THE SPATIAL AND TEMPORAL PATTERNS OF PRECIPITATION IN TEXAS

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THE SPATIAL AND TEMPORAL TRENDS IN PRECIPITATION IN TEXAS

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ABSTRACT

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Water sustains our cities, rural communities, businesses, industries, farms, ranches, and the natural environment. Any disruption to our water supply will significantly affect the economy and human life (Kursinski 2007). Water is an important, limited resource and any change in the hydrological cycle might result in an increase in flood or drought conditions (Kursinski 2007). Texas agricultural economies have adapted to precipitation regimes; however, they are vulnerable to precipitation anomalies, especially those that last more than one month (Lyons 1990). An analysis of 42 stations of annual and seasonal precipitation from 1932 – 2002 for the state of Texas is presented. Annual and seasonal total precipitation, precipitation days, and precipitation intensity are investigated using a linear regression model. Regression results reveal positive trends in annual precipitation, days with precipitation, and precipitation intensity for the southeast region. During the spring and summer months, an increase in precipitation intensity resulted for stations in the north central region, while the most notable trend during the

fall months showed an increase in precipitation in the eastern half of the state, while no change resulted in the west. A decrease in precipitation days was noted for stations in south Texas, with no change in intensity or total precipitation.

CHAPTER 1

INTRODUCTION

Statement of Research Problem

Precipitation is an important weather and climate element that has a significant impact on society (Kursinski 2007). Water is a vital resource for human life and is central to many national concerns including economic health and development, food security, and environmental quality (Dzurik 1996). Water sustains our cities, rural communities, businesses, industries, farms, ranches, and the natural environment, and any interruption to our water supply will adversely affect the economy and human life (Pittman et al. 2007).

From a societal perspective, water is a precious, limited resource and any change in the hydrological cycle might result in an increase in floods or droughts (Kursinski 2007). Texas agricultural economies have adapted to precipitation regimes; however, they are vulnerable to precipitation anomalies, especially those that last more than one month (Lyons 1990). This vulnerability has been studied and statistics show that the central United States from North Dakota to southern Texas is most likely to experience periods of drought or wet spells (Lyons 1990). Historically, periods of drought in Texas are well documented. Jensen (1996) notes that some of the earliest droughts include one in the 15th century along the Canadian River that decimated a native American tribe. Furthermore, a drought event in 1756 dried up the San Gabriel River, and the drought of

1822 caused crops planted by Stephen F. Austin to perish. Jensen (1996) states that at least one drought has affected Texas each decade from 1822 through the 20th century. The best two examples include the drought of the 1930s, and the drought of the early to mid-1950s. The drought of the 1930s seemed to be the worst drought inflicted upon Texas; however the statewide drought during the 1950s resulted in 244 of Texas' 254 counties being declared disaster areas (Ward 2000; Pittman et al. 2007). The drought in the 1950s lasted nine years and caused considerable stress to farmers, livestock, and to the public (Ward 2000). Quentin Martin, from the Lower Colorado River Authority (LCRA), examined tree-ring data and hydrologic data of the last 200 years to assess drought conditions that impacted Central Texas (Ward 2000). His findings imply that the drought of the 1950s was the worst in terms of intensity and magnitude. This drought was believed to begin in the Lower Rio Grande Valley and West Texas in 1949, with precipitation dropping by 40 percent from 1949 to 1951, and by 1952, half the state received 20 to 30 inches less rainfall than normal (Ward 2000). Average monthly precipitation in 1952 fell to 0.03 inches and is considered the lowest level since the Weather Bureau began collecting records in 1888 (Jensen 1996).

Texas is rapidly growing in population and future water demands could easily exceed the available water supplies. A major source of domestic water supply in Texas, especially in the early twentieth century was groundwater (aquifers); however during the twentieth century, the demand for water exceeded the aquifer yield and surface water supplies were sought (Ward 2000). The state water plan involves 16 regional water planning groups that represents a geographic region in Texas based on hydrologic and political borders (Pittman et al. 2007). The water planning groups review water use projections, implement management strategies in times of drought conditions, and recommend a management strategy when a water need is identified (Pittman et al. 2007). The population in Texas is projected to more than double by year 2060, to approximately 46 million. Pittman et al. (2007) state that if Texas does not implement the state water plan, about 85 percent of the state's projected population will not have enough water by 2060 during drought conditions. With this in mind, it is essential to investigate the changes in temporal and spatial precipitation patterns in Texas in order to improve domestic water supply management strategies (Harmel et al. 2003).

Using historical precipitation data, this research examines the spatial and temporal patterns of precipitation in Texas. The central goal of this research is to identify trends in monthly, annual, and seasonal precipitation for 42 weather stations in Texas, and to determine if areas around the state are becoming increasingly wet or dry. The results of this study will contribute to the understanding of precipitation patterns in Texas and will aid in making informed decisions and predictions as far as future water supplies are concerned for the state. In addition, the results of this study will be important to a large segment of the climatological, hydrologic, and atmospheric science communities. Further, variations in precipitation on a spatial and/or temporal scale may provide insight into precipitation behavior as an indicator of climate change.

Research Objectives and Hypotheses

Precipitation is one of the drivers of variability in the atmospheric water balance, and any change in precipitation for a location will have a significant impact on water resources for the state (Brommer 2006). Additionally, changes or modifications in the hydrologic cycle may either result in an increase in floods or drought conditions.

Findings from this study will contribute to the understanding of the spatial and temporal patterns of precipitation in Texas. Therefore, understanding variations and historical patterns of precipitation will aid in water resource management, drought mitigation, and community planning for the state.

The primary purpose of this dissertation is to analyze and present the spatiotemporal patterns of precipitation across the state of Texas. To investigate precipitation patterns in Texas, this study gathered data from 42 weather stations across the state over a period of 70 years. The main objective is to analyze the spatial and temporal behavior of annual and seasonal precipitation in Texas by using the methodology proposed by Karl et al. (1999) and subsequently utilized in Rodrigo and Trigo's (2007) study of rainfall trends in the Iberian Peninsula. The methods used in this analysis may be applied to other locations of similar size where there are a reasonable number of individual weather stations with precipitation data available. The goal of this research can be broken down into a number of smaller objectives:

1) The first objective is to identify the temporal patterns of monthly, seasonal, and annual precipitation for the period of record. In order to accomplish this task, the data will be used to create three new variables; total precipitation, precipitation days, and precipitation intensity. A detailed statistical analysis will be performed on the three variables to determine whether precipitation is increasing, decreasing, or steady at each station.

2) This study will examine the spatial patterns of precipitation across the state for the period of record.

3) Another goal is to understand interannual variability expressed as dry and moist periods.

Research Hypotheses

Several hypotheses were formulated to meet the objectives of this study and to address the following questions:

Group 1: Is total annual and seasonal precipitation increasing, decreasing, or staying steady at each station?

Group 2: Are annual and seasonal precipitation days (days with at least 0.1 mm precipitation) increasing, decreasing, or staying steady at each station?

Group 3: Is annual and seasonal precipitation intensity (precipitation per rain day) increasing, decreasing, or staying steady at each station?

The following hypotheses were grouped to the above questions:

Group 1: Total precipitation for each station:
- A) H_o: No trend in annual total precipitation
  H_1: A trend exists
- B) H_o: No trend in winter precipitation
  H_1: A trend exists
- C) H_o: No trend in spring precipitation
  H_1: A trend exists
- D) H_o: No trend in summer precipitation
  H_1: A trend exists
- E) H_o: No trend in fall precipitation
  H_1: A trend exists

Group 2: Precipitation days for each station:
- A) H_o: No trend in annual total precipitation days
  H_1: A trend exists
- B) H_o: No trend in winter precipitation days
  H_1: A trend exists
- C) H_o: No trend in spring precipitation days
  H_1: A trend exists
- D) H_o: No trend in summer precipitation days
  H_1: A trend exists
- E) H_o: No trend in fall precipitation days
  H_1: A trend exists

Group 3: Intensity for each station:
- A) H_o: No trend in annual precipitation intensity
  H_1: A trend exists
- B) H_o: No trend in winter precipitation intensity

H_1: A trend exists
C) H_o: No trend in spring precipitation intensity
H_1: A trend exists
D) H_o: No trend in summer precipitation intensity
H_1: A trend exists
E) H_o: No trend in fall precipitation intensity
H_1: A trend exists

Summary of Work

This dissertation is organized into separate chapters and is structured as follows: Chapter two consists of a detailed literature review outlining previous studies and approaches in precipitation research. Chapter three describes the study area, its physical attributes, and precipitation in Texas. Chapter four describes and illustrates the locations of the Texas weather stations, details the data acquisition and preparation, and methods used in the analysis. Chapter five presents the results, and chapter six includes an analysis and discussion of results. Chapter seven provides a conclusion, limitations, and suggestions for further research.

CHAPTER 2

LITERATURE REVIEW

Studies on precipitation cross a number of disciplines, and for this review, I have drawn upon the literature within the disciplines of climatology, geography, hydrology, and the atmospheric sciences. This chapter will consider precipitation measurement, and approaches to precipitation research in Texas, the United States, and internationally.

Precipitation Measurement

The precipitation and climatological data resource books by Strangeways (2007) and Linacre (1992) discuss precipitation, its processes, its distribution in time and space, and measurement techniques. Early attempts at measuring precipitation were due to simple agricultural aids. For example, the need for regular rainfall for the cultivation of rice was an incentive for rain gauge measurement in Korea during the fifteenth century (Strangeways 2007). A bronze pillar instrument used as a rain gauge was introduced at the height of Korean civilization in 1441 and this instrument was used continuously until 1907 (Strangeways 2007).

In Europe, there were no known rain gauges until the seventeenth century (Strangeways 2007). A glass formed like a cylinder was a common rain gauge used during this particular period. The tipping bucket, a first known British gauge in the mid-seventeenth century resembles most of today's rain gauges. Since the eighteenth-century, a more developed academic approach arose out of scientific curiosity aided by improving technology to measure precipitation (Strangeways 2007). Gilbert White, known for his Natural History of Selborne (1789), recorded a series of precipitation readings from May 1779 to December 1786. Yet, White's brother-in-law, who recorded and observed rainfall for 59 years in England, kept the longest record by one person, using the same rain gauge at that time (Strangeways 2007).

Over half a century later, George James Symons' interest in precipitation was inspired by drought conditions in the United Kingdom (UK). Symons collected precipitation data, experimented with various gauges in use at the time, and published his first volume of *British Rainfall* (Strangeways 2007). Symons devoted his time improving precipitation measurement and data collection. These improvements benefited the field of meteorology; however, this came at the cost of great financial difficulties for Symons (Strangeways 2007). Upon Symons' death in 1900, he was receiving precipitation records from 3500 sites and by the mid-nineteenth century, all basic rain gauge design principles had been established (Strangeways 2007).

Measuring Precipitation with Rain Gauges

A rain gauge is a device that collects precipitation in the form of rain, drizzle, snow or hail, which is then measured. "The total precipitation is the sum of all liquid collected (including the water produced from melted solid precipitation), expressed as the depth it would cover on a flat surface assuming no losses due to evaporation, runoff, or percolation into the ground" (Strangeways 2007, 151). The common unit used in the past to measure precipitation was in inches. Although some countries still use this unit of measurement, millimeters are the more common unit used today for precipitation measurement.

The three most common types of rain gauges used to measure precipitation are the manual, mechanical, and electronic gauges. Although there are over 50 types of manual rain gauges used globally, the Symons 127 mm (5 in) model has been the standard in the United Kingdom since the twentieth century (Strangeways 2007). The gauge has a cylindrical opening above a funnel, which takes the collected water into a vessel below and is measured on a daily basis with a graduated cylinder (Linacre 1992). The rim is placed one meter above the ground over short grass or gravel to prevent water splash from its surroundings. If the gauge is unable to be read on a daily basis, a larger container is used so that weekly or monthly amounts of precipitation can be collected and stored. The most widely used rain gauge in the United States is the 324 cm^2 copper rain gauge (Strangeways 2007).

Mechanical chart recording gauges are used to provide information on the precise time when precipitation begins and ends at a station, and provides an approximate indication of precipitation rate (Strangeways 2007). The most common mechanical gauges used are the float-operated recorders and the weight-operated recording gauges. A typical float-operated recorder allows rain from the funnel to enter into a cylinder containing a float. As the water rises and enters, a pen records as it moves along a paper chart.

The tipping-bucket is the most common type of automatic electrical rain gauge in use today (Strangeways 2007). This rain gauge consists of two small buckets or levers that are balanced, and the bucket tips can be set to intervals of 0.1, 0.2, 0.25, 0.5, and 1mm. As the precipitation falls onto one of the two small buckets and is equal to the amount it is set to hold, the lever tips the bucket and an electrical signal is sent to the recording device (Strangeways 2007).

Measurement biases arise due to gauge under- catchment of precipitation, evaporative loss, out splash, leveling, the site of the gauge, human error, and wind which can significantly underestimate actual precipitation (Strangeways 2007). The most significant cause of error is typically turbulent airflow around the gauge that can deflect precipitation. A windshield can be placed around the gauge or the gauge can be placed into a pit with the rim at ground level to diminish the airflow problems.

Measuring Precipitation using Radar and Satellite Technology

Radar and satellite technology do not replace the use of rain gauges to measure precipitation. Strangeways (2003) notes that the advantage that radar has over ground-positioned rain gauges is that it gives an areal estimate rather than a single location measurement. Radar technology observes the speed at which the rain falls, detects whether the rainfall is moving horizontally toward or away from the radar antenna, and gives the location and the intensity of the rainfall. Melting snow enhances the reflectivity and can create errors in overestimating rain intensity and drizzle is underestimated because it is hard to detect below the radar beam (Strangeways 2003). Satellites carry a variety of sensing instruments, which measure electromagnetic radiation (EMR) reflected from, or emitted by the atmosphere (Strangeways 2003). In addition, once the satellite has scanned the rain clouds and the EMR is collected, the data has to be inferred through a set of algorithms for interpretation.

Although precipitation data are subject to errors and biases, gauges that measure precipitation remain the most common approach to ground-based measurement (New et al. 2001). Throughout the twentieth century, rain gauge measurements provide a wealth of information about trends and variability of precipitation (New et al. 2001). Satellite coverage for precipitation extends back only to 1974; however, the digital archives are growing and are continuing to provide coverage (New et al. 2001).

Approaches to Precipitation Research

The precipitation characteristics most often studied include precipitation amount, precipitation intensity, and precipitation frequency (Brommer 2006). These characteristics provide valuable information concerning the general dryness or wetness of a location, and identify regional trends in precipitation (Palecki et al. 2005). The most common time scale for recording rainfall is daily accumulation (Palecki et al. 2005). Precipitation is often quantified through measurements at specific locations, and have typically been calculated over long averaging periods, such as monthly, seasonal, and annual time scales (Brommer 2006). These studies provide clues to important patterns in the variation of total precipitation, and the frequency and intensity of the rain events (Brommer 2006). The remainder of this chapter will review selected studies and research on precipitation patterns in other countries, the United States, and in Texas. These studies focus on research that uses rain gauge data. The studies address fundamental questions about precipitation characteristics, and determine the spatial and temporal patterns of precipitation over different time scales.

Precipitation Studies in Other Countries

A large number of studies on precipitation trends exist and this section reviews selected studies of precipitation patterns internationally. The following studies utilized rain gauge data to analyze precipitation patterns in the late nineteenth and twentieth centuries. Table 2.1 provides a summary for the studies discussed below.

Kiely et al. (1998) examined long-term trends in diurnal precipitation at Valentia on the west coast of Ireland from 1940 to 1993. The authors applied the Pettitt-Mann-Whitney statistical tests to hourly precipitation data and found a 10% increase in mean annual precipitation after 1975. The increase in precipitation was significant in March and October. Brunetti et al. (2001) examined changes in total precipitation, rain days, and extreme rain events in northeastern Italy for the period 1920-1998. Using a series of statistical tests (i.e. Craddock homogeneity and Mann-Kendall tests), the authors found a negative trend in the average annual number of wet days, and on a seasonal basis, a decrease in wet days is evident in spring and autumn.

Archer and Fowler (2004) examined the spatial and temporal variation in precipitation in the Upper Indus Basin of Pakistan from 1895 to 1999. Using correlation and regression, the authors did not find a significant trend in precipitation since 1895. However, there were significant increases occurred in winter, summer, and annual precipitation at several stations from 1961 to 1999. Moberg and Jones (2005) analyzed twentieth century trends in precipitation in Europe from 1901-1999. The authors conducted a linear trend analysis and results showed a seasonal increase in precipitation intensity and frequency during the winter months. Yu et al. (2006) evaluated long-term patterns in annual and seasonal precipitation from 1897-2001 in Taiwan using the cumulative deviation test, the Mann-Whitney-Pettitt, and Kruskal-Wallis statistical tests. The authors identified an annual increase in rainfall in northern Taiwan, and a decline in rainfall in the central and southern regions of the country.

Cheung et al. (2008) used a linear regression model to investigate temporal precipitation and its spatial distribution within Ethiopia. Using rain gauge data from 134 stations between 1960 and 2002, the authors did not find significant results in annual precipitation using the one-sample t-test. The authors did find a significant decline in precipitation from June to September in southwest and central Ethiopia. Other time-series studies in Ethiopia reveal various results. Osman and Sauerborn (2002) found that summer precipitation in the central highland of Ethiopia declined during the latter half of the twentieth century, whereas Seleshi and Zasnke (2004) found a decline in annual precipitation in the eastern, southern, and southwestern regions of the country.

Using the Mann-Kendall and Sen's T statistical tests, Partal and Kahya (2006) analyzed trends in long-term annual mean and monthly total precipitation in Turkey from 1929 to 1993. They found a decrease in annual mean precipitation along the Black Sea coastline, and in the western and southern sections of the country. Rodrigo and Trigo (2007) analyzed trends in daily rainfall in the Iberian Peninsula from 1951 to 2002 using the Mann-Kendall statistic and linear regression model. Although the number of wet days did not reveal a significant change, the authors found that there was a decrease in daily intensity of rainfall on both annual and seasonal timescales.

Precipitation Studies in the United States

This section reviews selected studies of precipitation patterns in the United States as summarized in Table 2.2. Lettenmaier et al. (1994) evaluated spatial patterns in precipitation for the period 1948-1988 in the contiguous United States. The authors applied the Kendall's test on the monthly and annual rainfall data and slope estimator to determine trend magnitudes. There was an increase in precipitation from September through December at as many as 25 percent of the stations in the central part of the country (Lettenmaier et al. 1994).

Table 2.1. Summary of Recent Studies on Precipitation Trends Internationally

Author(s)	Year	Location	Findings
Kiely et al.	1998	Valentia, Ireland	Ten percent increase in mean annual precipitation in March and October after 1975.
Brunetti et al.	2001	Northeastern Italy	Negative trend in the average annual number of wet days, and less wet days seasonally in the spring and autumn months.
Archer and Fowler	2004	Upper Indus Basin, Pakistan	No significant trend since 1895. However, significant increases in precipitation in winter, summer, and annually at several stations from 1961 to 1999 were noted.
Moberg and Jones	2005	Europe	Seasonal increases in precipitation intensity and frequency during the winter months.
Yu et al.	2006	Taiwan	Annual increase in rainfall in northern Taiwan. A decline in rainfall in the central and southern regions of the country were noted.
Partal and Kahya	2006	Turkey	A decrease in annual mean precipitation along the Black Sea coastline, and in the western and southern sections of the country.
Cheung et al.	2008	Ethiopia	No significant results in annual precipitation. A decline in precipitation from June to September in southwest and central Ethiopia was noted.
Osman and Sauerborn	2002	Ethiopia	A decline in summer precipitation during the latter half of the twentieth century.
Seleshi and Zasnke	2004	Ethiopia	A decline in annual precipitation in the eastern, southern, and southwestern regions.
Rodrigo and Trigo	2007	Iberian Peninsula	No significant change in the number of wet days, however, there was a decrease in daily intensity of rainfall on both annual and seasonal time scales.

Using daily data, Karl and Knight (1998) investigated monthly, seasonal, and annual precipitation patterns across the contiguous United States from 1919 to 1996. The authors found that precipitation increased (roughly 10%) since 1910. They found that the proportion of annual precipitation derived from extreme events has increased relative to more moderate events, and that the number of events had increased significantly in every region across the contiguous United States (Karl and Knight 1998).

Kunkel and Andsager (1999) studied long-term twentieth century trends in extreme precipitation for the United States and Canada from 1931-1996. Using the Kendall tau statistic, the authors found lengthy periods of below-average number of precipitation events in the 1930s and 1950s, and an above-average number of precipitation events in the early 1940s, early 1980s, and 1990s. Kunkel et al. (2003) examined temporal variations in extreme precipitation in the United States from 1895 to 2000 and found similar results to the Kunkel and Andsager (1999) study. The authors found that the frequency of heavy precipitation events was greater in the late nineteenth and early twentieth centuries. Heavy precipitation decreased around the 1930s, followed by a general increase into the 1990s. Overall, the authors found that the frequency of extreme precipitation events was as high around the start of the twentieth century as it was toward the end of the twentieth century.

Stafford et al. (2000) examined precipitation trends in Alaska from 1949 to 1998. The total precipitation was analyzed for linear trends using least squares regression and analysis of variance (ANOVA) was used to determine seasonal and regional changes in precipitation. The authors found an increase in total precipitation for three of the four seasons, while summer precipitation decreased at many stations (Stafford et al. 2000).

Table 2.2. Summary of Recent Studies on Precipitation Trends in the United States

Author(s)	Year	Location	Findings
Lettenmaier et al.	1994	Contiguous United States	An increase in precipitation from September through December was noted at 25 percent of the stations in the central part of the U.S.
Karl and Knight	1998	Contiguous United States	Extreme events has changed disproportionately and increased relative to more moderate events. The number of extreme events has increased significantly in every region across the contiguous United States.
Kunkel and Andsager	1999	United States and Canada	Results show below average precipitation events in the 1930s and 1950s, and above average precipitation events in the early 1940s, early 1980s, and 1990s were noted.
Kunkel et al.	2003	United States	Frequency of heavy precipitation events was greater in the late nineteenth and early twentieth centuries. Heavy precipitation decreased in the 1930s and increased into the 1990s.
Stafford et al.	2000	Alaska	Increase in total precipitation for three of the four seasons, while summer precipitation decreased at many stations.
Groisman et al.	2004	United States	Precipitation and very heavy precipitation increased during the twentieth century.

Groisman et al. (2004) published a compilation of changes in the hydrologic cycle in the contiguous United States using daily precipitation data from 1961 to 1990. Using linear trend estimates, the authors found that precipitation and very heavy precipitation increased during the twentieth century (Groisman et al. 2004).

Precipitation Studies in Texas

Few studies exist on the spatial and temporal precipitation patterns in Texas. A summary of recent studies is listed in Table 2.3. Lyons (1990) examined the spatial and temporal variability of monthly precipitation in Texas from 1923 to 1984 using synoptic analysis. Anomalously wet months in Texas correlated with a northward shift of high pressure, while dry months were associated with a southward shift in high pressure.

Harmel et al. (2003) examined long-term precipitation records from a rain gauge network located at the USDA-SC5 Blackland Experimental watershed facility near Riesel, Texas. The authors found increases in October rainfall, non-spring rainfall, and the number of rain days in both summer and fall.

Haragan (1978) examined the spatial and temporal variability of average precipitation of 63 stations in the Panhandle from 1944 to 1973. The author found a west-to-east precipitation gradient that increases near Miami in the month of May, whereas the same occurred over Palo Duro Canyon in June with a ridge extending southwestward to the town of Littlefield. In this analysis, the precipitation climatology showed that the local convection is influenced by topography in the Texas Panhandle.

Choi et al. (2008) examined a method to disaggregate daily rainfall into hourly precipitation in Texas. The method is based on measured precipitation data and generates disaggregated hourly hyetographs that match daily totals. This method can be applied and utilized to estimate precipitation intensity and duration.

Asquith (1998) examined depth-duration frequency (DDF) and intensity-duration frequency (IDF) of annual precipitation at the Tom Miller Dam on the Colorado River in Austin, Texas. Asquith (1998) computed DDF and IDF values and created a report with tables listing the frequency data in minutes, hours, and days. The values are considered applicable and can be used by the City of Austin and Travis County in times of heavy precipitation events.

Table 2.3. Summary of Recent Studies on Precipitation Trends in Texas

Author(s)	Year	Location	Findings
Lyons et al.	1990	Texas	Anomalously wet months correlated with a northward shift of high pressure. Dry months were associated with a southward shift in high pressure.
Harmel et al.	2003	North Central Texas	Increases in October rainfall, non-spring rainfall, and the number of rain days during the summer and fall months.
Choi et al.	2008	Texas	Examined a method to disaggregate daily precipitation into hourly values. This technique can be applied to estimate precipitation intensity and duration.
Asquith	1998	Austin, Texas	Created a report with tables listing precipitation frequency data in minutes, hours, and days. This report can be used in times of heavy precipitation events.

Summary

The research summarized in this chapter has addressed precipitation trends on global and local scales, and has revealed trends either spatially or temporally over many regions of the world. Although several studies show the spatial patterns of precipitation, many examined the temporal aspects that have resulted in an increase in precipitation towards the latter half of the twentieth century (Karl and Knight 1998; Kiely et al. 1998; Kunkel and Andsager 1999; Kunkel et al. 2003; Archer and Fowler 2004; and Groisman et al. 2004). When depicting changes in precipitation temporally, this may help answer fundamental questions about precipitation characteristics that have not been addressed previously. For example, are these events lasting longer in duration? Is the duration of storm systems changing?

CHAPTER 3

THE STUDY AREA

Location and Physical Geography of Texas

Texas is the largest state in the conterminous United States. It lies within latitudes 25°50' N to 36° 30' N and longitudes 93°31'W to 106°39'W. Texas is divided into 254 counties and covers an area of 678,051 km^2 (261,797 mi^2) (Figure 3.1). The state occupies approximately seven percent of the total U.S. water and land area with 950 km (367 mi) of coastline bordering the western Gulf of Mexico (Texas Almanac 2007). Along with the Gulf of Mexico, the Rio Grande River to the south and west, the Red River to the north, and Sabine River to the east all present natural borders.

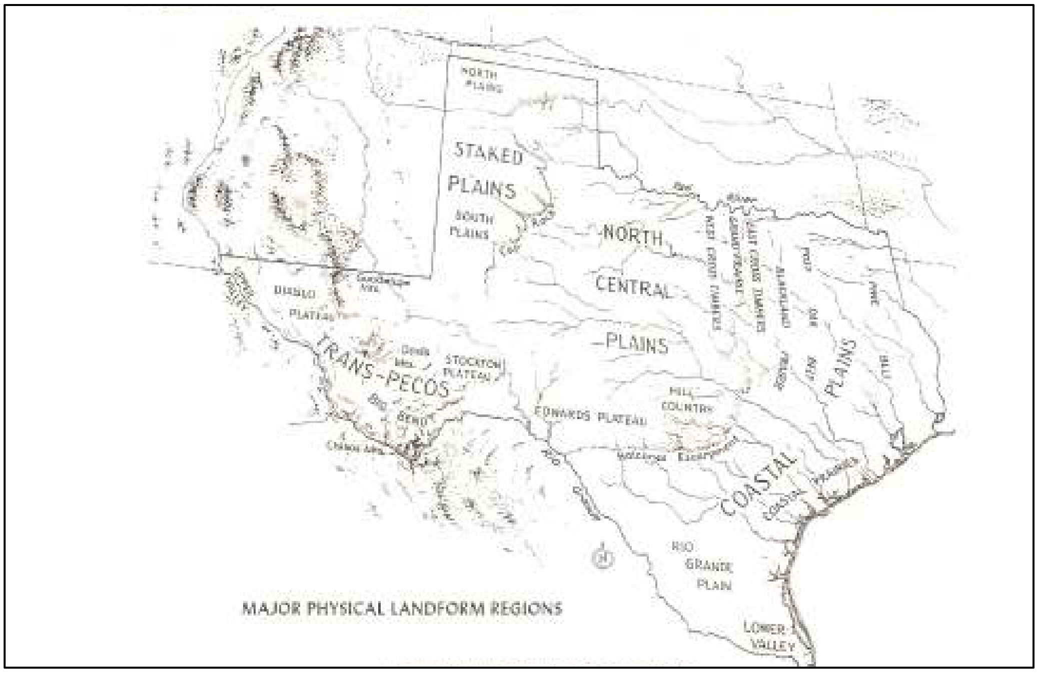
Source: TAMIU, 2007.

Figure 3.1. The Study Area - Texas

The physiography of Texas spans a wide range of features from the High Plains to the north, the Guadalupe Mountains to the west, the Black Prairie to the east, and the coastal plains in the southeast and southern portions of the state. In Central Texas, the dominant landform is the Balcones Escarpment. This feature, originally formed along a fault zone, produced a sharp topographic break between the Great Plains and Gulf Coastal Plain physiographic boundaries (Petersen 1995) (Figure 3.2). Much of the state consists of flat plains, prairies, and plateaus.

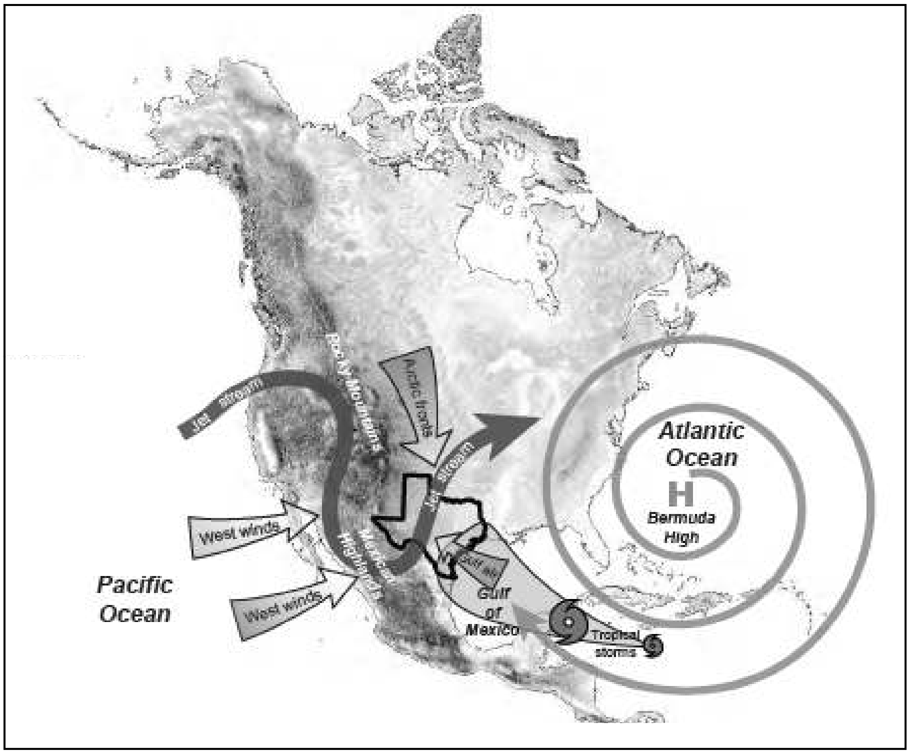
Climatic variations exist from Texas' unique geographic location, movement of seasonal air masses, winds, and pressure systems (Figure 3.3). According to the Köppen climate classification system, Texas is a transition region between arid (BW), semi-arid (BS), and humid subtropical (Cfa) climates. The Gulf of Mexico moderates temperatures along the Gulf Coast, and both the Gulf of Mexico and the Pacific Ocean provide a major source of moisture for the region. The Rocky Mountains guide arctic cold fronts that move southward during the fall, winter, and early spring months. This allows the cold air masses to enter the state.

Mean annual temperatures across the state vary along latitudinal lines except for the mountainous regions in far west Texas. Based upon temperature data for the period 1961-1990, average temperatures range from 23.3 °C (74 °F) in the southern-most region of Texas near Brownsville, to 12.7 °C (55 °F) in the northern regions of the Panhandle (Bomar 1999). Average temperatures for the mountains in west Texas vary from 13.8 °C (57 °F) to 16.6 °C (62 °F) (Bomar 1999).



Source: Petersen, 1995.

Figure 3.2. Physiographic Boundaries in Texas

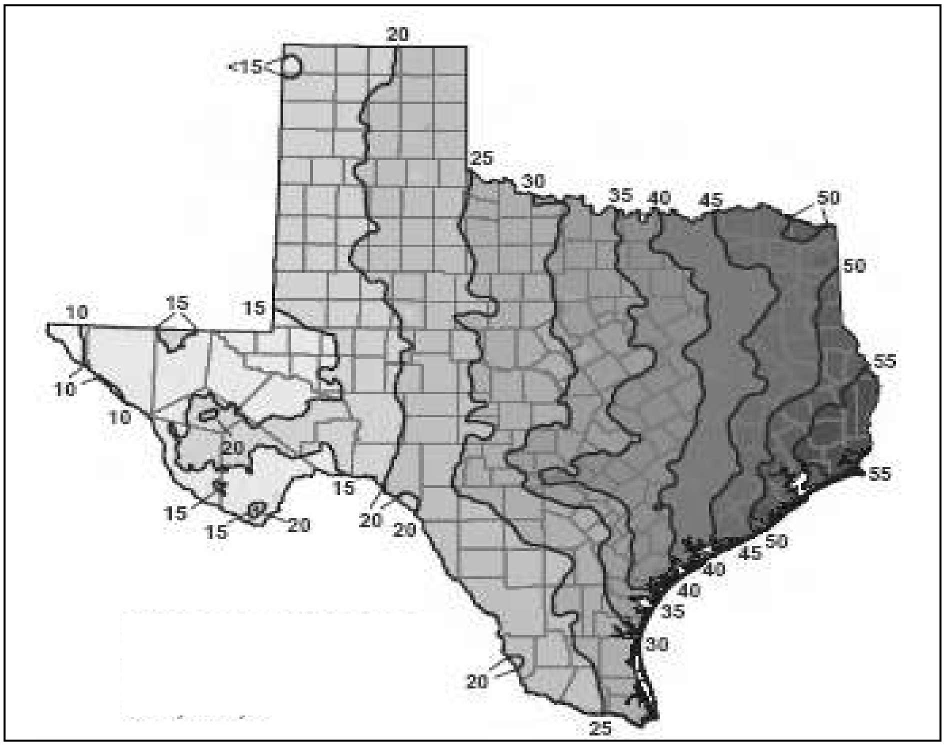


Source: Pittman, E.G., et al. 2007.

Figure 3.3. The interaction of seasonal air masses that affect the weather and climate in Texas.

Precipitation in Texas

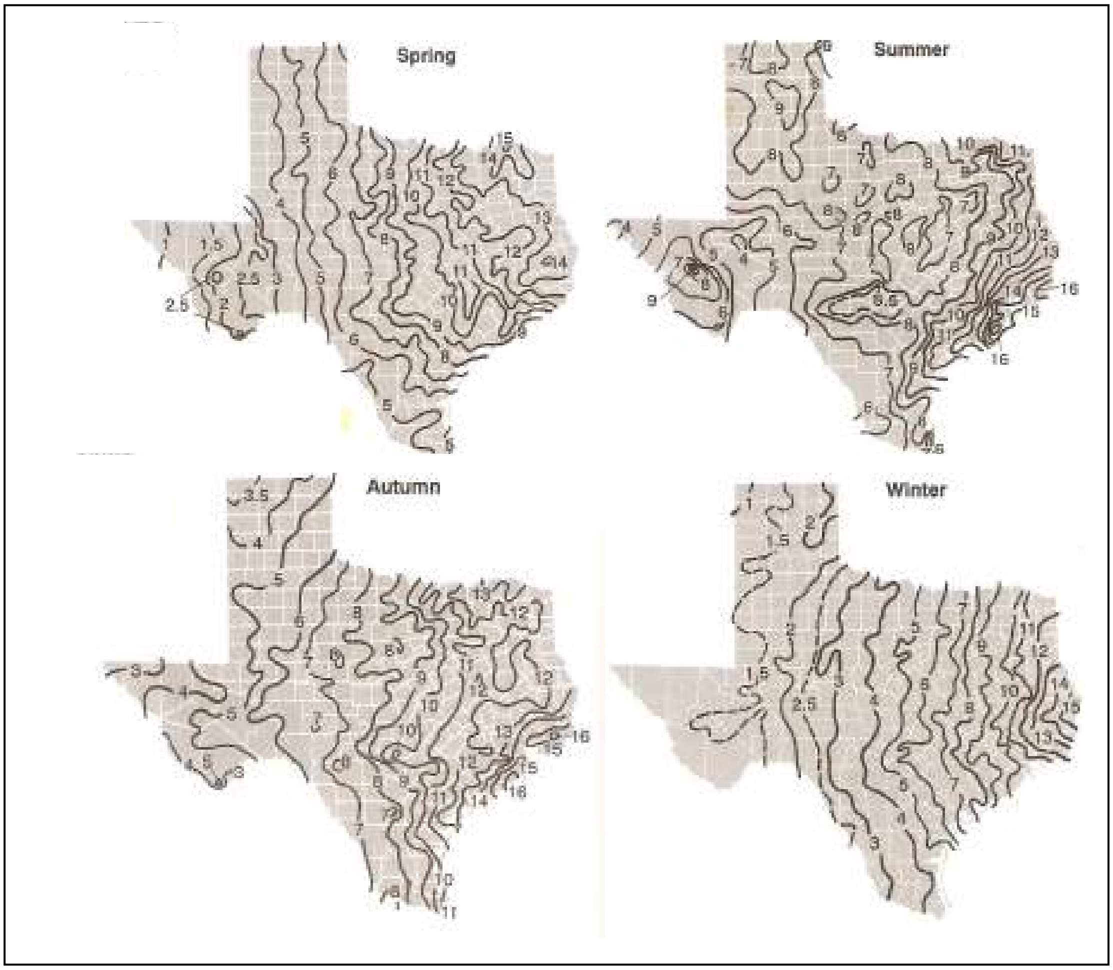
Based upon climatological data for the period 1961 to 1990, Texas is a transitional state between two radical precipitation regimes. Average annual precipitation in Texas decreases westward from 21.9 cm (8.63 in) at La Tuna near El Paso in the western region of the state, to 149.6 cm (58.93 in) near Orange, in the lower Sabine River valley in East Texas (Bomar, 1999) (Figure 3.4). In general, mean annual rainfall distribution in Texas follows longitudinal lines, and decreases approximately 25.4 mm (1 in) for each 24.1 km (15 mi) moving from east to west (Bomar 2001). The mountains in west Texas, and the Balcones Escarpment in central Texas, are characterized by an increase in average annual precipitation, which presents the most obvious exception to the east-to-west increase in aridity (Swanson, 1995).



Source: Pittman, E.G., et al. 2007.

Figure 3.4. Average annual precipitation (in) for Texas, 1971 - 2000.

Figure 3.5 illustrates average precipitation (in) for each season based upon data from 1961-1990 (Bomar 1999). Over much of the state, spring is the wettest season of the year; however west Texas receives most of its rainfall during the summer months from convective storms. In the north central, central, and southeastern areas of the state, a secondary peak of rainfall at the end of summer or at the onset of autumn occurs due to tropical activity.



Source: Bomar, George, 1999.

Figure 3.5. Average seasonal precipitation (in) in Texas, 1961 - 1990.

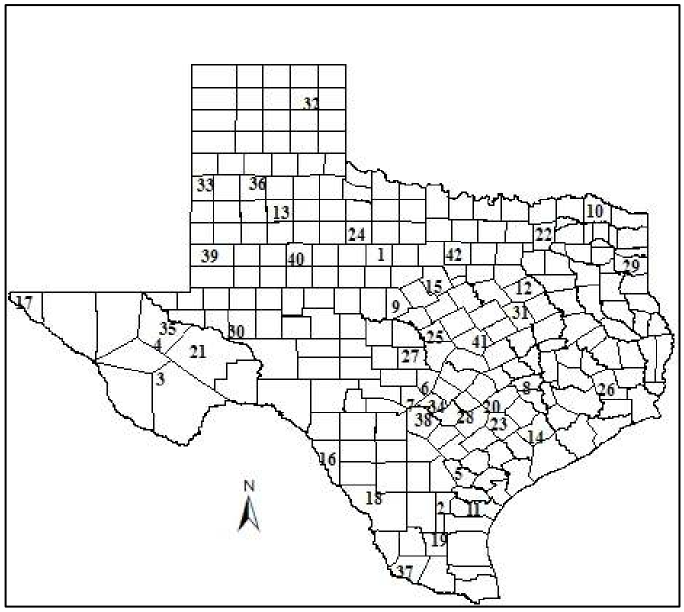
CHAPTER 4

METHODOLOGY AND DATA SOURCES

The National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) developed the United States Historical Climatology Network (USHCN) to analyze U.S. climate and to assist in detecting regional climate change. The USHCN provides high quality data sets of meteorological variables from 1221 stations from the U.S. Cooperative Observing Network within the 48 contiguous United States (Easterling et al. 1996). The digital archive contains monthly and daily precipitation data for selected stations in the United States. The data for each of the stations in the USHCN are subjected to quality control, homogeneity testing, and adjustment procedures (Easterling et al. 1996). The selection of each station by the USHCN and the series of adjustments applied to the data make this database the best long-term precipitation data available for the contiguous United States. The original period of record varies for each station; however, the stations were selected for the USHCN based on length of period of record, percent missing data, number of station moves, and spatial coverage (Easterling et al. 1996). Metadata include the station history, information concerning station moves, instrumentation, observing times, and elevation.

Data Preparation

This study used precipitation data from 42 stations in Texas covering the period of 1932 – 2002 (Figure 4.1). A list of the stations along with their station name, geographic coordinates, and elevation is given in Table 4.1. Due to similar climatic characteristics such as temperature, humidity, and precipitation, the stations were grouped into seven distinct regions: west, Panhandle, north central, northeast, central, southeast, and south (Table 4.2). For this study, the data set consists of monthly precipitation totals from the USHCN's database, and daily data from the National Climatic Data Center (NCDC). The daily data from the NCDC will be used to establish the number of days each station by month experienced at least 0.1 mm of precipitation. Daily data from the NCDC prior to 1954 is not available. For this study, the period of record for the daily data is 1955-2002. Although the most common units to use in an analysis of this caliber would be metric, this study will be using English units provided by the USHCN. A list of conversions is included in Appendix A.



Source: Easterling, D. R., et al., 1996.

Figure 4.1. Locations of the 42 Stations

Table 4.1. Texas Weather Stations with Coordinates and Elevation Data

	Station Name	Lat N	Long W	Elevation m		Station Name	Lat N	Long W	Elevation m
1	Albany	32.73	99.28	527	22	Greenville	33.15	96.12	163
2	Alice	27.73	98.07	54	23	Hallettsville	29.47	96.95	124
3	Alpine	30.37	103.67	1376	24	Haskell	33.17	99.75	467
4	Balmorhea	30.98	103.75	796	25	Lampasas	31.05	98.18	336
5	Beeville	28.45	97.70	82	26	Liberty	30.05	94.80	9
6	Blanco	30.10	98.42	435	27	Llano	30.75	98.68	266
7	Boerne	29.80	98.72	395	28	Luling	29.67	97.65	161
8	Brenham	30.17	96.40	94	29	Marshall	32.53	94.35	111
9	Brownwood	31.72	99.00	423	30	McCamey	31.13	102.20	917
10	Clarksville	33.63	95.03	134	31	Mexia	31.68	96.48	153
11	Corpus Christi	27.77	97.50	6	32	Miami	35.70	100.63	730
12	Corsicana	32.08	96.47	136	33	Muleshoe	34.23	102.73	1124
13	Crosbyton	33.65	101.25	1000	34	New Braunfels	29.73	98.12	198
14	Danevang	29.05	96.23	0	35	Pecos	31.42	103.50	796
15	Dublin	32.10	98.33	423	36	Plainview	34.18	101.70	1028
16	Eagle Pass	28.70	100.48	329	37	Rio Grande City	26.38	98.87	37
17	El Paso	31.80	106.40	1235	38	San Antonio	29.53	98.47	246
18	Encinal	28.03	99.42	153	39	Seminole	32.72	102.67	1010
19	Falfurrias	27.23	98.13	34	40	Snyder	32.72	100.92	741
20	Flatonia	29.67	97.12	190	41	Temple	31.08	97.32	207
21	Ft. Stockton	30.88	102.87	917	42	Weatherford	32.77	97.82	253

Table 4.2. List of Texas Stations by Region

Region	Station Name		Region	Station Name
West	El Paso		Central	Lampassas
	Balmorhea			Temple
	Alpine			Llano
	Pecos			Blanco
	Ft. Stockton			Boerne
	McCamey			New Braunfels
				San Antonio
Panhandle	Seminole			Luling
	Snyder			Flatonia
	Crosbyton			Hallettsville
	Muleshoe			
	Plainview		South	Alice
	Miami			Eagle Pass
				Encinal
North Central	Haskell			Beeville
	Albany			Corpus Christi
	Brownwood			Falfurrias
	Dublin			Rio Grande City
	Weatherford			
			Southeast	Brenham
Northeast	Mexia			Danevang
	Corsicana			Liberty
	Greenville			
	Clarksville			
	Marshall			

Missing Data

It is common practice to screen the data for missing values before the data can be used in the subsequent analysis. There are several reasons why precipitation may be missing from the database. Data may be missing due to rain gauge malfunction, floods, tornadoes, landslides, hurricanes, vandalism, and errors in reporting. Data estimation procedures were conducted to fill in the missing values. A common method to estimate missing precipitation data from a data set is regression analysis. For example, the data from one station (B) is compared with those from another station (A), and the hypothesis is made that simultaneous measurements at A and B have a constant relationship (Linacre 1992, 66). The missing precipitation values for each of the stations were estimated by using precipitation values from neighboring stations. The regression model allowed this study to develop estimates and substitute missing monthly and precipitation day data for the 42 Texas stations. There was approximately less than 10 percent of the data missing between 1932 and 2002 for all stations total, and the regression models were used to estimate any missing values.

Precipitation Variables

The monthly data from the USHCN was used to develop annual and seasonal totals for the 42 stations. Annual totals were tabulated from the monthly data for each station of each year during the period of record. Using the monthly precipitation data, seasonal totals for each year were created as follows: Winter (December of the previous year, January, February); Spring (March, April, May); Summer (June, July, August); and Fall (September, October, November).

The following three groups of variables were calculated for each station using the monthly data from the USHCN and daily data from the NCDC for the period of record.

(1) Total precipitation: The annual and seasonal amounts of precipitation. Period of record: 1932 – 2002.

(2) Precipitation Days: The number of days with a minimum precipitation of 0.1mm for each season and year. Period of record: 1955 – 2002.

(3) Intensity Index: The intensity index (total precipitation divided by the number of days with precipitation) for each season and year. Period of record: 1955 – 2002.

The seasonal and annual calculations were performed from the monthly and daily data using Microsoft Excel. Once the annual and seasonal totals were calculated, the data for each station was transferred to SPSS for statistical analysis.

Statistical Analysis and GIS Application

A variety of statistical techniques, both parametric and non-parametric were used to assess precipitation patterns in Texas. In applying these statistical tests, it was possible to examine linear trends, and whether or not areas around the state are becoming increasingly dry, wet, or that no changes exist.

Descriptives

Basic descriptive statistics computed for this study included the mean, standard deviation, maximum, minimum, deciles, probability, and coefficient of variation. Descriptive statistics were computed for each station for total precipitation, precipitation days, and precipitation intensity. Probability was computed using the precipitation day data and the mean values are illustrated in a series of maps.

Linear Regression

Existence of a temporal trend was tested using linear regression on total precipitation, precipitation days, and precipitation intensity for all stations during the period of record. Using a linear regression model to analyze the statistical relationship between variables is common in climatological research. As an example, Rodrigo and Trigo (2007) utilized a linear regression model to show trends in daily rainfall in the Iberian Peninsula over a 51-year period. Karl and Knight (1998) utilized a linear regression model to illustrate trends in precipitation amount, frequency, and intensity for a period of 86 years during the twentieth century for the United States. In this analysis, linear regression was used to estimate the slope coefficient of the temporal trend in each of the three precipitation variables. The slope of the line indicates direction and strength of the trend. Validation of the trend models consists of two parts: (1) a statistically significant slope coefficient, and (2) normally distributed residuals (using Kolmogorov-Smirnov statistical test). Tests were evaluated at the 95% level.

Probability of Precipitation

For each station, the probability of a day with precipitation was calculated using daily data from 1955 – 2002. This value indicates the percentage of seasonally wet and dry days at each station. The probability of a day with precipitation was calculated as follows:

$$\text{Probability of a day with precipitation} = \frac{100\ (\text{number of days with precipitation})}{\text{Number of days in season}}$$

GIS

This study uses a geographic analysis mapping program (ArcMAP) for visualizing and spatially analyzing the linear regression results for total precipitation, precipitation days, and precipitation intensity for all 42 stations. The spatial distribution of the trends was depicted by using graduated symbol maps. Annual and seasonal mean values for the coefficient of variability and probability of a day with precipitation was mapped for all 42 stations.

CHAPTER 5

RESULTS

The diversity in climate conditions for the state of Texas varies from the arid conditions in the west to wetter conditions in the eastern section of the state. The variety of weather elements that characterize the climate of Texas is not due to its size, but to its position on the North American continent. Texas weather is unique and is due to its proximity to the warm Gulf of Mexico waters, the wind flow from the eastern North Pacific, and the cooler air from the north. This keeps Texas weather in a constant state of change. Precipitation decreases from east to west with half of the state, mainly the western half, receiving less than 30 inches of precipitation on average per year (Bomar 1999). For this study, Texas is divided into seven regions with similar climatic characteristics such as temperature, humidity, and precipitation (Figure 5.1). The seven regions include west, Panhandle, north central, northeast, central, southeast, and south.

This chapter presents a description of the climate for each region and station in Texas, and the results of the statistical analyses for the 42 study stations. The climate for the individual stations was determined using the Koppen climate classification system. Annual precipitation and annual temperature data from the USHCN from 1971 – 2000 were used to determine the climate for the individual stations. The stations used in this study were classified as either as B (arid or semi-arid) climate, or a C (humid subtropical) climate type. Descriptive statistics are presented for annual and seasonal total precipitation, precipitation days, and precipitation intensity. For each station, the mean, standard deviation, maximum and minimum, deciles, the coefficient of variation (CV), and probability is given in a series of tables. Second, linear regression was used to determine the magnitude of the linear temporal trend in annual and seasonal total precipitation, precipitation days, and precipitation intensity. Statistical significance was at the 0.05 level. For each region, a discussion of the results for annual and seasonal precipitation is presented.

West Texas

West Texas is mountainous and borders New Mexico to the west and Mexico to the south. In this region there are three distinct Köppen climate types; BWk (mid-latitude cold desert), BSh (semi-arid hot steppe), BSk (semi arid cold steppe), and BWh (arid hot desert). The six weather stations in this region are El Paso (17), Balmorhea (4), Alpine (3), Pecos (35), Ft. Stockton (21), and McCamey (30) (Figure 5.1).

