

El Niño and La Niña Episodes and Their Impact On The Weather In Interior Central California

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Introduction

El Niño and La Niña episodes have been shown in numerous studies to have large scale and regional impacts on weather patterns and seasonal climate averages. This study reviews the observed values of various weather parameters in the Central California interior in order to see what, if any, correlations there are due to El Niño and La Niña episodes on a more local scale.

Methodology

Oceanic Niño Index (ONI) values, defined as sea surface temperature anomalies in the Niño 3.4 region (located at 5°N to 5°S and 120° to 170°W) of the eastern and central equatorial Pacific Ocean based on the 1971-2000 base period, were obtained from the Climate Prediction Center (CPC) for each year since 1950 to the present. These values were analyzed for departures of 0.5°C warmer than normal for at least three consecutive three month periods which indicated an El Niño episode and departures of 0.5°C cooler than normal for at least three consecutive three month periods which inferred a La Niña episode for the purposes of this report. It is noted that the official definition of an El Niño and La Niña events varies from this in that it uses five consecutive three month periods instead of three consecutive three month periods with the same temperature threshold. However, it was decided to use three consecutive three month periods as it allows for a larger data set to be analyzed. Episodes were then defined from a July-June period for simplistic purposes and also to correspond to the same months as the water season. The El Niño episode of 1993-1994 was included despite the fact that one month in one of the three month periods where ONI values were 0.5°C warmer than normal did extend into July of the following episode, i.e., July 1994. However, given the consistent warmer than normal values through the entire episode, it was felt it was reasonable to include this episode in this study.

The next step was to rate El Niño and La Niña episodes into three categories – strong, moderate and weak based on ONI values. At least three consecutive three month periods with a given value were used to rate episodes. The thresholds for rating ONI values were obtained from correspondence with CPC.

For El Niño episodes events were defined as:

Weak – ONI values from +0.5°C to +0.9°C

Moderate – ONI values from +1.0°C to +1.8°C

High – ONI values greater than +1.8°C

For La Niña episodes events were defined as:

Weak – ONI values from -0.5°C to -0.9°C

Moderate – ONI values from -1.0°C to -1.8°C

High – ONI values greater than -1.8°C

On a local scale, data from Fresno and Bakersfield was analyzed for climatic purposes as it represents the two largest population areas in the local area which also have the longest period of detailed climate records. However, it was felt that in order for the study to better represent the diverse valley and mountain topography of interior Central California, a station's records should be analyzed in the Sierra Nevada mountains. Grant Grove, located at 6600 feet in elevation, provided the most complete set of records for the length of time analyzed in this report.

Effects on precipitation, temperature and fog were analyzed for all three of the stations above. Due to the limited number of snowfall events in the San Joaquin Valley, snowfall was not analyzed for either Fresno or Bakersfield. The number of days with minimum temperatures at or below 28°F was analyzed only for Fresno and Bakersfield as it represents a critical threshold to the economy of the San Joaquin Valley. Fog events were not analyzed at Grant Grove as this station is classified as a cooperative observer and consistent records of this weather element are not kept.

For tornadoes, events were counted that occurred within the present County Warning and Forecast Area of the National Weather Service Office in Hanford, CA. The strongest rating for a tornado in the Hanford CWFA is a F2. Therefore, a separate category was assigned to this ranking to see if there was any correlation to El Niño and La Niña episodes. Only three F2 tornadoes are known to have ever occurred in the Hanford CWFA.

Precipitation

The table below lists precipitation totals for the Water Season (July-June) for years with an El Niño episode. Above normal values are shown in green and represent departures from normal of 110% or better. Brown values represent below normal values or 90% or less than normal. Above normal snowfall values are shown in blue and represent departures from normal of 110% or better, while below normal snowfall values are in purple and represent values of 90% or less than normal.

