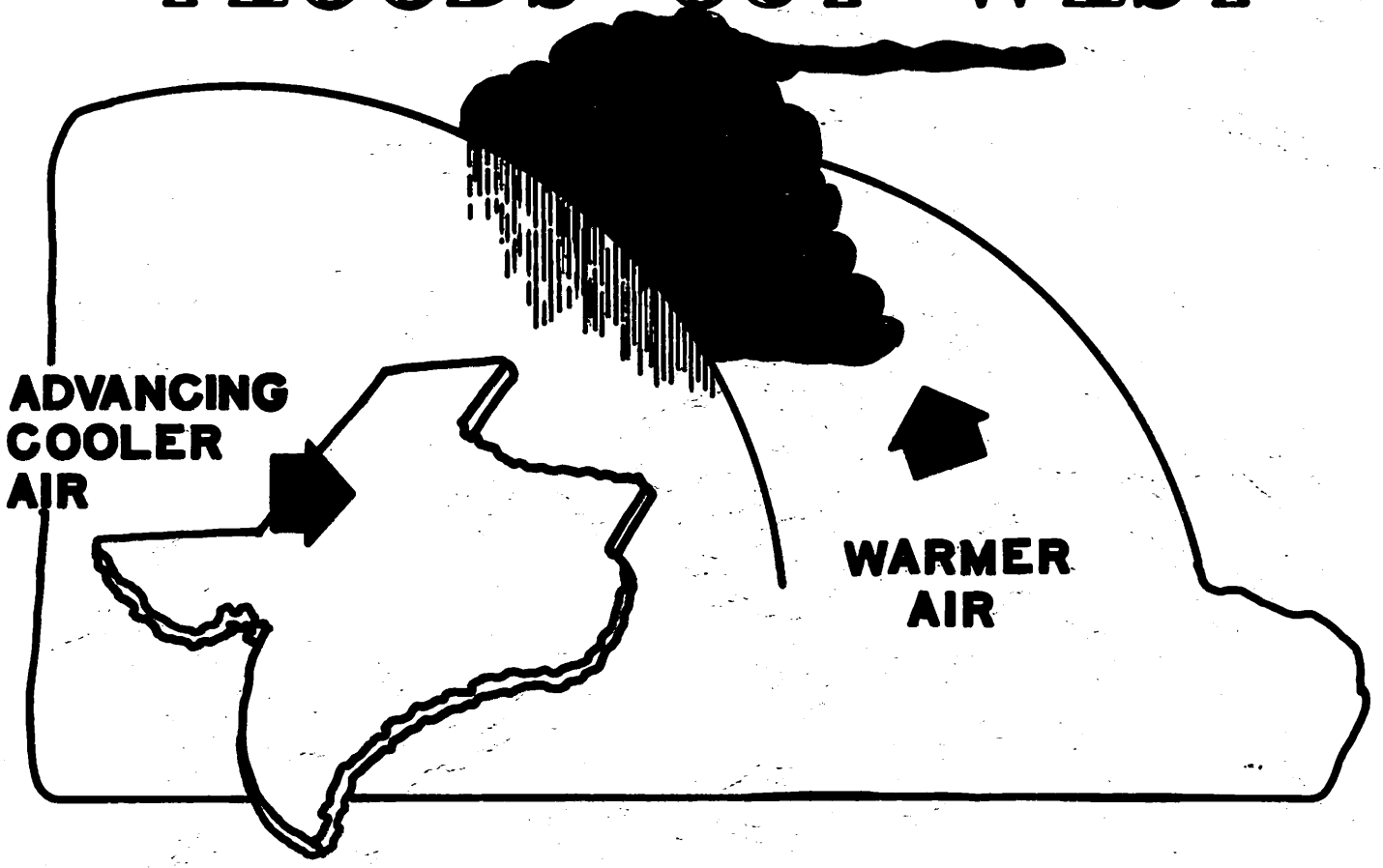
1978:

DROUGHT IN THE EAST FLOODS OUT WEST



A CHRONOLOGICAL REVIEW OF HIGHLIGHTS OF TEXAS WEATHER DURING THE YEAR

LP-89

TEXAS DEPARTMENT OF WATER RESOURCES

1978:

DROUGHT IN THE EAST--FLOODS OUT WEST

Written and prepared by

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Texas Department of Water Resources

January 1979

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The Rio Grande swelled to the highest levels in 74 years in late September when unusually heavy rains from Tropical Storm Paul struck Texas' Trans-Pecos region and Mexico's Rio Conchos Valley. (Above) Upstream near Heath Canyon, where the river peaked at over 30 feet; extensive lowland flooding occurred all along the Rio Grande from the Presidio Valley to Amistad Reservoir. (Below) The Presidio Valley inundated by the second-highest flood level of the Rio Grande in recorded history; a railroad bridge was washed away, and more than 7000 acres of farmland were damaged.

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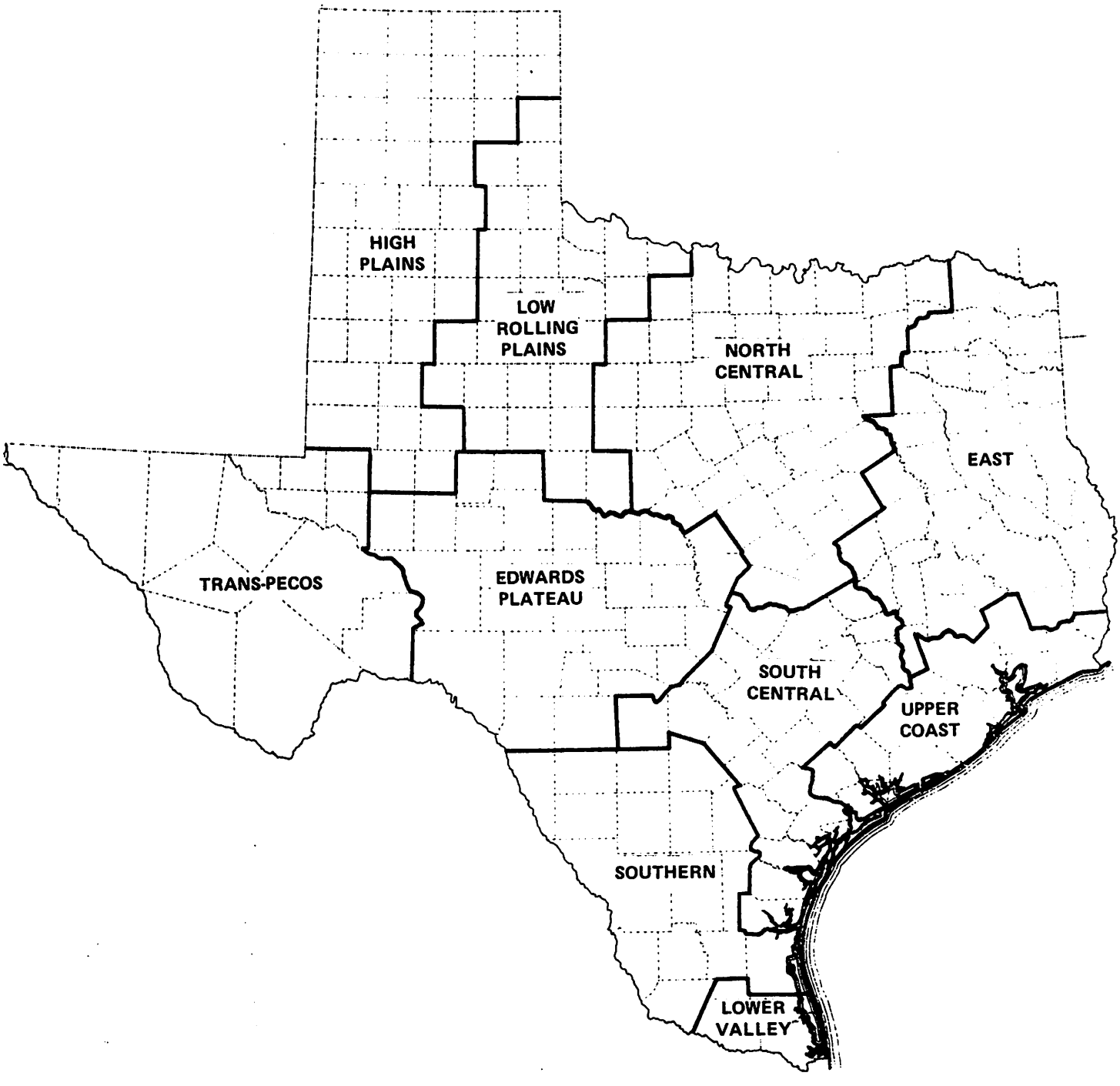

The ten climatic regions of Texas.

Texas' weather is frequently recognized for its everchanging nature. Sudden and drastic changes in the State's weather in virtually every month of any year lend support to the popular adage that "if anyone is dissatisfied with the current state of the weather, just wait around a short while and it will change." As in most every other year, 1978 contained at least its share of sharp variations in the weather pattern. But the year is distinguished more for the large number of occurrences of rare weather extremes. A severe drought in the normally verdant northeastern corner of the State and excessive rains that caused numerous floods in the western half of the State are two of many unusual features of the weather pattern that marks 1978 as one of the most bizarre years weatherwise of this century.

Many Texas residents, especially those in the central third of the State, surely will never forget the impact of Tropical Storm Amelia. The storm's remnants had more of an effect on the lives of a sizable segment of the State's populace than any other single weather event of 1978. In fact, the 25 deaths and property losses in the hundreds of millions of dollars attributable to Amelia rank the storm in the same category as the great rainstorm of September 1921.*

Although Amelia's flash-flooding rains serve as the most prominent highlight of the Texas weather scene during 1978, numerous other highly unusual weather events garnered a considerable amount of attention:

- The most severe drought since the infamous extreme drought of the 1950's that gripped northern North Central and East Texas for almost all of the year;

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*Regarded by many climatologists as probably the greatest rainstorm in Texas history, the residue of a hurricane that struck the eastern Mexican coast in early September 1921 dumped torrential rains on a 5-county area of central Texas, killing 215, causing property losses of over $19 million, and providing the town of Thrall with 36 inches of rain in an 18-hour period--the greatest rainfall amount ever recorded in the United States.

- The most severe flooding along the Upper Rio Grande since 1904, caused in part by near-record rains in the Trans-Pecos region of the State;

- The coldest weather ever observed in parts of Texas during the year's first two months, when temperatures averaged as much as 13 degrees below normal in some areas;

- One of the longest and most intense summer heat spells of the 20th century, which sent temperatures over 100 degrees for a 3-week period in July and contributed, according to medical authorities, to 24 deaths in the Dallas-Fort Worth area;

- The snowiest winter in Texas weather annals in northern North Central and East Texas, where five snowstorms in January and February gave the area 2-month totals of 10 to 30 inches of snow;

- An extraordinarily late snowstorm that left up to one foot of snow in early May in the Panhandle portion of the High Plains; and

- The absence of disastrous tornadoes, although well over 100 "twisters" were sighted by Texans during the year.

RAINFALL

The year 1978 was noticeably drier-than-usual in nearly two-thirds of the State (Figure 1). Significantly lesser rainfall than normal was common in practically all of North Central and East Texas and the Low Rolling Plains, while sizeable portions of the High Plains, Edwards Plateau, South Central Texas, and the Upper Coast also experienced appreciable rainfall deficits. The driest weather statewide extended from the eastern Upper Coast region into East Texas, where annual totals were barely two-thirds of normal. In these sections total amounts for the year ranged from 30 to 40 inches (Figure 2). Though Beaumont-Port Arthur's total of 34.78 inches would be plenty for the needs of most Texans, the year was the driest there in 14 years and the second driest since the drought of the 1950's.

