Central Coast Climate Science Education

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Misperception 6: Norse settlers thrived in Greenland during the Medieval Warm Period long before humans contributed any significant carbon dioxide to the atmosphere. Therefore, there is no reason to think humans are responsible for current climate change.

Response:

(Note: this is a greatly expanded version of my response to a request from Mr. John Lindsey for his "Weather Watch" San Luis Obispo Tribune column of March 15, 2015 for input regarding this frequently heard myth.)

From time to time I give talks on climate change and the dominant role humans are now playing in it. Frequently, some who reject this scientific consensus will offer objections they have read about in various "contrarian" websites. I keep a kind of mental list of the most common ones: Currently, #1 is "climate change is just part of a natural cycle", while #2 is "It hasn't warmed since 1998 even though CO2 has kept rising." (As it happens, we have just learned that 2014 was the warmest in over 130 years of instrumental global temperature records. In any case, the rate at which energy is being deposited in the Earth's climate system has not slowed at all in the last 15-20 years.) For responses to these two objections see
http://www.centralcoastclimatescience.org/tutorials-lesson-07.pdf
(especially pages 12-13) and
http://www.centralcoastclimatescience.org/tutorials-lesson-05.pdf
(especially page 11).

Close on the heels of these two is #3: *"The Vikings settled Greenland about 1000 years ago where it was much warmer than it is today but before humans had any noticeable effect on carbon dioxide levels. So the scientific consensus--that the current rapid increase in carbon dioxide due to fossil fuel consumption is primarily responsible for the current warming and changing climate--is discredited."* Sometimes this myth is embellished with the story that they had vineyards and shipped fine wines back to the Olde Country, so I also refer to this myth as:

THE "GRAPES GREW IN GREENLAND MYTH"

I want to provide the response of climate scientists and archeologists to this objection not only to explain why that inference is fallacious but also to attempt to illustrate the effort it takes to really provide an objective and detailed response. There are two issues to address: #1) Do we know how warm it really was compared to today's temperatures in Greenland? #2) More importantly, what bearing does the answer to the first question have on the scientific consensus on global warming?

There are two ways to address #1: 1a) Examine the historical and archeological evidence. 1b) Look at the physical evidence—responses of growth rates and the chemical makeup of organisms living at that time that are sensitive to temperature—so-called "temperature proxies"—since of course thermometers did not exist then.

Regarding (1a) there appear to have been two Norse settlements on the southwest and southern coast of Greenland, the locations of which are shown here (Figure 1).

Figure 1*: Norse settlements in Greenland during the Medieval Warm Period.*

Except near the coast and fjords, Greenland was then, and is now, covered with two miles of ice and has been for hundreds of thousands of years, as shown here in Figure 2:

Figure 2*. The Greenland ice sheet today. Except along the coast and into some of the fjords, Greenland is covered by a huge sheet of ice. Ice core samples show this has been the case for several hundred thousand years.*

The so-called "Eastern" settlement, located near the southern tip of Greenland, had a latitude about the same as that as Oslo, Norway, (60N) while the more northerly ("Western") settlement was at a latitude of about 64N.

Reading what professional archeologists infer about the climate based on excavations of ruins and historical material I would summarize it something like this: "Sheep and cows were raised, kept outside in summer and in barns in winter. Some barley was grown but growing other grains was problematic. The growing season was short and the fjords froze early. They also relied heavily on seals and other sea life for food. *Exports* were walrus ivory tusks, some furs, and dairy products, while *imports* were iron tools, timber (timber

was very scarce in Greenland then and now) and luxury goods including wine."

