PACIFIC NORTHWEST CLIMATE CHANGES

ISSUE SUMMARY

The TSD's statement that all United States regions will warm greater than the global average is based solely on GCM models which even IPCC lead author Kevin Trenberth (2007) has admitted doesn't represent the current state of the climate in any way and can't be used for regional assessment until they are properly initialized.

The CCSP support document cherry picks the starting and ending times for trends in temperatures and snow water equivalent in order to find warming and diminished snowpack. If you look at longer term periods, you find no trends. The shorter trends relate to cyclical patterns in the Pacific, strongly supported by peer review literature..

SPECIFIC ERRORS IN THE EF/TSD

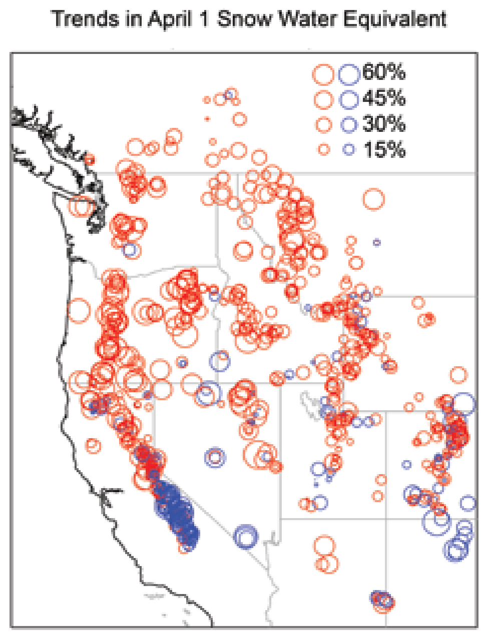
TSD ES 3: All of the U.S. is very likely to warm during this century, and most areas of the U.S. are expected to warm by more than the global average.

TSD Page 29: Rising temperatures have generally resulted in rain rather than snow in locations and seasons where climatological average (1961–1990) temperatures were close to 0°C.

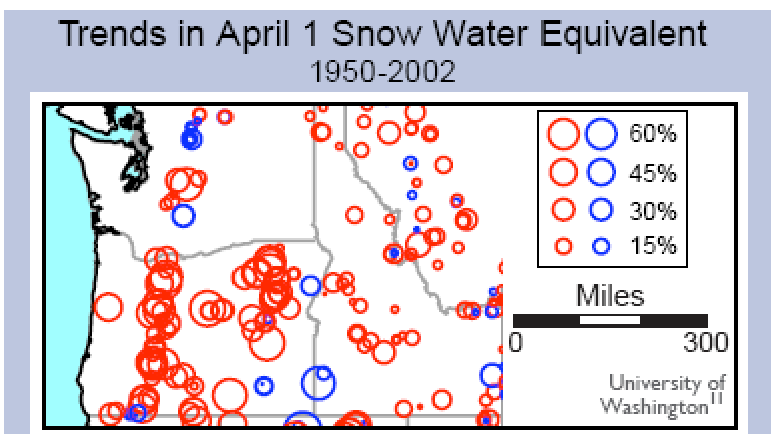
COMMENTS

This comment focuses on the Pacific Northwest Region of the United States that the supporting CCSP document has incorrectly captured past conditions by cherry picking start time of the data period in clear violation of the Federal Information Quality Act (IQA) which demands an honest assessment as the starting point for any analysis. Further since it has been admitted by the IPCC modeler lead authors such as Kevin Trenberth that the models show no skill in predicting regional weather, there is no basis for any projections of impacts for any region when starting with an inaccurate initial assessment.

In addition every reputable meteorologist and climatologist recognizes the changes seen in the 1977 to 1998 period were the result of the PDO flip in 1977 (Great Pacific Climate Shift) which favored an increase in El Ninos which forced the jet stream south. EPA's own April 1 Snow water equivalent (SWE) chart shown in the original draft CCSP, 2008 below shows that California water increased as northern areas diminished.



After that was pointed out, the authors of the CCSP cropped this image to focus only on the Pacific Northwest in order to mislead EPA and any uninformed reader. EPA's responsibility under the Federal Information Quality Act (IQA) was to review the source documentation and data to make an independent judgment about the science and the data. This is a pervasive fatal flaw in the Endangerment Finding and the Technical Support Document. EPA's reliance "studies" that would fail to meet the requirements of the IQA invalidates the Endangerment Finding.



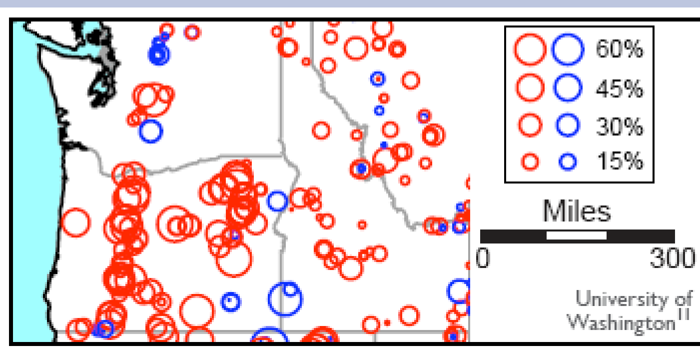
April 1 snowpack (a key indicator of natural water storage available for the warm season) has declined throughout the Northwest. In the Cascade Mountains, April 1 snowpack declined by an average of 25 percent, with some areas experiencing up to 60 percent declines. On the map, decreasing trends are in red and increasing trends are in blue[12].

"Regionally-averaged temperature rose about 1.5°F over the past century (with some areas experiencing increases up to 4°F) and is projected to increase another 3 to 10°F during this century[3], with higher emissions scenarios resulting in the upper end of this range. Increases in winter precipitation and decreases in summer precipitation are projected by many climate models though these projections are less certain than those for temperature. Impacts related to changes in snowpack, streamflows, sea level, forests, and other important aspects of life in the Northwest are already underway, with more severe impacts expected over coming decades in response to continued and more rapid warming.

Declining springtime snowpack leads to reduced summer streamflows, straining water supplies.

The Northwest is highly dependent on temperature sensitive springtime snowpack to meet growing, and often competing, water demands such as municipal and industrial uses, agricultural irrigation, hydropower production, navigation, recreation, and in-stream flows that protect aquatic ecosystems including threatened and endangered species. Higher cool season (October through March) temperatures cause more precipitation to fall as rain rather than snow and contribute to earlier snowmelt. April 1 snowpack, a key indicator of natural water storage available for the warm season, has already declined substantially throughout the region. The average decline in the Cascade Mountains, for example, was about 25 percent over the past 40 to 70 years, with most of this due to the 2.5°F increase in cool season temperatures over that period[5,]. Further declines in Northwest snowpack are projected to result from additional warming over this century, varying with latitude, elevation, and proximity to the coast. April 1 snowpack is projected to decline as much as 40 percent in the Cascades by the 2040s. Throughout the region, earlier snowmelt will cause a reduction in the amount of water available during the warm season[8].

