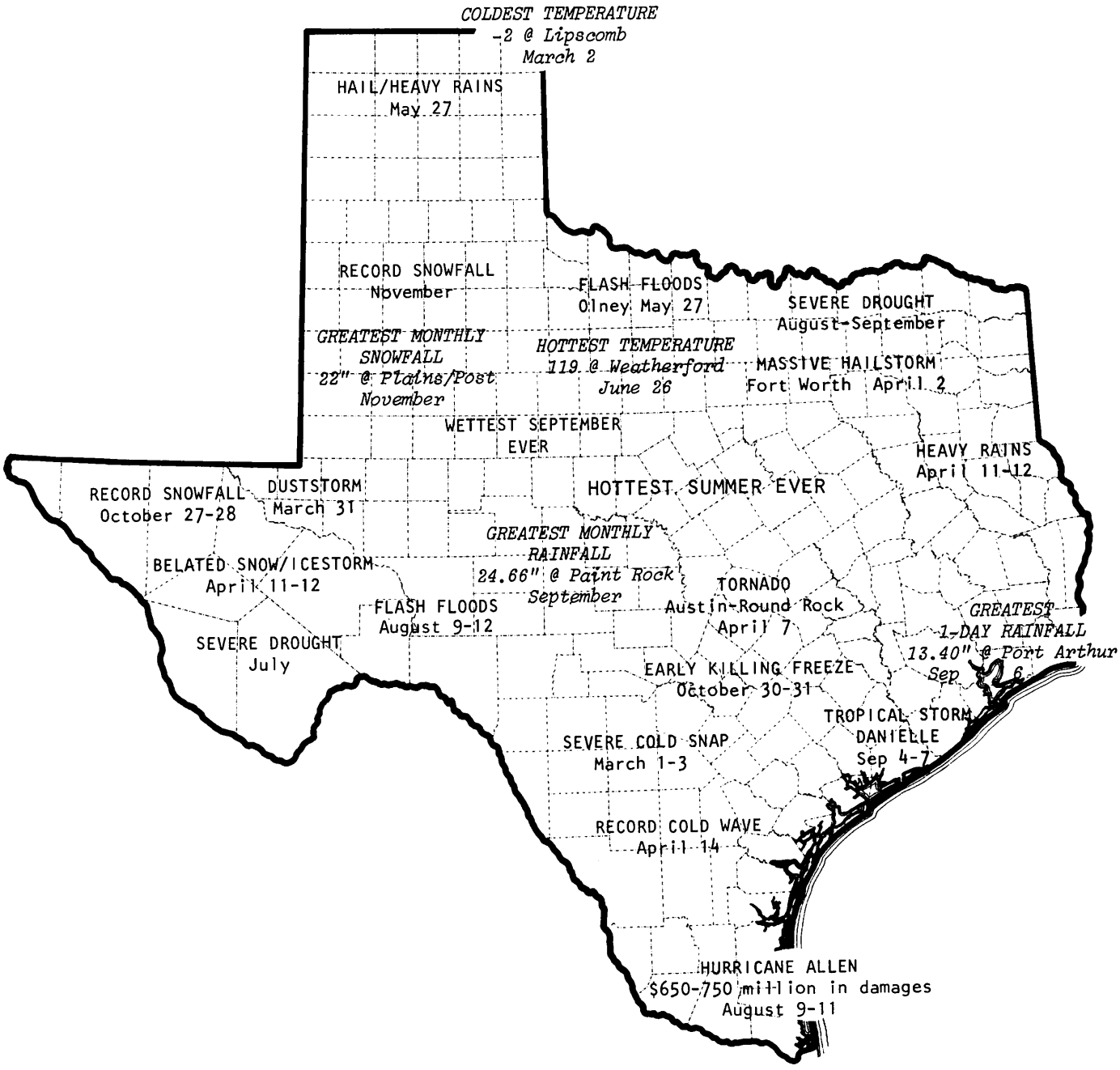
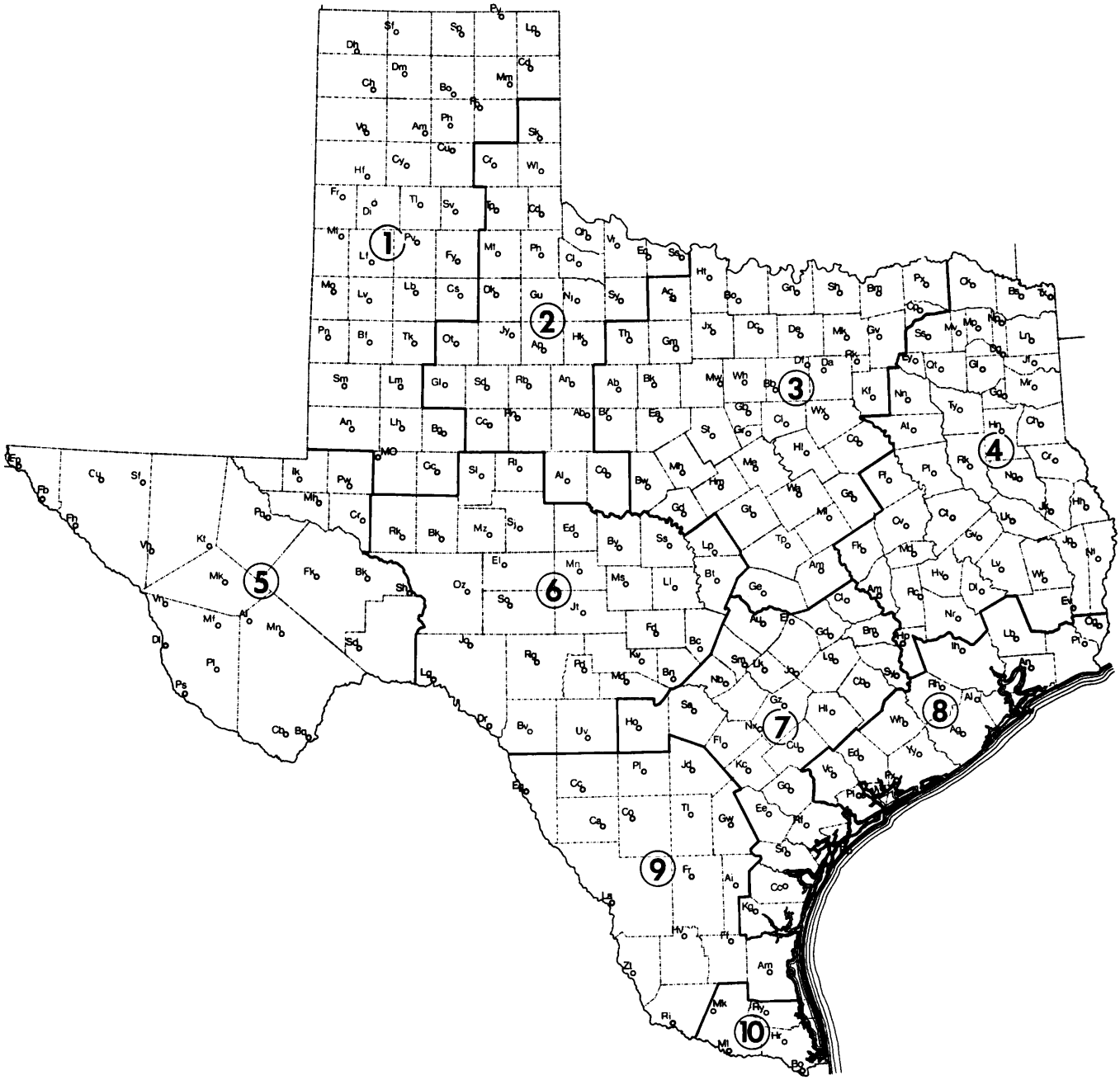