Most areas within 150 miles of the Rio Grande fared much better. In fact, the Trans Pecos witnessed 1978 as one of the wettest years of this century. In many areas of that westernmost region, annual rainfall totals were more than double the usual yearly amounts. The 15 to 25 inches of rain collected in many localities was the most in any year since 1941. The northern and southern thirds of the High Plains also received greater-than-usual rainfall, although not to the degree as in the Trans-Pecos. Most of South Central and Southern Texas, as well as the Lower Valley, had a slightly wetter-than-usual year. A sizeable portion of the Edwards Plateau, and very small parts of North Central and East Texas, also sustained slight rainfall surpluses.

The winter (January-March) of 1978 was exceptionally dry in most of Texas' ten climatic regions. Monthly rainfall totals less than half of the usual amounts were common during each month at numerous observation points. March was the driest month of the year for many Texas cities (Table 1).

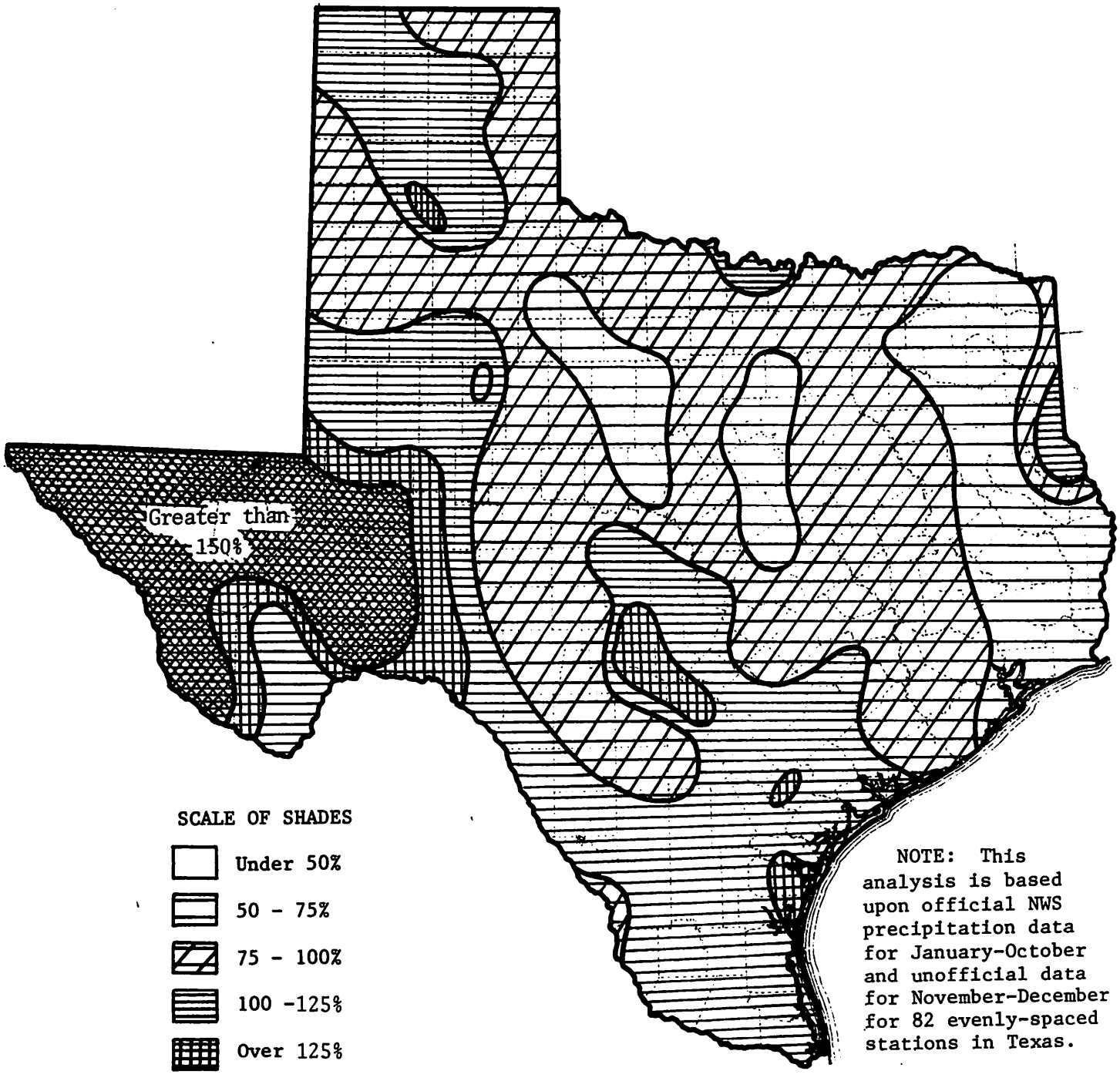


Figure 1. Total precipitation in 1978 expressed as a percentage of the normal annual amount.

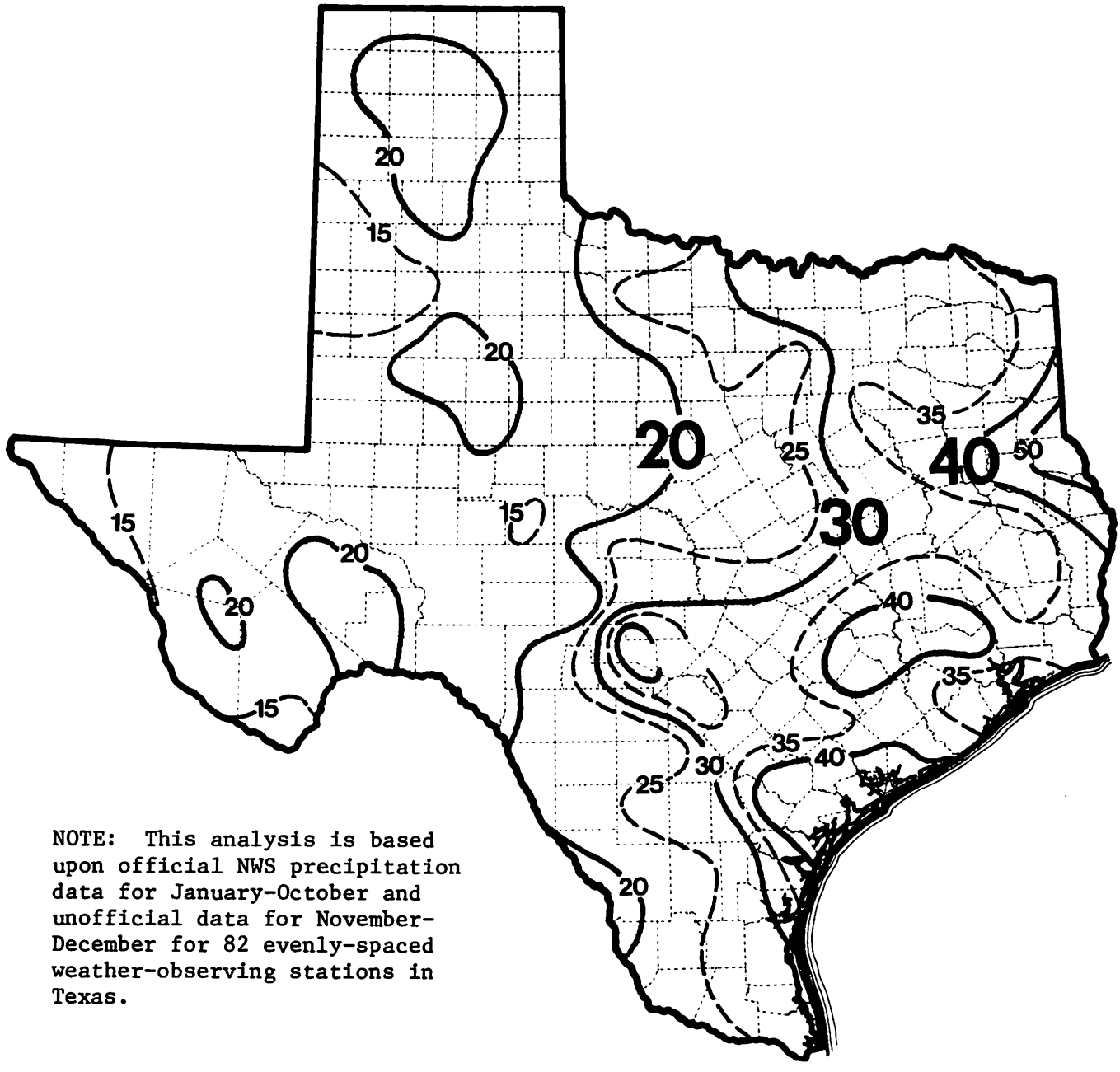


Figure 2. Total precipitation (in inches) in 1978.

Table 1. Precipitation totals (in inches) for selected Texas cities.

Metropolitan Areas	Total for 1978		Monthly Extremes			
	Amount	Percent of Normal	Driest Month	Driest Amount	Wettest Month	Wettest Amount
Abilene	18.28	77	Mar	0.17	Aug	6.70
Amarillo	22.01	108	Mar	0.21	Jun	6.50
Austin	30.97	95	Mar	0.84	May	5.78
Beaumont-Port Arthur	37.68	68	Oct	Trace	Jun	7.47
Bryan-College Station	31.76	81	Jul	0.53	Nov	6.15
Brownsville	26.88	107	May	Trace	Sep	8.28
Corpus Christi	39.14	137	Mar	0.03	Jun	12.04
Dallas-Fort Worth	24.37	75	Jul	0.33	May	8.01
Del Rio	19.26	114	Jan	0.07	May	3.46
El Paso	12.57	161	Apr	0.00	Sep	4.14
Galveston	29.23	69	May	Trace	Jan	8.88
Houston	44.93	93	Oct	0.05	Jun	9.37
Lubbock	13.70	74	Jul	0.15	Sep	3.29
Midland-Odessa	17.29	127	Mar	Trace	Sep	5.02
San Angelo	14.67	83	Dec	0.25	Aug	2.93
San Antonio	35.80	129	Oct	0.55	Sep	8.86
Victoria	43.08	125	Mar	0.54	Sep	19.05
Waco	23.77	76	Jul	0.26	Nov	4.57
Wichita Falls	23.57	86	Jul	0.27	Aug	4.16

Exceptions to this were an unusually wet January in the Upper Coast region, where monthly totals were double the amounts typical for that month. Galveston's total of 8.11 inches was the most in January in 34 years in that coastal city.

Spring (April-June) began on an ominous note for many Texans plagued by a persistent and worsening drought. While April typically signals the beginning of the "wet" season for many parts of the State, 1978's first full month of Spring elapsed as one of the driest in several decades. Beaumont-Port Arthur measured only 0.36 inch--or less than one-tenth of the usual amount--during April, making the month the second driest April since record-keeping was begun there 67 years ago; Houston's total of 0.57 inch was the least in April in that city since 1937. Areas to the north fared no better; Wichita Falls witnessed the driest April since 1933, while Dallas-Fort Worth received the least rainfall for any April in the past 30 years.

