I. Background Information

Name(s): George Taylor
Organization(s): CCM, Applied Climate Services LLC
Mailing Address(es): 5478 SW Philomath Blvd., Corvallis OR 97333
Phone(s): 541-231-3761
E-mail(s): taylorgh@comcast.net
Area of Expertise: Climatology, Climate Forecasting

Name(s): Joseph D'Aleo
Organization(s): Fellow of the AMS, CCM, WSI, Icecap
Mailing Address(es): 18 Glen Drive, Hudson, NH 03051
Phone(s): 603 595-4439
E-mail(s): jdaleo6331@aol.com
Area of Expertise: Climatology, Climate Forecasting for Agriculture and Energy

This comment focuses on the Pacific Northwest Region of the United States that the 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 honest 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. Your own April 1 Snow water equivalent (SWE) chart below shows that California water increased as northern areas diminished.

YOUR STATEMENTS IN ERROR

The Statement in question is on page 140. Totally bogus impacts were also shown on tourism for this region on page 47.

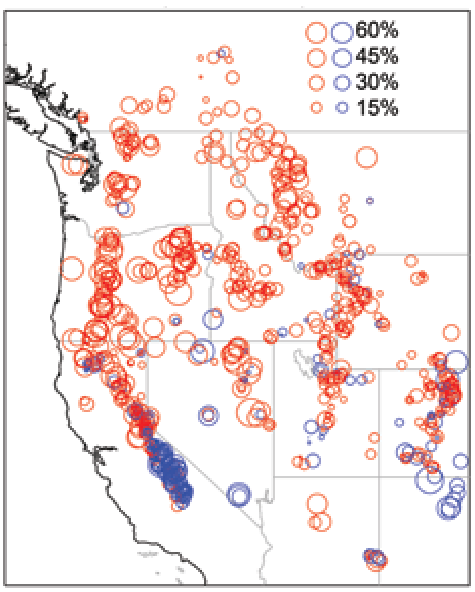
"The Northwest's rapidly growing population, as well as its forests, mountains, rivers, and coastlines, are already experiencing human-induced climate change and its impacts. Regionally averaged temperature rose about 1.5°F over the past century (with some areas experiencing increases up to 4°F), and is projected to increase another 3 to 10°F in this century, 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 in this century in response to continued and much 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 50 years, with most of this due to the 2.5°F warming in cool season temperatures over that period. Increasing declines in Northwest snowpack are projected to accompany additional warming in 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 2040s4. Throughout the region, earlier snowmelt will cause a reduction in the amount of water available during the warm season.

Trends in April 1 Snow Water Equivalent



(Following from page 47) The Mountain West is projected to see a continuation of the observed trend toward warmer winters and shorter snow seasons. Winter sports dependent on snow, including downhill skiing and snowboarding, cross-country skiing, snowshoeing, and snowmobiling are expected to see worsening conditions, potentially becoming unviable as soon as 2050 in some locations. Any significant shortening of the snow season is likely put some ski areas out of business. For example, a ski resort like Aspen is open for about 140 days; it takes the resort 100 days to break even and cover costs. If the season is compressed by a few dozen days, the resort can become unprofitable."

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:

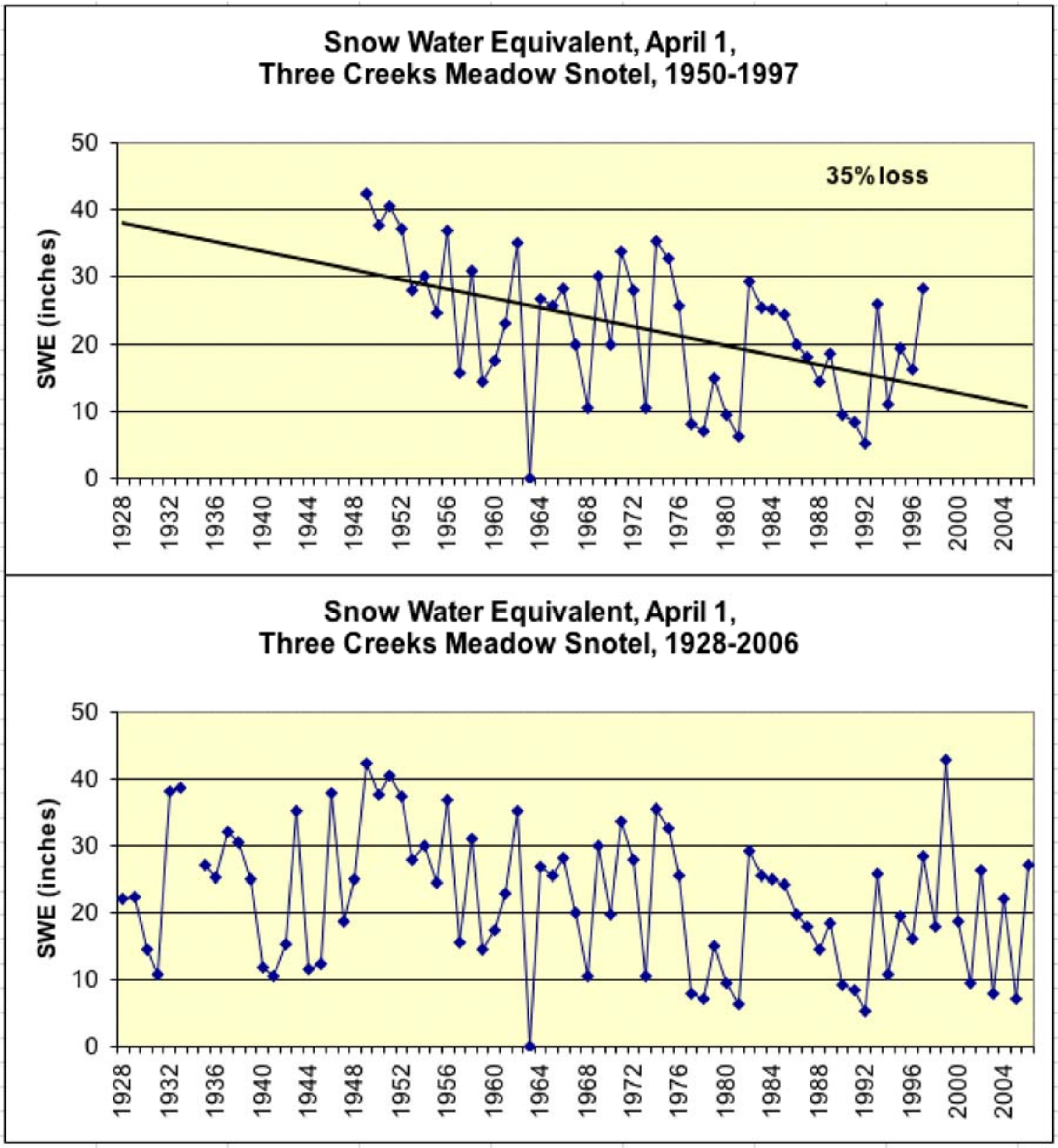
“Note the starting point for this analysis; the late 1940s-early 1950s were an exceptionally snowy period in Oregon and the Pacific Northwest. The Mote, et al papers used 1950 as a starting point because snowpack measurements were "widespread by the late 1940s" (Mote, et al, 2005) and much less extensive 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:

