Claim: Arctic, antarctic and Greenland ice loss is accelerating due to global warming

REBUTTAL

Satellite and surface temperature records and sea surface temperatures show that both the East Antarctic Ice Sheet and the West Antarctic Ice Sheet are cooling, not warming and glacial ice is increasing, not melting. Satellite and surface temperature measurements of the southern polar area show no warming over the past 37 years. Growth of the Antarctic ice sheets means sea level rise is not being caused by melting of polar ice and, in fact, is slightly lowering the rate of rise. Satellite Antarctic temperature records show 0.02C/decade cooling since 1979. The Southern Ocean around Antarctica has been getting sharply colder since 2006. Antarctic sea ice is increasing, reaching all-time highs. Surface temperatures at 13 stations show the Antarctic Peninsula has been sharply cooling since 2000.

The Arctic includes the Arctic Ocean, Greenland, Iceland, and part of Siberia and northern Alaska. Greenland, Iceland, northern Alaska, and northern Siberia contain the only glaciers in the general Arctic region.

Because of the absence of any land mass in the Arctic Ocean, most of the Arctic contains only floating sea ice. Because the arctic ice is floating, it is subject to intrusians of warmer water under the ice during the natural multidecadal warm cycles especially from the North Atlantic, which thins the ice and reduces the ice extent in summer with accompanying warmer air temperatures. Increased ice and colder aier temperatures are observed during cold water ocean cycles.

Arctic temperature records show that the 1920s and 1930s were warmer than 2000. Reported historic fluctuations of Arctic sea ice go back only to the first satellite images in 1979. That happens to coincide with the end of the 1945–1977 global cold period and the maximum extent of Arctic sea ice. During the warm period from 1978 until recently, the extent of sea ice has diminished, but increased in the past several years. The Greenland ice sheet has also grown recently.

THE ANTARCTIC ICE SHEET IS GROWING, NOT MELTING.

Previous studies showed cooling across all of the much larger East Antarctic Ice Sheet (Fig. 1) and warming limited to the Antarctic Peninsula of west Antarctica. In 2009, Steig et al. published a controversial paper, "Warming of the Antarctic Ice-Sheet Surface Since the 1957 International Geophysical Year," in *Nature* (Fig. 7.7), contending that warming instead was occurring.

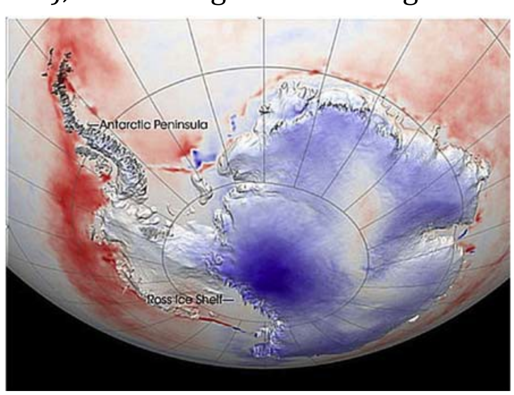


Figure 1. Antarctic temperatures (Blue = cooling, red = warming.) show that Antarctica is cooling, not warming

Measured satellite and surface temperatures confirm the lack of warming over most of Antarctica. The UAH and RSS satellite records (Figs. 2, 3, 4) are the most comprehensive.

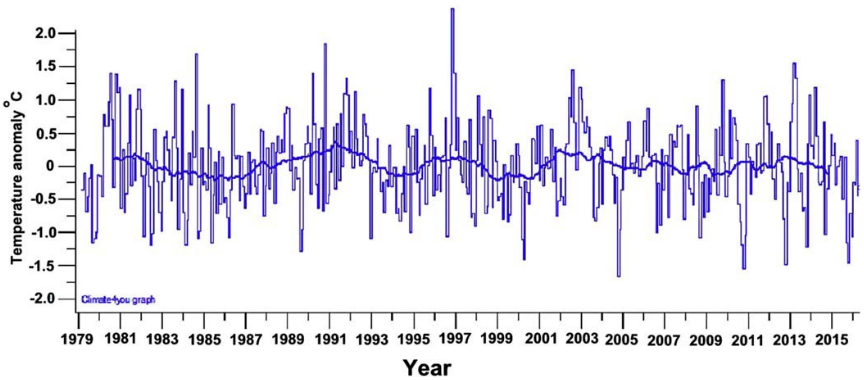


Figure 2. UAH Antarctic satellite temperatures show no warming for 37 years.

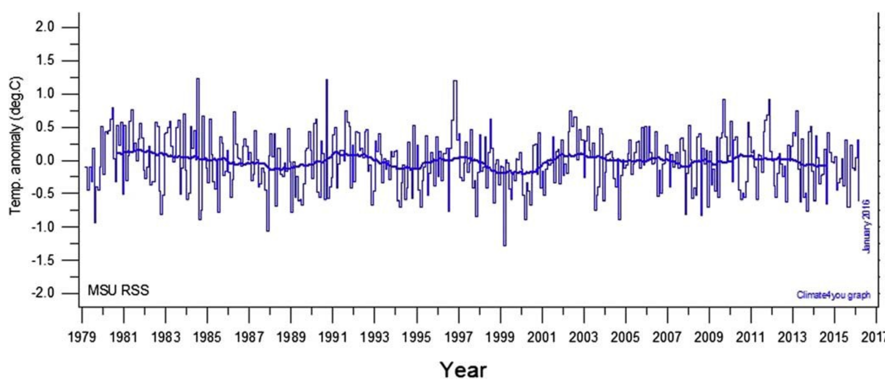


Figure 3. RSS Antarctic satellite temperatures show no warming for 37 years.