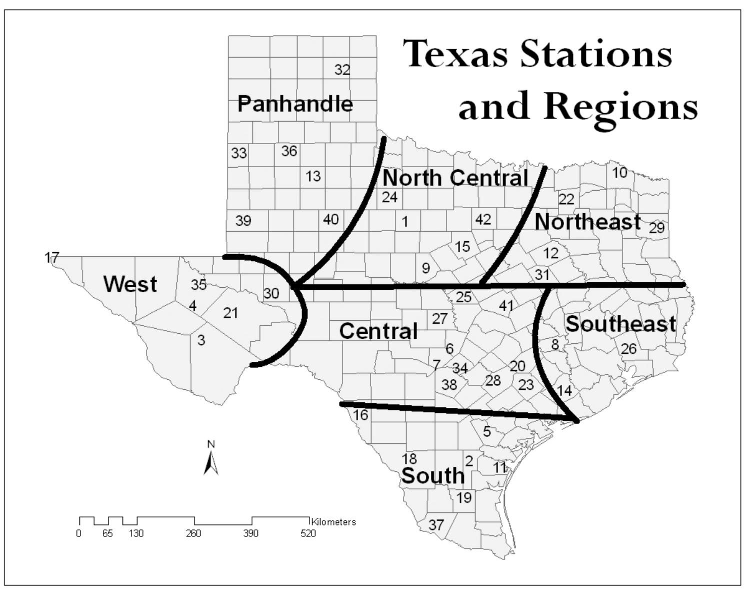


Figure 5.1. Texas Weather Stations and Regions

El Paso

El Paso is located on the far western edge of Texas and is classified as a middle latitude desert climate (Köppen climate classification BWh) with hot summers, low humidity, and mild to cool, dry winters. Descriptive statistics for total precipitation, precipitation days, precipitation intensity, and probability are given in Tables 5.1, 5.2, 5.3, and 5.4. Annual total precipitation averages 8.33 inches, of which the largest portion occurs during the summer months. Annually, this station receives an average of 22.25 days of precipitation. Precipitation intensity averages 0.3901 inch per day. Seasonally, the minimum amount of precipitation occurred during the winter months, whereas the maximum amount of precipitation occurred during the summer months. A comparison of the CV suggests that the summer months have the smallest amount of precipitation variability, while spring is the most variable. For precipitation days, the CV suggests that the summer months have the least variability, while the spring is the most variable. The winter months show the smallest amount of variability in precipitation intensity, while fall is the most variable. The median values of total precipitation, precipitation days, and precipitation intensity is less than their respective mean values, except for summer and spring precipitation intensity. The decile values are given in each of the descriptive statistic tables below and provide an indication of the spread of observations for the period of record. The results show that in 10% of the years on record, annual precipitation will be at or below 5.36 inches. Ninety percent of the years will be at or below 12.53 inches, with 10% being above 12.53 inches. For precipitation days, results show that in 10% of the years on record, annual number of days will be at or below 14 days. Ninety percent will be at or below 32.1 days, with 10% being above 32.1 days.

For precipitation intensity, results show that 10% of the years on record was at or below 0.30 inch per day. Ninety percent of the years had 0.48 inch per day or less. Probability results show that this station has a 6.09% chance that any one day in the year would receive 0.1mm of rain. No significant trend in the precipitation variables was discerned (Table 5.5).

Table 5.1. El Paso – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		8.33	1.34	2.50	3.53	0.84
Std. Deviation		2.96	0.88	1.78	1.75	0.87
Minimum		2.73	0.00	0.16	0.80	0.00
Maximum		17.19	4.59	9.08	9.44	5.02
Coefficient of Variation		0.35	0.66	0.71	0.49	1.02
Deciles Percentiles	10	5.36	0.37	0.66	1.52	0.13
	20	5.76	0.61	0.90	1.95	0.25
	30	6.43	0.92	1.60	2.50	0.38
	40	7.07	0.97	1.93	2.89	0.48
	50	7.76	1.21	2.30	3.25	0.58
	60	8.28	1.34	2.50	3.71	0.67
	70	9.39	1.51	2.83	4.11	1.04
	80	10.95	1.97	3.38	4.82	1.20
	90	12.53	2.62	5.01	6.14	1.73

Table 5.2. El Paso – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		22.20	4.60	6.10	8.80	2.40
Std. Deviation		6.30	3.00	3.50	3.50	2.20
Minimum		12.00	00	00	2.00	00
Maximum		36.00	11.00	16.00	16.00	11.00
Coefficient of Variation		0.20	0.60	0.50	0.30	0.90
Deciles Percentile	10	14.00	1.00	2.00	3.90	0.00
	20	16.80	2.00	3.00	6.00	1.00
	30	18.00	2.70	4.00	7.00	1.00
	40	18.60	3.60	5.00	8.00	1.00
	50	21.50	4.00	5.50	9.00	2.00
	60	24.00	5.00	6.00	10.00	2.00
	70	26.30	7.00	7.00	11.00	3.00
	80	28.20	7.20	9.40	12.00	3.20
	90	32.10	9.10	12.00	14.00	5.10

Table 5.3. El Paso – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.39	0.28	0.41	0.42	0.29
Std. Deviation		0.07	0.11	0.17	0.11	0.15
Minimum		0.26	0.00	0.00	0.23	0.00
Maximum		0.52	0.66	0.93	0.73	0.71
Coefficient of Variation		0.18	0.41	0.40	0.26	0.51
Deciles Percentile	10	0.30	0.14	0.23	0.26	0.00
	20	0.31	0.23	0.28	0.31	0.17
	30	0.33	0.24	0.31	0.34	0.24
	40	0.35	0.25	0.35	0.40	0.26
	50	0.38	0.27	0.40	0.43	0.30
	60	0.42	0.29	0.44	0.47	0.32
	70	0.44	0.32	0.47	0.48	0.34
	80	0.45	0.35	0.50	0.52	0.39
	90	0.48	0.41	0.61	0.57	0.47

Table 5.4. El Paso – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		6.09	5.20	6.65	9.75	2.62
Std. Deviation		1.73	3.40	3.86	3.91	2.45
Variance		3.01	11.61	14.91	15.29	6.02
Minimum		3.28	0.00	0.00	2.19	0.00
Maximum		9.86	12.22	17.39	17.58	11.95
Deciles Percentile	10	3.83	1.11	2.17	4.28	0.00
	20	4.60	2.22	3.26	6.59	1.08
	30	4.93	3.00	4.34	7.69	1.08
	40	5.09	4.00	5.43	8.79	1.08
	50	5.89	4.44	5.97	9.89	2.17
	60	6.57	5.55	6.52	10.98	2.17
	70	7.20	7.77	7.60	12.08	3.26
	80	7.72	8.00	10.21	13.18	3.47
	90	8.79	10.11	13.04	15.38	5.54

Table 5.5. El Paso – Linear Regression Results

El Paso, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.020	0.14	0.15	.031
Winter	0.005	0.31	0.05	.015
Fall	0.000	0.99	0.05	.000
Summer	0.017	0.07	0.59	.045
Spring	-0.001	0.86	0.01	.000
Precipitation Days				
Annual	0.106	0.07	0.92	.061
Winter	0.023	0.42	0.61	.013
Fall	0.001	0.36	0.32	.017
Summer	0.033	0.31	0.97	.020
Spring	0.027	0.19	0.14	.034
Precipitation Intensity				
Annual	-0.001	0.34	0.40	.023
Winter	0.001	0.21	0.30	.034
Fall	-0.002	0.14	0.42	.045
Summer	-0.001	0.68	0.89	.004
Spring	-0.001	0.23	0.83	.031

Balmorhea

Balmorhea is classified as a middle latitude desert climate (Köppen climate classification BSk) semi-arid with hot summers, and mild to cool winters. Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.6, 5.7, 5.8, and 5.9. Annual total precipitation averages 13.03 inches of which the largest portion occurs during the fall and summer months. Annually, this station receives an average of 27.71 days of precipitation per year, most of which occurs during the summer months. Precipitation intensity averages 0.47 inch per day on an annual basis with the fall months receiving the highest precipitation intensity. A comparison of the CV suggests that the summer months have the smallest amount of precipitation variability, while fall is the most variable. For precipitation days, the CV suggests that the summer months have the least variability, while the winter is the most variable. The summer months show the smallest amount of variability in precipitation intensity, while fall is the most variable. The data show that over the period of record, 50% of the total precipitation, precipitation days, and precipitation intensity is below their respective mean values. The results show that for 10% of the years on record, total annual precipitation will be at or below 6.59 inches. Ninety percent will be at or below 20.90 inches, with 10% above 20.90 inches. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 19 days. Ninety percent will be at or below 41 days, with 10% being above 41 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.33 inch per day. Ninety percent of the years had 0.65 inch per day or less. Probability results show that this station has a 7.59% chance of an increase in annual precipitation days per century. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values. Probability results show that this station has a 7.59% chance that any one day in the year would receive 0.1mm of rain. No significant trend in the precipitation variables was discerned (Table 5.10).

Table 5.6. Balmorhea – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		13.03	1.74	4.19	4.80	2.31
Std. Deviation		5.58	1.34	3.47	2.67	1.58
Minimum		3.41	0.00	0.22	0.68	0.16
Maximum		28.15	6.71	19.57	12.55	7.97
Coefficient of Variation		0.42	0.66	0.82	0.55	0.68
Deciles Percentile	10	6.59	0.42	0.85	2.03	0.62
	20	8.79	0.60	1.53	2.49	0.87
	30	9.59	0.89	2.44	2.86	1.12
	40	10.63	1.15	2.89	3.38	1.58
	50	11.90	1.46	3.35	4.43	2.09
	60	13.45	1.78	3.73	5.41	2.49
	70	14.68	2.12	4.76	6.02	3.08
	80	17.30	2.76	6.26	6.97	3.52
	90	20.90	3.49	8.98	8.59	4.39

Table 5.7. Balmorhea – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	47	48	48
	Missing	0	0	1	0	0
Mean		27.71	4.40	8.06	10.23	5.06
Std. Deviation		7.72	3.38	4.32	4.11	2.67
Minimum		13	0	1	3	1
Maximum		45	14	17	18	13
Coefficient of Variation		0.27	0.76	0.53	0.40	0.52
Deciles Percentile	10	19.00	.90	2.00	4.00	2.00
	20	22.00	1.00	4.00	6.00	3.00
	30	22.00	2.00	5.40	8.00	3.00
	40	24.00	3.00	7.00	9.60	4.00
	50	25.50	3.50	8.00	10.00	5.00
	60	27.40	5.00	8.00	11.00	5.40
	70	31.60	6.00	10.00	12.00	6.00
	80	36.00	6.40	12.40	14.20	7.00
	90	41.00	9.10	14.20	17.00	9.10

Table 5.8. Balmorhea – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	45	47	48	48
	Missing	0	3	1	0	0
Mean		0.47	0.42	0.60	0.49	0.57
Std. Deviation		0.15	0.25	0.46	0.27	0.62
Minimum		0.24	0.00	0.06	0.11	0.04
Maximum		1.15	1.70	2.62	1.66	4.14
Coefficient of Variation		0.32	0.59	0.77	0.54	1.09
Deciles Percentiles	10	0.33	0.25	0.25	0.23	0.17
	20	0.36	0.28	0.34	0.32	0.21
	30	0.38	0.33	0.37	0.39	0.31
	40	0.41	0.35	0.41	0.41	0.35
	50	0.46	0.38	0.43	0.43	0.41
	60	0.49	0.40	0.50	0.49	0.44
	70	0.51	0.43	0.60	0.54	0.56
	80	0.60	0.53	0.77	0.56	0.81
	90	0.64	0.61	1.24	0.74	1.17

Table 5.9. Balmorhea – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	47	48	48
	Missing	0	0	1	0	0
Mean		7.59	4.88	8.76	11.24	5.50
Std. Deviation		2.11	3.76	4.70	4.51	2.90
Variance		4.48	14.17	22.10	20.41	8.46
Minimum		3.56	0.00	1.08	3.29	1.08
Maximum		12.32	15.55	18.47	19.78	14.13
Deciles Percentiles	10	5.20	1.00	2.17	4.39	2.17
	20	6.02	1.11	4.34	6.59	3.26
	30	6.02	2.22	5.86	8.79	3.26
	40	6.57	3.33	7.60	10.54	4.34
	50	6.98	3.88	8.69	10.98	5.43
	60	7.50	5.55	8.69	12.08	5.86
	70	8.65	6.66	10.86	13.18	6.52
	80	9.86	7.11	13.47	15.60	7.60
	90	11.23	10.11	15.43	18.68	9.89

Table 5.10. Balmorhea – Linear Regression Results

Balmorhea, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	-0.005	0.86	0.49	.000
Winter	-0.004	0.61	0.35	.004
Fall	-0.005	0.81	0.01	.001
Summer	0.005	0.73	0.32	.002
Spring	-0.004	0.66	0.50	.003
Precipitation Days				
Annual	0.037	0.64	0.17	.005
Winter	0.025	0.46	0.32	.012
Fall	0.001	0.98	0.49	.000
Summer	0.030	0.47	0.98	.011
Spring	-0.008	0.74	0.53	.002
Precipitation Intensity				
Annual	-0.001	0.30	0.40	.023
Winter	0.001	0.60	0.04	.006
Fall	0.004	0.32	0.00	.022
Summer	0.001	0.65	0.02	.004
Spring	-0.001	0.80	0.01	.001

Alpine

Alpine is the southern most station in the west Texas division. This station is classified as a middle latitude desert climate (Köppen climate classification BSk) semi-arid with hot summers, and mild to cool winters. Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.11, 5.12, 5.13, and 5.14. Annual total precipitation averages 15.99 inches, of which the largest portion occurs during the summer months. Annually, this station receives an average of 32.08 days of precipitation, most of which occurs during the summer months. Precipitation intensity averages 0.50 inch per day on an annual basis, with the summer and fall months receiving the highest precipitation intensity. A comparison of the CVs suggests that the summer season has the smallest amount of precipitation variability, while the winter is most variable. For precipitation days, the CV suggests that the summer season has the smallest amount of variability, while the winter is most variable.

For precipitation intensity, fall months have the smallest amount variability, while the spring is most variable. The data show that over the period of record, 50% of the total precipitation, precipitation days, and precipitation intensity is below their respective mean values. The results show that for 10% of the years on record, total annual precipitation will be at or below 9.25 inches. Ninety percent will be at or below 22.89 inches, with 10% above 22.89 inches. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 22.90 days. Ninety percent will be at or below 41 days, with 10% being above 41 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.36 inch per day. Ninety percent of the years had 0.71 inch per day or less. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values. Probability results show that this station has an 8.78% chance that any one day in the year would receive 0.1mm of rain. No significant trend in the precipitation variables was discerned (Table 5.15).

Table 5.11. Alpine – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		15.99	1.63	4.48	7.73	2.13
Std. Deviation		4.99	1.14	2.89	2.86	1.47
Minimum		7.72	0.03	0.71	2.22	0.14
Maximum		33.09	5.75	13.92	16.36	7.57
Coefficient of Variation		.0.31	0.69	0.64	0.36	0.68
Deciles Percentiles	10	9.24	0.36	1.35	4.50	0.66
	20	11.80	0.71	2.08	5.08	0.93
	30	13.11	0.90	2.55	5.71	1.21
	40	13.98	1.08	2.98	6.75	1.64
	50	15.08	1.25	3.72	7.48	1.83
	60	16.78	1.71	4.21	8.41	2.10
	70	18.04	2.00	5.60	9.32	2.42
	80	20.15	2.61	7.04	10.20	3.17
	90	22.89	3.46	8.46	11.89	4.03

Table 5.12. Alpine – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		32.08	4.15	8.77	14.75	4.90
Std. Deviation		8.33	2.85	3.85	4.97	3.00
Minimum		20	0	3	5	0
Maximum		52	14	18	26	15
Coefficient of Variation		0.25	0.68	0.43	0.33	0.61
Deciles Percentiles	10	22.90	1.00	4.00	8.80	1.90
	20	25.60	1.80	5.00	11.00	3.00
	30	27.70	3.00	6.70	12.00	3.00
	40	28.60	3.00	7.00	13.00	4.00
	50	30.00	3.50	8.00	14.00	4.00
	60	31.00	4.40	9.00	16.00	5.00
	70	34.30	6.00	10.30	17.00	6.00
	80	40.20	6.00	11.20	18.20	6.20
	90	45.40	8.00	15.10	23.10	9.10

Table 5.13. Alpine – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.50	0.36	0.50	0.55	0.44
Std. Deviation		0.12	0.22	0.16	0.23	0.44
Minimum		0.33	0.00	0.21	0.20	0.00
Maximum		0.83	1.23	1.04	1.52	3.28
Coefficient of Variation		0.23	0.62	0.32	0.41	0.99
Deciles Percentiles	10	0.36	0.09	0.32	0.32	0.15
	20	0.41	0.20	0.38	0.38	0.27
	30	0.43	0.27	0.41	0.43	0.33
	40	0.45	0.32	0.44	0.46	0.34
	50	0.47	0.33	0.45	0.50	0.38
	60	0.52	0.36	0.50	0.53	0.42
	70	0.54	0.41	0.58	0.60	0.45
	80	0.58	0.48	0.65	0.69	0.50
	90	0.71	0.62	0.74	0.86	0.59

Table 5.14. Alpine – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		8.78	4.60	9.53	16.20	5.32
Std. Deviation		2.28	3.16	4.18	5.47	3.26
Variance		5.21	10.03	17.50	29.93	10.67
Minimum		5.47	0.00	3.26	5.49	0.00
Maximum		14.24	15.55	19.56	28.57	16.30
Deciles Percentiles	10	6.27	1.11	4.34	9.67	2.06
	20	7.01	2.00	5.43	12.08	3.26
	30	7.58	3.33	7.28	13.18	3.26
	40	7.83	3.33	7.60	14.28	4.34
	50	8.21	3.88	8.69	15.38	4.34
	60	8.49	4.88	9.78	17.58	5.43
	70	9.39	6.66	11.19	18.68	6.52
	80	11.01	6.66	12.17	20.00	6.73
	90	12.43	8.88	16.41	25.38	9.89

Table 5.15. Alpine – Linear Regression Results

Alpine	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.012	0.68	0.75	.002
Winter	-0.006	0.33	0.10	.013
Fall	0.007	0.68	0.07	.002
Summer	0.012	0.48	0.89	.008
Spring	-0.003	0.69	0.12	.002
Precipitation Days				
Annual	0.136	0.14	0.64	.051
Winter	0.007	0.80	0.26	.001
Fall	0.001	0.96	0.68	.000
Summer	0.084	0.12	0.82	.056
Spring	0.046	0.18	0.54	.042
Precipitation Intensity				
Annual	0.001	0.61	0.53	.006
Winter	0.002	0.35	0.32	.018
Fall	0.001	0.91	0.19	.000
Summer	-0.004	0.08	0.15	.064
Spring	0.001	0.70	0.00	.003

Pecos

The climate of Pecos is classified as a middle latitude desert climate (Köppen climate classification BWh) with hot summers, low humidity, and mild to cool winters. Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.16, 5.17, 5.18, and 5.19. Annual total precipitation averages 10.37 inches, of which the largest portion occurs during the summer and fall months. Annually, this station receives an average of 23.44 days of precipitation, most of which occurs during the fall and summer months. Precipitation intensity averages 0.48 inch per day on an annual basis, with the summer and fall months receiving the highest precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual and summer precipitation days. A comparison of the CV suggests that the summer season has the smallest amount of precipitation variability, while spring is the most variable. For precipitation days, the CV suggests that the summer season has the smallest amount of variability, while the fall is the most variable. The summer months have the smallest variability with regards to precipitation intensity, while the winter is most variable. The median values of total precipitation, precipitation days, and precipitation intensity is less than their respective mean values except for annual and summer season precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 5.14 inches. Ninety percent had 17.46 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 15 days. Ninety percent will be at or below 31 days, with 10% being above 31 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.23 inch per day. Ninety percent of the years had 0.80 inch per day or less. Probability results show that this station has a 6.42% chance that any one day in the year would receive 0.1mm of rain. No significant trend in the precipitation variables was discerned (Table 5.20).

Table 5.16. Pecos – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		10.37	1.38	3.39	3.65	1.94
Std. Deviation		4.55	1.15	2.55	1.87	1.56
Minimum		2.36	0.00	0.00	0.52	0.04
Maximum		22.55	5.71	12.86	9.17	7.53
Coefficient of Variation		0.43	0.69	0.75	0.51	0.80
Deciles Percentiles	10	5.14	0.19	0.64	1.47	0.37
	20	6.71	0.42	1.38	1.88	0.76
	30	8.09	0.64	1.97	2.26	1.05
	40	8.48	0.85	2.62	2.96	1.18
	50	9.01	1.23	2.85	3.62	1.53
	60	10.62	1.37	3.44	3.79	1.86
	70	11.49	1.73	3.75	4.55	2.34
	80	14.33	2.21	4.99	5.24	2.71
	90	17.46	2.73	7.27	6.67	3.80

Table 5.17. Pecos – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		23.44	4.02	7.52	7.75	4.02
Std. Deviation		7.116	2.847	3.567	3.297	2.255
Minimum		5	0	1	1	0
Maximum		46	13	17	21	9
Coefficient of Variation		0.30	0.70	0.47	0.42	0.55
Deciles Percentiles	10	15.00	.90	3.00	3.00	1.00
	20	16.80	2.00	4.80	5.00	2.00
	30	19.00	2.00	5.70	6.70	3.00
	40	21.00	3.00	6.00	7.00	3.00
	50	23.50	4.00	7.00	8.00	4.00
	60	25.40	4.00	8.00	8.00	4.00
	70	27.00	5.00	9.30	9.00	6.00
	80	29.00	6.00	10.20	10.00	6.00
	90	31.00	6.30	13.00	11.10	7.10

Table 5.18. Pecos – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.48	0.47	0.65	0.61	0.51
Std. Deviation		0.22	0.77	0.76	0.43	0.43
Minimum		0.19	0.00	0.04	0.04	0.00
Maximum		1.17	5.10	4.29	2.37	1.86
Coefficient of Variation		0.47	1.63	1.16	0.71	0.84
Deciles Percentiles	10	0.23	0.00	0.11	0.20	0.11
	20	0.29	0.03	0.16	0.28	0.16
	30	0.32	0.07	0.27	0.33	0.23
	40	0.37	0.21	0.32	0.41	0.31
	50	0.43	0.30	0.41	0.52	0.35
	60	0.48	0.39	0.58	0.60	0.45
	70	0.56	0.48	0.64	0.70	0.59
	80	0.66	0.73	0.85	0.84	0.88
	90	0.80	1.02	1.71	1.29	1.21

Table 5.19. Pecos – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		6.42	4.46	8.17	8.51	4.37
Std. Deviation		1.94	3.16	3.87	3.62	2.45
Variance		3.80	10.00	15.03	13.12	6.00
Minimum		1.36	0.00	1.08	1.09	0.00
Maximum		12.60	14.44	18.47	23.07	9.78
Deciles Percentiles	10	4.10	1.00	3.26	3.29	1.08
	20	4.60	2.22	5.21	5.49	2.17
	30	5.20	2.22	6.19	7.36	3.26
	40	5.75	3.33	6.52	7.69	3.26
	50	6.43	4.44	7.60	8.79	4.34
	60	6.95	4.44	8.69	8.79	4.34
	70	7.39	5.55	10.10	9.89	6.52
	80	7.94	6.66	11.08	10.98	6.52
	90	8.49	7.00	14.13	12.19	7.71

Table 5.20. Pecos – Linear Regression Results

Pecos	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.017	0.520	0.261	.006
Winter	0.002	0.811	0.201	.001
Fall	0.001	0.943	0.047	.000
Summer	0.016	0.122	0.843	.035
Spring	-0.004	0.680	0.099	.002
Precipitation Days				
Annual	0.113	0.205	0.796	.039
Winter	0.056	0.110	0.482	.061
Fall	0.001	0.992	0.448	.000
Summer	0.036	0.383	0.932	.018
Spring	0.035	0.183	0.987	.0420
Precipitation Intensity				
Annual	0.000	0.833	0.563	.001
Winter	0.007	0.007	0.011	.020
Fall	-0.000	-0.001	0.006	.000
Summer	-0.000	-0.001	0.242	.001
Spring	-0.002	0.629	0.094	.005

Ft. Stockton

The climate of Ft. Stockton is classified as a middle latitude desert climate (Köppen climate classification BSh) semi-arid with hot summers, and mild to cool winters. Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.21, 5.22, 5.23, and 5.24. Annual total precipitation averages 13.27 inches, of which the largest portion occurs during the summer and fall months. Annually, this station receives an average of 27.17 days of precipitation, most of which occurs during the summer and fall months. Precipitation intensity averages 0.49 inch per day on an annual basis with the summer and fall months receiving the highest precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual precipitation and summer precipitation intensity. A comparison of the CV suggests that the summer season has the smallest amount of precipitation variability, while the winter is most variable. For precipitation days and precipitation intensity, the CV suggests that the summer months have the smallest amount of variability, while the winter months are most variable. The results show that for 10% of the years on record, total annual precipitation will be at or below 7.84 inches. Ninety percent will be at or below 19.80 inches, with 10% above 22.89 inches. For precipitation days, results show that 10% of the years on record, annual number of days will be at or below 15 days. Ninety percent will be at or below 37.20 days, with 10% being above 37.20 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.38 inch per day. Ninety percent of the years had 0.63 inch per day or less. Probability results show that this station has a 7.44% chance that any one day in the year would receive 0.1mm of rain. Linear regression results reveal a significant finding in annual intensity with 0.002 inch increase per precipitation day. Twelve percent of the variance is accounted for by the regression (Table 5.25).

Table 5.21. Ft. Stockton – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		13.27	1.77	4.07	4.69	2.72
Std. Deviation		4.85	1.28	2.90	2.15	1.62
Minimum		4.43	0.06	0.45	0.01	0.05
Maximum		28.79	5.72	12.95	10.39	7.93
Coefficient of Variation		0.37	0.72	0.71	0.46	0.60
Deciles Percentiles	10	7.84	0.36	1.07	2.17	0.90
	20	9.54	0.64	1.41	2.90	1.19
	30	10.48	0.92	1.99	3.61	1.57
	40	11.17	1.22	2.58	4.18	2.13
	50	12.74	1.48	3.43	4.40	2.62
	60	14.14	1.81	4.25	5.17	2.91
	70	14.67	2.36	5.19	5.39	3.30
	80	16.82	2.92	6.51	5.99	3.86
	90	19.79	3.73	7.68	7.70	5.24

Table 5.22. Ft. Stockton – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		27.17	4.40	8.02	9.10	5.54
Std. Deviation		7.84	3.31	3.90	3.69	3.06
Minimum		12	0	0	0	0
Maximum		44	18	19	20	15
Coefficient of Variation		0.28	0.75	0.47	0.41	0.55
Deciles Percentiles	10	15.00	1.00	4.00	4.00	2.00
	20	20.80	2.00	5.00	6.00	3.00
	30	22.70	2.00	5.00	7.70	4.00
	40	25.00	3.00	6.00	8.60	5.00
	50	27.00	4.00	7.00	9.00	5.00
	60	29.00	5.00	9.00	10.00	5.40
	70	32.00	6.00	10.30	11.00	7.00
	80	35.00	7.00	11.00	12.00	8.00
	90	37.20	8.00	13.10	13.10	10.00

Table 5.23. Ft. Stockton – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.49	0.38	0.51	0.51	0.47
Std. Deviation		0.11	0.20	0.26	0.16	0.21
Minimum		0.33	0.00	0.00	0.00	0.00
Maximum		0.84	1.01	1.66	0.98	1.04
Coefficient of Variation		0.22	0.52	0.51	0.33	0.45
Deciles Percentiles	10	0.38	0.17	0.26	0.33	0.25
	20	0.40	0.24	0.32	0.36	0.31
	30	0.42	0.29	0.34	0.40	0.36
	40	0.44	0.32	0.43	0.46	0.38
	50	0.46	0.35	0.46	0.52	0.41
	60	0.48	0.39	0.54	0.56	0.49
	70	0.52	0.40	0.59	0.61	0.53
	80	0.62	0.51	0.67	0.65	0.60
	90	0.63	0.67	0.81	0.70	0.82

Table 5.24. Ft. Stockton – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		7.44	4.88	8.71	10.00	6.02
Std. Deviation		2.14	3.67	4.23	4.05	3.33
Variance		4.62	13.54	17.97	16.45	11.10
Minimum		3.28	0.00	0.00	0.00	0.00
Maximum		12.05	20.00	20.65	21.97	16.30
Deciles Percentiles	10	4.10	1.11	4.34	4.39	2.17
	20	5.69	2.22	5.43	6.59	3.26
	30	6.21	2.22	5.43	8.46	4.34
	40	6.84	3.33	6.52	9.45	5.43
	50	7.39	4.44	7.60	9.89	5.43
	60	7.94	5.55	9.78	10.98	5.86
	70	8.76	6.66	11.19	12.08	7.60
	80	9.58	7.77	11.95	13.18	8.69
	90	10.19	8.88	14.23	14.39	10.86

Table 5.25. Ft. Stockton – Linear Regression Results

Ft. Stockton	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	-0.001	0.962	0.483	.000
Winter	-0.011	0.127	0.328	.033
Fall	0.011	0.484	0.244	.007
Summer	0.003	0.827	0.354	.001
Spring	0.344	0.344	0.531	.013
Precipitation Days				
Annual	-0.671	0.429	0.922	.004
Winter	-0.022	0.528	0.485	.005
Fall	-.051	0.222	0.097	.005
Summer	0.030	0.44	0.832	.003
Spring	-0.012	1.711	0.278	.021
Precipitation Intensity				
Annual	0.002	0.016	0.181	.120
Winter	0.003	0.056	0.533	.077
Fall	0.002	0.432	0.991	.013
Summer	0.002	0.088	0.508	.062
Spring	-0.001	0.379	0.161	.017

McCamey

The climate of McCamey is classified as a hot, semi-arid steppe (Köppen climate classification BSh) with hot summers, low humidity, and mild to cold, dry winters. Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.26, 5.27, 5.28, and 5.29. Annual precipitation averages 13.69 inches, most of which occurs during the summer and fall months. Annually, this station receives an average of 25.52 days of precipitation, of which the largest portion occurs during the summer and fall months. Annually, precipitation intensity averages 0.53 inch per day with the summer and fall months receiving the highest precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values. A comparison of the CV suggests that the summer season has the smallest amount of variability, while the fall is the most variable. For precipitation days, the CV suggests that the summer months have the smallest amount of variability, while the winter is the most variable. Spring precipitation intensity has the smallest amount of variability while the fall months are the most variable. The results show that for 10% of the years on record, total annual precipitation will be at or below 7.71 inches. Ninety percent will be at or below 19.51 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 18 days. Ninety percent will be at or below 35 days, with 10% being above 35 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.42 inch per day. Ninety percent of the years had 0.69 inch per day or less. Probability results show that this station has a 6.99%

chance that any one day in the year would receive 0.1mm of rain. Linear regression results reveal a significant finding in the number of precipitation days. Results show an increase of .078 days per year in the summer months during the period of record with 13.3% of the variance accounted for by the regression. (Table 5.30).

Table 5.26. McCamey – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		13.69	1.81	4.31	4.53	3.03
Std. Deviation		5.90	1.32	3.63	2.42	1.78
Minimum		5.57	0.08	0.39	0.67	0.29
Maximum		40.06	6.45	22.99	13.30	8.48
Coefficient of Variation		0.43	0.73	0.84	0.53	0.59
Deciles Percentiles	10	7.71	0.44	1.26	1.76	1.00
	20	9.05	0.64	2.04	2.58	1.46
	30	10.00	0.87	2.40	3.21	1.75
	40	11.25	1.37	3.12	3.45	2.24
	50	13.27	1.67	3.45	4.13	2.91
	60	14.26	1.87	3.82	4.53	3.24
	70	15.12	2.28	4.80	5.27	3.64
	80	16.46	2.77	6.08	6.53	4.50
	90	19.51	3.19	7.30	7.76	5.55

Table 5.27. McCamey – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		25.52	4.81	7.23	7.58	5.88
Std. Deviation		6.36	3.39	3.49	2.86	2.67
Minimum		14	0	2	2	1
Maximum		40	15	15	17	13
Coefficient of Variation		0.25	0.71	0.48	0.38	0.44
Deciles Percentiles	10	18.00	1.00	3.00	4.90	2.00
	20	19.80	2.00	4.00	5.00	4.00
	30	21.00	3.00	5.00	6.00	4.00
	40	22.60	3.00	5.60	6.60	5.00
	50	25.00	4.00	7.00	7.00	6.00
	60	27.40	5.00	8.00	8.00	6.00
	70	29.30	6.00	8.30	9.00	7.00
	80	31.00	7.00	10.20	9.20	8.00
	90	35.00	10.10	13.10	12.00	9.00

Table 5.28. McCamey – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.53	0.34	0.65	0.59	0.49
Std. Deviation		0.13	0.16	0.38	0.24	0.19
Minimum		0.27	0.00	0.20	0.22	0.00
Maximum		1.08	0.69	2.55	1.49	0.92
Coefficient of Variation		0.26	0.48	0.59	0.41	0.40
Deciles Percentiles	10	0.42	0.18	0.28	0.37	0.27
	20	0.44	0.24	0.37	0.40	0.32
	30	0.46	0.26	0.44	0.43	0.38
	40	0.47	0.28	0.53	0.48	0.43
	50	0.51	0.31	0.57	0.53	0.48
	60	0.53	0.34	0.61	0.58	0.52
	70	0.58	0.39	0.74	0.68	0.58
	80	0.62	0.52	0.85	0.80	0.67
	90	0.69	0.60	1.15	0.95	0.81

Table 5.29. McCamey – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		6.99	5.34	7.85	8.33	6.38
Std. Deviation		1.74	3.77	3.80	3.14	2.90
Variance		3.04	14.21	14.44	9.90	8.42
Minimum		3.83	.00	2.17	2.19	1.08
Maximum		10.95	16.66	16.30	18.68	14.13
Deciles Percentiles	10	4.93	1.11	3.26	5.38	2.17
	20	5.42	2.22	4.34	5.49	4.34
	30	5.75	3.33	5.43	6.59	4.34
	40	6.19	3.33	6.08	7.25	5.43
	50	6.84	4.44	7.60	7.69	6.52
	60	7.50	5.55	8.69	8.79	6.52
	70	8.02	6.66	9.02	9.89	7.60
	80	8.49	7.77	11.08	10.10	8.69
	90	9.58	11.22	14.23	13.18	9.78

Table 5.30. McCamey – Linear Regression Results

McCamey, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.003	0.919	0.136	.000
Winter	-0.001	0.890	0.480	.000
Fall	0.029	0.158	0.029	.029
Summer	-0.011	0.405	0.288	.010
Spring	-0.012	0.232	0.770	.021
Precipitation Days				
Annual	0.067	0.345	0.696	.020
Winter	0.022	0.056	0.531	.008
Fall	-0.024	0.054	0.447	.009
Summer	0.078	0.013	0.054	.133
Spring	-0.002	0.942	0.575	.005
Precipitation Intensity				
Annual	0.001	0.963	0.034	.000
Winter	0.002	0.149	0.091	.045
Fall	0.007	0.070	0.361	.070
Summer	-0.004	0.109	0.178	.055
Spring	-0.002	0.314	0.195	.022

Summary for West Texas

Most precipitation falls during the summer months for all west Texas stations. All stations showed more precipitation days during the summer months, while a majority of stations had higher precipitation intensity values during the fall months. The summer months showed the least amount of variability for precipitation and precipitation days for all stations, while the cooler months of spring, fall, and winter yielded higher variability during the period of record. All seasons, except summer, resulted in higher variability for precipitation intensity, with the fall months having the majority among the stations. The highest probability of a rain day for the stations was 8.78 % for Alpine. All other stations fell below this value. Most stations resulted in a positive skew for precipitation, precipitation days, and precipitation intensity. Median values fell less than the mean except for spring and summer intensity for El Paso, annual and summer precipitation days for Pecos, and summer precipitation intensity for Ft. Stockton.

Total precipitation, precipitation days, and precipitation intensity annually and seasonally were grouped into equal frequency deciles. For the given stations, the bottom deciles included the 10 % of events with the lowest values, while the top decile include the 10 % of events with the greatest value. Pecos resulted in the lowest value for annual precipitation with 10% of the years not exceeding 5.14 inches of precipitation. For Alpine, 10% of the years on record exceeded 22.89 inches of precipitation. El Paso resulted in the lowest value for precipitation days and intensity, with 10% of the years not exceeding 14 days and 0.030 inch per day of precipitation. For Ft. Stockton, 10 % of the years on record exceeded 37 days of precipitation, while Pecos exceeded 0.80 inch per day. There is a statistically significant increase in annual precipitation intensity of 0.002 inch per day over the period of record for Ft. Stockton, while a statistically significant increase of 0.078 in precipitation days during the summer months was found for McCamey. No other trends were found.

The Panhandle

The Panhandle is the most northerly region in Texas, bordered by the state of New Mexico to the west and Oklahoma to the north and east. Summers are hot and the winter months are cold with moderate snowfall. Precipitation from storms is most frequent during the spring and early summer months. These storms are a result of the movement of the "Marfa Front" or "dry line"; a sharp gradient in low-level moisture not present in the late summer months (Bomar 1999). In this region, the BSk (mid-latitude cold steppe) is the only climate type common to the stations of the region. The six weather stations and their respective station number in this region include Seminole (39), Snyder (40), Crosbyton (13), Muleshoe (33), Plainview (36), and Miami (32) (Figure 5.1).

Seminole

Seminole (Köppen climate classification BSk) is the southern most station in the Panhandle region. This climate is classified as semi-arid with hot summers, and mild to cool winters. Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.31, 5.32, 5.33, and 5.34. Annual precipitation averages 16.60 inches, of which the largest portion occurs during the summer months. Annually, this station receives an average of 32.58 days of precipitation, most of which occurs during the summer months. Annually, precipitation intensity averages 0.52 inch per day. The winter months receive the least amount of precipitation per day while the summer receives more. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except annual precipitation, spring and summer precipitation days, and annual and summer precipitation intensity. A comparison of the CV suggests that the summer months have the smallest amount of precipitation variability, while the winter is most variable. The CV suggests that the summer months for precipitation days have the smallest amount of variability, while the winter months are most variable, and the spring months have the smallest variability for precipitation intensity while the summer months are most variable. The results show that for 10 % of the years on record, total annual precipitation will be at or below 8.16 inches. Ninety percent will be at or below 24.17 inches, with 10 % above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 23.9 days. Ninety percent will be at or below 43 days, with 10% being above 43 days. For precipitation intensity, results show that 10 % of the years on record experienced at or below 0.39 inch per day. Ninety percent of the years had 0.66 inch per day or less. Probability results show that this station has an 8.93% chance that any one day in the year would receive 0.1mm of rain. Linear regression results do not indicate significant findings in regard to an increase or decrease in precipitation, precipitation days, or precipitation intensity during the period of record (Table 5.35).

Table 5.31. Seminole – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		16.60	1.86	4.69	6.33	4.01
Std. Deviation		6.19	1.44	2.88	2.97	2.93
Minimum		1.85	0.08	0.88	1.36	0.37
Maximum		37.63	7.07	13.57	16.13	16.74
Coefficient of Variation		0.37	0.77	0.61	0.47	0.73
Deciles Percentiles	10	8.16	0.30	1.69	2.80	1.18
	20	11.51	0.67	2.18	3.37	1.58
	30	13.33	0.88	2.60	4.60	2.03
	40	15.01	1.04	3.26	5.51	2.65
	50	16.65	1.39	3.85	5.98	3.34
	60	18.15	2.02	4.66	6.45	4.30
	70	19.78	2.41	5.69	7.65	5.01
	80	21.50	3.00	7.15	9.02	5.77
	90	24.17	4.16	8.80	10.06	6.76

Table 5.32. Seminole – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		32.58	5.31	8.54	11.33	7.38
Std. Deviation		7.514	3.708	3.531	3.663	3.317
Minimum		14	0	2	4	2
Maximum		45	16	19	19	14
Coefficient of Variation		0.23	0.68	0.41	0.32	0.45
Deciles Percentiles	10	23.90	1.00	4.00	5.00	3.00
	20	25.00	2.00	5.00	8.80	4.00
	30	27.70	3.00	6.00	9.70	4.70
	40	29.00	4.00	7.00	11.00	6.00
	50	32.50	4.50	8.00	11.50	7.50
	60	34.40	6.40	9.00	12.40	8.00
	70	38.00	7.00	10.30	14.00	10.00
	80	40.40	8.00	11.20	14.20	10.20
	90	43.00	9.10	13.10	16.00	12.00

Table 5.33. Seminole – Precipitation Intensity [in/day]Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.52	0.33	0.52	0.59	0.53
Std. Deviation		0.09	0.14	0.23	0.16	0.28
Minimum		0.28	0.00	0.18	0.23	0.12
Maximum		0.75	0.68	1.44	1.02	1.87
Coefficient of Variation		0.18	0.34	0.44	0.29	0.54
Deciles Percentiles	10	0.39	0.18	0.29	0.34	0.27
	20	0.45	0.22	0.33	0.45	0.36
	30	0.47	0.25	0.41	0.50	0.39
	40	0.49	0.30	0.43	0.53	0.39
	50	0.53	0.33	0.46	0.59	0.44
	60	0.55	0.36	0.53	0.62	0.53
	70	0.56	0.38	0.58	0.67	0.60
	80	0.59	0.47	0.68	0.73	0.67
	90	0.66	0.55	0.84	0.78	0.83

Table 5.34. Seminole – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		8.93	5.94	9.28	12.45	8.01
Std. Deviation		2.03	4.06	3.83	4.02	3.60
Variance		4.12	16.52	14.72	16.20	13.00
Minimum		4.38	0.00	2.17	4.39	2.17
Maximum		12.32	17.77	20.65	20.87	15.21
Deciles Percentiles	10	6.54	1.11	4.34	5.49	3.26
	20	6.84	2.22	5.43	9.67	4.34
	30	7.58	3.33	6.52	10.65	5.10
	40	7.94	4.44	7.60	12.08	6.52
	50	8.90	5.00	8.69	12.63	8.15
	60	9.42	7.11	9.78	13.62	8.69
	70	10.41	7.77	11.19	15.38	10.86
	80	11.06	8.88	12.17	15.60	11.08
	90	11.78	10.11	14.23	17.58	13.04

Table 5.35. Seminole – Linear Regression Results

Seminole, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.042	0.238	0.998	.020
Winter	0.006	0.419	0.098	.010
Fall	-0.006	0.075	0.152	.002
Summer	0.022	0.185	0.922	.025
Spring	0.002	0.898	0.270	.000
Precipitation Days				
Annual	0.083	0.272	0.551	.025
Winter	0.067	0.058	0.636	.071
Fall	-0.006	0.874	0.631	.001
Summer	-0.01	0.763	0.995	.002
Spring	0.025	0.413	0.638	.014
Precipitation Intensity				
Annual	0.001	0.754	0.860	.014
Winter	-0.001	0.763	0.774	.233
Fall	-0.001	0.790	0.316	.013
Summer	-0.001	0.695	0.149	.002
Spring	0.004	0.099	0.977	.014

Snyder

Snyder is classified as a semi-arid cold steppe (Köppen climate classification BSk) with hot summers and mild to cool winters. Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.36, 5.37, 5.38, and 5.39. Annual precipitation averages 20.90 inches, of which the largest portion occurs during the summer months. Annually, this station receives an average of 36.25 days of precipitation, most of which occurs during the summer months. Annually, precipitation intensity averages 0.59 inches per day. The winter months receive the least amount of precipitation per day, while the summer receives the most. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for fall and summer precipitation days. A comparison of the CV suggests that the spring months has the smallest amount of precipitation variability, while the winter is most variable. For precipitation days, the CV suggests that the summer months have the smallest amount of variability, while the winter is most variable. All seasons are fairly uniform in variability with regards to precipitation intensity. The results show that for 10 % of the years on record, total annual precipitation will be at or below 12.58 inches. Ninety percent will be at or below 29.89 inches, with 10 % above this value. For precipitation days, results show that for 10 % of the years on record, annual number of days will be at or below 26.80 days. Ninety percent will be at or below 45.10 days, with 10 % being above 45.10 days. For precipitation intensity, results show that 10 % of the years on record experienced at or below 0.46 inch per day. Ninety percent of the years had 0.78 inch per day or less. Probability results show that this station has a 9.93% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show a significant finding in winter precipitation intensity with an increase of 0.004 inch per precipitation day, and 23.3% of the variance is accounted for by the regression.

Table 5.36. Snyder – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		20.96	2.43	5.72	7.02	5.79
Std. Deviation		6.57	1.77	3.26	3.72	2.59
Minimum		9.38	0.14	0.75	0.75	1.11
Maximum		44.02	9.22	14.67	20.50	13.02
Coefficient of Variation		0.31	0.72	0.57	0.53	0.45
Deciles Percentiles	10	12.58	0.54	2.27	2.77	2.25
	20	15.52	0.97	2.97	3.35	3.52
	30	17.28	1.17	3.89	4.60	4.29
	40	19.13	1.59	4.33	5.51	4.77
	50	20.17	2.00	4.78	6.39	5.67
	60	21.31	2.58	5.77	7.55	6.20
	70	23.86	3.23	6.98	9.38	7.05
	80	25.87	3.72	8.06	10.31	8.00
	90	29.89	4.90	11.46	10.92	8.56

Table 5.37. Snyder – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		36.25	6.25	9.75	10.77	9.46
Std. Deviation		6.59	3.81	3.72	3.50	3.75
Minimum		22	1	2	3	3
Maximum		49	16	18	19	18
Coefficient of Variation		0.18	0.61	0.38	0.32	0.40
Deciles Percentiles	10	26.80	2.00	5.00	6.00	5.00
	20	30.00	3.00	6.00	7.80	5.80
	30	33.70	4.00	7.00	9.00	7.00
	40	34.00	5.00	8.00	9.60	8.00
	50	35.50	5.00	10.00	11.00	9.00
	60	38.00	6.00	11.00	11.40	10.00
	70	40.00	7.00	12.00	13.00	11.30
	80	43.20	9.20	13.00	14.00	13.00
	90	45.10	13.00	15.10	15.10	15.10

Table 5.38. Snyder – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.59	0.35	0.59	0.65	0.61
Std. Deviation		0.12	0.13	0.20	0.22	0.21
Minimum		0.42	0.11	0.29	0.25	0.30
Maximum		1.01	0.81	1.28	1.23	1.43
Coefficient of Variation		0.21	0.38	0.34	0.34	0.34
Deciles Percentiles	10	0.46	0.21	0.38	0.40	0.40
	20	0.49	0.24	0.41	0.45	0.42
	30	0.50	0.27	0.48	0.53	0.46
	40	0.54	0.31	0.52	0.58	0.52
	50	0.58	0.34	0.56	0.63	0.60
	60	0.60	0.36	0.60	0.67	0.68
	70	0.62	0.39	0.67	0.74	0.71
	80	0.65	0.44	0.75	0.88	0.77
	90	0.78	0.54	0.87	0.98	0.85

Table 5.39. Snyder – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		9.93	6.94	10.59	11.83	10.28
Std. Deviation		1.80	4.23	4.04	3.85	4.08
Variance		3.26	17.94	16.36	14.86	16.68
Minimum		6.02	1.11	2.17	3.29	3.26
Maximum		13.42	17.77	19.56	20.87	19.56
Deciles Percentiles	10	7.34	2.22	5.43	6.59	5.43
	20	8.21	3.33	6.52	8.57	6.30
	30	9.23	4.44	7.60	9.89	7.60
	40	9.31	5.55	8.69	10.54	8.69
	50	9.72	5.55	10.86	12.08	9.78
	60	10.41	6.66	11.95	12.52	10.86
	70	10.95	7.77	13.04	14.28	12.28
	80	11.83	10.22	14.13	15.38	14.13
	90	12.35	14.44	16.41	16.59	16.41

Table 5.40. Snyder – Linear Regression Results

Snyder, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.035	0.348	0.697	.013
Winter	0.003	0.720	0.213	.002
Fall	0.008	0.663	0.220	.003
Summer	0.016	0.437	0.670	.009
Spring	0.005	0.734	0.889	.002
Precipitation Days				
Annual	0.094	0.266	0.625	.030
Winter	0.040	0.271	0.332	.029
Fall	0.140	0.706	0.848	.004
Summer	-0.001	0.978	0.961	.000
Spring	0.263	0.263	0.622	.030
Precipitation Intensity				
Annual	-0.001	0.806	0.132	.000
Winter	0.004	0.001	0.713	.233
Fall	-0.001	0.444	0.784	.013
Summer	0.006	0.770	0.621	.002
Spring	-0.002	0.293	0.339	.009

Crosbyton

Crosbyton is classified as a semi-arid desert (Köppen climate classification BSk) with hot summers and mild to cool winters. Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.41, 5.42, 5.43, and 5.44. Annual precipitation averages 21.86 inches, of which the largest portion occurs during the summer months. Annually, this station receives an average of 40.08 days of precipitation, most of which occurs during the summer months. Annually, this station averages 0.5439 inch per day with most occurring during the fall months. The winter months receive the least amount of precipitation per day. A comparison of the CV suggests that the summer months has the smallest amount of precipitation variability, while the winter is most variable. For precipitation days, the CV suggests that the spring, summer, and fall months are fairly uniform and have the smallest amount of precipitation variability, while the winter months is most variable. The summer months resulted in the smallest amount variability in regards to precipitation intensity, while the fall is most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values except for annual precipitation days and fall precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 14.62 inches. Ninety percent will be at or below 29.39 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 29.90 days. Ninety percent will be at or below 50 days, with a 10% being above 50 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.45 inch per day. Ninety percent of the years had 0.63 inch per day or less. Probability results show that this station has a 10.98% chance that any one day in the year would receive 0.1mm of rain. Linear regression results do not indicate significant findings in regard to an increase or decrease in precipitation, precipitation days, or precipitation intensity during the period of record (Table 5.45).

Table 5.41. Crosbyton – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		21.8	2.44	5.98	7.68	5.75
Std. Deviation		6.26	1.59	3.28	3.32	3.03
Minimum		7.62	0.06	0.77	1.66	1.11
Maximum		44.42	7.96	16.33	16.44	15.90
Coefficient of Variation		0.28	0.65	0.55	0.43	0.53
Deciles Percentiles	10	14.62	0.67	2.25	3.47	2.56
	20	16.74	0.95	3.11	4.35	3.18
	30	18.35	1.26	3.89	5.64	3.61
	40	18.90	1.84	4.66	6.30	4.73
	50	21.89	2.15	5.16	7.28	5.51
	60	23.21	2.64	6.63	8.52	5.82
	70	25.16	3.15	7.10	9.84	6.37
	80	26.97	3.67	8.28	11.28	8.11
	90	29.39	4.79	10.87	11.78	10.14

Table 5.42. Crosbyton – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		40.08	6.46	9.94	13.04	10.65
Std. Deviation		7.51	3.70	3.85	4.68	3.68
Minimum		21	0	2	5	4
Maximum		57	15	18	21	20
Coefficient of Variation		0.19	0.57	0.39	0.36	0.35
Deciles Percentiles	10	29.90	2.00	4.90	6.00	6.00
	20	33.80	3.00	7.00	8.00	7.00
	30	36.70	4.00	7.70	10.00	8.70
	40	38.60	5.00	8.60	11.00	10.00
	50	40.50	6.00	9.00	13.00	10.50
	60	42.00	7.00	11.40	15.00	11.00
	70	44.00	9.00	12.00	16.00	12.00
	80	47.00	10.00	13.00	18.00	13.20
	90	50.00	12.00	16.10	19.10	16.00

Table 5.43. Crosbyton – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	47	48	48	48
	Missing	0	1	0	0	0
Mean		0.54	0.36	0.60	0.59	0.53
Std. Deviation		.077	0.12	0.23	0.15	0.16
Minimum		0.36	0.17	0.22	0.31	0.23
Maximum		0.72	0.66	1.21	0.91	0.96
Coefficient of Variation		0.14	0.33	0.38	0.26	0.31
Deciles Percentiles	10	0.45	0.20	0.33	0.39	0.33
	20	0.47	0.24	0.38	0.46	0.37
	30	0.50	0.29	0.44	0.49	0.43
	40	0.52	0.31	0.53	0.52	0.48
	50	0.54	0.33	0.62	0.57	0.52
	60	0.57	0.37	0.65	0.64	0.55
	70	0.59	0.42	0.71	0.68	0.61
	80	0.61	0.47	0.77	0.74	0.70
	90	0.63	0.52	0.97	0.83	0.74

Table 5.44. Crosbyton – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		10.98	7.17	10.80	14.33	11.57
Std. Deviation		2.05	4.11	4.18	5.14	4.00
Variance		4.23	16.91	17.51	26.51	16.01
Minimum		5.75	0.00	2.17	5.49	4.34
Maximum		15.61	16.66	19.56	23.07	21.73
Deciles Percentiles	10	8.19	2.22	5.32	6.59	6.52
	20	9.26	3.33	7.60	8.79	7.60
	30	10.05	4.44	8.36	10.98	9.45
	40	10.57	5.55	9.34	12.08	10.86
	50	11.09	6.66	9.78	14.28	11.41
	60	11.50	7.77	12.39	16.48	11.95
	70	12.05	10.00	13.04	17.58	13.04
	80	12.87	11.11	14.13	19.78	14.34
	90	13.69	13.33	17.50	20.98	17.39

Table 5.45. Crosbyton – Linear Regression Results

Crosbyton, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.007	0.839	0.423	.001
Winter	-0.001	0.847	0.726	.001
Fall	-0.001	0.975	0.403	.000
Summer	-0.003	0.872	0.702	.000
Spring	0.010	0.562	0.172	.005
Precipitation Days				
Annual	-0.012	0.860	0.952	.001
Winter	-0.001	0.972	0.404	.001
Fall	0.004	0.892	0.741	.000
Summer	0.766	0.766	0.589	.002
Spring	0.727	0.727	0.541	.002
Precipitation Intensity				
Annual	0.001	0.139	0.955	.047
Winter	0.001	0.256	0.679	.029
Fall	-0.001	0.646	0.901	.005
Summer	0.001	0.547	0.649	.012
Spring	0.003	0.061	0.904	.024

Muleshoe

Muleshoe is classified as semi-arid cool steppe (Köppen climate classification BSk) with hot summers, and mild to cool winters. Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.46, 5.47, 5.48, and 5.49. Muleshoe receives an average of 17.18 inches precipitation per year, with most occurring during the summer months. Annually, this station receives an average of 35.38 days of precipitation, of which the largest portion occurs during the summer months. Annually, this station averages 0.48 inch of precipitation per day with most occurring during the summer and fall months. The winter months receive the least amount of precipitation per day. A comparison of the CV suggests that the summer months have the smallest amount of precipitation variability, while the spring is the most variable. For precipitation days, the CV suggests that the summer months have the smallest amount of variability, while the winter is most variable. The spring months show the smallest amount of variability in regards to precipitation intensity, while the fall months are most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values except for spring precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 11.81 inches. Ninety percent will be at or below 21.85 inches, with 10 % above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 28 days. Ninety percent will be at or below 44.10 days, with a 10% being above 44.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.39 inch per day. Ninety percent of the years had 0.59 inch per day or less. Probability results show that this station has a 9.69% chance that any one day in the year would receive 0.1mm of rain. Linear regression results do not indicate significant findings in regard to an increase or decrease in precipitation, precipitation days, or precipitation intensity during the period of record (Table 5.50).