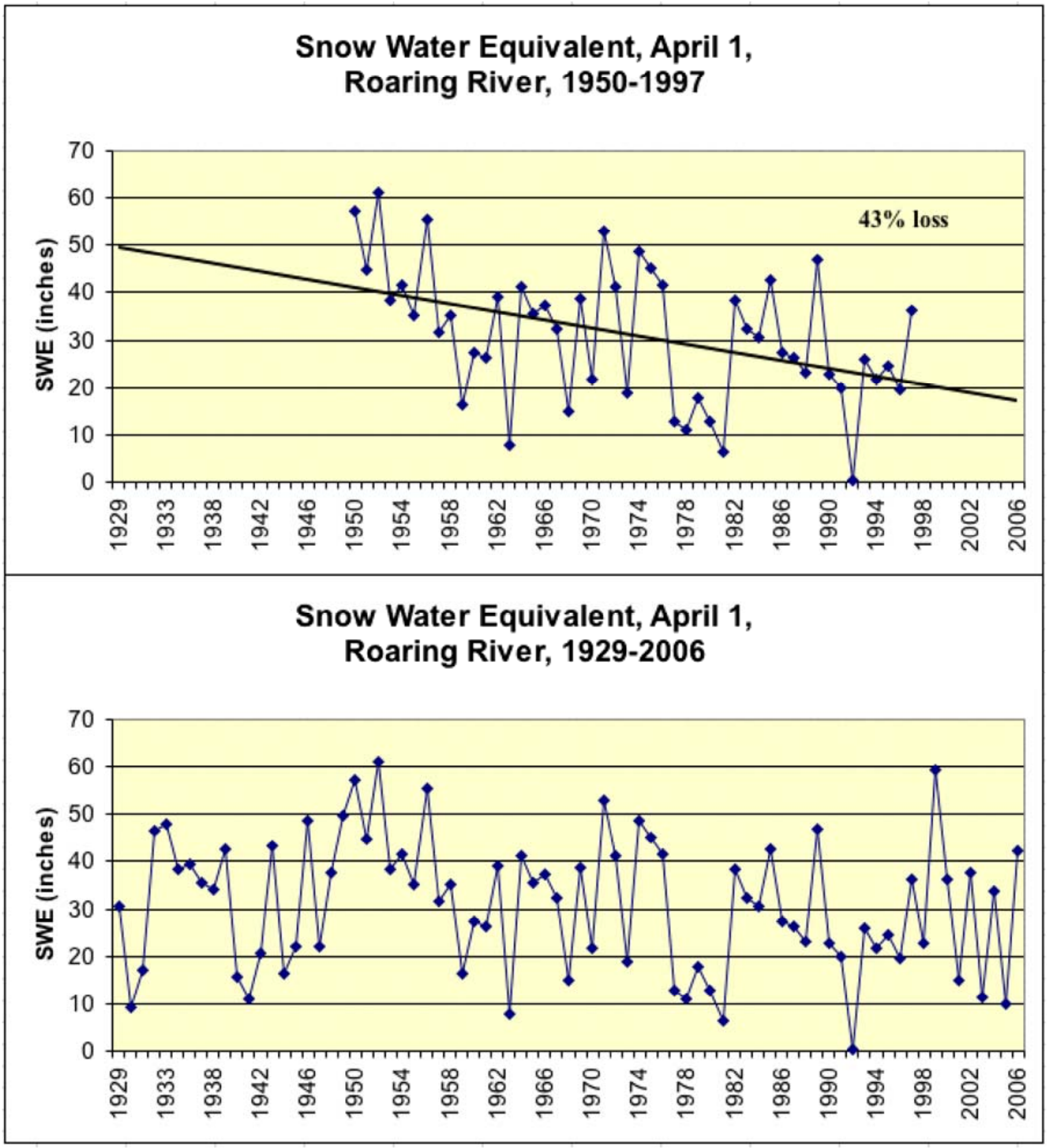
“The use of snowpack trends from 1950 through current suggests a much different (steeper) trend than if period of record measurements are used. Granted, there exist relatively few stations that extend back prior to 1940, but those stations whose records are available make it clear than monotonic decreases 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.”

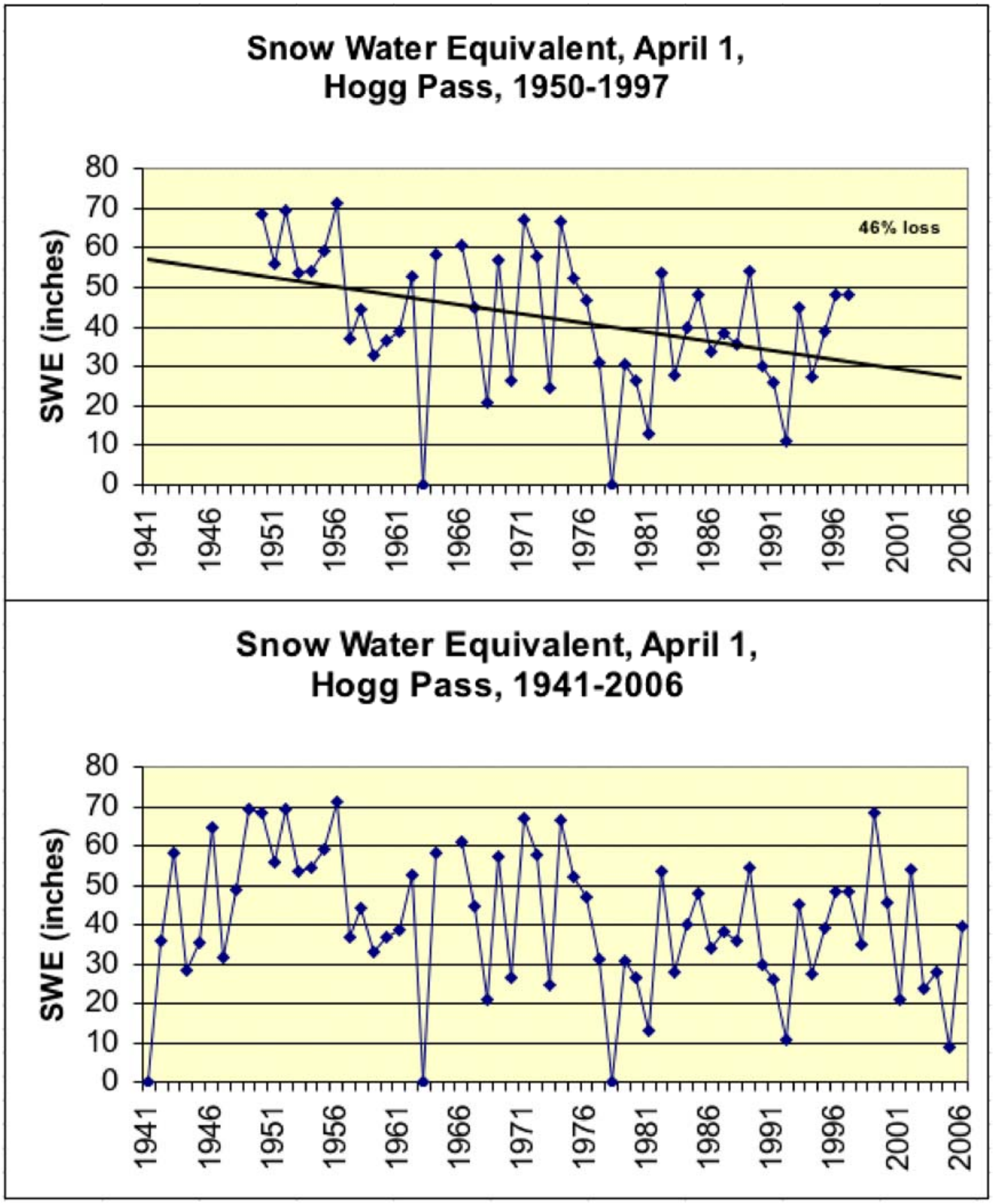
Among the charts shown in the article were the following. Each chart shows the 1950-1997 trend (the period used for the Mote et al papers) and a best-fit linear trend (including the percentage reduction in snowpack for the period). The second chart shows the period of record through 2006.