Episode	Strength of Episode	Fresno Water Season Precipitation Total	Bakersfield Water Season Precipitation Total	Grant Grove Water Season Precipitation Total	Grant Grove Seasonal Snowfall Total
1951-1952	Weak	13.95"	8.68"	72.49"	411.5"
1957-1958	Moderate	18.99"	10.01"	62.05"	328.5"
1963-1964	Weak	6.76"	4.60"	33.16"	221.1"
1965-1966	Moderate	6.14"	5.18"	30.75"	141.5"
1968-1969	Weak	22.98"	8.78"	87.65"	338.5"
1969-1970	Weak	9.12"	3.35"	33.08"	106.5"
1972-1973	Strong	13.94"	8.00"	52.05"	301.0"
1976-1977	Weak	7.61"	4.19"	19.49"	72.0"
1977-1978	Weak	18.16"	11.73"	65.65"	251.0"
1982-1983	Strong	23.57"	9.94"	80.31"	298.0"
1986-1987	Moderate	9.32"	5.58"	23.31"	94.1"
1987-1988	Moderate	8.07"	5.55"	32.74"	142.0"
1991-1992	Moderate	11.05"	7.00"	M	M
1992-1993	Weak	16.53"	9.35"	M	M
1993-1994	Weak	8.56"	5.79"	28.11"	172.0"
1994-1995	Moderate	19.03"	10.29"	74.51"	334.6"
1997-1998	Strong	20.16"	14.73"	62.58"	370.8"
2002-2003	Moderate	9.80"	5.93"	42.26"	152.8"
2004-2005	Weak	15.84"	9.20"	58.93"	222.0"
2006-2007	Weak	6.03"	3.06"	22.03"	115.4"
30 Year Normal	N/A	11.23"	6.49"	41.60"	192.2"

Overall only strong El Niño episodes tend to correlate to well above normal precipitation for the water season. Precipitation amounts tend to vary anywhere from well above to well below normal for weak to moderate El Niño events. The six wettest years in Fresno are all El Niño years, with four of the six being strong El Niño episodes. The wettest water season in Fresno ever in 1982-1983 was a strong El Niño. Of the four wettest water seasons in Bakersfield since 1950-1951, all have been El Niño. The wettest water season in Bakersfield in 1997-1998 was a strong El Niño. In Grant Grove, the three wettest water seasons on record all occurred during strong El Niño episodes. The wettest water season on record at Grant Grove was in 1968-1969, also a strong El Niño. Snowfall totals

were above normal in 10 out of the 20 winter seasons (July-June) in which complete totals were available for at Grant Grove. However, there does appear to be a clear correlation between well above normal snowfall during strong El Niño episodes. All water seasons at Grant Grove that had above normal precipitation during El Niño events also had above normal snowfall.

The table below lists precipitation totals for the Water Season (July-June) for years with a La Niña episode. Above normal values are shown in green and represent departures from normal of 110% or better. Brown values represent below normal values or 90% or less than normal. Above normal snowfall values are shown in blue and represent departures from normal of 110% or better, while below normal snowfall values are in purple and represent values of 90% or less than normal.

Episode	Strength of Episode	Fresno Water Season Precipitation Total	Bakersfield Water Season Precipitation Total	Grant Grove Water Season Precipitation Total	Grant Grove Seasonal Snowfall Total
1950-1951	Weak	10.30"	5.21"	45.19"	163.0"
1954-1955	Moderate	10.28"	4.64"	37.37"	167.0"
1955-1956	Strong	13.40"	3.90"	58.91"	180.0"
1956-1957	Weak	8.20"	4.70"	36.22"	136.5"
1961-1962	Weak	11.37"	6.44"	49.44"	271.6"
1964-1965	Moderate	11.20"	5.75"	43.80"	237.0"
1967-1968	Weak	7.24"	5.19"	22.40"	115.0"
1970-1971	Moderate	8.53"	6.66"	31.81"	203.6"
1971-1972	Weak	5.34"	3.00"	27.01"	145.2"
1973-1974	Strong	10.42"	5.11"	44.99"	195.5"
1974-1975	Weak	7.69"	6.71"	40.86"	213.1"
1975-1976	Moderate	8.18"	4.37"	22.59"	138.0"
1983-1984	Weak	7.62"	5.26"	39.38"	91.0"
1984-1985	Moderate	7.94"	4.04"	30.22"	186.5"
1988-1989	Strong	8.73"	3.74"	33.25"	185.0"
1995-1996	Weak	10.92"	6.57"	44.62"	139.1"
1998-1999	Moderate	7.01"	6.96"	27.08"	170.6"
1999-2000	Moderate	12.91"	5.15"	41.91"	176.3"
2000-2001	Weak	10.56"	5.77"	29.95"	254.1"
30 Year Normal	N/A	11.23"	6.49"	41.60"	192.2"