May brought substantial rains to most sections; in fact, too much rain fell too quickly in parts of the High and Low Rolling Plains regions, where 4 to 10 inches were common measurements. A 10-inch rain in 90 minutes sent a 12-foot wall of water surging through scenic Palo Duro Canyon, and flooding was also widespread elsewhere in Randall County, where 4 persons drowned, 15 others were injured, and $8 million to $10 million in damages were incurred as a result of the raging flood waters. But at the other end of the State, rainfall was scarce. For the first time in 26 years, not enough rain fell in Galveston during May to be measured, and Beaumont-Port Arthur's monthly total of 0.10 inch constituted only 2 percent of the normal amount for that area. Fortunately, June brought relief to the Upper Coast with rains totaling 5 to 10 inches at most points, while the High Plains fared better than usual with rains generally 3 inches or greater.

The Texas summer (July-September) began on a dry note, but tropical influences intervened to give some areas of the State more rain than they could handle. July was much drier than usual in most sections, particularly in North Central Texas, the Low Rolling Plains, and northern East Texas, where monthly totals of less than half the usual amount were common. In early August, however, the scene changed drastically as Tropical Storm Amelia and her remnants traced a broad swath of flood-related destruction from South Central Texas through the Edwards Plateau into the Low Rolling Plains and western North Central Texas, yielding general rains of at least 5 inches (and more than 10 inches at numerous points) in two days' time (for more on Amelia, see the section "Hurricanes and Tropical Storms"). Four weeks later, Tropical Storm Debra gave much of the Upper Coast and East Texas appreciable rains of 2 to 5 inches although in northern East Texas, where severe drought was widespread, the rains were insufficient to effect a reversal in the moisture situation. Then, in late September, Tropical Storm Paul survived long enough after crashing into western Mexico to yield 5 to 9 inches of rain--and phenomenal flooding--in the Trans Pecos.

Early autumn mercifully brought a respite to some of those areas of Texas plagued by too much rain during the late summer. October was sufficiently dry in the Low Rolling Plains and Edwards Plateau to allow those areas to return almost to near-normal moisture conditions. But November unleashed more heavy rains on most sections, especially in the Trans Pecos and Edwards Plateau, where monthly totals were typically 5 to 10 times the usual late-in-the-year amounts. Del Rio observed the wettest November in 55 years, and Waco's 4.57 inches was the most collected there in any month since April 1977. The year ended much as it began; December was a dry month in most sections, with more than half of the State receiving less than half of the usual amount.

Among the extremes in daily rainfall amounts measured during 1978, Albany collected on August 4 the most rainfall--29.05 inches--of any of Texas' 598 National Weather Service cooperative observing stations when Tropical Storm Amelia's remains dumped incessant torrents of rain on the western North Central Texas community. As one would expect, Albany also possessed the distinction of having the greatest monthly total rainfall--31.19 inches--of any Texas station. Much of Guadalupe Mountain National Park was washed by rains of 12 to 15 inches in late September when Tropical Storm Paul moved inland into Mexico. Among other heavy rains over short time periods were: 1-day rains of 10 to 15 inches in areas that lay within Amelia's path across central portions of the State, including 15.20 inches at World's End Ranch (Edwards Plateau), 14.29 inches at Haskell (Low Rolling Plains), and 11.60 inches at Kerrville (Edwards Plateau); nearly 16 inches of rain at Victoria during a 3-day period in mid-September as a result of a tropical depression that moved inland from the Gulf of Mexico; and 10.79 inches at Refugio (South Central) on June 1. By contrast, from February 13 to May 20--or a period of 97 consecutive days--no measurable rain fell at Presidio (Trans Pecos); Imperial (Trans-Pecos) was not far behind with the second longest string of dry-weather days--96.

DROUGHT

While she is likely to be remembered as a killer storm that wrought unparalleled destruction in parts of central Texas, Tropical Storm Amelia played a significant role in reversing the drought situation in much of the State. By spilling torrents of rain on a broad area of parched plateau in the first few days of August, the storm's remnants singlehandedly terminated a lengthy spell of severe drought that had plagued the region since the late summer of 1977. However, the storm expired before it could bestow enough rain to alleviate severe drought in the Red River Valley of North Central and East Texas. It remained Tropical Storm Debra's task to lessen the drought in that area. Still another storm of tropical origin--named Paul--deluged the Trans-Pecos in late September with rains substantial enough to provide wetter-than-normal conditions for the rest of the year.

The status of drought in Texas shifted dramatically with the passing of the seasons (Figure 3). Whereas a broad swath of Texas was in the throes of a moderate to severe drought during the first few weeks of the year, by the year's end that prolonged moisture deficiency had been supplanted by conditions ranging from near-normal to considerably wetter than usual. Drought was a mainstay in much of the Texas weather picture for the first seven months of 1978 until Amelia arrived on the scene. Pockets of severe drought developed, shifted slightly during the spring and summer, then vanished almost entirely with the advent of autumn.

The Palmer Drought Index for the ten climatic regions of Texas for each month of 1978 shows that mild to severe drought was common in most sections for much of the year (Figure 4). Although most areas within 100 miles of

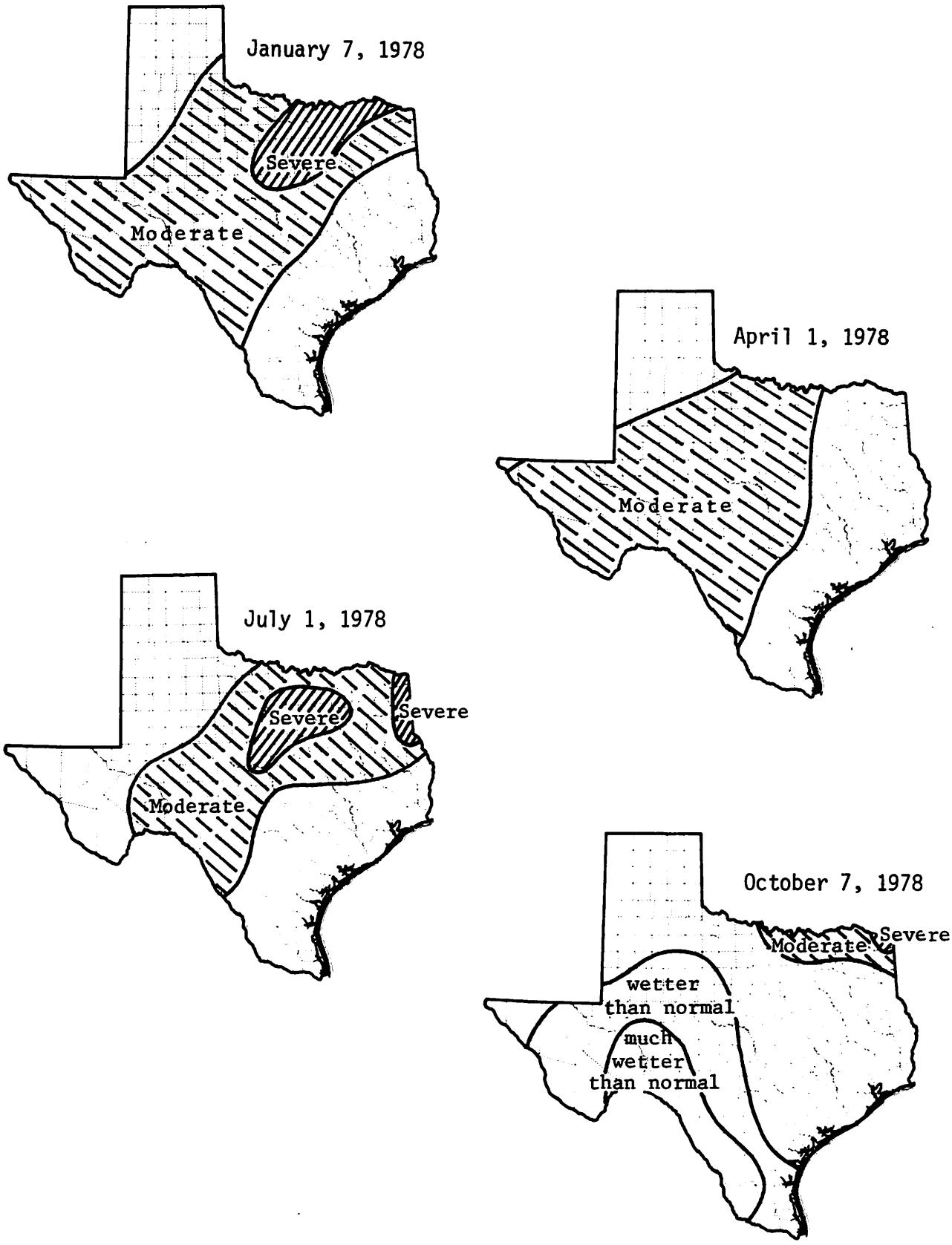
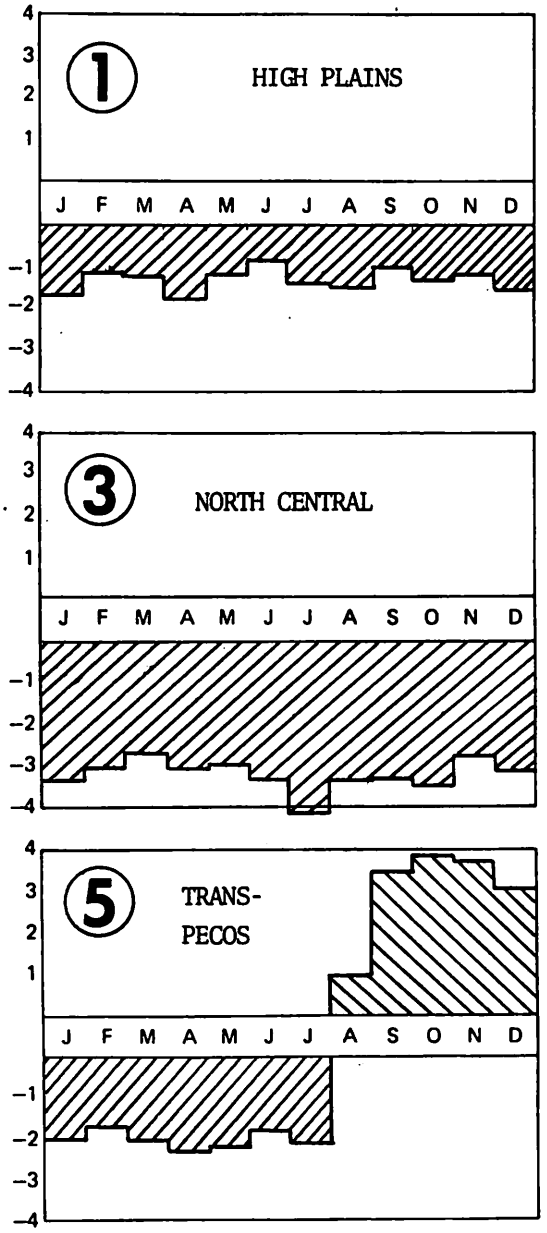


Figure 3. The status of drought and wet weather conditions for each season of 1978 (based on the Palmer Drought Index).



INDEX	CHARACTER OF THE WEATHER
4	Very much wetter than normal
3	Much wetter than normal
2	Moderately wetter than normal
1	Slightly wetter than normal
0–1	Incipient wet spell
−1–0	Incipient drought
−1	Mild drought
−2	Moderate drought
−3	Severe drought
−4	Extreme drought

NOTE: Index values for November and December were estimated by the author using preliminary rainfall data for those two months.