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:

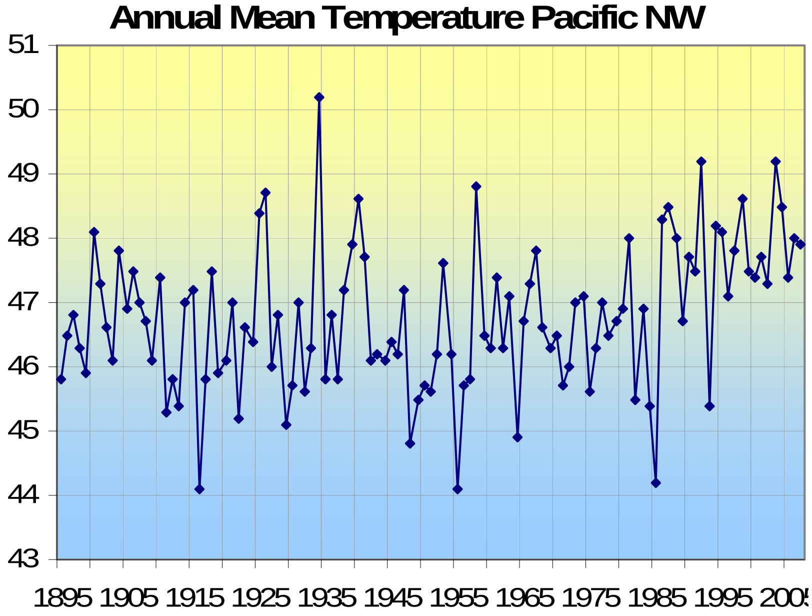
http://seattletimes.nwsource.com/html/localnews/2008094636_climate06m.html

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

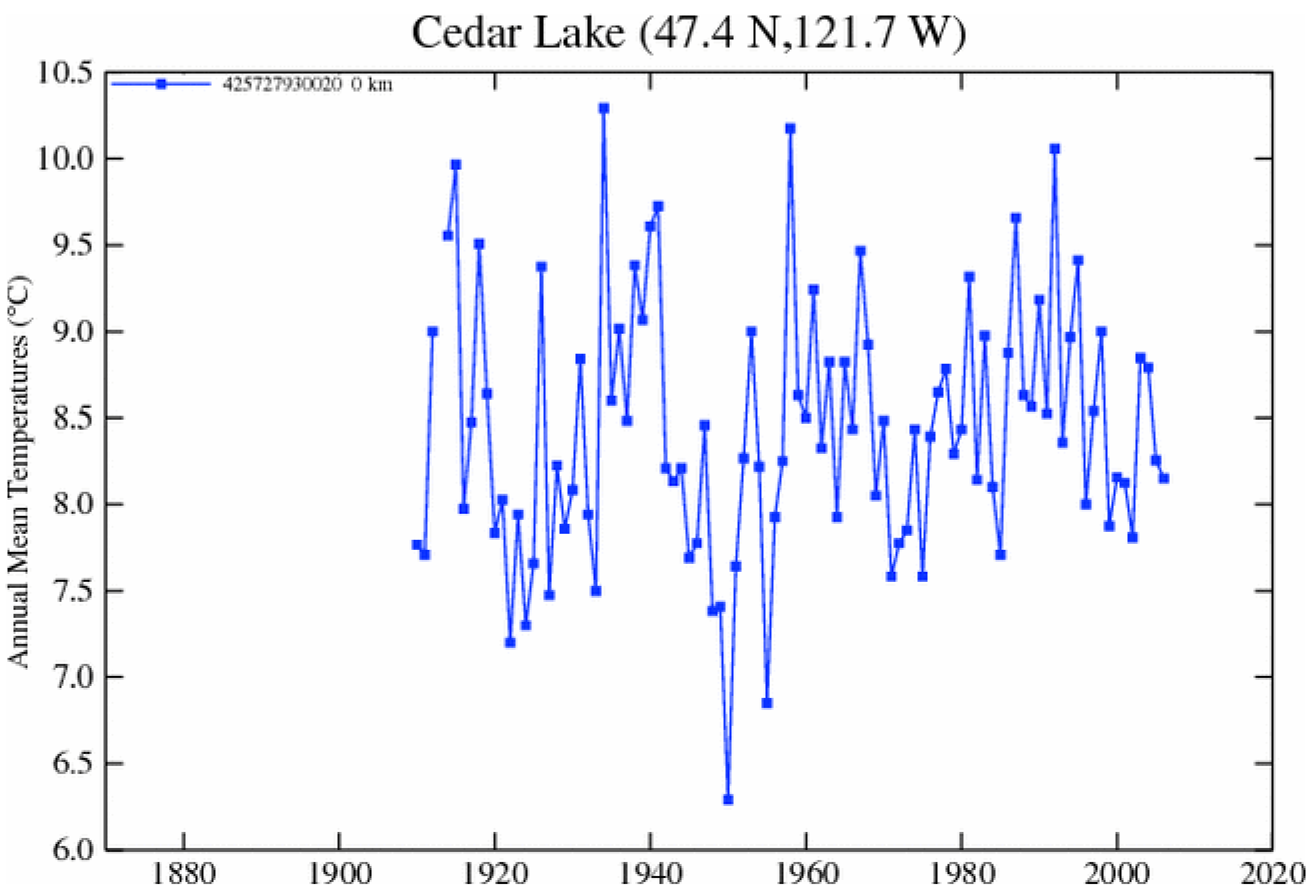
“Despite previous studies suggesting a warmer climate is already taking a bite out of Washington's snowpack, there's no clear evidence that human-induced climate change has caused a drop in 20th century snow levels, according to a new study by University of Washington scientists.”

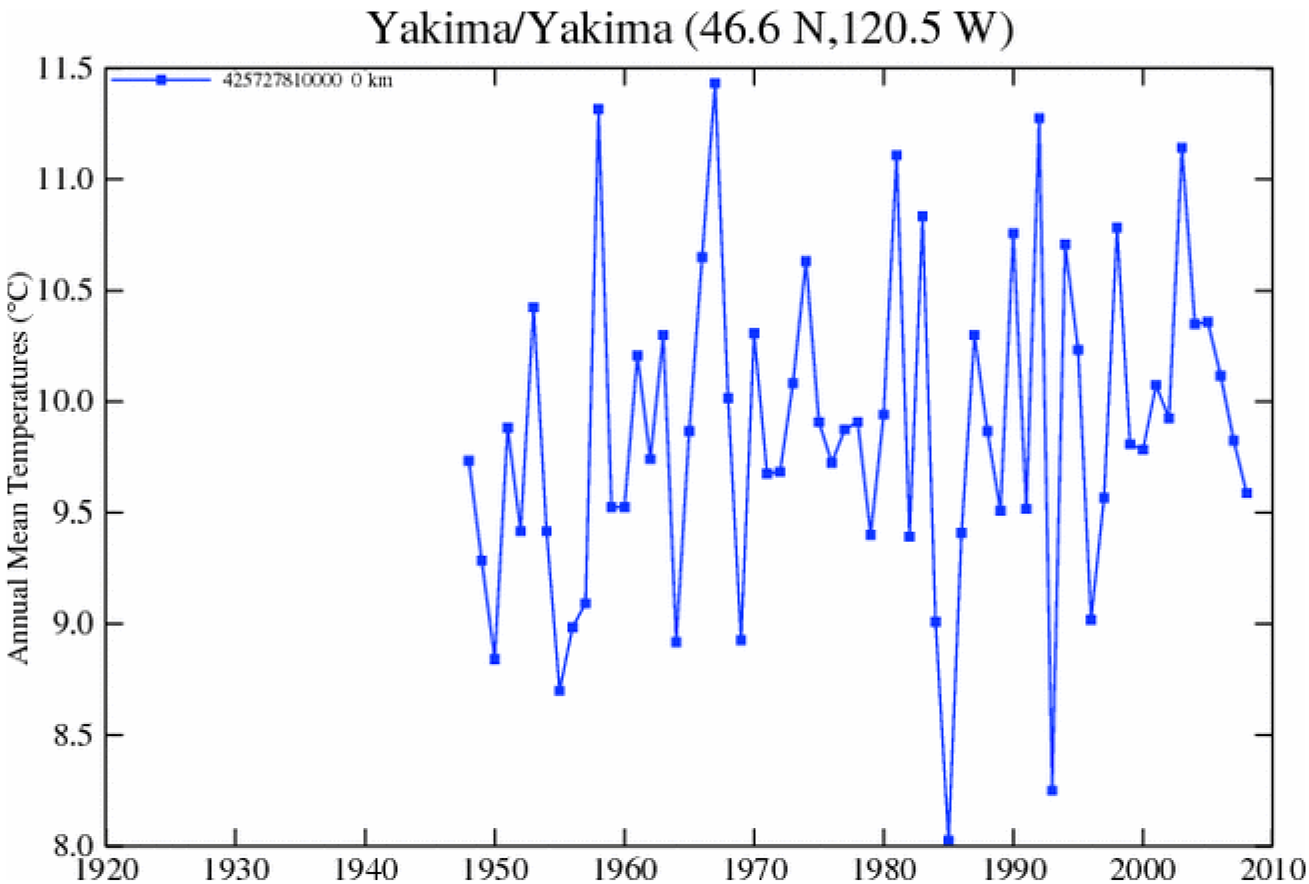
It is comforting that use of appropriate data records has dispelled some “bad science” conclusions. One hopes that policymakers will recognize this and modify their policies accordingly.