Table 5.46. Muleshoe – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		17.17	1.58	4.32	7.40	3.87
Std. Deviation		5.01	0.97	2.19	2.88	2.64
Minimum		7.75	0.24	1.20	2.65	0.26
Maximum		43.52	4.80	10.33	14.78	16.99
Coefficient of Variation		0.29	0.61	0.50	0.39	0.68
Deciles Percentiles	10	11.81	0.47	1.72	3.87	1.21
	20	13.69	0.73	2.37	4.85	1.60
	30	14.15	0.88	2.63	5.40	2.07
	40	15.33	1.16	3.30	6.18	2.91
	50	17.07	1.44	4.11	7.25	3.53
	60	18.25	1.66	4.74	8.27	4.16
	70	19.40	2.00	5.30	8.60	4.70
	80	20.50	2.30	5.97	9.62	5.89
	90	21.85	3.11	7.45	12.29	7.06

Table 5.47. Muleshoe – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		35.38	4.67	8.69	14.02	7.94
Std. Deviation		5.90	2.44	3.26	4.01	3.52
Minimum		20	1	2	4	2
Maximum		48	11	17	23	15
Coefficient of Variation		0.16	0.52	0.37	0.29	0.44
Deciles Percentiles	10	28.00	2.00	5.00	9.00	3.00
	20	30.80	3.00	6.00	10.80	4.00
	30	32.00	3.00	7.00	12.00	5.70
	40	34.00	4.00	7.00	13.00	6.60
	50	35.00	4.00	8.00	14.00	8.00
	60	36.40	4.00	9.00	15.00	10.00
	70	38.30	5.30	10.00	16.30	10.00
	80	40.00	7.20	11.20	17.20	11.00
	90	44.10	8.10	14.00	19.00	12.00

Table 5.48. Muleshoe – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.48	0.31	0.51	0.54	0.46
Std. Deviation		0.07	0.09	0.14	0.13	0.16
Minimum		0.37	0.14	0.26	0.31	0.13
Maximum		0.66	0.60	0.95	0.87	0.86
Coefficient of Variation		0.15	0.30	0.28	0.24	0.36
Deciles Percentiles	10	0.39	0.21	0.34	0.38	0.24
	20	0.41	0.22	0.38	0.43	0.30
	30	0.43	0.25	0.42	0.45	0.36
	40	0.45	0.28	0.45	0.48	0.40
	50	0.47	0.30	0.48	0.52	0.44
	60	0.49	0.34	0.51	0.54	0.50
	70	0.51	0.36	0.56	0.61	0.54
	80	0.55	0.39	0.63	0.66	0.60
	90	0.59	0.45	0.73	0.75	0.70

Table 5.49. Muleshoe – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		9.69	5.18	9.44	15.40	8.62
Std. Deviation		1.61	2.71	3.54	4.41	3.83
Variance		2.61	7.37	12.57	19.50	14.70
Minimum		5.47	1.11	2.17	4.39	2.17
Maximum		13.15	12.22	18.47	25.27	16.30
Deciles Percentiles	10	7.67	2.22	5.43	9.89	3.26
	20	8.43	3.33	6.52	11.86	4.34
	30	8.76	3.33	7.60	13.18	6.19
	40	9.31	4.44	7.60	14.28	7.17
	50	9.58	4.44	8.69	15.38	8.69
	60	9.97	4.44	9.78	16.48	10.86
	70	10.49	5.88	10.86	17.91	10.86
	80	10.95	8.00	12.17	18.90	11.95
	90	12.08	9.00	15.21	20.87	13.04

Table 5.50. Muleshoe – Linear Regression Results

Muleshoe, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.003	0.916	0.545	.000
Winter	-0.003	0.489	0.553	.007
Fall	0.008	0.484	0.329	.007
Summer	0.004	0.767	0.727	.001
Spring	-0.007	0.069	0.370	.004
Precipitation Days				
Annual	0.111	0.111	0.856	.052
Winter	0.010	0.674	0.053	.004
Fall	0.120	0.749	0.317	.002
Summer	0.046	0.244	0.892	.028
Spring	0.040	0.264	0.374	.026
Precipitation Intensity				
Annual	0.001	0.900	0.840	.000
Winter	0.001	0.599	0.875	.006
Fall	0.002	0.083	0.827	.064
Summer	-0.001	0.310	0.791	.022
Spring	0.001	0.702	0.927	.003

Plainview

Plainview is classified as a semi-arid cool steppe (Köppen climate classification BSk) with hot summers, and mild to cool winters. Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.51, 5.52, 5.53, and 5.54. Plainview receives an average of 19.04 inches of precipitation per year, with most occurring during the summer months. Annually, this station receives an average of 36.81 days of precipitation, of which the largest portion occurs during the summer months. Annually, this station averages 0.54 inch of precipitation per day, with most occurring during the summer months. The winter months receive the least amount of precipitation per day. A comparison of the CV suggests that the summer months have the smallest amount of precipitation variability, while the winter is most variable. For precipitation days, the CV suggests that the summer months have the smallest amount of variability, while the winter is most variable. The CV suggests that the winter months have the smallest amount of variability for precipitation intensity, while the spring is most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values. The results show that for 10% of the years on record, total annual precipitation will be at or below 13.36 inches. Ninety percent will be at or below 26.65 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 29.80 days. Ninety percent will be at or below 47 days, with 10% being above 47.00 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.44 inch per day. Ninety percent of the years had 0.69 inch per day or less. Probability results show that this station has a 10.08% chance that any one day in the year would receive 0.1mm of rain. Linear regression results do not indicate significant findings in regard to an increase or decrease in precipitation, precipitation days, or precipitation intensity during the period of record (Table 5.55).

Table 5.51. Plainview – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		19.40	1.99	4.54	7.55	5.31
Std. Deviation		5.26	1.23	2.51	3.25	2.62
Minimum		8.88	0.09	0.31	2.00	1.14
Maximum		34.35	5.53	11.23	16.11	11.87
Coefficient of Variation		0.27	0.62	0.55	0.43	0.49
Deciles Percentiles	10	13.36	0.58	1.91	3.10	2.39
	20	15.41	0.86	2.32	4.41	3.37
	30	16.25	1.20	2.97	5.91	3.69
	40	17.80	1.43	3.60	6.54	4.13
	50	18.76	1.71	4.06	7.08	4.57
	60	20.27	2.15	4.70	8.31	5.21
	70	21.60	2.66	5.21	9.12	6.53
	80	23.56	2.99	6.59	9.94	7.06
	90	26.65	3.83	8.82	12.07	9.69

Table 5.52. Plainview – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		36.81	5.25	8.92	13.02	9.58
Std. Deviation		6.50	2.86	3.60	4.27	4.06
Minimum		19	0	1	5	2
Maximum		48	11	16	22	17
Coefficient of Variation		0.18	0.54	0.40	0.33	0.42
Deciles Percentiles	10	29.80	2.00	4.00	7.00	4.90
	20	32.00	3.00	6.00	9.80	5.00
	30	33.70	3.00	7.00	11.00	6.00
	40	36.00	4.00	8.00	11.00	8.00
	50	37.00	5.00	8.00	12.50	10.00
	60	38.00	6.00	9.00	14.00	11.00
	70	39.30	7.00	11.00	15.30	12.30
	80	42.20	8.00	12.00	17.00	14.00
	90	47.00	10.00	15.00	19.00	15.00

Table 5.53. Plainview – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	47	48	48	48
	Missing	0	1	0	0	0
Mean		0.54	0.36	0.52	0.60	0.59
Std. Deviation		0.10	0.09	0.17	0.19	0.23
Minimum		0.30	0.24	0.29	0.25	0.29
Maximum		0.83	0.75	1.10	1.31	1.52
Coefficient of Variation		0.19	0.24	0.34	0.33	0.40
Deciles Percentiles	10	0.44	0.27	0.34	0.40	0.36
	20	0.44	0.29	0.36	0.44	0.40
	30	0.47	0.30	0.43	0.48	0.45
	40	0.50	0.33	0.45	0.55	0.49
	50	0.52	0.34	0.48	0.58	0.56
	60	0.55	0.39	0.49	0.59	0.60
	70	0.58	0.40	0.59	0.65	0.66
	80	0.62	0.41	0.64	0.74	0.70
	90	0.69	0.47	0.76	0.87	0.83

Table 5.54. Plainview – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		10.08	5.83	9.69	14.30	10.41
Std. Deviation		1.78	3.18	3.91	4.69	4.41
Variance		3.17	10.11	15.32	22.01	19.49
Minimum		5.20	0.00	1.08	5.49	2.17
Maximum		13.15	12.22	17.39	24.17	18.47
Deciles Percentiles	10	8.16	2.22	4.34	7.69	5.32
	20	8.76	3.33	6.52	10.76	5.43
	30	9.23	3.33	7.60	12.08	6.52
	40	9.86	4.44	8.69	12.08	8.69
	50	10.13	5.55	8.69	13.73	10.86
	60	10.41	6.66	9.78	15.38	11.95
	70	10.76	7.77	11.95	16.81	13.36
	80	11.56	8.88	13.04	18.68	15.21
	90	12.87	11.11	16.30	20.87	16.30

Table 5.55. Plainview – Linear Regression Results

Plainview, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.011	0.701	0.769	.002
Winter	-0.003	0.673	0.336	.003
Fall	0.004	0.737	0.359	.002
Summer	0.003	0.865	0.904	.000
Spring	0.005	0.730	0.148	.002
Precipitation Days				
Annual	0.042	0.526	0.803	.009
Winter	0.016	0.550	0.687	.008
Fall	0.034	0.330	0.499	.020
Summer	-0.022	0.972	0.970	.002
Spring	-0.001	0.991	0.654	.000
Precipitation Intensity				
Annual	-0.001	0.152	0.716	.044
Winter	0.001	0.397	0.688	.016
Fall	0.001	0.775	0.052	.002
Summer	-0.003	0.097	0.358	.059
Spring	-0.001	0.468	0.336	.011

Miami

Miami is classified as a semi-arid cool steppe (Köppen climate classification BSk) with hot summers, and mild to cool winters. Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.56, 5.57, 5.58, and 5.59. Miami receives an average of 22.02 inches of precipitation per year, of which the largest portion occurs during the summer months. Annually, this station receives an average of 40.90 days of precipitation, most of which occurs during the summer months. Annually, this station averages 0.5567 inch per day, most of which is relatively uniform between the spring, summer, and fall months. A comparison of the CV suggests that the summer months have the smallest amount of precipitation variability, while the winter is the most variable. For precipitation days, the CV suggests that the summer months have the smallest amount of variability, while the winter is the most variable, and the summer months show the smallest amount of variability in regards to precipitation intensity, while the winter is the most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual and summer precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 14.80 inches. Ninety percent will be at or below 29.31 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 32.80 days. Ninety percent will be at or below 50.10 days, with 10% being above 50.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.40 inch per day. Ninety percent of the years had 0.71 inch per day or less. Probability results show that this station has an 11.20% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual total precipitation with an increase in 0.073 inch of precipitation per year with 6.4% of the variance accounted for by the regression, and an increase in winter precipitation intensity with 0.0067 inch increase per precipitation day with 16.2% of the variance accounted for by the regression (Table 5.60).

Table 5.56. Miami – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		22.02	2.24	4.91	8.09	6.74
Std. Deviation		5.99	1.44	2.74	3.51	3.45
Minimum		10.87	0.41	0.32	2.58	1.71
Maximum		39.23	8.28	12.86	16.84	21.56
Coefficient of Variation		0.27	0.64	0.56	0.43	0.51
Deciles Percentiles	10	14.80	0.86	1.79	3.45	3.24
	20	17.20	1.05	2.86	4.66	3.56
	30	18.39	1.16	3.30	6.27	4.79
	40	19.83	1.63	3.79	6.64	5.49
	50	21.38	1.91	4.27	7.56	6.02
	60	23.28	2.19	4.87	8.70	7.03
	70	25.01	2.75	5.72	9.77	8.13
	80	26.91	3.31	7.19	11.21	9.23
	90	29.31	4.20	9.00	12.94	10.75

Table 5.57. Miami – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		40.90	5.44	9.19	14.21	12.02
Std. Deviation		6.947	2.673	3.874	3.831	4.620
Minimum		26	2	2	5	4
Maximum		56	12	19	24	22
Coefficient of Variation		0.17	0.49	0.42	0.26	0.38
Deciles Percentiles	10	32.80	2.00	5.00	9.00	5.00
	20	34.00	3.00	6.00	10.80	8.00
	30	36.00	3.00	7.00	12.00	9.00
	40	38.60	4.00	7.00	14.00	10.60
	50	41.00	5.00	8.00	15.00	11.50
	60	43.00	6.00	9.40	16.00	12.40
	70	45.30	7.00	11.00	16.30	15.00
	80	47.00	8.00	13.00	17.00	16.20
	90	50.10	9.10	16.00	18.00	18.10

Table 5.58. Miami – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.55	0.41	0.57	0.58	0.57
Std. Deviation		0.10	0.22	0.27	0.153	0.16
Minimum		0.38	0.00	0.25	0.29	0.35
Maximum		0.78	1.12	2.01	0.92	1.13
Coefficient of Variation		0.18	0.55	0.48	0.26	0.29
Deciles Percentiles	10	0.40	0.19	0.34	0.39	0.38
	20	0.44	0.25	0.41	0.44	0.42
	30	0.49	0.29	0.43	0.47	0.44
	40	0.52	0.33	0.46	0.51	0.47
	50	0.55	0.37	0.50	0.56	0.56
	60	0.59	0.43	0.53	0.64	0.60
	70	0.61	0.51	0.61	0.68	0.63
	80	0.65	0.55	0.74	0.73	0.66
	90	0.71	0.69	0.82	0.77	0.76

Table 5.59. Miami – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		11.20	6.04	9.98	15.61	13.06
Std. Deviation		1.90	2.97	4.21	4.21	5.02
Variance		3.62	8.82	17.73	17.72	25.21
Minimum		7.12	2.22	2.17	5.49	4.34
Maximum		15.34	13.33	20.65	26.37	23.91
Deciles Percentiles	10	8.98	2.22	5.43	9.89	5.43
	20	9.31	3.33	6.52	11.86	8.69
	30	9.86	3.33	7.60	13.18	9.78
	40	10.57	4.44	7.60	15.38	11.52
	50	11.23	5.55	8.69	16.48	12.50
	60	11.78	6.66	10.21	17.58	13.47
	70	12.41	7.77	11.95	17.91	16.30
	80	12.87	8.88	14.13	18.68	17.60
	90	13.72	10.11	17.39	19.78	19.67

Table 5.60. Miami – Linear Regression Results

Miami, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.073	0.033	0.413	.064
Winter	0.009	0.269	0.134	.018
Fall	0.020	0.189	0.094	.025
Summer	0.007	0.711	0.602	.002
Spring	0.034	0.082	0.459	.043
Precipitation Days				
Annual	0.072	0.281	0.543	.024
Winter	0.010	0.680	0.317	.003
Fall	0.032	0.401	0.115	.014
Summer	0.046	0.898	0.472	.000
Spring	0.030	0.496	0.626	.010
Precipitation Intensity				
Annual	0.001	0.341	0.657	.020
Winter	0.001	0.005	0.261	.162
Fall	-0.011	0.689	0.114	.004
Summer	-0.086	0.596	0.583	.006
Spring	0.020	0.243	0.645	.030

Summary for the Panhandle

Most precipitation falls during the summer months for all Panhandle stations. All stations showed more precipitation days during the summer months, while a majority of stations resulted in higher precipitation intensity during the summer months, except Crosbyton during fall months. The summer months resulted in the least amount of variability for precipitation and precipitation days for all stations, while the winter yielded more variability. All seasons resulted in higher variability for precipitation intensity, with the fall months being the majority among the stations. The highest probability of a rain day was 11.20 % for Miami. All other stations fell below this value. Most stations resulted in a positive skew for precipitation, precipitation days, and precipitation intensity. Median values fell less than the mean except for annual precipitation, spring, and summer precipitation days, and annual, summer, and spring precipitation intensity for Seminole; fall and summer precipitation days for Snyder; annual precipitation days and fall precipitation intensity for Crosbyton; spring precipitation days for Muleshoe; and annual summer precipitation days for Miami.

Total precipitation, precipitation days, and precipitation intensity annually and seasonally were grouped into equal frequency deciles. For the given stations, the bottom decile included the 10 % of events with the lowest values, while the top decile include the ten percent of events with the greatest value. Seminole resulted in the lowest values for precipitation with 10 % of the years not exceeding 8.16 inches of precipitation 23.9 precipitation days, and 0.39 inch per day. For Snyder, 10 % of the years on record exceeded 29.89 inches of precipitation and 0.78 inch per day. For Miami, 10 % of the years on record exceeded 50.10 days of precipitation. There is a statistically significant increase in winter precipitation intensity of 0.004 inch per precipitation day over the period of record for Snyder, and a 0.0067 inch per precipitation day during the winter for Miami during the period of record. No other trends were found.

North Central

The North Central region is classified as subtropical with hot, humid summers. In this region, there is one distinct climate type based on the Köppen climate classification; Cfa (humid subtropical). This division has a bimodal precipitation pattern with May and September being the wettest months (Swanson 1995). Precipitation in May is a result of frontal storms from the north, and September precipitation is a result of frontal systems from the north, and tropical systems that migrate out of the Gulf of Mexico in the early fall months (Swanson 1995). The five weather stations in this region include Haskell (24), Albany (1), Brownwood (9), Dublin (15), and Weatherford (42) (Figure 5.1).

Haskell

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.61, 5.62, 5.63, and 5.64. Haskell (Köppen climate classification Cfa) receives an average of 24.55 inches of precipitation per year, with most occurring during the summer months. Annually, this station receives an average of 41.06 days of precipitation, of which the largest portion occurs during the spring months. Annually, this station averages 0.6119 inch per day with most occurring during the summer months. A comparison of the CV suggests that the spring months have the smallest amount of precipitation variability, while winter is the most variable. For precipitation days, the CV shows that the summer months have the smallest amount of variability, and the winter is the most variable. The spring months show the least variability in precipitation intensity, while the summer is the most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 15.87 inches. Ninety percent will be at or below 33.15 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 31.80 days. Ninety percent will be at or below 51.10 days, with 10% being above 51.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.48 inch per day. Ninety percent of the years had 0.72 inch per day or less. Probability results show that this station has an 11.25% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant trends in fall and winter precipitation intensity. Results show a decrease of 0.005 inch per precipitation day in fall intensity, with 12.7% of the variance accounted for by the regression. In addition, there is a 0.004 inch per precipitation day increase in winter precipitation intensity with 12.3% of the variance was accounted for by the regression (Table 5.65).

Table 5.61. Haskell – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		24.55	3.64	6.37	7.56	6.89
Std. Deviation		6.43	2.26	3.13	3.77	2.88
Minimum		10.14	0.27	1.29	1.34	1.18
Maximum		48.20	12.07	14.75	17.06	15.47
Coefficient of Variation		0.26	0.62	0.49	0.50	0.42
Deciles Percentiles	10	15.87	1.13	2.58	2.63	3.25
	20	19.40	1.61	3.79	3.80	4.66
	30	20.86	2.48	4.56	5.77	5.38
	40	22.86	2.77	5.11	6.47	6.11
	50	23.77	3.18	6.00	7.26	6.66
	60	26.18	3.62	6.94	7.90	7.43
	70	27.90	4.17	7.35	9.17	8.04
	80	30.10	5.66	7.98	11.19	9.01
	90	33.15	7.09	10.59	12.16	10.54

Table 5.62. Haskell – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		41.06	7.94	10.50	10.98	11.58
Std. Deviation		7.552	3.900	3.707	3.761	4.201
Minimum		25	1	4	3	4
Maximum		60	16	20	22	23
Coefficient of Variation		0.18	0.49	0.35	0.34	0.36
Deciles Percentiles	10	31.80	2.00	6.00	6.00	6.90
	20	34.80	4.80	6.80	7.80	8.00
	30	37.40	6.00	9.00	9.00	9.00
	40	39.00	7.00	9.00	10.00	10.00
	50	39.50	7.50	10.00	11.00	11.00
	60	42.00	9.00	11.40	12.00	12.40
	70	45.00	10.00	12.00	12.30	14.00
	80	48.20	11.00	14.00	14.00	16.00
	90	51.10	14.10	15.20	16.10	17.10

Table 5.63. Haskell – Precipitation Intensity [in/day]Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.61	0.45	0.64	0.70	0.61
Std. Deviation		0.10	0.18	0.21	0.33	0.18
Minimum		0.41	0.21	0.25	0.19	0.30
Maximum		0.99	1.23	1.26	2.44	1.21
Coefficient of Variation		0.17	0.39	0.33	0.47	0.30
Deciles Percentiles	10	0.48	0.28	0.32	0.36	0.40
	20	0.52	0.31	0.50	0.46	0.46
	30	0.56	0.38	0.55	0.56	0.49
	40	0.58	0.39	0.58	0.58	0.55
	50	0.61	0.41	0.61	0.67	0.56
	60	0.63	0.46	0.67	0.73	0.61
	70	0.66	0.51	0.71	0.79	0.65
	80	0.68	0.53	0.81	0.91	0.79
	90	0.72	0.65	0.97	1.01	0.84

Table 5.64. Haskell – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		11.25	8.81	11.41	12.06	12.59
Std. Deviation		2.06	4.33	4.02	4.13	4.56
Variance		4.28	18.77	16.23	17.08	20.85
Minimum		6.84	1.11	4.34	3.29	4.34
Maximum		16.43	17.77	21.73	24.17	25.00
Deciles Percentiles	10	8.71	2.22	6.52	6.59	7.50
	20	9.53	5.33	7.39	8.57	8.69
	30	10.24	6.66	9.78	9.89	9.78
	40	10.68	7.77	9.78	10.98	10.86
	50	10.82	8.33	10.86	12.08	11.95
	60	11.50	10.00	12.39	13.18	13.47
	70	12.32	11.11	13.04	13.51	15.21
	80	13.20	12.22	15.21	15.38	17.39
	90	14.00	15.66	16.52	17.69	18.58

Table 5.65. Haskell – Linear Regression Results

Haskell, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.018	0.624	0.190	.003
Winter	0.008	0.530	0.137	.006
Fall	0.012	0.488	0.141	.007
Summer	-0.006	0.755	0.810	.001
Spring	0.003	0.819	0.751	.001
Precipitation Days				
Annual	0.046	0.561	0.843	.007
Winter	0.035	0.389	0.993	.016
Fall	0.020	0.597	0.854	.006
Summer	0.003	0.929	0.782	.000
Spring	-0.017	0.696	0.925	.003
Precipitation Intensity				
Annual	-0.001	0.427	0.961	.014
Winter	0.0040	0.015	0.489	.123
Fall	-0.005	0.013	0.940	.127
Summer	0.0002	0.994	0.144	.000
Spring	0.0003	0.853	0.313	.001

Albany

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.66, 5.67, 5.68, and 5.69. Albany (Köppen climate classification Cfa) receives an average of 27.51 inches of precipitation per year, of which the largest portion occurs during the spring months. Annually, this station receives an average of 42.63 days of precipitation, most of which occurs during the spring months. Annually, this station averages 0.6639 inch per day with most occurring during the summer months. A comparison of the CV suggests that the spring months have smallest amount of precipitation variability, while the winter is the most variable. For precipitation days, the CV suggests that the summer months have the least variability, while the winter is the most variable. The spring months show the smallest amount of variability in precipitation intensity, while the summer is the most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual and summer precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 17.18 inches. Ninety percent will be at or below 38.22 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 32.90 days. Ninety percent will be at or below 53.10 days, with 10% being above 53.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.48 inch per day. Ninety percent of the years had 0.86 inch per day or less. Probability results show that this station has an 11.67% chance that any one day in the year would receive 0.1mm of rain. Linear regression results do not indicate significant findings in regard to an increase or decrease in precipitation, precipitation days, or precipitation intensity during the period of record (Table 5.70).

Table 5.66. Albany – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		27.51	4.22	7.28	7.68	8.28
Std. Deviation		8.22	2.75	3.82	4.84	3.27
Minimum		11.07	0.38	0.91	1.19	2.39
Maximum		48.60	15.32	20.42	33.91	20.71
Coefficient of Variation		0.29	0.65	0.52	0.63	0.39
Deciles Percentiles	10	17.18	1.12	2.87	2.88	5.16
	20	19.95	1.80	3.50	4.20	5.90
	30	23.81	2.40	4.37	4.95	6.56
	40	25.57	3.31	6.00	5.94	7.01
	50	26.73	3.94	6.94	7.20	7.56
	60	28.11	4.31	7.79	8.17	8.16
	70	30.30	5.39	8.80	8.61	9.31
	80	33.86	6.26	10.89	10.03	10.98
	90	38.22	6.96	12.10	12.12	12.86

Table 5.67. Albany – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		42.63	8.38	11.21	10.94	12.08
Std. Deviation		7.49	3.75	4.36	3.13	3.91
Minimum		27	1	2	5	6
Maximum		62	16	19	19	23
Coefficient of Variation		0.18	0.45	0.38	0.29	0.32
Deciles Percentiles	10	32.90	3.00	5.90	6.00	7.00
	20	35.80	4.80	7.00	8.00	8.80
	30	38.00	6.00	8.00	9.00	10.00
	40	40.60	7.60	10.00	10.60	10.60
	50	43.00	8.00	11.00	11.50	11.50
	60	44.40	9.40	12.40	12.00	13.00
	70	46.00	11.00	13.00	13.00	14.00
	80	48.20	12.00	16.00	14.00	15.20
	90	53.10	14.00	17.00	14.10	17.10

Table 5.68. Albany – Precipitation Intensity [in/day]Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.66	0.50	0.69	0.71	0.69
Std. Deviation		0.15	0.21	0.23	0.49	0.20
Minimum		0.41	0.18	0.26	0.30	0.34
Maximum		1.28	1.18	1.38	3.77	1.14
Coefficient of Variation		0.23	0.42	0.34	0.70	0.29
Deciles Percentiles	10	0.48	0.28	0.43	0.40	0.40
	20	0.54	0.35	0.49	0.49	0.49
	30	0.58	0.37	0.53	0.52	0.55
	40	0.60	0.40	0.59	0.56	0.59
	50	0.63	0.47	0.65	0.61	0.68
	60	0.69	0.51	0.72	0.65	0.75
	70	0.72	0.59	0.78	0.72	0.78
	80	0.75	0.68	0.88	0.79	0.91
	90	0.86	0.82	1.03	1.05	0.96

Table 5.69. Albany – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		11.67	9.30	12.18	12.01	13.13
Std. Deviation		2.05	4.16	4.74	3.44	4.25
Variance		4.21	17.36	22.47	11.89	18.14
Minimum		7.39	1.11	2.17	5.49	6.52
Maximum		16.98	17.77	20.65	20.87	25.00
Deciles Percentiles	10	9.01	3.33	6.41	6.59	7.60
	20	9.80	5.33	7.60	8.79	9.56
	30	10.41	6.66	8.69	9.89	10.86
	40	11.12	8.44	10.86	11.64	11.52
	50	11.78	8.88	11.95	12.63	12.50
	60	12.16	10.44	13.47	13.18	14.13
	70	12.60	12.22	14.13	14.28	15.21
	80	13.20	13.33	17.39	15.38	16.52
	90	14.54	15.55	18.47	15.49	18.58

Table 5.70. Albany – Linear Regression Results

Albany, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.047	0.321	0.321	.014
Winter	0.012	0.435	0.677	.009
Fall	0.017	0.445	0.889	.008
Summer	0.013	0.627	0.108	.003
Spring	0.001	0.955	0.124	.000
Precipitation Days				
Annual	-0.005	0.492	0.998	.010
Winter	-0.017	0.660	0.977	.004
Fall	-0.027	0.548	0.882	.008
Summer	0.007	0.825	0.449	.001
Spring	-0.020	0.617	0.659	.005
Precipitation Intensity				
Annual	0.001	0.266	0.566	.027
Winter	0.003	0.098	0.180	.059
Fall	-0.001	0.490	0.682	.010
Summer	0.002	0.684	0.002	.004
Spring	0.002	0.255	0.778	.028

Brownwood

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.71, 5.72, 5.73, and 5.74. Brownwood (Köppen climate classification Cfa) receives an average of 28.27 inches of precipitation per year, with most occurring during the spring, summer, and fall months. Annually, this station receives an average of 41.92 days of precipitation, of which the largest portion occurs during the spring months. Annually, this station averages 0.68 inch per day, with most occurring during the fall months. A comparison of the CV suggests that the spring months have the smallest amount of precipitation variability, while winter is the most variable. For precipitation days, the CV suggests that the summer months have the least variability, while the winter is the most variable. The spring months show the smallest amount of variability in precipitation intensity, while summer is the most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual and fall precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 19.98 inches. Ninety percent will be at or below 37.02 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 30 days. Ninety percent will be at or below 52.10 days, with 10% being above 52.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.53 inch per day. Ninety percent of the years had 0.85 inch per day or less. Probability results show that this station has an 11.48% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual, spring, and summer precipitation intensity. Results show annual precipitation intensity increasing at 0.002 inch of precipitation per precipitation day, with 8.9% of the variance accounted for by the regression, and spring months with an increase of 0.004 inch of precipitation per precipitation day, with 10.5% of the variance accounted for by the regression. Summer months show an increase of 0.005 inch of precipitation per precipitation day with 8.6 % of the variance accounted for by the regression (Table 5.75).

Table 5.71. Brownwood – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		28.27	5.14	7.43	7.08	8.62
Std. Deviation		6.96	3.33	3.46	3.68	3.27
Minimum		12.83	0.78	0.48	0.63	2.81
Maximum		45.97	17.07	14.88	18.58	20.53
Coefficient of Variation		0.24	0.64	0.46	0.52	0.37
Deciles Percentiles	10	19.98	1.26	3.17	2.84	4.97
	20	21.57	2.25	4.01	3.90	6.05
	30	23.78	3.14	5.25	4.72	6.49
	40	26.10	3.64	6.15	5.43	7.18
	50	28.10	4.40	7.28	6.18	8.09
	60	29.89	5.38	8.28	7.97	9.26
	70	31.56	6.42	9.22	9.04	10.29
	80	35.58	7.41	10.63	9.84	10.93
	90	37.03	10.10	12.45	11.95	12.47

Table 5.72. Brownwood – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		41.92	9.31	10.44	10.25	11.90
Std. Deviation		8.29	4.20	4.33	3.55	4.27
Minimum		25	2	2	4	4
Maximum		60	20	19	18	22
Coefficient of Variation		0.19	0.45	0.41	0.35	0.36
Deciles Percentiles	10	30.00	3.00	5.00	6.00	6.90
	20	33.80	6.00	6.00	7.00	9.00
	30	37.00	6.00	7.00	8.00	9.00
	40	40.00	7.00	9.60	9.00	10.00
	50	42.00	9.00	10.50	10.00	11.00
	60	43.80	11.00	11.40	11.00	12.00
	70	46.00	12.00	13.00	12.30	14.00
	80	47.60	13.20	14.20	13.20	15.20
	90	52.10	15.00	17.00	15.10	19.10

Table 5.73. Brownwood – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48.00	48.00	48.00	48.00	48.00
	Missing	0.00	0.00	0.00	0.00	0.00
Mean		0.68	0.53	0.76	0.73	0.70
Std. Deviation		0.13	0.19	0.23	0.28	0.19
Minimum		0.44	0.25	0.24	0.39	0.44
Maximum		1.05	1.14	1.28	1.66	1.37
Coefficient of Variation		0.18	0.37	0.30	0.39	0.26
Deciles Percentiles	10	0.53	0.32	0.50	0.47	0.49
	20	0.58	0.35	0.56	0.51	0.54
	30	0.62	0.37	0.60	0.59	0.58
	40	0.65	0.44	0.67	0.60	0.64
	50	0.67	0.51	0.76	0.65	0.68
	60	0.70	0.56	0.83	0.69	0.72
	70	0.72	0.61	0.88	0.77	0.77
	80	0.76	0.68	0.96	0.97	0.82
	90	0.85	0.79	1.03	1.20	0.94

Table 5.74. Brownwood – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		11.48	10.35	11.35	11.26	12.93
Std. Deviation		2.27	4.67	4.71	3.90	4.65
Variance		5.17	21.81	22.22	15.19	21.63
Minimum		6.85	2.22	2.17	4.40	4.35
Maximum		16.44	22.22	20.65	19.78	23.91
Deciles Percentiles	10	8.22	3.33	5.43	6.59	7.50
	20	9.26	6.67	6.52	7.69	9.78
	30	10.14	6.67	7.61	8.79	9.78
	40	10.96	7.78	10.43	9.89	10.87
	50	11.51	10.00	11.41	10.99	11.96
	60	12.00	12.22	12.39	12.09	13.04
	70	12.60	13.33	14.13	13.52	15.22
	80	13.04	14.67	15.43	14.51	16.52
	90	14.27	16.67	18.48	16.59	20.76

Table 5.75. Brownwood – Linear Regression Results

Brownwood, Texas	**Slope Coefficient**	**Significance**	**One-Sample Kolmogorov-Smirnov Test**	**R^2**
Total Precipitation				
Annual	0.022	0.574	0.780	.005
Winter	-0.001	0.981	0.283	.000
Fall	0.019	0.336	0.972	.013
Summer	0.022	0.297	0.587	.016
Spring	-0.020	0.282	0.464	.0170
Precipitation Days				
Annual	-0.021	0.808	0.972	.001
Winter	-0.004	0.915	0.520	.000
Fall	0.020	0.662	0.785	.004
Summer	-0.007	0.851	0.705	.001
Spring	-0.032	0.475	0.558	.011
Precipitation Intensity				
Annual	0.002	0.039	0.590	.089
Winter	0.003	0.065	0.365	.072
Fall	-0.001	0.457	0.981	.012
Summer	0.005	0.044	0.237	.086
Spring	0.004	0.025	0.776	.105

Dublin

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.76, 5.77, 5.78, and 5.79. Dublin (Köppen climate classification Cfa) receives an average of 33.80 inches of precipitation per year, with most occurring during the spring, summer, and fall months. Annually, this station receives an average of 51.58 days of precipitation, of which the largest portion occurs during the spring months. Annually, this station averages 0.67 inches per day, with most occurring during the fall months. A comparison of the CV suggests that the spring months have the smallest amount of precipitation variability, while the winter is most variable. The CV suggests that the spring months have the smallest amount of variability while the winter is most variable for precipitation days and precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for spring precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 23.57 inches. Ninety percent will be at or below 44.40 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 41.80 days. Ninety percent will be at or below 64.20 days, with 10% being above 64.20 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.53 inch per day. Ninety percent of the years had 0.88 inch per day or less. Probability results show that this station has a 14.13% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual and summer total precipitation and annual, summer and winter precipitation intensity. Results show an increase of 0.105 inch per year in annual total precipitation with 7.0 % of the variance accounted for by the regression, and an increase of 0.066 inch per year during the summer months with 11.2 % of the variance accounted for by the regression. In addition, results show an increase of 0.003 inch per precipitation day annually with 14 % of the variance accounted for by the regression, and an increase of 0.005 precipitation per precipitation day during both the summer and winter months with 10.3% and 16.7% of the variance accounted for by the regression, respectively. Fall and spring shows an increase of 0.001 inch per precipitation day with approximately 1% of the variance accounted for by the regression (Table 5.80).

Table 5.76. Dublin – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71.00	71.00	71.00	71.00	71.00
	Missing	0.00	0.00	0.00	0.00	0.00
Mean		33.80	33.80	6.28	8.95	8.08
Std. Deviation		8.22	8.23	3.76	4.01	4.09
Minimum		18.29	18.29	1.03	2.09	0.92
Maximum		52.26	52.26	16.65	17.99	18.64
Coefficient of Variation		0.24	0.24	0.59	0.45	0.50
Deciles Percentiles	10	23.58	1.81	3.59	2.43	6.20
	20	25.88	2.85	5.57	4.83	7.09
	30	27.79	3.76	6.41	6.50	8.21
	40	30.51	4.72	7.46	6.96	9.17
	50	33.01	5.51	7.93	7.85	9.95
	60	36.07	6.61	9.60	8.61	11.16
	70	39.30	7.68	11.69	9.42	12.33
	80	42.41	9.64	12.85	10.68	14.32
	90	44.40	12.02	14.69	14.30	15.77

Table 5.77. Dublin – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		51.58	11.65	12.98	12.29	14.65
Std. Deviation		9.50	5.29	4.91	4.23	4.41
Minimum		31	3	5	4	7
Maximum		74	22	26	23	24
Coefficient of Variation		0.18	0.45	0.37	0.34	0.30
Deciles Percentiles	10	41.80	4.90	7.00	7.80	9.00
	20	43.00	7.00	8.80	9.00	10.00
	30	45.70	8.00	9.00	10.00	12.00
	40	48.60	9.00	12.00	11.00	13.00
	50	51.50	11.00	12.50	12.00	15.00
	60	53.00	12.40	14.00	13.00	15.40
	70	56.30	14.00	15.00	14.30	17.00
	80	60.20	17.20	16.40	16.00	18.40
	90	64.20	20.10	22.00	19.00	21.00

Table 5.78. Dublin – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.68	0.51	0.73	0.72	0.73
Std. Deviation		0.12	0.19	0.26	0.24	0.24
Minimum		0.52	0.23	0.34	0.20	0.31
Maximum		1.03	1.34	1.37	1.37	1.84
Coefficient of Variation		0.18	0.36	0.36	0.34	0.33
Deciles Percentiles	10	0.54	0.35	0.41	0.40	0.50
	20	0.56	0.37	0.50	0.56	0.55
	30	0.59	0.41	0.57	0.61	0.61
	40	0.62	0.46	0.62	0.64	0.64
	50	0.66	0.49	0.66	0.66	0.70
	60	0.69	0.51	0.73	0.71	0.76
	70	0.74	0.54	0.84	0.80	0.81
	80	0.80	0.62	0.94	0.92	0.86
	90	0.88	0.70	1.12	1.11	0.93

Table 5.79. Dublin – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		14.13	12.94	14.11	13.51	15.92
Std. Deviation		2.60	5.89	5.34	4.65	4.80
Variance		6.78	34.65	28.53	21.63	23.05
Minimum		8.49	3.33	5.43	4.40	7.61
Maximum		20.27	24.44	28.26	25.27	26.09
Deciles Percentiles	10	11.45	5.44	7.61	8.57	9.78
	20	11.78	7.78	9.57	9.89	10.87
	30	12.52	8.89	9.78	10.99	13.04
	40	13.32	10.00	13.04	12.09	14.13
	50	14.11	12.22	13.59	13.19	16.30
	60	14.52	13.78	15.22	14.29	16.74
	70	15.42	15.56	16.30	15.71	18.48
	80	16.49	19.11	17.83	17.58	20.00
	90	17.59	22.33	23.91	20.88	22.83

Table 5.80. Dublin – Linear Regression Results.

Dublin, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.105	0.026	0.494	.070
Winter	-0.001	0.993	0.489	.000
Fall	0.030	0.187	0.646	.025
Summer	0.066	0.004	0.300	.112
Spring	0.004	0.827	0.858	.001
Precipitation Days				
Annual	0.112	0.260	0.865	.027
Winter	0.029	0.597	0.697	.006
Fall	0.016	0.758	0.861	.002
Summer	0.053	0.227	0.476	.032
Spring	0.015	0.742	0.889	.002
Precipitation Intensity				
Annual	0.003	0.009	0.538	.140
Winter	0.005	0.005	0.078	.167
Fall	0.001	0.001	0.283	.009
Summer	0.005	0.005	0.225	.103
Spring	0.001	0.001	0.297	.007

Weatherford

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity are given in Tables 5.81, 5.82, 5.83, and 5.84. Weatherford (Köppen climate classification Cfa) receives an average of 33.37 inches of precipitation per year, with most occurring during the spring months. Annually, this station receives an average of 50.35 days of precipitation, of which the largest portion occurs during the spring months. Annually, this station averages 0.67 inch per day with most occurring during the fall months. A comparison of the CV shows that the spring months have the smallest amount of precipitation variability, while the winter is most variable. The CV shows that the spring months have the smallest amount of variability, while the winter months are most variable for precipitation days. The spring months show the smallest amount of variability, while the winter is most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 22.69 inches. Ninety percent will be at or below 44.04 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 37.90 days. Ninety percent will be at or below 60.10 days, with 10% being above 60.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.52 inch per day. Ninety percent of the years had 0.83 inch or less. Probability results show that this station has a 13.79% chance that any one day in the year would receive 0.1mm of rain. Linear regression results do not show significant findings in total precipitation, precipitation days, or precipitation intensity (Table 5.85).

Table 5.81. Weatherford – Total Precipitation Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		33.38	6.36	8.79	7.53	10.68
Std. Deviation		8.35	3.62	4.47	3.84	4.17
Minimum		16.66	1.27	2.50	0.71	4.26
Maximum		55.88	17.42	21.16	18.38	30.54
Coefficient of Variation		0.24	0.57	0.50	0.51	0.39
Deciles Percentiles	10	22.69	2.31	3.68	2.84	6.03
	20	25.15	3.03	4.12	4.03	7.35
	30	26.79	4.02	5.69	5.05	8.25
	40	31.03	4.67	6.98	6.23	9.60
	50	33.77	5.43	8.35	6.98	10.18
	60	35.82	6.21	9.40	8.18	10.81
	70	38.30	8.02	11.11	9.80	11.76
	80	40.56	9.45	12.17	11.18	13.29
	90	44.05	11.28	15.12	12.58	15.21

Table 5.82. Weatherford – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		50.35	11.58	12.52	11.21	14.96
Std. Deviation		8.11	4.60	4.34	3.64	4.26
Minimum		29	4	3	2	9
Maximum		73	22	22	20	29
Coefficient of Variation		0.16	0.39	0.34	0.32	0.29
Deciles Percentiles	10	37.90	5.90	7.00	6.00	9.90
	20	44.40	7.00	9.00	8.00	11.00
	30	47.00	8.70	10.00	9.00	12.00
	40	49.60	10.60	11.00	10.00	13.00
	50	51.00	11.00	12.50	11.00	14.00
	60	52.00	12.00	14.00	13.00	16.00
	70	54.00	14.00	15.30	13.00	17.00
	80	57.20	15.00	16.20	14.20	18.20
	90	60.10	19.00	18.10	16.00	20.20

Table 5.83. Weatherford – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.68	0.52	0.76	0.71	0.70
Std. Deviation		0.10	0.18	0.28	0.26	0.17
Minimum		0.44	0.26	0.32	0.42	0.36
Maximum		0.89	1.15	1.40	1.42	1.27
Coefficient of Variation		0.15	0.34	0.37	0.37	0.25
Deciles Percentiles	10	0.52	0.34	0.44	0.43	0.51
	20	0.59	0.38	0.50	0.48	0.58
	30	0.62	0.41	0.56	0.53	0.60
	40	0.66	0.45	0.62	0.56	0.64
	50	0.68	0.48	0.69	0.63	0.67
	60	0.71	0.53	0.80	0.69	0.73
	70	0.73	0.58	0.85	0.82	0.76
	80	0.75	0.62	1.01	0.93	0.82
	90	0.83	0.80	1.23	1.08	0.94

Table 5.84. Weatherford – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		13.79	12.87	13.61	12.32	16.26
Std. Deviation		2.22	5.12	4.72	4.01	4.63
Variance		4.94	26.21	22.32	16.08	21.47
Minimum		7.95	4.44	3.26	2.20	9.78
Maximum		20.00	24.44	23.91	21.98	31.52
Deciles Percentiles	10	10.38	6.56	7.61	6.59	10.76
	20	12.16	7.78	9.78	8.79	11.96
	30	12.88	9.67	10.87	9.89	13.04
	40	13.59	11.78	11.96	10.99	14.13
	50	13.97	12.22	13.59	12.09	15.22
	60	14.25	13.33	15.22	14.29	17.39
	70	14.79	15.56	16.63	14.29	18.48
	80	15.67	16.67	17.61	15.60	19.78
	90	16.47	21.11	19.67	17.58	21.96

Table 5.85. Weatherford – Linear Regression Results

Weatherford, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.069	0.150	0.857	.030
Winter	-0.006	0.756	0.131	.001
Fall	0.048	0.061	0.515	.050
Summer	0.031	0.153	0.882	.029
Spring	-0.008	0.722	0.296	.002
Precipitation Days				
Annual	0.082	0.334	0.741	.020
Winter	0.056	0.242	0.866	,030
Fall	0.043	0.341	0.909	.020
Summer	-0.007	0.846	0.180	.001
Spring	-0.015	0.733	0.721	.003
Precipitation Intensity				
Annual	0.001	0.193	0.964	.037
Winter	0.002	0.259	0.529	.028
Fall	-0.001	0.986	0.548	.000
Summer	0.003	0.228	0.222	.031
Spring	-0.001	0.529	0.584	.009

Summary for the North Central Region

Most precipitation and days with precipitation occur during the spring months for all North Central stations. Precipitation intensity is greatest during the fall months except for Haskell and Albany. The summer and spring months showed the least amount of variability for precipitation and precipitation days, while the variability for precipitation intensity was low during the spring months. The highest probability of a rain day resulted in 14.13% for Dublin. All other stations fell below this value. Most stations show a positive skew for precipitation, precipitation days, and precipitation intensity. Median values fell less than the mean except for annual and summer precipitation days for Albany; annual and fall precipitation days for Brownwood; spring precipitation days for Dublin; and annual precipitation intensity for Weatherford.

Total precipitation, precipitation days, and precipitation intensity annually and seasonally were grouped into equal frequency deciles. For the given stations, the bottom deciles included the 10% of events with the lowest values, while the top deciles include the 10% of events with the greatest value. Haskell showed the lowest values for precipitation with 10% of the years not exceeding 15.87 inches of precipitation, and 0.48 inch per day. Albany showed the lowest values for precipitation intensity with 10% of the years not exceeding 0.48 inch per day, and Brownwood with 30.00 precipitation days. For Dublin, 10% of the years exceeded 44.40 inches of precipitation, 64.20 precipitation days, and 0.88 inch per day.

There is a statistically significant increase of 0.105 inch of precipitation per year over the period of record for annual precipitation and 0.066 inch per year during the summer months for precipitation during the period of record for Dublin. Stations that experienced an increase in annual precipitation intensity include Brownwood and Dublin, and those stations that experienced an increase in winter precipitation include Haskell and Dublin. Haskell is the only station that resulted in a decrease in precipitation intensity during the fall months, while Brownwood and Dublin resulted in an increase in precipitation intensity during the summer months. Brownwood also resulted in an increase in spring precipitation intensity. No other trends were found.

Northeast

The Northeast region is classified as subtropical with hot, humid summers. In this region, there is one distinct climate type based on the Köppen climate classification; Cfa (humid subtropical). This region receives humid air from the Gulf of Mexico from the south during the summer months, and cyclonic storms from the north during the winter months. The five weather stations and their respective station number in this region include Mexia (31), Corsicana (12), Greenville (22), Clarksville (10), and Marshall (29) (Figure 4.1).

Mexia

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Mexia are given in Tables 5.86, 5.87, 5.88, and 5.89. Mexia (Köppen climate classification Cfa) receives an average of 39.31 inches of precipitation per year with most occurring during the spring months. Annually, this station receives an average of 55.83 days of precipitation, of which the largest portion occurs during the spring months. Annually, this station averages 0.72 inch per day with most occurring during the fall months. A comparison of the CV suggests that the spring months have smallest amount of precipitation variability, while the fall is most variable. The CV shows that the spring months have the smallest amount of variability, while the fall is most variable for precipitation days. The CV shows that the spring months have the smallest amount a variability, while the fall months is most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for fall total precipitation, and winter and fall precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 26.92 inches. Ninety percent will be at or below 52.94 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 41.70 days. Ninety percent will be at or below 69 days, with 10% being above 69.00 days. For precipitation intensity, results show that 10 % of the years on record experienced at or below 0.59 inch per day. Ninety percent of the years had 0.85 inch per day or less. Probability results show that this station has a 15.29% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual and winter precipitation intensity. Results show an increase of 0.002 inch of precipitation per precipitation day annually, with 9.3% of the variance accounted for by the regression, and an increase of 0.006 inch precipitation per precipitation day during the winter months, with 10.9% of the variance accounted for by the regression (Table 5.90).

