Cause of the ‘pause’ in global warming

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The absence of global warming for the past 17 years has been well documented. It has become known as “*the pause*.” and has been characterized as the “biggest mystery in climate science,” but, in fact, it really isn’t a mystery at all, it was predicted in 1999 on the basis of consistent, recurring patterns of the Pacific Decadal Oscillation (PDO) and Atlantic Multidecadal Oscillation (AMO) and global climate.

Perhaps the easiest way to understand the causal relationship between global warming/cooling and the PDO and AMO is to recount how these correlations were discovered. In 1999, while studying recent glacial fluctuations on Mt. Baker in the North Cascade Range, a pattern of recurring advances and retreats became apparent. In the wee hours one night, I came across a 1997 paper by Mantua, et al., “*A Pacific interdecadal climate oscillation with impacts on salmon production,*” an early recognition of the PDO. The PDO is an index, not a measured value, based on about a dozen or so parameters that are related to cyclical variations in sea surface temperatures in the NE Pacific. The term "Pacific Decadal Oscillation" (PDO) was coined by Steven Hare (1996). It has two modes, warm and cool, and flips back and forth between them every 25 to 30 years.

The Mantua et al. curve looked so similar to my glacial curve that I superimposed the two and was surprised to see that they corresponded almost exactly. I then compared them to global temperature and all three showed a remarkable correlation (Fig. 1).

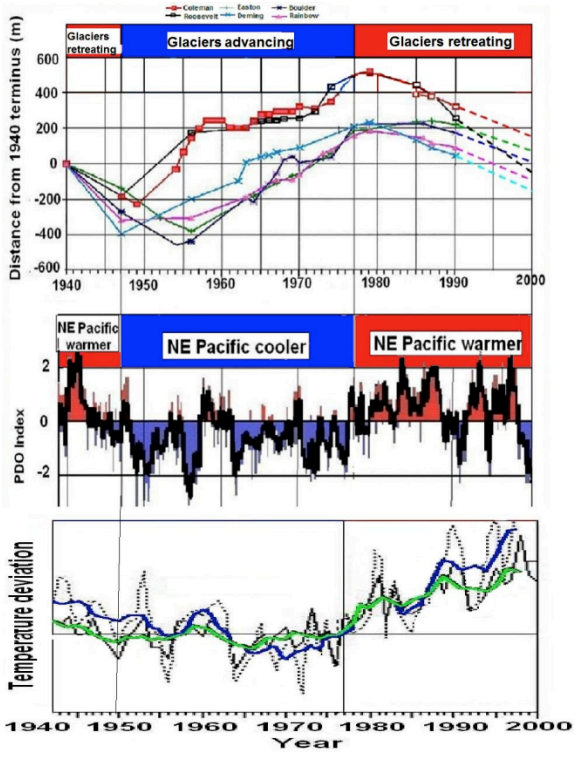

Figure 1. Correlation of glacier fluctuations on Mt. Baker with the Pacific Decadal Oscillation and global climate. (Easterbrook, 2001, 2011)

The significance of this correlation is that it clearly showed that the PDO was the driver of climate and glacial fluctuations on Mt. Baker. Each time the PDO mode flipped from one mode to another, global climate and glacier extent also changed. This discovery was significant in itself but was to lead to a lot more. At this point, it was clear that PDO drove global climate (Figs. 2,3), but what drove the PDO was not apparent.