COMMENTS FROM JOSEPH D’ALEO



First of any warming is the result of state issues with insufficient urban and site issue adjustment. Looking at true rural sites show little change. The following NASA plot of rural area Cedar Lake and small town Yakima shows this.





Time does not permit a full analysis of temperatures this. I will focus instead on snowfall and the real driver the PDO.

SNOWFALL - THE REAL DRIVER, THE PDO

Snowfall patterns are indeed cyclical and for the most part controlled by natural factors. With climate cycles there are always winners and losers. We all take our turns.

The Pacific Decadal Oscillation flipped in 1978 in what was called the Great Pacific Climate Shift. 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.

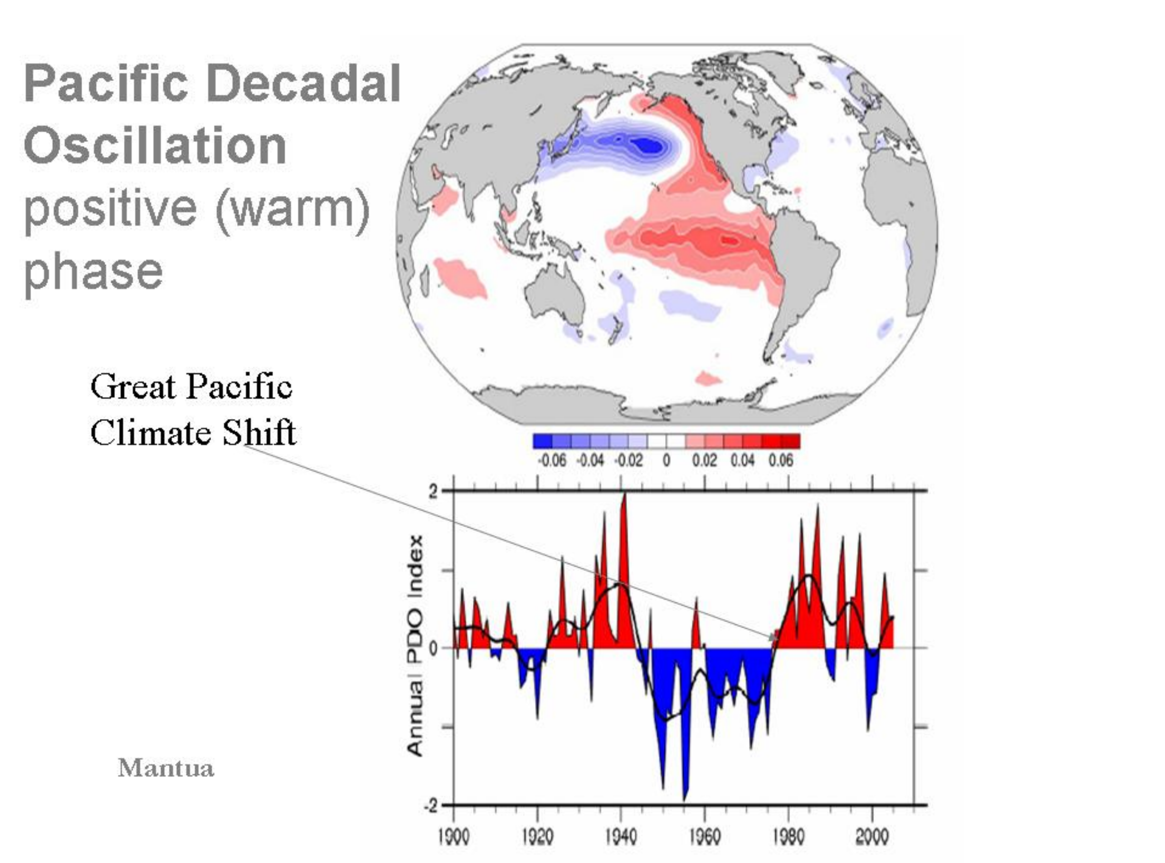


Figure 1: PDO cycle with seas surface temperatures in the Pacific after Mantua. PDO flipped into what is called the warm mode in 1978 and has been predominantly in that mode since.