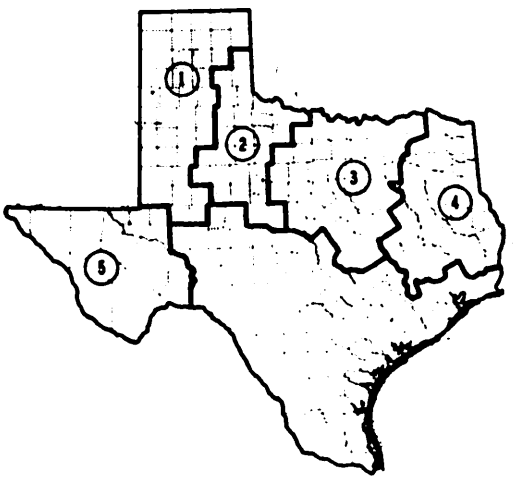
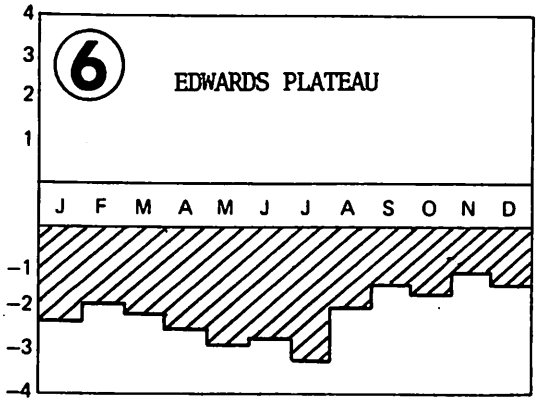
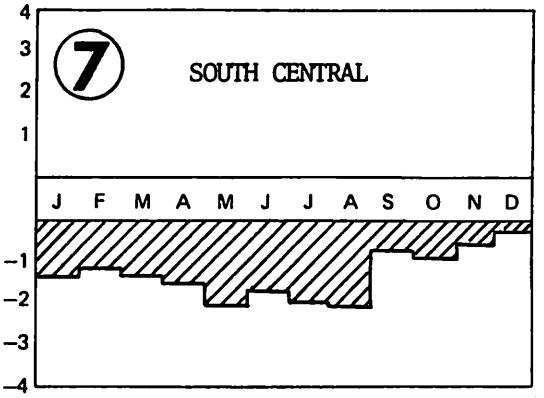
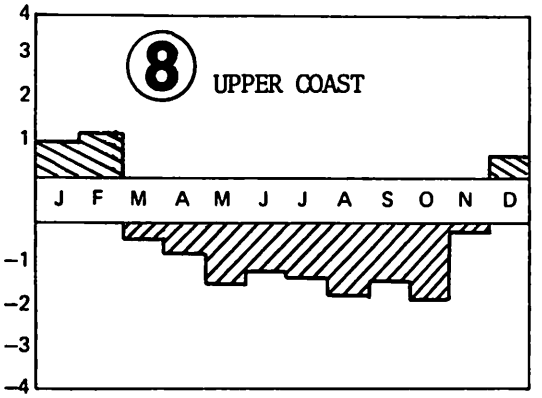
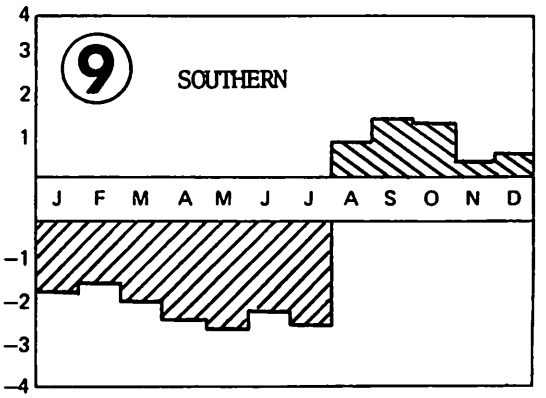


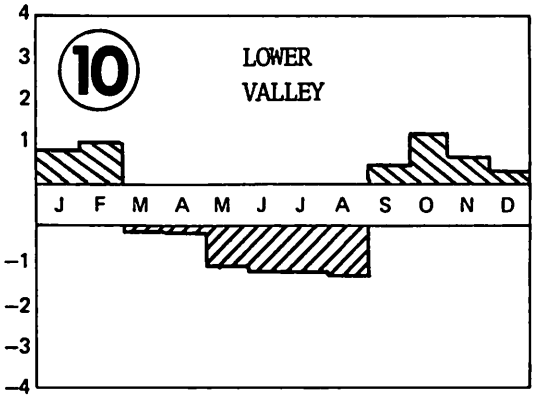
Figure 4. Monthly variation in the Palmer Index for each of the ten climatic regions of Texas.











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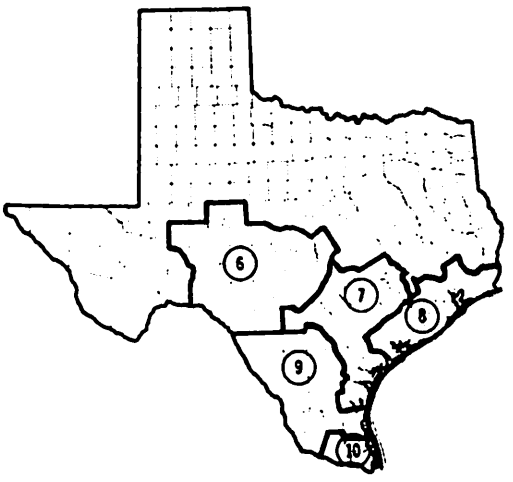


Figure 4. Monthly variation in the Palmer Index for each of the ten climatic regions of Texas--Continued

the coastline started the year with a moisture surplus, 1978 began with most of Texas' climate regions in dire need of moisture. A sizeable portion of North Central Texas was already in the throes of a severe drought when the year unfolded. Reversal of the moisture situation in several regions due to heavy rains from tropical storms was marked. Yet, much of Texas reported moisture deficits throughout the year.

The moderate to severe drought that prevailed in North Central and East Texas for most of 1978 was the longest and most intense of any drought since the memorable severe-to-extreme drought of the early and mid-1950's. Its origin traces back to the early summer of 1977. Whereas the drought in East Texas was not as severe as that which gripped North Central Texas during the first six months of 1978, both regions for the most part suffered to the same degree in the latter half of the year. The extreme northeastern portion of East Texas was seized by extreme drought for a 2-week period in late October.

The Trans-Pecos region of Texas sustained the most dramatic shift in moisture conditions during 1978. Substantial rains on several occasions in August totalling 3 to 8 inches soaked many areas and abruptly terminated mild to moderate drought that had prevailed in the region since August 1977. Termination of the drought in this region was ensured when Tropical Storm Paul delivered flood-producing rains in late September, at which time the index rose above the "much wetter than normal" level.

Southern Texas experienced a reversal similar in suddenness. A mild drought that began in the early autumn of 1977 had been aggravated by rainfall amounts of 15 to 20 percent of normal during the last few months of 1977 such that, as the year 1978 got underway, the region was suffering from moderate drought. Matters worsened further before they improved. The virtual absence

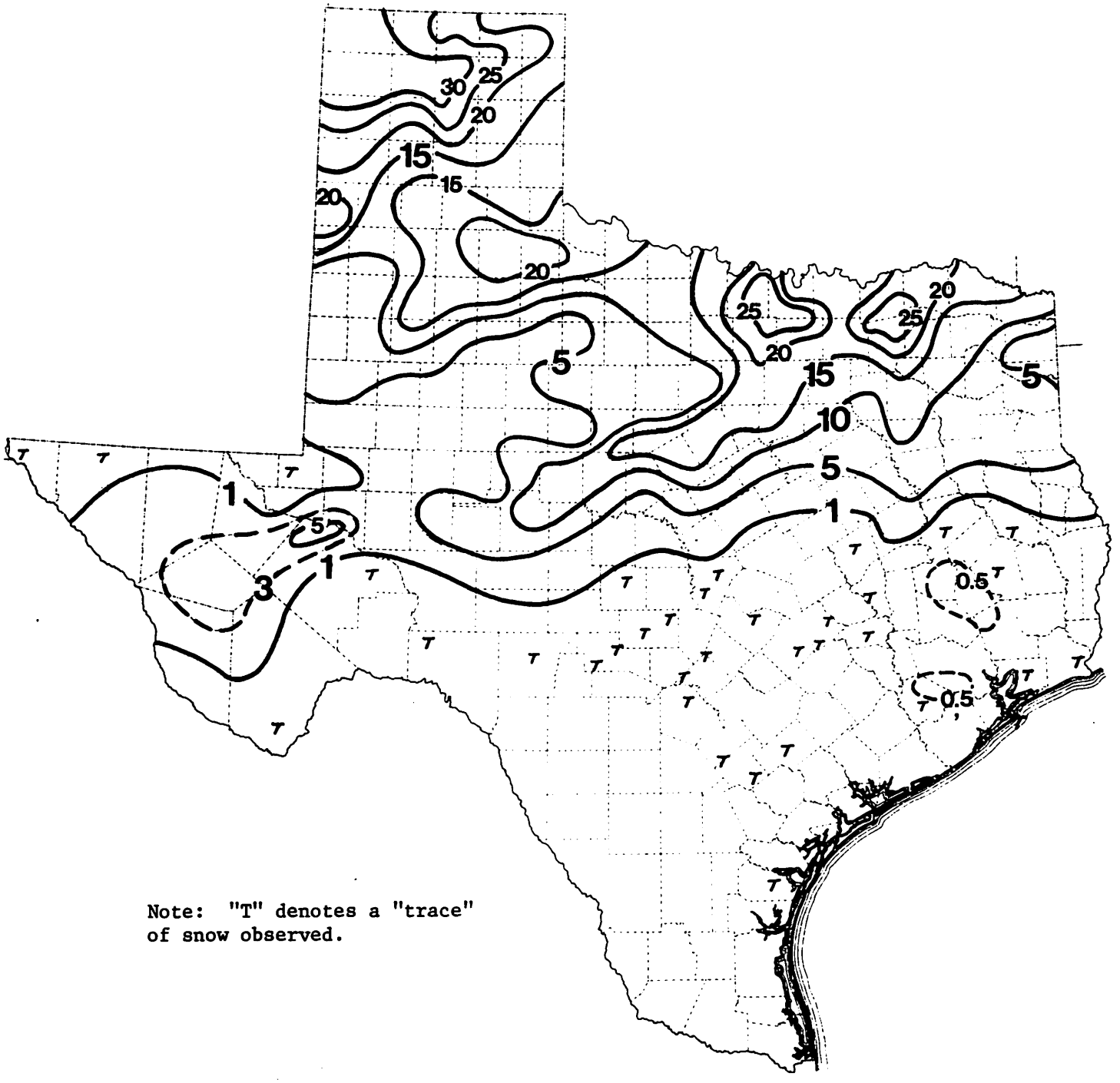
of rainfall in Webb, Zapata, and Duval Counties during the period February-April caused most surface water for livestock to disappear; more than 8000 head of cattle died in those three counties alone, while in Kinney and Val Verde Counties, 58,000 sheep and 33,000 goats were lost to the drought. The wild deer population suffered greatly as well. Rains of 2 to 5 inches softened the blow somewhat in May, but the torrential downpours from Tropical Storm Amelia in early August were needed to completely stop the drought.

The Edwards Plateau and Low Rolling Plains were the regions which bore the brunt of Amelia's torrential downpours, and hence, benefitted greatly from the drought-killing rains. Drought of at least 12 months duration was abruptly terminated in the two regions when Amelia deposited from 5 to 20 inches of rain at many points during a 3-day spell in early August. Almost overnight, moderate-to-severe drought gave way to wetter than normal moisture conditions. Indeed, the rains were so substantial that some parts of the Edwards Plateau near the Rio Grande experienced "much wetter than normal" moisture conditions--the antithesis of the worst degree of drought--during the first few weeks of autumn (Figure 4).