Trends in April 1 Snow Water Equivalent
1950-2002



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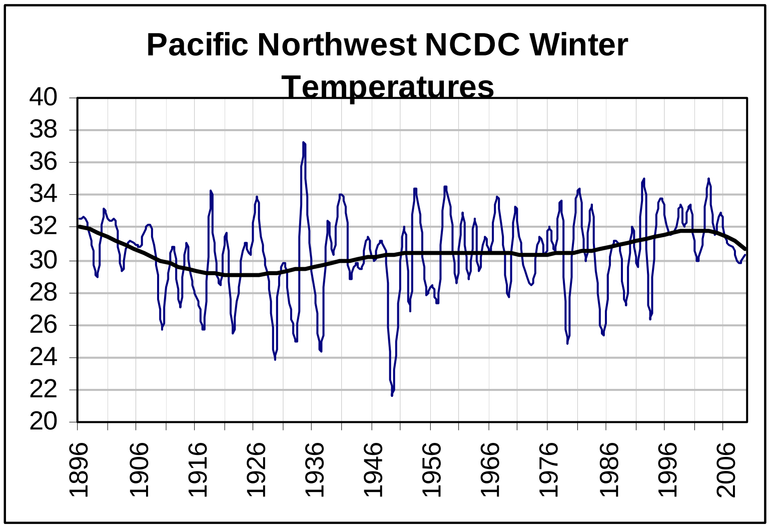
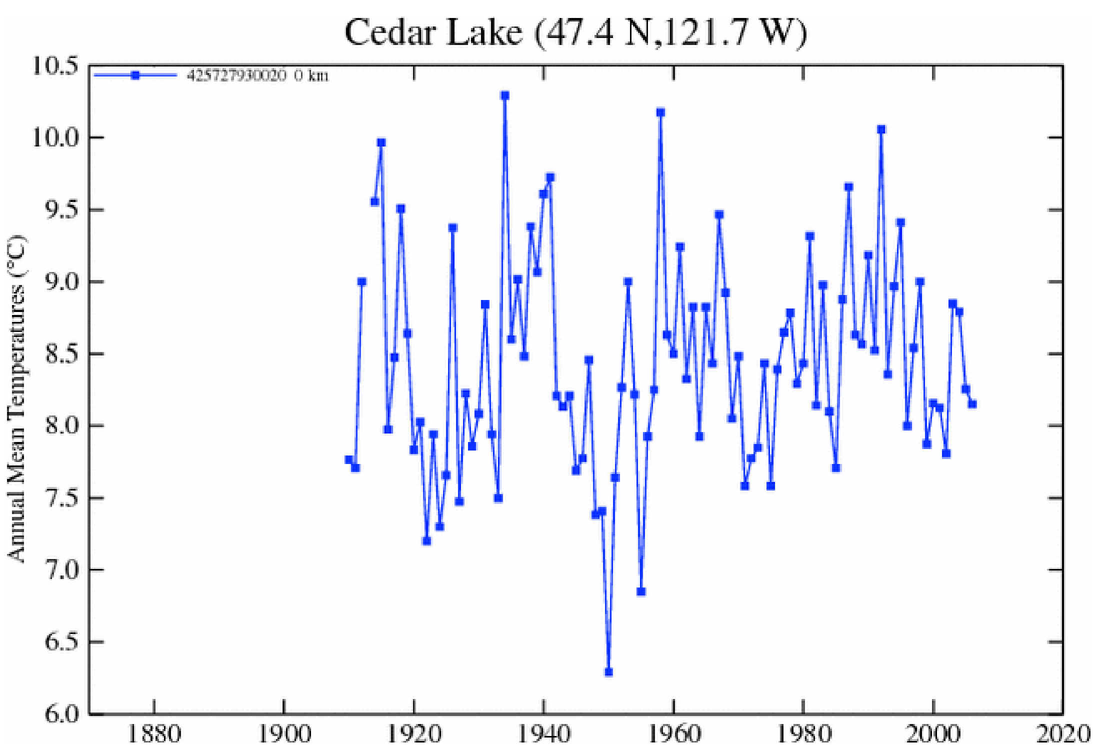
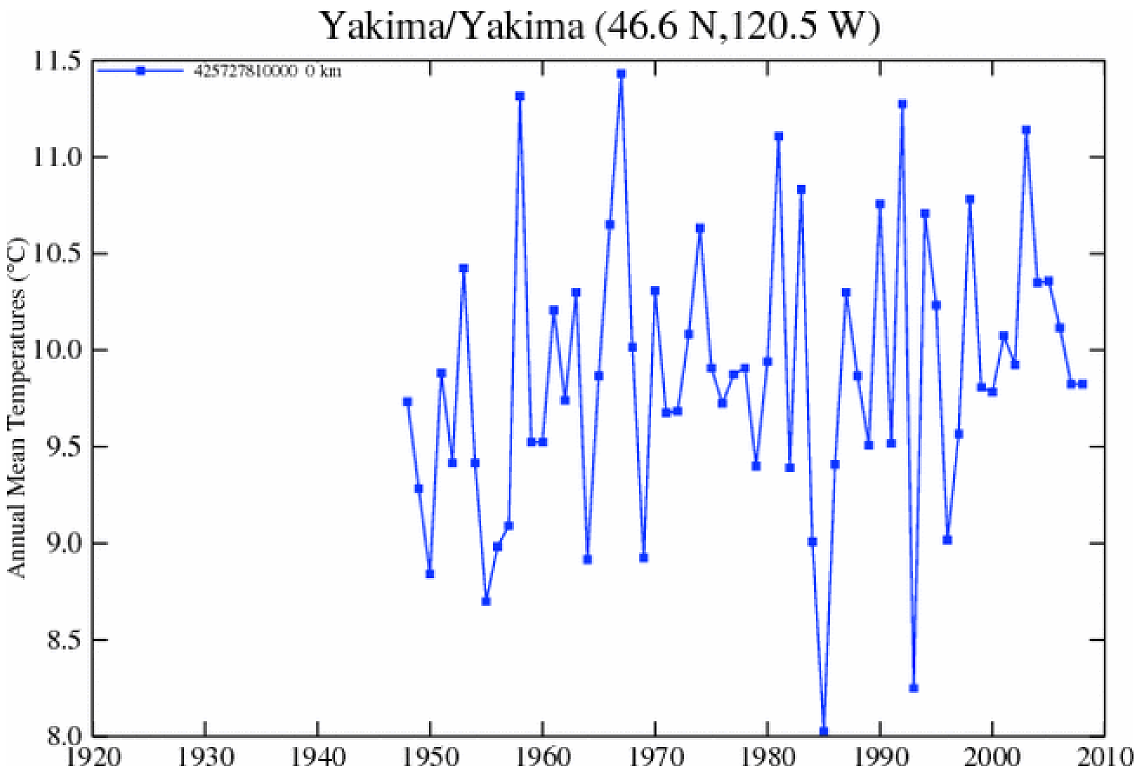


Winter (December to February) NCDC average temperatures from 1896 to 2009 shows little net trend with temperatures ending up below where they started in 1896. Looking at true rural sites show little change. The following NASA plot of rural area Cedar Lake and small town Yakima shows this.





SNOWFALL - THE REAL DRIVER, THE PDO

Snowfall/precipitation patterns are clearly cyclical and for the most part controlled by natural factors. With climate cycles there are always winners and losers. We all take our turns. There are multidecadal changes in the Pacific and Atlantic on a scale of 60-70 years (Zhang (1997), Minobe (1997)).

The Pacific Decadal Oscillation flipped in 1977 in what was called the Great Pacific Climate Shift. (Miller et al. (1994), Mantua et al.(1997)) With it water off the west coast and in the ENSO regions of the tropical Pacific warmed dramatically from the predominantly cold conditions of the prior 30 years.

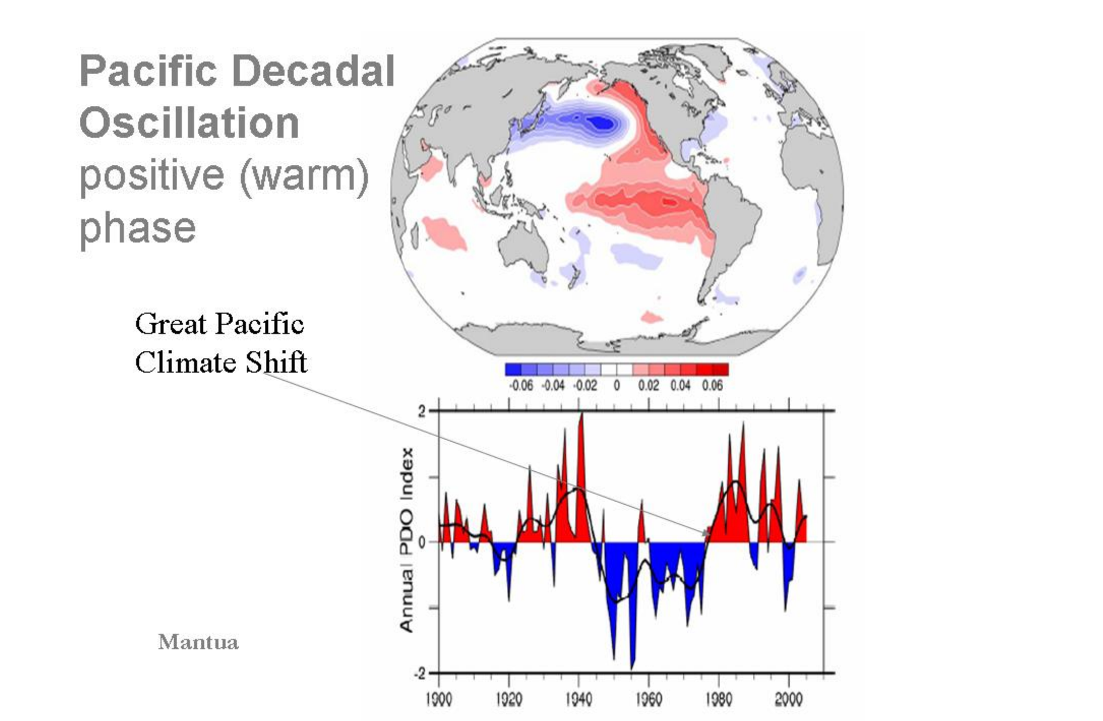


Figure 1: PDO cycle with seas surface temperatures in the Pacific after Mantua. PDO flipped into what is called the warm mode in 1978 and has been predominantly in that mode since.