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

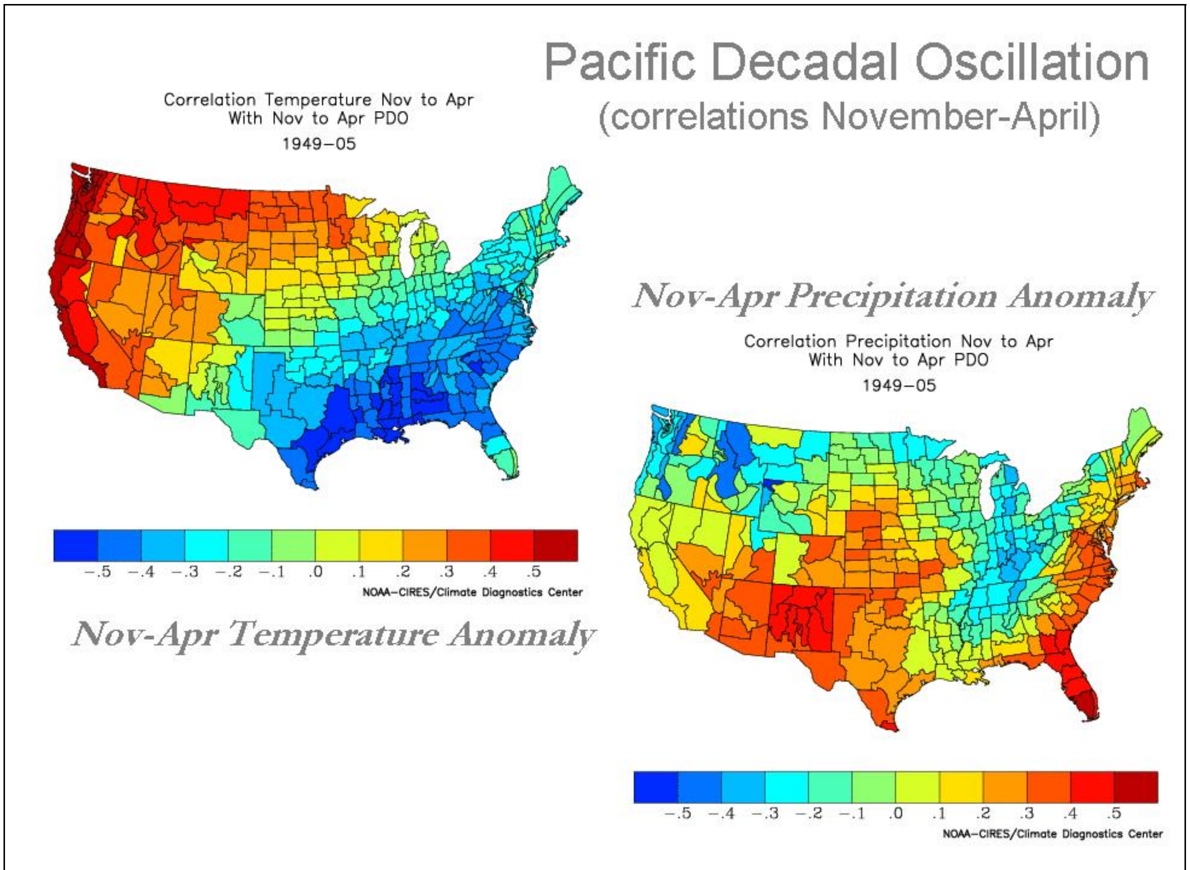


Figure 2: Correlations of Temperatures and Precipitation November to April with the PDO. In the wet season (the heart of the snow season) for the west (November to April), correlations with the positive PDO suggest warm and dry conditions in the northwest and wet conditions to the south.

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.

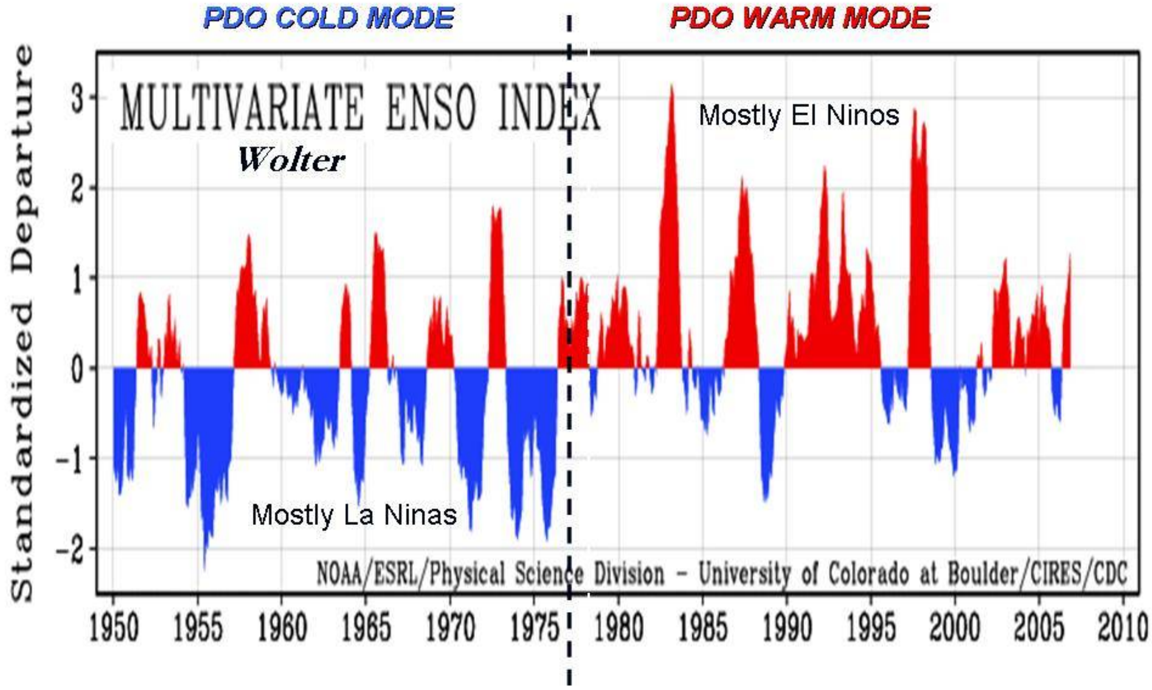


Figure 3: Wolter's Multivariate ENSO Index (MEI) since 1950. The plot starts in the early stages of a cold mode (1947 to 1977) and ends in the latter declining phases of the warm phase (1978-?). Note the increased frequency of La Nina in the cold mode of the PDO and El Nino in the warm mode.

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. In Mote's 2005 paper, he attributed the declining snowpack in the Northwest mainly to global warming. He did note in the conclusion that the PDO may have had some role (up to one-third) in the warming since 1920 but said only a small fraction of the precipitation changes can be explained by any of the changes in the Pacific (an unfounded statement).

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.

