ENSO AND AVALANCHE FATALITIES: IS THERE A CORRELATION?[1]

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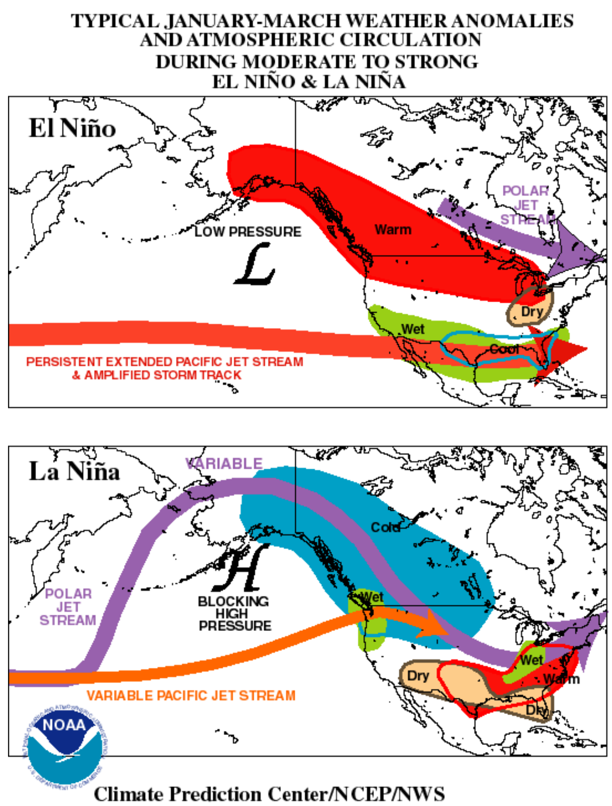
Abstract: Preliminary statistical evidence suggests that some correlation may exist between ENSO (El Niño Southern Oscillation) events and annual North American avalanche fatalities. While this potential correlation seems to extend to both El Niño and La Niña events and may operate on both regional and national levels, the degree of correlation may also be influenced by the strength of the event. Although the dataset is rather sparse and few definitive conclusions can be reached (especially when the potentially complicating effects of global warming are considered), it appears that both the event and the magnitude of the event influence the "character of the winter"—or how the winter evolves. As might be expected the winter's character directly relates to snowpack structure, the extent and frequency of important weak layer development and the ensuing load on such weak layers—all of which are common contributing factors to avalanche accidents. Some possible correlations between ENSO, snowpack structure and avalanche accidents are presented in terms of snowpack, weather and other factors.

Keywords: El Niño, La Niña, ENSO, weather, snowpack evolution, avalanche fatality, snowpack structure, character of the winter

1. INTRODUCTION

During the past 20+ years an increasing body of knowledge has evolved regarding our understanding and classification of El Niño and La Niña weather events, collectively known as ENSO (El Niño-Southern Oscillation). This knowledge base has expanded to include typical or preferred synoptic flow weather patterns most commonly associated with the particular ENSO event as well as the major anticipated weather impacts (see Figure 1 below, and Appendix A for a description of the associated weather). From these larger scale flow anomalies typically affecting North America during an ENSO event, both national and more regional weather and snowpack effects resulting from such normal or "neutral" winter deviations may be inferred. Although more detail has also arisen regarding the relative strength of individual ENSO events and the impact of these variable events on local, regional, and national weather (and associated snowpack) regimes, it may be premature to draw any conclusions from this rather limited data set (some events may contain less than three years of historical data).

Figure 1. Typical winter flow patterns associated with moderate to strong warm (El Niño) or cold (La Niña) events.



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Initially, this study began by correlating annual North American (US and Canadian) avalanche fatality data with a consensus data set consisting of historical ENSO anomalies provided by four separate US government agencies. These agencies included the Climate Prediction Center—National Center for Environmental Prediction (CPC-NCEP), Western Region Climate Center (WRCC), Climatic Data Center (CDC), and the Earth System Research Laboratory (ESRL-MEI). However, in the fall of 2007, NOAA's CPC developed a new definition of ENSO events through ERSST.v3:

DESCRIPTION: Warm and cold episodes are based on a threshold of +/- 0.5^{o}C for the Oceanic Niño Index (ONI) [3 month running mean of ERSST.v3 SST anomalies in the Niño 3.4 region (5^{o}N-5^{o}S, 120^o-170^{o}W)], based on the 1971-2000 base period. For historical purposes cold and warm episodes are defined when the threshold is met for a minimum of 5 consecutive over-lapping seasons.