The warm mode also favored warmer than normal temperatures and less than normal precipitation (figure 2).

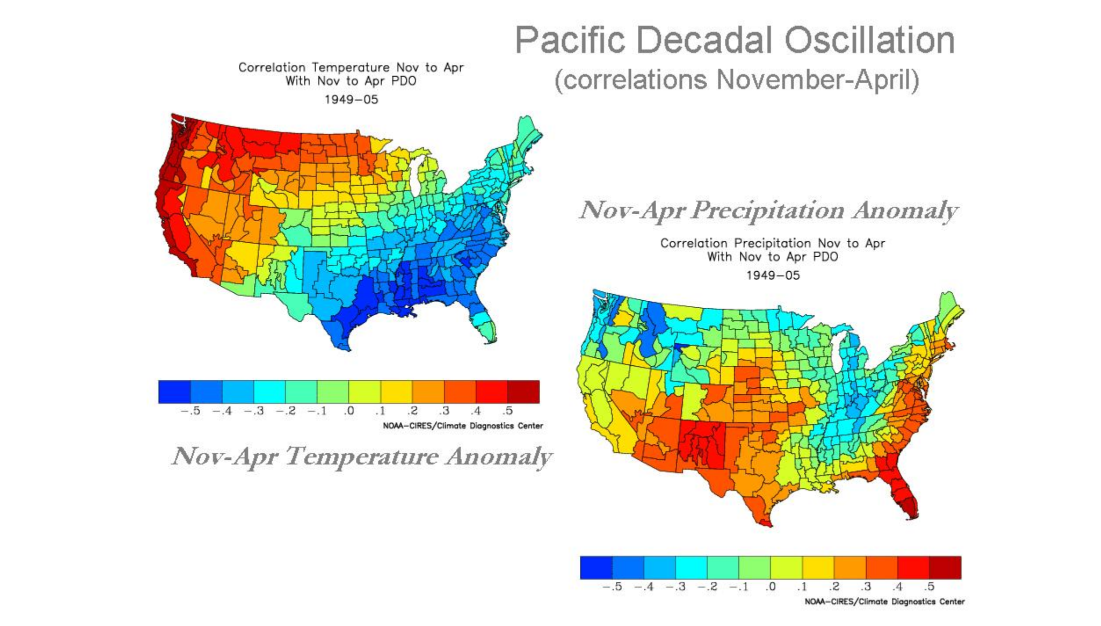


Figure 2: Correlations of Temperatures and Precipitation November to April with the PDO. In the wet season (the heart of the snow season) for the west (November to April), correlations with the positive PDO suggest warm and dry conditions in the northwest and wet conditions to the south.

With the sea surface pattern associated with the PDO warm phase in figure 1, El Ninos are favored. This can be clearly seen by the following plot of Wolter's Multivariate ENSO Index (MEI) (figure 3). Red spikes are associated with El Ninos and blue spikes with La Ninas. You can see the predominance of La Ninas in the cold PDO mode 1947 to 1977 and El Ninos since 1978. Indeed since 1978, there have been twice as many El Ninos as La Ninas.

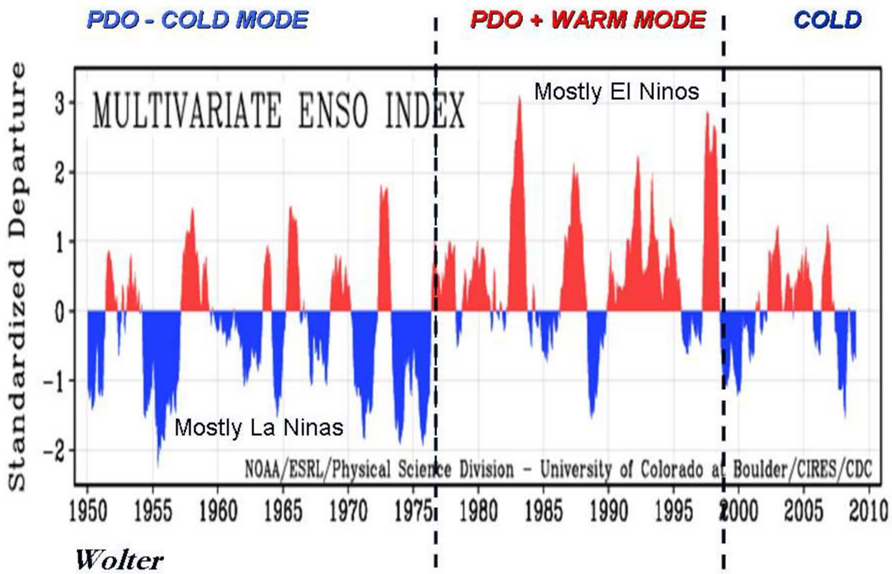


Figure 3: Wolter's Multivariate ENSO Index (MEI)(1997) since 1950. The plot starts in the early stages of a cold mode (1947 to 1977) and ends in the latter declining phases of the warm phase (1978-98). Note the increased frequency of La Nina in the cold mode of the PDO and El Nino in the warm mode.

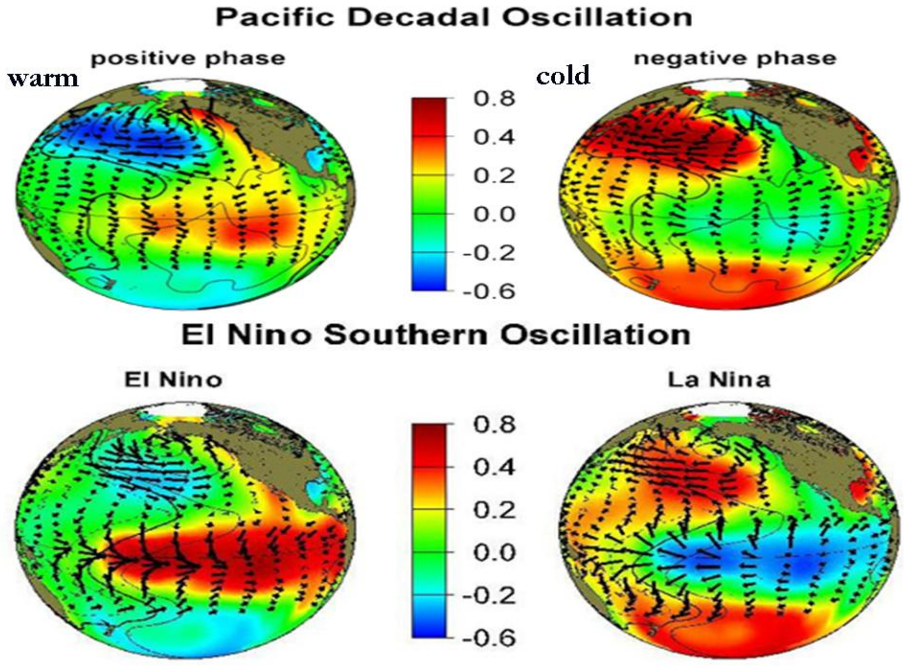


Figure 4: Ocean temperature patterns as established for the PDO warm and cold phases and the El Ninos and La Ninas. It is clear from the above why El Ninos are favored in the warm phase of the PDO and La Ninas in the cold phase.