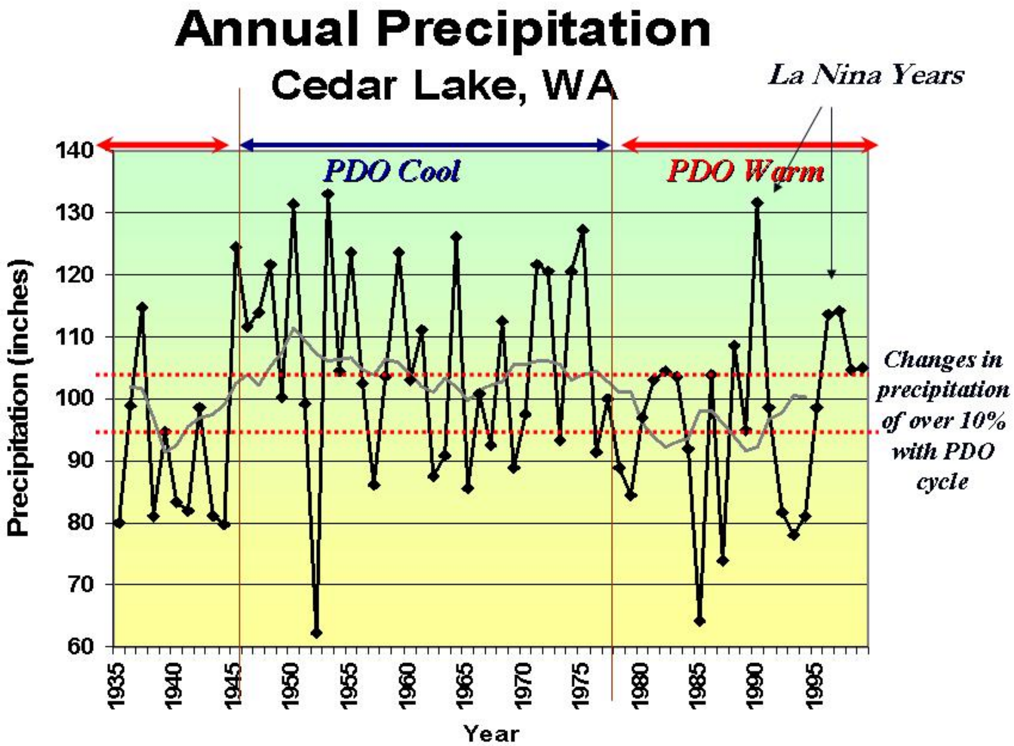
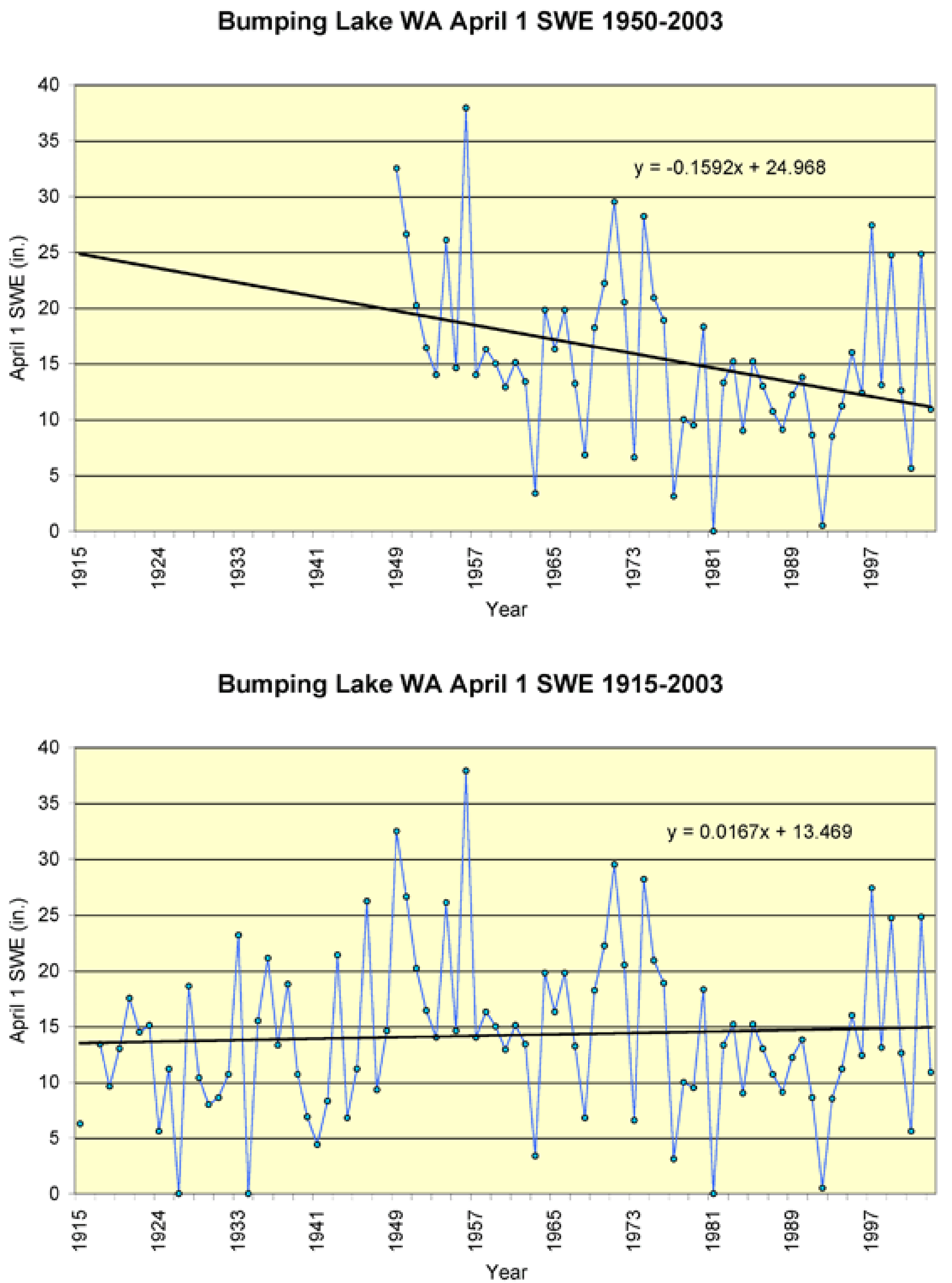


Figure 4: Cedar Lake, WA, annual precipitation since 1935. Note the negative anomalies during the warm PDO eras (1927-1947 and after 1977) but positive anomalies in the cold PDO period.

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 5a, 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.

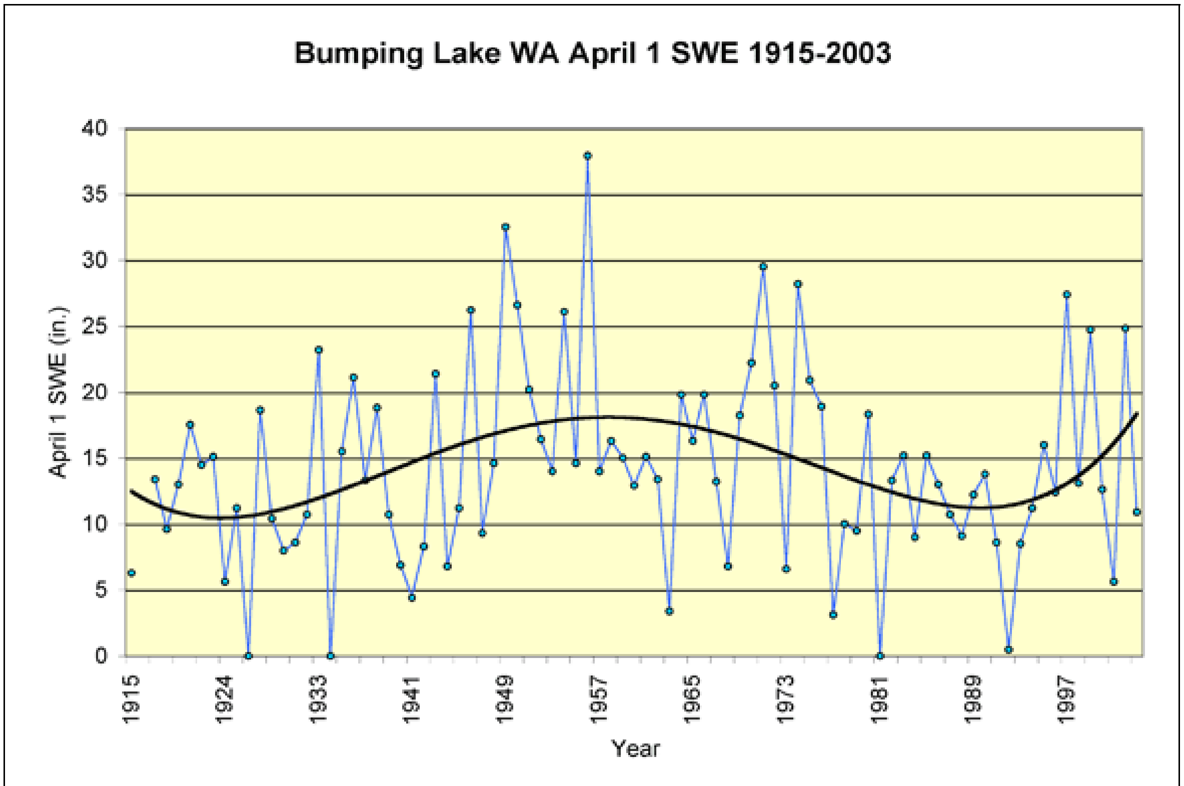
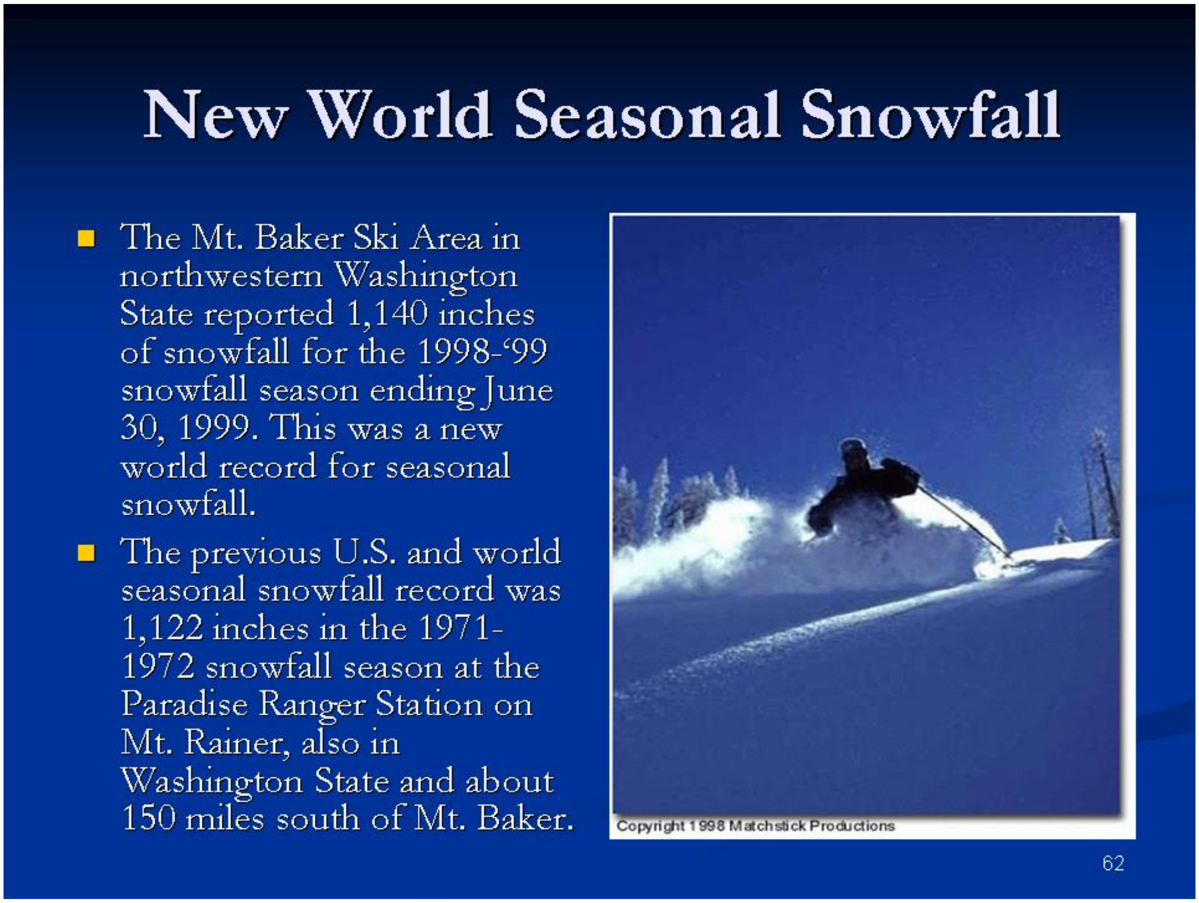