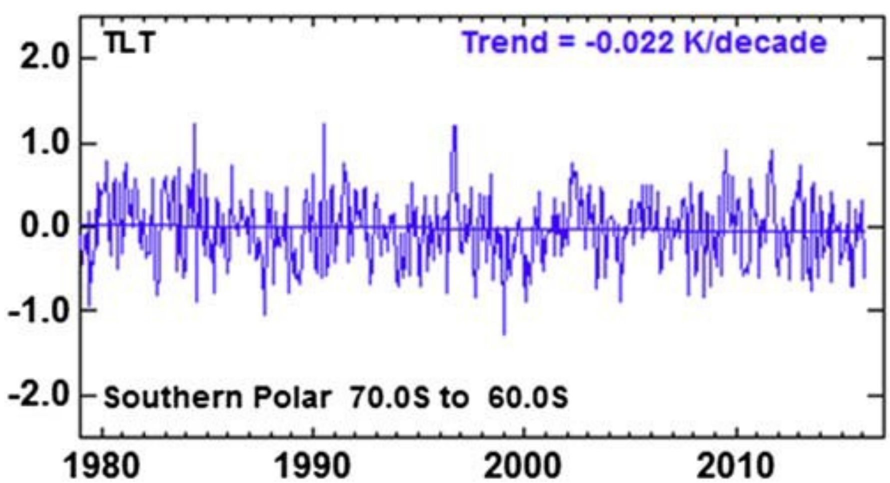


Figure 4. RSS Antarctic temperature record for the Southern Polar area, showing −0.02C/decade cooling since 1979. (UAH temperatures are similar, with a drop of −0.01

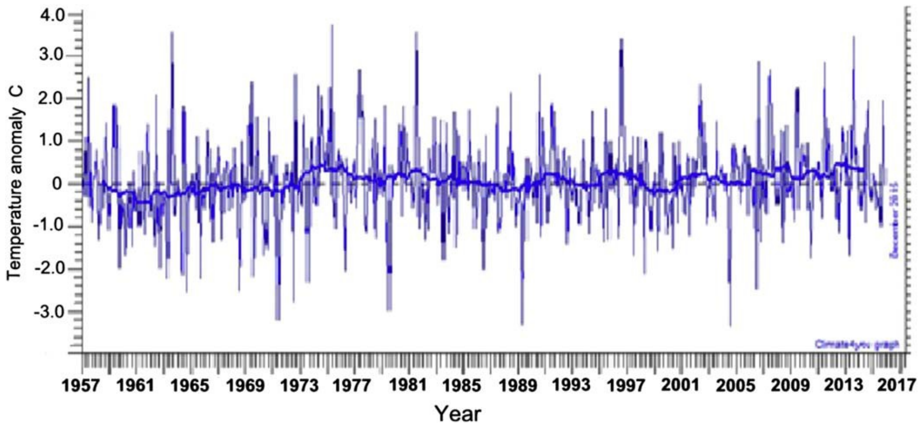


Figure 5. Antarctic surface temperatures since 1957. (HADCRUT)

The main conclusion to be drawn from these data is that at least 95% of glacial ice in Antarctica is increasing, not melting.

Cooling of the Southern Ocean around Antarctica

The Southern Ocean around Antarctica has been getting markedly colder since 2006 (Fig. 6). Sea ice has increased substantially, especially since 2012.

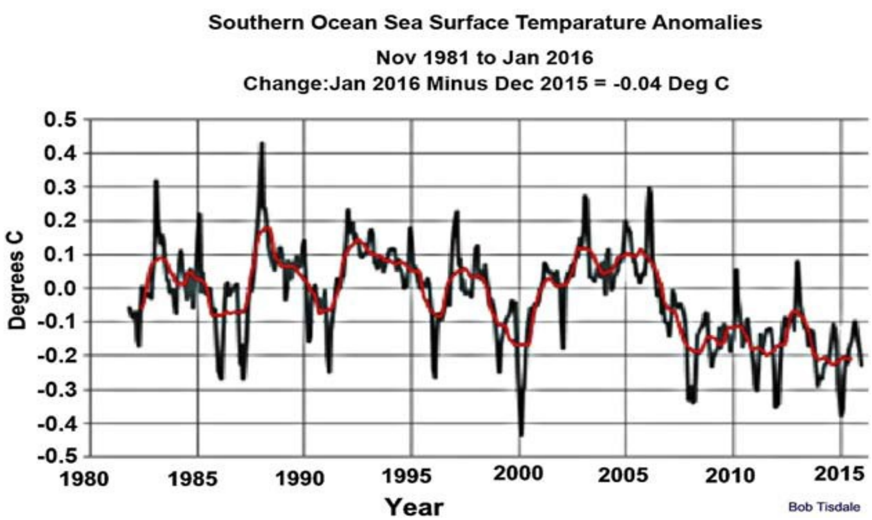


Figure 6. Temperature anomalies of the Southern Ocean showing sharp cooling since 2006.