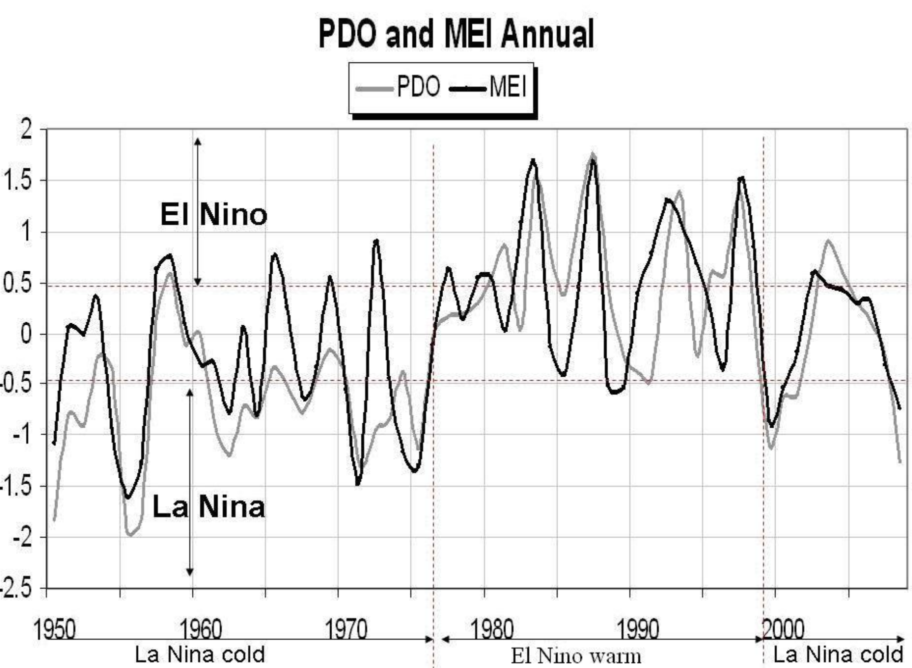


Figure 5: Wolter Multivariate ENSO Index (MEI) tracks very well with the PDO (Mantua)

El Ninos cause a shift south of the storm tracks, more snows for the southwest mountains and southern Rockies and less snow for the Pacific Northwest and mountains of southwest Canada across the Northern Rockies.

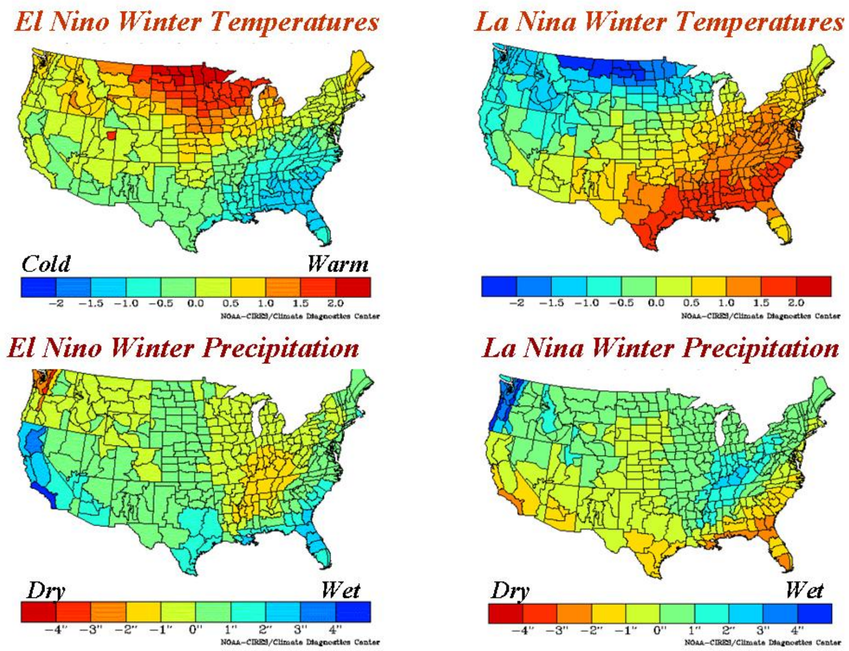


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Figure6: Winter (December to February) temperatures and precipitation for El Ninos and La Ninas as provided by NOAA CIRES CDC. La Ninas are colder and wetter in the Pacific Northwest while El Ninos are warmer and drier. Given the dominance of El Ninos in the warm PDO and La Ninas in the cold PDO explain the patterns shown in figure 2.

Indeed when one looks at precipitation in the mountains of the west extending back into the 1930s, one can clearly see how well the precipitation anomalies matched to the state of the PDO. Annual precipitation for Cedar Lake, WA is shown below and its relationship with the PDO is clear.

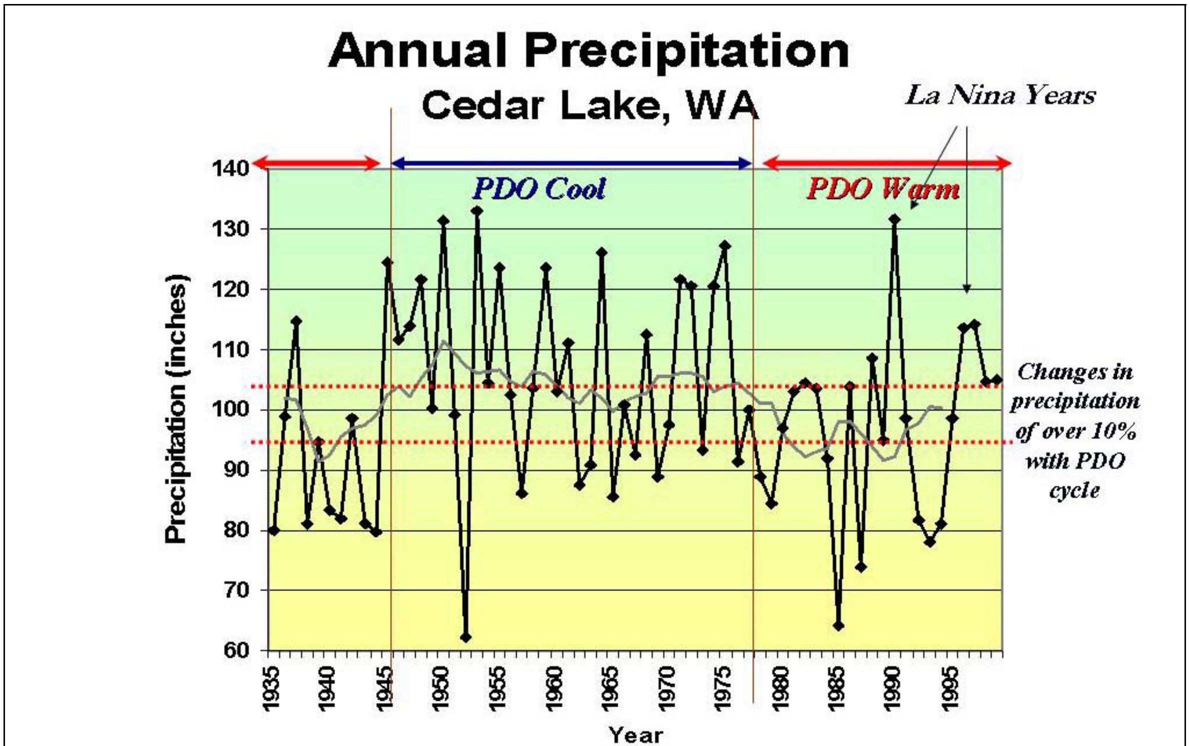
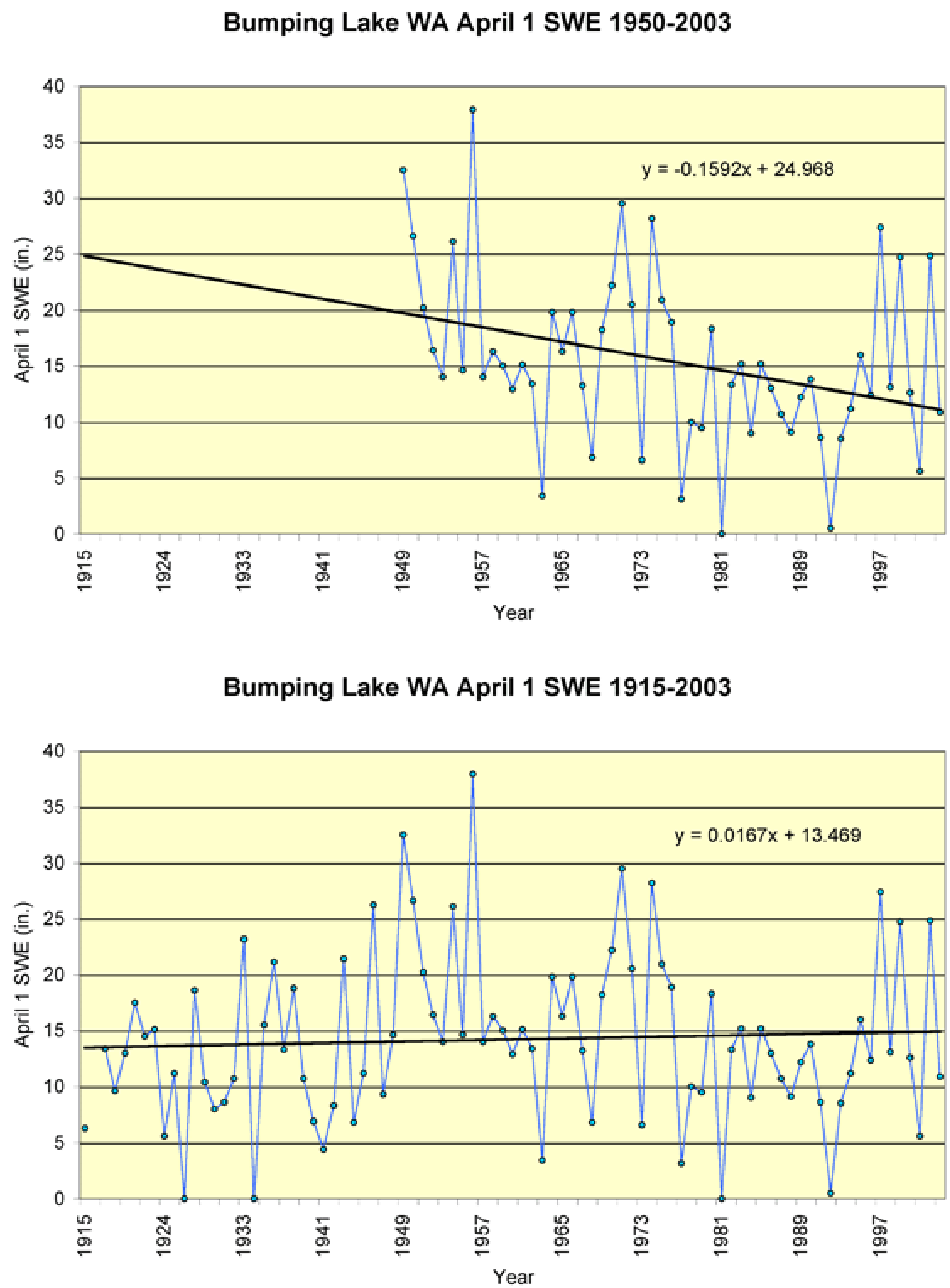