It is this updated ENSO event definition and associated dataset that has been used to define and categorize cold and warm events by season and for correlation of ENSO winters with existing avalanche fatality data sets. See Appendix B or consult the link above for a spreadsheet showing the evolution of historical ENSO events through seasonal tracking of the ONI (running three month period of the Oceanic Niño Index).

2. RESEARCH & APPLICATION

As strongly indicated by recent historical trends in annual avalanche fatality data for North America, an overall increase in deaths is evident (Figure 2) but appears somewhat cyclical. And in the US, ever since the 1950's when leisure time activities such as winter sports began to blossom, the annual fatality total has shown an irregular but significant increase from 1950 through the present (Figure 3).

There is little doubt among avalanche professionals that the periodic increases evidenced have been fueled by the advent of new equipment and new back country user groups, especially during the past 20+ years when a combination of increased back country travel, better equipment and more extreme winter sports activities (e.g., highmarking, extreme skiing, snowboarding, etc) have become much more commonplace.

For instance, the fatality increases evident in the 1970's and 80's were at least in part driven by an increase in back country skiing and related equipment (cross country, telemark and mountaineering skis) along with an initial lack of avalanche awareness within this user group. This was quickly followed by the increased accident toll in the mid-late 1990's through the present, a time when ever higher-tech snowboards, snowmobiles, shape skis, snowshoes and an extreme mind set combined to produce increasing numbers of new, independently minded and aggressive user groups. Within such groups, many have been constantly pressing and expanding the limits of their sport and the associated terrain in which they travel or recreate.

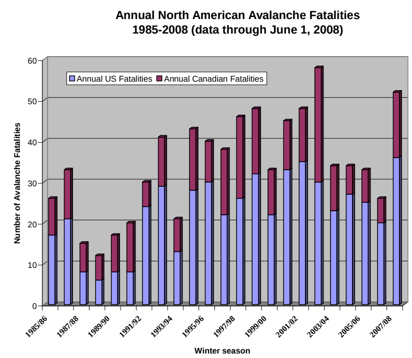

Figure 2. North American Avalanche Fatalities by winter season, 1985-2008. Data courtesy NWAC, CAC, CAIC and Avalanche.org.

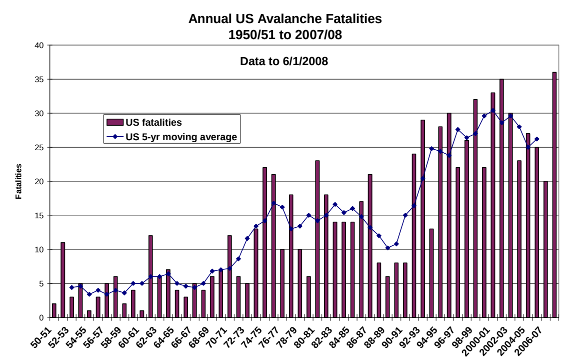

Figure 3. United States Avalanche Fatalities by winter season, 1950-2008. Data courtesy NWAC, CAIC and Avalanche.org.

However, despite the overall long term increase in avalanche fatalities driven by the factors above, the wide variability in season to season accidents and deaths seems less explainable by enhanced equipment, changing user groups, or increasing numbers of users. Could this inconsistency be more closely related to seasonal weather trends and the resulting variability in snowpack evolution? Could such accident variability be a result of (at least in part) snow and weather parameters like more persistent weak layers, enhanced instances of surface hoar, prolonged heavy snowfall events, or a lack or excess of rain crusts, all of which help define the *character* of the winter? Certainly unusual winters offer the possibility of unusual snowpack evolution—and in most instances *unusual* stability conditions offer ample opportunities for unexpected avalanches, surprised victims and an increase in fatalities.

If this association between dominant weather regimes and snowpack stability is the case, then it is reasonable to consider major factors that may impact winter weather in North America. This list of potential significant weather influences includes ENSO, global warming, the Arctic Oscillation (AO), Pacific Decadal Oscillation (PDO) and others (e.g., Madden-Julian Oscillation—MJO, Pacific North American Index--PNA). While each of the above may be a contributor to North American weather for a part of the winter (MJO) or for multiple winters (PDO, global warming, AO), it is beyond the scope of this paper to analyze all potential contributors to North American winter time weather and the avalanche accidents that may result. Hence, from this point forward, this paper will focus on ENSO events and their possible correlation to avalanche fatalities.