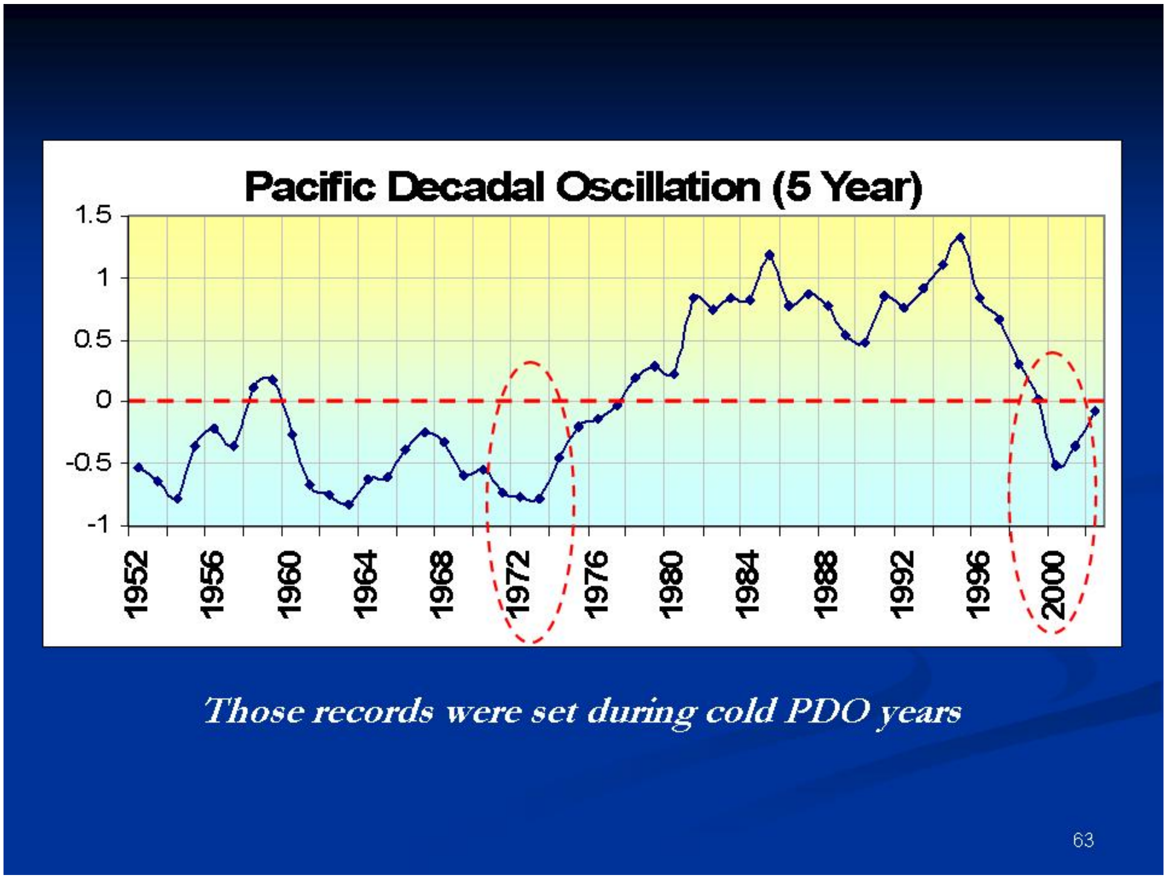
Figure 6: Same snow water equivalent since 1915 for Bumping Lake using a third order polynomial

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.

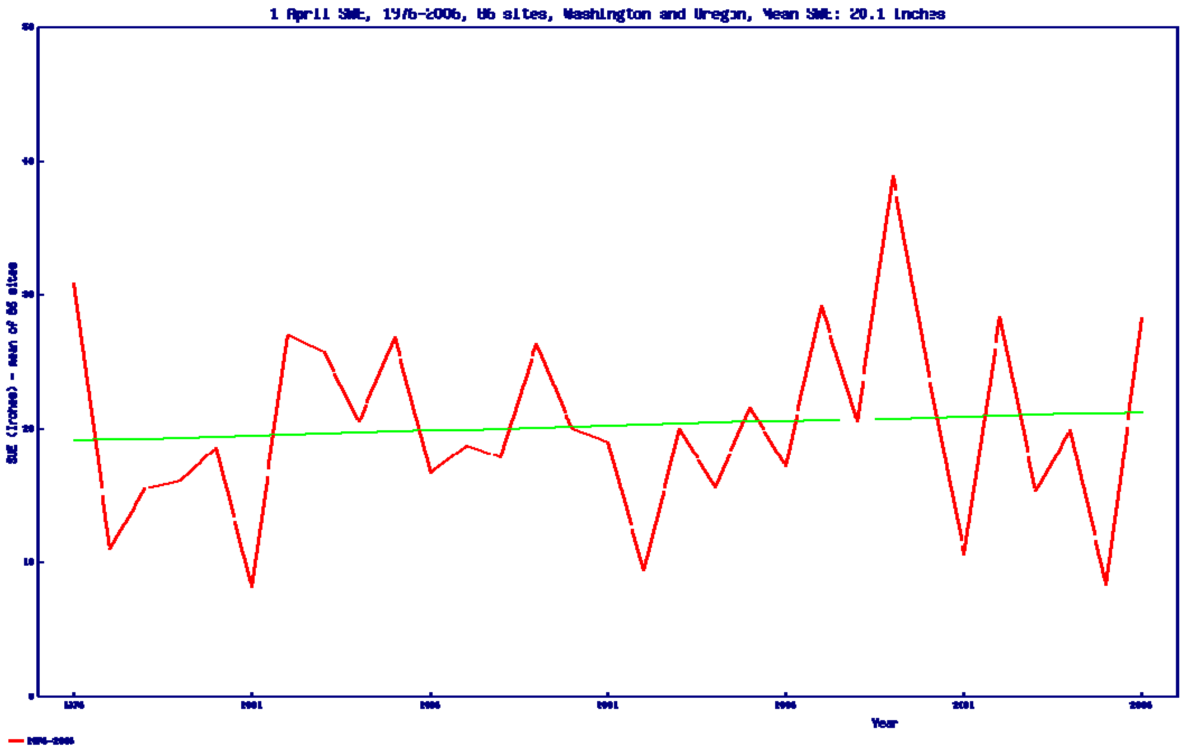


The PDO bounced positive again with the El Nino of 2002/03. The Pacific Northwest even experienced an unusual one year drought with this rebound but now after a few neutral years it is again turned strongly negative.in the last year (now NCEP PDO is more than 2 STD negative), the snowfall situation in the Pacific Northwest AND Rockies had a banner in places ALL-TIME record snow year. 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.