WEST ANTARCTIC ICESHEET

The West Antarctic Ice Sheet occupies a deep basin west of the main East Antarctic Ice Sheet. It comprises only about 8% of glacial ice in Antarctica. The Antarctic Peninsula has been cooling sharply since 2006. Ocean temperatures have been plummeting since about 2007, sea ice has reached all-time highs, and surface temperatures at 13 stations on or near the Antarctic Peninsula have been cooling since 2000. A plot of temperature anomalies at 13 Antarctic stations on or near the Antarctic Peninsula show that the Antarctic Peninsula was warming up until 2000 but has been cooling dramatically since then.

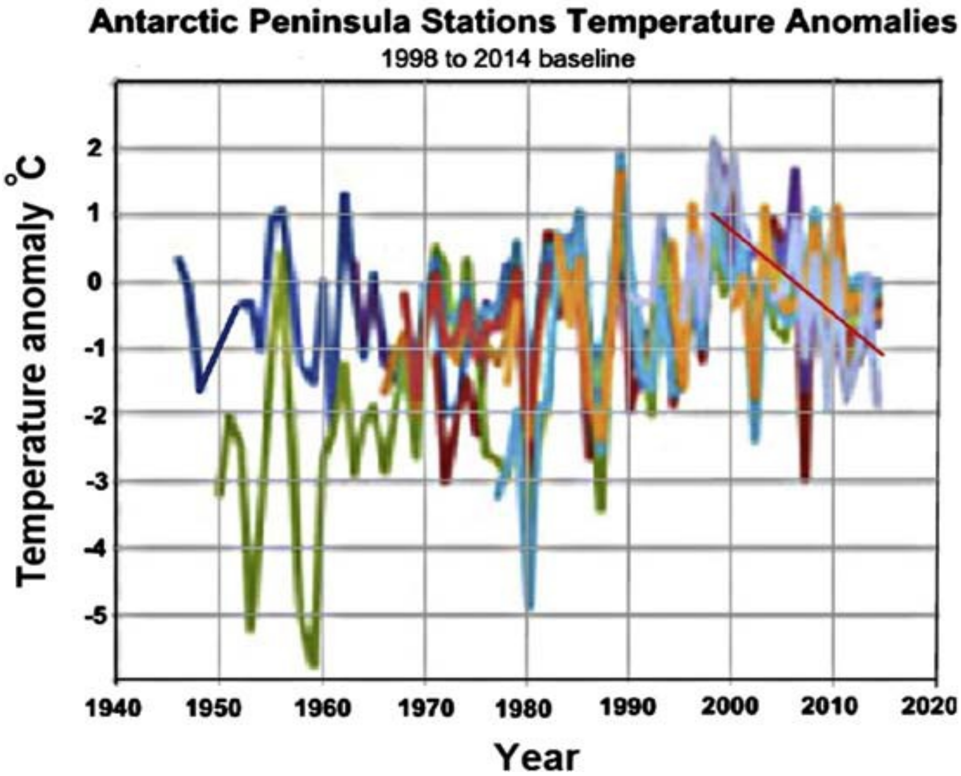


Figure 7. Temperature anomalies at 13 Antarctic stations on or near the Antarctic Peninsula, showing that the Antarctic Peninsula was warming up until 2000 but has been cooling dramatically since then.

The Larsen Ice Shelf Station has been cooling at an astonishing rate of 1.8° C per decade (18°C per century) since 1995 (Fig. 8). Nearby Butler Island records even faster cooling at 1.9 C/decade. Sea ice around Antarctica is increasing because ocean temperature from the surface to 100 m dropped below the freezing point in 2008 and has stayed there since.

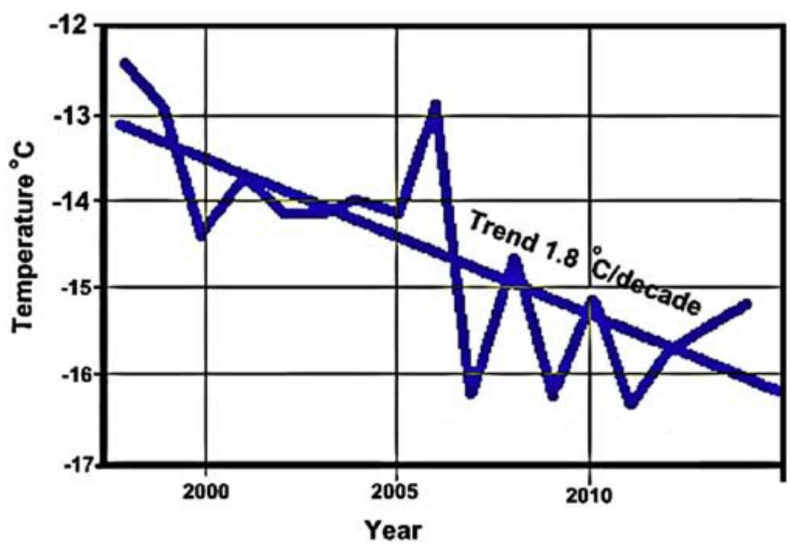


Figure 8. Annual average temperature at the Larsen Ice Shelf shows sharp cooling (1.8 ° C/decade). (Easterbrook, 2016) (From GISTemp.)