2.1 National ENSO Correlations

Since ENSO is one of the major cyclical weather events that produce significant deviations in wintertime precipitation and temperature patterns for North America, it is instructive to reproduce the annual fatality toll (Figure 3) for both the US and Canada and with fatality years coded by type of ENSO event. These charts are shown below in Figures 4 and 5 and from closer examination of the data, some interesting trends emerge.

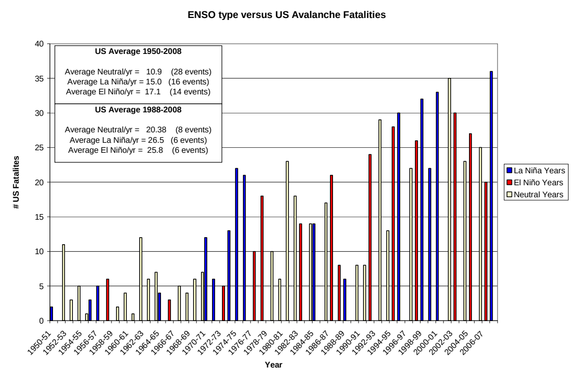

Figure 4. ENSO type versus annual US avalanche fatalities,1950-2008.

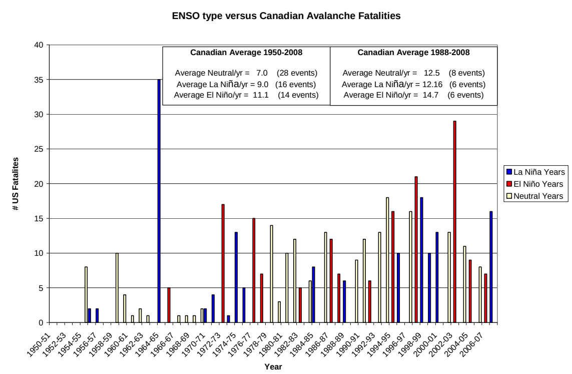

Figure 5. ENSO type versus annual Canadian avalanche fatalities,1950-2008. Fatality data courtesy Canadian Avalanche Association and Canadian Avalanche Center.

These trends (summarized in Figure 6) indicate that annual North American avalanche fatalities during ENSO years experience a significant increase (from about 29% to over 60%) over neutral years if all years of the study (1950-2008) are included. While annual US fatality totals also show a substantial increase during ENSO years if only more recent years are included (1988-2008), Canadian avalanche fatalities show a slight decrease (-2.7%) for La Niña years versus neutral years during this same more recent period.

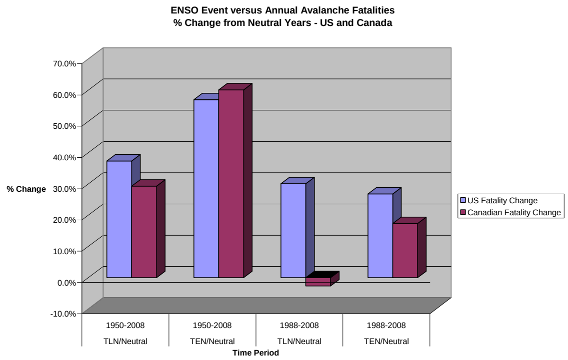

Figure 6. ENSO Event versus Annual Avalanche Fatalities; % Change from Neutral Years - US and Canada. (TEN = total El Niño Years, TLN = total La Niña years, Neutral = non-ENSO years)

If these annual fatality totals by country are compared with the strength of the ENSO event, a similar pattern emerges. Although the US annual fatality total shows significant increases throughout the spectrum of ENSO intensities (Figures 7 and 8) for both La Niñas and El Niños, the Canadian fatality figures for the same periods by ENSO magnitude show less significant increases or even a slight decrease (last 20 years during La Niña years only). However, it must be noted that some of the fatality statistics by ENSO type are based on relatively small sample sizes (6 years or less) and any correlations indicated can be very strongly impacted by an otherwise anomalous extreme occurring during a particular winter.

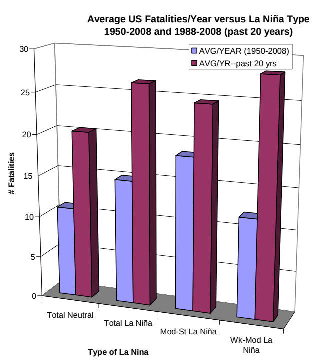

Figure 7. Average US Fatalities/Year versus La Niña Type.