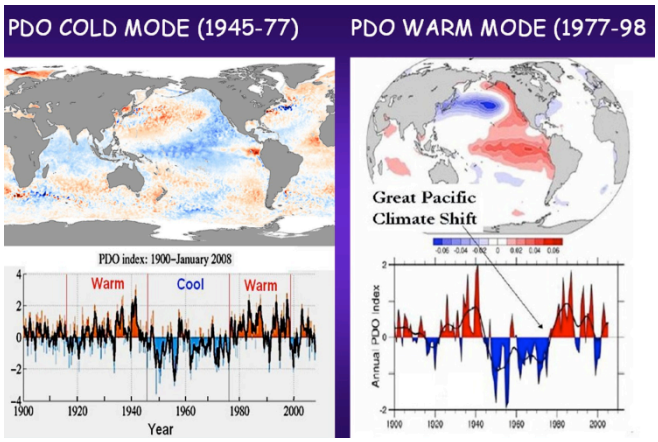

Figure 2. 1945-1977 PDO cold mode and 1977-1998 warm mode.
(Easterbrook 2011 modified from D'Aleo)

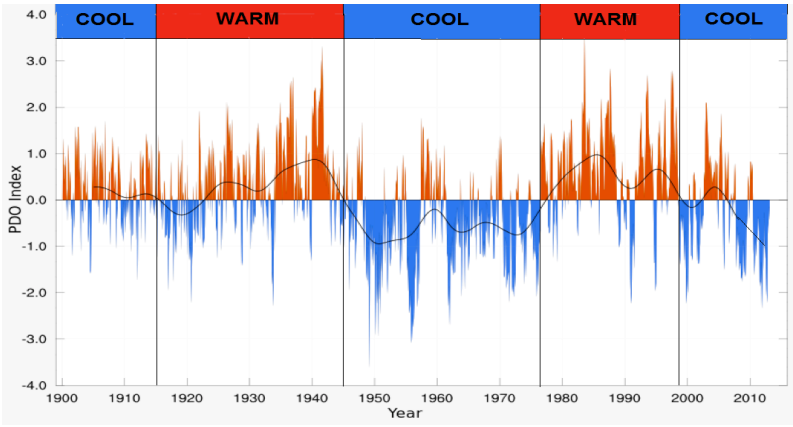

Figure 3. PDO fluctuations from 1900 to August 2012. Each time the PDO was warm, global climate warmed; each time the PDO was cool, global climate cooled.
(modified from http://jisao.washington.edu/pdo/)

In 2000, I presented a paper, "*Cyclical oscillations of Mt. Baker glaciers in response to climatic changes and their correlation with periodic oceanographic changes in the Northeast Pacific Ocean*" at the annual meeting of the Geological Society of America (GSA). The following year at the GSA meeting, I presented another paper "*The next 25 years: global warming or global cooling? Geologic and oceanographic evidence for cyclical climatic oscillations.*"

Since this recurring pattern of PDO fluctuation and global climate held true for the past century, what might the future hold? If the pattern continued, then might we project the same pattern into the future to see where we are headed, i.e., the past is the key to the future. If we want to know where we

are heading, we need to know where we've been. Each of the two PDO warm periods (1915-1945 and 1978-1998) and the three cool periods (1880-1915, 1945-1977, 1999-2014) lasted 25-30 years. If the flip of the PDO into its cool mode in 1999 persists, the global climate should cool for the next several decades. Using the past durations of PDO phases, I spliced a cool PDO (similar to the 1945-1977 cool period) onto the end of the curve and presented the data in a paper at the 2001 Geological Society of America meeting in Boston. In this paper, I proposed that, based on the past recurring pattern of PDO and global climate changes, we could expect 25-30 years of global cooling ahead (Fig. 4). With memories of the 1998 second warmest year of the century, the audience was stunned at such a prediction, especially since it directly contradicted the IPCC predictions of global warming catastrophe.

