New geologic evidence of past periods of oscillating, abrupt warming, and cooling

Two hundred years ago, Charles Lyell coined the phrase "The present is the key to the past." In today's highly contentious issues of global climate change, we might well add "The past is the key to the future, i.e., to forecast future geologic events, we must understand past climate changes. This paper documents past global climate changes in the geologic and historic past.

Recent laser imaging of the Earth's surface provides new evidence for abrupt, fluctuating, warm and cool climatic episodes that could not have been caused by changes in atmospheric CO_2. In a paper presented at the national meeting of the Geological Society of America in Portland, OR, Professor Don J. Easterbrook, Professor of Geology at Western Washington University, presented new data from airborne laser imagery showing well-defined, previously unknown, multiple moraines deposited by glaciers 11,700 to 10,250 years ago.

At least 9 significant, abrupt periods of warming that resulted in retreat of the Cordilleran Ice Sheet are documented by moraines from successive glacial retreats in the Fraser Lowland of NW Washington l(Fig. 1). In addition, smaller multiple glacier recessions are found within the more prominent episodes of glacier retreat. As indicated by the amount of glacier recession between each of the successive moraines, the warming events were of greater magnitude than those observed in recent centuries.

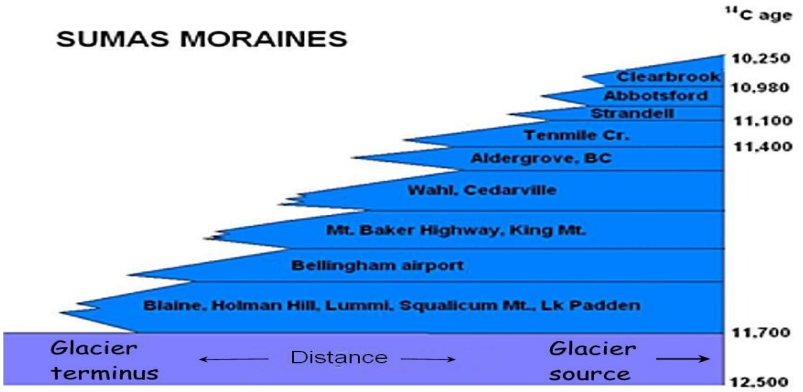

Figure 1. Successive terminal moraines from short–term glacier recessions caused by climatic warming between 11,700 and 10,250 years ago.

Isotope data from Greenland ice cores and show a consistent pattern of fluctuating warm and cool periods over the past 500 years (Fig. 2). The average period of warming/cooling oscillations over the past 500 years is 27 years, remarkably similar to the period of alternation between warm and cool Pacific Decadal Oscillation.

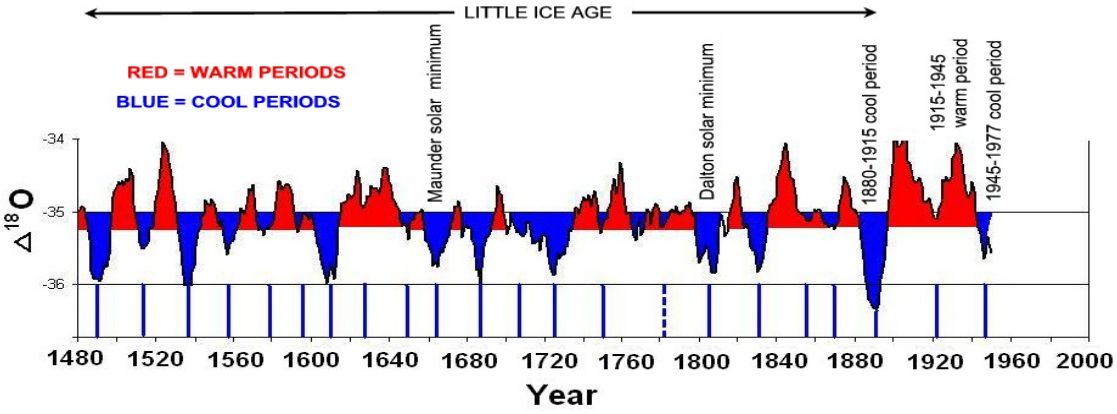

Figure 2. Paleotemperatures derived from oxygen isotope measurements of the GISP2 Greenland ice core. Red peaks are times of warming and blue are times of cooling. The average time period for each climatic oscillation is 27 years.