Table 5.86. Mexia – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		39.3	9.30	10.75	7.56	11.68
Std. Deviation		9.35	3.80	4.66	3.93	4.60
Minimum		20.44	2.77	2.80	.75	3.12
Maximum		58.14	20.78	23.31	22.13	26.33
Coefficient of Variation		0.23	0.41	0.43	0.52	0.39
Deciles Percentiles	10	26.92	4.39	4.79	3.42	6.86
	20	29.47	6.02	6.27	4.26	7.92
	30	33.82	7.49	8.03	5.00	9.06
	40	37.04	8.43	9.66	6.46	9.83
	50	38.85	9.00	10.88	7.25	10.70
	60	41.61	9.85	11.57	7.95	11.76
	70	44.83	10.29	12.64	8.95	13.17
	80	47.99	11.24	14.38	10.35	15.56
	90	52.94	15.15	17.36	12.65	18.51

Table 5.87. Mexia – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		55.83	14.94	14.44	10.73	15.63
Std. Deviation		10.18	5.18	4.64	4.08	4.71
Minimum		35	4	5	3	8
Maximum		78	30	25	20	29
Coefficient of Variation		0.18	0.35	0.32	0.38	0.30
Deciles Percentiles	10	41.70	9.80	8.90	5.90	9.00
	20	44.00	11.00	10.00	7.00	10.80
	30	52.70	11.70	11.70	8.00	13.00
	40	54.00	13.00	12.60	9.00	14.00
	50	56.50	15.00	15.00	10.50	16.00
	60	58.40	16.00	15.00	12.00	17.00
	70	61.30	17.30	17.00	13.00	17.30
	80	64.40	18.20	19.00	14.00	20.00
	90	69.00	22.00	21.00	16.20	22.00

Table 5.88. Mexia – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.72	0.64	0.79	0.72	0.75
Std. Deviation		0.12	0.28	0.17	0.27	0.23
Minimum		0.47	0.26	0.45	0.25	0.35
Maximum		1.22	2.08	1.08	1.50	1.34
Coefficient of Variation		0.16	0.43	0.21	0.37	0.31
Deciles Percentiles	10	0.60	0.36	0.56	0.43	0.50
	20	0.64	0.47	0.59	0.49	0.57
	30	0.66	0.49	0.71	0.59	0.61
	40	0.68	0.56	0.75	0.63	0.65
	50	0.71	0.59	0.78	0.67	0.71
	60	0.73	0.65	0.83	0.72	0.77
	70	0.77	0.73	0.92	0.78	0.83
	80	0.78	0.77	0.96	0.94	0.92
	90	0.85	0.94	1.03	1.12	1.14

Table 5.89. Mexia – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		15.29	16.60	15.69	11.79	16.98
Std. Deviation		2.79	5.76	5.05	4.49	5.12
Variance		7.79	33.22	25.54	20.18	26.23
Minimum		9.59	4.44	5.43	3.30	8.70
Maximum		21.37	33.33	27.17	21.98	31.52
Deciles Percentiles	10	11.42	10.89	9.67	6.48	9.78
	20	12.05	12.22	10.87	7.69	11.74
	30	14.44	13.00	12.72	8.79	14.13
	40	14.79	14.44	13.70	9.89	15.22
	50	15.48	16.67	16.30	11.54	17.39
	60	16.00	17.78	16.30	13.19	18.48
	70	16.79	19.22	18.48	14.29	18.80
	80	17.64	20.22	20.65	15.38	21.74
	90	18.90	24.44	22.83	17.80	23.91

Table 5.90. Mexia – Linear Regression Results

Mexia, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.059	0.274	0.921	.017
Winter	0.003	0.868	0.230	.000
Fall	0.046	0.088	0.842	.042
Summer	0.008	0.715	0.324	.002
Spring	-0.003	0.908	0.205	.000
Precipitation Days				
Annual	-0.066	0.538	0.916	.008
Winter	-0.035	0.513	0.960	.009
Fall	0.036	0.459	0.964	.012
Summer	-0.021	0.611	0.686	.006
Spri ng	-0.036	0.458	0.967	.012
Precipitation Intensity				
Annual	0.002	0.035	0.188	.093
Winter	0.006	0.022	0.130	.109
Fall	-0.001	0.873	0.746	.001
Summer	0.002	0.361	0.221	.018
Spring	0.001	0.536	0.571	.008

Corsicana

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Corsicana are given in Tables 5.91, 5.92, 5.93, and 5.94. Corsicana (Köppen climate classification Cfa) receives an average of 38.20 inches of precipitation per year, of which the largest portion occurs during the spring months. Annually, this station receives an average of 55.08 days of precipitation, most of which occurs during the spring months. Annually, this station averages 0.69 inch per day with most occurring during the fall months. A comparison of the CV suggests the winter and spring months have the smallest amount of precipitation variability, while the summer is most variable. The CV suggests that the spring months have the smallest amount of variability, while the summer is the most variable for precipitation days. The CV suggests that the summer months have the smallest amount of variability, while the spring months are most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for spring precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 27.99 inches. Ninety percent will be at or below 49.15 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 42.90 days. Ninety percent will be at or below 67.10 days, with 10% being above 67.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.56 inch per day. Ninety percent of the years had 0.78 inch per day or less. Probability results show that this station has a 15.36% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in winter precipitation intensity. Results show an increase of 0.005 inch of precipitation per precipitation day during the winter months (Table 5.95).

Table 5.91. Corsicana – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		38.21	8.99	9.83	7.24	12.10
Std. Deviation		8.62	3.55	4.86	3.84	4.83
Minimum		22.17	2.64	1.77	0.28	4.28
Maximum		61.50	19.09	24.70	15.58	28.36
Coefficient of Variation		0.22	0.39	0.49	0.53	0.39
Deciles Percentiles	10	27.99	4.76	4.18	2.46	5.97
	20	29.44	6.23	5.62	3.43	8.24
	30	32.43	7.37	6.70	4.87	9.03
	40	35.02	7.88	7.92	5.42	10.24
	50	38.01	8.41	9.16	6.35	11.81
	60	41.32	8.81	10.21	8.04	12.93
	70	43.90	10.09	11.37	9.17	13.89
	80	46.14	11.74	13.15	11.09	15.38
	90	49.15	13.61	16.32	12.66	19.48

Table 5.92. Corsicana – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		56.08	14.63	13.94	11.48	15.96
Std. Deviation		8.61	4.73	4.34	4.24	4.70
Minimum		36	7	5	2	6
Maximum		78	26	25	24	31
Coefficient of Variation		0.15	0.32	0.31	0.37	0.29
Deciles Percentiles	10	42.90	9.00	9.00	6.80	11.00
	20	49.60	10.00	10.00	8.00	12.80
	30	52.70	11.00	11.70	9.00	13.00
	40	54.60	12.60	12.00	11.00	14.00
	50	56.00	14.00	14.00	11.00	16.00
	60	57.40	15.40	15.00	12.00	16.40
	70	61.30	17.00	16.00	13.30	18.00
	80	63.00	18.00	17.00	16.00	19.00
	90	67.10	22.10	21.00	16.00	22.20

Table 5.93. Corsicana – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.69	0.61	0.75	0.65	0.75
Std. Deviation		0.09	0.19	0.27	0.23	0.21
Minimum		0.49	0.33	0.29	0.24	0.40
Maximum		0.96	1.09	1.49	1.23	1.22
Coefficient of Variation		0.13	0.30	0.35	0.34	0.30
Deciles Percentiles	10	0.57	0.39	0.45	0.35	0.50
	20	0.63	0.41	0.52	0.47	0.54
	30	0.65	0.50	0.57	0.52	0.58
	40	0.67	0.55	0.65	0.56	0.68
	50	0.68	0.58	0.71	0.60	0.73
	60	0.71	0.63	0.80	0.68	0.77
	70	0.75	0.72	0.87	0.73	0.84
	80	0.76	0.77	0.98	0.82	0.92
	90	0.78	0.83	1.11	0.96	1.14

Table 5.94. Corsicana – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		15.36	16.25	15.15	12.61	17.35
Std. Deviation		2.36	5.26	4.72	4.67	5.12
Variance		5.57	27.67	22.29	21.79	26.19
Minimum		9.86	7.78	5.43	2.20	6.52
Maximum		21.37	28.89	27.17	26.37	33.70
Deciles Percentiles	10	11.75	10.00	9.78	7.47	11.96
	20	13.59	11.11	10.87	8.79	13.91
	30	14.44	12.22	12.72	9.89	14.13
	40	14.96	14.00	13.04	12.09	15.22
	50	15.34	15.56	15.22	12.09	17.39
	60	15.73	17.11	16.30	13.19	17.83
	70	16.79	18.89	17.39	14.62	19.57
	80	17.26	20.00	18.48	17.58	20.65
	90	18.38	24.56	22.83	17.58	24.13

Table 5.95. Corsicana – Linear Regression Results.

Corsicana, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.064	0.202	0.686	.023
Winter	0.014	0.470	0.303	.008
Fall	0.044	0.113	0.373	.036
Summer	0.011	0.622	0.383	.004
Spring	-0.011	0.673	0.761	.003
Precipitation Days				
Annual	0.067	0.461	0.986	.013
Winter	-0.031	0.531	0.739	.009
Fall	0.019	0.678	0.918	.004
Summer	0.006	0.882	0.599	.000
Spring	0.010	0.839	0.877	.001
Precipitation Intensity				
Annual	0.001	0.490	0.913	.010
Winter	0.005	0.008	0.122	.145
Fall	-0.001	0.730	0.677	.003
Summer	0.001	0.870	0.677	.001
Spring	-0.002	0.357	0.880	.018

Greenville

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Greenville are given in Tables 5.96, 5.97, 5.98, and 5.99. Greenville (Köppen climate classification Cfa) receives an average of 42.72 inches of precipitation per year with most occurring during the spring months. Annually, this station receives an average of 58.75 days of precipitation, of which the largest portion occurs during the spring months. Annually, this station averages 0.73 inch per day with most occurring during the fall months. A comparison of the CV suggests the spring months have the smallest amount of precipitation variability, while the winter is most variable. The CV suggests that the spring months have the smallest amount of variability, while the winter is the most variable for precipitation days. The CV suggests that the winter months have the smallest amount of variability, while the spring months are the most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual precipitation, and summer precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 29.50 inches. Ninety percent will be at or below 52.25 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 47.70 days. Ninety percent will be at or below 73.10 days, with 10% being above 73.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.61 inch per day. Ninety percent of the years had 0.85 inch per day or less. Probability results show that this station has a 16.09% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in fall total precipitation, and annual, summer, and winter precipitation intensity, and summer precipitation days. Results show an increase of 0.061 inch of fall total precipitation, with 7.7% of the variance accounted for by the regression. In addition, results show an increase of 0.002 inches of precipitation per precipitation day annually, with 9.1% of the variance accounted for by the regression. Results also show an increase of 0.004 precipitation per precipitation day for the summer, with 10.6% of the variance accounted for by the regression, and 0.006 inch per precipitation day during the winter months, with 14.6% of the variance accounted for by the regression (Table 5.100).

Table 5.96. Greenville – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		42.72	42.72	9.27	11.12	8.78
Std. Deviation		9.00	9.00	3.89	4.58	3.85
Minimum		25.12	25.12	2.40	3.19	2.38
Maximum		75.24	75.24	19.50	22.19	17.89
Coefficient of Variation		0.21	0.21	0.42	0.41	0.43
Deciles Percentiles	10	29.51	4.32	5.90	3.72	7.44
	20	35.55	6.01	6.49	4.85	9.19
	30	39.09	6.82	8.62	6.08	11.27
	40	40.71	8.00	9.63	7.85	12.37
	50	42.89	9.00	10.83	8.76	13.82
	60	45.09	9.68	12.20	9.53	14.64
	70	46.65	11.06	13.29	10.65	15.56
	80	49.31	12.60	14.72	12.34	16.55
	90	52.25	14.44	18.07	14.01	18.52

Table 5.97. Greenville – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		58.75	58.75	14.04	14.27	12.63
Std. Deviation		9.43	9.44	4.79	4.71	4.00
Minimum		38.00	38.00	5.00	6.00	5.00
Maximum		78.00	78.00	25.00	24.00	22.00
Coefficient of Variation		0.16	0.16	0.34	0.32	0.31
Deciles Percentiles	10	47.70	8.00	7.00	6.90	11.90
	20	51.80	10.00	10.60	9.00	13.00
	30	54.00	11.00	12.00	10.70	14.70
	40	56.00	12.00	13.00	11.60	16.00
	50	58.00	13.00	14.00	12.00	17.50
	60	59.40	15.40	15.00	14.00	19.00
	70	65.00	17.00	17.30	15.30	19.60
	80	66.20	19.00	19.00	16.00	23.00
	90	73.10	21.00	20.20	17.10	24.00

Table 5.98. Greenville – Precipitation Intensity [in/day]Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.73	0.74	0.65	0.84	0.68
Std. Deviation		0.10	0.10	0.22	0.23	0.17
Minimum		0.47	0.47	0.32	0.43	0.38
Maximum		1.04	1.04	1.62	1.43	1.12
Coefficient of Variation		0.13	0.13	0.34	0.27	0.25
Deciles Percentiles	10	0.61	0.44	0.53	0.43	0.55
	20	0.68	0.48	0.64	0.52	0.60
	30	0.69	0.51	0.72	0.58	0.68
	40	0.72	0.55	0.76	0.62	0.73
	50	0.73	0.59	0.84	0.71	0.74
	60	0.74	0.66	0.90	0.74	0.77
	70	0.77	0.70	0.93	0.76	0.80
	80	0.81	0.78	0.99	0.82	0.85
	90	0.85	0.97	1.19	0.92	1.06

Table 5.99. Greenville – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		16.09	16.10	15.60	13.87	19.25
Std. Deviation		2.58	2.59	5.32	4.40	5.15
Variance		6.68	6.69	28.31	19.35	26.49
Minimum		10.41	10.41	5.56	5.49	9.78
Maximum		21.36	21.37	27.78	24.18	33.70
Deciles Percentiles	10	13.07	8.89	7.61	12.93	12.93
	20	14.19	11.11	11.52	14.13	14.13
	30	14.79	12.22	13.04	15.98	15.97
	40	15.34	13.33	14.13	17.39	17.39
	50	15.89	14.44	15.22	19.02	19.02
	60	16.27	17.11	16.30	20.65	20.65
	70	17.81	18.89	18.80	21.30	21.30
	80	18.14	21.11	20.65	25.00	25.00
	90	20.03	23.33	21.96	26.09	26.08

Table 5.100. Greenville – Linear Regression Results

Greenville, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.079	0.126	0.816	.034
Winter	0.012	0.594	0.860	.004
Fall	0.061	0.019	0.867	.077
Summer	-0.003	0.871	0.646	.000
Spring	0.004	0.876	0.404	.000
Precipitation Days				
Annual	0.052	0.601	0.865	.006
Winter	0.053	0.288	0.223	.024
Fall	0.058	0.239	0.987	.030
Summer	-0.068	0.009	0.617	.058
Spring	0.010	0.834	0.855	.001
Precipitation Intensity				
Annual	0.002	0.038	0.491	.091
Winter	0.006	0.007	0.354	.146
Fall	-0.001	0.896	0.934	.000
Summer	0.004	0.023	0.886	.106
Spring	0.001	0.918	0.260	.000

Clarksville

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Clarksville are given in Tables 5.101, 5.102, 5.103, and 5.104. Clarksville (Köppen climate classification Cfa) receives an average of 46.54 inches of precipitation per year, of which the largest portion occurs during the spring months. Annually, this station receives an average of 62.06 days of precipitation, most of which occurs during the spring months. Annually, this station averages 0.75 inch per day with most occurring during the fall months. A comparison of the CV suggests the winter months have the smallest amount of precipitation variability, while the summer is most variable. The CV suggests that the spring months have the smallest amount of variability, while the summer is the most variable for precipitation days. The CV suggests that the summer months have the smallest amount of variability, while the winter months are the most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for spring precipitation and precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 33.02 inches. Ninety percent will be at or below 59.84 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 49 days. Ninety percent will be at or below 77.20 days, with 10% being above 77.20 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.59 inch per day. Ninety percent of the years had 0.93 inch per day or less. Probability results show that this station has a 17.00% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in fall total precipitation, and fall precipitation intensity. Results show an increase of 0.095 inches of fall total precipitation per year, with 16.1% of the variance accounted for by the regression and an increase of 0.095 inch increase in precipitation per precipitation day, with 0.3% of the variance accounted for by the regression (Table 5.105).

Table 5.101. Clarksville – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		46.55	10.74	12.14	9.08	14.74
Std. Deviation		10.03	3.95	4.94	4.39	5.33
Minimum		27.16	3.43	3.20	2.04	4.65
Maximum		70.59	20.47	26.31	24.33	32.15
Coefficient of Variation		0.22	0.32	0.41	0.48	0.36
Deciles	10	33.02	5.75	6.43	4.14	8.48
Percentiles	20	37.25	6.81	7.79	5.34	9.73
	30	41.95	8.80	9.05	6.27	11.43
	40	43.52	9.77	10.61	7.04	12.78
	50	46.40	10.52	11.73	8.21	15.04
	60	49.08	11.19	12.75	9.50	16.44
	70	50.53	12.26	14.69	11.55	16.95
	80	55.54	13.53	15.87	12.85	18.48
	90	59.84	17.18	18.51	14.54	21.25

Table 5.102. Clarksville – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		62.06	15.56	14.69	12.77	18.90
Std. Deviation		10.33	4.77	5.03	4.47	4.85
Minimum		43	4	5	4	10
Maximum		85	25	26	22	32
Coefficient of Variation		0.17	0.31	0.34	0.35	0.26
Deciles	10	49.00	9.90	8.00	6.90	12.00
Percentiles	20	52.80	11.80	9.80	8.00	14.00
	30	56.70	13.00	11.70	10.70	16.00
	40	59.60	14.00	13.00	12.00	17.00
	50	60.00	15.00	14.50	12.50	19.50
	60	63.80	17.00	17.00	13.40	21.00
	70	66.30	18.30	18.00	16.00	22.00
	80	70.40	20.00	19.00	17.00	23.00
	90	77.20	21.10	21.00	19.10	24.00

Table 5.103. Clarksville – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.76	0.67	0.92	0.71	0.75
Std. Deviation		0.12	0.25	0.28	0.19	0.18
Minimum		0.55	0.41	0.40	0.34	0.36
Maximum		1.04	1.98	2.02	1.16	1.32
Coefficient of Variation		0.16	0.37	0.30	0.27	0.25
Deciles Percentiles	10	0.59	0.44	0.58	0.50	0.53
	20	0.65	0.50	0.70	0.54	0.60
	30	0.68	0.52	0.76	0.56	0.65
	40	0.72	0.59	0.83	0.64	0.69
	50	0.74	0.64	0.90	0.66	0.73
	60	0.77	0.69	0.95	0.75	0.78
	70	0.81	0.73	1.04	0.78	0.83
	80	0.88	0.81	1.13	0.88	0.93
	90	0.93	0.85	1.25	1.01	1.00

Table 5.104. Clarksville – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		17.00	17.29	15.96	14.03	20.54
Std. Deviation		2.83	5.30	5.47	4.92	5.28
Variance		8.02	28.10	29.92	24.22	27.87
Minimum		11.78	4.44	5.43	4.40	10.87
Maximum		23.29	27.78	28.26	24.18	34.78
Deciles Percentiles	10	13.42	11.00	8.70	7.58	13.04
	20	14.47	13.11	10.65	8.79	15.22
	30	15.53	14.44	12.72	11.76	17.39
	40	16.33	15.56	14.13	13.19	18.48
	50	16.44	16.67	15.76	13.74	21.20
	60	17.48	18.89	18.48	14.73	22.83
	70	18.16	20.33	19.57	17.58	23.91
	80	19.29	22.22	20.65	18.68	25.00
	90	21.15	23.44	22.83	20.99	26.09

Table 5.105. Clarksville – Linear Regression Results

Clarksville, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.077	0.183	0.850	.026
Winter	-0.017	0.458	0.601	.008
Fall	0.095	0.001	0.877	.161
Summer	-0.006	0.815	0.815	.001
Spring	-0.015	0.625	0.625	.003
Precipitation Days				
Annual	0.052	0.911	0.681	.000
Winter	0.053	0.505	0.882	.010
Fall	0.061	0.244	0.681	.029
Summer	0.054	0.251	0.930	.029
Spring	0.029	0.570	0.879	.007
Precipitation Intensity				
Annual	0.077	0.183	0.850	.088
Winter	-0.017	0.458	0.601	.096
Fall	0.095	0.001	0.877	.003
Summer	-0.006	0.815	0.460	.010
Spring	-0.015	0.625	0.846	.070

Marshall

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Marshall are given in Tables 5.106, 5.107, 5.108, and 5.109. Marshall (Köppen climate classification Cfa) receives an average of 48.45 inches of precipitation per year with most occurring during the spring and winter months. Annually, this station receives an average of 66.10 days of precipitation, of which the largest portion occurs during the winter months. Annually, this station averages 0.74 inches per day with most occurring during the spring months. A comparison of the CV suggests the spring months have the smallest amount of precipitation variability, while the summer are most variable. A comparison of the CV for precipitation days suggests the winter months have the smallest amount of variability, while the fall are most variable. The CV suggests that the spring months has the smallest amount of variability, while both the winter and summer months is the most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity is less than their respective mean values, except for annual and winter precipitation days and winter and fall precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 36.35 inches. Ninety percent will be at or below 63.50 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 53.10 days. Ninety percent will be at or below 83.10 days, with a 10% being above 83.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.62 inch per day. Ninety percent of the years had 0.86 inch per day or less. Probability results show that this station has an 18.11% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual and winter total precipitation, and annual, summer, and winter precipitation intensity. Results show an annual increase of 0.115 inch in annual total precipitation, with 5.0% of the variance accounted for by the regression, and 0.072 inch increase in fall precipitation per year, with 10.7% of the variance accounted for by the regression. In addition, linear regression results show an increase of 0.003 inches of precipitation per precipitation day annually, with 32.2% of the variance accounted for by the regression, an increase of 0.004 inch of precipitation per precipitation day during both the summer and winter months, with 9.5% and 13.0 of the variance accounted for by the regression, respectively (Table 5.110).

Table 5.106. Marshall – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		48.46	13.25	11.53	9.72	13.99
Std. Deviation		10.02	5.21	4.55	3.93	5.18
Minimum		29.58	5.57	3.87	2.81	5.21
Maximum		74.88	33.40	21.51	19.36	31.04
Coefficient of Variation		0.20	0.39	0.39	0.41	0.37
Deciles Percentiles	10	36.36	7.40	6.03	4.38	7.13
	20	39.17	8.48	6.51	5.99	9.18
	30	41.76	9.90	7.97	7.53	11.23
	40	45.46	11.54	10.40	8.60	12.21
	50	47.88	12.87	11.47	9.29	13.66
	60	50.74	14.20	12.84	10.34	14.84
	70	53.34	15.28	14.49	11.54	16.31
	80	57.01	16.65	15.50	13.36	18.17
	90	63.50	19.78	16.89	14.90	21.18

Table 5.107. Marshall – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		66.10	18.52	15.67	14.63	17.63
Std. Deviation		10.24	4.27	4.59	3.97	4.86
Minimum		47	10	7	6	10
Maximum		90	28	25	23	33
Coefficient of Variation		0.15	0.23	0.29	0.27	0.28
Deciles Percentiles	10	53.00	12.90	10.00	9.00	12.00
	20	56.80	14.00	10.80	11.60	13.00
	30	59.40	16.00	13.00	12.00	14.00
	40	62.60	17.00	14.00	13.00	16.00
	50	64.50	19.00	15.00	14.00	17.00
	60	68.40	20.00	17.00	16.00	19.00
	70	71.30	20.00	18.30	17.00	20.00
	80	74.00	22.20	20.00	18.20	22.20
	90	83.10	25.00	22.10	21.00	24.00

Table 5.108. Marshall – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.74	0.69	0.78	0.69	0.78
Std. Deviation		0.09	0.19	0.20	0.20	0.20
Minimum		0.55	0.33	0.45	0.44	0.40
Maximum		0.96	1.26	1.18	1.63	1.39
Coefficient of Variation		0.11	0.28	0.26	0.28	0.25
Deciles Percentiles	10	0.63	0.47	0.52	0.47	0.56
	20	0.68	0.51	0.58	0.55	0.62
	30	0.70	0.54	0.63	0.58	0.69
	40	0.72	0.61	0.70	0.61	0.74
	50	0.73	0.69	0.78	0.65	0.76
	60	0.76	0.73	0.84	0.73	0.78
	70	0.78	0.75	0.87	0.78	0.82
	80	0.82	0.84	0.94	0.82	0.93
	90	0.86	1.01	1.08	0.86	1.01

Table 5.109. Marshall – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		18.11	20.58	17.03	16.07	19.16
Std. Deviation		2.81	4.75	4.99	4.37	5.29
Variance		7.87	22.59	24.90	19.10	27.99
Minimum		12.88	11.11	7.61	6.59	10.87
Maximum		24.66	31.11	27.17	25.27	35.87
Deciles Percentiles	10	14.52	14.33	10.87	9.89	13.04
	20	15.56	15.56	11.74	12.75	14.13
	30	16.27	17.78	14.13	13.19	15.22
	40	17.15	18.89	15.22	14.29	17.39
	50	17.67	21.11	16.30	15.38	18.48
	60	18.74	22.22	18.48	17.58	20.65
	70	19.53	22.22	19.89	18.68	21.74
	80	20.27	24.67	21.74	20.00	24.13
	90	22.77	27.78	24.02	23.08	26.09

Table 5.110. Marshall – Linear Regression Results

Marshall, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.115	0.046	0.883	.050
Winter	-0.014	0.642	0.793	.003
Fall	0.072	0.005	0.952	.107
Summer	0.039	0.083	0.876	.043
Spring	0.002	0.933	0.921	.000
Precipitation Days				
Annual	0.020	0.792	0.882	.002
Winter	-0.011	0.798	0.959	.001
Fall	0.063	0.186	0.683	.038
Summer	-0.005	0.889	0.669	.000
Spring	-0.014	0.978	0.672	.000
Precipitation Intensity				
Annual	0.003	0.000	0.971	.322
Winter	0.004	0.012	0.730	.130
Fall	0.002	0.189	0.631	.037
Summer	0.004	0.033	0.568	.095
Spring	0.001	0.844	0.267	.001

Summary for the Northeast region

Most precipitation and days with precipitation occur during the spring months for the Northeast stations. Precipitation intensity is greatest for most stations during the fall months. The spring months resulted in the least amount of variability for most stations for precipitation and precipitation days. Mixed results showed for precipitation intensity; the variability was low except during the fall months. Mixed results occurred seasonally for high variability for precipitation, precipitation days, and precipitation intensity. The highest probability for a rain day was 18.11 % for Marshall. Most stations resulted in a positive skew for precipitation, precipitation days, and precipitation intensity. Median values fell less than the mean except for fall precipitation and winter and fall precipitation days for Mexia; spring precipitation days for Corsicana; annual precipitation and summer precipitation intensity for Greenville; spring precipitation and precipitation days for

Clarksville; and annual and winter precipitation days and winter and fall precipitation intensity for Marshall.

Total precipitation, precipitation days, and precipitation intensity annually and seasonally were grouped into equal frequency deciles. For the given stations, the bottom deciles included the 10% of events with the lowest values, while the top deciles include the 10 % of events with the greatest value. Mexia showed the lowest values for precipitation and precipitation days with 10% of the years not exceeding 26.92 inches of precipitation and 41.70 days with precipitation. Corsicana resulted in the lowest values for precipitation intensity with 10% of the years not exceeding 0.56 inches per day. For Marshall, 10% of the years recorded exceeded 63.50 inches of precipitation and 83.10 days of precipitation. For Clarksville, 10% of the years exceeded 0.93 inch per day of precipitation.

There is a statistically significant increase in annual precipitation for Marshall, and an increase in precipitation for Greenville and Clarksville during the fall months. Mexia, Greenville, and Marshall resulted in an increase in annual precipitation intensity, while Mexia, Corsicana, Greenville, and Marshall resulted in an increase in precipitation intensity during the winter months. Clarksville resulted in an increase in fall precipitation intensity, while Greenville and Marshall resulted in an increase in summer precipitation intensity. There were no trends in precipitation days.

Central Texas

In this region, the stations are all humid subtropical (Cfa) climate type. The Cfa climate has a bimodal precipitation pattern with May and September being the wettest months (Swanson 1995). Areas in this region classified as BSh represent a transition between deserts to the west and humid climates to the east. The ten weather stations in this region include Lampasas (25), Temple (41), Llano (27), Blanco (6), Boerne (7), New Braunfels (34), San Antonio (38), Luling (28), Flatonia (20), and Hallettsville (23) (Figure 4.1).

Lampasas

Lampasas is classified as a Cfa (humid subtropical) climate. Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Lampasas are given in Tables 5.111, 5.112, 5.113, and 5.114. Lampasas receives an average of 30.73 inches of precipitation per year with most occurring during the spring months. Annually, this station receives an average of 48.81 days of precipitation, of which the largest portion occurs during spring months. Annually, this station averages 0.62 inch per day with most occurring during the summer months. A comparison of the CV suggests the spring months have the smallest amount of precipitation variability, while the winter is most variable. The CV suggests that the fall months have the smallest amount of variability, while the winter is the most variable for precipitation days. The CV suggests that the spring months have the smallest amount of variability, while the summer months are the most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual and summer precipitation days, and annual precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 18.55 inches. Ninety percent will be at or below 42.25 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 38.60 days. Ninety percent will be at or below

59.10 days, with 10% being above 59.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.49 inch per day. Ninety percent of the years had 0.75 inch per day or less. Probability results show that this station has a 13.37% chance that any one day in the year would receive 0.1mm of rain. Linear regression results do not indicate significant findings in regard to an increase or decrease in precipitation, precipitation days, or precipitation intensity during the period of record (Table 5.115).

Table 5.111. Lampasas – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		30.73	6.10	8.12	7.19	9.28
Std. Deviation		8.11	3.43	3.86	3.95	3.72
Minimum		14.80	0.88	0.94	0.83	2.80
Maximum		48.36	21.68	20.99	19.24	24.54
Coefficient of Variation		0.26	0.56	0.47	0.55	0.40
Deciles Percentiles	10	18.55	2.02	3.19	2.55	4.56
	20	23.60	3.41	4.33	3.62	6.40
	30	26.51	4.33	5.91	4.84	7.01
	40	29.21	4.73	6.80	5.86	8.02
	50	30.08	5.51	7.90	6.99	9.06
	60	32.62	6.61	8.83	7.93	9.99
	70	34.56	7.44	9.91	8.36	11.37
	80	38.01	8.20	10.56	10.01	12.63
	90	42.25	10.53	13.19	12.82	13.64

Table 5.112. Lampasas – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		48.81	11.29	12.48	11.15	13.75
Std. Deviation		8.92	4.63	4.03	4.38	4.73
Minimum		24	3	4	3	5
Maximum		67	26	20	19	27
Coefficient of Variation		0.18	0.41	0.32	0.39	0.34
Deciles Percentiles	10	38.60	5.00	6.90	5.00	8.00
	20	41.00	7.00	8.80	7.00	9.00
	30	44.70	8.70	11.00	8.00	11.00
	40	47.00	10.00	11.60	9.60	12.00
	50	50.00	11.00	12.00	11.50	13.00
	60	51.00	12.00	13.00	12.00	15.00
	70	55.00	13.30	15.00	14.00	16.30
	80	57.20	15.00	16.20	15.00	18.20
	90	59.10	17.10	18.00	17.10	20.00

Table 5.113. Lampasas – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.63	0.52	0.67	0.69	0.64
Std. Deviation		0.09	0.15	0.18	0.27	0.15
Minimum		0.42	0.23	0.34	0.28	0.36
Maximum		0.79	0.84	1.05	1.42	1.00
Coefficient of Variation		0.14	0.28	0.26	0.38	0.23
Deciles Percentiles	10	0.49	0.32	0.44	0.35	0.48
	20	0.56	0.39	0.50	0.46	0.54
	30	0.58	0.40	0.59	0.52	0.56
	40	0.60	0.45	0.61	0.59	0.57
	50	0.63	0.51	0.63	0.66	0.59
	60	0.65	0.58	0.67	0.73	0.63
	70	0.68	0.61	0.74	0.80	0.69
	80	0.72	0.65	0.82	0.92	0.76
	90	0.75	0.71	0.95	1.08	0.89

Table 5.114. Lampasas – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		13.37	12.55	13.56	12.25	14.95
Std. Deviation		2.45	5.15	4.38	4.81	5.14
Variance		5.99	26.53	19.21	23.18	26.47
Minimum		6.58	3.33	4.35	3.30	5.43
Maximum		18.36	28.89	21.74	20.88	29.35
Deciles	10	10.58	5.56	7.50	5.49	8.70
Percentiles	20	11.23	7.78	9.57	7.69	9.78
	30	12.25	9.67	11.96	8.79	11.96
	40	12.88	11.11	12.61	10.55	13.04
	50	13.70	12.22	13.04	12.64	14.13
	60	13.97	13.33	14.13	13.19	16.30
	70	15.07	14.78	16.30	15.38	17.72
	80	15.67	16.67	17.61	16.48	19.78
	90	16.19	19.00	19.57	18.79	21.74

Table 5.115. Lampasas – Linear Regression Results

Lampasas, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	-0.007	0.869	0.988	.000
Winter	-0.003	0.843	0.620	.001
Fall	0.003	0.881	0.636	.000
Summer	0.016	0.483	0.776	.007
Spring	-0.029	0.173	0.982	.027
Precipitation Days				
Annual	0.121	0.196	0.980	.036
Winter	0.035	0.470	0.917	.011
Fall	0.027	0.515	0.999	.009
Summer	0.015	0.744	0.907	.002
Spring	0.044	0.372	0.94	.017
Precipitation Intensity				
Annual	-0.001	0.193	0.918	.037
Winter	-0.001	0.985	0.376	.000
Fall	-0.003	0.096	0.800	.059
Summer	-0.002	0.426	0.805	.014
Spring	-0.001	0.242	0.227	.030

Temple

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Temple are given in Tables 5.116, 5.117, 5.118, and 5.119. Temple (Köppen climate classification Cfa) receives an average of 34.71 inches of precipitation per year with most occurring during the spring months. Annually, this station receives an average of 49.92 days of precipitation, of which the largest portion occurs during spring months. Annually, this station averages 0.70 inch of precipitation per day with most occurring during the fall months. A comparison of the CV suggests the spring months have the smallest amount of precipitation variability, while the both the summer and fall months are most variable. The CV suggests that the spring months are the smallest amount of variability, while the winter is the most variable for precipitation days. The CV suggests that the spring months have the smallest amount of variability, while the winter months are the most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for summer precipitation, winter and spring precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 23.68 inches. Ninety percent will be at or below 46.66 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 37.80 days. Ninety percent will be at or below 61 days, with 10% being above 61.00 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.60 inch per day. Ninety percent of the years had 0.82 inch or less. Probability results show that this station has a 13.68% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual precipitation intensity with an increase of 0.001 inches of precipitation per precipitation day, with 8.6% of the variance accounted for by the regression (Table 5.120).

Table 5.116. Temple – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		34.72	7.50	9.55	7.41	10.07
Std. Deviation		8.77	3.59	4.93	3.79	3.95
Minimum		13.89	0.86	2.59	0.74	1.99
Maximum		53.13	20.04	27.23	18.43	19.93
Coefficient of Variation		0.25	0.48	0.51	0.51	0.39
Deciles Percentiles	10	23.69	2.94	3.82	2.31	5.14
	20	26.26	4.10	4.91	4.00	6.18
	30	29.26	5.40	6.35	5.49	7.77
	40	31.89	6.29	7.31	6.51	9.01
	50	34.44	7.04	9.11	7.74	9.87
	60	36.01	7.67	10.10	8.10	10.61
	70	40.73	9.16	11.85	8.82	12.47
	80	45.46	10.65	13.68	10.30	13.63
	90	46.66	12.43	15.92	12.61	15.50

Table 5.117. Temple – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		49.92	12.63	13.35	10.46	13.46
Std. Deviation		9.00	5.16	4.83	3.94	4.39
Minimum		26	3	5	1	5
Maximum		68	26	27	18	26
Coefficient of Variation		0.18	0.41	0.36	0.38	0.33
Deciles Percentiles	10	37.80	7.00	7.00	5.00	7.00
	20	43.00	7.80	9.00	7.00	9.00
	30	46.00	9.00	10.00	8.00	11.70
	40	48.00	10.60	11.60	10.00	13.00
	50	51.00	12.00	13.00	10.00	14.00
	60	51.00	13.40	14.00	11.00	14.00
	70	55.00	16.00	15.30	12.30	15.30
	80	57.40	17.00	16.40	14.20	17.00
	90	61.00	19.10	20.10	16.00	20.00

Table 5.118. Temple – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.70	0.58	0.75	0.73	0.71
Std. Deviation		0.09	0.21	0.23	0.26	0.20
Minimum		0.53	0.29	0.31	0.19	0.15
Maximum		0.97	1.54	1.70	1.24	1.33
Coefficient of Variation		0.12	0.36	0.31	0.35	0.28
Deciles Percentiles	10	0.60	0.34	0.46	0.34	0.51
	20	0.63	0.43	0.55	0.49	0.56
	30	0.65	0.49	0.66	0.62	0.60
	40	0.67	0.53	0.70	0.67	0.64
	50	0.69	0.55	0.74	0.72	0.71
	60	0.71	0.58	0.78	0.78	0.75
	70	0.74	0.60	0.84	0.86	0.78
	80	0.77	0.73	0.92	0.92	0.82
	90	0.82	0.82	1.03	1.14	0.96

Table 5.119. Temple – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		13.68	14.03	14.52	11.49	14.63
Std. Deviation		2.47	5.74	5.26	4.33	4.78
Variance		6.08	32.92	27.63	18.75	22.82
Minimum		7.12	3.33	5.43	1.10	5.43
Maximum		18.63	28.89	29.35	19.78	28.26
Deciles Percentiles	10	10.36	7.78	7.61	5.49	7.61
	20	11.78	8.67	9.78	7.69	9.78
	30	12.60	10.00	10.87	8.79	12.72
	40	13.15	11.78	12.61	10.99	14.13
	50	13.97	13.33	14.13	10.99	15.22
	60	13.97	14.89	15.22	12.09	15.22
	70	15.07	17.78	16.63	13.52	16.63
	80	15.73	18.89	17.83	15.60	18.48
	90	16.71	21.22	21.85	17.58	21.74

Table 5.120. Temple – Linear Regression Results

Temple, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.029	0.568	0.576	.005
Winter	-0.010	0.608	0.292	.004
Fall	0.049	0.086	0.180	.042
Summer	0.010	0.622	0.769	.004
Spring	-0.026	0.252	0.963	.019
Precipitation Days				
Annual	-0.08	0.396	0.891	.016
Winter	0.010	0.847	0.734	.001
Fall	-0.027	0.678	0.917	.004
Summer	0.004	0.905	0.871	.000
Spring	-0.041	0.373	0.765	.017
Precipitation Intensity				
Annual	0.001	0.044	0.851	.086
Winter	0.001	0.727	0.068	.003
Fall	0.003	0.154	0.826	.044
Summer	0.001	0.759	0.996	.002
Spring	0.002	0.191	0.453	.037

Llano

Llano is classified as a Cfa (humid subtropical) climate. Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Llano are given in Tables 5.121, 5.122, 5.123, and 5.124. Llano receives an average of 27.35 inches of precipitation per year of which the largest portion occurs during the spring months. Annually, this station receives an average of 43.69 days of precipitation, most of which occurs during the spring months. Annually, this station averages 0.6303 inch of precipitation per day with most occurring during the fall months. A comparison of the CV suggests the spring months have the smallest amount of precipitation variability, while the winter is most variable. The CV suggests that the spring months have the smallest amount of variability, while both the summer and fall months are the most variable for precipitation days. The CV suggests that the summer months have the smallest amount of variability, while the winter months are the most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual, winter, and spring precipitation days, and summer and winter precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 18.30 inches. Ninety percent will be at or below 37.33 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 33.90 days. Ninety percent will be at or below 56.10 days, with 10% being above 56.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.53 inch per day. Ninety percent of the years had 0.74 inch per day or less. Probability results show that this station has an 11.96% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in winter precipitation intensity with an increase of 0.004 inches of precipitation per precipitation day, with 9.2% of the variance accounted for by the regression (Table 5.125).

Table 5.121. Llano – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		27.36	4.95	7.61	6.66	8.14
Std. Deviation		7.12	3.10	3.67	3.61	2.83
Minimum		12.44	0.75	0.80	0.94	1.90
Maximum		48.38	20.28	20.52	16.36	14.82
Coefficient of Variation		0.25	0.63	0.48	0.54	0.35
Deciles Percentiles	10	18.30	1.24	3.65	2.13	4.54
	20	21.37	2.41	4.56	3.40	6.17
	30	23.86	3.10	5.24	4.47	6.53
	40	24.94	3.87	6.33	5.10	7.14
	50	27.26	4.35	7.32	6.16	7.85
	60	28.39	5.26	8.10	7.12	8.60
	70	29.63	6.13	9.39	8.53	9.50
	80	33.07	7.40	10.19	9.73	10.24
	90	37.33	8.34	11.61	11.75	12.55

Table 5.122. Llano – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		43.69	9.44	11.67	10.17	12.31
Std. Deviation		8.280	4.486	4.122	3.605	4.162
Minimum		24	2	3	3	6
Maximum		60	22	22	19	24
Coefficient of Variation		0.19	0.47	0.35	0.35	0.34
Deciles Percentiles	10	33.90	4.00	6.00	5.80	6.00
	20	36.80	5.00	8.00	7.00	8.80
	30	39.00	6.00	9.70	7.70	9.00
	40	41.00	7.60	11.00	9.00	11.00
	50	44.00	9.50	11.00	10.00	12.50
	60	45.00	10.40	13.00	12.00	14.00
	70	47.00	12.00	13.30	12.30	15.00
	80	50.20	13.20	15.00	13.00	16.00
	90	56.10	15.10	17.10	15.00	18.00

Table 5.123. Llano – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.63	0.52	0.68	0.66	0.66
Std. Deviation		0.09	0.22	0.21	0.19	0.21
Minimum		0.47	0.18	0.36	0.35	0.32
Maximum		0.85	1.55	1.25	1.12	1.51
Coefficient of Variation		0.13	0.41	0.30	0.29	0.31
Deciles Percentiles	10	0.53	0.30	0.46	0.38	0.43
	20	0.56	0.37	0.53	0.51	0.52
	30	0.58	0.39	0.58	0.55	0.54
	40	0.60	0.45	0.60	0.59	0.58
	50	0.61	0.52	0.63	0.63	0.65
	60	0.63	0.54	0.65	0.66	0.68
	70	0.66	0.57	0.73	0.74	0.72
	80	0.72	0.59	0.86	0.82	0.77
	90	0.74	0.78	1.03	0.95	0.96

Table 5.124. Llano – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		11.96	10.49	12.68	11.17	13.38
Std. Deviation		2.27	4.98	4.48	3.96	4.52
Variance		5.15	24.84	20.08	15.69	20.47
Minimum		6.58	2.22	3.26	3.30	6.52
Maximum		16.44	24.44	23.91	20.88	26.09
Deciles Percentiles	10	9.29	4.44	6.52	6.37	6.52
	20	10.08	5.56	8.70	7.69	9.57
	30	10.68	6.67	10.54	8.46	9.78
	40	11.23	8.44	11.96	9.89	11.96
	50	12.05	10.56	11.96	10.99	13.59
	60	12.33	11.56	14.13	13.19	15.22
	70	12.88	13.33	14.46	13.52	16.30
	80	13.75	14.67	16.30	14.29	17.39
	90	15.37	16.78	18.59	16.48	19.57

Table 5.125. Llano – Linear Regression Results

Llano, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.001	0.991	0.467	.000
Winter	0.001	0.951	0.633	.000
Fall	0.005	0.788	0.423	.001
Summer	0.005	0.808	0.716	.001
Spring	-0.014	0.373	0.761	.011
Precipitation Days				
Annual	0.099	0.254	0.971	.028
Winter	0.017	0.719	0.909	.003.
Fall	0.019	0.659	0.965	.004
Summer	0.045	0.227	0.692	.032
Spring	0.021	0.631	0.954	.005
Precipitation Intensity				
Annual	-0.010	0.600	0.543	.006
Winter	0.004	0.037	0.427	.092
Fall	-0.002	0.312	0.195	.022
Summer	-.0002	0.885	0.388	.021
Spring	-0.002	0.362	0.293	.018

Blanco

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Blanco are given in Tables 5.126, 5.127, 5.128, and 5.129. Blanco (Köppen climate classification Cfa) receives an average of 34.62 inches of precipitation per year, of which the largest portion occurs during spring months. Annually, this station receives an average of 51.52 days of precipitation, most of which occurs during the spring months. Annually, this station averages 0.66 inch of precipitation per day with most occurring during the fall months. A comparison of the CV suggests the spring months have the smallest amount of precipitation variability, while the winter is most variable. The CV suggests that the fall months have the smallest amount of variability, while the spring, summer, and winter are the most variable for precipitation days. The CV suggests that the spring months have the smallest amount of variability, while the winter months are the most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for summer precipitation, summer and fall precipitation days, and spring precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 21.54 inches. Ninety percent will be at or below 46.01 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 38.90 days. Ninety percent will be at or below 66.10 days, with 10% being above 66.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.55 inch per day. Ninety percent of the years had 0.83 inch per day or less. Probability results show that this station has a 14.11% chance that any one day in the year would receive 0.1mm of rain. Linear regression results do not show significant findings in total precipitation, precipitation days, or precipitation intensity (Table 5.130).

Table 5.126. Blanco – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		34.63	6.98	9.99	8.12	9.53
Std. Deviation		9.70	3.81	5.14	4.04	4.44
Minimum		14.36	1.15	1.77	0.91	0.98
Maximum		54.14	22.03	26.84	19.85	25.78
Coefficient of Variation		0.27	0.54	0.51	0.50	0.46
Deciles Percentiles	10	21.55	2.54	3.56	3.53	4.84
	20	25.99	3.90	5.72	5.04	5.75
	30	28.75	4.73	6.70	5.59	7.20
	40	30.86	5.28	7.98	6.75	7.51
	50	33.68	6.29	9.57	8.02	8.34
	60	38.39	7.13	11.19	8.52	10.02
	70	41.35	8.39	12.57	9.56	11.28
	80	43.51	10.18	13.98	11.05	13.21
	90	46.02	11.89	16.68	13.63	15.71

Table 5.127. Blanco – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		51.52	12.35	13.75	11.10	14.31
Std. Deviation		10.731	4.720	4.250	4.229	5.466
Minimum		25	3	4	2	3
Maximum		73	25	22	18	27
Coefficient of Variation		0.20	0.38	0.31	0.38	0.38
Deciles Percentiles	10	38.90	6.90	8.90	6.00	7.90
	20	44.60	8.00	10.00	7.00	9.00
	30	45.70	10.00	11.00	8.00	11.00
	40	48.60	10.60	13.00	9.60	12.00
	50	52.00	12.00	14.00	11.50	14.00
	60	54.00	13.40	15.00	13.00	16.00
	70	56.90	15.00	16.00	14.00	18.00
	80	61.00	16.20	17.20	15.20	18.20
	90	66.10	18.10	20.00	17.00	21.20

Table 5.128. Blanco – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.68	0.55	0.75	0.74	0.66
Std. Deviation		0.10	0.24	0.22	0.30	0.15
Minimum		0.49	0.14	0.28	0.30	0.33
Maximum		0.99	1.07	1.30	1.63	0.95
Coefficient of Variation		0.15	0.43	0.28	0.40	0.22
Deciles Percentiles	10	0.55	0.26	0.49	0.45	0.42
	20	0.60	0.35	0.58	0.51	0.55
	30	0.62	0.39	0.63	0.58	0.60
	40	0.64	0.44	0.65	0.64	0.64
	50	0.67	0.51	0.71	0.67	0.67
	60	0.69	0.58	0.75	0.71	0.68
	70	0.73	0.69	0.88	0.75	0.74
	80	0.77	0.74	0.97	0.88	0.78
	90	0.83	0.92	1.08	1.32	0.87

Table 5.129. Blanco – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		14.11	13.73	14.95	12.20	15.56
Std. Deviation		2.94	5.24	4.62	4.65	5.94
Variance		8.64	27.50	21.34	21.60	35.30
Minimum		6.85	3.33	4.35	2.20	3.26
Maximum		20.00	27.78	23.91	19.78	29.35
Deciles Percentiles	10	10.66	7.67	9.67	6.59	8.59
	20	12.22	8.89	10.87	7.69	9.78
	30	12.52	11.11	11.96	8.79	11.96
	40	13.32	11.78	14.13	10.55	13.04
	50	14.25	13.33	15.22	12.64	15.22
	60	14.79	14.89	16.30	14.29	17.39
	70	15.59	16.67	17.39	15.38	19.57
	80	16.71	18.00	18.70	16.70	19.78
	90	18.11	20.11	21.74	18.68	23.04

Table 5.130. Blanco – Linear Regression Results

Blanco, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.041	0.461	0.838	.008
Winter	-0.023	0.288	0.396	.016
Fall	0.040	0.175	0.565	.026
Summer	0.013	0.558	0.833	.005
Spring	0.007	0.782	0.238	.001
Precipitation Days				
Annual	0.044	0.698	0.974	.003
Winter	-0.014	0.773	0.952	.002
Fall	-0.002	0.950	0.683	.000
Summer	0.018	0.676	0.942	.004
Spring	0.042	0.461	0.955	.012
Precipitation Intensity				
Annual	-0.001	0.949	0.860	.000
Winter	0.001	0.709	0.631	.003
Fall	-0.001	0.851	0.295	.001
Summer	0.001	0.648	0.051	.005
Spring	0.001	0.940	0.961	.000

Boerne

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Boerne are given in Tables 5.131, 5.132, 5.133, and 5.134. Boerne (Köppen climate classification Cfa) receives an average of 34.50 inches of precipitation per year, of which the largest portion occurs during the fall months. Annually, this station receives an average of 51.33 days of precipitation, most of which occurs during the fall months. Annually, this station averages 0.69 inch of precipitation per day with most occurring during the fall months. A comparison of the CV suggests the spring months have the smallest amount of precipitation variability, while the winter is most variable. The CV suggests that the fall months have the smallest amount of variability, while the winter is the most variable for precipitation days. The CV suggests that the spring months have the smallest amount of variability, while the summer months are the most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual and summer precipitation days, and spring and fall precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 20.59 inches. Ninety percent will be at or below 50.38 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 37.80 days. Ninety percent will be at or below 68 days, with 10% being above 68 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.51 inch per day. Ninety percent of the years had 0.85 inch per day or less. Probability results show that this station has a 14.06% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual and fall total precipitation, and annual, summer, and fall precipitation intensity. Results show an increase of 0.155 inch in annual total precipitation per year, with 8.0% of the variance accounted for by the regression, and 0.069 inch increase in fall precipitation per year, with 8.6% of the variance accounted for by the regression In addition, linear regression results show an increase of 0.003 inches of precipitation per precipitation day annually, with 14.3% of the variance accounted for by the regression, an increase of 0.010 inch of precipitation per precipitation day during the summer, with 13.9% of the variance accounted for by the regression, and 0.004 inch of precipitation per precipitation day during the fall months, with 9.7% of the variance accounted for by the regression (Table 5.135).

Table 5.131. Boerne – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		34.50	6.48	9.90	8.85	9.27
Std. Deviation		11.34	4.21	4.91	5.49	4.36
Minimum		10.29	1.04	2.04	1.58	0.57
Maximum		64.17	29.44	25.24	31.90	22.61
Coefficient of Variation		0.32	0.65	0.49	0.62	0.47
Deciles Percentiles	10	20.60	2.14	4.54	3.25	4.34
	20	24.72	3.29	5.41	4.09	5.18
	30	26.77	3.81	6.46	5.45	7.13
	40	30.04	4.80	8.31	6.08	8.07
	50	33.50	5.69	8.98	8.02	9.25
	60	37.65	6.89	10.30	9.03	9.53
	70	41.01	8.30	12.26	10.88	10.73
	80	44.34	9.36	14.63	12.88	12.64
	90	50.39	10.95	16.86	16.23	14.84

Table 5.132. Boerne – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		51.33	12.04	14.38	11.08	13.73
Std. Deviation		10.66	5.50	4.39	3.78	5.35
Minimum		29	1	6	4	1
Maximum		70	27	24	19	26
Coefficient of Variation		0.21	0.46	0.31	0.34	0.40
Deciles Percentiles	10	37.80	4.00	8.90	5.90	6.00
	20	41.00	7.00	10.80	7.00	8.80
	30	46.00	9.00	11.70	8.70	10.70
	40	49.00	11.00	13.00	10.00	13.00
	50	52.00	11.00	14.00	12.00	13.50
	60	54.40	13.00	15.40	13.00	15.40
	70	56.00	16.00	17.00	14.00	16.30
	80	61.40	17.20	18.20	14.20	18.20
	90	68.00	19.10	20.10	15.10	21.00

Table 5.133. Boerne – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.69	0.53	0.73	0.80	0.69
Std. Deviation		0.13	0.21	0.21	0.37	0.18
Minimum		0.42	0.26	0.35	0.37	0.21
Maximum		1.09	1.47	1.47	1.99	1.13
Coefficient of Variation		0.19	0.39	0.29	0.46	0.26
Deciles	10	0.51	0.31	0.44	0.42	0.44
Percentiles	20	0.59	0.36	0.56	0.50	0.53
	30	0.62	0.43	0.65	0.56	0.58
	40	0.66	0.46	0.69	0.66	0.65
	50	0.69	0.53	0.75	0.68	0.71
	60	0.72	0.55	0.78	0.85	0.73
	70	0.74	0.59	0.82	0.88	0.82
	80	0.77	0.63	0.84	1.09	0.85
	90	0.85	0.73	0.95	1.36	0.89

Table 5.134. Boerne – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		14.06	13.38	15.63	12.18	14.92
Std. Deviation		2.92	6.12	4.78	4.16	5.82
Variance		8.54	37.46	22.86	17.31	33.87
Minimum		7.95	1.11	6.52	4.40	1.09
Maximum		19.18	30.00	26.09	20.88	28.26
Deciles Percentiles	10	10.36	4.44	9.67	6.48	6.52
	20	11.23	7.78	11.74	7.69	9.57
	30	12.60	10.00	12.72	9.56	11.63
	40	13.42	12.22	14.13	10.99	14.13
	50	14.25	12.22	15.22	13.19	14.67
	60	14.90	14.44	16.74	14.29	16.74
	70	15.34	17.78	18.48	15.38	17.72
	80	16.82	19.11	19.78	15.60	19.78
	90	18.63	21.22	21.85	16.59	22.83

Table 5.135. Boerne – Linear Regression Results

Boerne, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.155	0.017	0.895	.080
Winter	-0.001	0.949	0.478	.000
Fall	0.069	0.013	0.367	.086
Summer	0.058	0.065	0.307	.048
Spring	0.024	0.327	0.596	.014
Precipitation Days				
Annual	0.134	0.233	0.967	.031
Winter	0.064	0.269	0.942	.027
Fall	-0.008	0.859	0.826	.001
Summer	0.035	0.374	0.574	.017
Spring	0.043	0.437	0.965	.013
Precipitation Intensity				
Annual	0.003	0.008	0.914	.143
Winter	-0.002	0.331	0.241	.021
Fall	0.004	0.031	0.746	.097
Summer	0.009	0.009	0.486	.139
Spring	0.002	0.208	0.760	.034

New Braunfels

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for New Braunfels are given in Tables 5.136, 5.137, 5.138, and 5.139. New Braunfels (Köppen climate classification Cfa) receives an average of 34.20 inches of precipitation per year, of which the largest portion occurs during the fall months. Annually, this station receives an average of 48.58 days of precipitation, most of which occurs during the spring months. Annually, this station averages 0.71 inches of precipitation per day with most occurring during fall months. A comparison of the CV suggests the spring months have the smallest amount of precipitation variability, while the winter is most variable. The CV suggests that both spring and fall months have the smallest amount of variability, while the winter is the most variable for precipitation days. The CV suggests that the spring months have the smallest amount of variability, while the summer months are the most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual, spring, fall, and winter precipitation days, and annual precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 20.12 inches. Ninety percent will be at or below 48.68 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 35.90 days. Ninety percent will be at or below 61.10 days, with 10% being above 61.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.52 inch per day. Ninety percent of the years had 0.87 inch per day or less. Probability results show that this station has a 13.31% chance that any one day in the year would receive 0.1mm of rain. Linear regression results do not show significant findings in total precipitation, precipitation days, or precipitation intensity (Table 5.140).