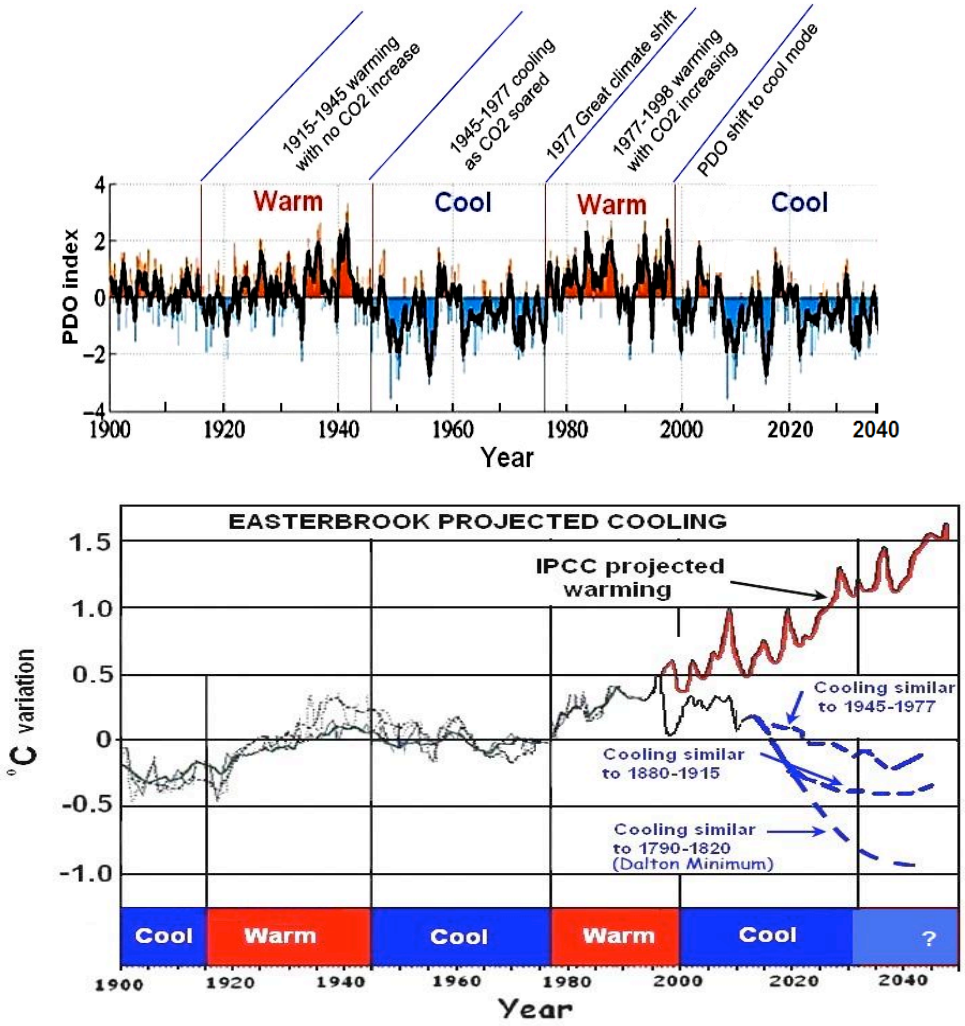

Figure 4. (Top) PDO fluctuations and projections to 2040 based on past PDO history. (Bottom) Projected global cooling in coming decades based on extrapolation of past PDO recurring patterns.

My first projection of future global cooling was based on continuation of past recurring PDO fluctuations for the past century. But what about earlier climate changes? Because climate changes recorded in the oxygen isotope measurements from the GISP2 Greenland ice core had such an accurate chronology from annual layering in the ice, it seemed a perfect opportunity to see if similar changes had occurred in previous centuries, so I plotted the oxygen isotope accelerator measurements made by

Stuiver and Grootes (1997) for the past 450 years. Oxygen isotope ratios are a function of temperature, so plotting them gives a paleo-temperature curve. This was a real eye-opener because the curve (Fig. 4) showed about 40, regularly-spaced, warm/cool periods with average cycles of 27 years, very similar to the PDO cycle. There was no way to determine what the PDO looked like that far back, but the GISP2 warm/cool cycles were so consistent that correlation with PDO 25-30 year cycles seemed like a good possibility. Historically known warm/cool periods showed up in the GISP2 curve, i.e., the 1945-1977 cool period, the 1915-1945 warm period, the 1880-1915 cool period, the Little Ice Age, Dalton Minimum cooling, the Maunder Minimum cooling, and many others, lending credence to the validity of the GISP2 measurements.