As far as vineyards are concerned a Danish arctic scientist, Dr. Svend Funder, wrote:
"Let me, as a geologist, assure you that the last wine plants to grow in Greenland were those that grew on Nussuaq in the early Paleocene, 60 million years ago." (Nussuaq was part of the Western settlement, located near present day Nuuk.) But it should be noted that even if some wine *had been* produced by these Norse settlers, one could not jump to the conclusion that the climate was as balmy as it is here in our own San Luis Obispo County; some wine grapes are "cold hardy" to -20F°—see, for example
http://viticulture.hort.iastate.edu/cultivars/Alpenglow.pdf

As far as how the "grapes grew in Greenland" myth originated, there seem to be two possibilities: One is that the myth grew out of confusion over the name "Vineland" given by the Norse to parts of North America, not Greenland. The other, and more likely one, involves the ambiguity in the old Norse word "vin" which can also mean "berries" or even "pasture".

It is not easy to translate this information into temperature scales to compare with the present climate. In Nuuk, the largest city in Greenland today, and in the same area as the Western Norse settlement, today's wintertime temperature minima average around +14 F— but of course they can sometimes go much lower, while summer maxima are in the mid-forties with four or five frost free months. As discussed below, this may have been similar to the temperature in the Western settlement during the Medieval warm period.

As for what caused the demise of these two Norse Greenland settlements, a highly variable and subsequent colder climate certainly was a contributing factor. But as described in several recent papers, it was just one factor along with cultural, economic and political challenges besetting the Norse Greenlanders.

The other approach ("1b") to learning about the Norse settlement climate is to use "temperature proxies". (A recent paper providing an example of this used "alkenone unsaturation in sediments of two lakes" if you really want to know!) These authors reconstructed temperatures going back several thousand years. The Norse were by no means the first inhabitants of Greenland and the authors of this paper show that over this extended period the climate was

highly variable and, as noted above, cold episodes were likely a factor, though certainly not the only factor, in the demise of these waves of settlements.

An interesting result of this paper is that there appears to have been an *anti-correlation* between the climate on the Greenland west coast and that further to the east (e.g. in Ireland): when one place was warmer than normal the other was colder than normal and vice versa. The authors suggest this may have been caused by back-and-forth shifts in the North Atlantic ocean currents. Such "temperature see-saw" effects in this part of the globe have been known for some time. (See for example the discussion by Kuipers et al. in "The Journal of the North Atlantic, Special Volume 6, p. 1-14, 2014)

This brings us to the second and more important question: What bearing does the existence of these Norse Settlements and the climate there during this time have on the scientific consensus regarding the nature and cause of the present global warming? The answer is: **very little**. A general result of paleoclimatological research during the last 2000 years and up until about the beginning of the 20th century, is that ***these changing climate patterns were regional, not global***

Here are brief excerpts from the group of experts who summarized the paleoclimate evidence regarding the medieval warm period as part of the most recent IPCC review of ancient climates, couched in the usual cautious scientific language:

"Continental-scale surface temperature reconstructions show, with high confidence, multidecadal intervals during the Medieval Climate Anomaly (950 to 1250) that were in some regions as warm as in the mid-20th century and in others as warm as in the late 20th century. ***With high confidence, these intervals were not as synchronous across seasons and regions as the warming since the mid-20th century****", while "NH (northern hemisphere) reconstructions covering part or all of the first millennium suggest that some earlier 50-year periods might have been as warm as the 1963–2012 mean instrumental temperature, but the higher temperature of the last 30 years appear to be, at least, likely the warmest 30-year period in all reconstructions… however, the confidence in this finding is lower prior to 1200, because the evidence is less reliable and there are fewer independent lines of evidence" (From IPCC AR5 Working Group 1, Chapter 5, 2013).*

Note the sentence above I have put in bold face: What they are saying is that in contrast to the nearly uniform warming across the entire planet we are now experiencing, the warming during the period of these Norse settlements was

not uniform over the planet or even over the northern hemisphere: While one region may have been unusually warm others were normal or even cooler than normal during the same time, one example of which is the "see-saw" effect noted earlier.

These conclusions can be graphically demonstrated by comparing Figures 3 and 4, showing the contrast between the regional warming of the Medieval Warming Period and the global warming pattern currently underway.