SNOWSTORMS AND SNOWFALL

It was the frequency of snowstorm occurrence as well as the amount of snow that marked 1978 as one of the snowiest ever in the northern third of Texas. Too, a heavy snow fell in the northern High Plains as late as the first week of May. In fact, the winter of 1978 was the snowiest ever in recorded weather history for most of northern North Central and East Texas. A total of five snowstorms lashed the region during January and February, leaving at least several inches of snow on the ground on each occasion. The Dallas-Fort Worth area measured more than 13 inches in February and experienced the most snowfall--17.6 inches--in any single winter since at least 1898. Snowfall was heavy in the High and Low Rolling Plains too, but these regions usually receive the greatest number of snowstorms and the heaviest amounts of any area of the State. The most unusual feature of the snow season there was the lateness of the last significant snowfall--the first week of May. The winter was typical in the southern third of the State, where no snow of consequence fell.

Up to ten times the normal amount of snow fell in northern North Central Texas during January and February. Cumulative snowfall totals amounted to at least 15 inches in many areas, while numerous points near the Red River measured from 20 to 25 inches (Figure 5). At least two-thirds of the total seasonal snowfall resulted from two snowstorms that struck the region during February. Still, the 5 to 10 inches that accumulated during January was enough to mark that month as one of the snowiest ever. Snowfall was unusually heavy--from two to three times the usual--in much of the Low Rolling Plains region too. The winter passed with that area collecting at least one foot of snow.



Note: "T" denotes a "trace" of snow observed.

Figure 5. Snowfall totals (in inches) for the winter and spring (January-May) of 1978.

The northern half of the Edwards Plateau shared in the phenominally heavy winter snowfall. Up to 5 inches fell in the northernmost counties of the region from one snowstorm in January. San Angelo saw 9 inches of snow fall on January 20 and 21, making the month the snowiest since January 1926, when 13 inches accumulated in that plateau city.

Nearly double the normal amount of snow--or up to 30 inches--fell in the Panhandle portion of the High Plains. Almost one-quarter of the total came from the phenominally late snowstorm of early May, when one-half foot of snow fell in the two northernmost tiers of Panhandle counties. Even the northeastern portion of the Trans-Pecos received somewhat heavier snowfall totals during the winter. Yet most of the Trans-Pecos failed to collect its usual 2 to 4 inches of snow.

The snowline--the southern boundary of snowfall accumulations on any one day of at least one inch--extended as far south as near Junction (Edwards Plateau), Lampasas (Edwards Plateau), and Centerville (East). Traces of snow were observed as far south as Chisos Basin (Trans Pecos), Pandale (Edwards Plateau), San Antonio and Runge (South Central), Corpus Christi, Galveston, and Port Arthur.

The first significant snowstorm of the autumn gave modest amounts of 3 to 4 inches of snow to the central and northern parts of the High and Low Rolling Plains. Later in November, at least a couple of inches of snow accumulated in some of the mountainous areas of the western Trans-Pecos. More snow--2 to 5 inches--fell in the High and Low Rolling Plains during the first week of December. The year ended on an icy note when 1 to 3 inches of snow combined with an ice storm to glaze all of the High and Low Rolling Plains on December 30 and 31.

TEMPERATURES

Although 1978 brought some of the coldest and hottest weather ever seen by many Texas residents, the year on the whole was neither appreciably cooler or warmer than usual. While temperatures averaged over the whole of the year for most locations were below normal, departures were for the most part within 2 degrees of normal (Figure 6). Greatest negative deviations from normal occurred in the Edwards Plateau, where numerous points measured mean annual temperatures of more than 2 degrees --but less than 3--below normal. Only the western and eastern extremities of the State observed warmer-than-usual weather for the year. Mean annual temperatures for some Trans-Pecos localities were nearly 2 degrees above normal, while a few points in the eastern Upper Coast registered average readings of less than 1 degree above normal. True to form, coolest mean annual temperatures--in the low 50's--occurred in the northern High Plains, while warmest readings--in the low 70's--were common in the Lower-Valley (Figure 7).

Texas traditionally registers coldest temperatures of the year during either January or February. The year 1978 was exceptional, however, in that a blast of Arctic air on December 9 and 10 dropped temperatures in much of Texas at least several degrees below readings measured earlier in the year. During this spell morning temperatures dipped well below zero in the northern High Plains and into the teens in northern South Central and southern East Texas (Table 2). Earlier in the year, seiges of cold Arctic air during the periods January 17-22 and February 17-18 dropped temperatures into the 20's over the southern half of Texas. Below-zero readings occurred in the High Plains on February 17 and 18, while readings in the teens were common in the northern Low Rolling Plains and North Central

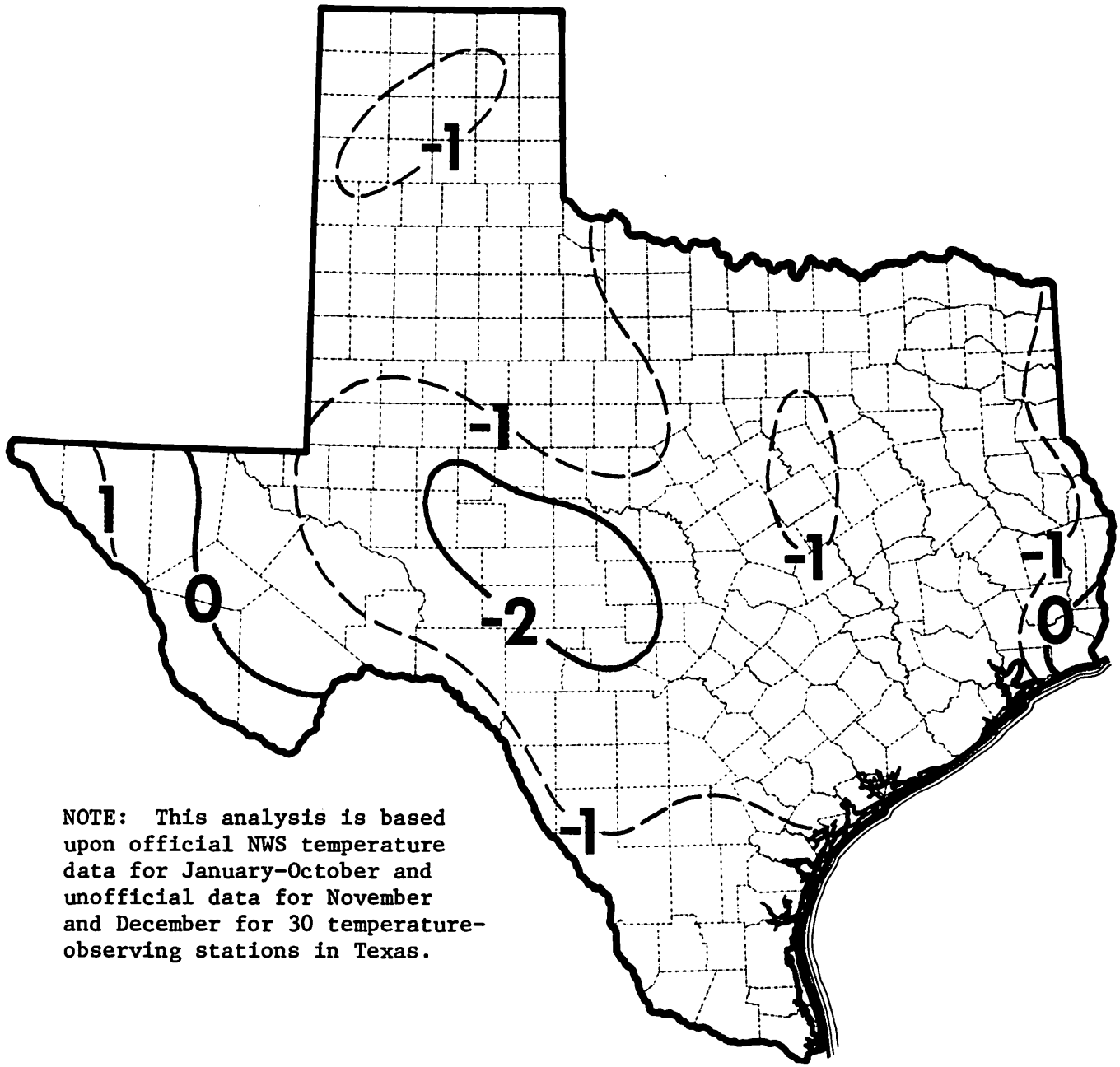


Figure 6. Departure (^{o}F) of mean annual temperature from normal

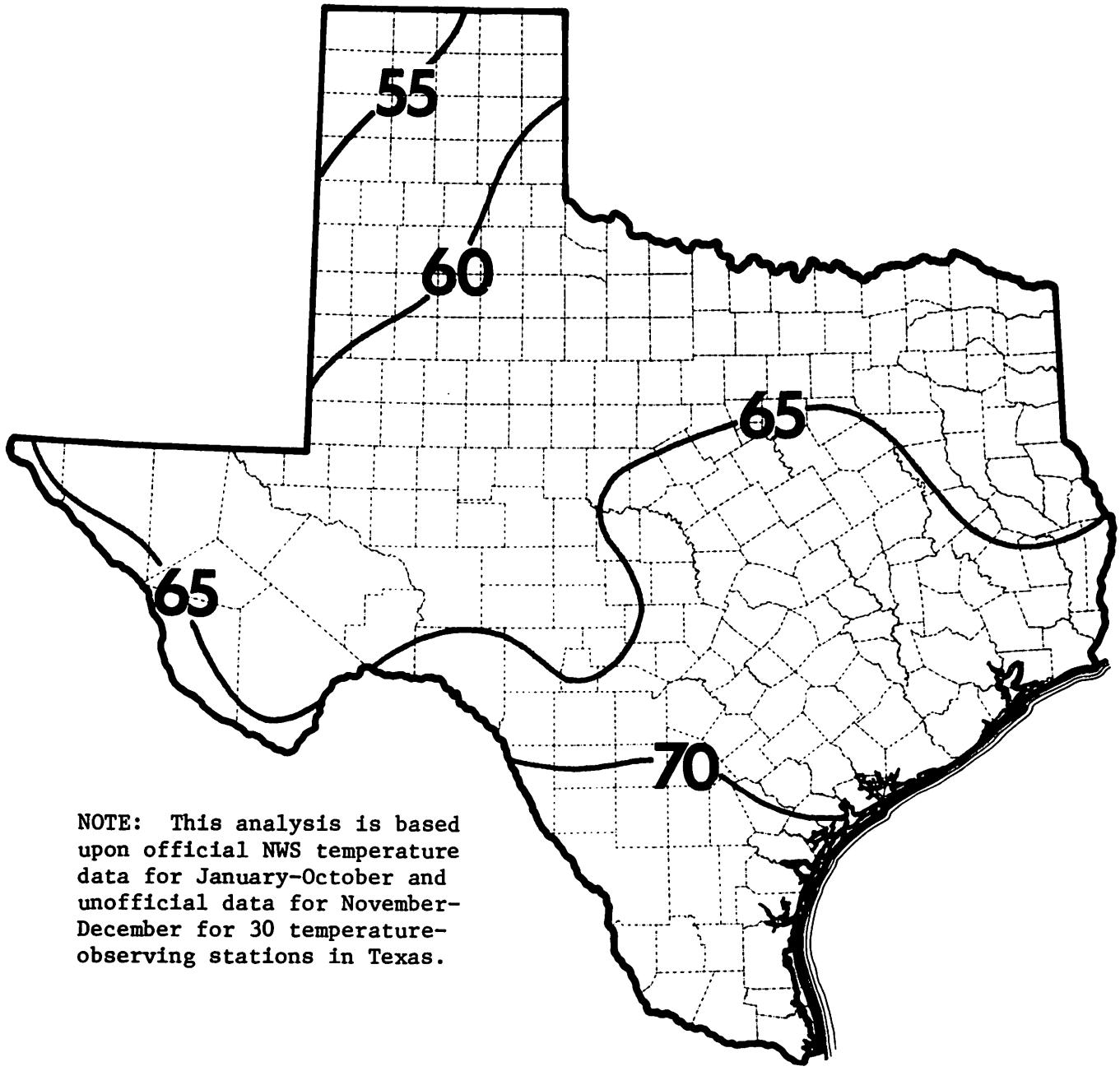


Figure 7. Mean annual temperature (^{o}F)

Table 2. Mean and extreme temperatures (^{o}F) for selected cities in Texas during 1978.