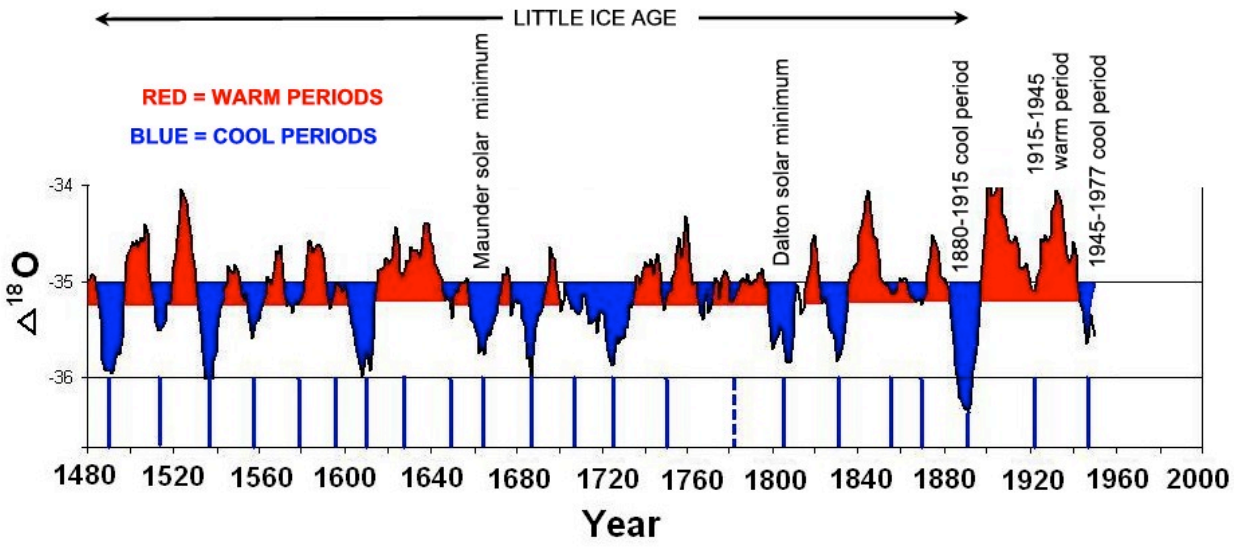

Figure 5. Warm and cool periods to 1480 AD from oxygen isotope measurements from the GISP2 Greenland ice core. The average length of a warm or cool cycle is 27 years.

When I presented this data and my climate projections at the 2006 GSA meeting in Philadelphia, Bill Broad of the NY Times was in the audience. He wrote a feature article in the NY Times about my data and predictions and the news media went bonkers. All of the major news networks called for interviews, then curiously all except CNN, MSNBC, and Fox abruptly canceled, apparently because my data posed a threat to IPCC predictions of catastrophic warming.

Nine additional papers expanding the geologic evidence for global cooling were presented from 2007 to 2009 and several longer papers were published from 2011-2014, including

"*Multidecadal tendencies in Enso and global temperatures related to multidecadal oscillations*," Energy & Environment, vol. 21, p. 436-460. (D'Aleo, J. and Easterbrook, D.J., 2010).

"*Geologic Evidence of Recurring Climate Cycles and Their Implications for the Cause of Global Climate Changes: The Past is the Key to the Future,*" in the Elsevier volume "*Evidence-Based Climate Scien*ce; p. 3-51. (2011)

"*Relationship of Multidecadal Global Temperatures to Multidecadal Oceanic Oscillations*," in the Elsevier volume "*Evidence-Based Climate Scien*ce; p. 161-180. (D'Aleo, J. and Easterbrook, D.J., 2011)

"*Observations: The Cryosphere*," *in* Climate Change Reconsidered II, Physical Science (Easterbrook, D.J., Ollier, C.D., and Carter, R.M., 2013), p. 645-728.