THE ARCTIC

The Arctic includes the Arctic Ocean, Greenland, Iceland, and part of Siberia and northern Alaska. Because of the absence of any land mass in the Arctic Ocean, most of area lacks glaciers, which require a land mass. Thus, most of the Arctic contains only floating sea ice. Greenland, Iceland, northern Alaska, and northern Siberia contain the only glaciers in the general Arctic region. Arctic temperature records show that the 1920s and 1930s were warmer than 2000. Records of historic fluctuations of Arctic sea ice go back only to the first satellite images in 1979. That happens to coincide with the end of the 1945–1977 global cold period and the maximum extent of Arctic sea ice. During the warm period from 1978 until recently, the extent of sea ice has diminished, but increased in the past several years. The Greenland ice sheet has also grown recently.

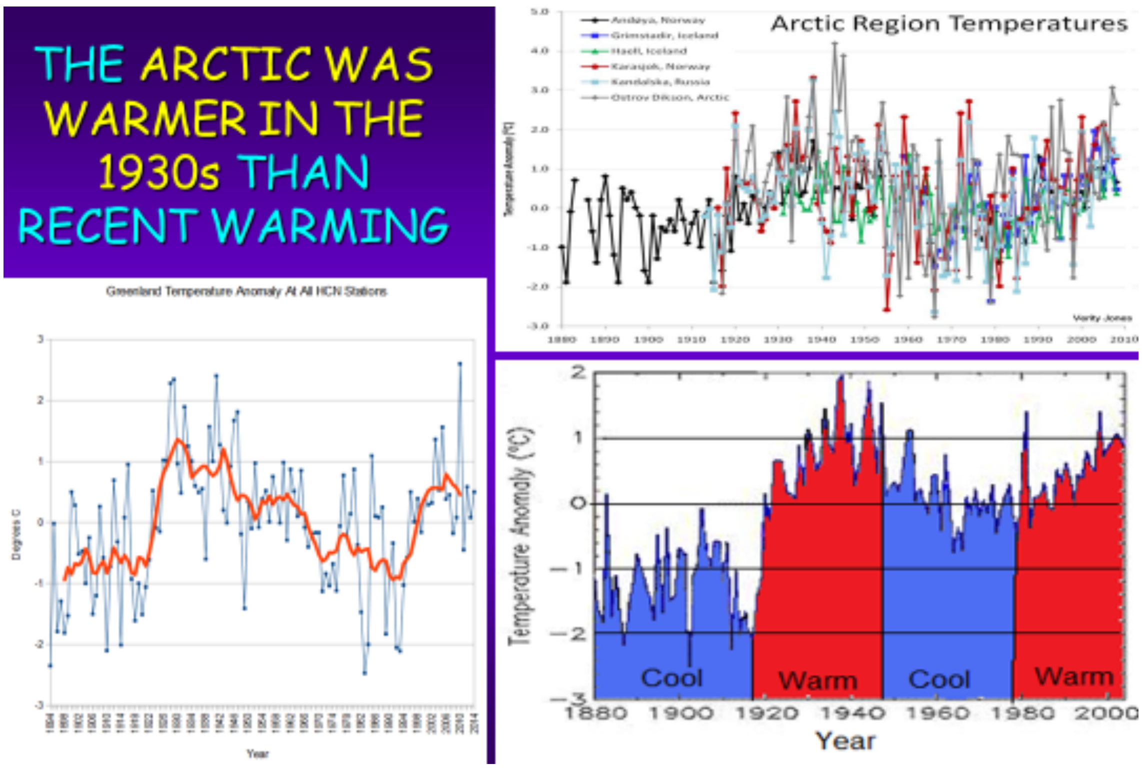


Figure 9. Arctic temperatures were warmer in the 1930s than today. The graph on the left shows temperatures in Greenland from 1894 to 2014 (high temperatures in left center during the 1930s) were warmer than today (right side). Upper right graph is Arctic temperature from Iceland, Russia, and Norway showing that the 1930s were warmer than recent decades. Lower right shows Arctic temperatures from 1880 to 2000 for 70 –90° latitude. Note that the 1920s and 1930s were warmer than 2000. (Easterbrook, 2016).

Greenland GISP2 ice core (figure 11) shows the millennium scale warm and cold cycles. Note that the peak of the Minoan, Roman, Medieval and current warming have been successively lower.