Table 5.136. New Braunfels – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		34.21	6.76	9.77	8.27	9.23
Std. Deviation		10.61	4.18	5.47	4.12	4.13
Minimum		10.12	1.19	1.82	1.86	2.00
Maximum		61.60	30.08	34.43	20.19	20.27
Coefficient of Variation		0.31	0.61	0.56	0.50	0.45
Deciles Percentiles	10	20.12	2.95	3.37	3.35	4.10
	20	23.98	3.48	5.18	5.00	5.84
	30	28.84	4.65	6.19	5.65	6.67
	40	31.08	5.48	8.08	6.65	7.80
	50	34.13	5.89	9.48	7.50	8.71
	60	36.83	7.06	10.25	8.63	9.58
	70	39.81	7.67	12.13	9.33	11.27
	80	43.07	9.30	13.58	10.97	11.94
	90	48.69	11.51	16.21	14.22	16.08

Table 5.137. New Braunfels – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		48.58	11.90	12.81	10.88	12.85
Std. Deviation		9.87	4.84	4.41	4.00	4.42
Minimum		26	3	3	5	4
Maximum		74	25	26	22	23
Coefficient of Variation		0.20	0.40	0.34	0.37	0.34
Deciles Percentiles	10	35.90	5.90	7.00	5.00	6.90
	20	39.40	8.00	8.80	7.00	9.00
	30	44.00	9.00	10.00	8.00	10.00
	40	47.60	10.00	11.60	9.60	11.00
	50	49.50	12.00	13.00	10.50	13.00
	60	50.80	13.00	14.00	11.40	14.40
	70	52.30	14.30	14.30	13.30	15.00
	80	57.00	15.20	17.00	15.00	17.00
	90	61.10	19.00	17.20	17.00	19.10

Table 5.138. New Braunfels – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.72	0.54	0.81	0.80	0.71
Std. Deviation		0.13	0.18	0.32	0.30	0.19
Minimum		1.00	0.00	1.00	0.00	0.00
Maximum		1.00	1.00	2.00	2.00	1.00
Coefficient of Variation		0.18	0.32	0.39	0.38	0.26
Deciles Percentiles	10	0.52	0.34	0.54	0.40	0.43
	20	0.60	0.37	0.58	0.56	0.55
	30	0.64	0.41	0.60	0.64	0.61
	40	0.69	0.49	0.63	0.70	0.67
	50	0.72	0.52	0.70	0.73	0.70
	60	0.76	0.56	0.81	0.81	0.73
	70	0.78	0.64	0.91	0.92	0.79
	80	0.82	0.69	1.03	1.08	0.87
	90	0.87	0.74	1.20	1.13	0.96

Table 5.139. New Braunfels – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		13.31	13.22	13.93	11.95	13.97
Std. Deviation		2.70	5.39	4.80	4.41	4.81
Variance		7.31	29.01	23.01	19.41	23.13
Minimum		7.12	3.33	3.26	5.49	4.35
Maximum		20.27	27.78	28.26	24.18	25.00
Deciles Percentiles	10	9.84	6.56	7.61	5.49	7.50
	20	10.79	8.89	9.57	7.69	9.78
	30	12.05	10.00	10.87	8.79	10.87
	40	13.04	11.11	12.61	10.55	11.96
	50	13.56	13.33	14.13	11.54	14.13
	60	13.92	14.44	15.22	12.53	15.65
	70	14.33	15.89	15.54	14.62	16.30
	80	15.62	16.89	18.48	16.48	18.48
	90	16.74	21.11	18.70	18.68	20.76

Table 5.140. New Braunfels – Linear Regression Results

New Braunfels, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.07	0.255	0.876	.019
Winter	-0.007	0.745	0.227	.002
Fall	0.043	0.169	0.760	.027
Summer	0.024	0.313	0.283	.015
Spring	-0.003	0.890	0.459	.000
Precipitation Days				
Annual	-0.006	0.968	0.736	.000
Winter	0.027	0.596	0.935	.006
Fall	-0.04	0.378	0.843	.017
Summer	-.0029	0.945	0.869	.000
Spring	0.013	0.776	0.914	.002
Precipitation Intensity				
Annual	0.001	0.319	0.913	.022
Winter	-0.001	0.392	0.865	.016
Fall	0.001	0.782	0.153	.002
Summer	0.005	0.092	0.892	.061
Spring	0.001	0.726	0.898	.003

San Antonio

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for San Antonio are given in Tables 5.141, 5.142, 5.143, and 5.144. San Antonio (Köppen climate classification Cfa) receives an average of 30.32 inches of precipitation per year, of which the largest portion occurs during the fall months. Annually, this station receives an average of 46.02 days of precipitation, most of which occurs during the fall months. Annually, this station averages 0.683 inch of precipitation per day with most occurring during the summer months. A comparison of the CV suggests the spring months have the smallest amount of precipitation variability, while the winter is most variable. The CV suggests that the summer months has the smallest amount of variability, while the winter is the most variable for precipitation days. The CV suggests that the summer months have the smallest amount of variability, while the winter months are the most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual precipitation, and spring precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 17.87 inches. Ninety percent will be at or below 42.75 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 31 days. Ninety percent will be at or below 59.10 days, with 10% being above 59.10 days. For precipitation intensity, results show that 10 % of the years on record experienced at or below 0.53 inch per day. Ninety percent of the years had 0.89 inch per day or less. Probability results show that this station has a 12.60% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual total precipitation, and summer precipitation days. Results show an annual increase of 0.108 inch in annual total precipitation, with 5.8% of the variance accounted for by the regression and a 0.073 increase in precipitation days per year during the summer months, with 10.3% of the variance accounted for by the regression (Table 5.145).

Table 5.141. San Antonio – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		30.33	5.27	8.63	8.10	8.33
Std. Deviation		9.26	3.64	4.91	3.89	4.17
Minimum		13.70	0.44	1.26	2.00	0.52
Maximum		52.28	25.97	23.04	18.94	21.73
Coefficient of Variation		0.31	0.69	0.56	0.48	0.49
Deciles Percentiles	10	17.88	2.00	2.77	3.56	3.59
	20	21.72	2.73	4.16	4.72	4.78
	30	24.10	3.45	5.72	5.31	5.74
	40	26.21	4.11	6.66	6.43	6.75
	50	30.40	4.44	8.13	7.30	7.65
	60	32.24	5.32	8.65	8.78	8.47
	70	36.48	6.07	10.14	10.15	10.49
	80	38.86	6.98	12.77	11.47	11.50
	90	42.75	9.79	16.71	13.78	13.67

Table 4.142. San Antonio – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		46.02	10.33	12.73	10.69	12.17
Std. Deviation		9.70	5.11	5.07	3.20	4.73
Minimum		28	1	3	5	2
Maximum		63	25	25	18	22
Coefficient of Variation		0.21	0.49	0.39	0.29	0.38
Deciles Percentiles	10	31.00	3.90	6.80	6.00	5.00
	20	36.80	6.80	8.00	7.00	7.80
	30	40.70	7.00	10.00	9.00	8.00
	40	43.60	8.60	11.00	9.60	12.00
	50	45.00	10.00	12.50	10.50	13.00
	60	50.40	11.40	14.00	12.00	14.00
	70	52.30	13.00	15.00	13.00	15.00
	80	55.00	14.00	17.00	14.00	16.00
	90	59.10	19.00	19.10	15.00	19.00

Table 5.143. San Antonio – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.68	0.52	0.72	0.77	0.69
Std. Deviation		0.12	0.183	0.254	0.303	0.221
Minimum		0	0	0	0	0
Maximum		1	1	1	2	1
Coefficient of Variation		0.17	0.35	0.35	0.39	0.32
Deciles Percentiles	10	0.53	0.31	0.41	0.46	0.35
	20	0.58	0.34	0.49	0.51	0.56
	30	0.62	0.41	0.56	0.56	0.59
	40	0.66	0.44	0.59	0.6	0.61
	50	0.67	0.47	0.65	0.7	0.65
	60	0.71	0.51	0.78	0.76	0.69
	70	0.74	0.59	0.89	0.85	0.77
	80	0.76	0.63	0.96	1.08	0.95
	90	0.89	0.79	1.06	1.26	1.03

Table 5.144. San Antonio – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		12.60	11.48	13.84	11.74	13.22
Std. Deviation		2.66	5.68	5.52	3.52	5.15
Variance		7.07	32.27	30.45	12.39	26.51
Minimum		7.67	1.11	3.26	5.49	2.17
Maximum		17.26	27.78	27.17	19.78	23.91
Deciles Percentiles	10	8.49	4.33	7.39	6.59	5.43
	20	10.08	7.56	8.70	7.69	8.48
	30	11.15	7.78	10.87	9.89	8.70
	40	11.95	9.56	11.96	10.55	13.04
	50	12.33	11.11	13.59	11.54	14.13
	60	13.81	12.67	15.22	13.19	15.22
	70	14.33	14.44	16.30	14.29	16.30
	80	15.07	15.56	18.48	15.38	17.39
	90	16.19	21.11	20.76	16.48	20.65

Table 5.145. San Antonio – Linear Regression Results

San Antonio, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.108	0.043	0.976	.058
Winter	0.019	0.608	0.138	.004
Fall	0.051	0.071	0.323	.047
Summer	0.030	0.175	0.385	.027
Spring	0.013	0.519	0.428	.004
Precipitation Days				
Annual	0.145	0.153	0.957	.044
Winter	0.038	0.472	0.846	.011
Fall	-0.039	0.459	0.845	.012
Summer	0.073	0.026	0.893	.103
Spring	0.071	0.149	0.838	.045
Precipitation Intensity				
Annual	0.001	0.435	0.680	.013
Winter	-0.001	0.633	0.452	.005
Fall	0.003	0.224	0.872	.032
Summer	0.001	0.880	0.306	.000
Spring	-0.001	0.596	0.603	.006

Luling

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Luling are given in Tables 5.146, 5.147, 5.148, and 5.149. Luling (Köppen climate classification Cfa) receives an average of 35.04 inches of precipitation per year with most occurring during the fall months. Annually, this station receives an average of 51.52 days of precipitation, of which the largest portion occurs during the fall months. Annually, this station averages 0.69 inch of precipitation per day with most occur during the fall months. A comparison of the CV suggests the summer months have the smallest amount of precipitation variability, while the winter is most variable. The CV suggests that the summer months have the smallest amount of variability, while both the spring and fall are the most variable for precipitation days. The CV suggests that the fall months have the smallest amount of variability, while both the spring and summer months are the most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for fall and winter precipitation days, and fall precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 22.21 inches. Ninety percent will be at or below 47.89 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 36.80 days. Ninety percent will be at or below 62.50 days, with 10% being above 62.50 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.53 inch per day. Ninety percent of the years had 0.89 inch per day or less. Probability results show that this station has a 14.11% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings with an increase of 0.062 inch of fall total precipitation per year, with 6.1% of the variance accounted for by the regression (Table 5.150).

Table 5.146. Luling – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		35.05	6.94	10.08	8.25	9.76
Std. Deviation		9.52	3.90	5.26	3.53	4.17
Minimum		16.13	1.01	1.28	1.95	2.31
Maximum		57.78	27.28	27.52	19.09	22.79
Coefficient of Variation		0.27	0.56	0.52	0.42	0.43
Deciles Percentiles	10	22.22	3.15	3.50	4.02	4.72
	20	26.79	3.96	5.51	5.08	5.89
	30	28.98	5.04	7.09	6.20	7.28
	40	31.35	5.58	8.31	7.20	8.57
	50	34.73	6.38	8.95	8.05	9.45
	60	37.04	7.49	11.10	8.97	10.41
	70	41.01	7.91	12.05	9.38	12.33
	80	43.78	8.48	14.25	10.25	13.02
	90	47.89	10.94	17.87	14.07	14.07

Table 5.147. Luling – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		51.52	12.90	13.90	11.35	13.38
Std. Deviation		10.35	4.44	4.87	3.69	4.74
Minimum		27	5	4	4	4
Maximum		74	25	23	19	24
Coefficient of Variation		0.20	0.34	0.35	0.32	0.35
Deciles Percentiles	10	36.80	7.90	7.00	7.00	6.00
	20	42.80	9.00	9.80	7.80	8.80
	30	46.00	10.00	11.00	9.00	11.70
	40	50.00	11.00	12.00	10.00	13.00
	50	52.00	13.00	14.00	11.00	13.00
	60	54.00	14.00	15.00	12.40	14.40
	70	57.30	15.30	16.00	14.00	16.00
	80	59.20	17.00	19.20	15.00	17.00
	90	65.20	19.00	21.10	16.00	20.00

Table 5.148. Luling – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.70	0.55	0.78	0.72	0.73
Std. Deviation		0.12	0.26	0.26	0.21	0.21
Minimum		0.52	0.19	0.31	0.33	0.33
Maximum		1.00	1.24	1.45	1.19	1.54
Coefficient of Variation		0.17	0.48	0.34	0.29	0.29
Deciles Percentiles	10	0.53	0.24	0.45	0.44	0.47
	20	0.59	0.32	0.51	0.55	0.58
	30	0.61	0.36	0.60	0.59	0.61
	40	0.65	0.42	0.72	0.65	0.64
	50	0.70	0.52	0.78	0.70	0.68
	60	0.73	0.58	0.83	0.73	0.73
	70	0.76	0.67	0.91	0.80	0.81
	80	0.78	0.76	1.00	0.91	0.88
	90	0.89	0.95	1.11	1.06	1.00

Table 5.149. Luling – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		14.11	14.33	15.10	12.48	14.54
Std. Deviation		2.84	4.93	5.30	4.06	5.16
Variance		8.05	24.34	28.12	16.52	26.58
Minimum		7.40	5.56	4.35	4.40	4.35
Maximum		20.27	27.78	25.00	20.88	26.09
Deciles Percentiles	10	10.08	8.78	7.61	7.69	6.52
	20	11.73	10.00	10.65	8.57	9.57
	30	12.60	11.11	11.96	9.89	12.72
	40	13.70	12.22	13.04	10.99	14.13
	50	14.25	14.44	15.22	12.09	14.13
	60	14.79	15.56	16.30	13.63	15.65
	70	15.70	17.00	17.39	15.38	17.39
	80	16.22	18.89	20.87	16.48	18.48
	90	17.86	21.11	22.93	17.58	21.74

Table 5.150. Luling – Linear Regression Results

Luling, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.089	0.104	0.949	.038
Winter	-0.001	0.971	0.048	.000
Fall	0.062	0.039	0.617	.061
Summer	-0.001	0.988	0.463	.000
Spring	0.020	0.403	0.505	.010
Precipitation Days				
Annual	0.066	0.541	0.823	.008
Winter	0.038	0.417	0.865	.014
Fall	-0.016	0.747	0.946	.002
Summer	0.019	0.622	0.926	.005
Spring	0.026	0.600	0.852	.006
Precipitation Intensity				
Annual	0.001	0.310	0.769	.022
Winter	-0.001	0.733	0.583	.003
Fall	0.002	0.460	0.964	.012
Summer	0.001	0.835	0.721	.001
Spring	0.002	0.189	0.667	.037

Flatonia

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Flatonia are given in Tables 5.151, 5.152, 5.153, and 5.154. Flatonia (Köppen climate classification Cfa) receives an average of 37.68 inches of precipitation per year, of which the largest portion occurs during the fall months. Annually, this station receives an average of 53.96 days of precipitation, most of which occurs during the winter months. Annually, this station averages 0.71 inch of precipitation per day, with most occurring during the fall months. A comparison of the CV suggests the spring months have the smallest amount of precipitation variability, while the fall is most variable. The CV suggests that the fall months have the smallest amount of variability, while the spring is the most variable for precipitation days. The CV suggests that the spring months have the smallest amount of variability, while the summer months are the most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual precipitation, and fall, and spring precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 24.09 inches. Ninety percent will be at or below 53.60 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 39.90 days. Ninety percent will be at or below 68.10 days, with 10% being above 68.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.56 inch per day. Ninety percent of the years had 0.87 inch per day or less. Probability results show that this station has a 14.78% chance that any one day in the year would receive 0.1mm of rain. Linear regression results do not show significant findings in total precipitation, precipitation days, or precipitation intensity (Table 5.155).

Table 5.151. Flatonia – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		37.69	7.71	10.59	8.70	10.39
Std. Deviation		10.77	3.57	5.83	4.55	4.76
Minimum		17.26	2.16	1.15	2.22	1.11
Maximum		60.26	25.18	31.11	25.33	27.57
Coefficient of Variation		0.28	0.46	0.55	0.52	0.45
Deciles Percentiles	10	24.09	3.81	4.24	4.05	4.56
	20	28.43	4.55	5.83	4.97	6.58
	30	30.41	5.33	6.88	6.17	7.82
	40	32.57	6.73	7.97	7.19	8.48
	50	36.91	7.94	9.24	7.66	9.74
	60	39.67	8.30	11.12	8.38	11.13
	70	44.68	9.21	13.16	10.16	12.02
	80	49.37	9.78	14.86	11.58	13.82
	90	53.61	11.63	18.69	13.96	16.95

Table 5.152. Flatonia – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		53.98	14.21	13.67	12.38	13.65
Std. Deviation		10.05	4.81	4.50	4.36	4.88
Minimum		33	4	4	5	4
Maximum		77	28	23	21	24
Coefficient of Variation		0.18	0.34	0.33	0.35	0.36
Deciles Percentiles	10	39.90	7.90	7.90	6.90	6.00
	20	45.80	10.00	10.00	9.00	7.80
	30	48.70	11.70	11.00	9.70	11.70
	40	51.60	13.00	12.00	10.00	13.00
	50	54.00	14.00	14.00	11.00	15.00
	60	56.00	15.40	15.00	13.40	16.00
	70	58.00	16.30	16.00	15.00	17.00
	80	62.20	17.00	17.00	17.00	17.00
	90	68.10	19.20	20.00	19.10	19.10

Table 5.153. Flatonia – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.71	0.54	0.81	0.70	0.73
Std. Deviation		0.12	0.14	0.30	0.27	0.18
Minimum		0.44	0.30	0.25	0.30	0.28
Maximum		1.03	0.90	1.45	1.36	1.16
Coefficient of Variation		0.17	0.26	0.36	0.38	0.25
Deciles Percentiles	10	0.56	0.35	0.44	0.38	0.52
	20	0.60	0.41	0.55	0.45	0.59
	30	0.66	0.46	0.63	0.51	0.62
	40	0.69	0.50	0.68	0.57	0.67
	50	0.71	0.54	0.77	0.65	0.71
	60	0.72	0.59	0.80	0.76	0.79
	70	0.76	0.61	1.00	0.82	0.83
	80	0.81	0.65	1.11	0.90	0.93
	90	0.87	0.71	1.18	1.15	0.97

Table 5.154. Flatonia – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		14.78	15.79	14.86	13.60	14.83
Std. Deviation		2.75	5.35	4.90	4.80	5.31
Variance		7.58	28.63	24.00	23.05	28.23
Minimum		9.04	4.44	4.35	5.49	4.35
Maximum		21.10	31.11	25.00	23.08	26.09
Deciles Percentiles	10	10.93	8.78	8.59	7.58	6.52
	20	12.55	11.11	10.87	9.89	8.48
	30	13.34	13.00	11.96	10.66	12.72
	40	14.14	14.44	13.04	10.99	14.13
	50	14.79	15.56	15.22	12.09	16.30
	60	15.34	17.11	16.30	14.73	17.39
	70	15.89	18.11	17.39	16.48	18.48
	80	17.04	18.89	18.48	18.68	18.48
	90	18.66	21.33	21.74	20.99	20.76

Table 5.155. Flatonia – Linear Regression Results

Flatonia, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.045	0.470	0.533	.008
Winter	-0.009	0.659	0.434	.003
Fall	0.057	0.091	0.406	.041
Summer	-0.011	0.668	0.522	.003
Spring	-0.011	0.597	0.652	.003
Precipitation Days				
Annual	0.078	0.461	0.958	.012
Winter	-0.016	0.744	0.801	.002
Fall	0.009	0.847	0.905	.001
Summer	0.050	0.270	0.177	.026
Spring	0.033	0.514	0.621	.009
Precipitation Intensity				
Annual	-0.001	0.821	0.808	.001
Winter	-0.001	0.483	0.945	.011
Fall	-0.001	0.820	0.361	.011
Summer	-0.001	0.561	0.623	.009
Spring	-0.001	0.785	0.833	.002

Hallettsville

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Hallettsville are given in Tables 5.156, 5.157, 5.158, and 5.159. Hallettsville (Köppen climate classification Cfa) receives an average of 39.42 inches of precipitation per year, of which the largest portion occurs during the spring months. Annually, this station receives an average of 55.33 days of precipitation, most of which occurs during the fall months. Annually, this station averages 0.73 inch of precipitation per day with most occurring during the fall months. A comparison of the CV suggests the spring months have the smallest amount of precipitation variability, while the summer is most variable. The CV suggests that the fall months have the smallest amount of variability, while the summer is the most variable for precipitation days. The CV suggests that the winter months have the smallest amount of variability, while the fall months are the most variable for precipitation intensity. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual and fall precipitation, winter and fall precipitation days, and spring precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 25.26 inches. Ninety percent will be at or below 53.80 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 39.90 days. Ninety percent will be at or below 70 days, with a 10% being above 70 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.60 inch per day. Ninety percent of the years had 0.89 inch per day or less. Probability results show that this station has a 15.15% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in fall total precipitation with an increase of 0.072 inches, with 7.7% of the variance accounted for by the regression (Table 5.160).

Table 5.156. Hallettsville – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		39.42	8.12	10.73	9.78	10.79
Std. Deviation		10.77	3.80	5.41	5.52	4.90
Minimum		18.01	1.71	1.80	2.38	1.51
Maximum		64.43	25.58	29.17	29.67	23.75
Coefficient of Variation		0.27	0.47	0.50	0.56	0.45
Deciles Percentiles	10	25.27	3.91	3.99	4.05	4.80
	20	28.80	4.71	4.80	5.29	6.73
	30	31.63	6.02	7.26	6.14	7.82
	40	37.24	7.08	9.16	7.68	9.16
	50	40.45	7.67	10.91	8.53	10.08
	60	42.14	8.58	12.33	10.18	11.21
	70	44.24	9.53	13.89	11.58	12.48
	80	48.96	11.01	15.06	12.79	16.18
	90	53.81	12.42	17.74	16.57	17.99

Table 5.157. Hallettsville – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		55.33	13.73	14.52	13.92	13.10
Std. Deviation		10.37	4.56	4.38	5.31	4.75
Minimum		35	5	5	3	3
Maximum		90	25	22	29	25
Coefficient of Variation		0.18	0.33	0.30	0.38	0.36
Deciles Percentiles	10	39.90	8.00	7.00	7.90	7.00
	20	47.80	9.00	11.00	9.80	9.00
	30	51.00	10.70	12.00	11.00	10.00
	40	53.00	13.00	13.00	11.60	11.00
	50	54.00	14.00	15.00	13.50	12.50
	60	56.00	15.00	16.00	15.00	14.40
	70	58.30	15.30	17.00	16.30	15.30
	80	63.00	17.20	18.00	18.00	18.00
	90	70.00	19.20	21.00	20.20	19.10

Table 5.158. Hallettsville – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.74	0.58	0.79	0.71	0.81
Std. Deviation		0.12	0.17	0.29	0.22	0.26
Minimum		0.50	0.34	0.36	0.33	0.30
Maximum		1.07	1.07	1.62	1.26	1.66
Coefficient of Variation		0.15	0.28	0.36	0.31	0.32
Deciles Percentiles	10	0.60	0.37	0.45	0.44	0.52
	20	0.63	0.45	0.57	0.51	0.58
	30	0.67	0.48	0.65	0.56	0.67
	40	0.70	0.51	0.68	0.61	0.73
	50	0.73	0.56	0.72	0.66	0.82
	60	0.76	0.60	0.77	0.80	0.84
	70	0.78	0.66	0.90	0.84	0.89
	80	0.83	0.70	1.04	0.89	1.02
	90	0.89	0.81	1.23	0.97	1.19

Table 5.159. Hallettsville – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		15.15	15.25	15.78	15.29	14.24
Std. Deviation		2.84	5.07	4.77	5.84	5.16
Variance		8.08	25.73	22.72	34.06	26.66
Minimum		9.59	5.56	5.43	3.30	3.26
Maximum		24.66	27.78	23.91	31.87	27.17
Deciles Percentiles	10	10.93	8.89	7.61	8.68	7.61
	20	13.10	10.00	11.96	10.77	9.78
	30	13.97	11.89	13.04	12.09	10.87
	40	14.52	14.44	14.13	12.75	11.96
	50	14.79	15.56	16.30	14.84	13.59
	60	15.34	16.67	17.39	16.48	15.65
	70	15.97	17.00	18.48	17.91	16.63
	80	17.26	19.11	19.57	19.78	19.57
	90	19.18	21.33	22.83	22.20	20.76

Table 5.160. Hallettsville – Linear Regression Results

Hallettsville, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.105	0.094	0.996	.040
Winter	-0.001	0.991	0.864	.000
Fall	0.072	0.019	0.885	.077
Summer	0.011	0.713	0.253	.002
Spring	0.015	0.597	0.650	.004
Precipitation Days				
Annual	0.028	0.799	0.391	.001
Winter	-0.021	0.662	0.913	.004
Fall	0.010	0.821	0.703	.001
Summer	0.003	0.945	0.559	.000
Spring	0.030	0.541	0.774	.008
Precipitation Intensity				
Annual	0.001	0.125	0.842	.050
Winter	0.001	0.258	0.537	.028
Fall	0.001	0.562	0.165	.007
Summer	0.002	0.232	0.399	.031
Spring	0.002	0.306	0.394	.023

Summary for the Central Texas Region

Most precipitation and days with precipitation occur during the spring and fall months for the Central Texas stations. Precipitation is greatest during the fall months except for Lampasas, Boerne, and San Antonio. The majority of the stations showed the least amount of variability for precipitation during the spring months. A majority of stations resulted in low variability during the spring months for precipitation intensity. Variability for precipitation was highest during the winter months for a majority of the stations and highest for precipitation days during the fall months. High variability occurred between summer, winter, and fall months for precipitation intensity for the Central Texas stations. The highest probability of a rain day resulted in 15.15% for Hallettsville. Median values fell below the mean except for annual and summer precipitation days and annual precipitation intensity for Lampasas; summer precipitation, and winter and spring precipitation days for Temple; annual, winter, and spring precipitation days, and summer and winter precipitation intensity for Llano; summer precipitation, summer and fall precipitation days, and spring precipitation intensity for Blanco; annual and summer precipitation days, and spring and fall precipitation intensity for Boerne; annual, spring, and fall precipitation days, and annual precipitation intensity for New Braunfels; annual precipitation and spring precipitation days for San Antonio, fall and winter precipitation days and fall precipitation intensity for Luling; annual precipitation and fall and spring precipitation days for Flatonia; and annual and fall precipitation, winter and fall precipitation days, and spring precipitation intensity for Hallettsville.

Total precipitation, precipitation days, and precipitation intensity annually and seasonally were grouped into equal frequency deciles. For the given stations, the bottom deciles included the 10% of events with the lowest values, while the top deciles include the 10% of events with the greatest value. San Antonio resulted in the lowest values for precipitation and precipitation days with 10% of the years not exceeding 17.87 inches of precipitation and 31.00 days with precipitation. Boerne resulted in the lowest values for precipitation intensity with 10% of the years not exceeding 0.51 inch of precipitation per day. For Hallettsville, 10% of the years on record exceeded 53.80 inch of precipitation and 0.89 inch of precipitation per day. For San Antonio and Luling, 10% of the years on record exceeded 0.89 inch of precipitation per day, while Flatonia exceeded 68.10 precipitation days. There is a statistically significant increase in annual precipitation for Bourne and San Antonio, while Bourne, Luling, and Hallettsville show an increase in fall precipitation over the period of record. San Antonio is the only station to show an increase in precipitation days during the summer months during the period of record.

There is an increase in annual precipitation intensity for Temple and Boerne, while Llano resulted in an increase in winter precipitation intensity. Boerne resulted in an increase in fall and summer precipitation intensity, while there were no stations that resulted in an increase or decrease in spring precipitation intensity.

Southeast

The southeast region is classified as subtropical with hot, humid summers. In this region, there is one distinct climate type based on the Köppen climate classification; Cfa (humid subtropical). This region receives humid tropical air from the Gulf of Mexico during the summer, and cyclonic storms during the winter months. The three weather stations in this region include Brenham (8), Danevang (14), and Liberty (26) (Figure 5.1).

Brenham

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Brenham are given in Tables 5.161, 5.162, 5.163, and 5.164. Brenham (Köppen climate classification Cfa) receives an average of 41.96 inches of precipitation per year, of which the largest portion occurs during the fall months. Annually, this station receives an average of 59.50 days of precipitation, most of which occurs during the fall months. Annually, this station averages 0.72 inch of precipitation per day with most occur during the fall months. A comparison of the CV suggests that the spring months have the smallest amount of precipitation variability, while fall is the most variable. For precipitation days, the CV suggests that the fall months have the least variability, while the summer is the most variable. The winter months show the smallest amount of variability in precipitation intensity, while spring is the most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual and summer precipitation days, and annual and winter precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 28.50 inches. Ninety percent will be at or below 56.47 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 43.80 days. Ninety percent will be at or below 72.50 days, with 10% being above 69 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.56 inch per day. Ninety percent of the years had 0.89 inch per day or less. Probability results show that this station has a 16.30% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual and fall total precipitation. Results show an increase of 0.143 inch per year in annual total precipitation, with 7.5% of the variance accounted for by the regression, and 0.117 inch per year increase in fall precipitation, with 15.6% of the variance accounted for by the regression (Table 5.165).

Table 5.161. Brenham – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		41.96	9.62	12.08	9.23	10.97
Std. Deviation		10.76	3.91	6.10	4.42	4.18
Minimum		18.79	2.81	2.13	1.22	3.59
Maximum		64.59	22.85	40.79	19.45	19.81
Coefficient of Variation		0.25	0.41	0.50	0.47	0.38
Deciles Percentiles	10	28.50	5.04	4.70	3.42	5.49
	20	32.99	6.01	6.88	5.03	7.08
	30	35.42	6.85	9.04	6.33	8.38
	40	38.61	8.44	10.91	7.56	9.32
	50	41.20	9.45	11.67	8.95	10.20
	60	44.36	10.71	12.68	10.06	12.07
	70	48.03	11.56	14.04	11.59	13.55
	80	52.11	12.63	15.71	13.49	15.63
	90	56.48	14.01	18.52	15.61	16.75

Table 5.162. Brenham – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		59.50	16.06	15.81	12.83	14.71
Std. Deviation		10.06	5.13	4.33	4.95	4.87
Minimum		40	5	6	2	6
Maximum		89	30	24	23	26
Coefficient of Variation		0.16	0.32	0.27	0.38	0.33
Deciles Percentiles	10	43.80	9.00	10.00	6.90	8.00
	20	51.80	11.80	12.00	8.80	10.00
	30	54.70	14.00	14.00	10.00	11.70
	40	57.60	15.00	14.60	11.00	12.60
	50	61.50	15.00	15.50	13.00	14.50
	60	62.40	17.40	17.00	14.00	16.40
	70	64.00	19.00	18.30	16.00	18.00
	80	65.00	20.20	19.40	17.20	19.20
	90	72.50	22.20	22.00	20.10	22.00

Table 5.163. Brenham – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.72	0.58	0.84	0.71	0.78
Std. Deviation		0.12	0.13	0.32	0.21	0.26
Minimum		0.46	0.37	0.32	0.31	0.34
Maximum		1.03	0.90	1.94	1.33	1.73
Coefficient of Variation		0.16	0.21	0.38	0.30	0.33
Deciles Percentiles	10	0.57	0.40	0.44	0.47	0.50
	20	0.63	0.43	0.59	0.57	0.60
	30	0.66	0.49	0.67	0.61	0.64
	40	0.71	0.56	0.77	0.63	0.68
	50	0.73	0.60	0.80	0.70	0.72
	60	0.74	0.63	0.86	0.73	0.77
	70	0.76	0.66	0.95	0.84	0.87
	80	0.80	0.69	1.05	0.88	0.96
	90	0.89	0.74	1.25	1.02	1.12

Table 5.164. Brenham – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		16.30	17.85	17.19	14.10	15.99
Std. Deviation		2.76	5.70	4.71	5.45	5.30
Variance		7.61	32.49	22.20	29.67	28.10
Minimum		10.96	5.56	6.52	2.20	6.52
Maximum		24.38	33.33	26.09	25.27	28.26
Deciles Percentiles	10	12.00	10.00	10.87	7.58	8.70
	20	14.19	13.11	13.04	9.67	10.87
	30	14.99	15.56	15.22	10.99	12.72
	40	15.78	16.67	15.87	12.09	13.70
	50	16.85	16.67	16.85	14.29	15.76
	60	17.10	19.33	18.48	15.38	17.83
	70	17.53	21.11	19.89	17.58	19.57
	80	17.81	22.44	21.09	18.90	20.87
	90	19.86	24.67	23.91	22.09	23.91

Table 5.165. Brenham – Linear Regression Results

Brenham, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.143	0.021	0.770	.075
Winter	-0.018	0.413	0.915	.010
Fall	0.117	0.001	0.349	.156
Summer	0.017	0.510	0.774	.006
Spring	0.014	0.561	0.466	.005
Precipitation Days				
Annual	0.196	0.061	0.999	.074
Winter	0.0081	0.880	0.837	.001
Fall	0.049	0.273	0.998	.026
Summer	0.090	0.078	0.727	.066
Spring	0.050	0.326	0.950	.021
Precipitation Intensity				
Annual	0.001	0.138	0.687	.047
Winter	-0.001	0.954	0.876	.000
Fall	0.004	0.203	0.625	.035
Summer	0.001	0.516	0.621	.009
Spring	-0.001	0.994	0.276	.000

Danevang

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Danevang are given in Tables 5.166, 5.167, 5.168, and 5.169. Danevang (Köppen climate classification Cfa) receives an average of 41.62 inches of precipitation per year, of which the largest portion occurs during the fall months. Annually, this station receives an average of 58.54 days of precipitation, most of which occurs during the summer months. Annually, this station averages 0.73 inch of precipitation per day with most occurring during the fall months. A comparison of the CV suggests that the spring months have the smallest amount of precipitation variability, while winter is the most variable. For precipitation days, the CV suggests that the summer months have the least variability, while the spring is the most variable. The spring months show the smallest amount of variability in precipitation intensity, while winter is the most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for spring precipitation, and spring and fall precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 29.13 inches. Ninety percent will be at or below 56.69 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 45.70 days. Ninety percent will be at or below 70.10 days, with 10% being above 70.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.55 inch per day. Ninety percent of the years had 0.93 inch per day or less. Probability results show that this station has a 16.03% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual and fall total precipitation, and annual, spring, summer, fall, and winter precipitation days. Results show an increase of 0.164 inches per year in annual total precipitation, with 9.4% of the variance accounted for by the regression, and a 0.090 inch per year increase in fall precipitation, with 10.1% of the variance accounted for by the regression. For precipitation days, linear regression results shows an increase of 0.201days per year increase annually, with 9.7% of the variance accounted for by the regression. Results also show 0.370 days per year increase for precipitation days during the summer months, with 1.8% of the variance accounted for by the regression, 0.156 days per year increase in precipitation days during the fall months, with 4.3% of the variance accounted for by the regression, and 0.348 days per year increase in precipitation days during the winter months, with 1.9% of the variance accounted for by the regression (Table 5.170).

Table 5.166. Danevang – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		41.62	8.52	12.12	11.45	9.53
Std. Deviation		11.09	3.35	5.89	5.25	5.13
Minimum		18.29	2.80	3.36	3.06	2.32
Maximum		68.89	22.09	27.41	30.59	26.36
Coefficient of Variation		0.27	0.39	0.49	0.46	0.53
Deciles Percentiles	10	29.13	4.71	5.42	5.53	3.88
	20	33.03	5.96	6.09	7.07	4.61
	30	34.09	6.58	8.48	8.43	5.84
	40	38.57	7.14	9.23	9.13	7.37
	50	40.07	7.67	10.13	11.09	9.67
	60	42.91	8.75	12.57	11.95	10.28
	70	48.32	9.81	15.14	13.35	11.48
	80	51.82	11.59	17.72	15.47	12.79
	90	56.69	12.45	21.00	17.48	16.56

Table 5.167. Danevang – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		58.54	14.27	15.67	16.71	11.79
Std. Deviation		9.03	4.30	5.02	4.73	4.52
Minimum		38	6	5	8	4
Maximum		76	26	26	29	22
Coefficient of Variation		0.15	0.30	0.32	0.28	0.38
Deciles Percentiles	10	45.70	8.90	8.00	11.00	5.90
	20	51.80	11.00	11.00	12.80	7.80
	30	54.00	11.70	12.70	14.00	9.00
	40	56.60	13.00	14.00	15.00	10.60
	50	58.50	14.00	16.00	16.00	12.00
	60	62.00	15.00	17.00	17.40	13.00
	70	65.00	16.00	18.30	19.30	14.30
	80	67.00	17.20	19.20	20.20	15.00
	90	70.10	21.00	23.00	23.10	17.30

Table 5.168. Danevang – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.73	0.61	0.83	0.70	0.80
Std. Deviation		0.12	0.16	0.27	0.18	0.28
Minimum		0.51	0.34	0.40	0.41	0.32
Maximum		0.99	1.19	1.76	1.33	1.45
Coefficient of Variation		0.16	0.27	0.33	0.27	0.35
Deciles Percentiles	10	0.55	0.39	0.54	0.49	0.46
	20	0.62	0.45	0.61	0.54	0.53
	30	0.67	0.55	0.65	0.59	0.60
	40	0.70	0.56	0.70	0.63	0.71
	50	0.73	0.59	0.77	0.70	0.79
	60	0.75	0.62	0.84	0.72	0.83
	70	0.80	0.68	0.89	0.75	0.87
	80	0.83	0.76	1.08	0.82	1.04
	90	0.93	0.80	1.19	0.91	1.25

Table 5.169. Danevang – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		16.03	15.86	17.03	18.36	12.82
Std. Deviation		2.48	4.78	5.46	5.20	4.92
Variance		6.13	22.89	29.83	27.03	24.23
Minimum		10.41	6.67	5.43	8.79	4.35
Maximum		20.82	28.89	28.26	31.87	23.91
Deciles Percentiles	10	12.52	9.89	8.70	12.09	6.41
	20	14.19	12.22	11.96	14.07	8.48
	30	14.79	13.00	13.80	15.38	9.78
	40	15.51	14.44	15.22	16.48	11.52
	50	16.03	15.56	17.39	17.58	13.04
	60	16.99	16.67	18.48	19.12	14.13
	70	17.81	17.78	19.89	21.21	15.54
	80	18.36	19.11	20.87	22.20	16.30
	90	19.21	23.33	25.00	25.38	18.80

Table 5.170. Danevang – Linear Regression Results

Danevang, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.164	0.009	0.989	.094
Winter	0.012	0.518	0.181	.000
Fall	0.090	0.007	0.733	.101
Summer	0.022	0.456	0.260	.008
Spring	0.037	0.207	0.701	.023
Precipitation Days				
Annual	0.201	0.032	0.995	.097
Winter	0.042	0.348	0.999	.019
Fall	0.074	0.156	0.995	.043
Summer	0.044	0.370	0.447	.018
Spring	0.040	0.400	0.999	.015
Precipitation Intensity				
Annual	0.001	0.325	0.973	.021
Winter	0.005	0.922	0.488	.000
Fall	0.007	0.564	0.264	.007
Summer	0.001	0.759	0.682	.002
Spring	0.004	0.227	0.639	.032

Liberty

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Liberty are given in Tables 5.171, 5.172, 5.173, and 5.174. Liberty (Köppen climate classification Cfa) receives an average of 54.75 inches of precipitation per year, of which the largest portion occurs during the fall months. Annually, this station receives an average of 71.90 days of precipitation, most of which occurs during the summer months. Annually, this station averages 0.78 inch of precipitation per day with most occurring during the fall months. A comparison of the CV suggests that the winter months have the smallest amount of precipitation variability, while fall is the most variable. For precipitation days, the CV suggests that the winter months have the least variability, while the spring is the most variable. The summer months show the smallest amount of variability in precipitation intensity, while fall is the most variable. The data shows that over the period of record, 50% of the total precipitation, precipitation days, and precipitation intensity are below their respective mean values except for annual and summer precipitation days, and annual precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 37.97 inches. Ninety percent will be at or below 70.08 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 56 days. Ninety percent will be at or below 89.10 days, with 10 % being above 89.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.59 inch per day. Ninety percent of the years had 0.95 inch per day or less. Probability results show that this station has a 19.69% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual and fall total precipitation, and annual precipitation intensity. Results show an increase of 0.221 inch per year in annual total precipitation, with 11.9% of the variance accounted for by the regression. In addition, results show a 0.132 inch per year increase in fall precipitation, with 15.8% of the variance accounted for by the regression. In addition, linear regression results show an increase of 0.004 inch of precipitation per precipitation day on an annual basis, with 18.4% of the variance accounted for by the regression (Table 5.175).

Table 5.171. Liberty – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		54.76	13.57	14.56	14.11	12.39
Std. Deviation		13.26	4.64	6.87	6.09	5.51
Minimum		29.64	4.58	4.57	5.74	1.96
Maximum		88.14	27.89	34.32	33.75	24.05
Coefficient of Variation		0.24	0.34	0.47	0.43	0.44
Deciles Percentiles	10	37.98	7.49	5.85	7.70	5.86
	20	42.37	9.68	7.84	9.09	6.93
	30	45.06	10.85	9.49	10.26	8.69
	40	50.55	11.54	11.57	11.55	10.19
	50	54.00	12.69	14.08	12.50	12.09
	60	59.94	14.39	16.16	13.98	14.11
	70	63.58	15.92	18.32	15.80	15.79
	80	66.16	17.42	21.10	18.81	17.21
	90	70.08	20.03	23.55	21.99	19.83

Table 5.172. Liberty – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		71.90	19.25	17.71	19.96	14.98
Std. Deviation		11.48	4.60	4.92	5.66	4.87
Minimum		51	8	8	7	4
Maximum		100	29	26	33	25
Coefficient of Variation		0.15	0.24	0.27	0.28	0.32
Deciles Percentiles	10	56.00	13.00	11.90	12.90	9.00
	20	61.60	15.80	13.00	14.80	11.00
	30	64.00	16.70	15.00	15.00	12.00
	40	68.60	18.00	16.60	18.00	13.00
	50	72.00	18.50	17.00	20.00	14.50
	60	75.40	20.00	18.00	22.00	16.40
	70	77.30	22.30	19.00	23.30	19.00
	80	79.20	24.00	24.00	25.20	20.00
	90	89.10	25.00	25.00	27.00	21.10

Table 5.173. Liberty – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.78	0.70	0.91	0.72	0.79
Std. Deviation		0.15	0.23	0.37	0.20	0.24
Minimum		0.54	0.27	0.38	0.42	0.34
Maximum		1.23	1.36	2.29	1.38	1.57
Coefficient of Variation		0.19	0.32	0.40	0.28	0.30
Deciles Percentiles	10	0.59	0.44	0.51	0.50	0.47
	20	0.63	0.51	0.61	0.54	0.55
	30	0.68	0.57	0.73	0.60	0.64
	40	0.71	0.60	0.81	0.65	0.76
	50	0.80	0.67	0.84	0.69	0.79
	60	0.84	0.74	0.91	0.73	0.85
	70	0.88	0.81	0.98	0.82	0.92
	80	0.90	0.88	1.15	0.87	1.00
	90	0.95	0.99	1.43	1.03	1.09

Table 5.174. Liberty – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		19.69	21.39	19.25	21.93	16.28
Std. Deviation		3.15	5.11	5.35	6.22	5.29
Variance		9.90	26.14	28.61	38.74	28.03
Minimum		13.97	8.89	8.70	7.69	4.35
Maximum		27.40	32.22	28.26	36.26	27.17
Deciles Percentiles	10	15.34	14.44	12.93	14.18	9.78
	20	16.88	17.56	14.13	16.26	11.96
	30	17.53	18.56	16.30	16.48	13.04
	40	18.79	20.00	18.04	19.78	14.13
	50	19.73	20.56	18.48	21.98	15.76
	60	20.66	22.22	19.57	24.18	17.83
	70	21.18	24.78	20.65	25.60	20.65
	80	21.70	26.67	26.09	27.69	21.74
	90	24.41	27.78	27.17	29.67	22.93

Table 5.175 Liberty – Linear Regression Results

Liberty, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.221	0.003	0.685	.119
Winter	0.006	0.824	0.594	.001
Fall	0.132	0.001	0.805	.158
Summer	0.050	0.150	0.340	.030
Spring	0.030	0.350	0.708	.013
Precipitation Days				
Annual	0.131	0.28	0.972	.025
Winter	-0.056	0.245	0.622	.029
Fall	0.028	0.587	0.632	.006
Summer	0.097	0.100	0.970	.058
Spring	0.061	0.231	0.900	.031
Precipitation Intensity				
Annual	0.004	0.002	0.590	.184
Winter	0.005	0.029	0.811	.100
Fall	0.007	0.054	0.115	.078
Summer	0.001	0.736	0.386	.002
Spring	0.004	0.086	0.939	.063

Summary for the Southeast Region

Most precipitation occurs during the fall months, while the majority of precipitation days occur during the summer months. Precipitation intensity is highest for the majority of stations during the fall months. A majority of the stations showed the least amount of variability for precipitation during the spring months, while results were mixed between spring, summer, fall and winter for precipitation days and intensity. A majority of the stations showed the highest amount of variability during the fall months for precipitation, and the spring months for precipitation days. The highest probability of a rain day was 19.69% for Liberty. All other stations fell below this value. Most stations resulted in a positive skew for precipitation, precipitation days, and precipitation intensity. Median values fell less than the mean except for annual and summer precipitation days and annual and winter precipitation intensity for Brenham; spring precipitation, and spring and fall precipitation days for Danevang; and annual and summer precipitation days, and annual precipitation intensity for Liberty.

Total precipitation, precipitation days, and precipitation intensity annually and seasonally were grouped into equal frequency deciles. For the given stations, the bottom deciles included the 10 % of events with the lowest values, while the top deciles include the 10 % of events with the greatest value. Brenham resulted in the lowest values for precipitation and days with precipitation with 10% of the years not exceeding 28.50 inches of precipitation and 43.80 days with precipitation. Danevang resulted in the lowest values for precipitation intensity with 10% of the year not exceeding 0.55 inch of precipitation per day. For Liberty, 10% of the years on record exceeded 70.08 inch of precipitation, 89.10 precipitation days, and 0.95 inch of precipitation per day.

There is a statistically significant increase for all stations in annual precipitation and fall precipitation. Danevang shows an increase in annual, winter, fall, summer, and spring precipitation days, while Liberty resulted in an increase in annual precipitation intensity.

South

In this region, there are two distinct climate types based on the Köppen climate classification; Cfa (humid subtropical) and BSh (subtropical semi-arid hot steppe). Areas in this region experience hot summers and dry winters (Swanson 1995). The Cfa climate humid subtropical with warm summers is controlled by proximity to the Gulf of Mexico. During the winter, this region can be affected by strong polar air masses and is also subjected to occasional tropical disturbances during the summer and fall months. The seven weather stations in this region include Eagle Pass (16), Encinal (18), Beeville (5), Alice (2), Corpus Christi (11), Falfurrias (19), and Rio Grande City (37) (Figure 5.1).

Eagle Pass

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Eagle Pass are given in Tables 5.176, 5.177, 5.178, and 5.179. Eagle Pass (Köppen climate classification BSh) receives an average of 20.63 inches of precipitation per year, of which the largest portion occurs during the summer months. Annually, this station receives an average of 32.10 days of precipitation, most of which occurs during the fall months. Annually, this station averages 0.66 inch of precipitation per day with most occur during the summer months. A comparison of the CV suggests that the fall months have the smallest amount of precipitation variability, while winter is the most variable. For precipitation days, the CV suggests that the fall months have the least variability, while the winter is the most variable. The fall months show the smallest amount of variability in precipitation intensity, while winter is the most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for summer precipitation days and summer precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 12.18 inches. Ninety percent will be at or below 31.63 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 22.80 days. Ninety percent will be at or below 43.60 days, with 10% being above 43.60 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.46 inch per day. Ninety percent of the years had 0.88 inch per day or less.

Probability results show that this station has an 8.79% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual and spring precipitation intensity. Results show a decrease of 0.002 inch per precipitation day, with 8.1% of the variance accounted for by the regression, and a decrease of 0.007 inch per precipitation day in spring precipitation intensity, with 12.1% of the variance accounted for by the regression.