Reprints of any of these publications may be obtained from http://myweb.wwu.edu/dbunny/ or by emailing dbunny14@yahoo.com.

During these years, important contributions were made by Joe D'Aleo, who showed that during warm periods, warm El Nino phases occurred more frequently and with greater intensity than cooler La Nina phases and vice versa. He also documented the role of the Atlantic Multidecadal Oscillation (AMO), which is similar to the PDO. The AMO has multi-decadal warm and cool modes with periods of about 30 years, much like the PDO.

So the question now becomes how could my predictions be validated? Certainly not by any computer climate models, which had proven to be essentially worthless. The obvious answer is to check my predictions against what the climate does over several decades. We've been within my predicted cooling cycle for more than a decade, so what has happened? We've now experienced 17 years with no global warming (in fact, slight cooling) despite the IPCC prediction that we should now be ~1° F warmer (Figs. 6, 7, 8). So far my 1999 prediction seems to be on track and should last for another 20-25 years.

Conclusions

The 'mysterious pause' in global warming is really not mysterious at all. It is simply the continuation of climatic cycles that have been going on for hundreds of years. It was predicted in 1999, based on repeated patterns of cyclical warm and cool PDO phases so it is neither mysterious nor surprising. The lack of global warming for the past 17 years is just as predicted. Continued cooling for the next few decades will totally vindicate this prediction. Time and nature will be the final judge of these predictions.

What drives these oceanic/climatic cycles remains equivocal. Correlations with various solar parameters appear to be quite good, but the causal mechanism remains unclear. More on that later.

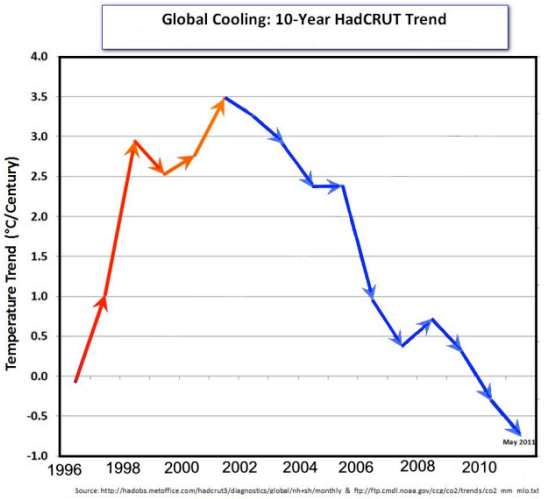

Figure 6. Temperature trend (°C/century) since 1996. Red = warming, blue = cooling.

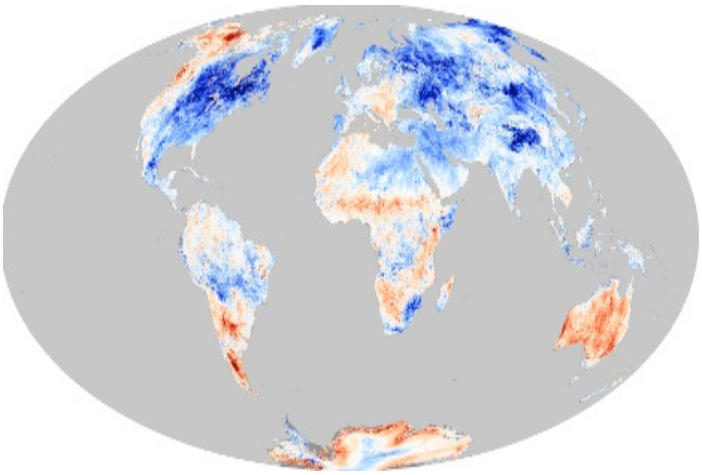

Figure 7. Global cooling since 2000 (Earth Observatory)