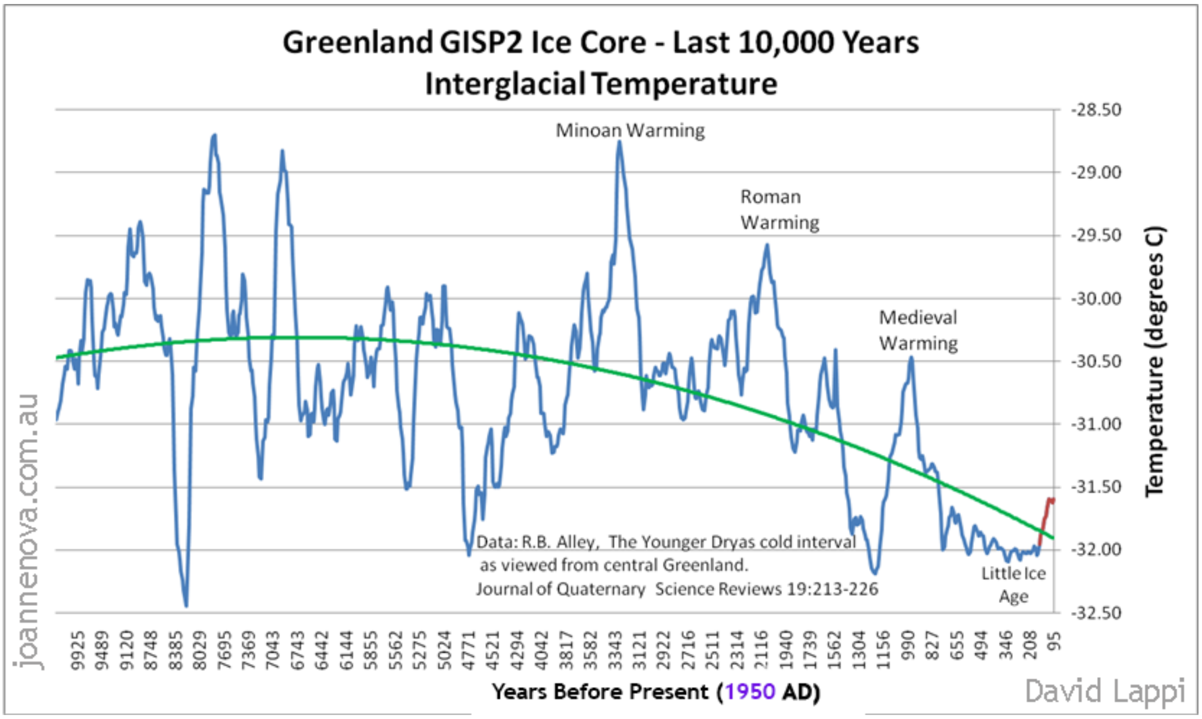
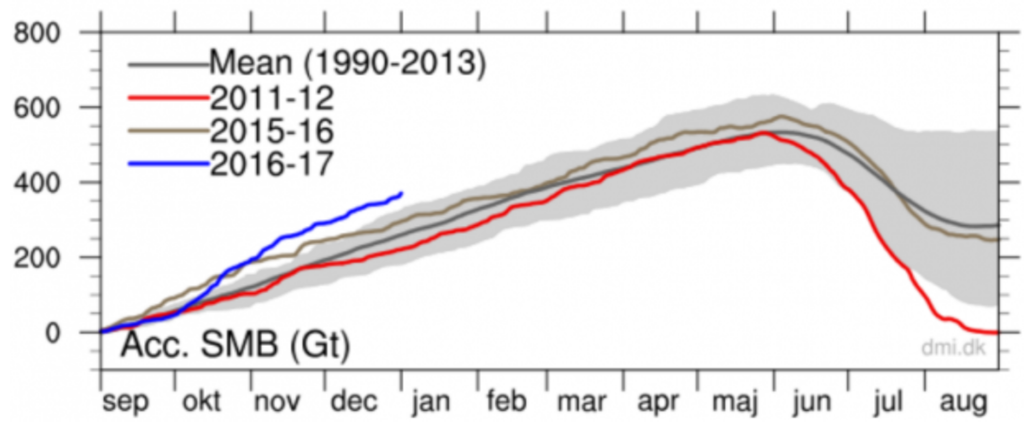


Figure 11: Greenland GISP2 Ice Core Temperatures

Greenland's ice sheet has been gaining ice and snow at a rate not seen in years, [based on Danish Meteorological Institute (DMI) data] showing that the Greenland ice sheet's mass surface budget has been growing significantly since October 2016 (Figure 11). Greenland's surface mass budget for winter 2016-2017 is already more than two standard deviations higher than the northern ice sheet's mean snow and ice accumulation over the last 24 years. DMI data shows the ice sheet added eight gigatons of ice and snow Jan. 1, well above the standard deviation for that day.



Screenshot from the Danish Meteorological Institute's website

Figure 11. Recent growth of the Greenland ice sheet. (Danish Meteorological Institute)

A 2019 study by [*Bevis etal*] claimed "*Greenland is melting faster than scientists previously thought, with the pace of ice loss increasing four-fold since 2003."* Their claim that ice loss in 2012 was greater than in 2003 is based on one year's weather, and not the long-term trend. Note that by 2016/17, the Greenland Surface Ice Mass Balance had rebounded to near the top of the 1981-2010 annual range.