Overall La Niña episodes tend to be drier than normal to near normal across interior Central California with snowfall generally near normal to below normal. The number of drier than normal water seasons is noticeably higher at Bakersfield than at Fresno or Grant Grove. It is interesting to note that one of the few wetter than normal La Niña episodes was 1955-1956 which featured historic flooding in the central San Joaquin

Valley shortly after Christmas 1955. December 1955 is not only the wettest December ever on record for Fresno but also the fourth wettest month ever on record in Fresno.

Temperature

The table below lists the average temperature for meteorological winter (December through February) for years with an El Niño episode. Warmer than normal seasons were defined as those with departures from normal of greater than 2°F above normal and are depicted in orange, while cooler than normal seasons (depicted in blue) were defined as those with departures from normal of at less than 2°F below normal.

Episode	Strength of Episode	Fresno Average Temperature	Bakersfield Average Temperature	Grant Grove Average Temperature
1951-1952	Weak	46.6	48.8	28.5
1957-1958	Moderate	48.5	50.9	35.9
1963-1964	Weak	43.7	46.3	34.3
1965-1966	Moderate	44.2	46.2	31.9
1968-1969	Weak	45.2	49.0	31.5
1969-1970	Weak	49.3	53.8	36.3
1972-1973	Strong	46.0	49.6	31.4
1976-1977	Weak	48.1	51.6	37.9
1977-1978	Weak	51.7	56.0	36.1
1982-1983	Strong	47.9	48.3	35.3
1986-1987	Moderate	48.5	47.9	34.2
1987-1988	Moderate	47.5	49.7	31.5
1991-1992	Moderate	48.4	49.5	M
1992-1993	Weak	48.1	49.7	M
1993-1994	Weak	47.5	49.1	35.1
1994-1995	Moderate	50.4	51.4	35.9
1997-1998	Strong	47.9	48.9	32.6
2002-2003	Moderate	50.3	51.1	36.0
2004-2005	Weak	49.4	49.7	35.5
2006-2007	Weak	47.4	48.4	34.0
30 Year Normal	N/A	47.5	49.4	35.4

During strong El Niño events, temperatures tend to average near normal in the San Joaquin Valley with below normal temperatures at Grant Grove. However, there appears to be no correlation between weak to moderate El Niño events and temperatures at either of the three locations.

The table below lists the average temperature for meteorological winter (December through February) for years with a La Niña episode. Warmer than normal seasons were defined as those with departures from normal of greater than 2°F above normal and are depicted in orange, while cooler than normal seasons (depicted in blue) were defined as those with departures from normal of less than 2°F below normal.