Table 5.176. Eagle Pass – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		20.64	2.67	5.70	6.66	5.64
Std. Deviation		7.05	2.14	3.29	4.36	3.47
Minimum		6.01	0.17	0.42	0.53	0.49
Maximum		38.26	11.84	18.60	22.19	19.89
Coefficient of Variation		0.34	0.80	0.57	0.65	0.62
Deciles Percentiles	10	12.19	0.61	2.37	2.01	1.69
	20	14.45	1.07	2.80	3.01	2.36
	30	16.05	1.42	3.47	3.73	3.55
	40	17.67	1.75	4.30	4.98	4.13
	50	20.22	2.14	4.98	5.87	5.04
	60	22.23	2.48	6.05	6.80	5.88
	70	23.24	2.73	7.10	8.50	7.17
	80	26.77	3.96	8.41	9.61	8.61
	90	31.64	5.91	9.81	12.68	9.93

Table 5.177. Eagle Pass – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		32.10	5.50	9.60	8.85	8.13
Std. Deviation		9.12	3.95	4.19	4.50	4.34
Minimum		10	0	1	2	2
Maximum		55	19	23	21	18
Coefficient of Variation		0.28	0.72	0.44	0.51	0.53
Deciles Percentiles	10	22.80	1.00	3.90	3.00	2.90
	20	24.80	2.00	6.80	4.00	4.00
	30	26.00	3.00	8.00	5.70	5.70
	40	28.00	4.00	9.00	8.00	6.00
	50	32.00	4.50	9.00	9.00	7.50
	60	33.00	5.40	10.00	9.00	9.00
	70	35.30	6.30	11.00	11.30	10.00
	80	39.00	9.00	13.00	12.00	12.00
	90	43.60	11.00	15.00	14.10	15.10

Table 5.178. Eagle Pass – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	47	48	48	48
	Missing	0	1	0	0	0
Mean		0.67	0.48	0.67	0.77	0.69
Std. Deviation		0.14	0.23	0.24	0.30	0.28
Minimum		0.43	0.16	0.26	0.27	0.24
Maximum		0.95	1.41	1.36	1.37	1.53
Coefficient of Variation		0.21	0.47	0.36	0.39	0.41
Deciles Percentiles	10	0.46	0.27	0.38	0.39	0.38
	20	0.55	0.31	0.49	0.46	0.48
	30	0.60	0.35	0.53	0.55	0.53
	40	0.61	0.37	0.56	0.70	0.61
	50	0.66	0.42	0.65	0.78	0.64
	60	0.69	0.46	0.68	0.85	0.72
	70	0.75	0.56	0.75	0.96	0.77
	80	0.80	0.65	0.89	1.06	0.87
	90	0.88	0.72	1.03	1.21	1.09

Table 5.179. Eagle Pass – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		8.79	6.11	10.44	9.73	8.83
Std. Deviation		2.50	4.39	4.56	4.95	4.72
Variance		6.25	19.28	20.75	24.46	22.30
Minimum		2.74	0.00	1.09	2.20	2.17
Maximum		15.07	21.11	25.00	23.08	19.57
Deciles Percentiles	10	6.25	1.11	4.24	3.30	3.15
	20	6.79	2.22	7.39	4.40	4.35
	30	7.12	3.33	8.70	6.26	6.20
	40	7.67	4.44	9.78	8.79	6.52
	50	8.77	5.00	9.78	9.89	8.15
	60	9.04	6.00	10.87	9.89	9.78
	70	9.67	7.00	11.96	12.42	10.87
	80	10.68	10.00	14.13	13.19	13.04
	90	11.95	12.22	16.30	15.49	16.41

Table 5.180. Eagle Pass – Linear Regression Results

Eagle Pass, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.002	0.952	0.805	.000
Winter	-0.009	0.441	0.021	.009
Fall	0.029	0.127	0.398	.033
Summer	-0.005	0.820	0.287	.001
Spring	-0.012	0.535	0.352	.006
Precipitation Days				
Annual	0.021	0.820	0.755	.001
Winter	-0.006	0.878	0.226	.001
Fall	-0.022	0.606	0.541	.006
Summer	0.019	0.676	0.792	.004
Spring	0.037	0.410	0.709	.015
Precipitation Intensity				
Annual	-0.002	0.049	0.964	.081
Winter	-0.002	0.391	0.136	.016
Fall	-0.001	0.894	0.400	.000
Summer	-0.001	0.677	0.712	.004
Spring	-0.007	0.015	0.405	.121

Encinal

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Encinal are given in Tables 5.181, 5.182, 5.183, and 5.184. Encinal (Köppen climate classification BSh) receives an average of 21.35 inches of precipitation per year, of which the largest portion occurs during the fall months. Annually, this station receives an average of 29.48 days of precipitation, most of which occurs during the fall months. Annually, this station averages 0.76 inch of precipitation per day with most occurring during the fall months. A comparison of the CV suggests that both the spring and summer months have the smallest amount of precipitation variability, while winter is the most variable. For precipitation days, the CV suggests that the fall months have the least variability, while the winter is the most variable. The fall months show the smallest amount of variability in precipitation intensity, while winter is the most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for fall precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 13.72 inches. Ninety percent will be at or below 31.92 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 17 days. Ninety percent will be at or below 43 days, with 10% being above 43 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.52 inch per day. Ninety percent of the years had 1.11 inch per day or less. Probability results show that this station has an 8.07% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual, fall, and winter precipitation days, and annual precipitation intensity. Results show a decrease of 0.35 precipitation days annually, with 25.6% of the variance accounted for by the regression, and a decrease of 0.107 days during the fall months, with 13.4% of the variance accounted for by the regression. Results also show a decrease of 0.184 days during the winter months, with 41.4% of the variance accounted for by the regression. In addition, linear regression results show an annual increase of 0.0094 inch in precipitation per precipitation day, with 29.3% of the variance accounted for by the regression, and a 0.019 inch increase in precipitation per precipitation day during the winter months with 9.6% of the variance accounted for by the regression (Table 5.185).

Table 5.181. Encinal – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		21.35	3.24	6.51	5.94	5.49
Std. Deviation		6.53	2.26	3.86	3.31	3.12
Minimum		9.71	0.00	0.95	0.66	0.00
Maximum		37.39	11.04	20.54	14.59	13.20
Coefficient of Variation		0.31	0.69	0.59	0.56	0.56
Deciles Percentiles	10	13.72	1.02	2.08	2.09	1.93
	20	15.59	1.42	3.64	2.98	2.69
	30	16.98	1.99	4.30	3.69	3.43
	40	18.73	2.24	4.94	4.47	4.08
	50	20.77	2.75	5.60	5.54	5.15
	60	22.54	3.36	6.63	6.61	6.22
	70	24.02	3.86	7.69	7.68	6.76
	80	27.24	4.54	9.73	9.05	8.53
	90	31.92	6.70	11.51	10.46	9.68

Table 5.182. Encinal – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		29.48	6.52	8.40	7.50	7.06
Std. Deviation		9.83	4.00	4.07	4.01	4.06
Minimum		13	0	2	2	0
Maximum		53	19	22	18	20
Coefficient of Variation		0.33	0.72	0.48	0.53	0.58
Deciles Percentiles	10	17.00	1.90	2.90	3.00	2.00
	20	19.00	3.00	4.00	4.00	3.00
	30	23.70	4.00	6.00	5.00	4.70
	40	25.60	5.00	7.60	6.00	6.00
	50	28.50	6.00	8.50	6.50	7.00
	60	32.00	6.40	9.00	8.00	7.00
	70	34.30	8.00	10.00	10.00	9.00
	80	37.20	9.20	11.20	11.00	10.20
	90	43.00	13.00	14.00	13.10	13.00

Table 5.183. Encinal – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	46	48	48	47
	Missing	0	2	0	0	1
Mean		0.77	0.64	0.87	0.87	0.79
Std. Deviation		0.24	0.84	0.36	0.60	0.52
Minimum		0.43	0.00	0.28	0.25	0.11
Maximum		1.41	5.47	1.95	3.91	3.54
Coefficient of Variation		0.31	1.32	0.42	0.68	0.65
Deciles Percentiles	10	0.52	0.15	0.38	0.33	0.38
	20	0.58	0.24	0.50	0.42	0.48
	30	0.60	0.28	0.69	0.54	0.50
	40	0.63	0.35	0.76	0.67	0.55
	50	0.69	0.44	0.82	0.79	0.68
	60	0.77	0.48	0.93	0.85	0.83
	70	0.86	0.56	1.03	0.95	0.93
	80	0.98	0.80	1.15	1.07	1.06
	90	1.11	1.36	1.38	1.45	1.28

Table 5.184. Encinal – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		8.07	7.25	9.13	8.24	7.68
Std. Deviation		2.69	4.44	4.43	4.40	4.42
Variance		7.25	19.75	19.65	19.37	19.53
Minimum		3.56	0.00	2.17	2.20	0.00
Maximum		14.52	21.11	23.91	19.78	21.74
Deciles Percentiles	10	4.66	2.11	3.15	3.30	2.17
	20	5.21	3.33	4.35	4.40	3.26
	30	6.49	4.44	6.52	5.49	5.11
	40	7.01	5.56	8.26	6.59	6.52
	50	7.81	6.67	9.24	7.14	7.61
	60	8.77	7.11	9.78	8.79	7.61
	70	9.40	8.89	10.87	10.99	9.78
	80	10.19	10.22	12.17	12.09	11.09
	90	11.78	14.44	15.22	14.40	14.13

Table 5.185. Encinal – Linear Regression Results

Encinal, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	-0.008	0.827	0.724	.001
Winter	-0.017	0.172	0.028	.027
Fall	0.011	0.612	0.210	.004
Summer	-0.001	0.940	0.496	.000
Spring	-0.014	0.433	0.804	.009
Precipitation Days				
Annual	-0.355	0.001	0.833	.256
Winter	-0.184	0.001	0.812	.414
Fall	-0.107	0.011	0.979	.134
Summer	-0.073	0.377	0.571	.017
Spring	-0.027	0.525	0.832	.009
Precipitation Intensity				
Annual	0.009	0.001	0.836	.293
Winter	0.019	0.037	0.013	.096
Fall	0.006	0.066	0.974	.072
Summer	0.008	0.180	0.103	.039
Spring	0.009	0.079	0.192	.067

Beeville

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Beeville are given in Tables 5.186, 5.187, 5.188, and 5.189. Beeville (Köppen climate classification Cfa) receives an average of 31.21 inches of precipitation per year, of which the largest portion occurs during the fall months. Annually, this station receives an average of 46.96 days of precipitation, most of which occurs during the fall months. Annually, this station averages 0.69 inch of precipitation per day with most occurring during the fall months. A comparison of the CV suggests that the summer months have the smallest amount of precipitation variability, while winter is the most variable. For precipitation days, the CV suggests that the fall months have the least variability, while the winter is the most variable. The winter months show the smallest amount of variability in precipitation intensity, while fall is the most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual precipitation, and summer precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 18.63 inches. Ninety percent will be at or below 43.26 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 36.90 days. Ninety percent will be at or below 60.10 days, with a 10% being above 60.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.52 inch per day. Ninety percent of the years had 0.89 inch per day or less. Probability results show that this station has a 12.87% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in fall and winter precipitation days. There is a decrease of 0.107 precipitation days during the fall months, with 4.3% of the variance accounted for by the regression (Table 5.190).

Table 5.186. Beeville – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		31.22	5.71	9.34	8.67	7.52
Std. Deviation		8.58	3.29	5.05	4.53	4.04
Minimum		13.89	0.59	0.76	0.98	0.95
Maximum		48.13	18.68	30.27	23.84	20.00
Coefficient of Variation		0.27	0.58	0.53	0.52	0.54
Deciles Percentiles	10	18.63	2.50	3.95	3.57	2.87
	20	22.11	3.18	5.21	5.12	3.76
	30	26.76	3.73	6.59	6.09	5.26
	40	30.23	4.56	7.87	7.16	5.98
	50	32.11	5.02	8.50	7.95	6.90
	60	34.35	5.53	9.70	9.16	7.81
	70	35.83	6.30	10.38	10.13	9.46
	80	37.64	7.53	12.88	11.36	10.28
	90	43.27	9.98	15.14	14.07	12.88

Table 5.187. Beeville – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		46.98	10.31	13.33	12.56	10.67
Std. Deviation		9.04	4.57	4.02	4.3	4.34
Minimum		27	3	5	3	2
Maximum		67	25	23	22	19
Coefficient of Variation		0.19	0.44	0.30	0.35	0.41
Deciles Percentiles	10	36.90	5.00	8.00	6.90	5.00
	20	40.00	6.00	10.00	9.00	7.00
	30	41.70	7.00	11.00	10.00	8.00
	40	44.60	8.00	12.00	12.00	9.00
	50	46.00	10.00	13.00	13.00	10.00
	60	47.40	11.00	14.00	14.00	12.00
	70	52.00	13.30	14.30	15.00	13.30
	80	55.00	14.00	16.20	16.00	15.00
	90	60.10	16.00	19.20	19.00	17.10

Table 5.188. Beeville – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.69	0.56	0.76	0.71	0.69
Std. Deviation		0.14	0.19	0.33	0.29	0.24
Minimum		0.44	0.20	0.34	0.29	0.27
Maximum		1.05	0.94	1.89	2.01	1.35
Coefficient of Variation		0.19	0.34	0.44	0.41	0.34
Deciles Percentiles	10	0.53	0.31	0.43	0.47	0.37
	20	0.58	0.36	0.47	0.51	0.45
	30	0.61	0.44	0.57	0.57	0.52
	40	0.65	0.51	0.60	0.58	0.62
	50	0.67	0.54	0.67	0.64	0.68
	60	0.69	0.60	0.74	0.68	0.79
	70	0.76	0.66	0.81	0.77	0.84
	80	0.81	0.77	0.99	0.85	0.87
	90	0.90	0.81	1.28	1.16	0.98

Table 5.189. Beeville – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		12.87	11.46	14.49	13.80	11.59
Std. Deviation		2.48	5.08	4.37	4.78	4.73
Variance		6.14	25.80	19.12	22.81	22.34
Minimum		7.40	3.33	5.43	3.30	2.17
Maximum		18.36	27.78	25.00	24.18	20.65
Deciles Percentiles	10	10.11	5.56	8.70	7.58	5.43
	20	10.96	6.67	10.87	9.89	7.61
	30	11.42	7.78	11.96	10.99	8.70
	40	12.22	8.89	13.04	13.19	9.78
	50	12.60	11.11	14.13	14.29	10.87
	60	12.99	12.22	15.22	15.38	13.04
	70	14.25	14.78	15.54	16.48	14.46
	80	15.07	15.56	17.61	17.58	16.30
	90	16.47	17.78	20.87	20.88	18.59

Table 5.190. Beeville – Linear Regression Results

Beeville, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.070	0.155	0.644	.029
Winter	-0.017	0.368	0.110	.012
Fall	0.050	0.082	0.380	.043
Summer	0.024	0.357	0.389	.012
Spring	0.008	0.734	0.354	.002
Precipitation Days				
Annual	-0.011	0.903	0.489	.000
Winter	-0.031	0.511	0.812	.009
Fall	-0.107	0.011	0.979	.043
Summer	-0.073	0.377	0.571	.016
Spring	-0.027	0.525	0.832	.016
Precipitation Intensity				
Annual	0.001	0.273	0.550	.032
Winter	0.001	0.791	0.855	.002
Fall	0.004	0.169	0.132	.014
Summer	0.003	0.235	0.081	.030
Spring	0.001	0.744	0.809	.002

Alice

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Alice are given in Tables 5.191, 5.192, 5.193, and 5.194. Alice (Köppen climate classification Cfa) receives an average of 27 inches of precipitation per year, of which the largest portion occurs during the fall months. Annually, this station receives an average of 39.23 days of precipitation, most of which occurs during the fall months. Annually, this station averages 0.72 inch of precipitation per day with most occurring during the fall months. A comparison of the CV suggests that the fall months have the smallest amount of precipitation variability, while winter is the most variable. For precipitation days, the CV suggests that the summer months have the least variability, while the winter is the most variable. The spring months show the smallest amount of variability in precipitation intensity, while summer is the most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual precipitation days. The results show that for 10% of the years on record, total annual precipitation will be at or below 16.95 inches. Ninety percent will be at or below 39.49 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 24.90 days. Ninety percent will be at or below 51.10 days, with 10% being above 51.10 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.52 inch per day. Ninety percent of the years had 0.96 inch per day or less. Probability results show that this station has a 10.74% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual and fall precipitation days, and annual and fall precipitation intensity. Results show a decrease of 0.25 days per year with 13.3% of the variance accounted for by the regression, and a decrease of 0.17 days per year during the fall months, with 27.4% of the variance accounted for by the regression. Additionally, results show an increase of .0049 inch of precipitation per precipitation day on an annual basis, with 13.3% of the variance accounted for by the regression, and an increase of .014 inches of precipitation per precipitation day during the fall months, with 17.8% of the variance accounted for by the regression (Table 5.195).

Table 5.191. Alice – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		27.00	4.21	9.27	7.60	5.94
Std. Deviation		7.77	2.96	5.07	4.38	3.57
Minimum		12.98	0.58	1.68	0.50	0.30
Maximum		45.25	17.11	24.74	26.25	18.41
Coefficient of Variation		0.28	0.70	0.55	0.57	0.59
Deciles Percentiles	10	16.96	1.44	4.27	2.89	2.03
	20	20.10	2.01	5.42	4.20	2.76
	30	22.14	2.47	6.45	5.28	3.68
	40	24.93	2.83	6.92	5.72	4.07
	50	26.91	3.56	7.75	6.71	5.19
	60	28.86	4.22	8.92	7.94	6.28
	70	30.70	5.12	10.40	8.97	7.44
	80	32.69	6.15	13.27	10.25	8.78
	90	39.49	7.78	17.31	12.97	10.62

Table 5.192. Alice – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		39.23	8.40	11.50	10.63	8.69
Std. Deviation		9.85	4.53	4.57	4.32	3.88
Minimum		18	1	3	1	1
Maximum		57	19	23	18	17
Coefficient of Variation		0.25	0.54	0.48	0.41	0.45
Deciles Percentiles	10	24.90	2.00	6.00	4.90	3.90
	20	29.80	5.00	7.80	7.00	5.00
	30	33.00	5.00	9.00	8.00	6.00
	40	38.00	7.00	10.00	9.00	7.00
	50	40.00	7.50	11.00	10.00	8.50
	60	42.80	8.40	12.40	12.00	10.00
	70	45.30	10.30	14.00	13.00	11.00
	80	49.20	12.20	16.00	16.00	12.20
	90	51.10	16.00	18.00	16.10	14.10

Table 5.193. Alice – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.73	0.53	0.91	0.78	0.66
Std. Deviation		0.19	0.28	0.48	0.52	0.27
Minimum		0.43	0.25	0.24	0.12	0.26
Maximum		1.32	2.00	3.08	3.75	1.75
Coefficient of Variation		0.26	0.53	0.52	0.66	0.40
Deciles Percentiles	10	0.52	0.32	0.51	0.42	0.37
	20	0.60	0.36	0.58	0.51	0.44
	30	0.63	0.38	0.71	0.57	0.50
	40	0.66	0.40	0.74	0.63	0.60
	50	0.68	0.47	0.75	0.65	0.63
	60	0.71	0.51	0.86	0.74	0.68
	70	0.75	0.56	1.01	0.83	0.76
	80	0.86	0.61	1.23	0.95	0.82
	90	0.96	0.83	1.37	1.16	0.98

Table 5.194. Alice – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		10.74	9.33	12.50	11.68	9.44
Std. Deviation		2.70	5.04	4.97	4.75	4.23
Variance		7.29	25.36	24.69	22.54	17.86
Minimum		4.93	1.11	3.26	1.10	1.09
Maximum		15.62	21.11	25.00	19.78	18.48
Deciles Percentiles	10	6.82	2.22	6.52	5.38	4.24
	20	8.16	5.56	8.48	7.69	5.43
	30	9.04	5.56	9.78	8.79	6.52
	40	10.41	7.78	10.87	9.89	7.61
	50	10.96	8.33	11.96	10.99	9.24
	60	11.73	9.33	13.48	13.19	10.87
	70	12.41	11.44	15.22	14.29	11.96
	80	13.48	13.56	17.39	17.58	13.26
	90	14.00	17.78	19.57	17.69	15.33

Table 5.195. Alice – Linear Regression Results

Alice, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.015	0.732	0.559	.002
Winter	-0.013	0.435	0.110	.009
Fall	0.025	0.388	0.069	.011
Summer	0.005	0.843	0.462	.001
Spring	-0.004	0.828	0.201	.001
Precipitation Days				
Annual	-0.257	0.011	0.959	.133
Winter	-0.009	0.141	0.589	.047
Fall	-0.171	0.000	0.858	.274
Summer	-0.018	0.685	0.795	.004
Spring	0.007	0.85	0.917	.001
Precipitation Intensity				
Annual	0.004	0.011	0.058	.133
Winter	0.005	0.080	0.078	.065
Fall	0.0143	0.003	0.145	.178
Summer	0.0011	0.830	0.101	.001
Spring	0.0019	0.494	0.861	.010

Corpus Christi

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Corpus Christi are given in Tables 5.196, 5.197, 5.198, and 5.199. Corpus Christi (Köppen climate classification Cfa) receives an average of 29.93 inches of precipitation per year, of which the largest portion occurs during the fall months. Annually, this station receives an average of 43.00 days of precipitation, most of which occurs during the fall months. Annually, this station averages 0.72 inch of precipitation per day with most occurring during the spring months. A comparison of the CV suggests that the fall months have the smallest amount of precipitation variability, while winter is the most variable. For precipitation days, the CV suggests that the fall months have the least variability, while the spring is the most variable. The fall months show the smallest amount of variability in precipitation intensity, while spring is the most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values, except for annual and summer precipitation days and annual precipitation intensity. The results show that for 10% of the years on record, total annual precipitation will be at or below 19.37 inches. Ninety percent will be at or below 41.50 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 31 days. Ninety percent will be at or below 56 days, with 10% being above 56 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.54 inch per day. Ninety percent of the years had 0.87 inch per day or less. Probability results show that this station has an 11.78% chance that any one day in the year would receive 0.1mm of rain. Linear regression results show significant findings in annual total precipitation with an increase of 0.099 inch per year, with 6.0% of the variance accounted for by the regression (Table 5.200).

Table 5.196. Corpus Christi – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		29.93	5.15	10.00	8.13	6.64
Std. Deviation		8.42	3.57	4.67	4.68	3.74
Minimum		14.66	0.63	3.19	1.19	1.25
Maximum		48.07	19.39	23.47	19.50	19.83
Coefficient of Variation		0.28	0.69	0.47	0.57	0.56
Deciles Percentiles	10	19.37	1.53	4.23	3.03	2.25
	20	21.95	2.20	5.54	3.65	3.39
	30	23.86	3.16	6.68	4.83	4.02
	40	26.27	3.87	8.05	5.89	5.44
	50	29.89	4.21	9.09	7.30	5.79
	60	31.54	4.87	10.62	8.29	7.09
	70	36.78	6.43	11.95	10.20	8.25
	80	38.98	7.07	14.39	12.90	9.52
	90	41.51	9.99	17.09	14.74	11.82

Table 5.197. Corpus Christi – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		43.00	9.02	13.79	11.27	8.85
Std. Deviation		8.78	4.04	4.44	3.97	4.30
Minimum		25	1	6	4	1
Maximum		60	17	29	21	22
Coefficient of Variation		0.20	0.44	0.32	0.35	0.49
Deciles Percentiles	10	31.00	4.00	8.80	6.00	4.00
	20	34.80	6.00	9.80	7.00	4.80
	30	38.70	6.70	11.70	8.70	6.00
	40	40.60	8.00	13.00	10.00	7.00
	50	43.50	8.00	13.00	12.00	8.00
	60	45.00	10.00	14.40	12.40	9.40
	70	47.00	12.00	15.30	13.30	11.00
	80	51.20	13.20	18.00	15.00	13.20
	90	56.00	15.00	19.10	16.10	15.00

Table 5.198. Corpus Christi – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.73	0.55	0.78	0.75	0.80
Std. Deviation		0.13	0.25	0.30	0.38	0.43
Minimum		0.48	0.23	0.31	0.26	0.23
Maximum		0.96	1.40	1.71	2.33	2.35
Coefficient of Variation		0.18	0.45	0.38	0.51	0.54
Deciles Percentiles	10	0.54	0.35	0.45	0.38	0.39
	20	0.57	0.39	0.54	0.45	0.50
	30	0.63	0.41	0.61	0.52	0.61
	40	0.71	0.42	0.68	0.60	0.65
	50	0.76	0.44	0.72	0.71	0.71
	60	0.80	0.47	0.80	0.81	0.78
	70	0.82	0.60	0.88	0.90	0.86
	80	0.84	0.78	0.97	0.93	0.96
	90	0.87	0.92	1.21	1.13	1.33

Table 5.199. Corpus Christi – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		11.78	10.02	14.99	12.39	9.62
Std. Deviation		2.41	4.49	4.83	4.37	4.68
Variance		5.79	20.20	23.38	19.10	21.87
Minimum		6.85	1.11	6.52	4.40	1.09
Maximum		16.44	18.89	31.52	23.08	23.91
Deciles Percentiles	10	8.49	4.44	9.57	6.59	4.35
	20	9.53	6.67	10.65	7.69	5.22
	30	10.60	7.44	12.72	9.56	6.52
	40	11.12	8.89	14.13	10.99	7.61
	50	11.92	8.89	14.13	13.19	8.70
	60	12.33	11.11	15.65	13.63	10.22
	70	12.88	13.33	16.63	14.62	11.96
	80	14.03	14.67	19.57	16.48	14.35
	90	15.34	16.67	20.76	17.69	16.30

Table 5.200. Corpus Christi – Linear Regression Results

Corpus Christi, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.009	0.04	0.910	.060
Winter	0.005	0.805	0.137	.001
Fall	0.052	0.052	0.813	.054
Summer	0.039	0.145	0.647	.030
Spring	0.011	0.600	0.417	.004
Precipitation Days				
Annual	0.055	0.549	0.979	.008
Winter	-0.031	0.465	0.390	.012
Fall	0.003	0.947	0.744	.000
Summer	0.047	0.257	0.888	.028
Spring	0.037	0.406	0.838	.015
Precipitation Intensity				
Annual	0.001	0.799	0.329	.001
Winter	-0.003	0.894	0.005	.000
Fall	0.001	0.608	0.499	.006
Summer	-0.001	0.779	0.069	.002
Spring	-0.004	0.366	0.140	.018

Falfurrias

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Falfurrias are given in Tables 5.201, 5.202, 5.203, and 5.204. Falfurrias (Köppen climate classification Cfa) receives an average of 25.05 inches of precipitation per year, of which the largest portion occurs during the fall months. Annually, this station receives an average of 39.92 days of precipitation, most of which occurs during the fall months. Annually, this station averages 0.67 inch of precipitation per day with most occurring during the spring months. A comparison of the CV suggests that the spring months have the smallest amount of precipitation variability, while winter is the most variable. For precipitation days, the CV suggests that the fall months have the least variability, while the winter is the most variable. The spring months show the smallest amount of variability in precipitation intensity, while summer is the most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values. The results show that for 10% of the years on record, total annual precipitation will be at or below 16.27 inches. Ninety percent will be at or below 36.58 inches, with 10% above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 27 days. Ninety percent will be at or below 50 days, with 10% being above 50 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.47 inch per day. Ninety percent of the years had 0.88 inch per day or less. Probability results show that this station has a 10.38% chance that any one day in the year would receive 0.1mm of rain. Linear regression results do not show significant findings in total precipitation, precipitation days, or precipitation intensity (Table 5.205).

Table 5.201. Falfurrias – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		25.06	3.97	8.29	7.11	5.45
Std. Deviation		8.07	2.62	5.40	4.08	3.04
Minimum		10.39	0.42	1.53	1.12	0.74
Maximum		55.15	14.38	36.66	19.87	15.94
Coefficient of Variation		0.32	0.66	0.65	0.57	0.56
Deciles Percentiles	10	16.27	1.06	3.34	2.48	2.05
	20	18.63	1.63	3.80	3.56	2.94
	30	21.12	2.41	5.34	4.36	3.53
	40	22.46	3.15	6.16	5.43	4.02
	50	23.50	3.70	7.21	6.32	4.93
	60	25.36	4.13	8.64	7.82	5.88
	70	27.95	4.50	9.43	8.50	6.87
	80	30.20	6.06	10.86	10.24	7.75
	90	36.59	7.58	15.18	12.80	8.50

Table 5.202. Falfurrias – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		37.92	8.44	11.58	10.15	7.75
Std. Deviation		8.90	4.83	4.12	3.91	3.89
Minimum		22	1	5	3	2
Maximum		60	19	21	19	22
Coefficient of Variation		0.23	0.57	0.35	0.38	0.50
Deciles Percentiles	10	27.00	2.90	6.00	5.00	4.00
	20	29.00	4.00	8.00	7.00	4.80
	30	31.00	6.00	9.00	7.70	5.00
	40	33.60	6.60	10.00	8.00	6.00
	50	37.00	7.00	11.00	10.00	7.00
	60	40.00	9.00	13.00	11.40	8.00
	70	43.30	10.30	14.00	13.00	9.00
	80	47.20	13.00	16.00	14.00	11.20
	90	50.00	16.00	18.00	15.10	13.00

Table 5.203. Falfurrias – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		0.68	0.53	0.76	0.75	0.68
Std. Deviation		0.17	0.25	0.36	0.45	0.30
Minimum		0.46	0.17	0.24	0.23	0.09
Maximum		1.23	1.35	1.93	3.10	1.61
Coefficient of Variation		0.25	0.48	0.47	0.60	0.45
Deciles Percentiles	10	0.48	0.25	0.37	0.33	0.35
	20	0.56	0.33	0.45	0.45	0.41
	30	0.58	0.39	0.55	0.55	0.51
	40	0.61	0.42	0.61	0.59	0.57
	50	0.65	0.45	0.68	0.67	0.63
	60	0.70	0.51	0.77	0.71	0.71
	70	0.73	0.58	0.85	0.84	0.77
	80	0.77	0.71	0.98	0.90	0.91
	90	0.88	0.93	1.34	1.21	1.07

Table 5.204. Falfurrias – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		10.38	9.38	12.59	11.15	8.42
Std. Deviation		2.44	5.37	4.48	4.31	4.23
Variance		5.95	28.84	20.05	18.55	17.92
Minimum		6.03	1.11	5.43	3.30	2.17
Maximum		16.44	21.11	22.83	20.88	23.91
Deciles Percentiles	10	7.40	3.22	6.52	5.49	4.35
	20	7.95	4.44	8.70	7.69	5.22
	30	8.49	6.67	9.78	8.46	5.43
	40	9.21	7.33	10.87	8.79	6.52
	50	10.14	7.78	11.96	10.99	7.61
	60	10.96	10.00	14.13	12.53	8.70
	70	11.86	11.44	15.22	14.29	9.78
	80	12.93	14.44	17.39	15.38	12.17
	90	13.70	17.78	19.57	16.59	14.13

Table 5.205. Falfurrias – Linear Regression Results

Falfurrias, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.004	0.92	0.406	.000
Winter	-0.013	0.394	0.241	.011
Fall	0.017	0.573	0.087	.005
Summer	0.008	0.729	0.538	.002
Spring	-0.021	0.227	0.724	.021
Precipitation Days				
Annual	-0.088	0.345	0.748	.019
Winter	-0.059	0.243	0.693	.030
Fall	-0.051	0.231	0.226	.031
Summer	-0.016	0.686	0.768	.004
Spring	0.046	0.252	0.445	.028
Precipitation Intensity				
Annual	0.001	0.575	0.259	.007
Winter	-0.001	0.573	0.146	.007
Fall	0.004	0.218	0.296	.003
Summer	-0.001	0.964	0.041	.000
Spring	0.001	0.847	0.542	.001

Rio Grande City

Descriptive statistics for total precipitation, precipitation days, and precipitation intensity for Rio Grande City are given in Tables 5.206, 5.207, 5.208, and 5.209. Rio Grande City (Köppen climate classification BSh) receives an average of 19.73 inches of precipitation per year, of which the largest portion occurs during the fall months. Annually, this station receives an average of 32.02 days of precipitation, most of which occurs during the fall months. Annually, this station averages 0.66 inch of precipitation per day with most occurring during the fall months. A comparison of the CV suggests that the summer months have the smallest amount of precipitation variability, while winter is the most variable. For precipitation days, the CV suggests that the summer months have the least variability, while the winter is the most variable. The summer months show the smallest amount of variability in precipitation intensity, while winter is the most variable. The median values of total precipitation, precipitation days, and precipitation intensity are less than their respective mean values. The results show that for 10% of the years on record, total annual precipitation will be at or below 11.99 inches. Ninety percent will be at or below 30.40 inches, with 10 % above this value. For precipitation days, results show that for 10% of the years on record, annual number of days will be at or below 21.00 days. Ninety percent will be at or below 42.40 days, with 10% being above 42.40 days. For precipitation intensity, results show that 10% of the years on record experienced at or below 0.47 inch per day. Ninety percent of the years had 0.86 inch per day or less. Probability results show that this station has an 8.77% chance that any one day in the year would receive 0.1mm of rain. Linear regression results do not show significant findings in total precipitation, precipitation days, or precipitation intensity (Table 5.210).

Table 5.206. Rio Grande City – Total Precipitation [in] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	71	71	71	71	71
	Missing	0	0	0	0	0
Mean		19.74	2.67	7.16	5.52	4.40
Std. Deviation		7.43	1.92	4.78	3.30	2.71
Minimum		5.29	0.12	0.47	0.83	0.15
Maximum		48.35	8.14	30.59	19.24	12.98
Coefficient of Variation		0.37	0.72	0.67	0.59	0.62
Deciles Percentiles	10	11.99	0.59	2.61	2.11	1.61
	20	13.81	1.21	4.01	2.76	2.29
	30	15.93	1.38	4.72	3.80	2.91
	40	17.01	1.86	5.71	4.25	3.30
	50	18.39	2.22	6.62	4.68	3.85
	60	19.40	2.58	6.92	5.58	4.52
	70	21.24	3.26	7.92	6.58	4.91
	80	25.57	3.80	8.79	7.68	6.07
	90	30.40	5.87	12.30	9.28	7.75

Table 5.207. Rio Grande City – Precipitation Days Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		32.02	6.81	10.60	7.96	6.65
Std. Deviation		8.40	4.31	5.03	3.69	3.59
Minimum		14	0	3	1	2
Maximum		54	18	29	15	17
Coefficient of Variation		0.27	0.63	0.47	0.46	0.53
Deciles Percentiles	10	21.00	2.00	5.00	2.90	3.00
	20	25.80	3.00	6.80	5.00	3.80
	30	27.00	4.00	8.00	6.00	4.00
	40	29.00	5.00	9.00	6.00	5.00
	50	31.00	5.00	9.00	7.00	6.00
	60	33.40	7.00	10.00	8.40	6.40
	70	36.30	8.30	12.00	10.00	8.00
	80	39.20	12.00	14.20	11.20	10.00
	90	42.40	13.10	18.00	14.00	11.20

Table 5.208. Rio Grande City – Precipitation Intensity [in/day] Descriptive Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	47	48	48	48
	Missing	0	1	0	0	0
Mean		0.66	0.45	0.80	0.75	0.68
Std. Deviation		0.18	0.22	0.37	0.31	0.31
Minimum		0.38	0.20	0.31	0.28	0.23
Maximum		1.42	1.34	2.19	1.66	2.01
Coefficient of Variation		0.27	0.49	0.46	0.41	0.46
Deciles Percentiles	10	0.47	0.23	0.39	0.37	0.36
	20	0.53	0.28	0.48	0.44	0.45
	30	0.56	0.31	0.58	0.56	0.55
	40	0.59	0.34	0.67	0.65	0.59
	50	0.63	0.42	0.75	0.71	0.61
	60	0.68	0.46	0.82	0.81	0.67
	70	0.72	0.50	0.91	0.92	0.76
	80	0.75	0.60	1.07	1.00	0.84
	90	0.86	0.68	1.28	1.13	1.04

Table 5.209. Rio Grande City – Probability Statistics

		Annual	Winter	Fall	Summer	Spring
N	Valid	48	48	48	48	48
	Missing	0	0	0	0	0
Mean		8.77	7.57	11.53	8.75	7.22
Std. Deviation		2.30	4.80	5.48	4.05	3.91
Variance		5.30	22.99	30.00	16.44	15.26
Minimum		3.84	0.00	3.26	1.10	2.17
Maximum		14.79	20.00	31.52	16.48	18.48
Deciles Percentiles	10	5.75	2.22	5.43	3.19	3.26
	20	7.07	3.33	7.39	5.49	4.13
	30	7.40	4.44	8.70	6.59	4.35
	40	7.95	5.56	9.78	6.59	5.43
	50	8.49	5.56	9.78	7.69	6.52
	60	9.15	7.78	10.87	9.23	6.96
	70	9.95	9.22	13.04	10.99	8.70
	80	10.74	13.33	15.43	12.31	10.87
	90	11.62	14.56	19.57	15.38	12.17

Table 5.210. Rio Grande City – Linear Regression Results

Rio Grande City, Texas	Slope Coefficient	Significance	One-Sample Kolmogorov-Smirnov Test	R^2
Total Precipitation				
Annual	0.082	0.055	0.181	.052
Winter	0.013	0.235	0.285	.020
Fall	0.050	0.065	0.038	.048
Summer	0.018	0.327	0.168	.014
Spring	0.0002	0.990	0.124	.000
Precipitation Days				
Annual	-0.054	0.542	0.922	.008
Winter	-0.042	0.35	0.320	.019
Fall	-0.035	0.506	0.081	.010
Summer	0.022	0.557	0.620	.008
Spring	0.011	0.768	0.245	.022
Precipitation Intensity				
Annual	0.001	0.366	0.510	.018
Winter	0.004	0.070	0.548	.071
Fall	0.001	0.615	0.719	.006
Summer	0.001	0.860	0.708	.001
Spring	-0.002	0.464	0.140	.012

Summary for the South Region

Most precipitation, days with precipitation, and precipitation intensity occur during the fall months. A majority of the stations showed the least amount of variability during the fall months for precipitation and days with precipitation. High variability occurred during the winter months for precipitation and days with precipitation. The highest probability of a rain day was in 12.87% for Beeville. Most stations resulted in a positive skew for precipitation, precipitation days, and precipitation intensity. Median values fell less than the mean except for summer precipitation days and summer precipitation intensity for Eagle Pass; fall precipitation days for Encinal; annual precipitation and summer precipitation days for Beeville; annual precipitation days for Alice; and annual and summer precipitation days and annual precipitation intensity for Corpus Christi.

Total precipitation, precipitation days, and precipitation intensity annually and seasonally were grouped into equal frequency deciles. For the given stations, the bottom deciles included the 10% of events with the lowest values, while the top deciles include the 10 % of events with the greatest value. Rio Grande City resulted in the lowest value for precipitation with 10% of the years not exceeding 11.99 inches of precipitation. Encinal resulted in the lowest values for precipitation days with 10% of the years not exceeding 17 days of precipitation and Eagle Pass with 0.46 inch of precipitation per day. For Beeville, 10% of the years on record exceeded 43.26 inches of precipitation and 60.10 days of precipitation. Results also showed that 10% of the years exceeded 1.11 inches of precipitation per day for Encinal.

There is a statistically significant increase in annual precipitation for Corpus Christi. Encinal and Alice resulted in a decrease in annual precipitation days, while Encinal and Beeville resulted in a decrease in winter precipitation days. Encinal, Beeville, and Alice resulted in a decrease in fall precipitation days. Eagle Pass resulted in a decrease in annual precipitation intensity, while Encinal and Alice resulted in an increase in annual precipitation intensity. Alice resulted in an increase in fall precipitation intensity, while Eagle Pass showed a decrease in spring precipitation intensity.

CHAPTER 6

DISCUSSION OF TRENDS

The purpose of this study was to identify trends in annual and seasonal precipitation at 42 weather stations in Texas to determine if areas around the state are becoming increasingly wet or dry. This chapter presents a discussion of the results from chapter five using a series of maps for annual and seasonal precipitation, precipitation days, precipitation intensity, probability of a rain day, and precipitation variability. The maps were developed using the ArcMap program and illustrate the significant decadal trends. Numeric values indicated on the map depict whether trends are increasing or decreasing at the stations. Stations that do not have values on the maps imply that no trend exists during the period of record. The probability maps illustrate the probability that any day will receive precipitation. A table indicating trends in precipitation, precipitation days, and precipitation intensity are presented in Table 6.1 for all stations annually and seasonally.

Annual

Figures 6.1, 6.2, and 6.3 show the linear regression results for annual total precipitation, precipitation days and precipitation intensity over the reference period 1932 – 2002. Overall, linear regression results suggest there has been a positive trend in annual total precipitation for several stations in the eastern half of the state, with no change for stations in the western half. An increase in precipitation days was found for one station in southeast Texas, and a decrease in the number of days for two stations in south Texas. There were no significant trends in precipitation days for the rest of the stations in the state. Changes in the amount of total precipitation can be caused directly by changes in the number of precipitation events, by the amount of precipitation occurring in each event, or a combination of both. The effects are a result of the sequence of synoptic conditions influencing the particular area (Robinson 2007).

Annual precipitation intensity increased for several stations in the eastern half of the state, while a decrease was found for only one station (i.e. Eagle Pass) in the south region of the state. There were no changes in precipitation intensity for stations in the Panhandle. Ft. Stockton was the only station in west Texas that showed an increase in precipitation intensity, while there were no changes in total precipitation or days with precipitation. In general, positive trends in annual precipitation and precipitation intensity resulted largely for stations in the eastern half of the state. Interestingly, Danevang is the only station in the southeast that is increasing in both annual total precipitation and the number of days with precipitation. Located near the Gulf of Mexico, Danevang is subjected to tropical activity during the late spring to fall months, as well as air mass (convective) thunderstorms, and frontal storms in the cooler months (Bomar 1999). The results suggest that precipitation from these events are occurring more frequently given that Danevang has shown an increase in 2.01 days with precipitation, and 1.64 inches of precipitation per decade during the period of record. Liberty, located in southeast Texas resulted both in an increase in annual precipitation intensity and annual total precipitation. This station is receiving greater precipitation and more precipitation despite no change in the number of days with precipitation. Precipitation associated with a slow-moving upper atmospheric storm system or the remains of a stalled tropical storm system can create an increase in total precipitation and intensity. In addition, when warm, moist Gulf air is fed into a stalled large-scale weather system, heavy or intense precipitation can result as well (Bomar 1999). While both Alice and Encinal in south Texas are decreasing in annual precipitation days, results reveal that there is no change in total precipitation. However, there is an increase in precipitation intensity at these stations. The stations are receiving more precipitation on days that it does rain. The neighboring station in Corpus Christi shows an increase in total precipitation but no statistically significant change in the number of days or precipitation intensity for the period of record.

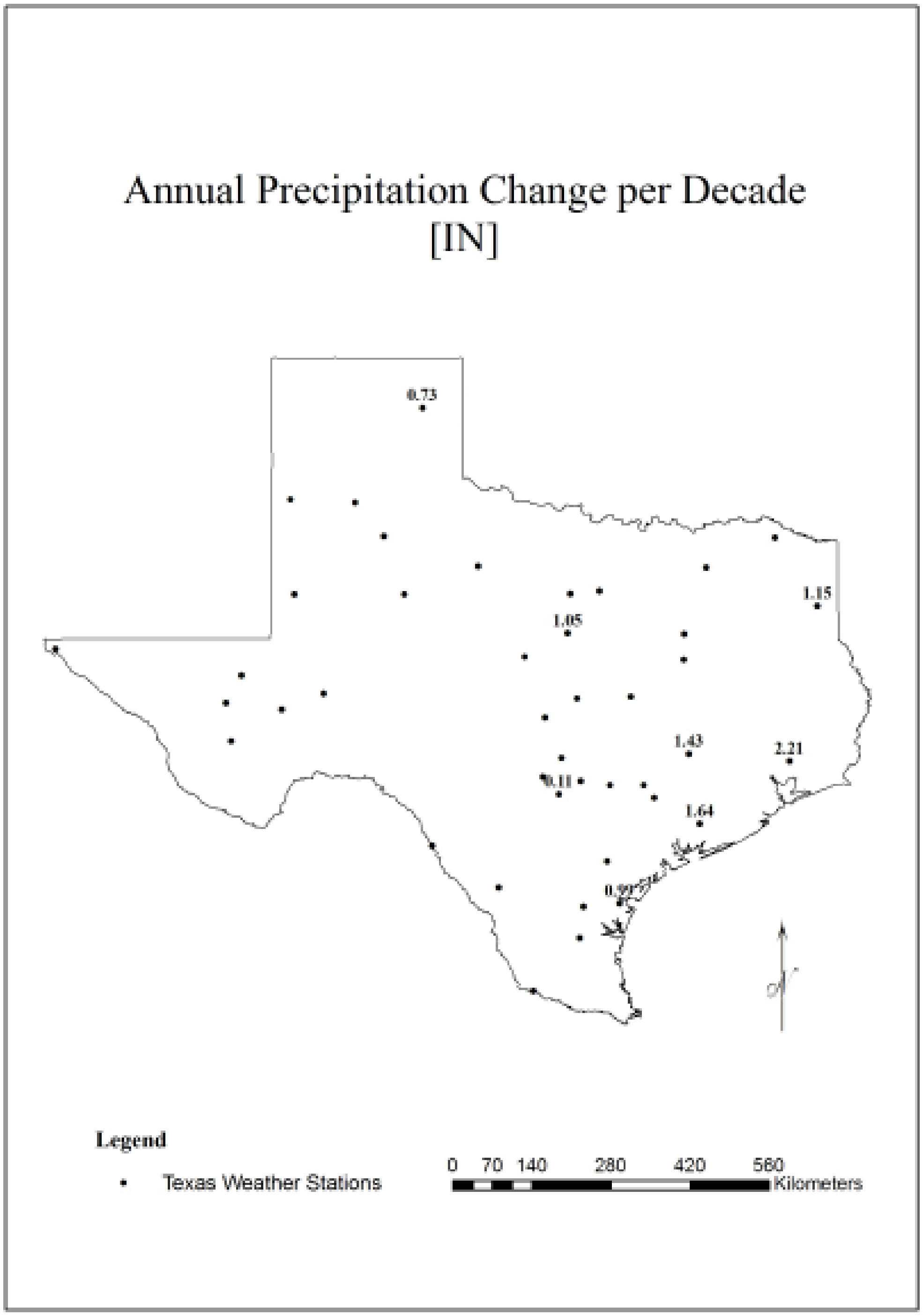


Figure 6.1. Annual Precipitation, Change per Decade, 1932 - 2002

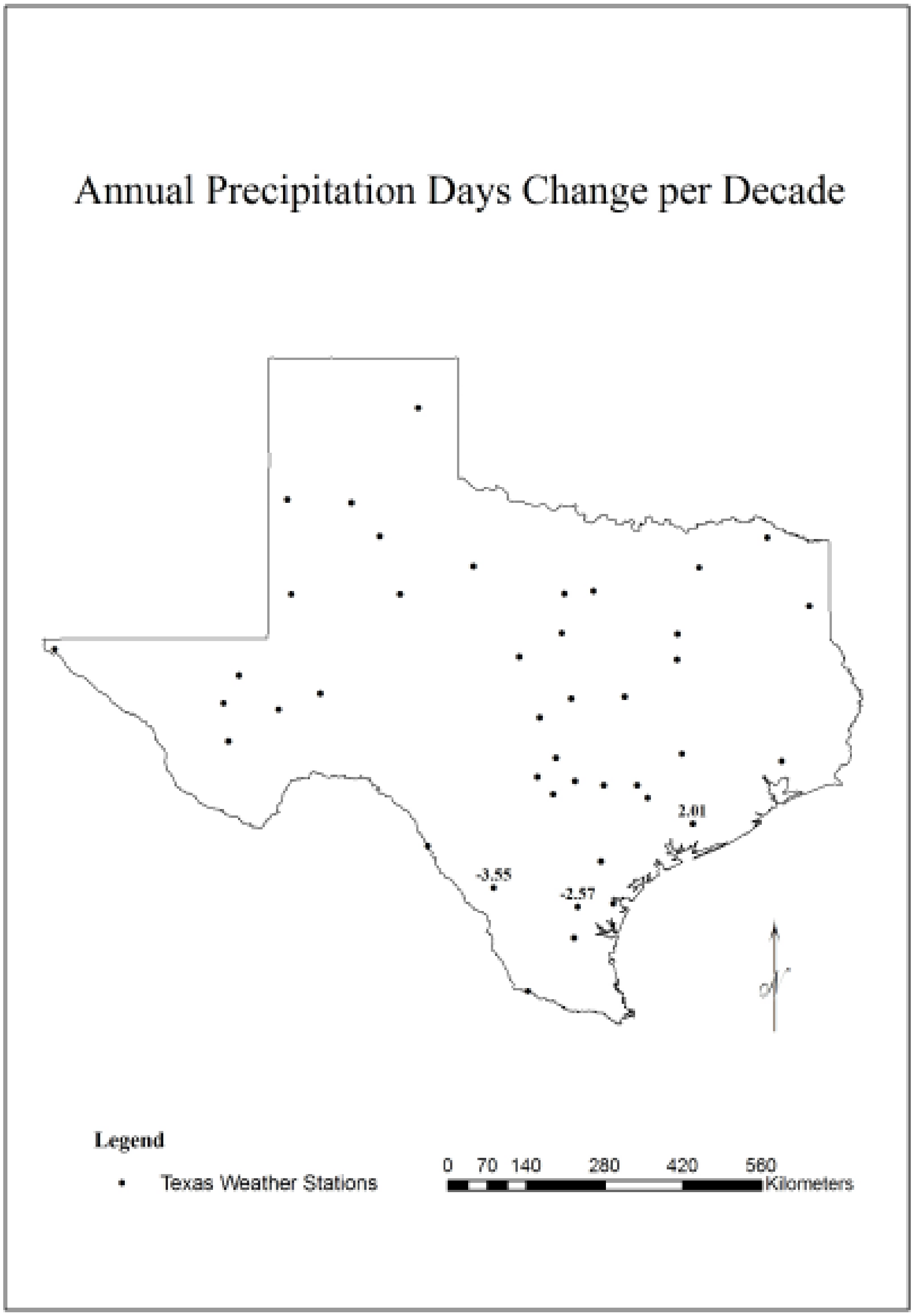


Figure 6.2. Annual Precipitation Days Change per Decade, 1932 - 2002

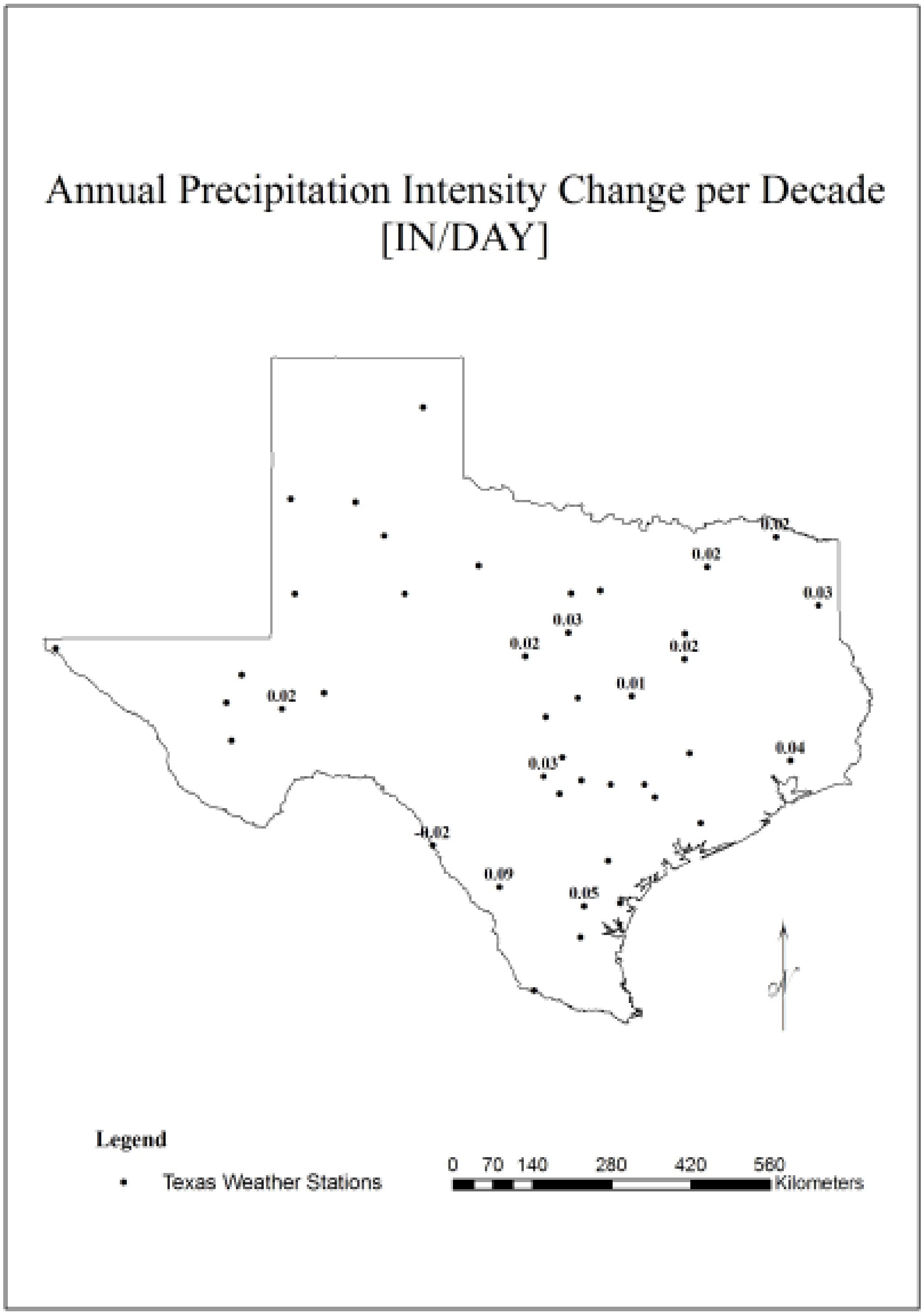


Figure 6.3. Annual Precipitation Intensity Change per Decade, 1932 - 2002

Spring

Figures 6.4, 6.5, and 6.6 show the linear regression results for spring total precipitation, precipitation days, and precipitation intensity over the reference period 1932 – 2002. There were no significant trends found for total precipitation or precipitation days for the spring months. Two significant trends were found for precipitation intensity. An increase in spring precipitation intensity resulted for the Brownwood station in north central Texas, while a decrease in precipitation intensity occurred for the Eagle Pass station in South Texas. The Brownwood station is subjected to contrasting air masses associated with frontal activity during the spring months, which can produce higher amounts of rainfall in short periods of time.