LOCALE	ANNUAL AVERAGE	DEPARTURE FROM NORMAL (1941-70)	EXTREMES	
			LOW	HIGH
HIGH PLAINS				
Amarillo	56.1	-1.3	-4	105
Dalhart	54.4	-0.8	-7	104
Lubbock	59.6	-0.1	-2	106
Midland-Odessa	62.2	-1.7	13	103
LOW ROLLING PLAINS				
Abilene	64.3	-0.2	12	110
Childress	61.1	-0.7	5	108
Wichita Falls	62.2	-1.9	4	114
NORTH CENTRAL				
Dallas-Fort Worth	64.4	-1.1	9	107
Waco	66.4	-0.7	18	107
EAST				
Longview	64.4	-1.1	17	106
Lufkin	64.8	-1.9	16	100
TRANS PECOS				
El Paso	64.8	1.4	13	111
EDWARDS PLATEAU				
Del Rio	69.2	-0.8	25	104
San Angelo	64.1	-2.1	14	106
SOUTH CENTRAL				
Austin	67.1	-1.0	19	105
Corpus Christi	71.3	-0.6	21	101
San Antonio	67.4	-1.4	18	101
UPPER COAST				
Beaumont-Port Arthur	69.2	0.7	24	97
Galveston	68.4	-1.4	28	93
Houston	67.2	-1.7	20	102
Victoria	68.8	-1.3	22	99
SOUTHERN				
Cotulla	70.7	-1.1	21	105
LOWER VALLEY				
Brownsville	73.7	-0.1	31	100
McAllen	73.5	-0.2	30	101

NOTE: Annual average temperatures and departures from normal as given above may vary slightly (a few tenths of a degree) from the official data, since the computations in this report are based upon unofficial data for the months of November and December.

Texas.

Although some sections of the Lower Valley escaped a freeze during the winter (January-March) of 1978, the surge of arctic air in early December led to subfreezing weather in all areas of the State. Morning readings hovered around 30 degrees in the Low Valley on December 10. Areas within 30 miles of the Rio Grande in the Lower Valley avoided a freeze when the coldest January spell struck, but some of those areas sustained a mild freeze on February 22 (Figure 8). Another oddity of the cold weather season of 1978 was that the longest string of freeze days occurred not in the High Plains but in the northern Low Rolling Plains; Wellington sustained freezing temperatures on 65 consecutive mornings during the first three months of the year. The High Plains city of Dimmitt recorded the most number of freeze days during the winter and spring of 1978 with a total of 86. The last spring freeze occurred at Pampa (30 degrees), Dimmitt (32 degrees) and Dumas (31 degrees) on May 5, while freezing weather was first observed in the autumn at Lipscomb (High Plains) with a morning low temperature of 30 degrees on October 14.

The torrid Texas summer was one of the longest and most intense of this century. Many localities from the Trans-Pecos to North Central and Southern Texas sustained from 2 to 3 times the usual number of afternoons when temperatures climb to at least 100 degrees (Table 3). The stifling heat was most intense in July, when mean monthly temperatures in much of the northern half of the State were from 2 to 4 degrees above normal; some points in the Low Rolling Plains and North Central Texas suffered from mean monthly temperatures of 90 degrees or more! June was a near-normal month temperature-wise, while August on the whole was a slightly cooler-than-usual month statewide.

The first significant spell of 100-degree weather struck virtually all

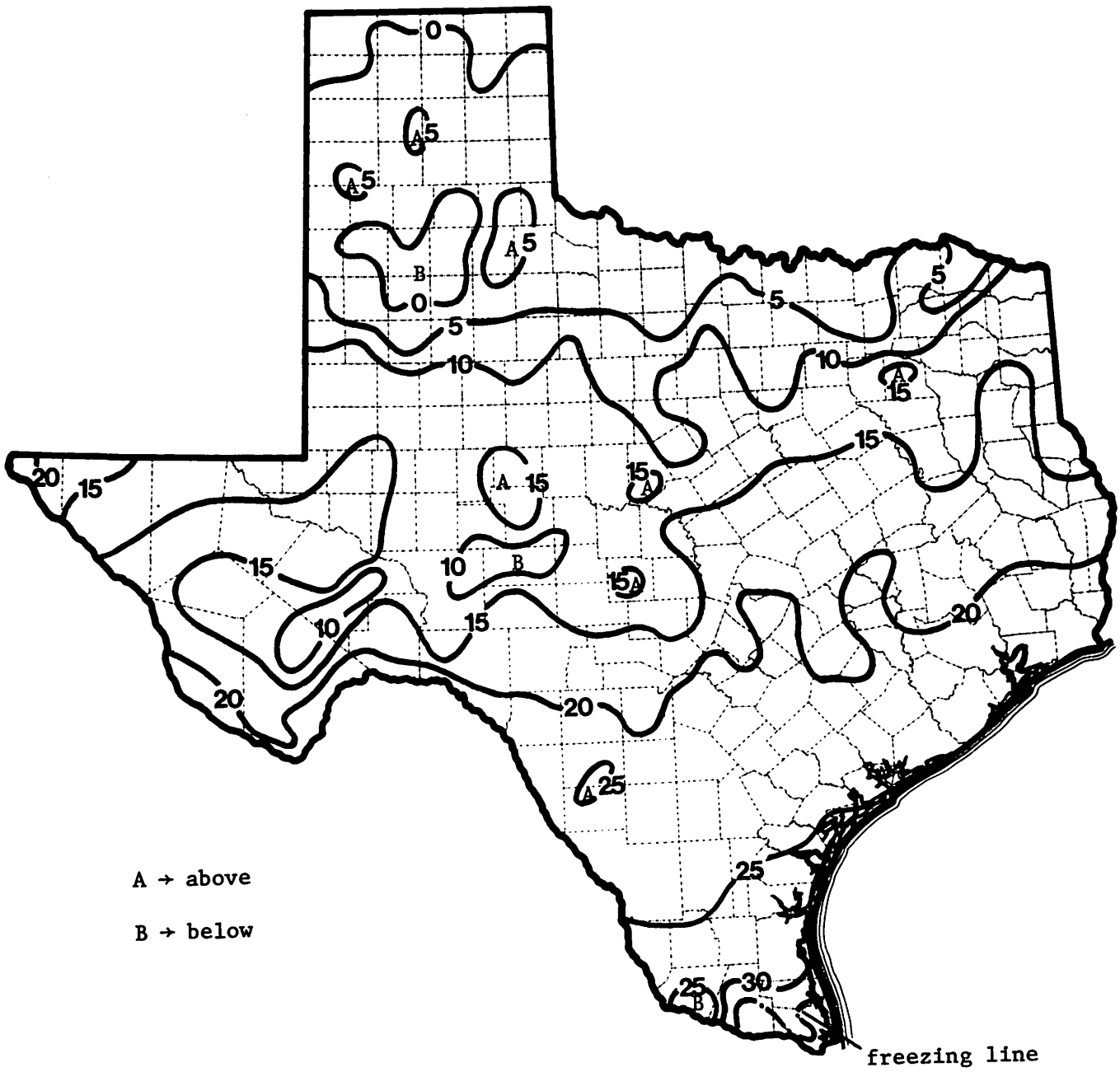


Figure 8. Lowest temperature (^{O}F) observed during the winter (January-March) of 1978.

Table 3. The number of 100-degree days during June-August 1978 as compared with the recent past (1940-1977).

Metropolitan Area	Number of 100-degree Days		
	1978 (Jun-Aug)	Mean (1940-77)	Greatest Number Prior to 1978
Abilene	37	14	44 (1943)
Austin	6	10	32 (1963)
Dallas-Fort Worth	35	17	47 (1956)
Del Rio	32	19	68 (1953)
El Paso	31	14	33 (1969)
Longview	17	8	39 (1954)
Lubbock	16	7	21 (1940)
San Angelo	7	18	60 (1969)
Waco	46	17	57 (1969)
Wichita Falls	48	29	52 (1956)

Metropolitan Area	Greatest Number of Consecutive 100-degree Days		
	1978 (Jun-Aug)	Mean (1940-77)	Longest String Prior to 1978
Abilene	21	3	29 (1952)
Austin	5	2	16 (1951)
Dallas-Fort Worth	18	4	25 (1952)
Del Rio	22	5	28 (1952)
El Paso	14	3	10 (1944/1957)
Longview	5	2	15 (1951/1954)
Lubbock	6	2	6 (1944)
San Angelo	4	4	18 (1943/1969)
Waco	20	4	30 (1969)
Wichita Falls	25	6	26 (1969)

of the western half of Texas in mid-May. But the longest spell of oppressive heat hit much of the State in late June and continued uninterruptedly for nearly one month. During this period afternoon readings soared to 110 degrees or above in a sizeable portion of the Low Rolling Plains and North Central Texas (Figure 9). An 18-day span during which temperatures reached 100 degrees every afternoon in the Dallas-Fort Worth area took 21 lives and sickened 53 other residents. Zapata (Southern) captured the distinction of having experienced the most lengthy spell of 100-degree days--33--from June 21 to July 23. Candelaria (Trans-Pecos) measured the greatest total of 100-dgreee days during the year with 74. Lajitas (Trans-Pecos) and Pecos observed the first 100-degree readings of the year on April 1 with afternoon highs of 101 degrees and 100 degrees, respectively. The 103-degree high of September 19 at Pecos was the latest 100-degree reading to occur during the year.

