GREENLAND – NATURAL VARIABILITY

The described changes in Greenland are not at all unprecedented nor are they as described. Many peer review papers support interaction with the Atlantic multidecadal cycles and other factors not greenhouse warming are the real drivers.

Changes to temperature and ice happen predictably every 60 years or so and is in fact entirely natural, related to multidecadal ocean cycles and possibly recently accentuated by major undersea volcanism and the invasion of tundra shrubs and deposition of soot from Asia.

Records of arctic ice cover extent start in 1979. Multidecadal cyclical warming was observed before in the 1800s and middle 1900s long before the industrial revolution. Also there is more recent evidence showing the idea of lubrication by melt water accelerating loss of glacial or icecap ice is not valid.

THE OCEAN MULTIDECADAL CYCLES

The natural multidecadal cycles in the Pacific (called the Pacific Decadal Oscillation or PDO) and Atlantic (called the Atlantic Multidecadal Oscillation or AMO) correlate strongly with temperatures over Greenland and the arctic.

In early May 2008, a paper appeared in Nature (Keenlyside) showing how by including long term ocean cycles in models the recent global cooling or at least lack of warming may continue to 2020. The same week, a story by NASA's Earth Observatory reported on the flip of the Pacific Decadal Oscillation to its cool mode. "This multi-year Pacific Decadal Oscillation 'cool' trend can intensify La Niña or diminish El Niño impacts around the Pacific basin," said Bill Patzert, an oceanographer and climatologist at NASA's Jet Propulsion Laboratory, Pasadena, Calif. "The persistence of this large-scale pattern tells us there is much more than an isolated La Niña occurring in the Pacific Ocean."

GREENLAND

Many recent studies have addressed Greenland ice mass balance. They yield a broad picture of slight inland thickening and strong near-coastal thinning, primarily in the south along fast-moving outlet glaciers. AR4 assessment of the data and techniques suggests overall mass balance of the Greenland Ice Sheet ranging between growth by 25 Gigatonnes per year (Gt/year) and shrinkage by 60 Gt/year for 1961-2003. This range changes to shrinkage by 50 to 100 Gt/year for 1993-2003 and by even higher rates between 2003 and 2005.

Most recently a study by van de Waal in Science showed as the New Scientist reported that "Much noise has been made about how water lubricates the base of Greenland's ice sheet, accelerating its slide into the oceans. In a rare "good news" announcement, climatologists now say the ice may not be in such a hurry to throw itself into the water after all. Mother Nature, it seems, has given it brakes.

Since 1991, the western edge of Greenland's ice sheet has actually slowed its ocean-bound progress by 10%, say the team, who have studied the longest available record of ice and water flow in the region." They looked at how meltwater has correlated with the speed of ice flow at the western edge of the sheet, just north of the Arctic Circle, since 1991. They found that meltwater pouring down holes in the ice – called "moulins" – did indeed cause ice velocities to skyrocket, from their typical 100m per year to up to 400m per year, within days or weeks.

But the acceleration was short-lived, and ice velocities usually returned to normal within a week after the waters began draining. Over the course of the 17 years, the flow of the ice sheet actually decreased slightly, in some parts by as much as 10%.

"For some time, glaciologists believed that more meltwater equaled higher ice speeds," van de Waal says. "This would be kind of disastrous, but apparently it is not happening."

Van de Waal believes that the channels that carry the meltwater out to sea freeze up during the winter months. In summer, pulses of water rushing down the moulins to the bedrock overwhelm the narrowed channels, and the increased pressure lifts the ice sheet off the rock, enabling it to move faster.

However, after a few days the channels are forced open by the water, and it drains away from the glacier. As a result, the ice grinds back down against the bedrock and the lubricant effect is lost. NO LUBRICATION: Van De Waal says this indicates that, overall, meltwater has a negligible effect on the rate at which the ice sheet moves."