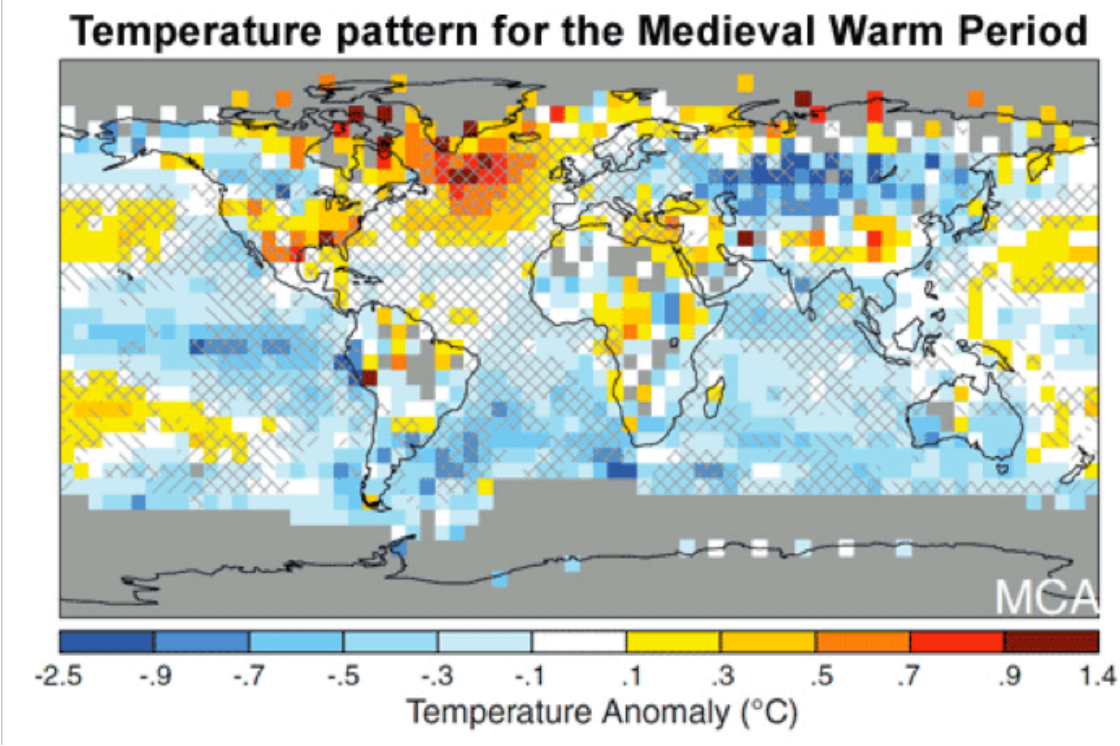

***Figure 3**: A temperature reconstruction using "proxies" for the medieval warm period (roughly 900-1250) for the world. The temperature scale is relative to the baseline period 1961-1990.*
Source: Mann et al in SCIENCE magazine: Vol. 326 no. pp. 1256-1260 2009

(Note: My "Figure 4" is labeled as "Figure 2" in the image below.)