Figure 7: Cedar Lake, WA, annual precipitation since 1935. Note the negative anomalies during the warm PDO eras (1927-1947 and after 1977) but positive anomalies in the cold PDO period.

Even more relevant and dramatic in demonstrating the importance of the starting point in this analysis and of the importance of the PDO is use of the snow water equivalent for Bumping Lake, WA, for the years from 1950 and then from 1915. Note the large spike around 1950 which Mote intentionally chose to show a decline.



Figures 8a, b: Snow Water Equivalent for Bumping Lake, WA in a from 1950 and from 1915

If one uses a third order polynomial, one can clearly see the cyclical nature of thee precipitation. Note the recent rise since the PDO turned neutral or negative in 1997.

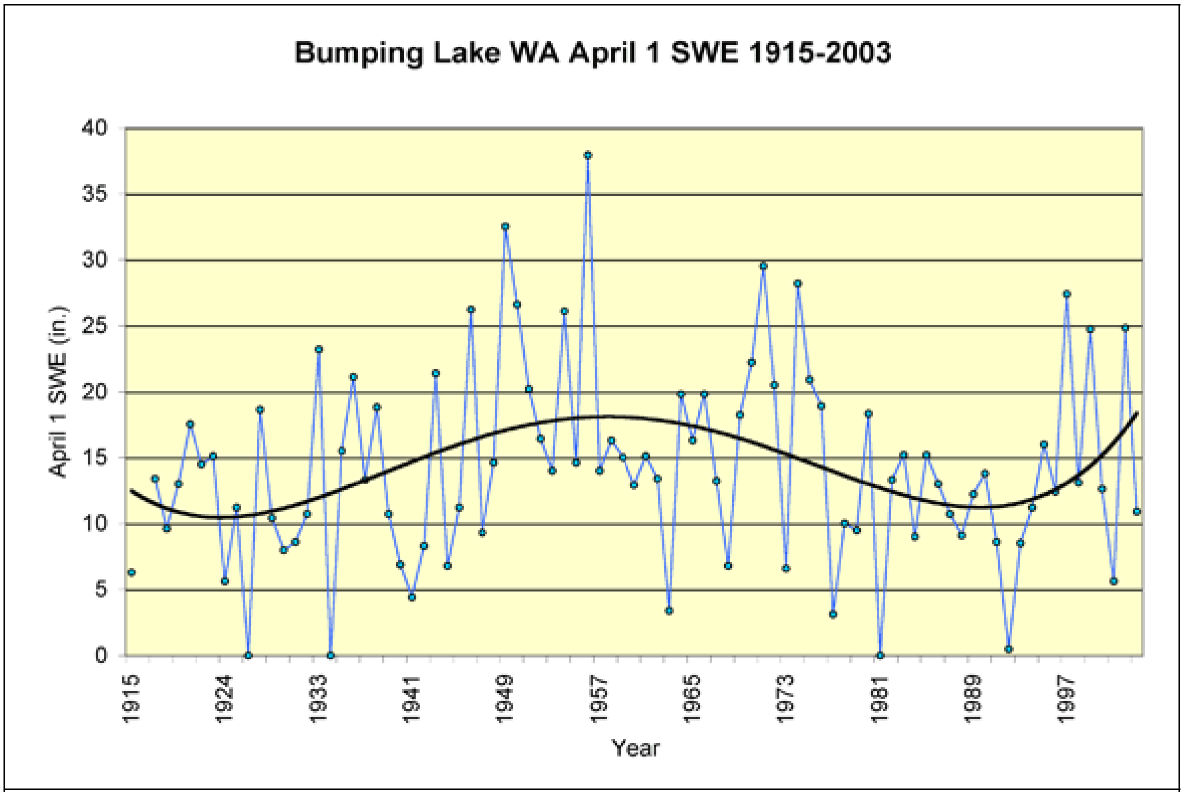
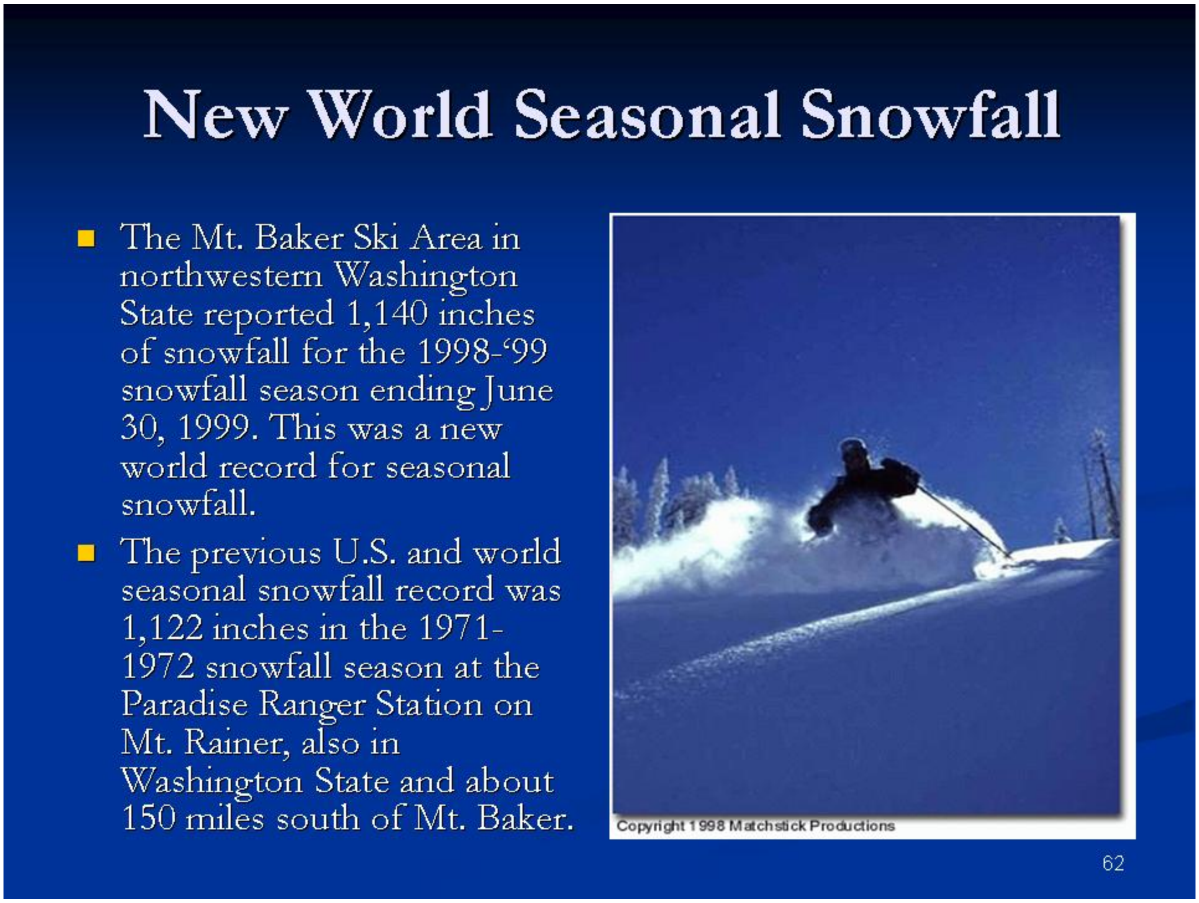