Episode	Strength of Episode	Fresno Average Temperature	Bakersfield Average Temperature	Grant Grove Average Temperature
1950-1951	Weak	48.8	51.1	35.8
1954-1955	Moderate	44.1	47.0	31.7
1955-1956	Strong	47.9	50.5	33.0
1956-1957	Weak	46.8	49.1	34.6
1961-1962	Weak	44.5	45.8	33.1
1964-1965	Moderate	48.3	49.4	35.2
1967-1968	Weak	47.7	50.7	34.4
1970-1971	Moderate	46.5	48.8	34.5
1971-1972	Weak	45.3	47.3	33.5
1973-1974	Strong	48.1	51.5	35.1
1974-1975	Weak	45.9	49.3	34.2
1975-1976	Moderate	45.9	51.1	37.9
1983-1984	Weak	49.9	49.8	36.9
1984-1985	Moderate	47.0	47.5	33.5
1988-1989	Strong	45.4	47.6	32.3
1995-1996	Weak	51.0	51.8	35.7
1998-1999	Moderate	45.8	46.0	36.3
1999-2000	Moderate	50.3	50.9	36.1
2000-2001	Weak	47.6	48.6	35.0
30 Year Normal	N/A	47.5	49.4	35.4

From the above data overall there does not appear to be a clear correlation between La Niña episodes and temperatures during the December through February period across the area especially at both Fresno and Bakersfield. However, two of the coldest meteorological winters at Grant Grove during a La Niña episode, did occur during a strong La Niña.

Because of the connection often made between El Niño and the month of December, it was decided to analyze just the average temperature for the month of December for the same three locations.

The table below lists the average temperature for December for years with an El Niño episode. Warmer than normal Decembers were defined as those with departures from normal of greater than 2°F above normal and are depicted in orange, while cooler than normal Decembers (depicted in blue) were defined as those with departures from normal of at less than 2°F below normal.

Episode (July-June)	Strength of Episode	Fresno Average Temperature	Bakersfield Average Temperature	Grant Grove Average Temperature
1951-1952	Weak	44.8	46.8	29.6
1957-1958	Moderate	45.3	47.6	37.6
1963-1964	Weak	40.0	41.5	37.7
1965-1966	Moderate	42.0	42.8	33.4
1968-1969	Weak	43.3	47.0	31.0
1969-1970	Weak	46.2	51.1	37.1
1972-1973	Strong	40.9	43.6	31.0
1976-1977	Weak	46.5	51.1	40.5
1977-1978	Weak	51.2	57.1	40.2
1982-1983	Strong	45.4	46.4	34.7
1986-1987	Moderate	47.5	47.1	37.5
1987-1988	Moderate	44.2	47.0	29.5
1991-1992	Moderate	47.0	48.2	37.4
1992-1993	Weak	45.3	46.5	30.4
1993-1994	Weak	45.6	46.9	35.1
1994-1995	Moderate	45.3	45.8	34.4
1997-1998	Strong	44.7	46.2	33.2
2002-2003	Moderate	49.3	51.2	31.1
2004-2005	Weak	46.5	46.4	39.4
2006-2007	Weak	47.1	48.2	35.2
30 Year Normal	N/A	45.2	47.2	36.0

During strong El Niño events, temperatures tend to average near normal in the San Joaquin Valley and below normal to near normal at Grant Grove during the month of December. There does not appear to be any direct correlations during weak to moderate El Niño episodes. The correlation of colder than normal meteorological winters and colder than normal Decembers appears to be most pronounced in the higher elevations of the Sierra Nevada than in the San Joaquin Valley.

The table below lists the average temperature for December for years with a La Niña episode. Warmer than normal Decembers were defined as those with departures from normal of greater than 2°F above normal and are depicted in orange, while cooler than normal Decembers (depicted in blue) were defined as those with departures from normal of less than 2°F below normal.