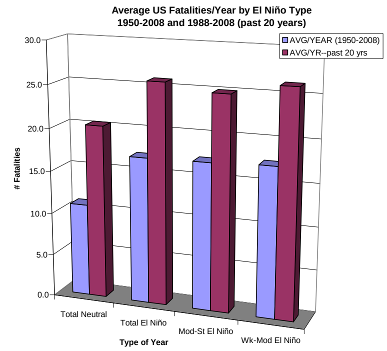

Figure 8. Average US Fatalities/Year versus El Niño Type.

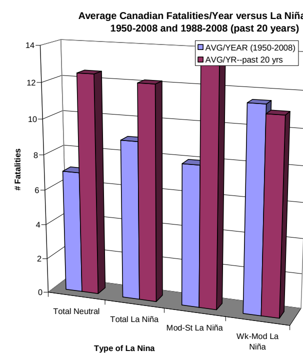

Figure 9. Average Canadian Fatalities/Year versus La Niña Type.

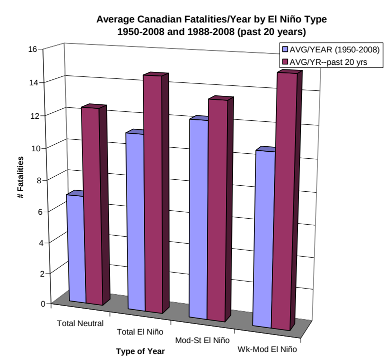

Figure 10. Average Canadian Fatalities/Year versus El Niño Type.

2.2 Regional ENSO Correlations

Focusing on more local (by state) responses to ENSO events within the US, the next few figures show the annual fatality variability by ENSO event and intensity for Washington State (Figures 11 and 12). As with earlier possible explanations for the increased US fatality response to ENSO events, a potential reason for the lack of a significant direction (increase or decrease) for Washington State fatality variations during El Niño events may also be found in the *character* of the winter.

For this more local ENSO response, the typical flow patterns associated with El Niño (Figure 1) need to be revisited. During strong El Niño events, much of the jetstream energy and the preferred storm track is normally shifted southward over California and the southwest US. While this flow pattern may limit heavy snowfall episodes in the NW, it also tends to limit warming events and associated rain amounts (prolonged warm air intrusion is kept to the south). However, the associated weather pattern may produce heavier snowfall along the Cascade east slopes (closed lows to the south); also periods of clearing between storms tracking by to the south may provide ample growth regimes for surface hoar and upper level faceting. Thus, despite a slightly lower than normal snowpack in most instances (especially near and west of the Cascade crest), El Niño events in Washington State may lead to an almost normal amount of avalanche activity (and fatalities)—owing to the increase in hoar frost or faceted layers that may be buried by subsequent snowfall, along with potentially enhanced snowfall events east of the Cascade crest.

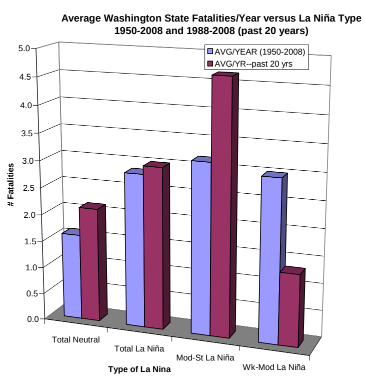

Figure 11. Average Washington State Fatalities/Year versus La Niña Type.

A differing Northwest response unfolds during La Niña winters, especially those years with moderate to strong events. In this situation, an overall cooler west to northwesterly upper level flow often results in prolonged periods of heavy snowfall, cool temperatures and strong winds in Washington State. This wind driven snowfall arrives without the more well-known rainfall events that normally help settle and stabilize the NW snowpack and give crusts that might otherwise act to “bridge over” or limit the destabilizing effects of buried weak layers. Such weather also tends to produce abundant upper level faceting early in the season, with subsequent cool snowy weather limiting and/or slowing stabilization of these persistent facets while adding more load. This scenario produces a dangerous winter “*character*”—one in which awesome powder is often interrupted by significant direct action avalanching, prolonged deep instabilities, and a cadre of unexpected avalanches in unusual places.