During the past century, two episodes of global warming and two of global cooling have occurred (Fig. 3), all of which can be tied to glacial oscillations, oceanic temperature changes, atmospheric temperature changes, and solar variation.

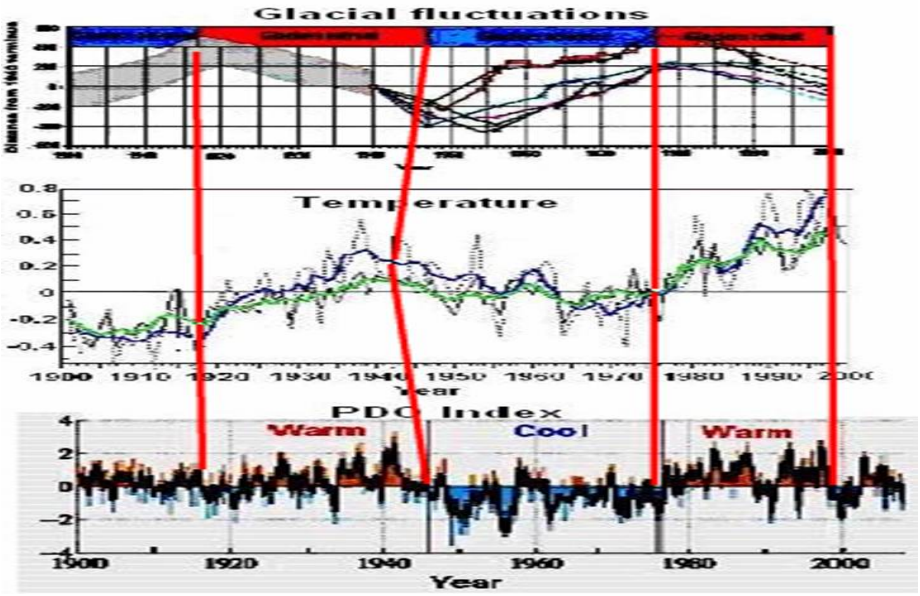

Figure 3. Coincidence of Pacific Decadal Oscillation (PDO), global temperature, and glacier fluctuations in the North Cascades. Glaciers advanced during the 1880–1915 cool period when the PDO was cool, then when the PDO switched to its warm mode, global temperatures warmed, and glaciers retreated from ~1915–1945. The PDO changed from warm to cool ~1945–1977, global temperatures cooled and glaciers advanced once again. In 1977, the PDO switched from cool to warm mode, global temperatures warmed, and glaciers retreated. In 1999, the PDO changed back to its cool mode and global cooling began.

What we can learn from this geologic climate changes is that the past is indeed the key to the future. In 1999, the year after the warmest year of recent times, I projected the climate pattern from the past century and past 500 years into the future and predicted that we would be due for 25–30 years of global cooling beginning about 2000. The PDO changed from its warm to cool mode in 1999 and since then we have had global cooling, quite moderate to flat (interrupted by two warm El Ninos) and intensifying since 2007.