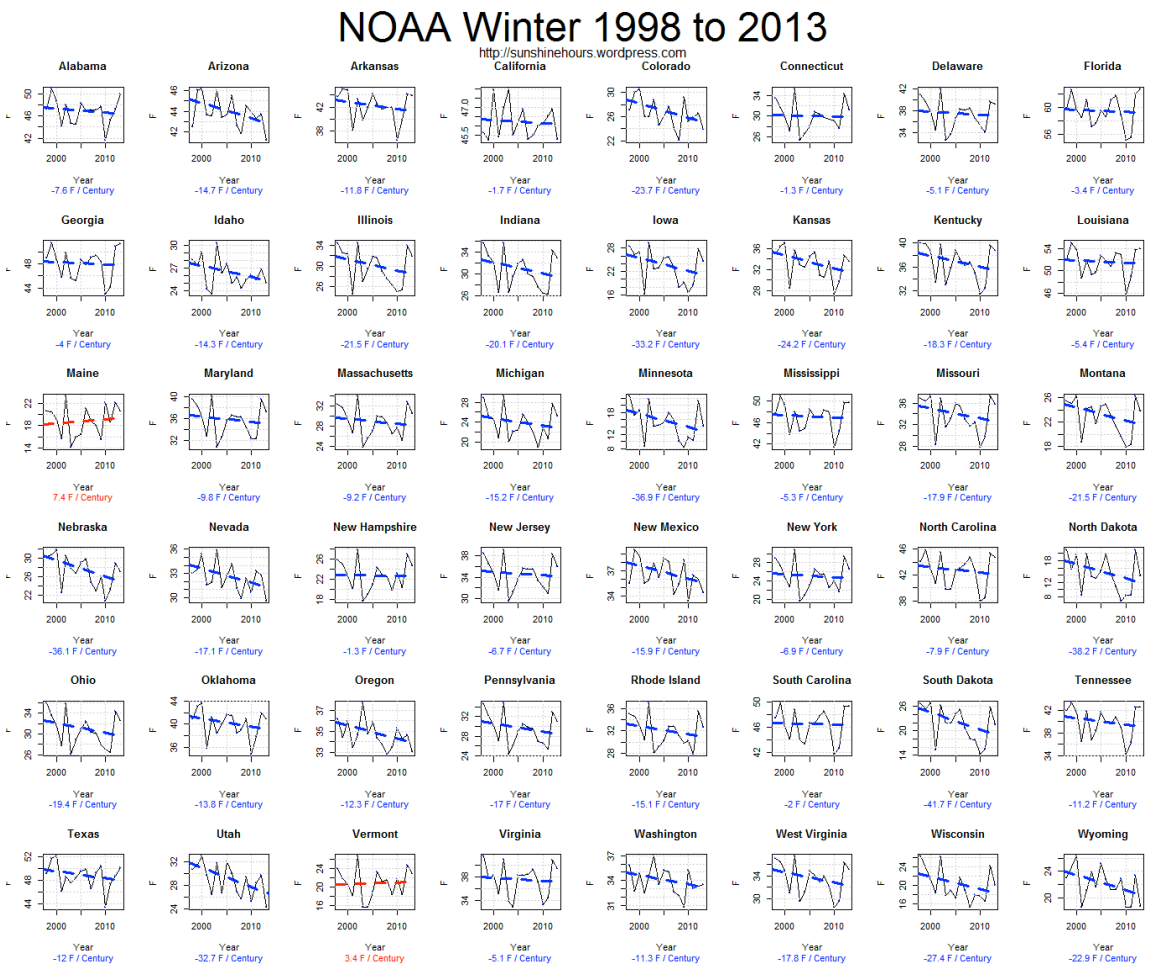

Figure 8. Winter temperatures in the U.S. 1998-2013. 46 of the 48 states were significantly colder.

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