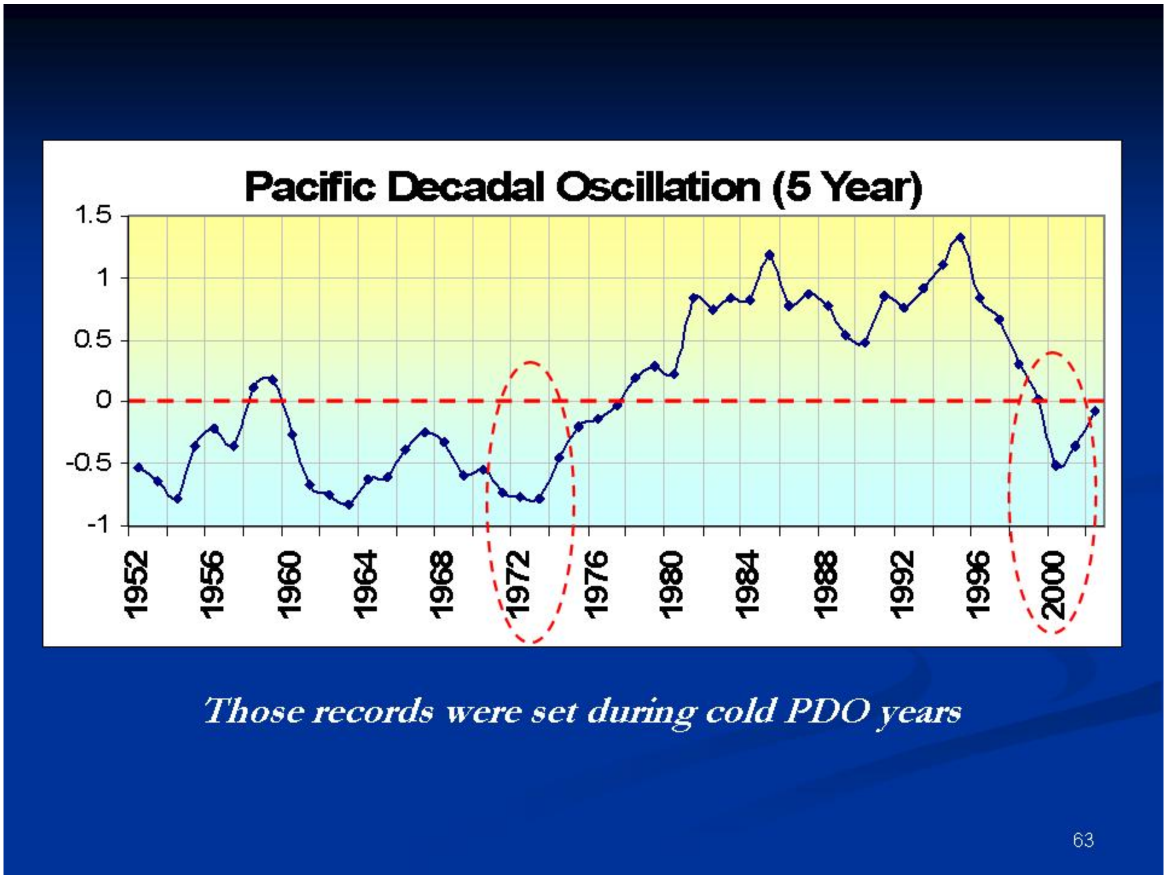
Figure 9: Same snow water equivalent since 1915 for Bumping Lake using a third order polynomial

This matches the PDO cycle to a tee, with enhanced snow during the cold eras from 1947 to 1977 and after 1997 and reduced snowpack during the warm eras (1922 to 1947, 1977 to 1997)

Now you might recall that in 1999/2000 that Mt. Baker in Washington set a new world record for seasonal snowfall. That broke the record set in 1971/72.



In the late 1990s the PDO reverted back negative for a few years, back to the state it was in 1971/72, when the prior record had been set. A significant three year La Nina shifted the storm track north targeting the Pacific Northwest.

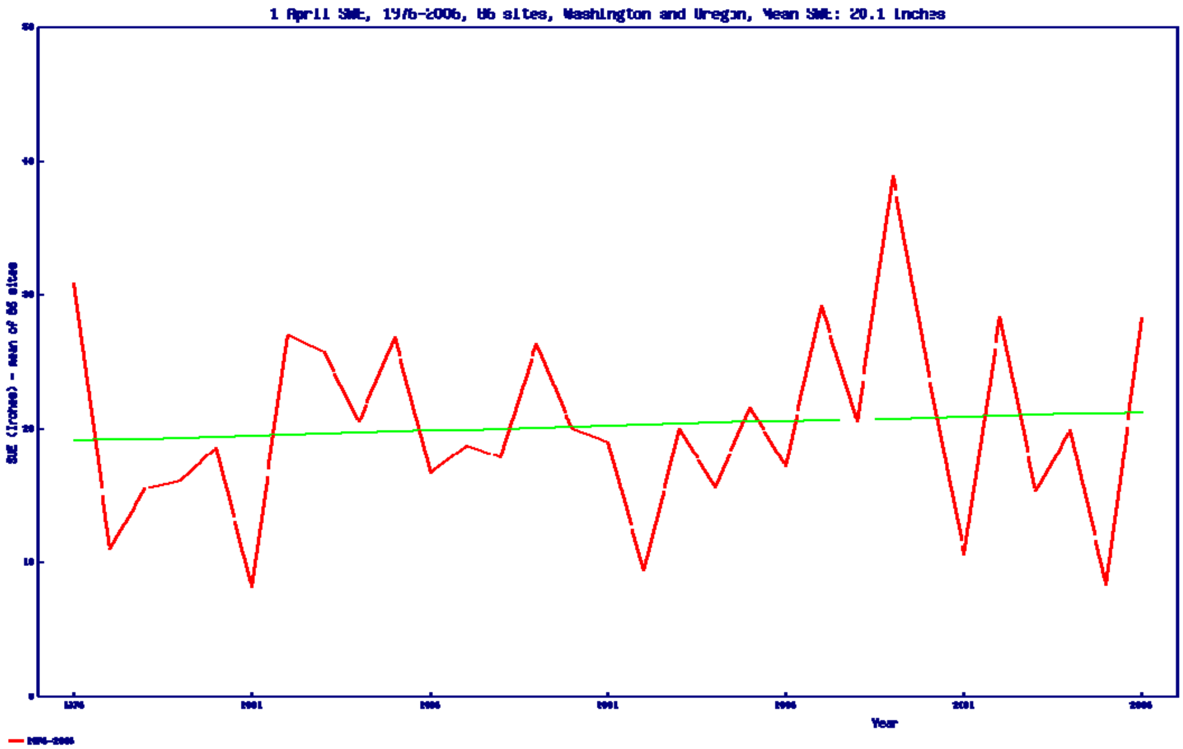


The PDO bounced positive again with the El Nino of 2002/03. The Pacific Northwest even experienced an unusual one year drought with this rebound but now after a few neutral years it is again turned strongly negative.in the last two years (now NCEP PDO is nearly 2 STD negative), the snowfall situation in the Pacific Northwest AND Rockies has had successive banner years in places ALL-TIME record snow years. Snow was still on the ground in the mountains in July turning flower tours into snow tours.

