Chapter 5

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The average annual maximum daily temperature in the state generally increases from about 70˚F in the northern Panhandle to about 82˚F in the Lower Rio Grande Valley, with the exception of mountainous areas in Far West Texas.

Average annual precipitation ranges from over 55 inches in Beaumont to less than 10 inches in El Paso. Average annual gross lake surface evaporation ranges from less than 45 inches in East Texas to more than 90 inches in Far West Texas.

Except for the wetter, eastern portion of the state, evaporation exceeds precipitation for most of Texas, yielding a semiarid climate that becomes arid in Far West Texas.

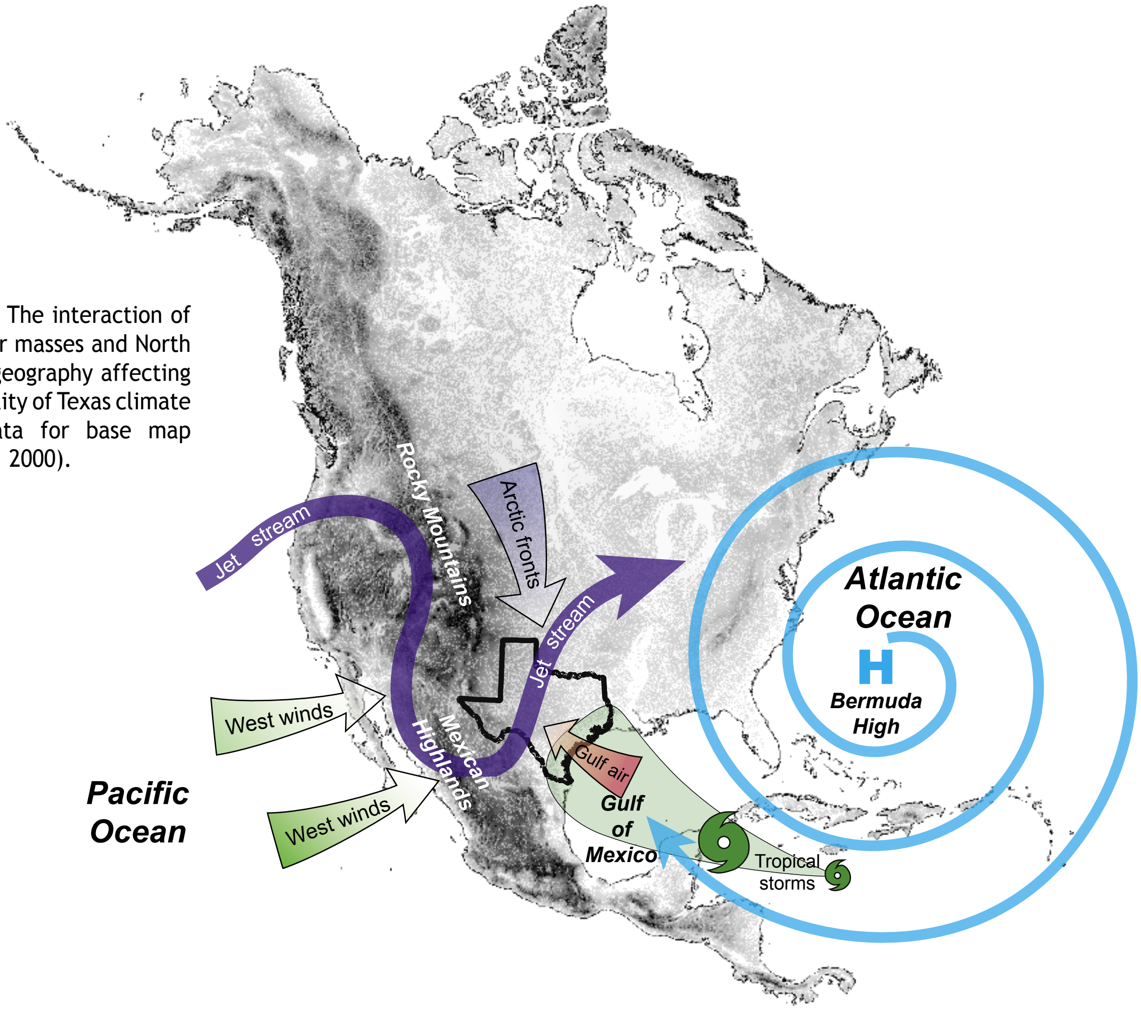
The Gulf of Mexico is a dominant influence on the state's climate, moderating its temperature and precipitation. The El Niño Southern Oscillation also affects the state's moisture patterns and is responsible for long-term changes in Texas' precipitation.