Numerous temperature records were broken during both the winter and summer. For the 3-month period of December 1977-February 1978, Houston and Galveston both sustained the coldest weather ever observed in those two locales with mean monthly temperatures of 46.6 and 50.0 degrees, respectively. The year's first month will long be remembered as the coldest January of this century in Dallas-Fort Worth, Houston, and Wichita Falls. At least another half-dozen major cities in the State observed the coldest January in 38 years. February brought little relief, as Houston sustained the coldest second month of the year in its weather history, and Galveston and Amarillo witnessed the coldest February in 73 years. However, the weather pattern had shifted so abruptly by early summer that extremes at the opposite end of the temperature spectrum were commonly observed. El Paso endured the hottest temperature ever observed--111 degrees on June 24--during the month of June. The next month Abilene and

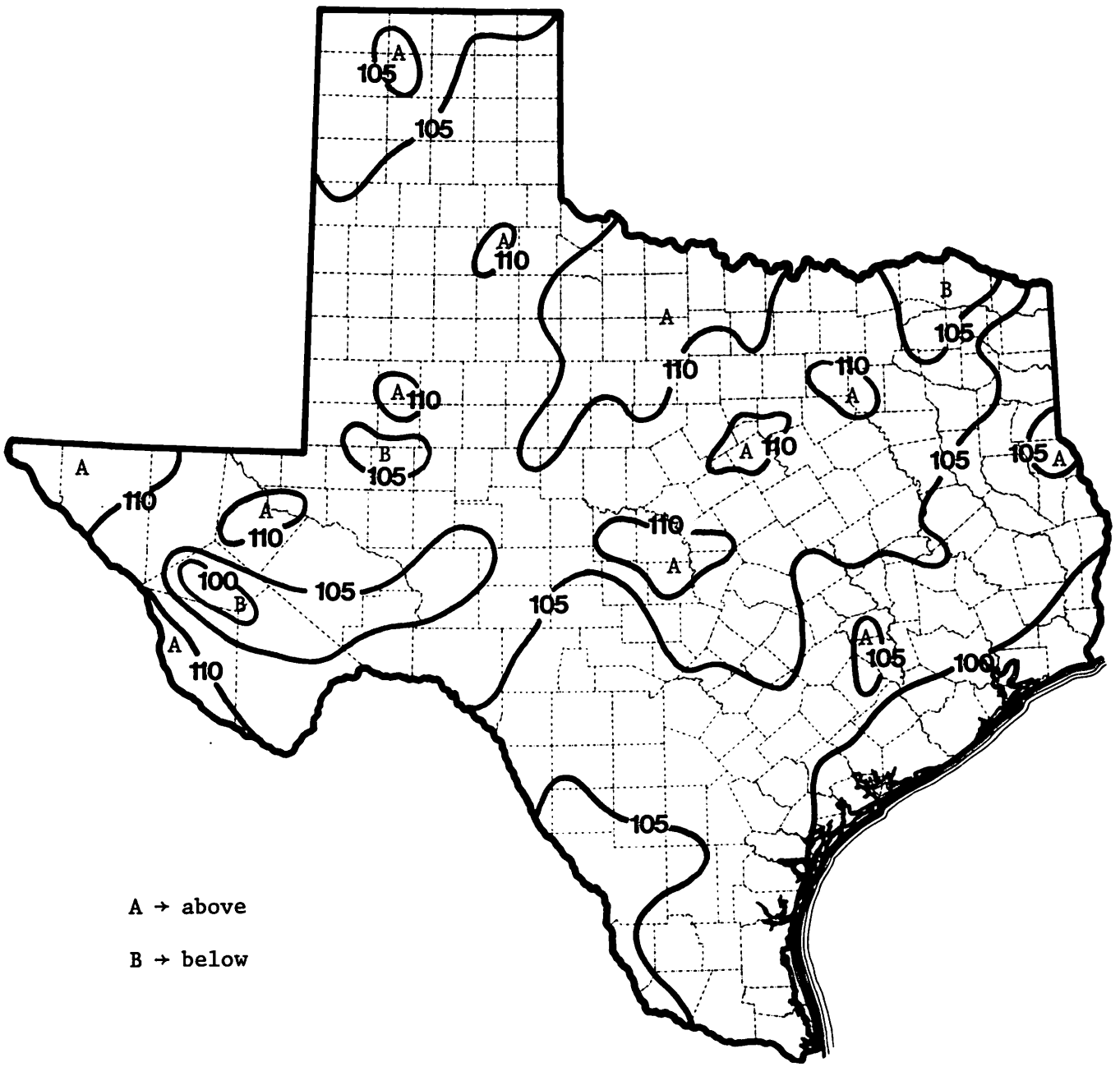


Figure 9. Highest temperature (^{O}F) observed during 1978.

Beaumont-Port Arthur suffered the hottest July of the 20th century for those two areas, and Wichita Falls mean temperature for the month of July of 89.9 degrees tied 1934 for the hottest July of this century in that Red River city.

HURRICANES AND TROPICAL STORMS

As in 1976 and 1977, the hurricane-tropical storm season passed with the Texas Coastline escaping major damage from wind and high water. That is not to say that the 1978 season was an inactive one for Texans. The catastrophic effects of the remnants of Tropical Amelia qualify the 1978 season as another in a large number of years when tropical cyclones dealt the Lone Star State a devastating blow. Tropical Storm Deborah bestowed much-needed rain to portions of East Texas wracked by moderate-to-severe drought. And, as in the two previous years, tropical storm systems from the Pacific Ocean affected western sections of the State.

Tropical Storm Amelia gained infamy not for the substantial rains and 50 mile-hour winds that she gave to the coastlines of Southern and South Central Texas. Rather, the storm will long be remembered for her persistence as a storm system--and for some of the worst flooding of the 20th century in the "Texas Hill Country" and the Low Rolling Plains. In addition to her perseverence, Amelia traversed a path that is virtually unique in the history of Texas' weather (Figure 10).* Flash floods produced by the tropical storm killed 25 persons, injured 150 others, and caused an estimated $50 million in the three federally-declared disaster counties of Bandera, Kerr, and Kendall. One day later another 6 persons died in Shackelford County as the storm's residue wandered into the extreme western portion of North Central Texas.

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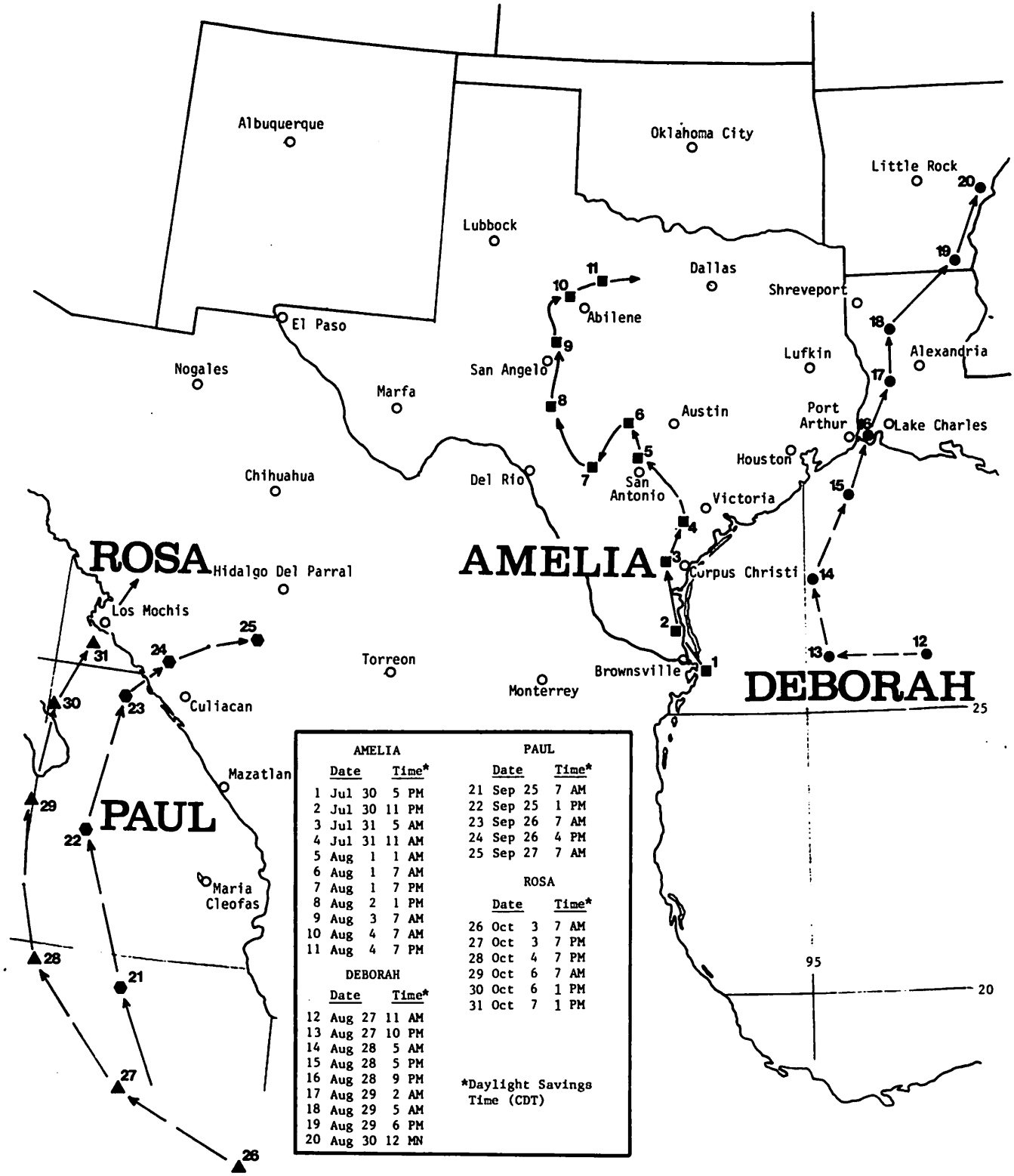
*How Tropical Storm Amelia thrived for so long once on shore and produced devastating flash floods is the subject of the report, "An Analysis of Weather Conditions Relative to Occurrence of Flash Flooding Rains in Central Texas," from the Texas Department of Water Resources.



AMELIA		
	Date	Time*
1	Jul 30	5 PM
2	Jul 30	11 PM
3	Jul 31	5 AM
4	Jul 31	11 AM
5	Aug 1	1 AM
6	Aug 1	7 AM
7	Aug 1	7 PM
8	Aug 2	1 PM
9	Aug 3	7 AM
10	Aug 4	7 AM
11	Aug 4	7 PM

DEBORAH		
	Date	Time*
12	Aug 27	11 AM
13	Aug 27	10 PM
14	Aug 28	5 AM
15	Aug 28	5 PM
16	Aug 28	9 PM
17	Aug 29	2 AM
18	Aug 29	5 AM
19	Aug 29	6 PM
20	Aug 30	12 MN

PAUL		
	Date	Time*
21	Sep 25	7 AM
22	Sep 25	1 PM
23	Sep 26	7 AM
24	Sep 26	4 PM
25	Sep 27	7 AM

ROSA		
	Date	Time*
26	Oct 3	7 AM
27	Oct 3	7 PM
28	Oct 4	7 PM
29	Oct 6	7 AM
30	Oct 6	1 PM
31	Oct 7	1 PM

*Daylight Savings Time (CDT)

Figure 10. Tracks of tropical cyclones which affected Texas weather during 1978: Hurricane Rosa and Tropical Storms Deborah, Amelia, and Paul

Amelia suddenly developed at mid-afternoon on July 30 less than 50 miles off the extreme lower Texas coast, moved north-northwestward and struck the Texas coastline midway between Brownsville and Port Isabel just before midnight on that day. Three to 5-inch rains fell along the coast northward to Corpus Christi, while wind damage was minimal. Once over land, the storm began disintegrating as it continued moving northwestward deeper into the State on the following morning. However, the storm revived and spilled torrents of rain along the Balcones Escarpment, soaking the watersheds of the Guadalupe, Median, and Sabinal rivers and filling those rivers and numerous other streams and creeks in the region to overflowing. By dawn of August 2, the raging floodwaters had taken the lives of 25 unsuspecting riverfront residents and campers.