CORRECTION REQUIRED

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 and should be deleted or rewritten.

If you wish to correct these data issues and correctly show the historical changes and include a more accurate forecast, it is suggested that the following wording be substituted:

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 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.

References:

Ackerman, S., UW SSEC Urban Heat Islands

CCSP, 2006, Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences, US Climate Change Science Program, Suite 250, 1717 Pennsylvania Ave, NW, Washington, DC , 339 pp, http://www.climatescience.gov/Library/sap/sap1-1/public-review-draft/sap1-1prd-all.pdf

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)

Gouretski, V. and Koltermann, K.P. 2007. How much is the ocean really warming? Geophysical Research Letters 34: 10.1029/2006GL027834

Kalnay, E., Cai, M., Impacts of urbanization and land-use change on climate, 2003, Nature, 423, 528-531

*Karl, T.R., H.F. Diaz, and G. Kukla, 1988: Urbanization: its detection and effect in the United States climate record, J. Climate, **1**, 1099-1123.*

Landsberg, H.E., 1981: The Urban Climate, Academic Press

Mantua, N.J. and S.R. Hare, Y. Zhang, J.M. Wallace, and R.C. Francis,1997: Pacific interdecadal climate oscillation with impacts on salmon production. Bulletin of the American Meteorological Society, 78, pp. 1069-1079.

McPhaden, M.J and D. Zhang (2002), "Slowdown of the meridional overturning circulation in the upper Pacific Ocean", Nature, 415(7), 603–608 (2002).

Miller, A.J., D.R. Cayan, T.P. Barnett, N.E. Graham and J.M. Oberhuber, 1994: The 1976-77 climate shift of the Pacific Ocean. Oceanography 7, 21-26.

Minobe, S. 1997: A 50-70 year climatic oscillation over the North Pacific and North America. Geophysical Research Letters, Vol 24, pp 683-686.

Moberg, D. and A. 2003. Hemispheric and Large-Scale Air Temperature Variations: An Extensive Revision and Update to 2001. Journal of Climate, 16, 206-223.

Mote, P. W., 2003. Trends in Temperature and Precipitation in the Pacific Northwest During the Twentieth Century. Northwest Science, 77, 271-282.

Mote, P. W., M. Clark, and A. F. Hamlet, 2004. Variability and Trends in Mountain Snowpack in Western North America. 15th Symposium on Global Change and Climate Variations, Seattle, Washington.

Mote, P. W., A.F. Hamlet, M.P. Clark and D.P. Lettenemier, 2005. Declining Mountain Snowpack in Western North America. Bull. Amer. Meteo. Soc., 86, 39-49.

*Oke, T.R. 1973. City size and the urban heat island. Atmospheric Environment **7**: 769-779.*

Pielke R.A. Sr., G. Marland, R.A. Betts, T.N. Chase, J.L. Eastman, J.O. Niles, D.D.S. Niyogi and S.W. Running. (2002) "The Influence of Land-use Change and Landscape Dynamics on the Climate System: Relevance to Climate-Change Policy Beyond the Radiative Effect of Greenhouse Gases." Philosophical Transactions of the Royal Society of London. A360:1705-1719

Pielke, RA Sr. and T. Matsui (2005) "Should Light Wind and Windy Nights have the Same Temperature Trends at Individual Levels Even if the Boundary Layer Averaged Heat Content Change is the Same?" Geophysical Research Letters (32) L21813, doi:10.1029/2005GL024407, 2005.

Pielke, R.A., Sr, 2003. Heat Storage Within the Earth System, BAMS, March, 331-335.

Pielke Sr., R.A., C. Davey, D. Niyogi, S. Fall, J. Steinweg-Woods, K. Hubbard, X. Lin, M. Cai, Y.-K. Lim, H. Li, J. Nielsen-Gammon, K. Gallo, R. Hale, R. Mahmood, S. Foster, R.T. McNider, and P. Blanken, 2007: Unresolved issues with the assessment of multi-decadal global land surface temperature trends. J. Geophys. Res., 112, D24S08, doi:10.1029/2006JD008229,

Pielke Sr., R.A. J. Nielsen-Gammon, C. Davey, J. Angel, O. Bliss, N. Doesken, M. Cai., S. Fall, D. Niyogi, K. Gallo, R. Hale, K.G. Hubbard, X. Lin, H. Li, and S. Raman, 2007: Documentation of uncertainties and biases associated with surface temperature measurement sites for climate change assessment. Bull. Amer. Meteor. Soc., 88:6, 913-928.

Pielke, R. A., Sr., J. Eastman, T. N. Chase, J. Knaff, and T. G. F. Kittel, 1998. The 1973-1996 trends in depth-averaged tropospheric temperature, J. Geophys. Res., 103, 16,927-16,933.

Pielke R.A. Sr., G. Marland, R.A. Betts, T.N. Chase, J.L. Eastman, J.O. Niles, D.D.S. Niyogi and S.W. Running. (2002) "The Influence of Land-use Change and Landscape Dynamics on the Climate System: Relevance to Climate-Change Policy Beyond the

Radiative Effect of Greenhouse Gases." Philosophical Transactions of the Royal Society of London. A360:1705-1719

Pielke, R.A., Sr, 2003. Heat Storage Within the Earth System, BAMS, March, 331-335.
Power, S.B. and I.N. Smith (2007), "Weakening of the Walker Circulation and apparent dominance of El Niño both reach record levels, but has ENSO really changed?" Geophysical Research Letters, vol. 34, L18702, doi:10.1029/2007GL030854, 2007

Ren G. Y., Z. Y. Chu, Z. H. Chen, Y. Y. Ren (2007), Implications of temporal change in urban heat island intensity observed at Beijing and Wuhan stations, Geophys. Res. Lett., 34, L05711, doi:10.1029/2006GL027927

Willis J. K., D. P. Chambers, R. S. Nerem (2008), Assessing the globally averaged sea level budget on seasonal to interannual timescales, J. Geophys. Res., 113, C06015, doi:10.1029/2007JC004517.

Willmott, C. J., S. M. Robeson and J. J. Feddema, 1991. Influence of Spatially Variable Instrument Networks on Climatic Averages. Geophysical Research Letters, 18(12), 2249-2251.

Wolter, K., and M.S. Timlin, 1993: Monitoring ENSO in COADS with a seasonally adjusted principal component index. Proc. of the 17th Climate Diagnostics Workshop, Norman, OK, NOAA/N MC/CAC, NSSL, Oklahoma Clim. Survey, CIMMS and the School of Meteor., Univ. of Oklahoma, 52-57.

Zhang, Y., J.M. Wallace, D.S. Battisti, 1997: ENSO-like interdecadal variability: 1900-93. Journal of Climate, 10, 1004-1020