Episode (July-June)	Strength of Episode	Fresno Average Temperature	Bakersfield Average Temperature	Grant Grove Average Temperature
1950-1951	Weak	50.9	52.6	41.0
1954-1955	Moderate	43.7	46.3	35.1
1955-1956	Strong	50.1	52.5	33.8
1956-1957	Weak	44.5	47.3	38.9
1961-1962	Weak	43.7	45.3	33.3
1964-1965	Moderate	49.0	50.7	34.6
1967-1968	Weak	42.6	45.3	30.1
1970-1971	Moderate	46.3	49.1	30.6
1971-1972	Weak	42.9	45.4	26.9
1973-1974	Strong	47.2	50.0	38.2
1974-1975	Weak	44.5	46.8	33.8
1975-1976	Moderate	43.9	48.0	39.6
1983-1984	Weak	51.1	50.6	35.2
1984-1985	Moderate	46.5	47.2	31.2
1988-1989	Strong	44.5	47.2	33.4
1995-1996	Weak	50.5	52.0	37.2
1998-1999	Moderate	42.8	43.5	35.0
1999-2000	Moderate	47.0	47.5	38.7
2000-2001	Weak	47.8	48.1	41.5
30 Year Normal	N/A	45.2	47.2	36.0

The effects on December temperatures tend to vary widely during La Niña episodes especially depending on location. Strong La Niñas tend to average at or above normal in the San Joaquin Valley in December as evidenced by the average temperatures at Fresno and Bakersfield. However, at Grant Grove, strong La Niña events tend to run at or below normal. Overall there appears to be no correlation with December average temperature and La Niña for weak to moderate episodes at both Fresno and Grant Grove. Bakersfield at a more southern latitude, however, has only seen one December average below normal during a La Niña episode. All other Decembers in Bakersfield have averaged at or above normal. Thus, there seems to be more of correlation with La Niña and average December temperatures across southern portions of the San Joaquin Valley than at points further north. Likely, this is due to the historical correlations showing drier than normal conditions in southern California and the southwestern United States during La Niña events, which Bakersfield is geographically closer to. With less precipitation is less storm activity and thus temperatures have the ability to reach high values due to the lack of cloud cover around.

The table below lists the number of days with minimum temperatures of 28°F or below for years with an El Niño episode (July-June period).

Episode	Strength of Episode	Number of Days With Minimum Temperatures of 28°F Or Below At Fresno	Number of Days With Minimum Temperatures of 28°F Or Below At Bakersfield
1951-1952	Weak	12	6
1957-1958	Moderate	0	0
1963-1964	Weak	6	2
1965-1966	Moderate	19	1
1968-1969	Weak	2	2
1969-1970	Weak	10	6
1972-1973	Strong	14	5
1976-1977	Weak	5	0
1977-1978	Weak	4	0
1982-1983	Strong	0	1
1986-1987	Moderate	3	6
1987-1988	Moderate	9	4
1991-1992	Moderate	1	0
1992-1993	Weak	2	0
1993-1994	Weak	0	1
1994-1995	Moderate	0	4
1997-1998	Strong	3	3
2002-2003	Moderate	0	0
2004-2005	Weak	0	7
2006-2007	Weak	7	8
30 Year Normal	N/A	4.5	2.7

Looking at the number of days with minimum temperatures of 28°F or below during El Niño events, it is evident that there is no correlation between the two. As can be seen especially in the data for Fresno, there has been double to nearly quadruple the number of such minimums of the thirty year normal in weak, moderate and strong El Niño events.

The table below lists the number of days with minimum temperatures of 28°F or below for years with a La Niña episode (July-June period).

Episode	Strength of Episode	Number of Days With Minimum Temperatures of 28°F Or Below At Fresno	Number of Days With Minimum Temperatures of 28°F Or Below At Bakersfield
1950-1951	Weak	3	2
1954-1955	Moderate	8	5
1955-1956	Strong	1	1
1956-1957	Weak	20	3
1961-1962	Weak	12	3
1964-1965	Moderate	0	3
1967-1968	Weak	6	1
1970-1971	Moderate	9	3
1971-1972	Weak	8	7
1973-1974	Strong	0	0
1974-1975	Weak	11	2
1975-1976	Moderate	17	1
1983-1984	Weak	0	0
1984-1985	Moderate	0	1
1988-1989	Strong	10	7
1995-1996	Weak	0	0
1998-1999	Moderate	8	11
1999-2000	Moderate	0	1
2000-2001	Weak	0	1
30 Year Normal	N/A	4.5	2.7

The values in the above table show that there is no correlation between the occurrence of a La Niña and the frequency of minimum temperatures of 28°F or below. While the strong La Niña events of 1955-1956 and 1973-1974 showed a reduced frequency of minimums of 28°F or below, the strong event of 1988-1989 had nearly double the thirty year normal number of days with minimums of 28°F or below.