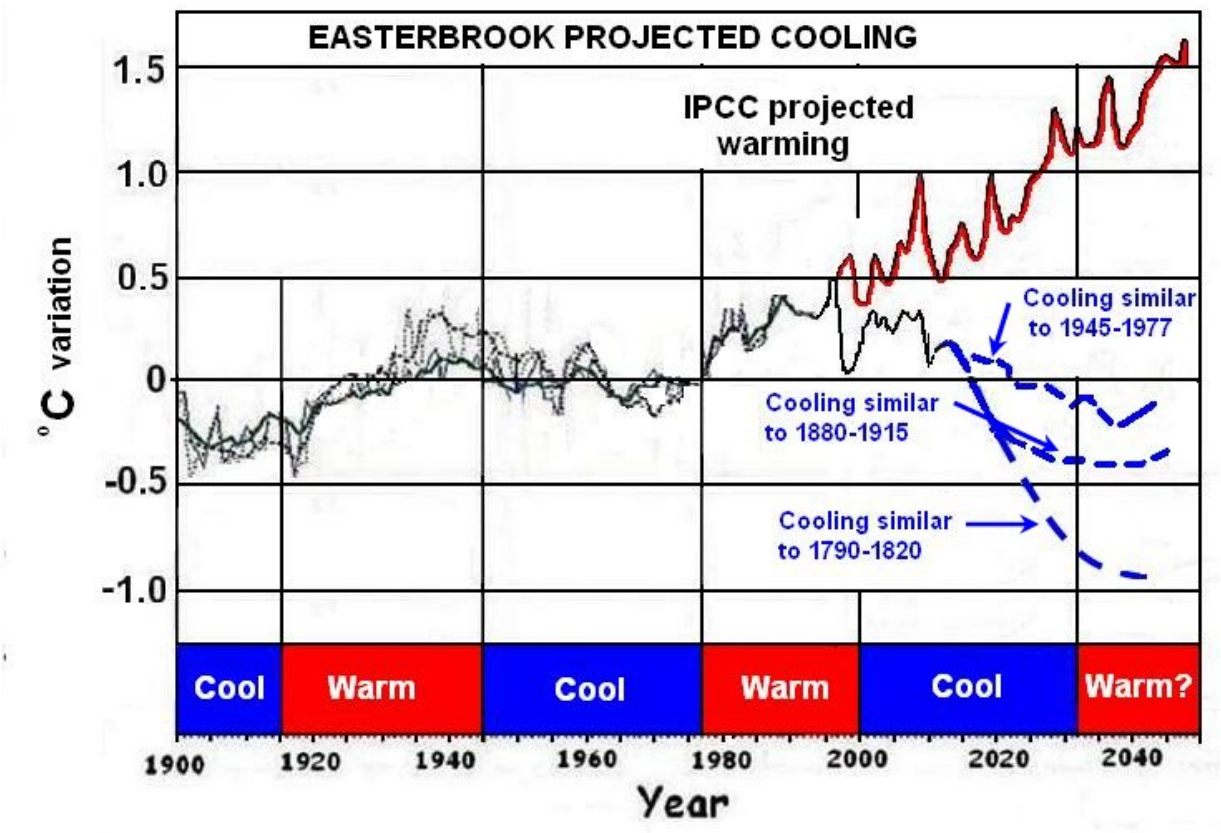

Figure 4. Projection of climate changes of the last century and past 500 years into the future. The black curve is temperature variation from 1900 to 2009; the red line is the IPCC projected warming from the IPCC website in 2000; the blue curves are several possible projections of climate change to 2040+ based on past global cooling periods (1945-1977; 1880 to 1915; and 1790 to 1820). The lack of sun spots during the past solar cycle has surpassed all records since the Dalton Minimum and some solar physicists have suggested we may be headed for a Dalton or Maunder type mimimum with severe cooling.

Abstract of paper presented to Geological Society of America, Oct. 19, 2009

THE ROLE OF THE OCEANS AND THE SUN IN LATE PLEISTOCENE AND HISTORIC GLACIAL AND CLIMATIC FLUCTUATIONS

EASTERBROOK, Don J., Dept. of Geology, Western Washington Univ, Bellingham, WA 98225, don.easterbrook@wwu.edu

Lidar imagery of the southern part of the Fraser Lowland in WA reveals previously unknown, multiple, latest Pleistocene (Sumas Stade) end moraines overlying Everson glaciomarine drift (gmd). Multiple marine shorelines extend from about 540' to about 100'above present sea level and are truncated by two of the oldest Sumas end moraines. These moraines are younger than the underlying Everson gmd, which is well dated at 11,700 ^{14}C yrs. B.P., and older than 11,400 ^{14}C yrs. B.P. basal bog dates behind the moraines. Recession of the ice from the outermost moraines was followed by building of at least nine end moraines, some of which clearly represent glacial readvances. Basal bog dates from a kettle in outwash from the youngest Sumas moraine has been dated at 10,250 ^{14}C yrs. B.P.

Isotope data from Greenland ice cores and historic atmospheric and oceanic temperature records show a consistent pattern of fluctuating 25-30–year warm and cool periods over the past 500 years. During the past century, five of these climate fluctuations can be tied to glacial oscillations, oceanic temperature changes, atmospheric temperature changes, and solar variation.

The question is—what drives these oscillations? The older fluctuations can be linked to changes in ^{14}C and ^{10}Be isotope production rates in the upper atmosphere, suggesting variation in cosmogenic radiation. Historic climatic and oceanic temperature fluctuations are associated with solar variations. The excellent correlation of glacial, climatic, oceanic, and solar variation strongly suggests cause and effect relationships. Past patterns of these variations allow projection into the future.

Expanded abstract and slides available for viewing at 2009 Portland GSA Annual Meeting (18-21 October 2009)