From the hot, dry desert of Far West Texas and the blue northers that blast the Llano Estacado to the humid, rainy pine forests of East Texas and the hurricanes that sweep across the Gulf Coast, Texas' climate is as varied as its landscape. That variability is a result of the interactions between Texas' unique geographic location and the movements of seasonal air masses, such as arctic fronts, the jet stream, subtropical west winds, tropical storms, and a subtropical high pressure system known as the Bermuda High (Figure 5.1). The Gulf of Mexico is a dominant geographical feature, moderating temperatures along the Gulf Coast and, more important, providing the major source of moisture for the state (Carr, 1967; Larkin and Bomar, 1983). The eastern Pacific Ocean and land-recycled moisture also provide, to a lesser extent, a source for annual rainfall to the state (Carr, 1967; Schmidt, 2001; Slade and Patton, 2003). Texas is prone to hurricanes that find their way into the Gulf of Mexico during the hurricane season. The Rocky Mountains guide cold fronts of arctic air moving southward into the state during the late fall, winter, and early spring and also extract much of the Pacific moisture from subtropical depressions carried eastward by subtropical west winds during the summer. During the spring and fall, warm, dry air from the high plains of northern Mexico is pulled into the state by the jet stream and collides with humid air from the Gulf of Mexico funneled in by the western limb of the Bermuda High system—resulting in severe thunderstorms and tornadoes.

5.1 Temperature, Precipitation, and Evaporation

In general, average annual maximum daily temperature gradually increases from less than 70˚F in the northern Panhandle to more than 82˚F in the Lower Rio Grande Valley, except for isolated mountainous areas of Far West Texas (Figure 5.2). In Far West Texas, the average annual maximum daily temperature sharply increases from less than 72˚F in the Davis and Guadalupe mountains to more than 80˚F in the Presidio and Big Bend areas. Average annual precipitation decreases from over 55 inches in Beaumont to less than 10 inches in El Paso (Figure 5.3). Average annual gross lake sur-

Figure 5.1. The interaction of seasonal air masses and North American geography affecting the variability of Texas climate (source data for base map from USGS, 2000).



face evaporation ranges from less than 45 inches in East Texas to more than 90 inches in Far West Texas (Figure 5.4).

Although most of the state's precipitation occurs in the form of rainfall, small amounts of ice and snow become increasingly probable toward the north and west. In addition, the variability of both daily temperature and precipitation totals increase inland across the state and away from the Gulf of Mexico. The majority of rainfall in Texas occurs during storm events when a large amount of precipitation falls over a short period of time.

Except for the wetter, eastern portion of the state, evaporation exceeds precipitation for most of Texas, yielding a semi-arid climate that becomes arid in Far West Texas. Relative humidity varies throughout the state, depending on rainfall and evaporation rates, but generally decreases from east to west.

5.2 Climate Divisions

The National Climatic Data Center divides Texas into 10 climate divisions (Figure 5.5). Climate divisions represent regions with similar climatic characteristics, such as vegetation, temperature, humidity, rainfall, and seasonal weather changes. Data collected at locations throughout the state are averaged within the divisions in order to make maps such as the one in Figure 5.5. These divisions are commonly used to report climatic information, such as precipitation, temperature, and drought indices.