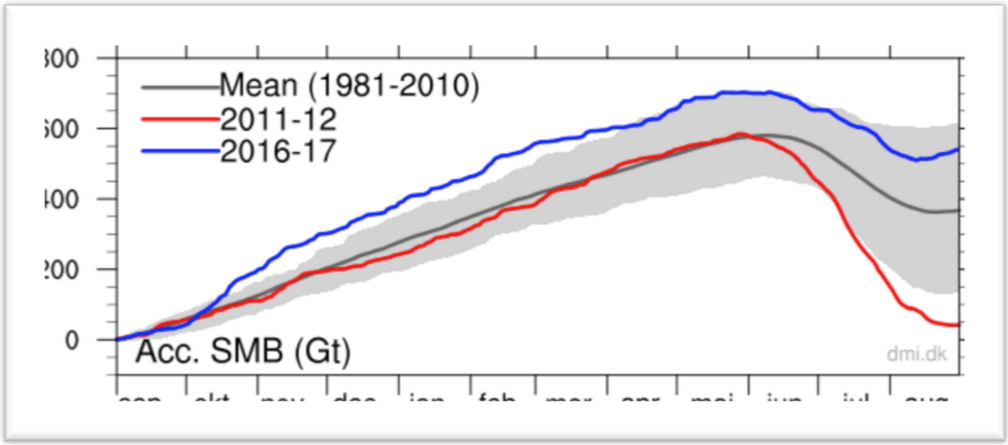


Figure 12. Recent growth of the Greenland ice sheet. (Danish Meteorological Institute)

See that Atlantic ocean temperatures as reflected by the Atlantic Multidecadal Oscillation links closely with Greenland temperatures.

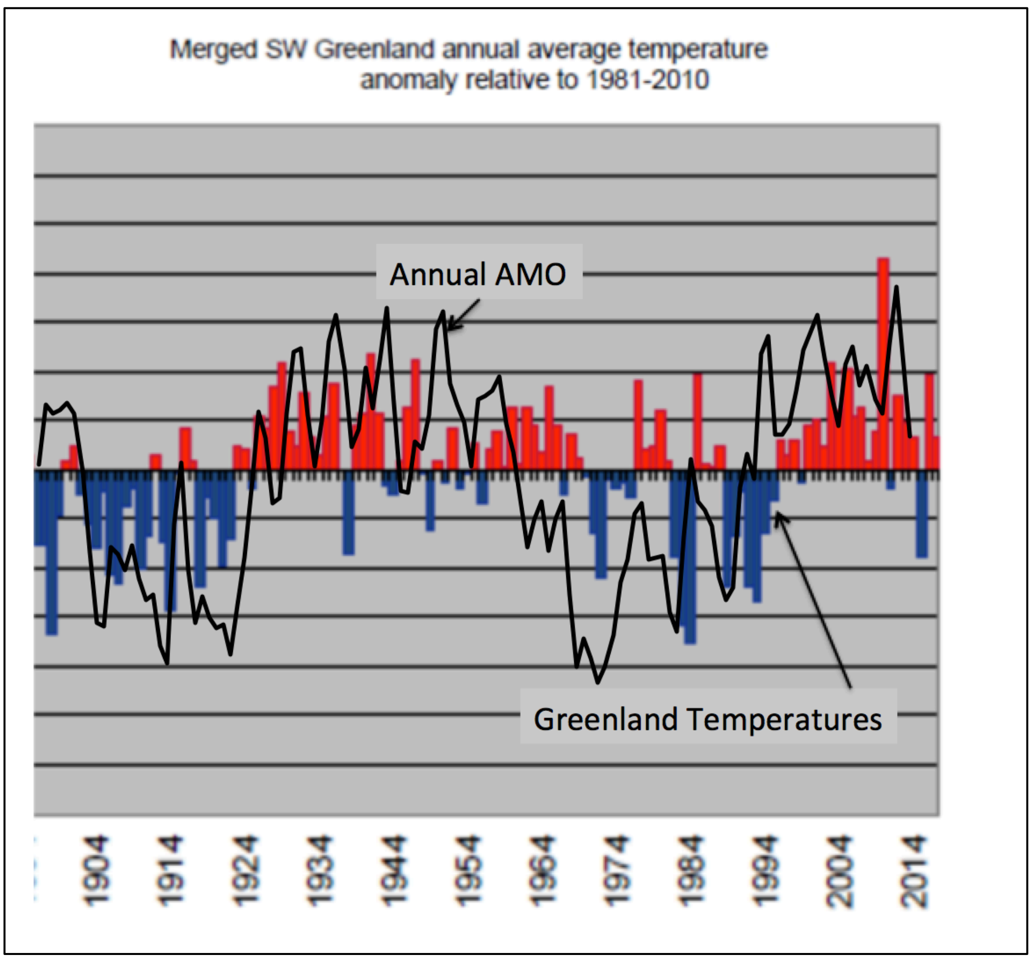


Figure 13. Greenland Annual Temperatures versus the AMO

ARCTIC ICE AND MULTIDECADAL OCEAN TEMPERATURE CYCLES

Changes in the arctic ice and temperatures strongly correlate with the ocean multidecadal cycles and solar activity and poorly with CO2. Both oceans exhibit multidecadal changes in ocean temperatures on the order of every 25-35 years.

Since the ice is floating, the North Atlantic and North Pacific are in their warm phases, warm water is carried by current under the ice thin it and shortening the ice cover season. There are many stories and anecdotal evidence that arctic ice was in a major decline from the 1920s to 1940s.

The following from Chylek (GRL 2009) shows the tight correlation of the AMO and arctic temperatures. The authors conclude "Our analysis suggests that the ratio of the Arctic to global temperature change varies on multi-decadal time scale. The commonly held assumption of a factor of 2–3 for the Arctic amplification has been valid only for the current warming period 1970 – 2008. The Arctic region did warm considerably faster during the 1910–1940 warming compared to the current 1970–2008 warming rate. During the cooling from 1940-1970 the Arctic amplification was extremely high, between 9 and 13. The Atlantic Ocean thermohaline circulation multi-decadal variability is suggested as a major cause of Arctic temperature variation."