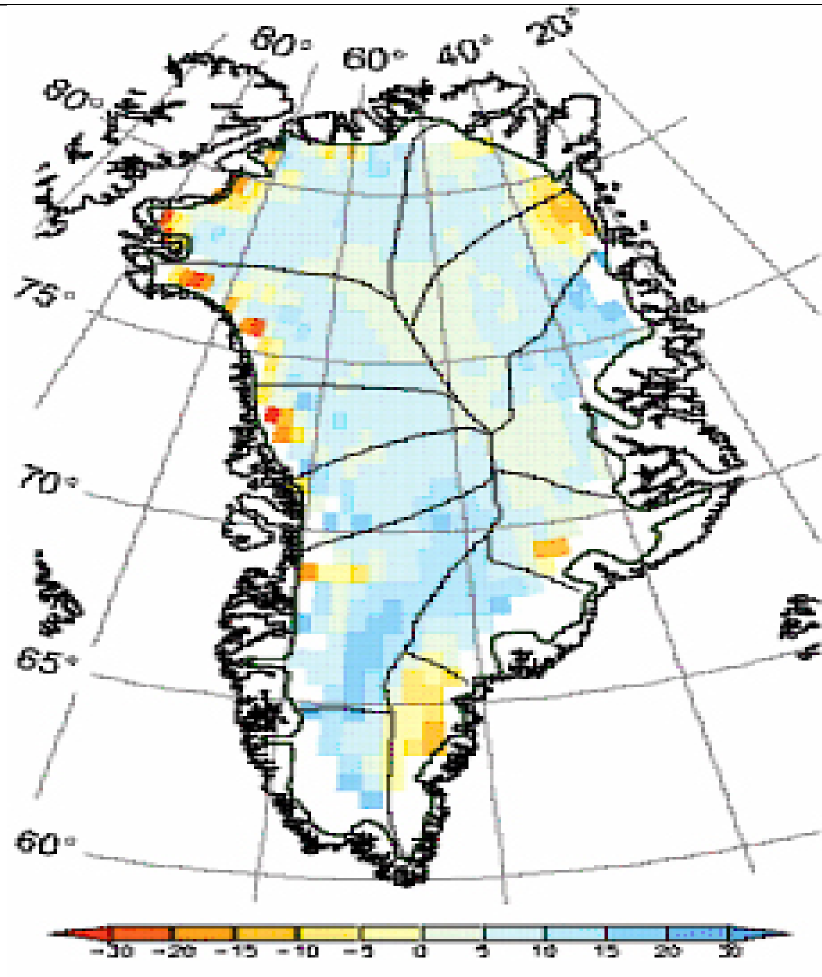

Figure 1: Greenland ice thickness changes as determined from NASA satellites

Other scientists have confirmed that interannual variability is very large, driven mainly by variability in summer melting and sudden glacier accelerations. Consequently, the short time interval covered by instrumental data is of concern in separating fluctuations from trends. But in a paper published in Science in February 2007, Dr. Ian Howat of the University of Washington reports that two of the largest glaciers have suddenly slowed, bringing the rate of melting last year down to near the previous rate. At one glacier, Kangerdlugssuaq, "average thinning over the glacier during the summer of 2006 declined to near zero, with some apparent thickening in areas on the main trunk."

Dr. Howat in a follow-up interview with the New York Times went on to add

"Greenland was about as warm or warmer in the 1930's and 40's, and many of the glaciers were smaller than they are now. This was a period of rapid glacier shrinkage world-wide, followed by at least partial re-expansion during a colder period from the 1950's to the 1980's. Of course, we don't know very much about how the glacier dynamics changed then because we didn't have satellites to observe it. However, it does suggest that large variations in ice sheet dynamics can occur from natural climate variability."

Thomas, et al. (2000) showed great variance in mass balance of the Greenland ice sheet with highly variable thickening and thinning depending on location. This February (2008) during a bitter cold winter, Denmark's Meteorological Institute stated that the ice between Canada and southwest Greenland reached its greatest extent in 15 years.