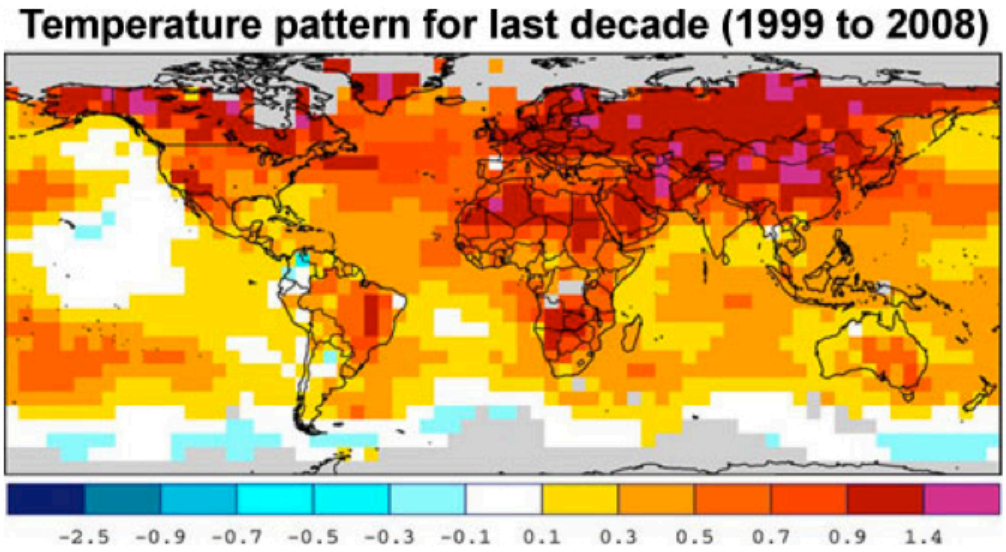

Figure 2 - Surface temperature anomaly for period 1999 to 2008, relative to the 1961– 1990 reference period. (Source: NOAA)

Figure 4*. The current warming pattern from 1999 to 2008 relative to the same baseline period as in Figure 3. Note that in contrast to Figure 3, the current warming is nearly world wide, and that in Greenland is comparable to that during the medieval warm period.*

In the first of these two maps, Figure 3, which is for the medieval warm period (covering the height of the Norse Greenland settlements) you can see that in portions of the world, especially in the area around Greenland and the ocean a bit to the southeast, the temperature was warmer than the baseline period (1961-1990) but in others (central Russia, for example) it was colder. By contrast, the current warming, shown in Figure 4, relative to this same baseline period, practically covers the entire globe, and the current warming in Greenland is comparable to the localized warming of the medieval warm period.

Note that in Figure 4 the warming over the last few decades has been most extreme in the arctic. The arctic seems in general to be one of the most sensitive to long term climate change, a phenomenon predicted by models and known as “arctic amplification”. Thus it would be interesting to see what the temperature record has been over the few thousand years in the entire arctic region. In fact, in a paper published by Kaufman et al. in SCIENCE, vol 325, p. 1236 (2009) entitled “Recent Warming Reverses Long Term Arctic Cooling”, the authors present the following plot (Figure 5) for the change in temperature based on a set of proxies all north of 60N latitude.

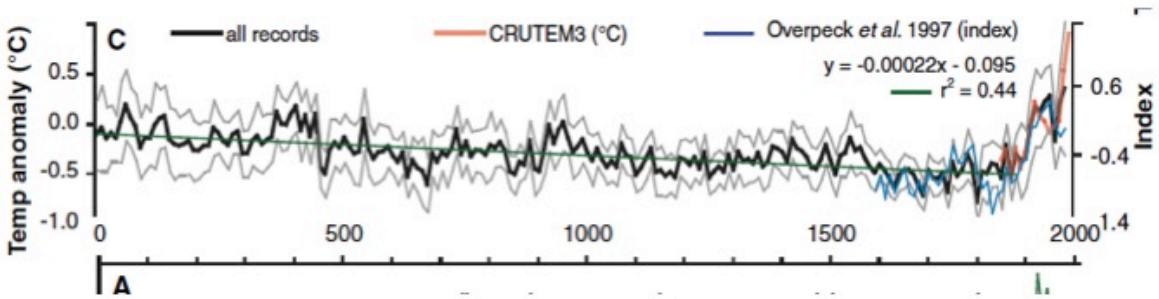

Figure 5: The temperature in the Arctic (latitude North of 60) over the last 2000 years. Note the gradual cooling until the sharp upturn starting around 1850. The figure is taken from Kaufman et al. SCIENCE, 3256, p. 1236 (2009)

The contrast between the medieval warm period and the temperature of the last several decades is further shown by a graph of the temperature reconstruction for the *entire northern hemisphere* (Figure 6—but labeled "Figure 1" in the image)