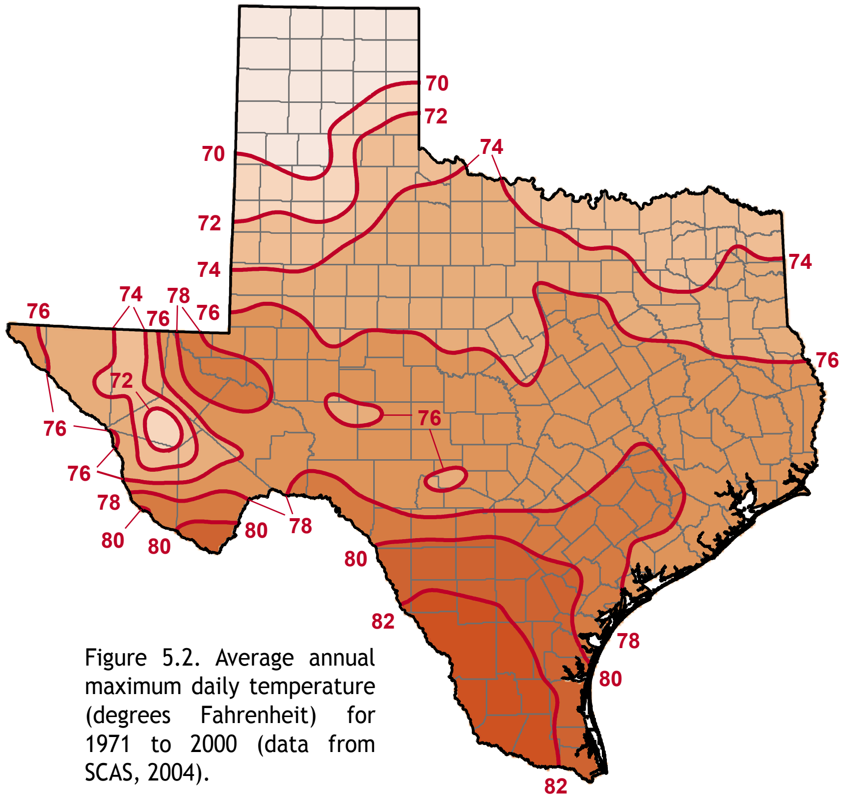


Figure 5.2. Average annual maximum daily temperature (degrees Fahrenheit) for 1971 to 2000 (data from SCAS, 2004).

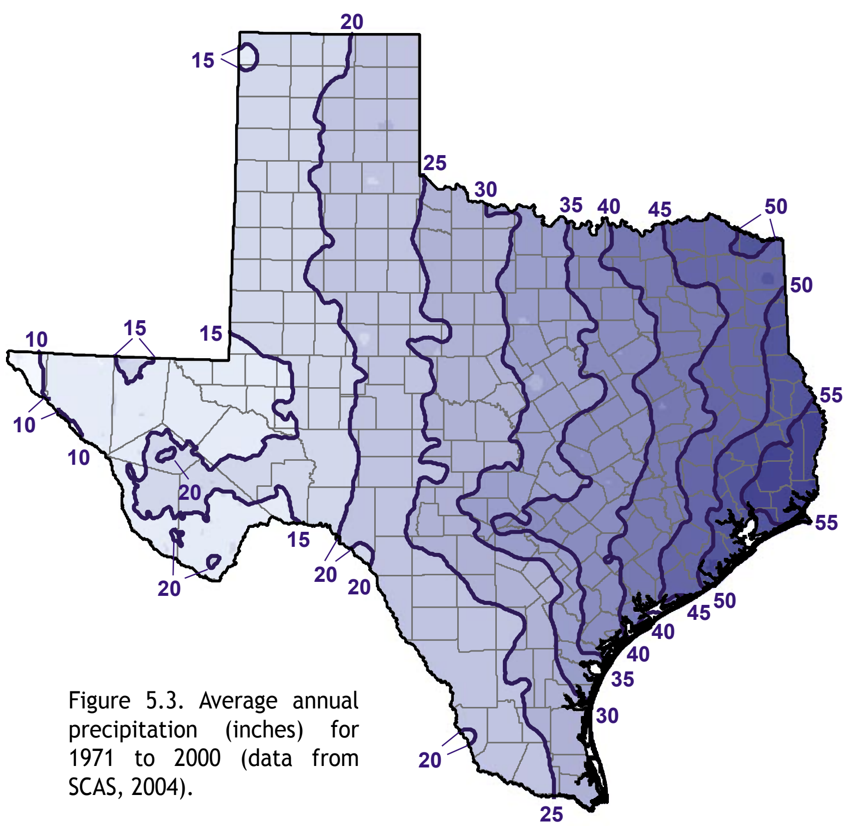


Figure 5.3. Average annual precipitation (inches) for 1971 to 2000 (data from SCAS, 2004).