The first tropical storm of the 1978 season was not finished, however. The well-defined extratropical storm moved northward across the Edwards Plateau unto the southern Low Rolling Plains, dumping 4 to 8 inches of rain on an area parched by moderate to severe drought. Again, it became reinvigorated while in the vicinity of Abilene and yielded flood-producing rains in a 6-county area of western North Central Texas. Rivers and streams burst out of their banks, floodwaters roared through communities, reservoirs filled and overflowed, and 6 more Texans were drowned. At last, the irrespressible storm waned and died over North Central Texas but not before it bestowed welcome rains on parts of drought-ridden North Central and East Texas.

Deborah began as a concentrated mass of rain showers in a low-pressure trough in the southeastern Gulf of Mexico on August 26, then organized itself into a tropical depression early on August 27 as it drifted westward about 250 miles east of Brownsville. The storm spared most of the Texas coastline

when it veered northward and struck land near the mouth of the Sabine River before midnight on August 28. Packing sustained winds of 55 miles per hour when she made landfall, Deborah spread considerable moisture into the Upper Coast and East Texas. Although she spawned several tornadoes in the eastern Upper Coast region, Deborah was benevolent in that rains of 1 to 3 inches fell in an area of Texas in need of substantive rain to eradicate an increasingly bothersome drought.

Tropical Storm Paul was the fourth Pacific tropical cyclone to affect Texas' weather in the last 3 years, and the storm's contribution to the Trans Pecos is sure to stand as a major highlight of that region's weather during the 20th century. Paul struck the Mexican coast near Culiacan early in the afternoon of September 24 and drifted eastward into northern Mexico, pumping copious amounts of Pacific moisture into the westernmost region of the State of Texas. The Rio Grande in the Presidio Valley filled to the highest level since 1904, not only from 4 to 8-inch rains in the western and southern Trans Pecos but from much heavier rains that deluged northern Mexico for several days and filled reservoirs there to levels that mandated record releases down the Rio Conchos into the Rio Grande at Presidio.

The upper Rio Grande was not the only conduit in Texas' Trans-Pecos region to swell from rains in association with Tropical Storm Paul. A disturbance in the upper atmosphere related to Paul (as the storm spun in the southern Gulf of California) produced torrential rains of up to 15 inches in and around Guadalupe National Park on September 25. The excessive rains flooded campgrounds and highways and sent the Pecos River over its banks at Mentone, which had to be evacuated, and at Pecos, where water stood several feet deep in the downtown area.

Fortunately for rain-weary residents of the Trans-Pecos, the last tropical system to affect Texas--Hurricane Rosa--generated only a cloud cover and a few patches of light rain along the upper Rio Grande. Rosa had been of hurricane strength until she crossed cooler water in the Gulf of California on October 6. The dying storm made landfall near Los Mochis on October 7 and was too weak to generate any weather of substance on the Texas side of the Rio Grande.

TORNADOES AND OTHER UNUSUAL EVENTS

Texans were extremely fortuitous in 1978 in that, while more than 125 tornadoes were observed to have occurred, damage or destruction of disastrous proportions was avoided. More than a score of communities were struck by twisters, but none suffered to any great degree. Even loss of life was held to a virtual minimum; only one death in the State during the year could be attributed directly to tornadoes.

Three of every four tornadoes which occurred in Texas in 1978 struck either during April or May (Table 4). Nearly all of the cyclones of these two months

Table 4. Number of incidences of tornadoes, funnel clouds, and waterspouts in Texas during the first 10 months of 1978.

TYPE/Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
TORNADOES										
North	0	0	0	15	32	4	1	0	1	0
West	0	0	0	16	32	5	4	0	0	0
South	0	0	0	1	2	1	7	3	4	1
FUNNEL CLOUDS										
North	0	0	2	10	21	4	1	0	1	0
West	0	0	0	1	24	13	3	0	3	0
South	0	0	0	0	1	20	17	8	14	3
WATERSPOUTS										
South	0	0	0	0	0	5	1	10	2	1

hit either in the western or northern thirds of the State. Only a tenth of all sighted tornadoes occurred in the south, and most of those struck in the summer. Funnel clouds--or tornadoes that develop but never touch land--were observed most often in May, June, and July. Waterspouts--or tornadoes which occur over open water--were most numerous off the coastline of the Upper Coast region in August.

Tornadoes struck no earlier in 1978 than April 3, and the first large outbreak of tornadoes--as well as the most extensive of the year--occurred nearly three weeks later, lashing parts of northern North Central and East Texas on May 11 (Table 5). This siege began at mid-afternoon in Ellis and

Table 5. Tornadoes of significance in Texas in 1978.

Location	Date	Time (LST)	Deaths	Injuries	Path length (mi)	Path width (ft)	Significance
15 miles NE of Childress	Apr 3	5:20pm	0	0	5	300	First tornado of the year
northern North Central Texas	Apr 22	3:50-4:40pm	0	0	-	-	First large outbreak
near Darrouzett	May 3	4:30pm	0	0	7	1200	Most destructive
northern North Central & East Texas	May 11	4:10-10:42pm	0	0	-	-	Day with greatest number (11)
near Memphis	May 26	10:19pm	1	0	3	180	First killer tornado

Hill Counties of North Central Texas and ended about six hours later in Smith County of East Texas. One tornado destroyed four homes, damaged several a automobiles, and flattened power lines in Midlothian. Straight-line winds

of 89 to 100 miles per hour associated with one severe thunderstorm in this storm system caused extensive window damage in Longview, where ten people were injured, and considerable tree damage in Tyler.

Hail easily surpassed tornadoes in terms of crop and property damage. The most devastating hailstorm of 1978 in Texas pounded Texarkana on April 22, inflicting $10 million in damage to residences and another $5.4 million to vehicles. One of the year's earliest hailstorms caused $2 million in damages to automobiles, residential roofs, and windows in Gainesville (North Central) on March 20. More than a million dollars in damages was sustained in the Johnson County communities of Joshua, Burleson, and Lillian on April 24; pieces of hail up to 4 inches long tore through metal roofs and outbuildings, and severe roof and window damage occurred at many residences. Joshua and Burleson suffered extensive damage--almost $500 thousand worth--a month earlier when thunderstorms ravaged the same area on March 20. What is apparently the largest observed hailstones--4-1/2 inches in diameter--observed in the State during the year fell at Aledo (North Central) on April 22 from a slow-moving thunderstorm. Tennis-ball-size hailstones covered the ground to a depth of 5 inches at the Gillespie County community of Doss (Edwards Plateau) on May 1.

Lightning occasionally posed problems for a few Texas residents. At least two people died in Texas after having been struck by lightning; a picnicker was killed while standing under a tree at Fabens on May 19, while a 15-year-old youth succumbed while hauling hay near Dubina in Fayette County (South Central) on August 3. On June 5 lightning struck an oil tank near Muenster in Cooke County (North Central), causing a fire that enveloped several oil-storage tanks.

In addition to the ravaging floods attributable to Tropical Storms Amelia and Paul and the flash floods that struck Canyon in May, numerous

other localized floods plagued parts of the State during the year. One man was drowned and several other people injured when flash floods struck San Antonio on September 13. More than 100 homes and automobiles were damaged by water when heavy thunderstorms caused sudden rises on creeks and streets in the city. The next day up to 16 inches of rain poured down on Center (East), isolating the city for several hours and forcing evacuation of homes; flooding also occurred in nearby San Augustine and Nacogdoches Counties. Water from heavy thunderstorms accumulated on the roof of a church building in Garland (North Central), causing it to collapse during a worship service and killing a small girl and injuring 57 other people. A flash flood produced in minutes by a massive thunderstorm drowned a camper in his sleeping bag at Boquillas (Trans Pecos) on June 1. On the same day, torrential rains flooded the courthouse and an auditorium and hospital in Corpus Christi and closed streets and highways in Refugio.

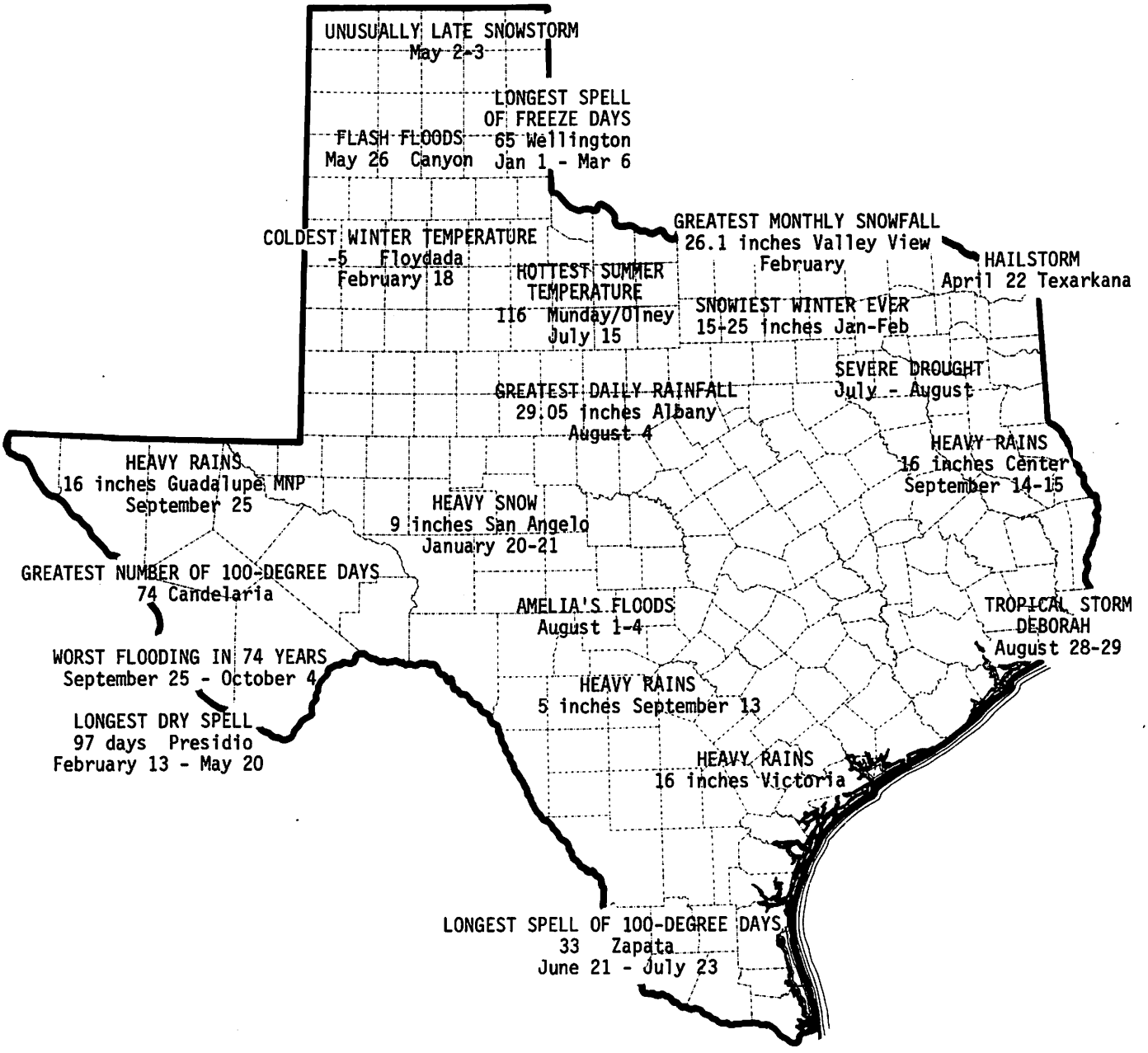


Figure 11. Phenominal weather events of 1978.