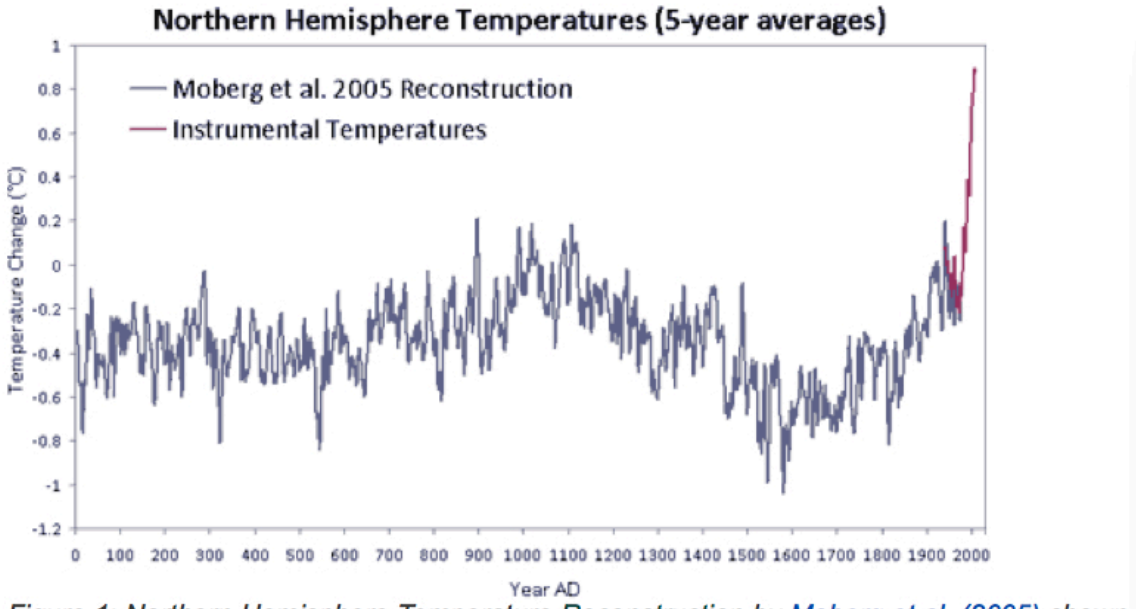

Figure 1: Northern Hemisphere Temperature Reconstruction by Moberg et al. (2005) shown in blue, Instrumental Temperatures from NASA shown in Red.

***Figure 6**: Temperature reconstruction for the Northern Hemisphere over the last 2000 years. The Medieval warm period peak around 1050 followed by the Little Ice age is obvious, but the recent sharp rise in the last decades is in marked contrast to these slow natural variations.*
From Moberg et al: NATURE magazine, Vol 433, pp. 613-617, 2005 but note that many subsequent research papers also reproduce the essential features of this work.

And finally, when we look at temperature reconstructions averaged over the entire globe, there is barely any trace of the medieval warm period (Figure 7) but the overall cooling is apparent during the last 1000 years until suddenly reversed in the last 100 years or so.