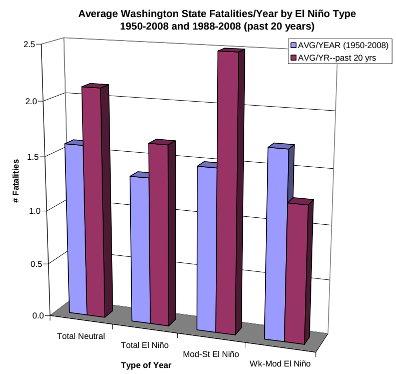

Figure 12. Average Washington State Fatalities/Year versus El Niño Type.

The Northwest Weather and Avalanche Center recently finished a comparison of snowpack evolution during ENSO and non-ENSO winters. It is instructive in this context to look at such a chart as it may provide another tool to provide a “*character*” for such winters. From this snowdepth chart for Snoqualmie Pass, WA, average La Niña winter snowdepth evolution by type of event is shown versus climatology for this location. Overall, the snowdepth evolution indicates dramatic increases in snowdepth over climatology for almost all types of La Niñas (heavy snowfall accumulation without significant rain events) and for almost all times of the winter. Similar charts for other higher elevation Cascade stations indicate like trends in snowpack accumulation—unusually heavy snowfall for prolonged periods. When unusually heavy snowfall is combined with unusual and prolonged low freezing levels, a potentially dangerous avalanche situation can develop, at both normal and at unusually low elevations. Such an unusual situation during the past strong La Niña winter in Washington produced a serious avalanche accident that claimed the life of one youngster out on a hike on a lower elevation and normally low avalanche danger trail (Lake Twenty-two Trail).

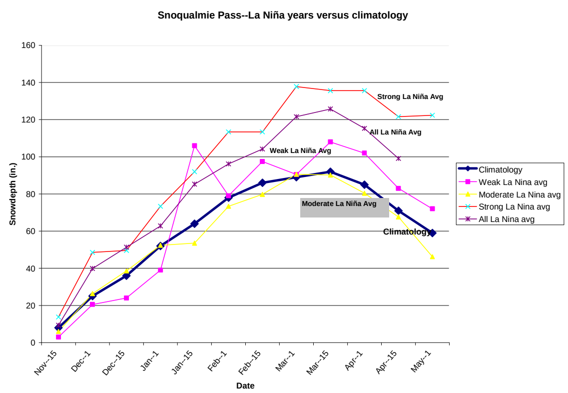

Figure 13. Snow depth comparison between La Niña type and climatology for Snoqualmie Pass, WA (914 m elevation).

Similar fatality variability versus ENSO event type for selected mountainous states within the US is shown in Figure 13, although this shows only the variation by ENSO event type (El Niño or La Niña) and historical time period.

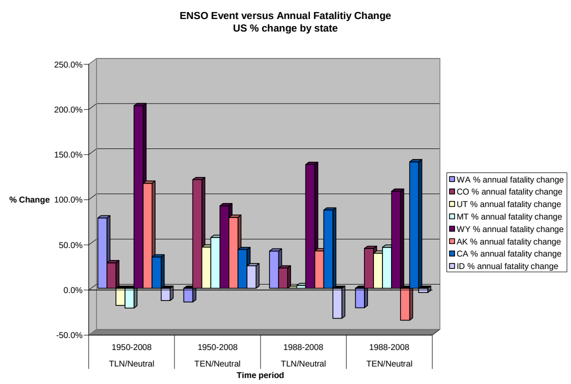

Figure 14. ENSO event versus annual fatality change in percent, selected US mountainous states.

As might be expected and as can be seen from the graph, there are significant variations in annual fatality averages versus ENSO event by region and by state. These variations most probably result from varying intensities and durations of the most typical synoptic or larger scale flow patterns associated with the particular ENSO event's magnitude. However, from the figure and the equivalent table below it is evident that most states experience a significant increase in avalanche fatalities during ENSO event driven years. Once again the "character" of the winter may be responsible—unusual winters produce unusual snowpacks and unusual avalanches. And these unusual avalanches can catch and bury even relatively seasoned back country travelers, especially those wishing to expand their personal limits or that of their equipment (particularly if caught on video).