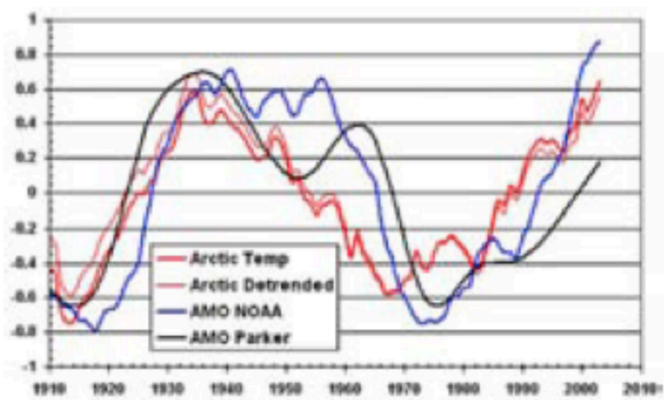


Figure 3. 11 year running average of the Arctic temperature (combined low and high Arctic stations with long term temperature records) anomaly (thin red line) with respect to 1910–2008 average, detrended anomaly (thick red line), and the AMO index anomaly. The NOAA (blue) and the [*Parker et al* [2007] (black) AMO index anomaly have been normalized to a peak value of 0.7 within 1930–1940s.

Figure 14: 11 running averages of the arctic temperatures versus the AMO

Both the Pacific multidecadal cycle (PDO) and the Atlantic Multidecadal Oscillation (AMO) are measured differently, both reflect a tripole of ocean temperatures. Both have warmer than normal water in the north and in the subtropics and cool relative to normal in the central Basin in the positive phase and cold north and tropics and warm in between in the negative phase. By normalizing the two data sets and then adding the two, you get a measure of net warmth or cooling potential for both global and arctic temperatures. See how well the sum tracks with the arctic temperatures (figure 13).

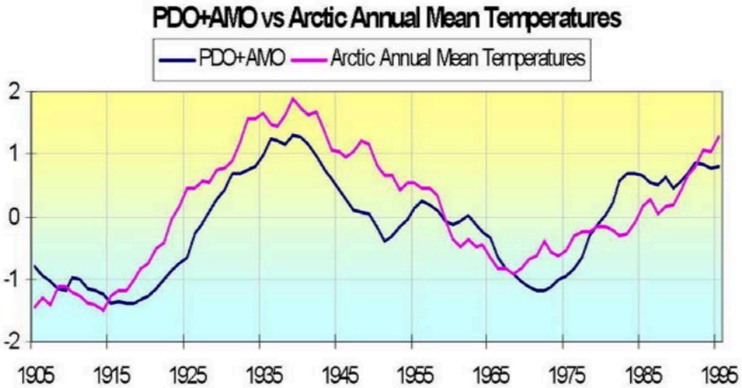


Figure 15: PDO+AMO versus Arctic Annual Mean Temperatures

There are many stories and anecdotal evidence that arctic ice was in a major decline from the 1920s to 1940s.

Francis et al. (GRL 2007) showed how the warming in the arctic and the melting ice was related to warm water (+3C) in the Barents Sea moving slowly into the Siberian arctic and melting the ice. She also noted the positive feedback of changed "albedo" due to open water then further enhances the warming. The International Arctic Research Center at the University of Alaska, Fairbanks showed how arctic temperatures have cycled with intrusions of Atlantic water - cold and warm (figures 14 and 15).