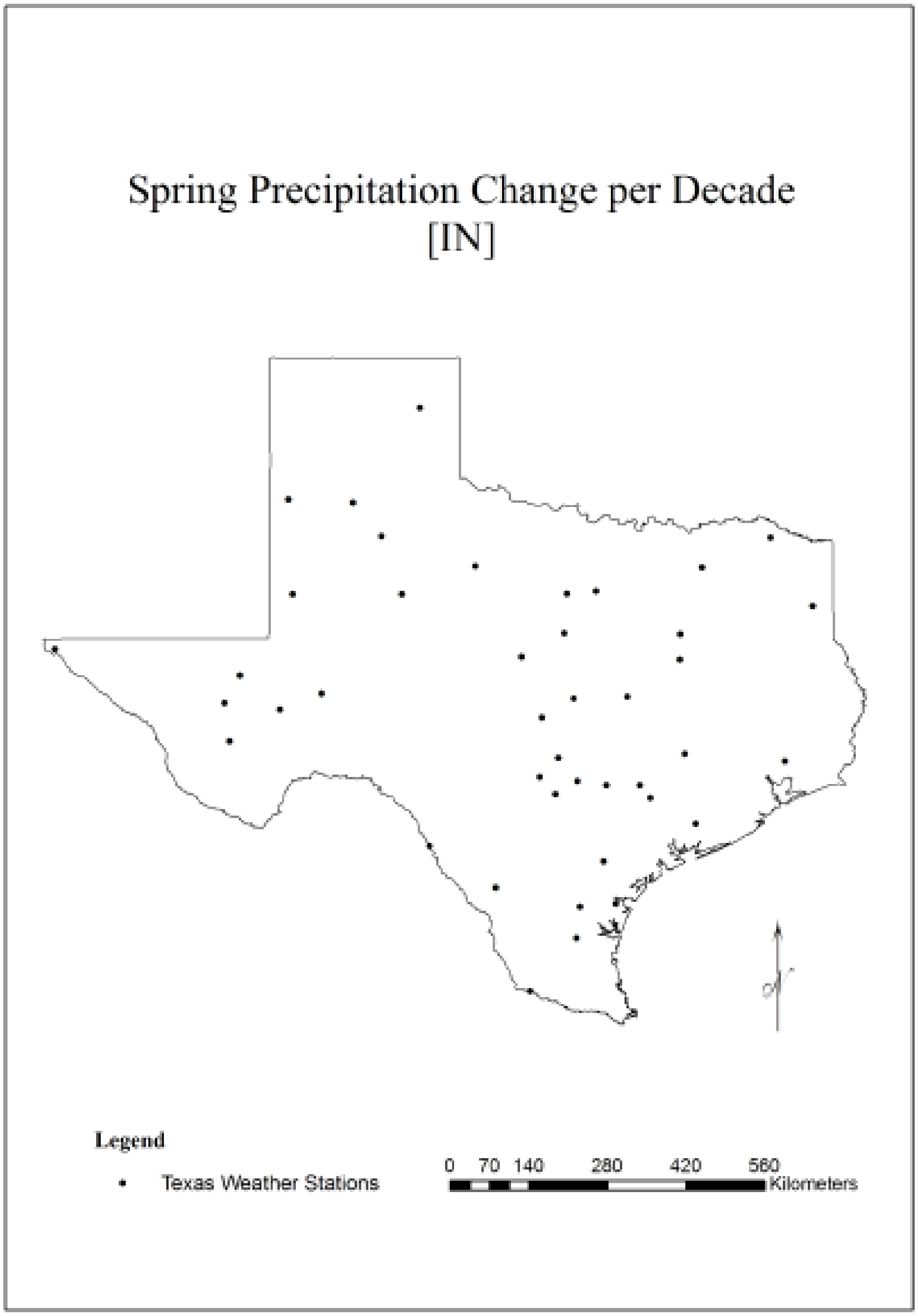


Figure 6.4. Spring Precipitation Change per Decade, 1932 - 2002

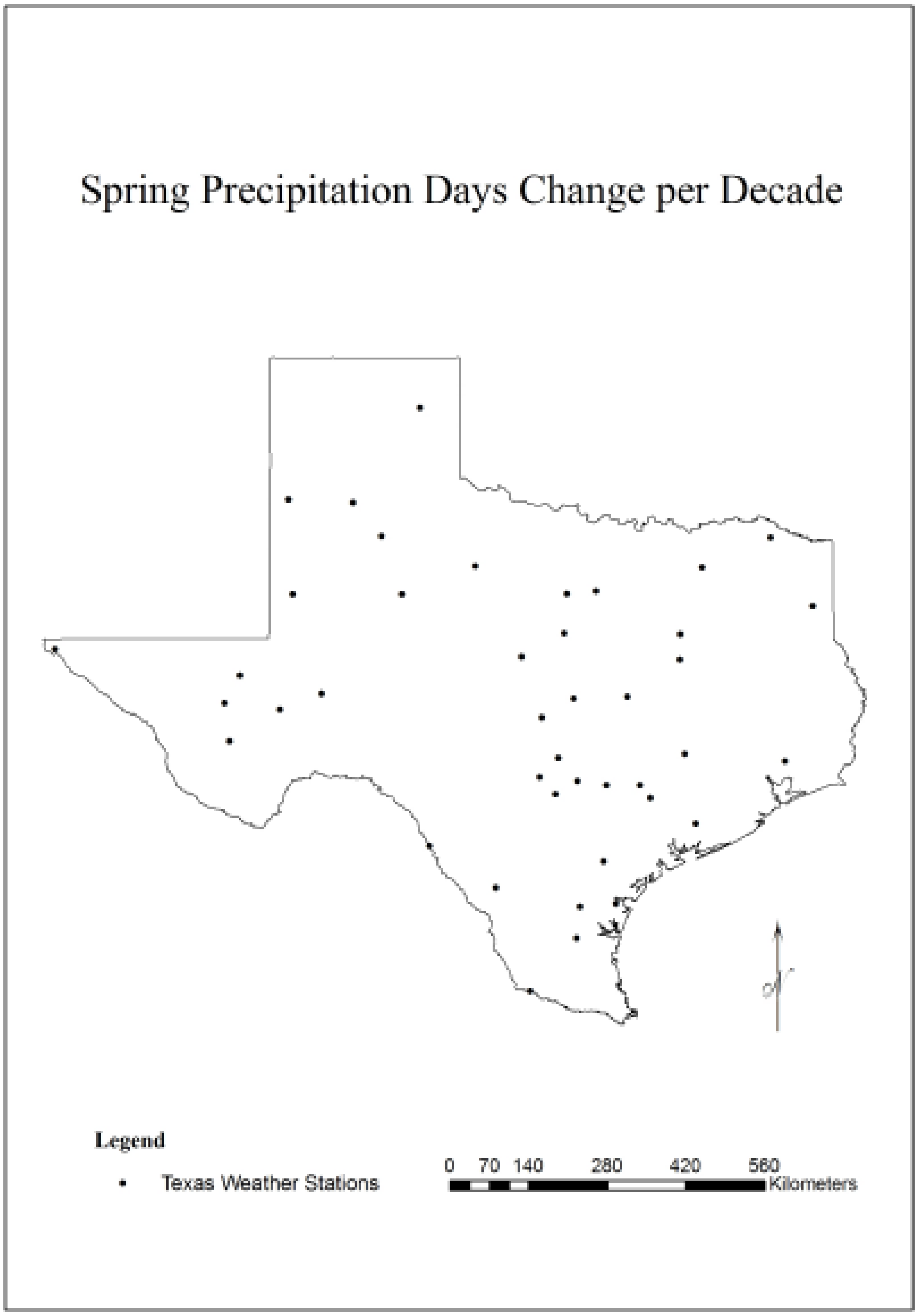


Figure 6.5. Spring Precipitation Days Change per Decade, 1932 - 2002

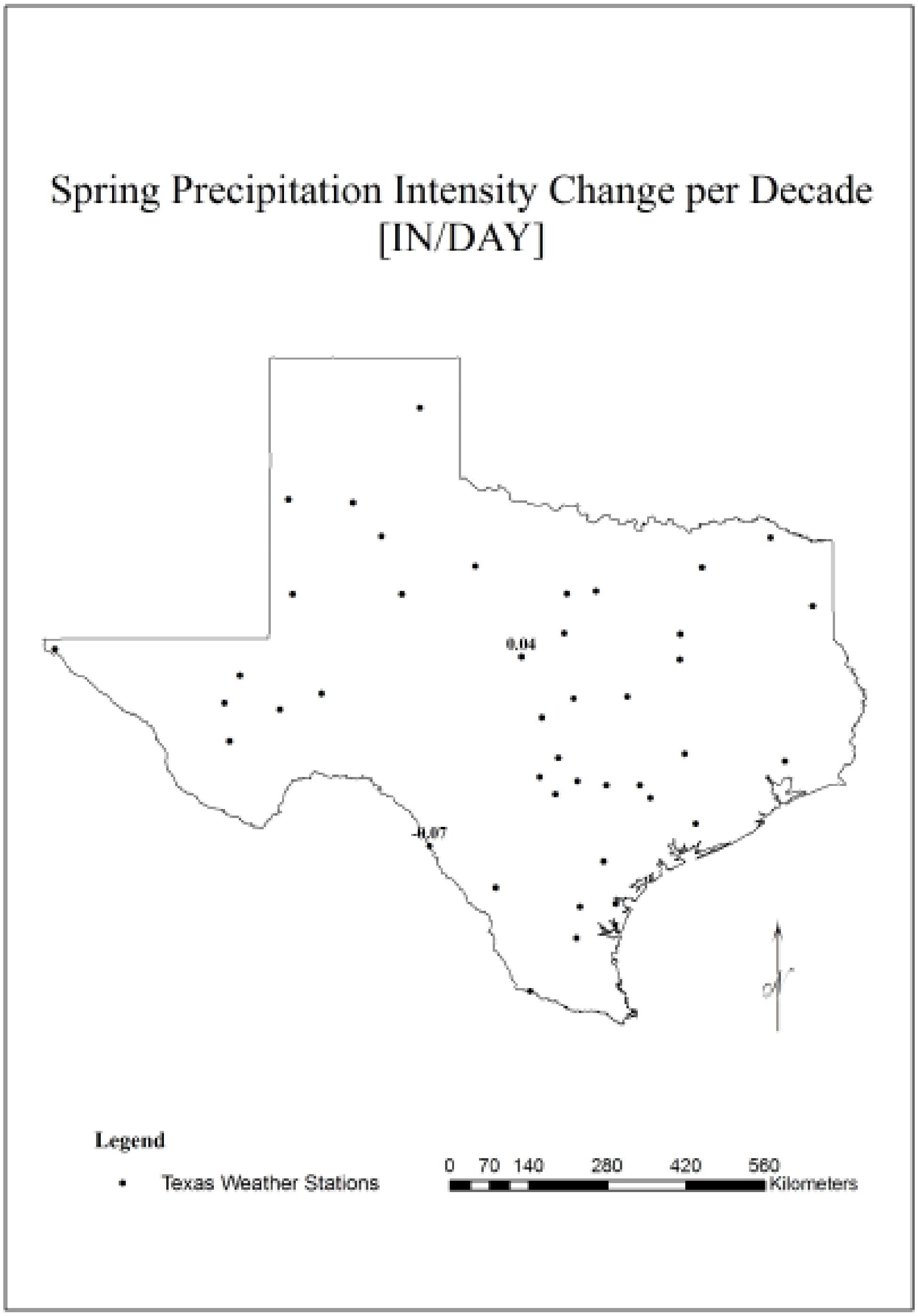


Figure 6.6. Spring Precipitation Intensity Change per Decade, 1932 – 2002

Summer

Figures 6.7, 6.8, and 6.9 show the linear regression results for summer total precipitation, precipitation days, and precipitation intensity over the reference period 1932 – 2002. An increase in summer precipitation resulted for the station in Dublin in north central Texas, while no other changes occurred for the rest of the state. Precipitation days increased for the station in McCamey in west Texas, and the station in San Antonio in Central Texas. Summer precipitation intensity increased for five stations in north central, northeast, and central Texas. Convective storms are common during the summer months, which may be a contributing factor to the positive trend in precipitation intensity. Dublin was the only weather station that resulted in an increase in both summer total precipitation and precipitation intensity. Dublin is receiving more precipitation on days that it does rain during the summer months.

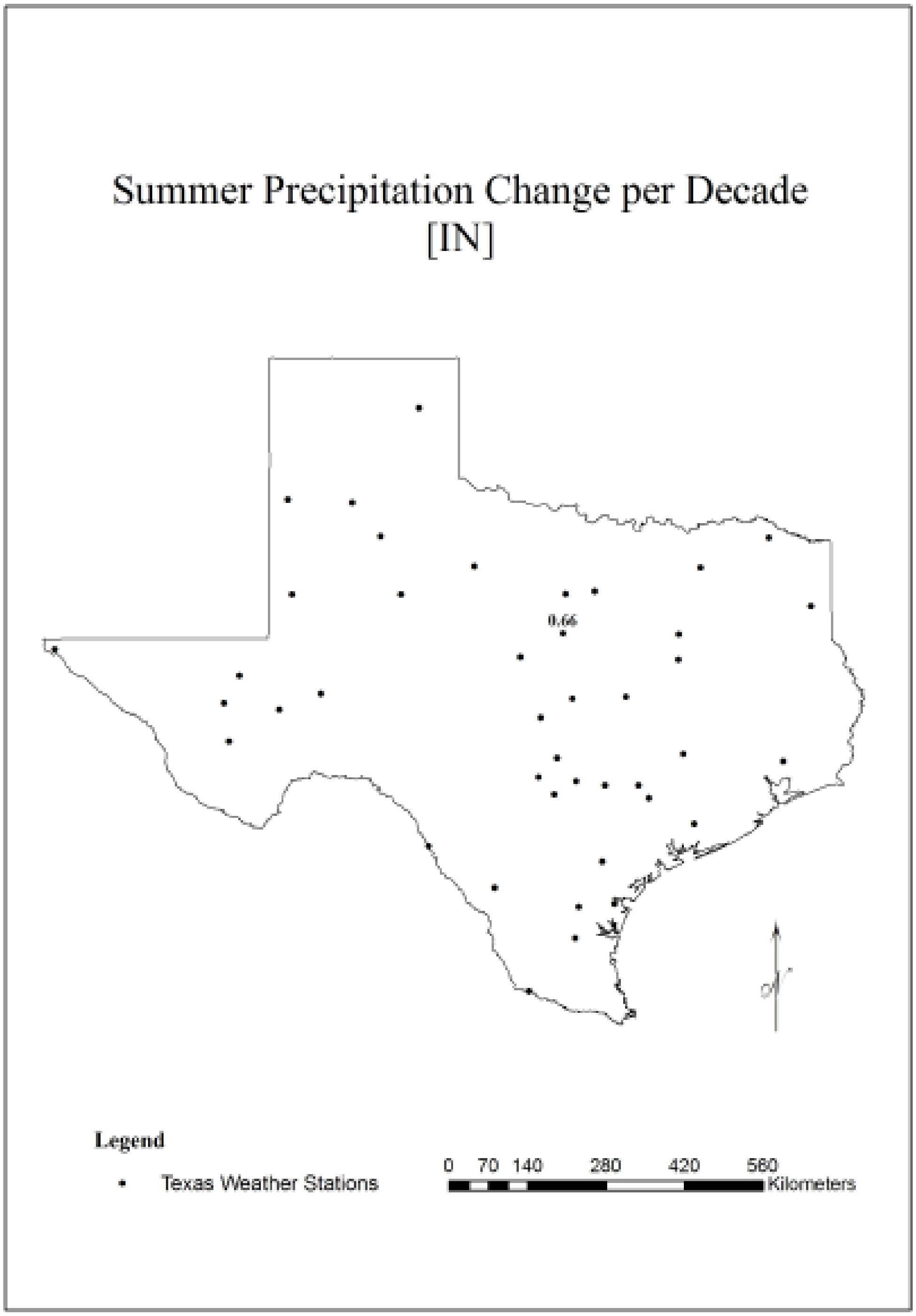


Figure 6.7. Summer Precipitation Change per Decade, 1932 - 2002

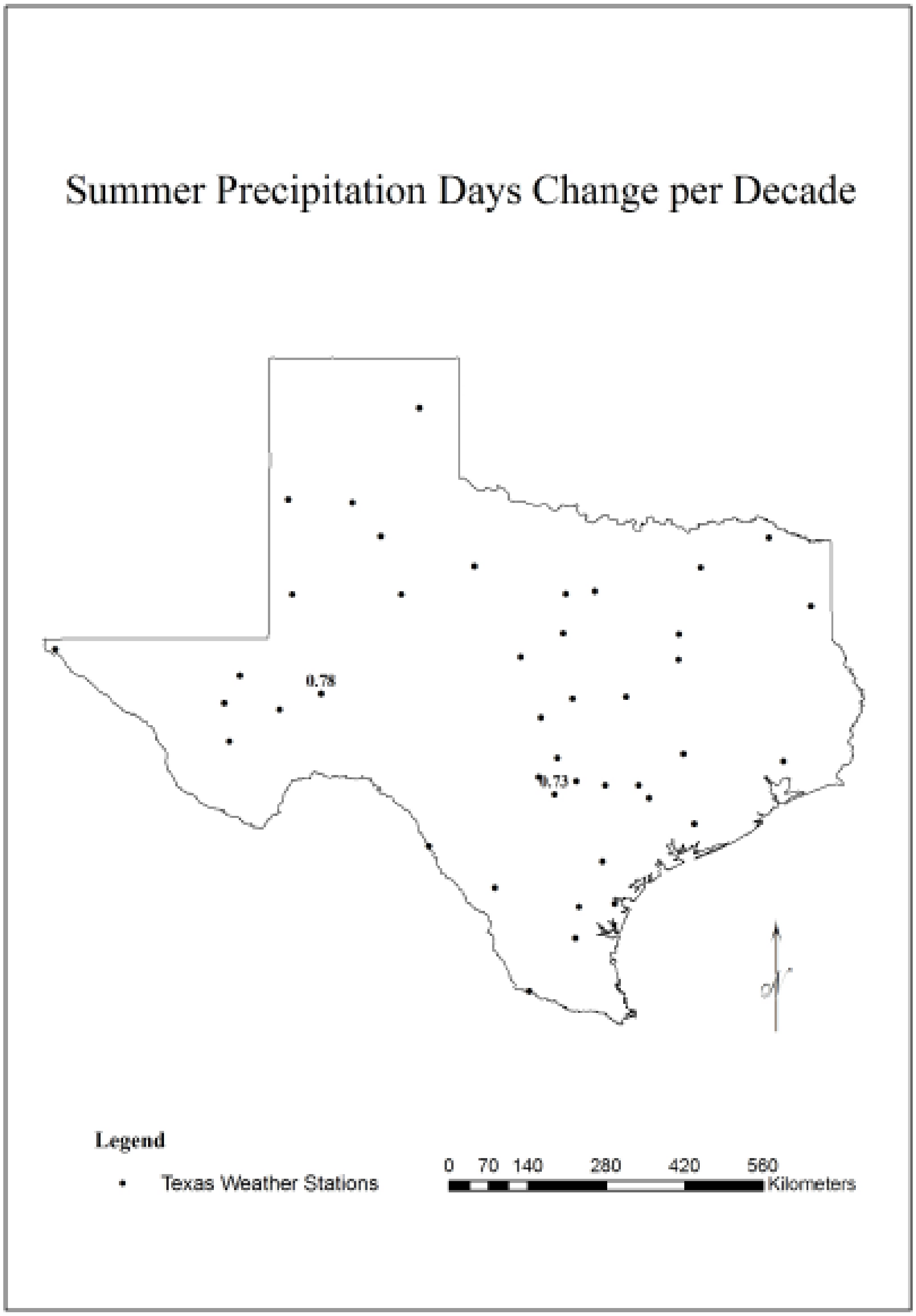


Figure 6.8. Summer Precipitation Days Change per Decade, 1932 - 2002

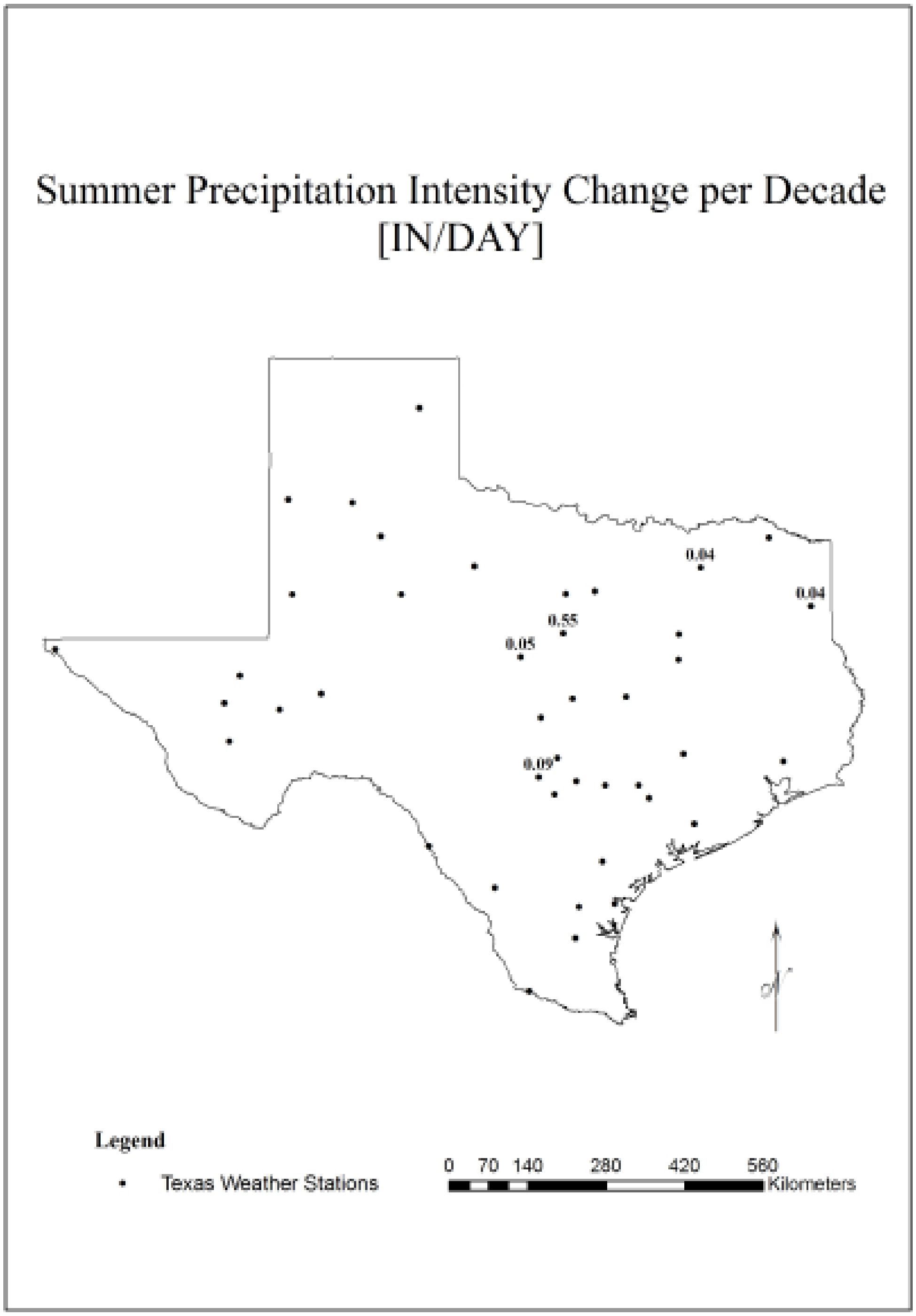


Figure 6.9. Summer Precipitation Intensity Change per Decade, 1932 - 2002

Fall

Figures 6.10, 6.11, and 6.12 show the linear regression results for fall total precipitation, precipitation days, and precipitation intensity over the reference period 1932 – 2002. An increase in fall precipitation was significant for stations in the eastern half of the state, while no changes resulted for stations in the south, the west, and the northern-most regions of the state. The number of days with fall precipitation decreased for Encinal in south Texas, but stayed the same for total precipitation. Encinal is receiving more precipitation on days that it does rain during the fall months. Fall precipitation intensity increased for the station in Boerne in central Texas, and Alice in south Texas, but decreased in Haskell in north central Texas. Boerne was the only station that showed both an increase in fall precipitation and precipitation intensity for the period of record. This trend indicates that this station is receiving more precipitation on days that it does rain. A contributing factor is due to frontal and tropical activity common to the region during the fall months. Orographic enhancement of precipitation from the Balcones Escarpment may also be a factor for an increase in precipitation and precipitation intensity for the station in Boerne.

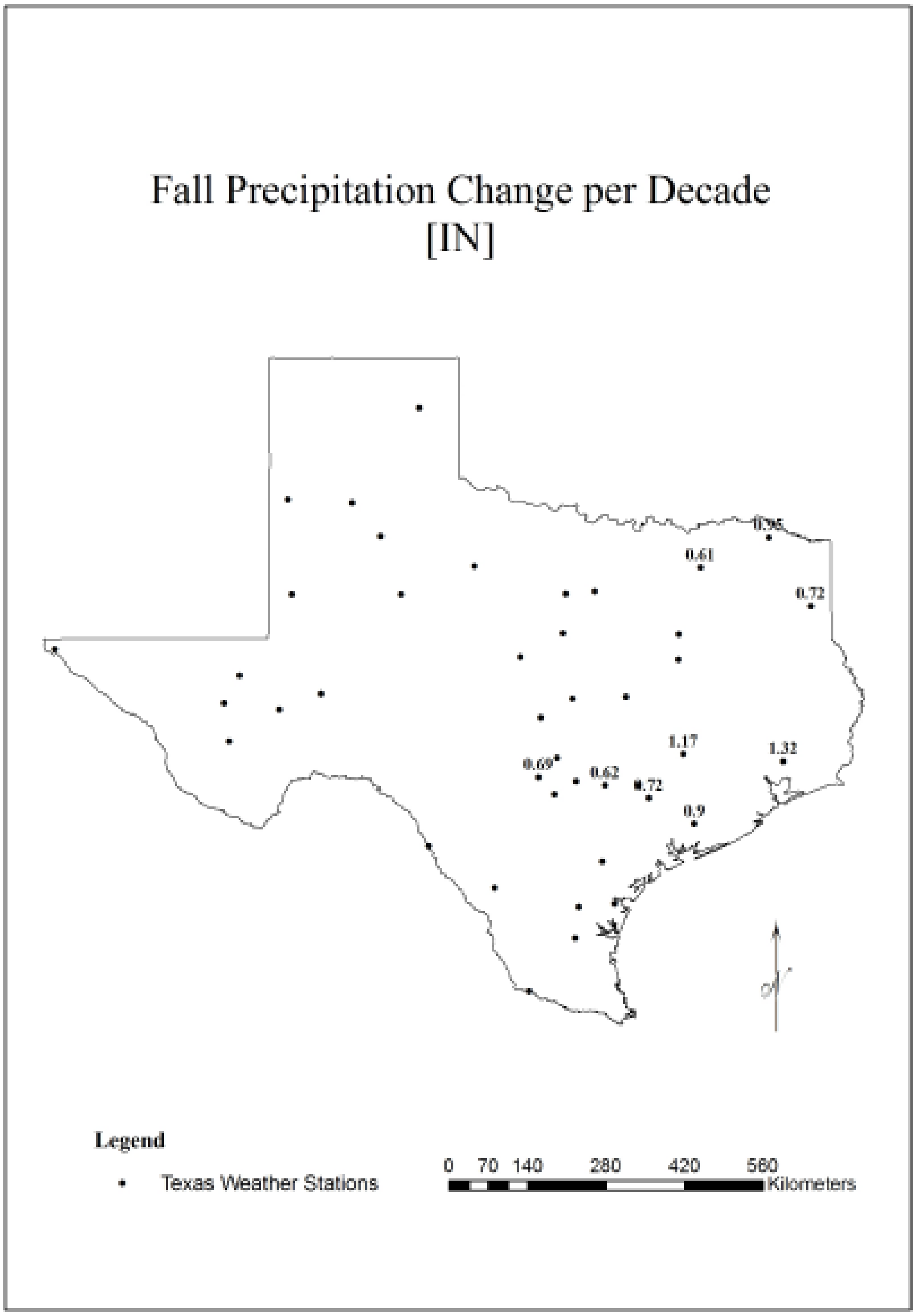


Figure 6.10. Fall Precipitation Change per Decade, 1932 - 2002

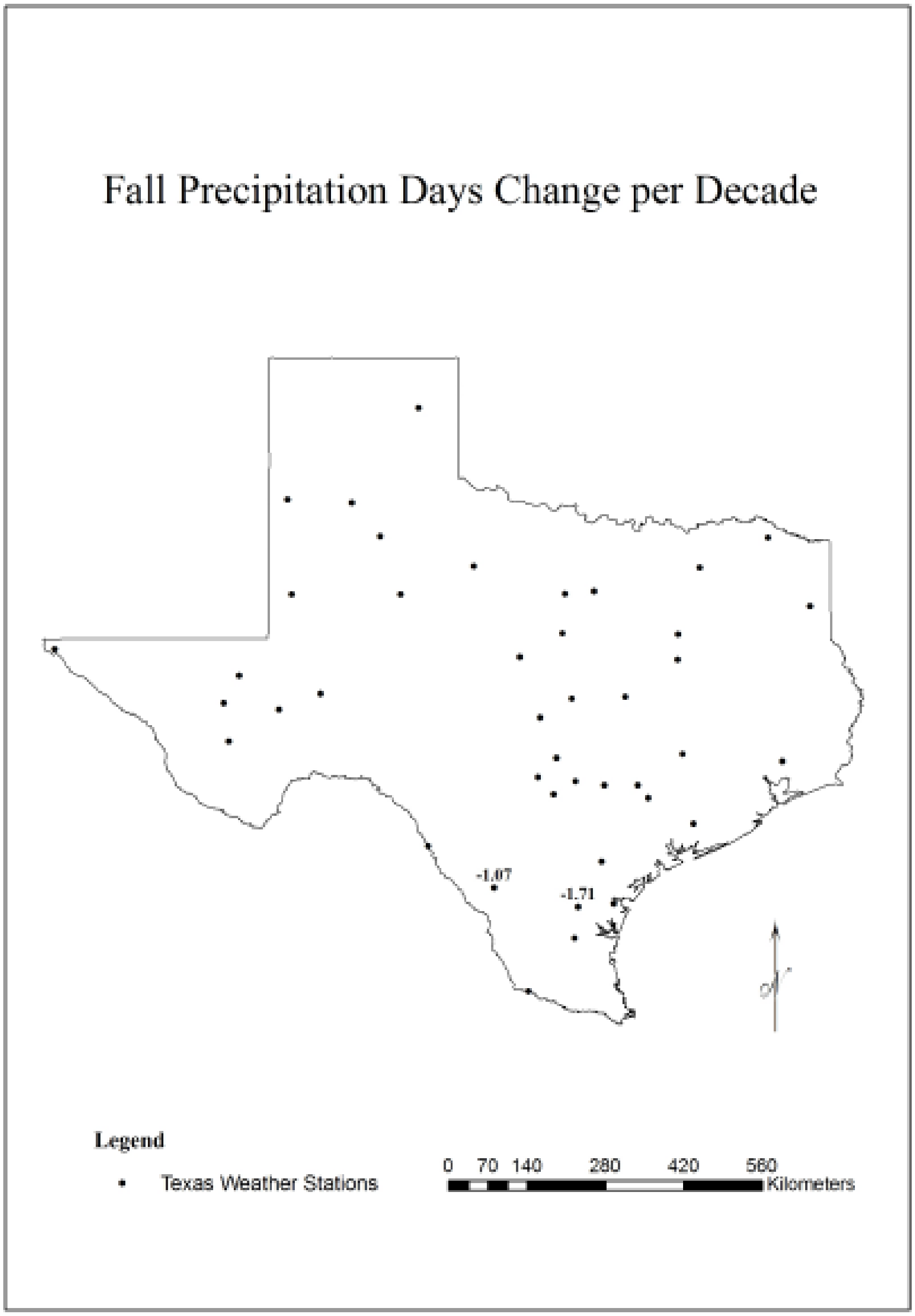


Figure 6.11. Fall Precipitation Days Change per Decade, 1932 - 2002

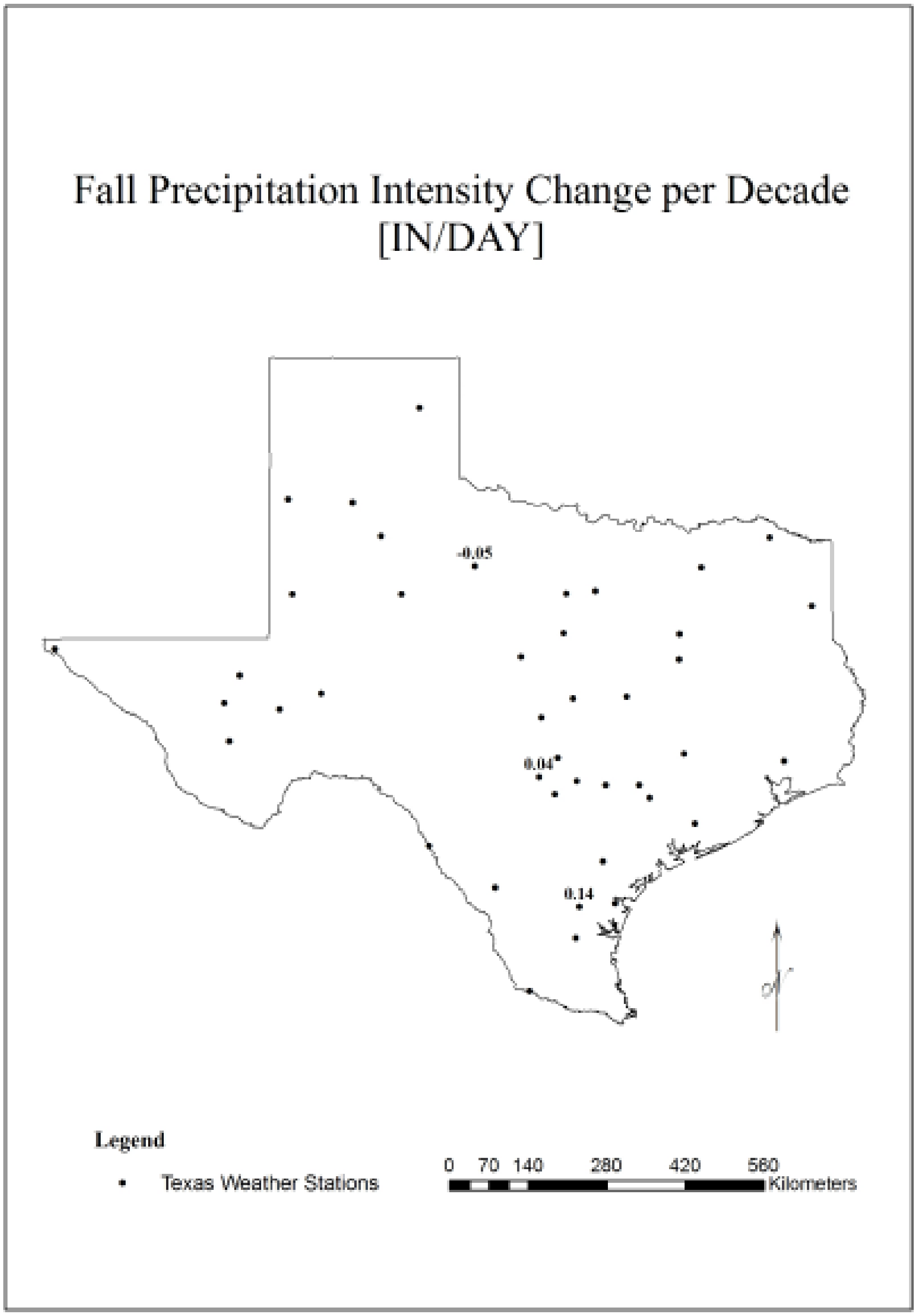


Figure 6.12. Fall Precipitation Intensity Change per Decade, 1932 - 2002

Winter

Figures 6.13. 6.14, and 6.15 show the linear regression results for winter total precipitation, precipitation days, and precipitation intensity over the reference period 1932 – 2002. For the winter months, a decrease in precipitation days occurred for the station in Encinal in south Texas, while no other changes were noted for the rest of the state during the winter months. Winter precipitation intensity increased for stations in the northeast, north central, the Panhandle, and southeast regions of the state. This trend indicates that more precipitation is occurring per event although the number of days is staying the same. No trends were noted for precipitation intensity for the south and western regions of the state. Frontal activity is the dominant weather phenomenon in Texas during the winter months and may be a factor for the increase in precipitation intensity.

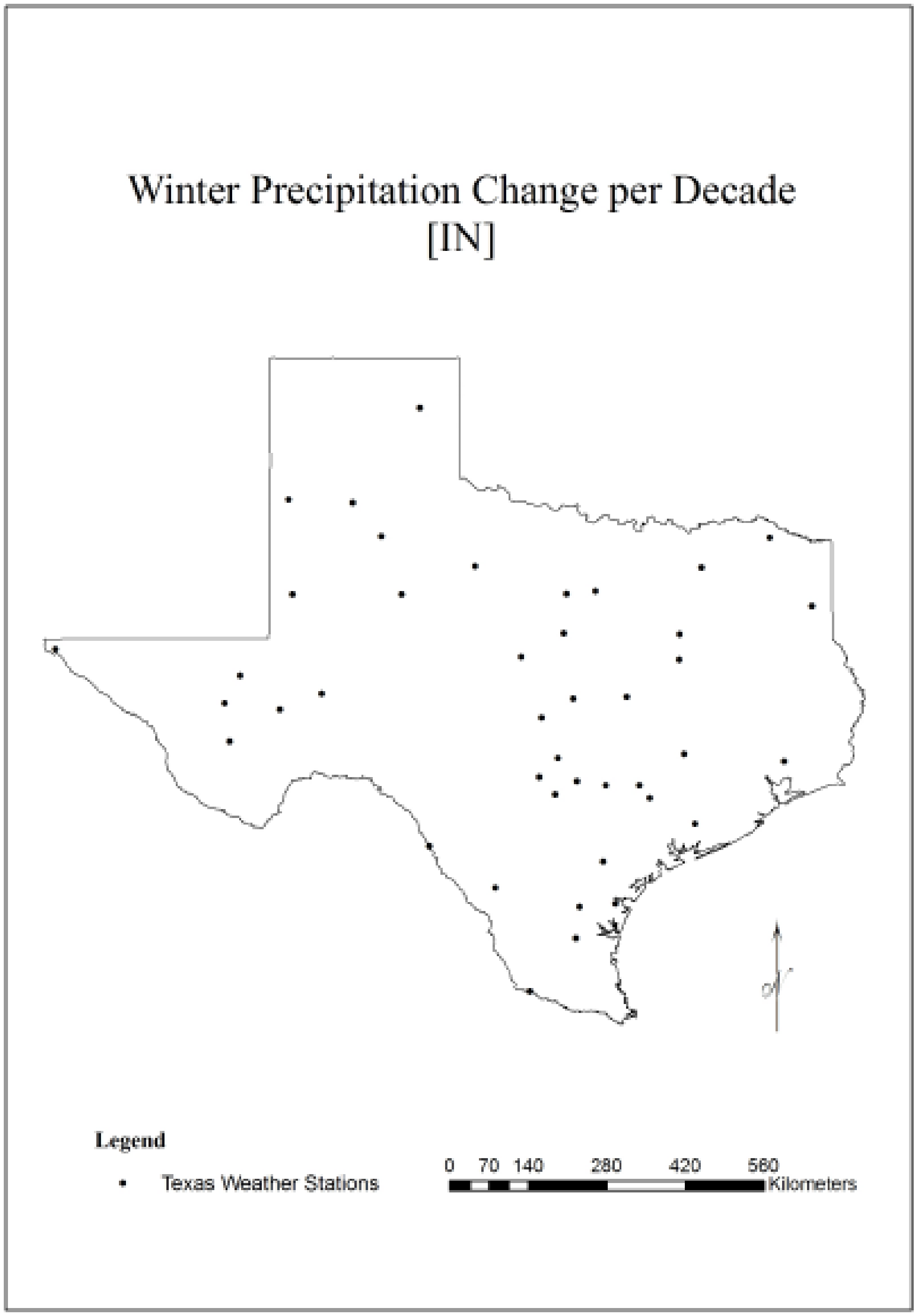


Figure 6.13. Winter Precipitation Change per Decade, 1932 - 2002

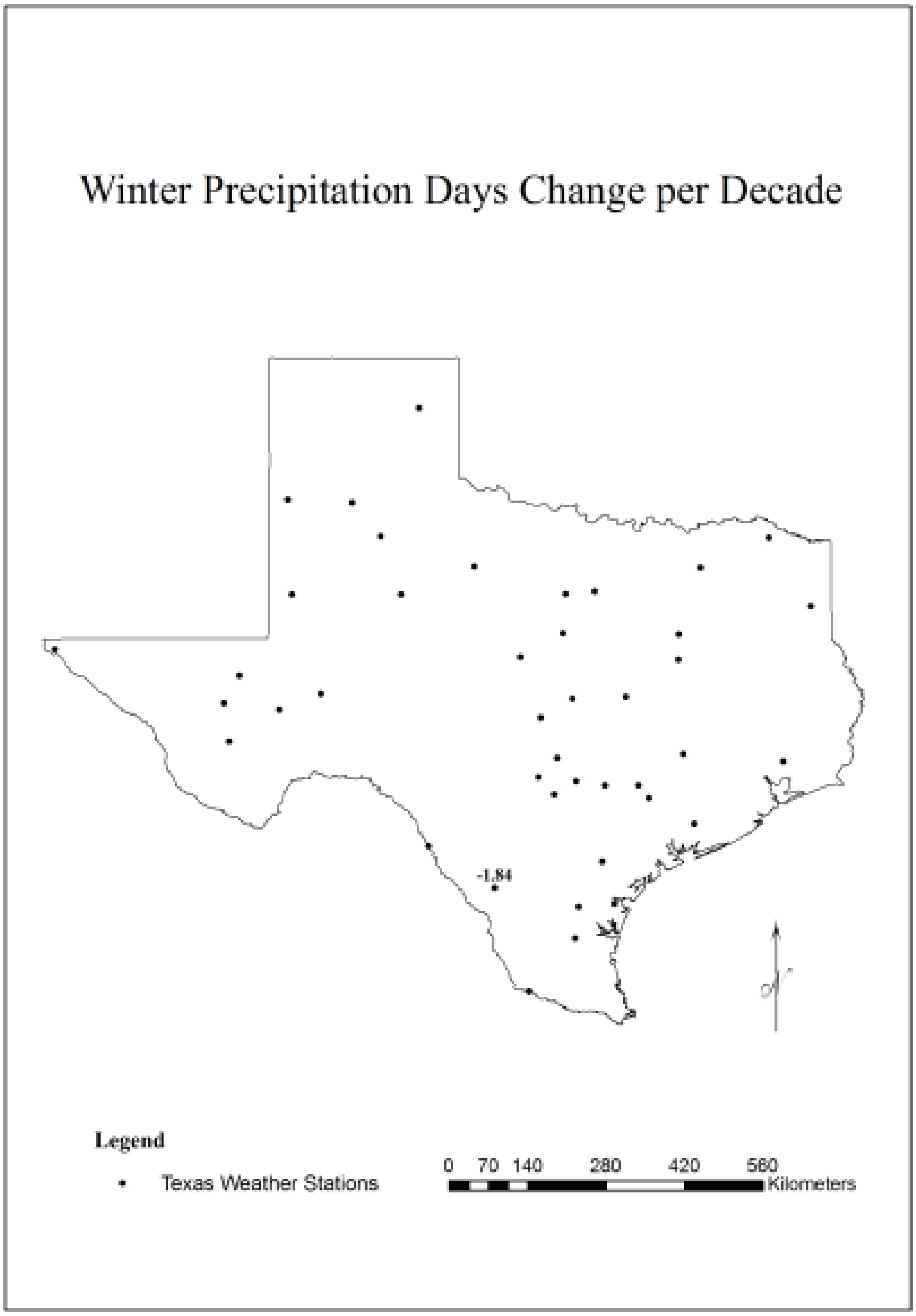


Figure 6.14. Winter Precipitation Days Change per Decade, 1932 - 2002

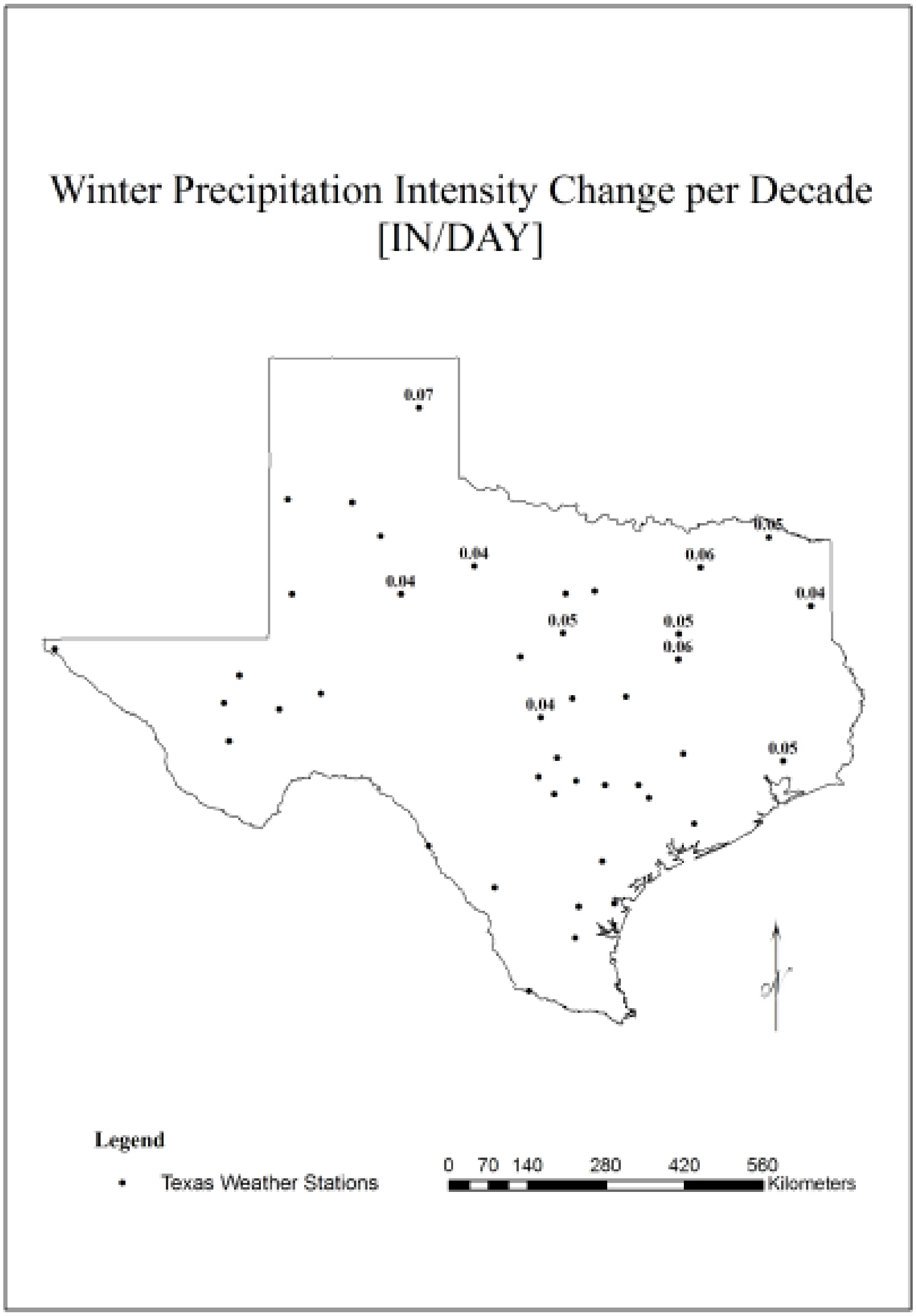


Figure 6.15. Winter Precipitation Intensity Change per Decade, 1932 - 2002

Probability

Figures 6.16, 6.17, 6.18, 6.19, and 6.20 show the annual and seasonal probability of a day with precipitation over the reference period 1932 – 2002. Annual probability of a day with precipitation was highest in the east and lowest in the west. This makes sense because climatologically, the eastern section of the state receives higher amounts of precipitation annually than locations in the western section of the state. Spring probability statistics reveal higher values in northeast Texas and lower values in the south and west. Precipitation associated with frontal activity is common in the northeast during the spring months, which could be a contributing factor to the higher probability values in this region as opposed to the west and southern reaches of the state. Summer probability statistics reveal higher values overall for stations in southeast Texas during the summer months. Probability values for the rest of the state are fairly uniform with south Texas having the lowest values. Summer precipitation in Texas, except for west Texas, is often dictated by the degree of activity or inactivity of tropical weather systems in the Gulf of Mexico (Bomar 1999). Higher probability values for stations in southeast Texas is related to persistent flow from the Gulf of Mexico that is common to this region during the summer months.

Fall probability statistics reveal higher values for days with fall precipitation for stations in southeast Texas, and lower values for stations in the west Texas. During the fall months, the North American monsoon rains typically do not influence west Texas past the month of September. The higher probability values for the southeast stations may be associated with tropical activity from the Gulf of Mexico that is common during the fall months. Winter probability statistics reveal high values in the southeast and northeast regions, and low values in the west. Again, frontal activity may be associated with the higher probability values in the southeast and northeast regions of the state.