As there were in the last negative phase (1947 to 1977), there will be more La Ninas than El Ninos (in that last phase a very nearly 2 to 1 ratio). The storm tracks will shift back north once again targeting the Pacific Northwest and British Columbia coasts.

The “cherry-picking” note can be shown in this note from Mark Albright, former state climatologist from Washington (stripped of his position when he made note of this).

Here is a plot of 1 April snowpack as measured at a composite of all 86 snotel sites with a complete record from 1976-2006 in the Washington and Oregon Cascade Mountains:



The linear trend line shows an 11% increase over the 31 year period.   This does not even include 2007 and 2008, both big snow years.

COMMENTS FROM GEORGE TAYLOR

A few years ago, several papers by scientists at the University of Washington (Mote, 2003; Mote, et al, 2004; Mote, et al, 2005) suggested that snowpack in the Pacific Northwest was declining due to global warming.

The Mote papers included the statement:

"A study of springtime mountain snowpack in the Pacific Northwest showed widespread declines in snowpack since 1950 at most locations with largest declines at lower elevations indicating temperature effects."

This author (George Taylor) responded with an article discussing Northwest snow trends, included was the following statement:

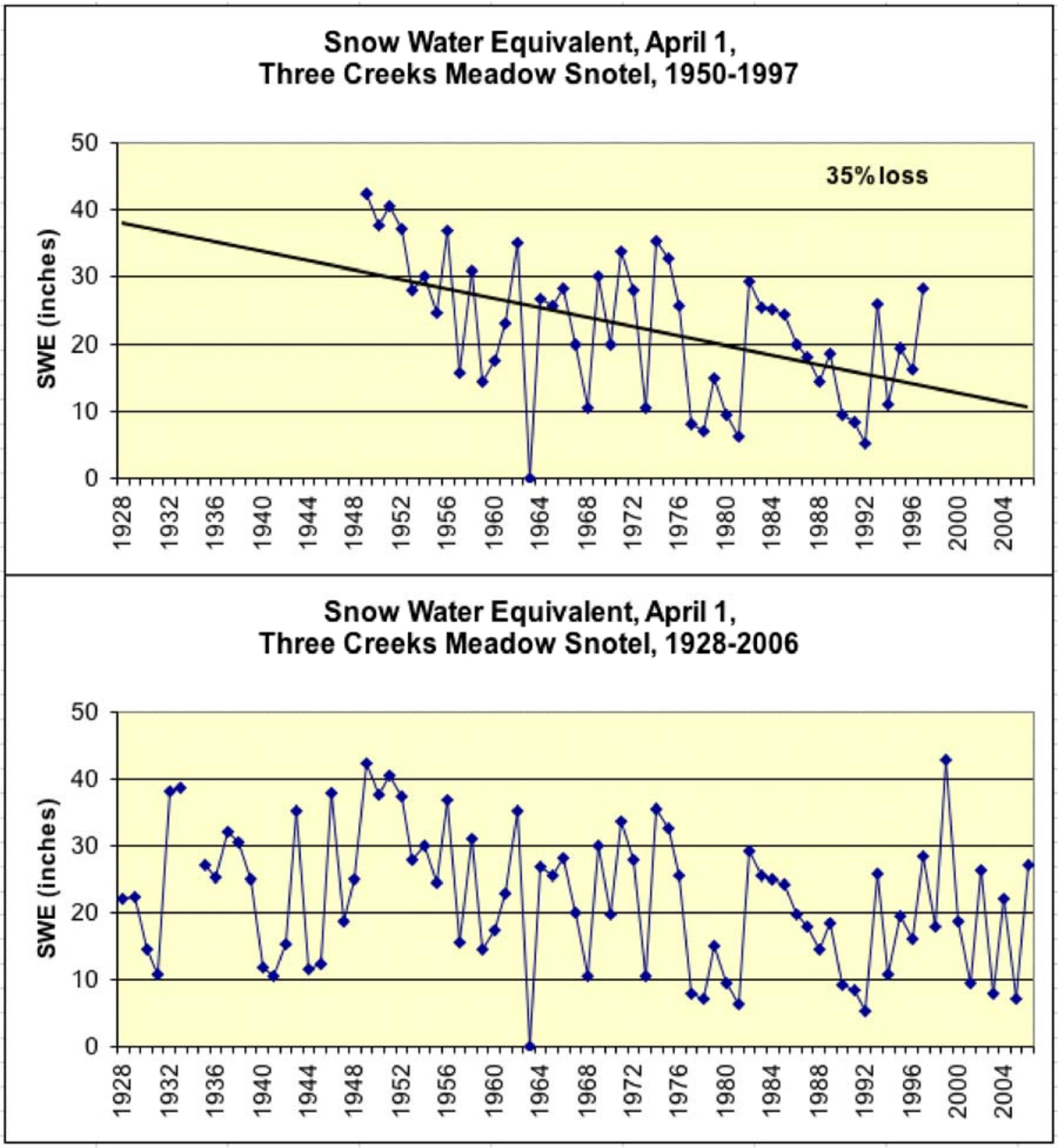
“Note the starting point for this analysis; the late 1940s-early 1950s were an exceptionally snowy period in Oregon and the Pacific Northwest. The Mote, et al papers used 1950 as a starting point because snowpack measurements were "widespread by the late 1940s" (Mote, et al, 2005) and much less extensive earlier. However, in view of the fact that climate conditions prior to the late 1940s were very different, one might wonder if inclusion of longer period data sets would change the result.”

They did. Period-of-record trends were very different for longer data sets than they were for the period beginning in 1950. The conclusions of that analysis:

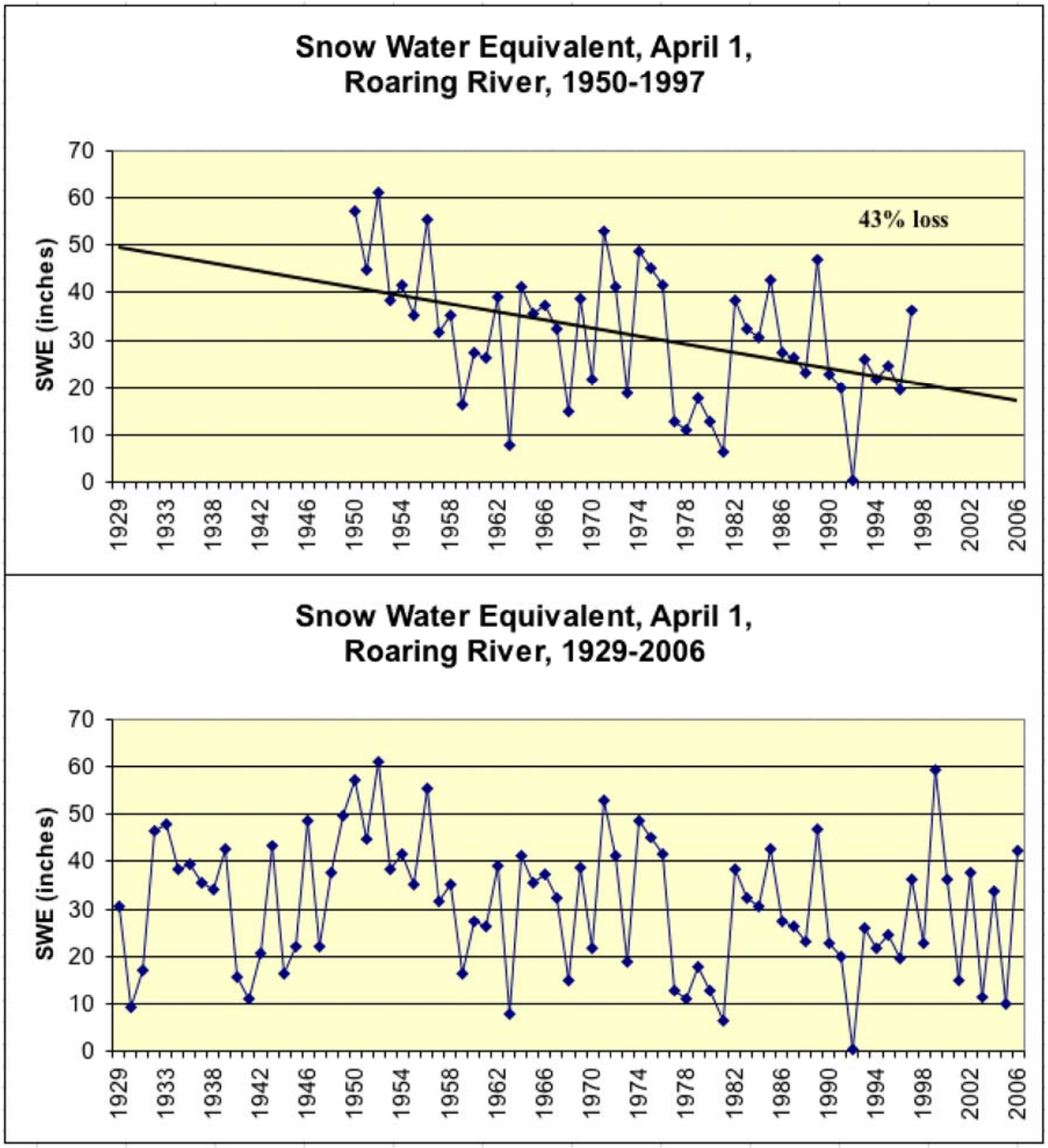
“The use of snowpack trends from 1950 through current suggests a much different (steeper) trend than if period of record measurements are used. Granted, there exist relatively few stations that extend back prior to 1940, but those stations whose records are available make it clear than monotonic decreases in snow pack do *not* occur through the entire period of record.