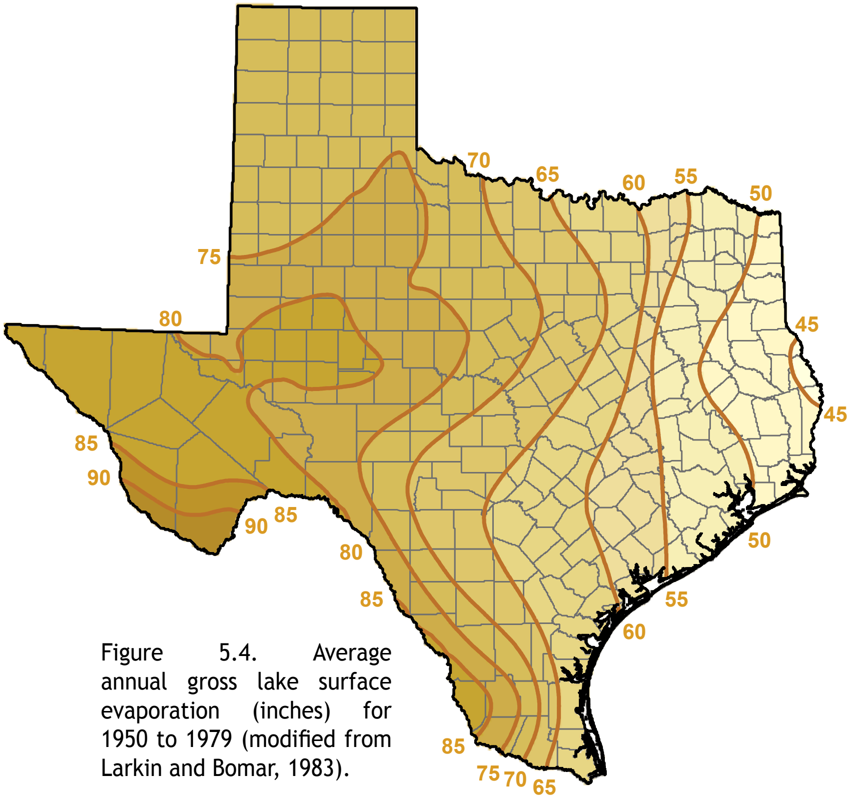


Figure 5.4. Average annual gross lake surface evaporation (inches) for 1950 to 1979 (modified from Larkin and Bomar, 1983).

5.3 Climate Influences

The El Niño Southern Oscillation, a cyclical fluctuation of ocean surface temperature and air pressure in the tropical Pacific Ocean, affects Pacific moisture patterns and is responsible for long-term (decadal) changes in Texas' precipitation, leading to periods of moderate to severe drought. During a weak oscillation, precipitation will generally be below average and some degree of drought will occur. However, during a strong oscillation, Texas will usually experience above average precipitation.

The range between summer and winter average monthly temperatures increases with increased distance from the Gulf of Mexico (Figure 5.5). In