Summary Annual Avalanche Fatalities versus ENSO				
REGION	% change **TLN/Neutral** 1950-2008	% change **TEN/Neutral** 1950-2008	% change **TLN/Neutral** 1988-2008	% change **TEN/Neutral** 1988-2008
US	37.4%	57.0%	30.1%	26.8%
Canada	29.3%	60.1%	-2.7%	17.3%
WA	77.9%	-15.2%	41.2%	-21.6%
CO	28.2%	120.2%	22.5%	44.1%
UT	-19.0%	45.7%	0.0%	38.9%
MT	-21.9%	56.3%	3.0%	45.5%
WY	202.2%	91.3%	137.0%	107.4%
AK	116.3%	78.6%	41.4%	-35.4%
CA	34.6%	42.9%	86.7%	140.0%
ID	-13.5%	25.0%	-33.3%	-4.8%

Table 1. Summary Annual Avalanche Fatalities versus ENSO by region or state, 1950-2008 and 1988-2008.

Like earlier charts, Table 1 and Figure 14 also indicate a variable but significant change in annual avalanche fatalities by ENSO event by state and region. Although the majority of regions show a fatality increase (ranging from 3% to over 200 %) with ENSO events in general (as compared to neutral years), some indicate an overall smaller but not insignificant decrease, while others show temporal changes (e.g., WA) that may be dependent on period of measure (e.g., 1950-2008 versus 1988-2008). Once again some of these changes may be artifacts of the limited datasets rather than actual correlations.

3. CONCLUSIONS

Many factors influence annual avalanche fatalities in a given area for any particular time period. As avalanche professionals are well aware, these factors include snowpack, weather, terrain and human effects, all of which are interrelated. The complexity of this interrelationship may limit conclusions drawn from any particular factor. However, the *character of the winter*, or how a particular winter season and its associated snowpack develops, may extend across all factors and have a broader application through its potential impact on the duration and frequency of avalanche danger. In this preliminary study, it appears that the *character of the winter*, the ensuing snowpack and its dangers, may be correlated with ENSO events. Over a winter this temporal and aerial danger distribution, especially if it results in unusual or unexpected snowpack evolution, may correlate to a higher (or in some instances lower) number of fatalities, depending on the region and the time frame sampled. At the very least, knowledge that an ENSO driven winter is imminent should trigger an increased awareness that deviations from a “normal” snowpack are possible, and that heightened awareness of such differences may be crucial to safe travel in snow covered terrain.

ACKNOWLEDGEMENTS

Any conclusions or patterns resulting from this study are possible only through the diligence and efforts of those who analyze and catalogue weather and avalanche accident data. For these efforts the author is indebted since without these databases none of the potential correlations indicated would be possible.

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APPENDIX A

El Niño and La Niña Related Weather Features over North America (Summary courtesy CPC)

General: During winter El Niño episodes (top map, Figure 1) feature a strong jet stream and storm track across the southern part of the United States, and less storminess and milder-than-average conditions across the North. La Niña episodes (bottom map, Figure 1) feature a very wave-like jet stream flow over the United States and Canada, with colder and stormier than average conditions across the North, and warmer and less stormy conditions across the South.

Detailed El Nino: El Niño episodes are associated with four prominent changes in the wintertime atmospheric flow across the eastern North Pacific and North America. The first is an eastward extension and equatorward shift of the East Asian jet stream from the International Date Line to the southwestern United States. The second is a more west-to-east flow of jet stream winds than normal across the United States. The third is a southward shift of the storm track from the northern to the southern part of the United States. The fourth is a southward and eastward shift of the main region of cyclone formation to just west of California. This shift results in an exceptionally stormy winter and increased precipitation across California and the southern U.S., and less stormy conditions across the northern part of the country. Also, there is an enhanced flow of marine air into western North America, along with a reduced northerly flow of cold air from Canada to the United States. These conditions result in a milder than normal winter across the northern states and western Canada.

Detailed La Nina: La Niña episodes are associated with three prominent changes in the wintertime atmospheric flow across the eastern North Pacific and North America. The first is an amplification of the climatological mean wave pattern and increased meridional flow across the continent and the eastern North Pacific. The second is increased blocking activity over the high latitudes of the eastern North Pacific. The third is a highly variable strength of the jet stream over the eastern North Pacific, with the mean jet position entering North America in the northwestern United States/ southwestern Canada. Accompanying these conditions, large portions of central North America experience increased storminess, increased precipitation, and an increased frequency of significant cold-air outbreaks, while the southern states experiences less storminess and precipitation. Also, there tend to be considerable month-to-month variations in temperature, rainfall and storminess across central North America during the winter and spring seasons, in response to the more variable atmospheric circulation throughout the period.