Figure 33. Highlights and statistics on Texas weather during 1980.

APPENDIX

A display and tabulation of stations whose data were analyzed to determine monthly precipitation on a Statewide basis


1
2
3
4
5
6
7
8
9
10

1 HIGH PLAINS

Am Amarillo
An Andrews
Bf Brownfield
Bg Big Spring
Bo Borger
Cd Canadian
Ch Channing
Cs Crosbyton
Cu Claude
Cy Canyon
Dh Dalhart
Di Dimmitt
Dm Dumas
Fr Friona
Fy Floydada
Gc Garden City
Hf Hereford
Lb Lubbock
Lf Littlefield
Lh Lenorah
Lm Lamesa
Lp Lipscomb
Lv Levelland
Ml Muleshoe
Mm Miami
Mo Morton
MO Midland-Odessa
Ph Panhandle
Pn Plains
Pp Pampa
Pv Plainview
Py Perryton
Sf Stratford
Sm Seminole
Sp Spearman
Sv Silverton
Tl Tulia
Tk Tahoka
Vg Vega

2 LOW ROLLING PLAINS

Ab Abilene
Al Ballinger
An Anson
Ap Aspermont
Cc Lake Colorado City
Cd Childress
Cl Crowell
Co Coleman
Cr Clarendon
Dk Dickens
Ec Electra
Gl Gail
Gu Guthrie
Hk Haskell
Jy Jayton
Mt Matador
Nj Benjamin
Ot Post
Ph Paducah
Qh Quanah
Rb Roby
Ro Roscoe
Sd Snyder
Sk Shamrock
Ss Wichita Falls
Sy Seymour
Tp Tampico
Vr Vernon
Wl Wellington

