

The Effects of El Niño/La Niña on Precipitation in West Central Texas

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1. Introduction

The 1997-98 El Niño episode has attracted a lot of media attention, as it is advertised to be one of the strongest El Niño events of the century. But what effects, if any, does El Niño have on precipitation across West Central Texas during the cool season?

During an El Niño year, the eastern Pacific Ocean becomes abnormally warm off the South American coast along Ecuador and Peru. This is the result of weakening easterly trade winds, which allows warmer water to travel further eastward than normal and reduces upwelling of deeper cool ocean water to the surface. Tropical convection migrates eastward with the warmer water, resulting in changes to the atmospheric circulation patterns over the Pacific. The changes in the atmospheric wind patterns can have far reaching effects on global weather. Most of the effects of El Niño occur during the winter and early spring months. Abnormal weather patterns attributed to El Niño include a strengthening of the upper level ridge off the Western U.S. Coast and a stronger subtropical jet stream. These changes can potentially cause more storm systems than normal to move across the Gulf Coast states. An El Niño event usually occurs once every three to seven years. A La Niña event is the opposite of an El Niño. During a La Niña year, unusually cold water is found along the western coast of South America. A La Niña occurs about half as often as an El Niño, and it can also have far reaching effects on global weather.

This study was undertaken to determine the effects of the El Niño and La Niña sea surface temperature anomalies on West Central Texas precipitation in terms of frequency and amounts. Precipitation data for Abilene and San Angelo were used for the period from 1952 through 1996. The results indicate that Abilene and San Angelo experience an increase in rainfall frequency and amounts during El Niño years, and an equivalent decrease in rainfall amounts and frequency during La Niña years. Most of the driest winters during the period of this study occurred during La Niña years, while most of the wettest winters were El Niño winters.

2. Methodology

The precipitation data for this study was obtained from the monthly Local Climatological Data (LCD) publications produced by the National Climatic Data Center (NCDC). This study covers the 45-year period from 1952 through early 1997, which includes 10 El Niño episodes, 9 La Niña episodes, and 26 "normal" winters. The precipitation data was collected for the months of October through May. Monthly and seasonal average rainfall amounts were calculated for both Abilene and San Angelo for El Niño, La Niña, and non-

event years. Averages were also calculated for the number of days of measurable rainfall in Abilene and San Angelo.

3. Results

The precipitation data from this study shows that winter and early spring monthly and seasonal precipitation amounts generally increase by a few inches across both Abilene and San Angelo during El Niño years, and decrease by the same amount during La Niña years (Tables 1 and 2). The difference in average cool season precipitation between El Niño and La Niña years was close to 6 inches for both Abilene and San Angelo. The cool season period referred to in the tables below is for the months of October through March. During La Niña years, the effects seem to diminish by April. El Niño years tend to show a continuation of above normal precipitation into April, but the effects seem to drop off by May. Note that in this study that the years used to calculate the "normal" precipitation are taken to be those years when an El Niño or La Niña event did not occur as opposed to the 30 year normals calculated by the National Climatic Data Center (NCDC).

Table 1. San Angelo Average Precipitation Oct. 1952 - May 1997

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Cool Season
Normal	2.12	1.23	0.79	0.92	0.94	1.00	1.45	2.91	7.00
La Niña	1.46	0.69	0.36	0.35	0.87	0.39	2.08	2.76	4.12
	(-0.66)	(-0.54)	(-0.43)	(-0.57)	(-0.07)	(-0.61)	(+0.63)	(-0.15)	(-2.88)
El Niño	3.91	0.93	1.21	1.00	1.83	1.12	1.99	3.22	10.00
	(+1.79)	(-0.30)	(+0.42)	(+0.08)	(+0.89)	(+0.12)	(+0.54)	(+0.31)	(+3.00)

Table 2. Abilene Average Precipitation Oct. 1952 - May 1997

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Cool Season
Normal	2.51	1.57	1.09	1.04	1.15	1.14	1.73	3.47	8.50
La Niña	1.45	0.77	0.61	0.46	1.05	0.63	2.83	3.31	4.97
	(-1.06)	(-0.80)	(-0.48)	(-0.58)	(-0.10)	(-0.51)	(+1.10)	(-0.16)	(-3.53)
El Niño	3.72	1.55	1.49	1.39	1.29	1.57	2.59	2.94	11.01
	(+1.21)	(-0.02)	(+0.40)	(+0.35)	(+0.14)	(+0.43)	(+0.86)	(-0.53)	(+2.51)

When the rainfall totals for October through March for each year are placed in order from smallest to largest and split in half, eight of the nine La Niña winters fall in the lower half of the rainfall totals for San Angelo, with three of the four driest winters being La Niña events. Eight of the ten El Niño winters are in the upper half of the rainfall totals, with the three wettest winters being El Niño events. For Abilene, all nine La Niña years are in the lower half of the rainfall totals, with three of the four driest winters being La Niña events.

Eight of the ten El Niño years are in the upper half of rainfall totals for Abilene. Two of the three wettest winters were El Niño winters.

In terms of rainfall frequency, Abilene and San Angelo experience more days of measurable rainfall during El Niño winters, and fewer days during La Niña winters. The table below shows the frequency data for both Abilene and San Angelo for the October through March period.

Table 3. Number of Days of Measurable Rainfall October through March

	El Niño	Normal	La Niña
Abilene	38	31	21
San Angelo	34	27	18

4. Conclusions

The precipitation data for both Abilene and San Angelo indicates that there is a relationship between average precipitation amounts and frequencies and El Niño/La Niña events. On average, El Niño winters are wetter than non-event years while La Niña winters are drier than non-event years. Most of the driest winters in this study were La Niña winters, while many of the wettest winters were El Niño winters. One thing to keep in mind is that these relationships are based on climatological averages for a period of 45 years. This does not guarantee that any individual El Niño winter will be above normal or any individual La Niña winter will be below normal. This study did not take into account the strength of El Niño or La Niña events. Further study should be performed to determine if there is a relationship between the strength of El Niño/La Niña events and precipitation amounts.