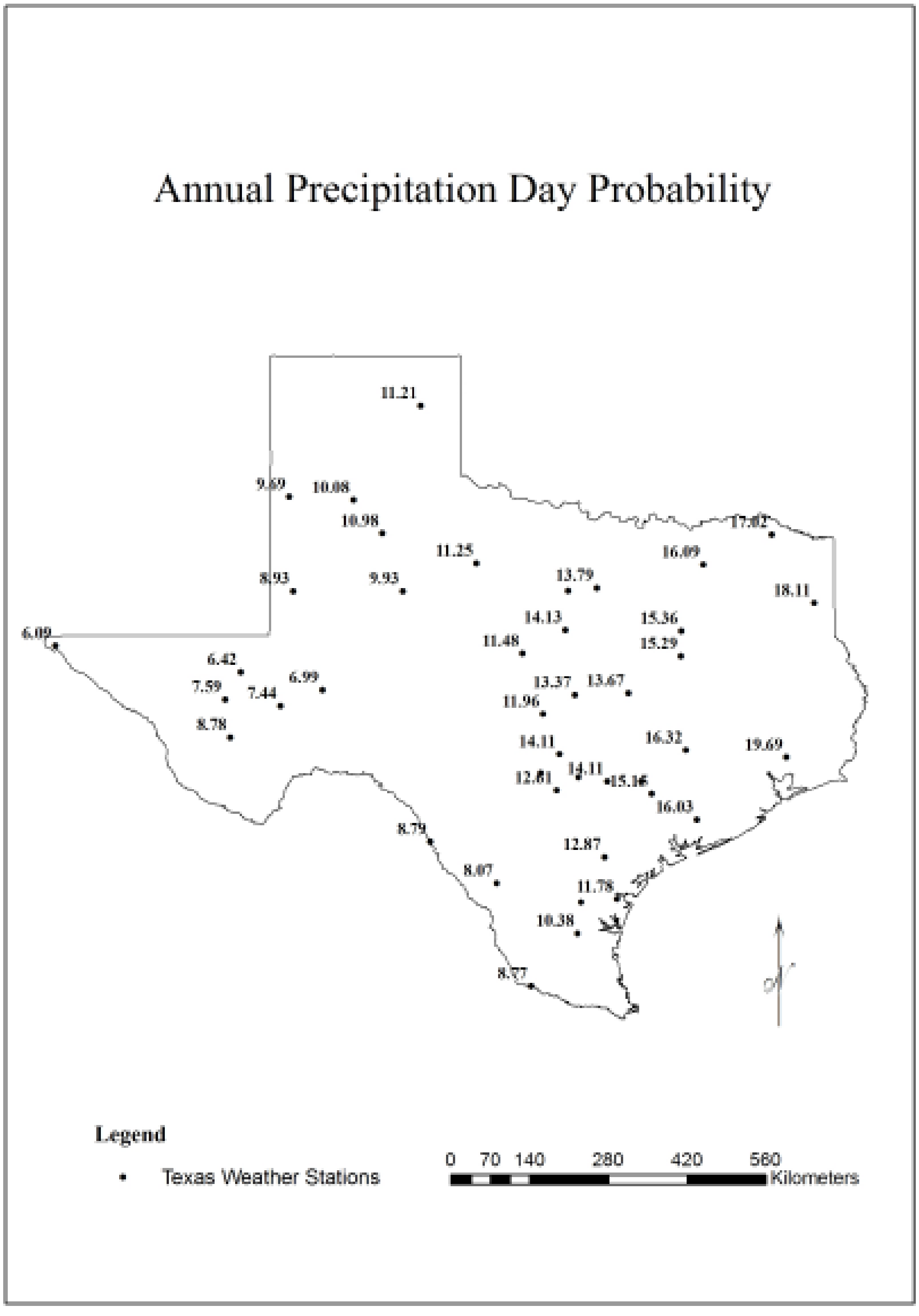


Figure 6.16. Annual Probability of a Day with Precipitation, 1932 - 2002

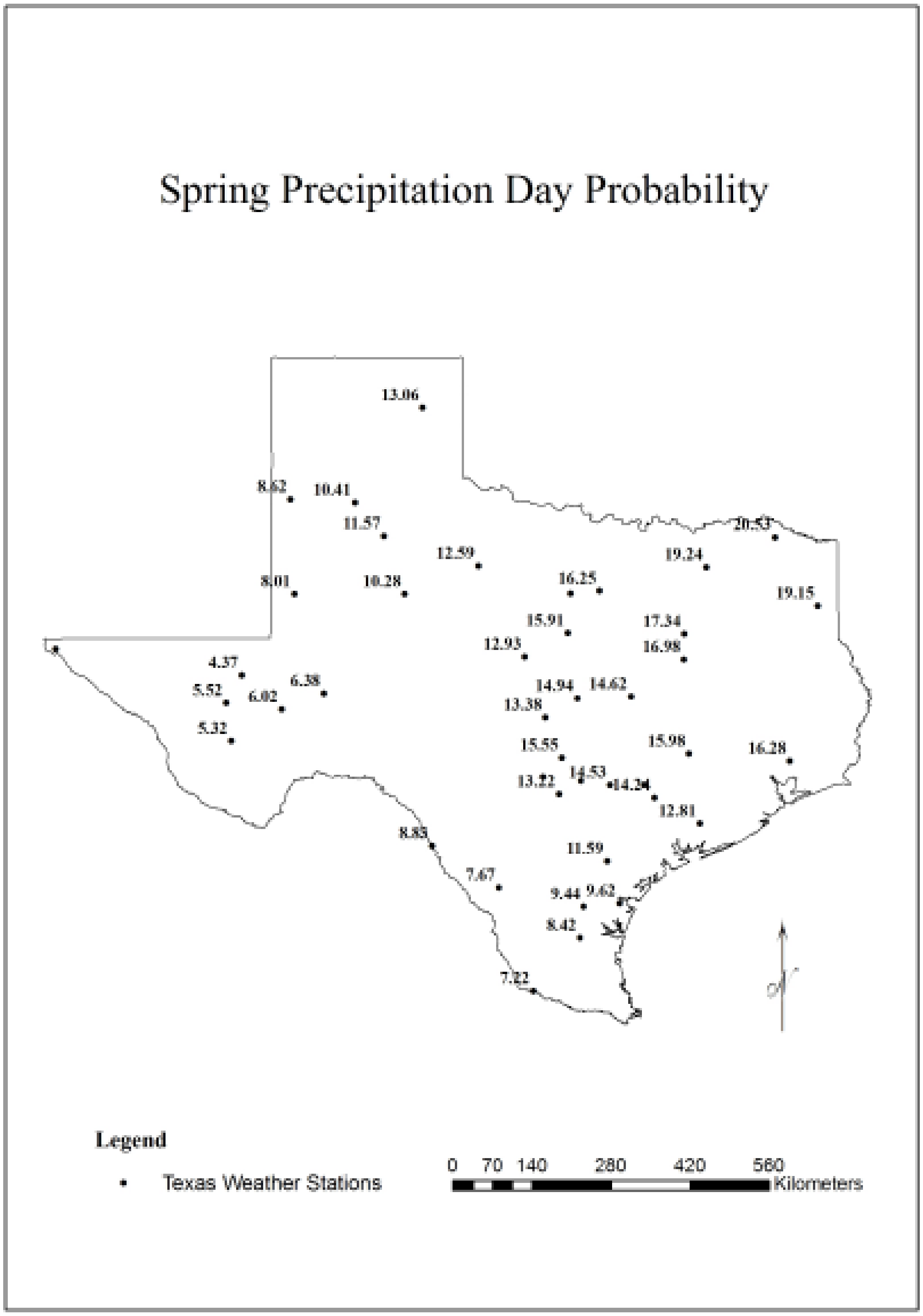


Figure 6.17. Spring Probability of a Day with Precipitation, 1932 - 2002

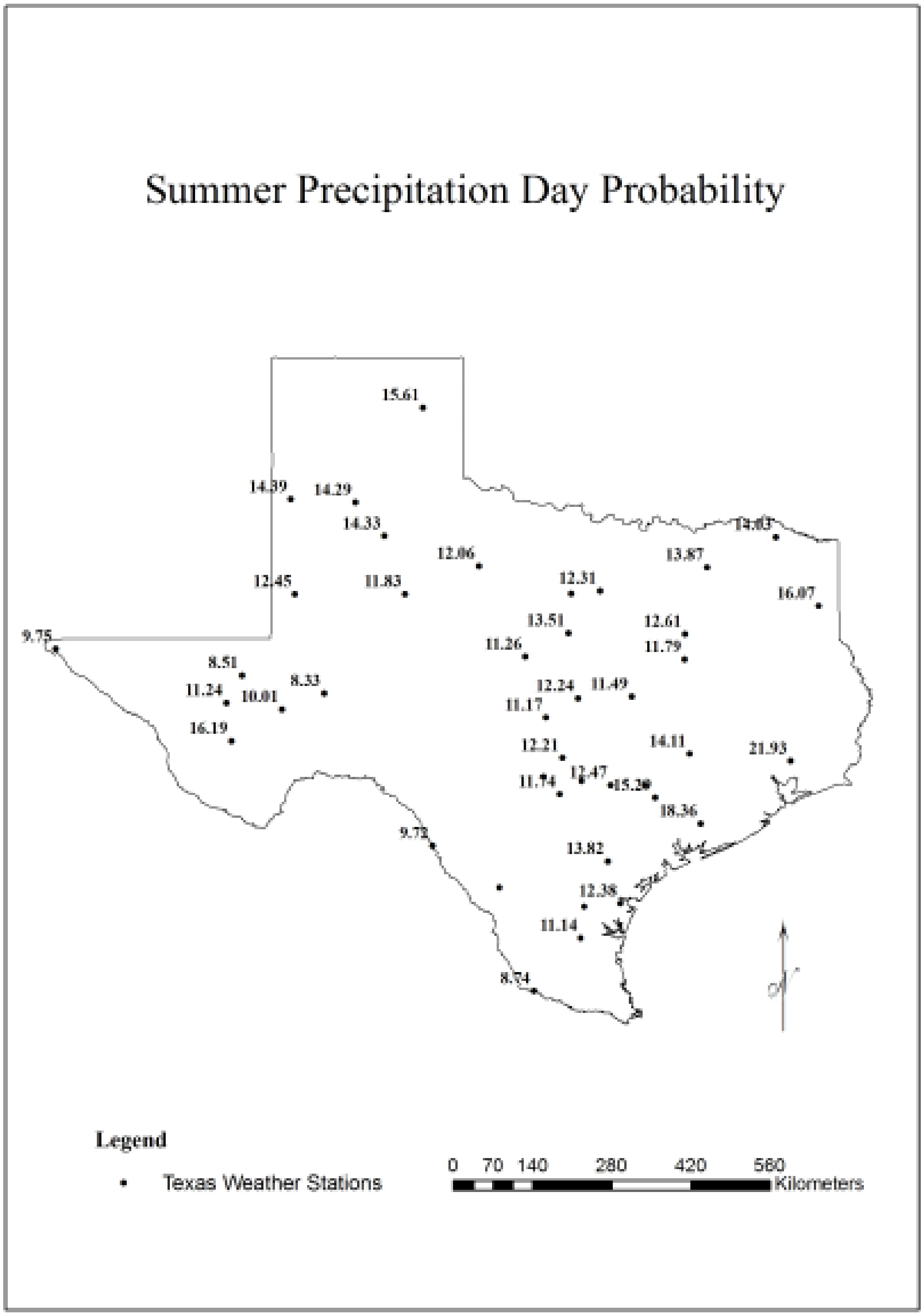


Figure 6.18. Summer Probability of a Day with Precipitation, 1932 - 2002

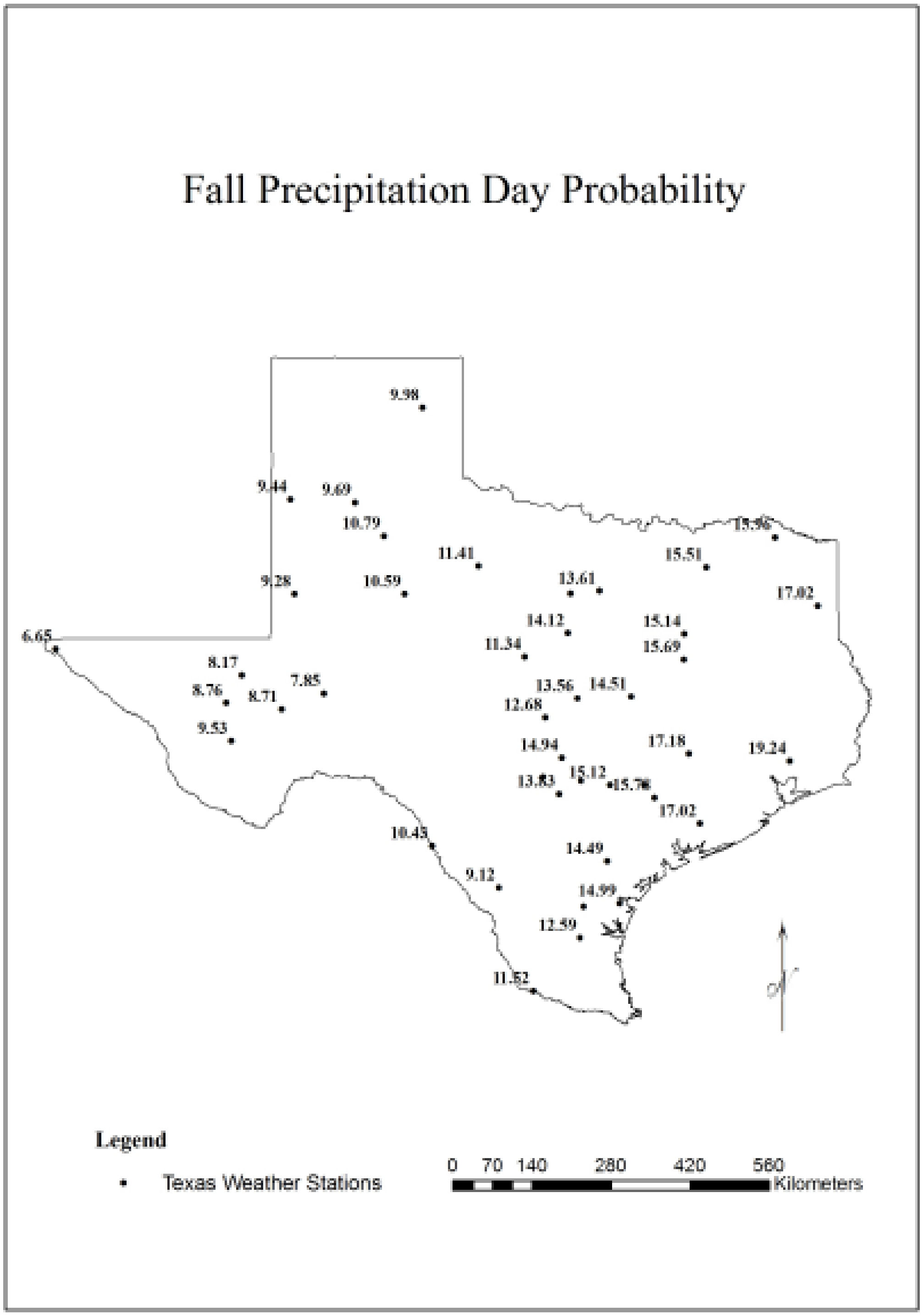


Figure 6.19. Fall Probability of a Day with Precipitation, 1932 - 2002

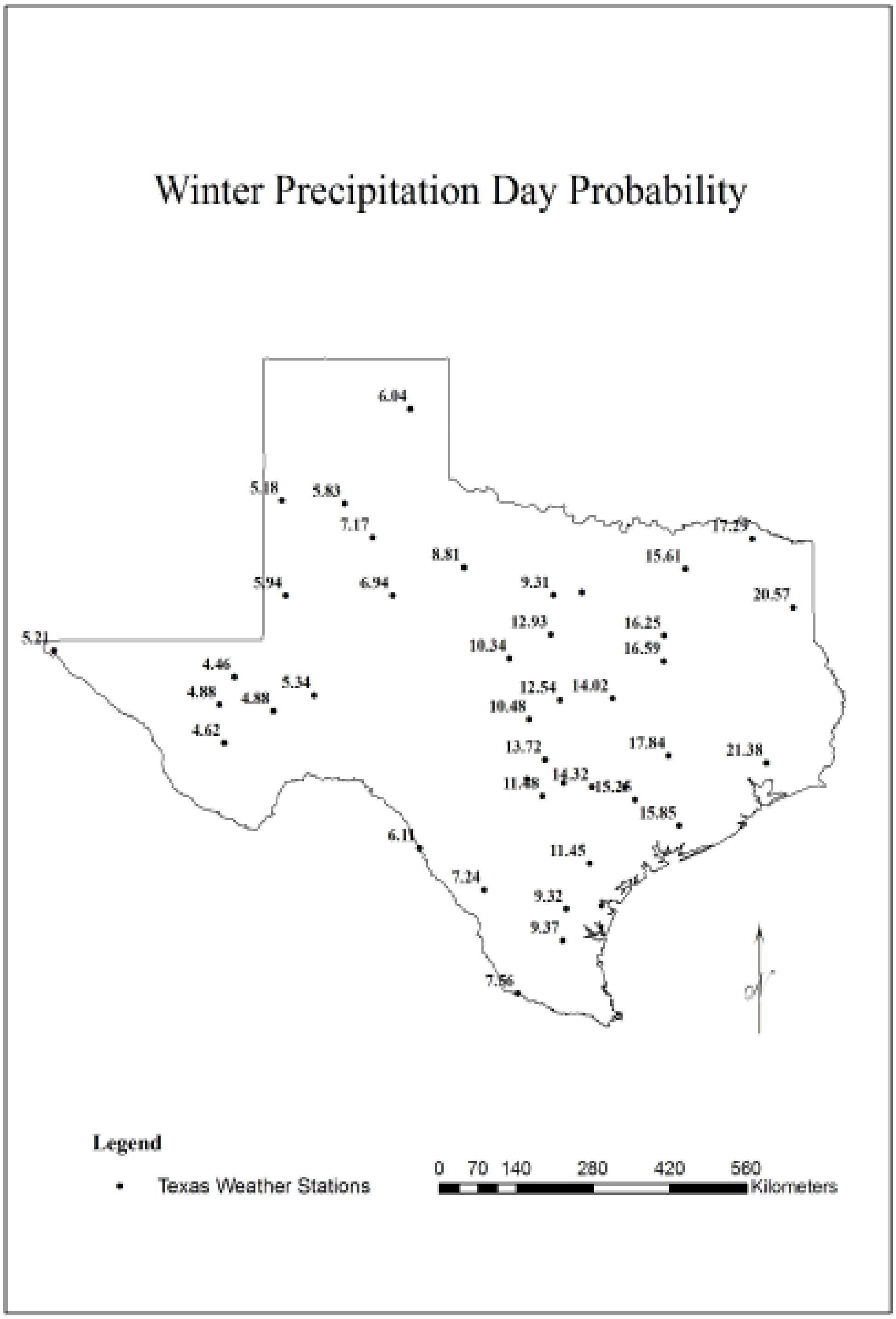


Figure 6.20. Winter Probability of a Day with Precipitation, 1932 - 2002

Variability

Figures 6.21, 6.22, 6.23, 6.24, and 6.25 show the coefficient of variation of annual and seasonal precipitation over the reference period 1932 – 2002. Variability in annual precipitation was lowest for southeast Texas while stations in west Texas experience a higher variability. Precipitation in arid environments such as in west Texas is subject to short pulses of precipitation events, which could be a contributory factor for the higher variability in annual precipitation. The area is also influenced by the North American monsoon (NA monsoon), also known as the Southwest United States monsoon. The NA monsoon is associated with the high pressure that moves northward toward southern Utah and Colorado during the summer months creating an easterly to southeasterly flow aloft, and a low pressure which develops from surface heating over the Southwest United States (Adams 2003). Pulses of low-level moisture are transported from the Gulf of California and upper level moisture is transported from the Gulf of Mexico by easterly winds aloft to this region (Adams 2003). This phenomenon brings a pronounced increase in precipitation from July to mid-September over a large area of the southwestern United States. Locations affected by the NA monsoon receive at least 50% of its annual precipitation in July, August, and September (Adams 2003). West Texas lies climatologically on the fringes of this phenomenon and this is a contributing factor to the high variability in annual precipitation in west Texas.

Spring precipitation was more variable for stations in the western region compared to stations in other regions around the state. Again, west Texas is subject to short pulses of heavy rainfall, which could be a contributing factor for the higher variability in spring precipitation, especially as frontal systems impact the region.

Further, orographic enhancement of precipitation from air masses coming from the north, the Pacific Ocean, and Gulf of Mexico can create a higher variability in precipitation for these stations in west Texas during the spring months.

During the summer months, the difference in variability across the state is not large. Precipitation is more variable for stations in west, north central, central, and south Texas, and less variable in the Panhandle, northeast, and southeast Texas.

Variability of fall precipitation reveals higher values in west Texas, while all other values around the state are fairly uniform. Winter precipitation is most variable for stations in the west and south regions, and lower in the northeast and southeast regions of the state. As stated above, west Texas is subject to short pulses of heavy rainfall, which could be a contributing factor for the higher variability in winter precipitation. In addition, orographic enhancement of precipitation can create a higher variability in precipitation for these stations in west Texas during the winter months.

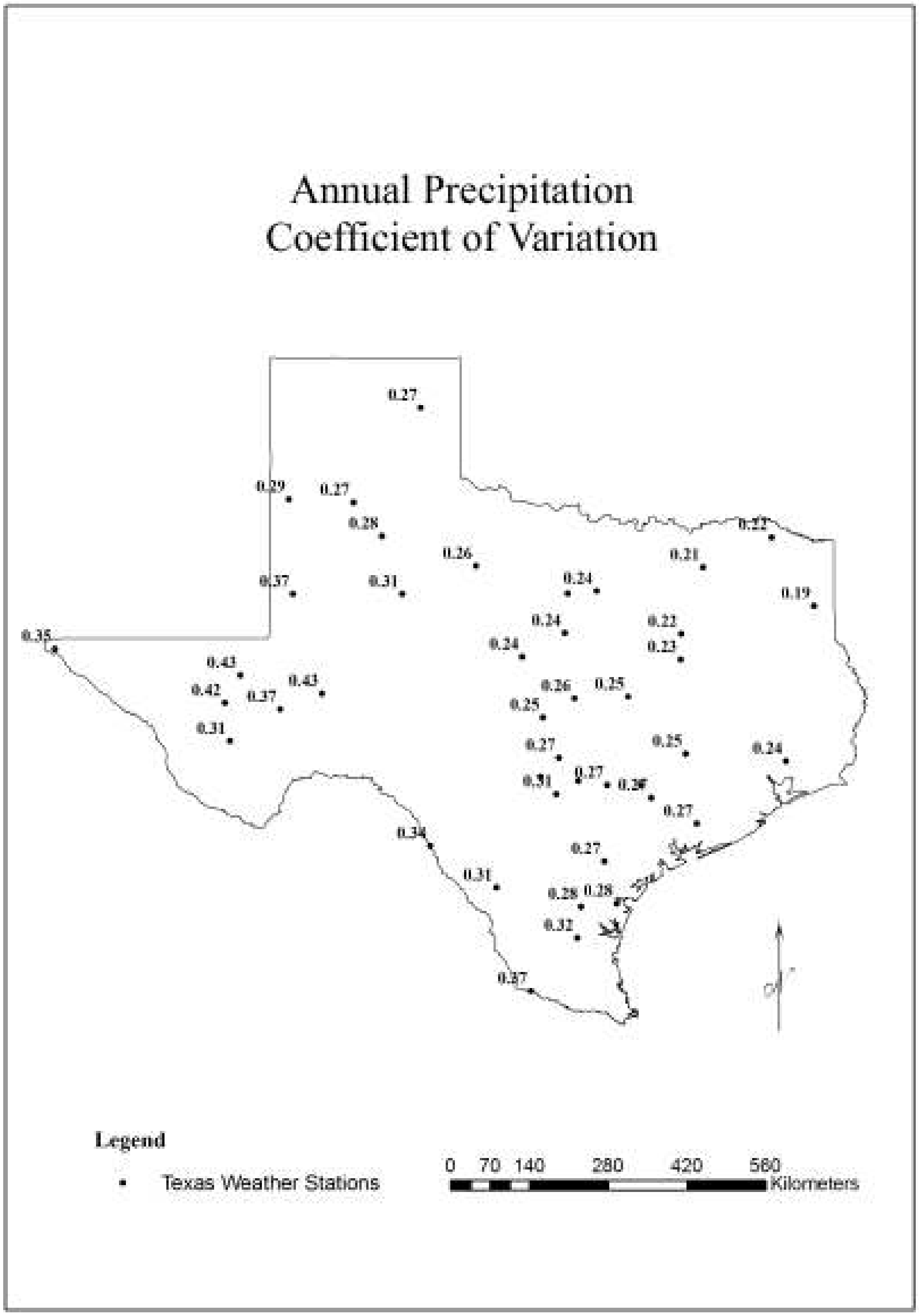


Figure 6.21. Annual Precipitation Coefficient of Variation, 1932 - 2002

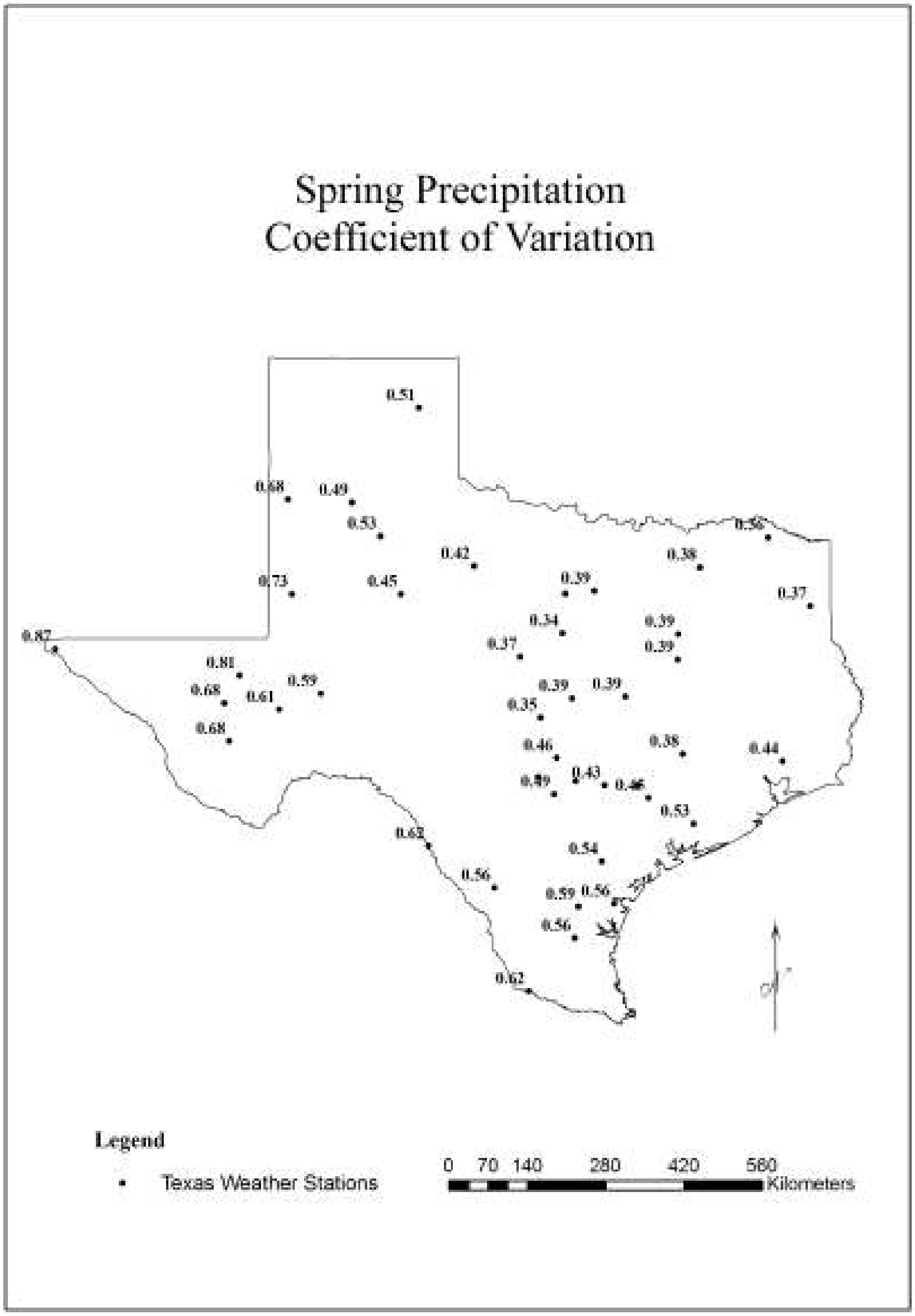


Figure 6.22. Spring Precipitation Coefficient of Variation, 1932 - 2002

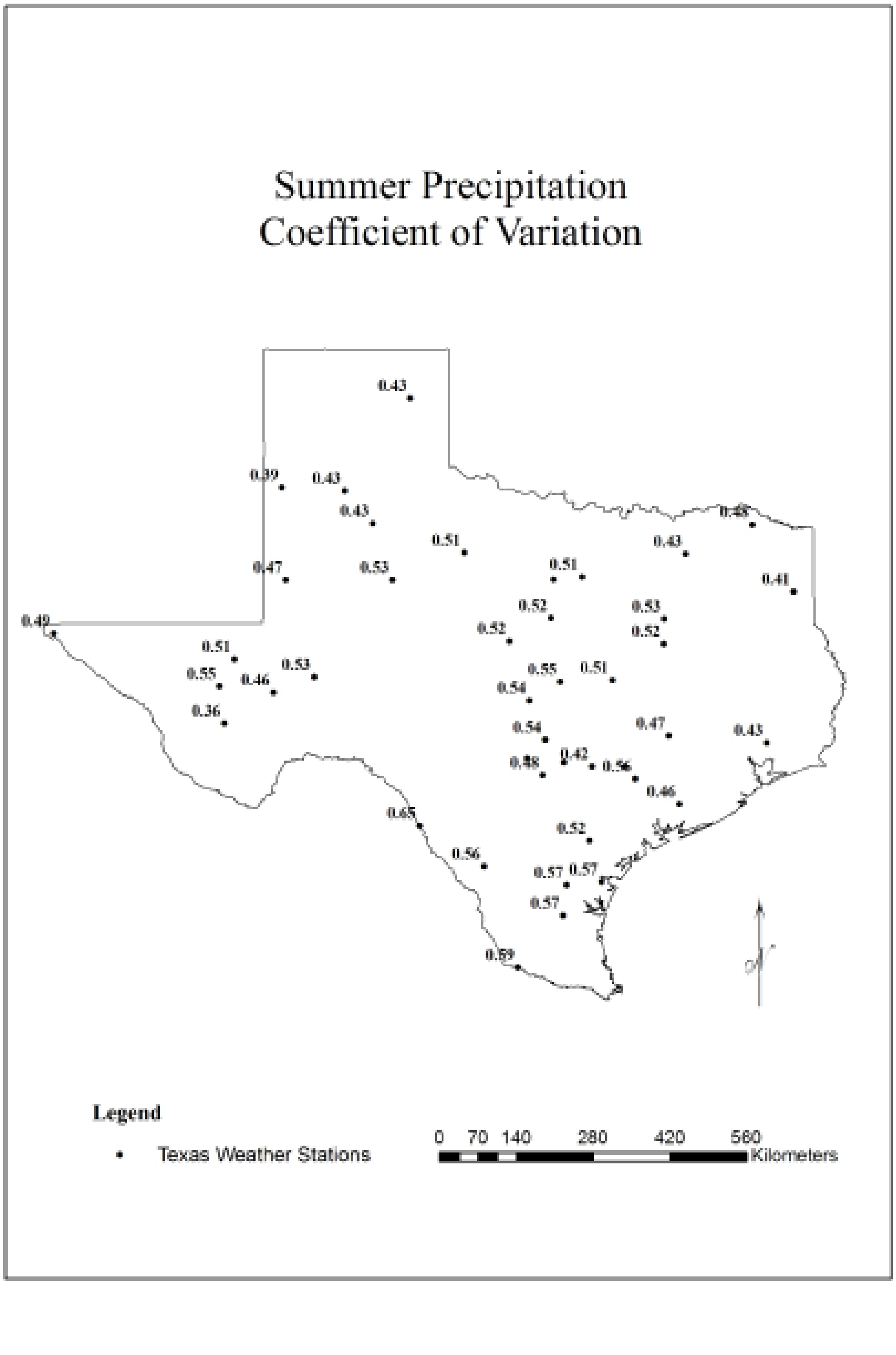


Figure 6.23. Summer Precipitation Coefficient of Variation, 1932 - 2002

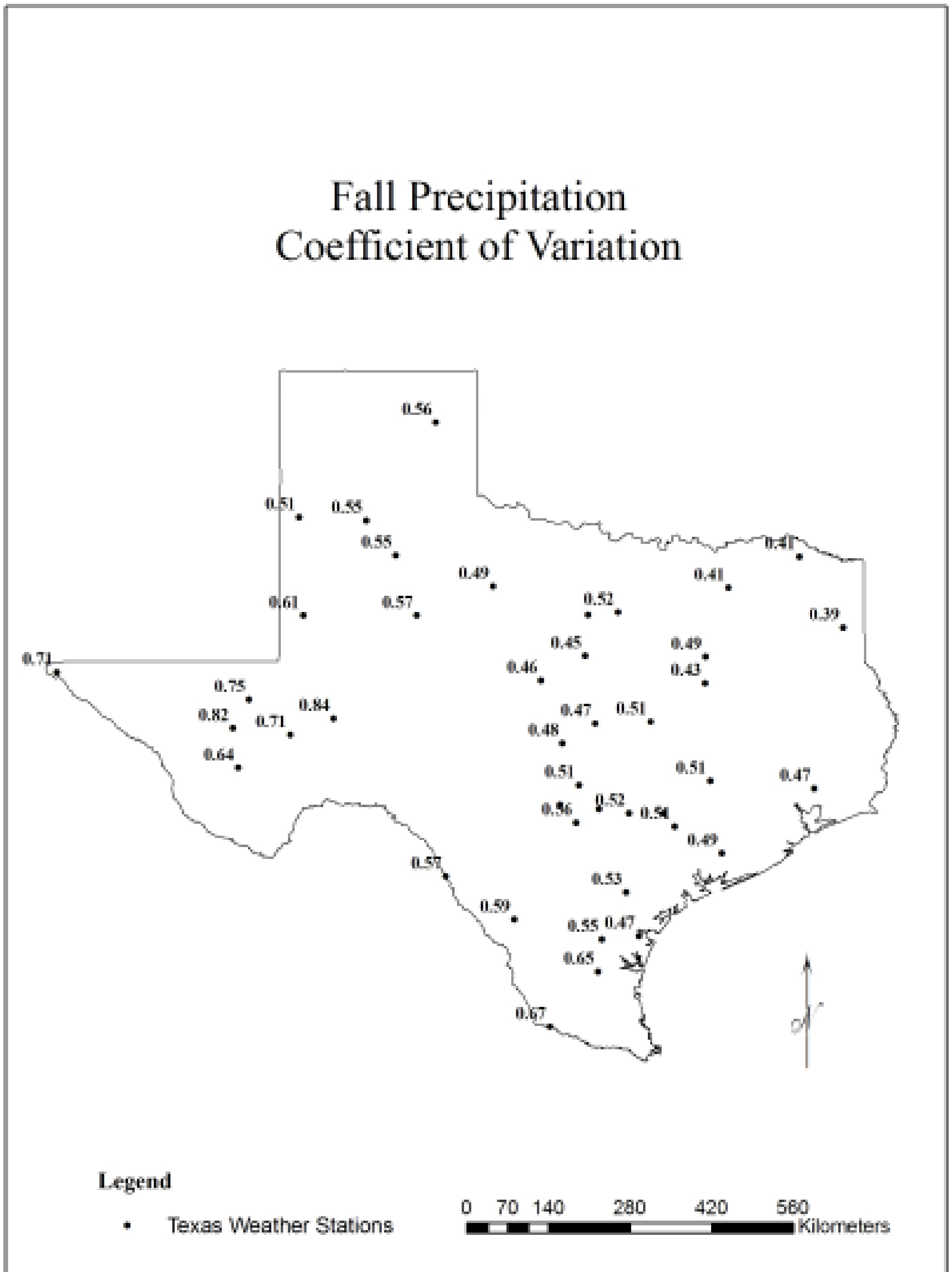


Figure 6.24. Fall Precipitation Coefficient of Variation, 1932 - 2002

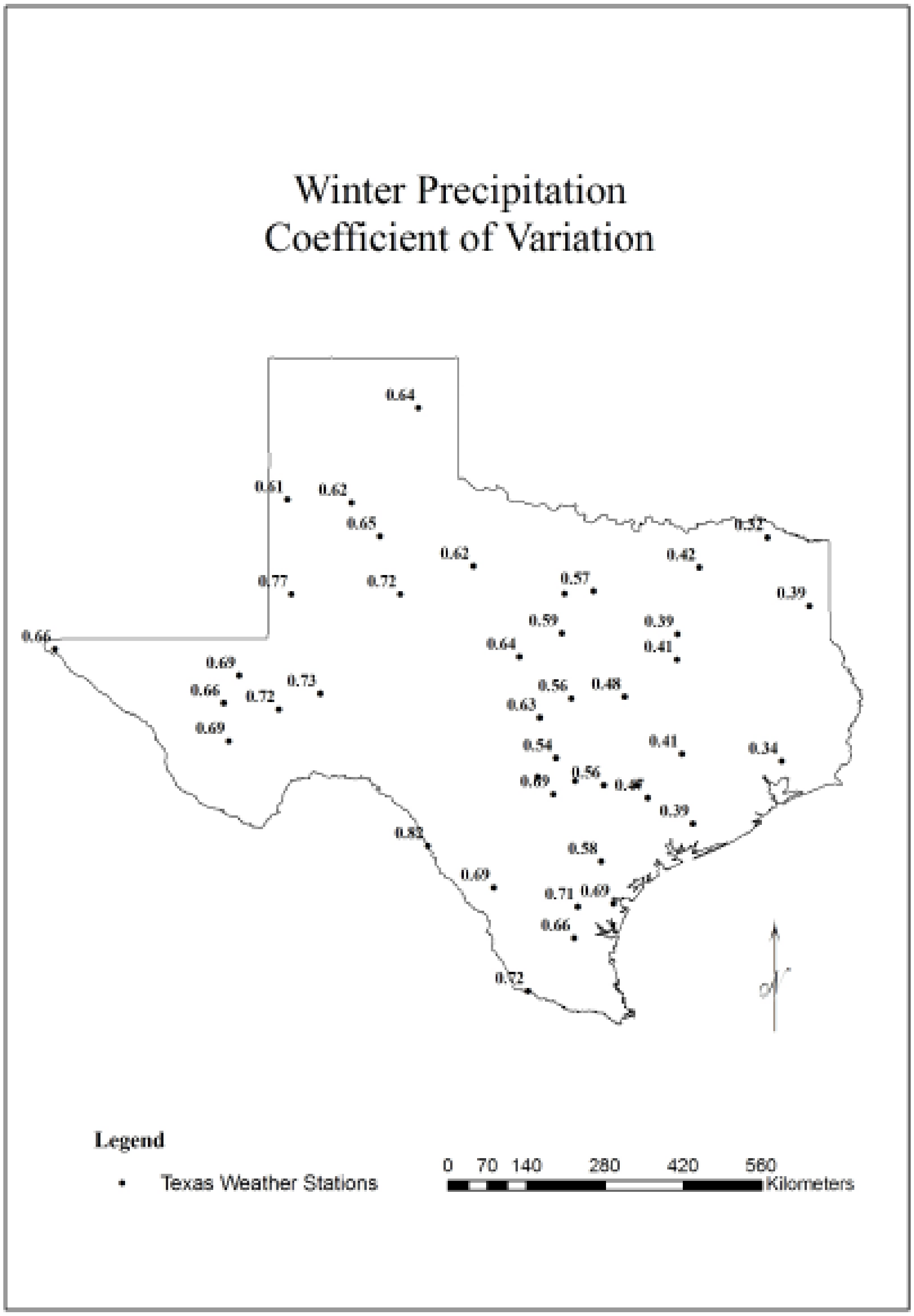


Figure 6.25. Winter Precipitation Coefficient of Variation, 1932 - 2002

Summary of Trend Results

Table 6.1 shows the results of the application of the linear regression test to detect trends for total precipitation, precipitation days, and precipitation intensity for all stations annually and seasonally over the referenced period 1932 – 2002. The trends in the table are expressed as either up-arrows, illustrating an increasing trend, or down-arrows, showing a decreasing trend. A dashed line indicates no trend during the referenced period of 1932 – 2002. For total precipitation, increasing trends annually and during the fall months are most notable for some stations in the southeast, central, and northeast locations. A decrease in annual, fall, and winter precipitation days has been detected mostly for stations in south Texas. There is an increase in precipitation intensity annually and during the summer, fall, and winter months for some stations in the north central, northeast, central, and south Texas. Although, an increase or decrease of precipitation trends is most notable for selected stations in the eastern half of the state, in terms of all stations, very few trends in precipitation, precipitation days, and precipitation intensity were found in this study.

Table 6.1. Summary of Trend Results, 1932 – 2002

Station		Total Precipitation					Precipitation Days					Precipitation Intensity				
		W	F	Su	Sp	A	W	F	Su	Sp	A	W	F	Su	Sp	A
West	El Paso	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Balmorhea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Alpine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Pecos	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Ft. Stockton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	↑
	McCamey	-	-	-	-	-	-	-	↑	-	-	-	-	-	-	-
Panhandle	Seminole	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Snyder	-	-	-	-	-	-	-	-	-	-	↑	-	-	-	-
	Crosbyton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Muleshoe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Plainview	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Miami	-	-	-	-	↑	-	-	-	-	-	↑	-	-	-	-
North Central	Haskell	-	-	-	-	-	-	-	-	-	-	↑	↓	-	-	-
	Albany	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Brownwood	-	-	-	-	-	-	-	-	-	-	-	-	↑	-	↑
	Dublin	-	-	↑	-	↑	-	-	-	-	-	↑	↑	↑	↑	↑
	Weatherford	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northeast	Mexia	-	-	-	-	-	-	-	-	-	-	↑	-	-	-	↑
	Corsicana	-	-	-	-	-	-	-	-	-	-	↑	-	-	-	-
	Greenville	-	↑	-	-	-	-	-	↓	-	-	↑	-	↑	-	↑
	Clarksville	-	↑	-	-	-	-	-	-	-	-	-	↑	-	-	-
	Marshall	-	↑	-	-	↑	-	-	-	-	-	↑	-	↑	-	↑
Central	Lampassas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Temple	-	-	-	-	-	-	-	-	-	-	-	-	-	-	↑
	Llano	-	-	-	-	-	-	-	-	-	-	↑	-	-	-	-
	Blanco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Boerne	-	↑	-	-	-	-	-	-	-	-	-	↑	↑	-	↑
	New Braunfels	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	San Antonio	-	-	-	-	↑	-	-	↑	-	-	-	-	-	-	-
	Luling	-	↑	-	-	-	-	-	-	-	-	-	-	-	-	-
	Flatonia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hallettsville	-	↑	-	-	-	-	-	-	-	-	-	-	-	-	-
South-east	Brenham	-	↑	-	-	↑	-	-	-	-	-	-	-	-	-	-
	Danevang	-	↑	-	-	↑	-	-	-	-	↑	↑	-	-	-	↑
	Liberty	-	↑	-	-	↑	-	-	-	-	-	-	-	-	-	-
South	Alice	-	-	-	-	-	-	↓	-	-	↓	-	↑	-	-	↑
	Eagle Pass	-	-	-	-	-	-	-	-	-	-	-	-	-	↓	↓
	Encinal	-	-	-	-	-	↓	↓	-	-	↓	↑	-	-	-	↑
	Beeville	-	-	-	-	-	-	↓	-	-	-	-	-	-	-	-
	Corpus Christi	-	-	-	-	↑	-	-	-	-	-	-	-	-	-	-
	Falfurrias	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Rio Grande City	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

CHAPTER 7

SUMMARY OF RESEARCH AND FINDINGS

Through a series of statistical analysis techniques, this study improves our knowledge regarding the spatial and temporal precipitation trends in Texas from 1932 – 2002. This research builds upon previous studies on precipitation in Texas and also offers a statistical method to examine precipitation trends in other regions. The main purpose of this work was to present an analysis of annual and seasonal precipitation for 42 stations across Texas during the period of record. The relative dearth of research on precipitation trends in Texas led to my primary objectives:

- The first objective was to identify the temporal patterns of annual and seasonal precipitation from 1932-2002. More specifically, was the total annual and seasonal precipitation, precipitation days, and precipitation intensity increasing, decreasing, or staying steady at each station during the period of record?
- The second objective was to examine the spatial patterns of precipitation across the state for the period of record.
- The third objective was to examine the variability expressed as dry and moist periods for the state.

Linear regression results showed positive trends in annual total precipitation for several stations in the eastern half of the state during the period of record. All stations in the southeast region showed positive trends during the period of record. While a large portion of stations in the eastern half of the state revealed positive trends in annual precipitation intensity, only one station in the south region resulted in a decrease in intensity. Two stations in the south showed an increase in precipitation intensity as well as a decrease in the number of days with precipitation on an annual basis. At these stations, more precipitation per event occurred despite the decrease in number of precipitation days.

The spring months did not reveal any trends or changes in total precipitation or days with precipitation spatially or temporally. The spring months resulted in a negative trend for precipitation intensity for one station in the south, and a positive trend for one station in the north central region. Precipitation intensity during the summer months revealed an increase for selected stations in the northern half of the state, while there were no changes in the number of days with precipitation at these stations. Convective and tropical storms affect these regions during the summer months, which may be a contributing factor to the positive trend in precipitation intensity at these stations.

The fall months revealed positive trends in total precipitation for various stations in the eastern to the northeastern half of the state. A contributing factor may be due to frontal and tropical activity common to the region during the fall months. There were no trends or changes during the period of record for fall total precipitation for stations in the west¸ the Panhandle, and south regions. One station in central Texas revealed both an increase in fall precipitation and precipitation intensity for the period of record. Along with frontal and tropical activity, orographic enhancement of precipitation was a factor for an increase in precipitation and precipitation intensity.

Winter precipitation intensity increased for various stations in the northeast, north central, Panhandle, and southeast regions of the state, while there were no changes in total precipitation or days with precipitation. New et al. (2001) noted similar results from studies that have identified an increase in the intensity of daily precipitation over the twentieth century in the United States. Frontal activity is the dominant weather phenomenon in Texas during the winter months, especially for those stations in the northern reaches of the state. There were no changes in winter precipitation intensity for stations in the south and western regions of the state.

Overall, an increase or decrease of trends in precipitation, precipitation days, and precipitation intensity was most notable for selected stations in the eastern half of the state. However, of the 630 hypothesis tested in this study, only 63 trends were detected. Approximately 90% of the stations resulted in no change in precipitation, days with precipitation, or precipitation intensity.

In general, variability of precipitation was higher for stations in west Texas annually and for all seasons during the period of record. The NA monsoon, convective activity, and the local topography contribute to the high variability in precipitation for stations in this region. Arid environments are subject to short pulses of precipitation over time and space.

An east-to-west trend in precipitation exists due to the distribution of moisture. A day with a probability of precipitation was consistently higher for stations in the east annually and seasonally. These stations receive convective storms, frontal precipitation during the spring and fall months, and are subjected to tropical activity from the Gulf of Mexico during the summer and fall months. For stations in west Texas, the probability of a day with precipitation was highest during the summer months when compared to other seasons and annually. This is most likely associated with the monsoonal rains and convective activity common in the summer months to stations in this region.

Limitations

Trend analysis of climate data is complicated by missing data. It is imperative that extensive quality control procedures are employed to ensure that only the most complete and reliable precipitation data sets are used. It may be difficult to replicate this study in other regions of the world simply because good quality data are not available for many regions internationally (New et al. 2001). Long-term reliable operational practices to collect and measure precipitation would greatly improve the trends derived from the observational record. The data sets used for this analysis had missing data and to overcome this issue, this study estimated missing values of monthly and precipitation day data on the 42 stations using regression analysis. Additionally, the USHCN only had data on 42 stations for the state, and as a consequence, many areas around the state such as the northwest Panhandle and the Edwards Plateau were underrepresented spatially and could not be analyzed in this study.

Future Research

The spatial and temporal patterns of precipitation were a primary focus of my dissertation research. The United States Historical Climatology Network offers precipitation data for 50 states. The methods used in this analysis could be extended to other regions within the United States.

In this dissertation, I focused on the trends in precipitation that occurred over a course of 70 years. One of the results showed an increase in annual, summer, and winter precipitation intensity for selected stations around the state. It would be interesting to compare those stations and determine if any extreme precipitation event such as those related to hurricanes or heavy thunderstorms was the cause during the period of record. Furthermore, I would like extend this study and compare the extreme precipitation trends and events to the synoptic causes during the period of record. For the second half of the twentieth century, data are available which would allow a more refined analysis; however, earlier periods may be difficult to construct as I may have to rely on the surface observational record (Sheridan 2002). Furthermore, such a synoptic climatology may need to be expanded to cover the Gulf of Mexico and central portions of the United States. I would also like to research extreme precipitation patterns in Texas because an increase of heavy precipitation events has serious ramifications for flood control and water resource management. Reliable and accurate knowledge of flood climatology is vital because it plays a role in many policy decisions. I would also like to investigate total precipitation and extreme precipitation patterns with regards to El Niño and La Niña events.

Another variable to be considered in this research is temperature. In general, as temperatures increase, evaporation rates also increase which leads to more precipitation (Solomon et al. 2007). Investigating temperatures in Texas as it relates to precipitation trends would generate another interesting dynamic to studying climate change on a regional level. Furthermore, I would like to study temperature and precipitation trends and its relationship to extreme precipitation events such as hurricanes that have affected Texas.

APPENDIX

Metric Conversion Chart

METRIC CONVERSION CHART

Converts LENGTH from English-to-metric and metric-to-English

Small Scale				Medium Scale				Large Scale			
Inches	cm	cm	Inches	Feet	m	m	Feet	Miles	km	km	Miles
0.01	0.025	0.01	0.004	0.01	0.003	0.01	0.033	0.01	0.016	0.01	0.006
0.1	0.254	0.1	0.039	0.1	0.030	0.1	0.328	0.1	0.161	0.1	0.062
0.2	0.508	0.2	0.079	0.2	0.061	0.2	0.656	0.2	0.322	0.2	0.124
0.3	0.762	0.3	0.118	0.3	0.091	0.3	0.984	0.3	0.483	0.3	0.186
0.4	1.016	0.4	0.157	0.4	0.122	0.4	1.312	0.4	0.644	0.4	0.248
0.5	1.270	0.5	0.197	0.5	0.152	0.5	1.640	0.5	0.805	0.5	0.311
0.6	1.524	0.6	0.236	0.6	0.183	0.6	1.968	0.6	0.966	0.6	0.373
0.7	1.778	0.7	0.276	0.7	0.213	0.7	2.296	0.7	1.127	0.7	0.435
0.8	2.032	0.8	0.315	0.8	0.244	0.8	2.624	0.8	1.288	0.8	0.497
0.9	2.286	0.9	0.354	0.9	0.274	0.9	2.952	0.9	1.449	0.9	0.559
1	2.54	1	0.39	1	0.30	1	3.28	1	1.61	1	0.62
2	5.08	2	0.79	2	0.61	2	6.56	2	3.22	2	1.24
3	7.62	3	1.18	3	0.91	3	9.84	3	4.83	3	1.86
4	10.16	4	1.57	4	1.22	4	13.12	4	6.44	4	2.48
5	12.70	5	1.97	5	1.52	5	16.40	5	8.05	5	3.11
6	15.24	6	2.36	6	1.83	6	19.68	6	9.66	6	3.73
7	17.78	7	2.76	7	2.13	7	22.96	7	11.27	7	4.35
8	20.32	8	3.15	8	2.44	8	26.24	8	12.88	8	4.97
9	22.86	9	3.54	9	2.74	9	29.52	9	14.49	9	5.59
10	25.4	10	3.94	10	3.05	10	32.8	10	16.10	10	6.21
20	50.8	20	7.87	20	6.10	20	65.6	20	32.20	20	12.42
30	76.2	30	11.81	30	9.14	30	98.4	30	48.30	30	18.63
40	101.6	40	15.75	40	12.19	40	131.2	40	64.40	40	24.84
50	127.0	50	19.69	50	15.24	50	164.0	50	80.50	50	31.05
60	152.4	60	23.62	60	18.29	60	196.8	60	96.60	60	37.26
70	177.8	70	27.56	70	21.34	70	229.6	70	112.70	70	43.47
80	203.2	80	31.50	80	24.38	80	262.4	80	128.80	80	49.68
90	228.6	90	35.43	90	27.43	90	295.2	90	144.90	90	55.89
100	254	100	39	100	30	100	328	100	161.0	100	62.1
200	508	200	79	200	61	200	656	200	322.0	200	124.2
500	1,270	500	197	500	152	500	1640	500	805.0	500	310.5
1,000	2,540	1,000	393.7	1,000	304.8	1,000	3,280	1,000	1610	1,000	621
2,000	5,080	2,000	787.4	2,000	609.6	2,000	6,560	2,000	3220	2,000	1242
5,000	12,700	5,000	1968.5	5,000	1524.0	5,000	16,400	5,000	8050	5,000	3105
1"= 2.54cm (= 0.254m) 1cm= 0.3937"				1'= 0.3048m (=304.8mm) 1m= 3.280' (=39.37")				1mile= 1.61kM 1km= 0.621miles			

Source: Anonymous. 2009. Metric Linear Conversion Chart. Available: http://www.vaughns-1-pagers.com/science/metric-conversion.htm. Accessed August 29, 2009.

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VITA

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