APPENDIX B

Cold and Warm Episodes by Season, 1950-2008

(Data courtesy of NOAA—Climate Prediction Center)

Changes to the Oceanic Niño Index (ONI)

DESCRIPTION: Warm (red) and cold (blue) episodes based on a threshold of +/- 0.5°C for the Oceanic Niño Index (ONI) [3 month running mean of ERSST.v3 SST anomalies in the Niño 3.4 region (5°N-5°S, 120°-170°W)], based on the 1971-2000 base period. For historical purposes cold and warm episodes (blue and red colored numbers) are defined when the threshold is met for a minimum of 5 consecutive over-lapping seasons.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1950	-1.7	-1.5	-1.4	-1.4	-1.3	-1.2	-0.9	-0.8	-0.8	-0.8	-0.9	-1.0
1951	-1.1	-0.9	-0.7	-0.4	-0.2	0.1	0.3	0.5	0.6	0.7	0.7	0.6
1952	0.3	0.2	0.1	0.1	0.0	-0.2	-0.3	-0.3	-0.1	-0.2	-0.2	-0.1
1953	0.1	0.3	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.2
1954	0.3	0.2	-0.2	-0.6	-0.8	-0.8	-0.8	-1.1	-1.2	-1.1	-1.1	-1.0
1955	-1.0	-0.9	-0.9	-1.0	-1.1	-1.0	-1.0	-1.0	-1.4	-1.8	-2.0	-1.7
1956	-1.2	-0.7	-0.6	-0.6	-0.5	-0.5	-0.6	-0.8	-0.8	-0.9	-0.8	-0.7
1957	-0.5	-0.1	0.3	0.6	0.7	0.9	0.9	0.9	0.9	0.9	1.2	1.5
1958	1.7	1.5	1.1	0.7	0.5	0.5	0.4	0.2	0.0	0.0	0.2	0.4
1959	0.4	0.5	0.4	0.2	0.1	-0.2	-0.4	-0.5	-0.4	-0.3	-0.2	-0.3
1960	-0.3	-0.3	-0.3	-0.1	-0.1	-0.1	0.0	0.0	0.0	-0.2	-0.2	-0.2
1961	-0.1	-0.2	-0.2	-0.1	0.1	0.2	0.1	-0.3	-0.6	-0.6	-0.5	-0.4
1962	-0.5	-0.5	-0.4	-0.5	-0.4	-0.3	-0.2	-0.3	-0.4	-0.6	-0.7	-0.7
1963	-0.6	-0.3	0.0	0.1	0.1	0.3	0.7	0.9	0.9	0.9	1.0	1.0
1964	0.9	0.4	0.0	-0.5	-0.7	-0.7	-0.7	-0.8	-1.0	-1.1	-1.1	-1.0
1965	-0.8	-0.5	-0.2	0.0	0.3	0.7	1.0	1.3	1.5	1.6	1.6	1.5
1966	1.2	1.1	0.8	0.5	0.3	0.2	0.2	0.0	-0.2	-0.2	-0.3	-0.3
1967	-0.4	-0.5	-0.6	-0.5	-0.2	0.0	0.0	-0.2	-0.4	-0.5	-0.4	-0.5
1968	-0.7	-0.8	-0.8	-0.7	-0.4	0.0	0.3	0.3	0.3	0.4	0.7	0.9
1969	1.0	1.0	0.9	0.8	0.6	0.5	0.4	0.4	0.6	0.7	0.7	0.6
1970	0.5	0.3	0.2	0.1	0.0	-0.3	-0.6	-0.7	-0.7	-0.7	-0.8	-1.1
1971	-1.3	-1.4	-1.2	-0.9	-0.8	-0.8	-0.8	-0.8	-0.8	-0.9	-1.0	-0.9
1972	-0.7	-0.3	0.0	0.3	0.6	0.8	1.1	1.4	1.6	1.8	2.1	2.1
1973	1.8	1.2	0.5	0.0	-0.5	-0.8	-1.0	-1.2	-1.4	-1.7	-1.9	-2.0
1974	-1.8	-1.6	-1.2	-1.1	-0.9	-0.7	-0.5	-0.4	-0.5	-0.7	-0.8	-0.7
1975	-0.6	-0.6	-0.7	-0.8	-0.9	-1.1	-1.3	-1.3	-1.5	-1.6	-1.7	-1.7