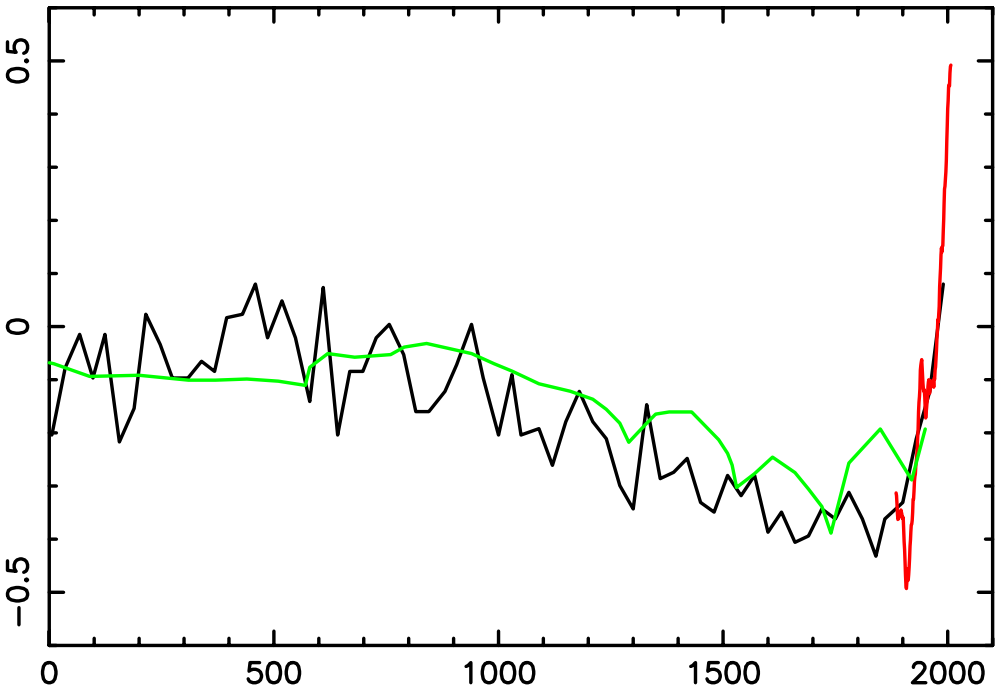

Figure 7*. Two worldwide temperature reconstructions covering the last 2000 years. The black graph is from the "Pages" consortium reconstruction, taken from Ahmed et al: Nature Geoscience: vol. 6, pp. 339-346, 2013.The green graph is a portion of low time-resolution results taken from Marcott et al. SCIENCE magazine, vol 339, pp 1198, 2013) The red graph is the NASA-GISS instrumental temperature record.*

The gradual cooling, especially in the arctic is almost certainly due to very slow changes in the Earth's orbital properties which change the amount of sunlight in the far north in any given season and affect the amount of snow and ice cover and hence the amount of sunlight absorbed or reflected. The reverse happened many thousands of years ago as the Earth emerged from the most recent ice age.

To summarize: Natural variability in regional climates probably involves two factors:

1) Factors *external* to the climate system, e.g. slow orbital changes of the Earth, periods of brighter or fainter than average solar brightness or periods of higher or lower than average volcanic activity.
(For a discussion of the possible influence of changes in solar brightness during the Medieval Warm period on the Greenland climate, see
Sha et al. in Palaeogeography, Palaeoclimatology, Palaeoecology Vol. 403, pp. 66-70. 2014)

2) Factors *internal* to the climate system, especially long-term meanderings in ocean currents that redirect the warmth that is always carried polewards from the equator to one high latitude location or to another.

But today we are experiencing planetary wide warming because of the rapid increase in carbon dioxide levels due to fossil fuel and land use changes. Today's CO2 levels are higher than any found on Earth in millions of years.

So, there is neither any compelling *archeological* evidence nor any *paleo-climatological* evidence justifying the argument that "Greenland was much warmer around 1000 AD than it is today." More importantly, the global pattern of rapid warming now being experienced today is very different from that during the Medieval Warm Period. The argument that the Norse Settlements in Greenland somehow "disprove" the scientific consensus about the dominant role that human-generated CO2 emissions play in the current warming is completely fallacious.

ARCTIC SEA ICE

A related misunderstanding involves Arctic sea ice. The same sources that propagate the notion that the Norse settlements in Greenland invalidate the scientific consensus concerning the dominant role that humans play in current warming also site historical stories about ice-free regions in the far north long before the recent sharp rise in atmospheric CO2. In fact, recent research reveals that a period known as the Holocene Thermal Maximum (HTM) about 8000- 6500 years ago *did* have less ice in northern Greenland than today. (See: Funder et al: SCIENCE Magazine Vol. 333, pp. 747-750 2011). (The full global temperature record showing the HTM can be seen in the work by Marcott et al. cited earlier.)

The situation is similar to that of the temperature—the HTM arose primarily due to external forces, in particular the slow orbital changes in the Earth described above that have caused the coming and going of ice ages over the last several hundred thousand years.