Tornadoes

The table below lists the total number of tornadoes reported for years with an El Niño episode (July-June period). The column on the right lists the number of tornadoes rated F2 or higher on the Fujita Scale.

Episode	Strength of Episode	Total Number of Tornadoes	Total Number of Tornadoes Rated F2 or greater
1951-1952	Weak	0	0
1957-1958	Moderate	2	Unknown – tornadoes not rated
1963-1964	Weak	1	0
1965-1966	Moderate	0	0
1968-1969	Weak	0	0
1969-1970	Weak	0	0
1972-1973	Strong	1	0
1976-1977	Weak	0	0
1977-1978	Weak	1	0
1982-1983	Strong	0	0
1986-1987	Moderate	0	0
1987-1988	Moderate	2	0
1991-1992	Moderate	1	0
1992-1993	Weak	3	0
1993-1994	Weak	1	0
1994-1995	Moderate	5	0
1997-1998	Strong	7	0
2002-2003	Moderate	2	0
2004-2005	Weak	3	0
2006-2007	Weak	0	0

In twelve out of the twenty El Niño episodes or 60%, there was at least one reported tornado within the Hanford CWFA. However, no F2 tornadoes have ever occurred during an El Niño episode in the Hanford CWFA. Since the late 1980s, there is a marked increase in the number of confirmed tornadoes in the Hanford CWFA. This is likely due to a combination of factors – increasing population and development, the implementation of Doppler Radar and an increase in public awareness in reporting severe weather. Overall trends show that during El Niño episodes, there is an increase in the occurrence of tornadoes in the Hanford CWFA. It should be noted that the record for the most tornadoes ever in the state of California of 30 was recorded in 2005, which was the end of an El Niño episode.

The table below lists the total number of tornadoes reported for years with a La Niña episode (July-June period). The column on the right lists the number of tornadoes rated F2 or higher on the Fujita Scale.

Episode	Strength of Episode	Total Number of Tornadoes	Total Number of Tornadoes Rated F2 or greater
1950-1951	Weak	0	0
1954-1955	Moderate	1	0
1955-1956	Strong	0	0
1956-1957	Weak	1	0
1961-1962	Weak	1	1
1964-1965	Moderate	0	0
1967-1968	Weak	0	0
1970-1971	Moderate	0	0
1971-1972	Weak	0	0
1973-1974	Strong	0	0
1974-1975	Weak	3	0
1975-1976	Moderate	0	0
1983-1984	Weak	0	0
1984-1985	Moderate	0	0
1988-1989	Strong	1	0
1995-1996	Weak	5	0
1998-1999	Moderate	1	0
1999-2000	Moderate	1	0
2000-2001	Weak	1	0

In nine of the nineteen La Niña episodes or 47%, tornadoes occurred in the Hanford CWFA. While not much of a correlation exists with La Niña episodes, especially with moderate or strong events, there are a few interesting trends to note during weak La Niña episodes. One of the three F2 tornadoes to only occur in the Hanford CWFA occurred in March 1962. Also, multiple tornadoes were reported during the 1974-1975 season (three) and during the 1995-1996 season (five). As with El Niño events, there is a marked increase in reports of tornadoes since the late 1980s during La Niña episodes. Again, this is likely due to a combination of factors – increasing population and development, the implementation of Doppler Radar and an increase in public awareness in reporting severe weather.