1976	-1.6	-1.2	-0.9	-0.6	-0.5	-0.2	0.1	0.3	0.6	0.8	0.8	0.8
1977	0.6	0.5	0.3	0.2	0.2	0.4	0.4	0.4	0.5	0.7	0.8	0.8
1978	0.8	0.5	0.0	-0.3	-0.4	-0.3	-0.3	-0.4	-0.4	-0.3	-0.2	-0.1
1979	-0.1	0.0	0.1	0.2	0.1	0.0	0.1	0.2	0.3	0.5	0.5	0.6
1980	0.5	0.4	0.3	0.2	0.3	0.3	0.2	0.0	-0.1	0.0	0.0	0.0
1981	-0.2	-0.4	-0.4	-0.3	-0.2	-0.3	-0.3	-0.3	-0.2	-0.1	-0.1	0.0
1982	0.0	0.1	0.2	0.4	0.7	0.7	0.8	1.0	1.5	1.9	2.2	2.3
1983	2.3	2.1	1.6	1.3	1.0	0.7	0.3	-0.1	-0.5	-0.7	-0.9	-0.7
1984	-0.4	-0.2	-0.2	-0.3	-0.4	-0.4	-0.3	-0.2	-0.2	-0.6	-0.9	-1.1
1985	-1.0	-0.9	-0.8	-0.8	-0.8	-0.6	-0.6	-0.5	-0.6	-0.4	-0.4	-0.4
1986	-0.5	-0.5	-0.3	-0.2	-0.1	0.0	0.2	0.4	0.6	0.9	1.0	1.2
1987	1.2	1.3	1.2	1.1	1.0	1.2	1.5	1.7	1.6	1.5	1.2	1.1
1988	0.7	0.5	0.1	-0.3	-0.9	-1.3	-1.4	-1.2	-1.3	-1.6	-2.0	-2.0
1989	-1.8	-1.6	-1.2	-0.9	-0.7	-0.4	-0.4	-0.4	-0.4	-0.3	-0.2	-0.1
1990	0.1	0.1	0.3	0.3	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4
1991	0.4	0.4	0.3	0.3	0.6	0.8	1.0	0.9	0.9	0.9	1.3	1.6
1992	1.8	1.7	1.5	1.4	1.2	0.9	0.5	0.2	-0.1	-0.1	0.1	0.3
1993	0.4	0.4	0.5	0.7	0.7	0.7	0.4	0.3	0.3	0.3	0.3	0.3
1994	0.2	0.2	0.2	0.3	0.4	0.4	0.5	0.5	0.7	0.9	1.3	1.3
1995	1.2	0.9	0.6	0.3	0.2	0.1	-0.1	-0.2	-0.5	-0.6	-0.8	-0.8
1996	-0.8	-0.7	-0.5	-0.3	-0.2	-0.2	-0.1	-0.2	-0.1	-0.2	-0.3	-0.4
1997	-0.4	-0.3	-0.1	0.3	0.8	1.3	1.7	2.0	2.2	2.4	2.5	2.5
1998	2.3	2.0	1.4	1.1	0.4	-0.1	-0.7	-1.0	-1.1	-1.2	-1.4	-1.5
1999	-1.5	-1.2	-0.9	-0.8	-0.8	-0.8	-0.9	-1.0	-1.0	-1.2	-1.4	-1.7
2000	-1.7	-1.4	-1.0	-0.8	-0.6	-0.6	-0.4	-0.4	-0.4	-0.5	-0.7	-0.7
2001	-0.7	-0.5	-0.4	-0.3	-0.1	0.1	0.1	0.0	0.0	-0.1	-0.1	-0.2
2002	-0.1	0.1	0.2	0.4	0.6	0.8	0.9	0.9	1.1	1.3	1.5	1.4
2003	1.2	0.9	0.5	0.1	-0.1	0.0	0.3	0.4	0.5	0.5	0.6	0.4
2004	0.4	0.2	0.2	0.2	0.3	0.4	0.7	0.8	0.9	0.8	0.8	0.8
2005	0.6	0.5	0.4	0.5	0.5	0.5	0.5	0.3	0.2	-0.1	-0.4	-0.8
2006	-0.8	-0.6	-0.3	-0.1	0.2	0.3	0.4	0.5	0.7	0.9	1.2	1.1
2007	0.8	0.4	0.1	-0.1	0.0	-0.1	-0.2	-0.5	-0.8	-1.1	-1.2	-1.4
2008	-1.5	-1.4	-1.1	-0.7	-0.5							