“Based on a limited analysis, there are indications that precipitation is a much more significant influence on snow pack than is temperature.”

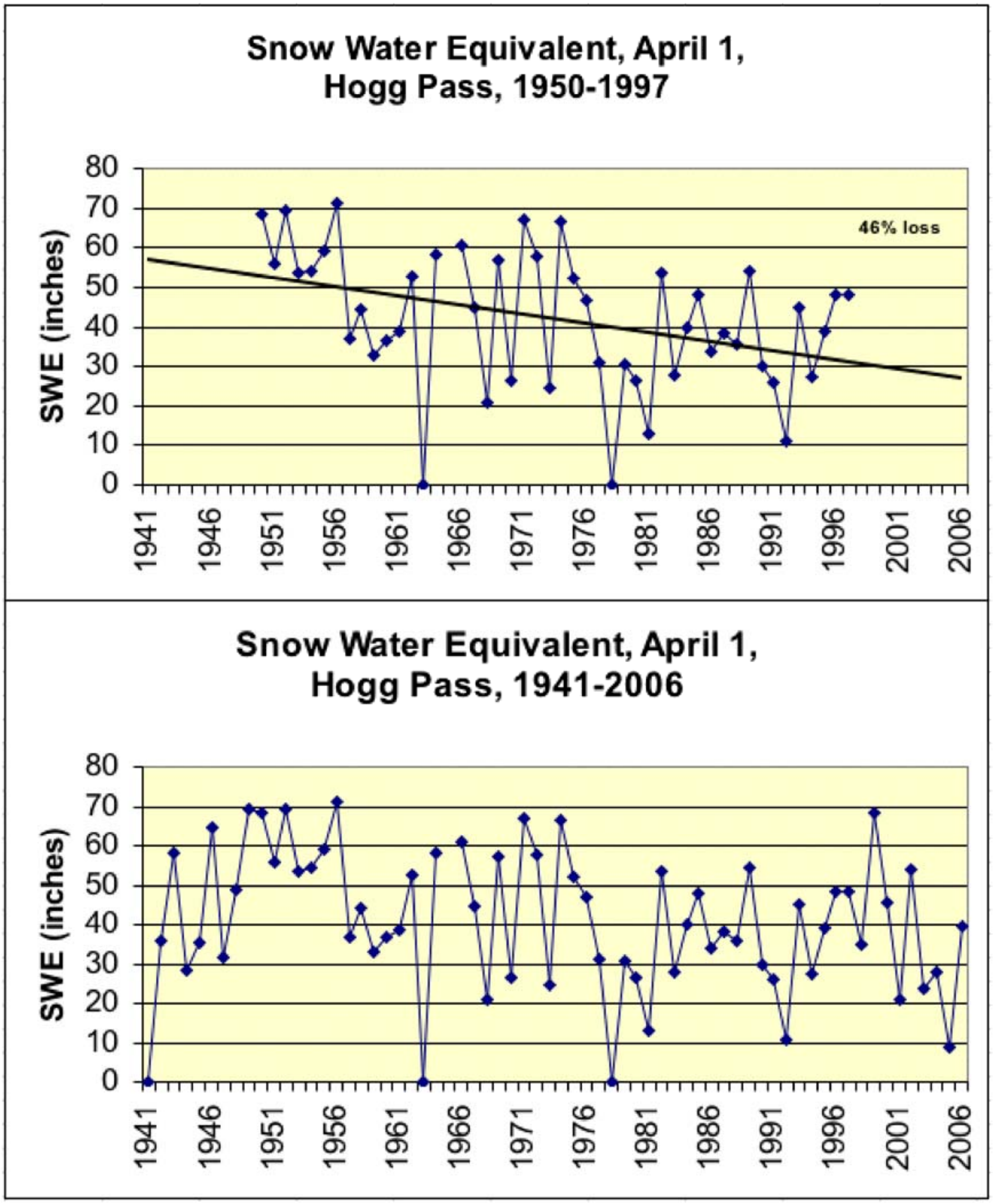
Among the charts shown in the article were the following. Each chart shows the 1950-1997 trend (the period used for the Mote et al papers) and a best-fit linear trend (including the percentage reduction in snowpack for the period). The second chart shows the period of record through 2006.



April 1 Snow Water Equivalent, Three Creeks Meadow, Oregon



April 1 Snow Water Equivalent, Roaring River, Oregon



April 1 Snow Water Equivalent, Hogg Pass, Oregon

Nonetheless, the idea that snows were decreasing due to global warming, and would likely keep doing so, became a common and popular one in the Northwest. Seattle's mayor, Oregon's Governor, and other public officials rushed to include this "fact" in their policy statements. For example, the Report to the Governor (of Oregon) from the Governor's Advisory Group on Global Warming (December 2004) stated:

> “Between 1950 and 2000, the April 1 snowpack declined. In the Cascades, the cumulative downward trend in snow-water equivalent is approximately 50% for the period 1950–1995. Timing of the peak snowpack has moved earlier in the year, increasing March streamflows and reducing June streamflows. Snowpack at low-to-mid elevations is the most sensitive to warming temperatures.”

However, in 2007 the “snow is going away” idea began to crumble. Washington Assistant State Climatologist Mark Albright confirmed that there was no significant long-term trend in snowpack. The winter of 2007-08 was one of the snowiest on record. And last month, the Seattle Times published the following news piece:

http://seattletimes.nwsource.com/html/localnews/2008094636_climate06m.html

According to the Times, “Maybe the snow in the Cascade Mountains isn't in such immediate peril from global warming after all.”

“Despite previous studies suggesting a warmer climate is already taking a bite out of Washington's snowpack, there's no clear evidence that human-induced climate change has caused a drop in 20th century snow levels, according to a new study by University of Washington scientists.”

This past winter exceeded snowfall amounts in 2007/08. Spokane, Washington set a new all-time record with 97.7 inches, breaking the record set at the hand-picked starting date for the analysis by Mote and CCSP, the winter of 1949/50. 2007/08 was third snowiest with 93.6 inches.

SPOKANE TOP FIVE SNOW SEASONS

1 2008-2009 97.7
2 1949-1950 93.5
3 2007-2008 92.6
4 1974-1975 89.0
5 1992-1993 87.3

It is comforting that use of appropriate data records has dispelled some “bad science” conclusions. One hopes that policymakers will recognize this and modify their policies accordingly.

CONCLUSION

Because of these serious misanalysis and errors of both commission and omission with cherry picking dates for SWE trends and lack of understanding of the real forcings at play, this entire section on regional climates clearly violates the data quality act. The following would more accurately describe the prospect for this region.

PACIFIC NORTHWEST

"The Northwest's rapidly growing population, as well as its forests, mountains, rivers, and coastlines, continue to experience natural climate change and its impacts.

Reduction in winter snows followed the Great Pacific Climate Shift in 1977. This has begun reversing with a reversal of the PDO in the late 1990s and especially the last two winters. The shift north of the storm track will accompany this shift with more frequent La Ninas.

Projections that the PDO's new state will remain for two decades suggests an increase in winter snowpack, earlier snows in the fall and later snowmelts. See Easterbrook (Western Washington University) and Patzert (JPL). Glaciers may advance as they did in the last snowy era. None of the disastrous consequences portrayed by the CCSP will occur.

References:

Federal Information Quality Act: Enacted as Section 515(a) of the FY 2001 Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law 106-554)

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