Dense Fog

The table below lists the total number of days with dense fog observed for the cool season (October – April) for years with an El Niño episode. Dense fog days were counted as a day where the visibility dropped to or below ¼ of a mile. Gray values represent 110% or more of the normal number of days with dense fog observed; yellow values has 90% or less than the normal number of days with dense fog observed.

Episode	Strength of Episode	Fresno Total	Bakersfield Total
1951-1952	Weak	25	12
1957-1958	Moderate	39	27
1963-1964	Weak	51	34
1965-1966	Moderate	39	33
1968-1969	Weak	30	22
1969-1970	Weak	32	13
1972-1973	Strong	42	20
1976-1977	Weak	27	20
1977-1978	Weak	32	30
1982-1983	Strong	49	36
1986-1987	Moderate	32	23
1987-1988	Moderate	33	24
1991-1992	Moderate	43	23
1992-1993	Weak	31	14
1993-1994	Weak	36	15
1994-1995	Moderate	35	14
1997-1998	Strong	48	28
2002-2003	Moderate	40	32
2004-2005	Weak	32	26
2006-2007	Weak	16	7
30 Year Normal	N/A	35	22

Overall, there appears to be little correlation between the number of days with dense fog and El Niño at Bakersfield. In Fresno, strong El Niño episodes tend to correlate to a higher number than average days with dense fog. However, there appears to be no direct correlation with weak to moderate El Niño episodes.

The table below lists the total number of days with dense fog observed for the cool season (October – April) for years with a La Niña episode. Dense fog days were counted as a day where the visibility dropped to or below ¼ of a mile. Gray values represent 110% or more of the normal number of days with dense fog observed; yellow values has 90% or less than the normal number of days with dense fog observed.

Episode	Strength of Episode	Fresno Total	Bakersfield Total
1950-1951	Weak	39	23
1954-1955	Moderate	47	38
1955-1956	Strong	41	20
1956-1957	Weak	31	25
1961-1962	Weak	44	37
1964-1965	Moderate	43	26
1967-1968	Weak	52	28
1970-1971	Moderate	40	26
1971-1972	Weak	41	22
1973-1974	Strong	42	25
1974-1975	Weak	38	28
1975-1976	Moderate	26	8
1983-1984	Weak	34	20
1984-1985	Moderate	36	33
1988-1989	Strong	43	28
1995-1996	Weak	32	23
1998-1999	Moderate	36	16
1999-2000	Moderate	11	3
2000-2001	Weak	23	18
30 Year Normal	N/A	35	22

Dense fog events generally appear to occur at greater than normal frequencies during La Niña episodes. However, the 1999-2000 cool season, which was a La Niña episode, was also the least foggiest ever on record at both Fresno and Bakersfield.

Conclusion

Overall, the most pronounced correlation between El Niño and La Niña episodes and weather in interior Central California involved precipitation. Strong El Niño events have all produced above normal precipitation for the water season at the three locations included in this study, and above normal snowfall at Grant Grove. La Niña events tend to bring near to below normal precipitation amounts for the water season at all three stations, with snowfall totals near to below normal at Grant Grove. The effect of La Niña on lower than normal precipitation totals for the water season was most pronounced at the most southern station studied, Bakersfield.

The effects of temperature across interior Central California varied during La Niña episodes. During El Niño episodes only ones classified as strong showed any significant trend, which generally was one of near normal in the San Joaquin Valley and near normal to below normal in the Sierra Nevada. No clear trend could be established for days where a minimum temperature dipped to or below 28°F in either El Niño or La Niña episodes.

Tornadoes were shown to have occurred on at least one instance in the Hanford County Forecast and Warning Area in 60% of the El Niño episodes. Days in which the visibility dropped to or below ¼ of a mile in fog in the San Joaquin Valley were more frequent during La Niña episodes at both Fresno and Bakersfield, while only Fresno showed a correlation with a higher than normal frequency of fog during strong El Niño episodes.

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