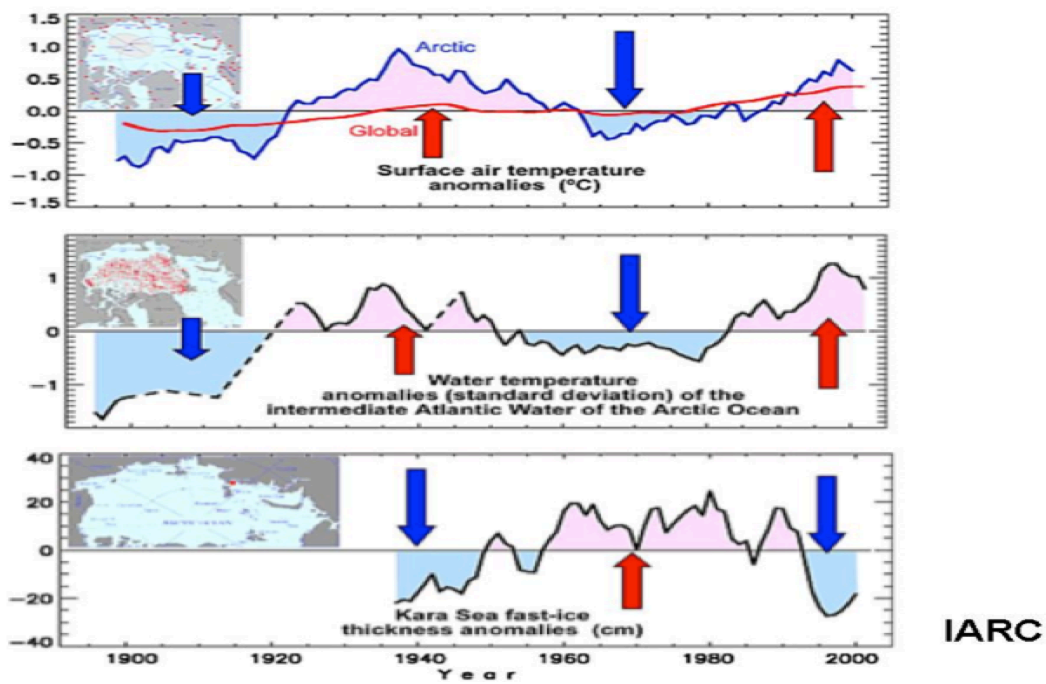


Figure 16: IAF IARC plot of arctic surface temperatures versus water temperatures in the intermediate Atlantic water of the Arctic ocean and Kara Sea fast-ice

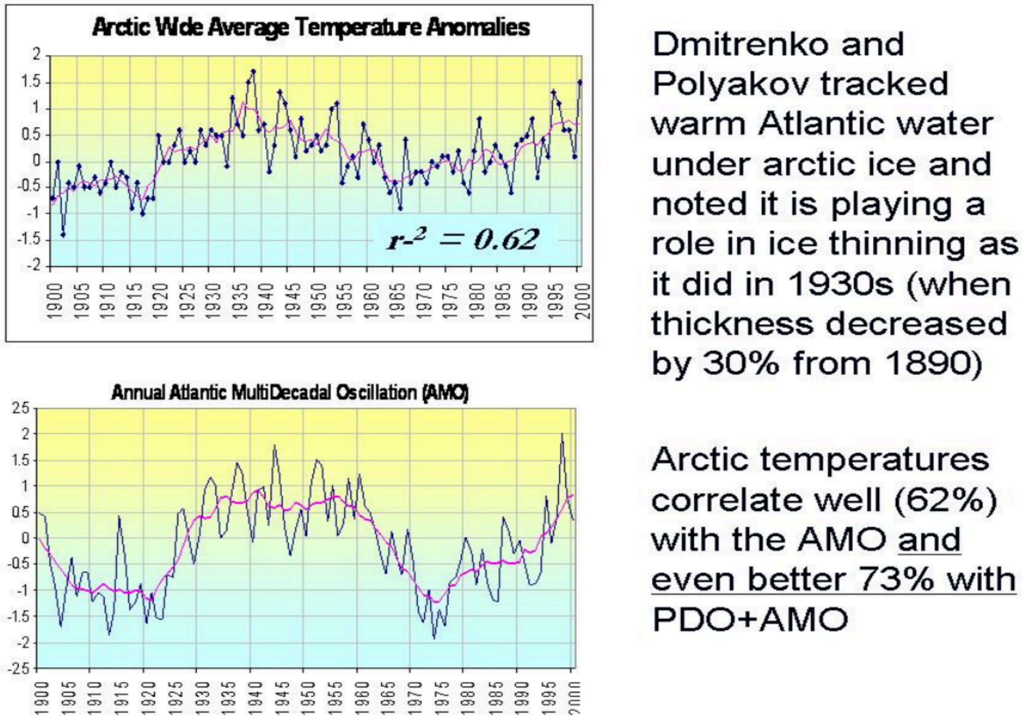


Figure 17"": Arctic wide average temperature anomalies versus the annual AMO

Before the NSIDC was silenced in their objectivity, they wrote after 2007,

"One prominent researcher, Igor Polyakov at the University of Fairbanks, Alaska, points out that pulses of unusually warm water have been entering the Arctic Ocean from the Atlantic, which several years later are seen in the ocean north of Siberia. These pulses of water are helping to heat the upper Arctic Ocean, contributing to summer ice melt and helping to reduce winter ice growth. Another scientist, Koji Shimada of the Japan Agency for Marine-Earth Science and Technology, reports evidence of changes in ocean circulation in the Pacific side of the Arctic Ocean. Through a complex interaction with declining sea ice, warm water entering the Arctic Ocean through Bering Strait in summer is being shunted from the Alaskan coast into the Arctic Ocean, where it fosters further ice loss. Many questions still remain to be answered, but these changes in ocean circulation may be important keys for understanding the observed loss of Arctic sea ice."

Are Natural Factors the Real Drivers?

A seminal work[1] dealing with this issue demonstrated that surface temperatures and the AMO and PDO behavior can be readily explained by natural factors, in particular, solar, volcanic and oceanic/ENSO activity. In addition, the work demonstrated that CO_2 did not have a statistically significant impact on the AMO or the PDO or land surface temperatures.

[1] James P. Wallace III, Anthony J. Finizza and Joseph D'Aleo, "A Simple KISS Model to Examine the Relationship Between Atmospheric CO_2 Concentration, and Ocean & Land Surface Temperatures, Taking into Consideration Solar and Volcanic Activity, As Well As Fossil Fuel Use." Evidence-Based Climate Science, Elsevier, Oxford, Amsterdam, pp. 353-382. ISBN: 9780123859563, Copyright @ 2011 Elsevier Inc. All rights reserved, Elsevier.

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