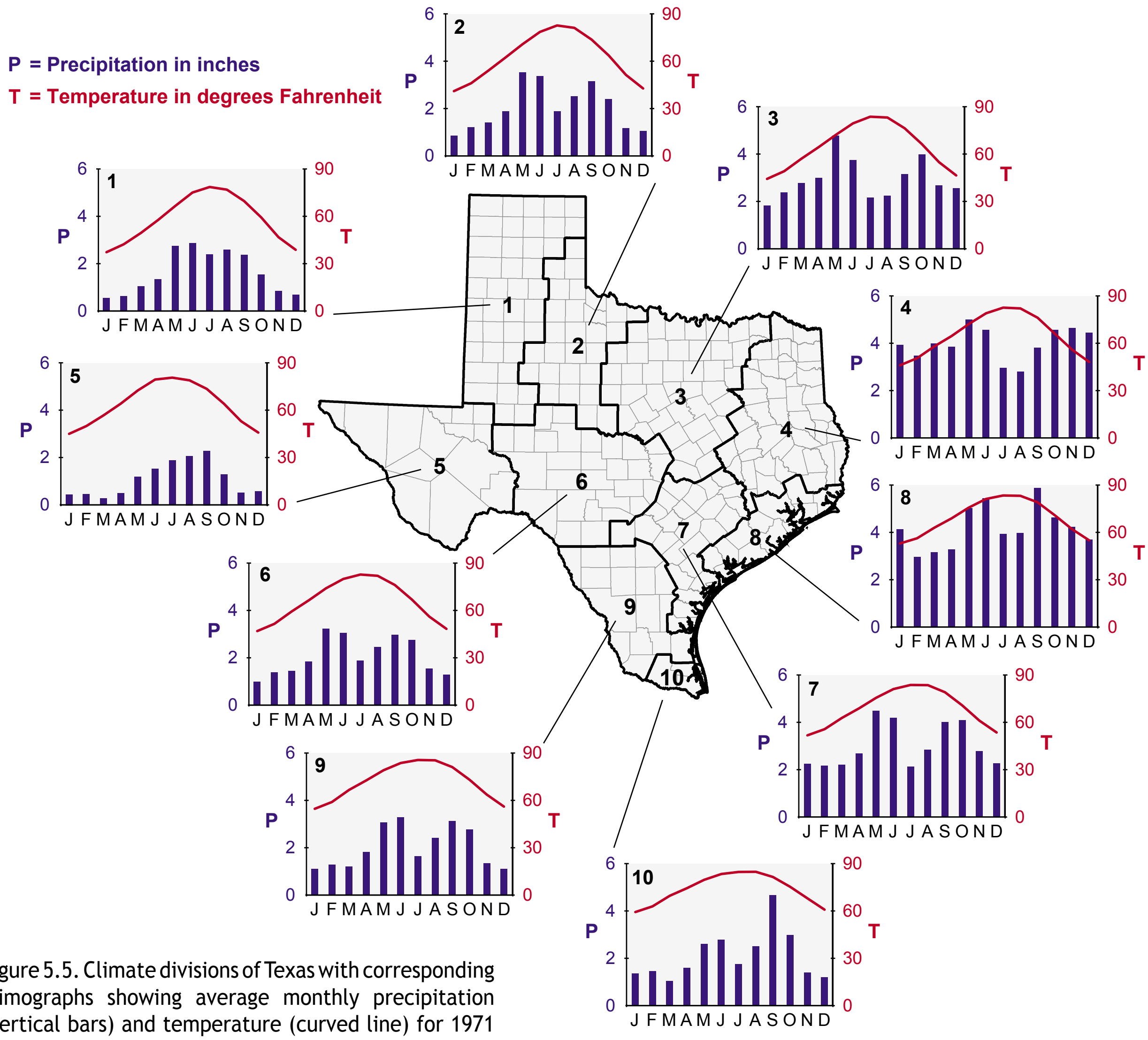


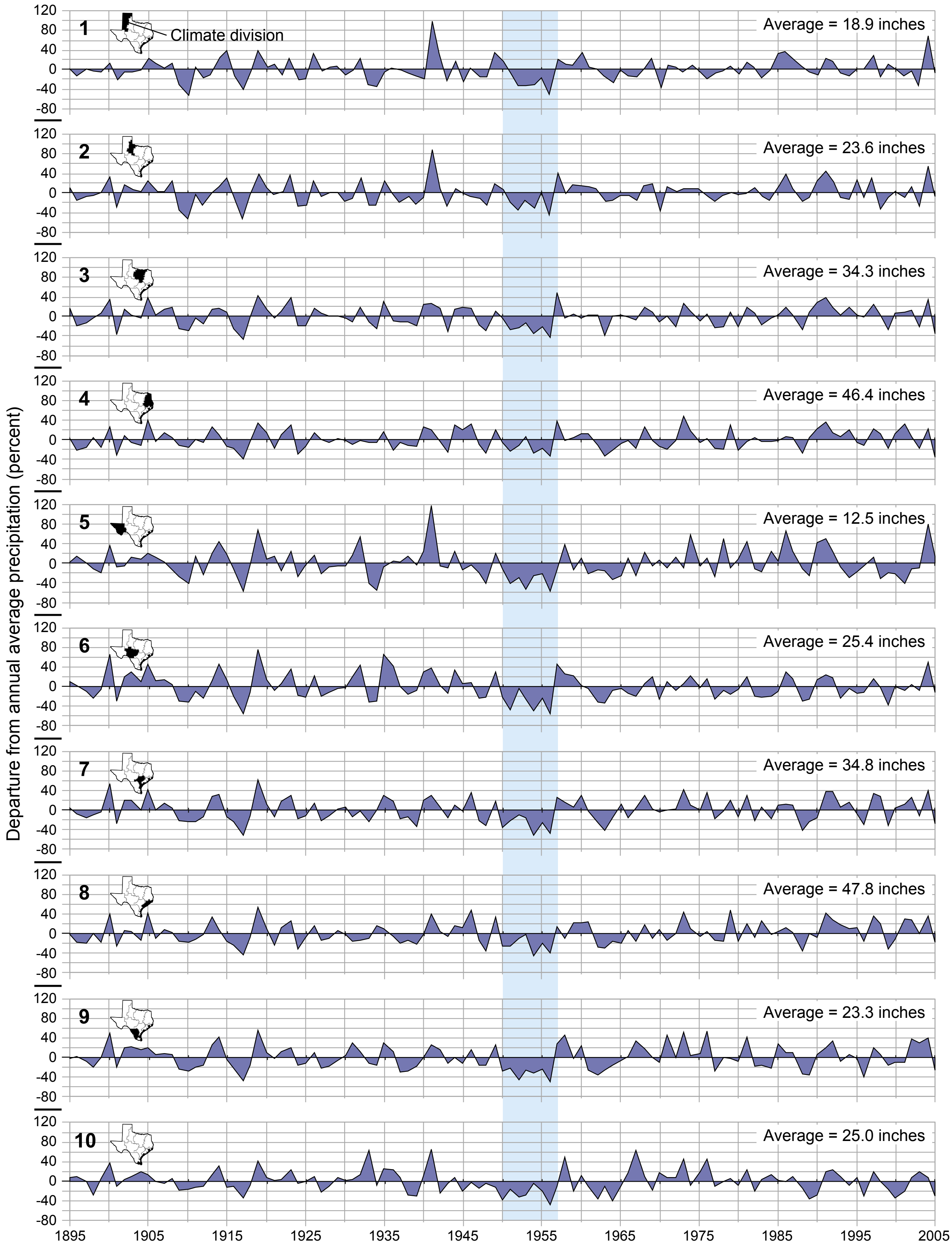
Figure 5.5. Climate divisions of Texas with corresponding climographs showing average monthly precipitation (vertical bars) and temperature (curved line) for 1971 to 2000 (data from NCDC, 2006).

addition, the state climate divisions nearest the Gulf Coast show more pronounced rainy seasons in the fall and spring. These two rainy seasons are affected by polar fronts interacting with moist Gulf air during those seasons. The fall season also includes precipitation associated with hurricanes and tropical depressions approaching or entering the state from the Gulf of Mexico.

5.4 Climate Trends

During the period of recorded precipitation from 1895 to 2005, the most severe statewide drought occurred during the 1950s when precipitation was about 30 percent below average. This drought persisted for five to seven years throughout most of the state (Figure 5.6). During the 1930s, northern and western parts of the state—along with a large portion of the central United States—experienced a drought compounded by poor agricultural management practices that stripped away large volumes of top soil, known as the Dust Bowl.

More recently, portions of South, Central, and West Texas have experienced recurrent periods of drought from the 1990s through 2006 (Figure 5.6). Some regions have experienced or are experiencing new droughts of record since the passage of Senate Bill 1, 75th Legislative Session, in 1997. The geographic



Note: Light blue shading indicates drought of record in Texas.

Figure 5.6. Historical plots of percent departure from average annual precipitation for each climate division of Texas for 1895 to 2005 (data from NCDC, 2006).

location and consequential climatic variability of the state creates the inevitability of recurrent drought interrupted by brief periods of floods. The frequency of droughts in the state is the reason Senate Bill 1 required the water supply planning process to meet water supply needs during a drought of record and is one of the reasons for the five-year cycle of review and update of the regional and state water plans. With the Senate Bill 1 planning process, the citizens of Texas will always have an up-to-date assessment of the adequacy of their water supply during drought conditions and the strategies and actions that will be required to meet water supply needs during the inevitable return to drought.

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