As in the temperature record, there is a high degree of regional variability—while some polar regions had a lot of ice others did not. In fact the situation with sea ice is more complicated than the variable regional temperatures since not just temperature but the details of wind and ocean currents strongly influence the distribution of sea ice. The "proxies" that stand-in for direct measures of arctic ice used by some researchers may not give the same results as different proxies used by others. Thus caution must be used in taking any one result as the last word on this subject.

Here are excerpts and a figure from another recent paper on sea ice: (Kinnard et al: NATURE magazine, Vol. 479 pp 509-513 2011).

*"…the duration and magnitude of the current decline in sea ice seem to be unprecedented for the past 1,450 years…*and *… the recent decrease in summer Arctic sea ice is consistent with anthropogenically forced warming".* But as before, regional variability is found in the locations of arctic sea ice during this period, dating back to about 600 AD. The unprecedented present decline mentioned above is illustrated in what is Figure 3a in the Kinnard paper, which is my Figure 8.

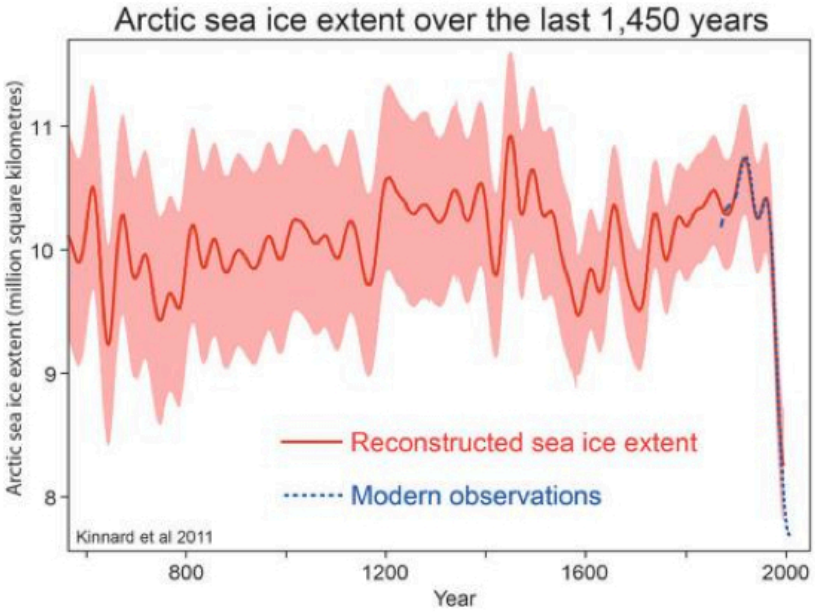

Figure 8*: The arctic sea ice extent dating from about 600 AD to the present. The pink shading represents the uncertainty in this reconstruction which of course increase as one goes further back in time. But the modern observations (which have dropped even further than shown in this graph—in 2014 it was at 5 million square kilometers) are well below those during the Medieval Warm Period.*

But the caveat noted above should be repeated: Different investigators report different results. Eventually further investigations will hone in on a consensus: That is how the scientific method works. In the meantime, the best guideline is perhaps the more cautious statement from the same IPCC review noted earlier:
There is medium confidence from reconstructions that the current (1980 to 2012) summer sea-ice retreat and increase in sea-surface temperatures in the Arctic are anomalous in the perspective of at least the last 2,000 years.

SHOULD I "DEBATE" CLIMATE SCIENCE?

This leads me to the last point: I'm frequently asked to "debate" climate science. Science is based upon *data* and painstaking research, not on who can deploy the cleverest "gotchas" during a debate.
It's easy during a debate to assert as "facts" things that aren't factual! For this reason I urged readers of the abbreviated printed version of this essay to go to this online version of the "Grapes Grew in Greenland" myth. Sadly, my experience is that very few readers will expend the time and effort to do so.
I'll close with another quote from the Danish geologist, Dr. Svend Funder, mentioned above: *"I don't think the Norse settlers in Greenland should be used as an excuse for keeping on with polluting the atmosphere."* I couldn't agree more.

I am grateful to the Danish scientists who shared their arctic expertise with me, but any errors of interpretation are strictly mine.