3 NORTH CENTRAL

Ab Albany
Ac Archer City
Am Cameron
Bb Benbrook Dam
Bk Breckenridge
Bm Bonham
Bo Bowie
Br Baird
Bw Brownwood
Cl Cleburne
Co Corsicana
Cp Cooper
Da Dallas
Dc Decatur
De Denton
Df Dallas-Fort Worth
Ea Eastland
Gb Granbury
Gd Goldthwaite
Ge Georgetown
Gm Graham
Gn Gainesville
Gr Glen Rose
Gs Groesbeck
Gt Gatesville
Gv Greenville
Hl Hillsboro
Hm Hamilton
Ht Henrietta
Jx Jacksboro
Kf Kaufman
Me Meridian State Park
Mh Comanche
Mk McKinney
Ml Marlin
Mw Mineral Wells
Px Paris
Rk Rockwall
Sh Sherman
St Stephenville
Th Throckmorton
Tp Temple
Wa Waco
Wh Weatherford
Wx Waxahachie

4 EAST

Am College Station
At Athens
Bs New Boston
Ch Carthage
Ck Clarksville
Cr Center
Ct Crockett
Cv Centerville
Dg Daingerfield
Dl Coldspring
Ev Evadale
Ey Emory
Ff Fairfield
Fk Franklin
Gg Longview
Gl Gilmer
Gv Groveton
Hh Hemphill
Hn Henderson
Hp Hempstead
Hv Huntsville
Jf Jefferson
Jk Jackson Hill
Jp Jasper
Lk Lufkin
Ln Linden
Lv Livingston
Md Madisonville
Mp Mount Pleasant
Mr Marshall
Mv Mount Vernon
Ng Nacogdoches
Nn Canton
Np Naples
Nr Conroe
Nt Newton
Pl Palestine
Qt Quitman
Rc Richards
Rk Rusk
Ss Sulphur Springs
Tx Texarkana
Ty Tyler
Wr Warren

5 TRANS-PECOS

Al Alpine
Bk Bakersfield
Bq Boquillas
Cb Chisos Basin
Cr Crane
Cu Cornudas
Dl Candelaria
Ep El Paso
Fb Fabens
Fh Fort Hancock
Fk Fort Stockton
Ik Wink
Kt Kent
Mf Marfa
Mh Monahans
Mk Mount Locke
Mn Marathon
Pl Plata
Pq Pecos
Ps Presidio
Pw Penwell
Sd Sanderson
Sf Salt Flat
Sh Sheffield
Vh Van Horn
Vn Valentine

6 EDWARDS PLATEAU

Bc Blanco
Bk Big Lake
Bn Boerne
Bt Burnet
Bv Brackettville
By Brady
Dr Del Rio
Ed Eden
El Eldorado
Fd Fredericksburg
Jt Junction
Jo Juno
Kv Kerrville

Lg Langtry
Ll Llano
Lp Lampasas
Md Medina
Mn Menard
Ms Mason
Mz Mertzon
Oz Ozona
Pd Prade Ranch
Rg Rocksprings
Rk Rankin
Rl Robert Lee
Sj San Angelo
Sl Sterling City
So Sonora
Ss San Saba
Uv Uvalde

7 SOUTH CENTRAL

Au Austin
Bm Brenham
Cb Columbus
Cc Corpus Christi
Cl Caldwell
Cu Cuero
Ee Beeville
El Elgin
Fl Floresville
Gd Giddings
Go Goliad
Gz Conzales
Hl Hallettsville
Ho Hondo
Jo Jeddo
Kc Karnes City
Kg Kingsville
Lg La Grange
Lk Lockhart
Nb New Braunfels
Nx Nixon
Rf Refugio
Rp Rockport
Sa San Antonio
Sm San Marcos
Sn Sinton
Sy Sealy

8 UPPER COAST

Ag Angleton
Al Alvin
An Anahuac
Ed Edna
Gv Galveston
Ih Houston
Lb Liberty
Og Orange
Pl Port Lavaca
Pt Port Arthur
Px Palacios
Rh Richmond
Vc Victoria
Wh Wharton
Yy Bay City

9 SOUTHERN

Al Alice
Am Armstrong
Ca Catarina
Cc Crystal City
Co Cotulla
Eg Eagle Pass
Ff Falfurrias
Fr Freer
Gw George West
Hv Hebronville
Jd Jourdanton
La Laredo
Pl Pearsall
Ri Rio Grande City
Tl Tilden
Zt Zapata

10 LOWER VALLEY

Bo Brownsville
Hr Harlingen
Mk McCook
Ml McAllen
Ry Raymondville