Temperatures were warmer in the 1930s and 1940s in Greenland. They cooled back to the levels of the 1880s by the 1980s and 1990s. In a GRL paper in 2003, Hanna and Cappelen showed a significant cooling trend for eight stations in coastal southern Greenland from 1958 to 2001 (-1.29ºC for the 44 years). The temperature trend represented a strong negative correlation with increasing CO_2 levels.

Shown below in figure 2, see the temperature plot for Godthab Nuuk in southwest Greenland. Note how closely the temperatures track with the AMO (which is a measure of the Atlantic temperatures 0 to 70N). It shows that cooling from the late 1950s to the late 1990s even as greenhouse gases rose steadily, a negative correlation over almost 5 decades. The rise after the middle 1990s was due to the flip of the AMO into its warm phase. They have not yet reached the level of the 1930s and 1940s.

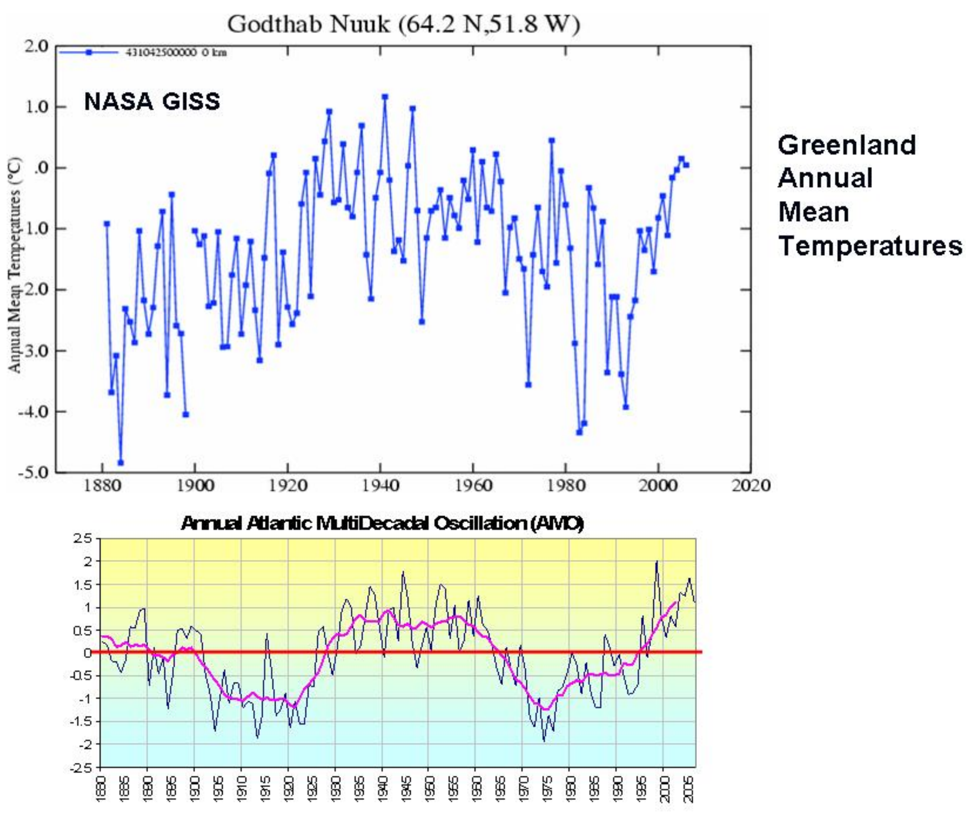

Figure 2: Godthab Nuuk, Greenland annual mean temperatures (NASA GISS) top and the AMO bottom (annual dark blue and 5 year running mean purple) source CDC Climate Indices

SUMMARY

Warming in Greenland has not yet reached the levels of the 1930s and 1940s. Temperatures in Greenland were much warmer in prior periods like the Medieval Warm Period. The idea that rapid melting and lubrication has been proven to be in error by the most recent research.

Greenhouse gases are not the causes of these natural cyclical changes. Given the current cooling of the atmosphere and ocean, accelerated melting of the glaciers and icecaps and the resultant threat of catastrophic sea level is highly unlikely.

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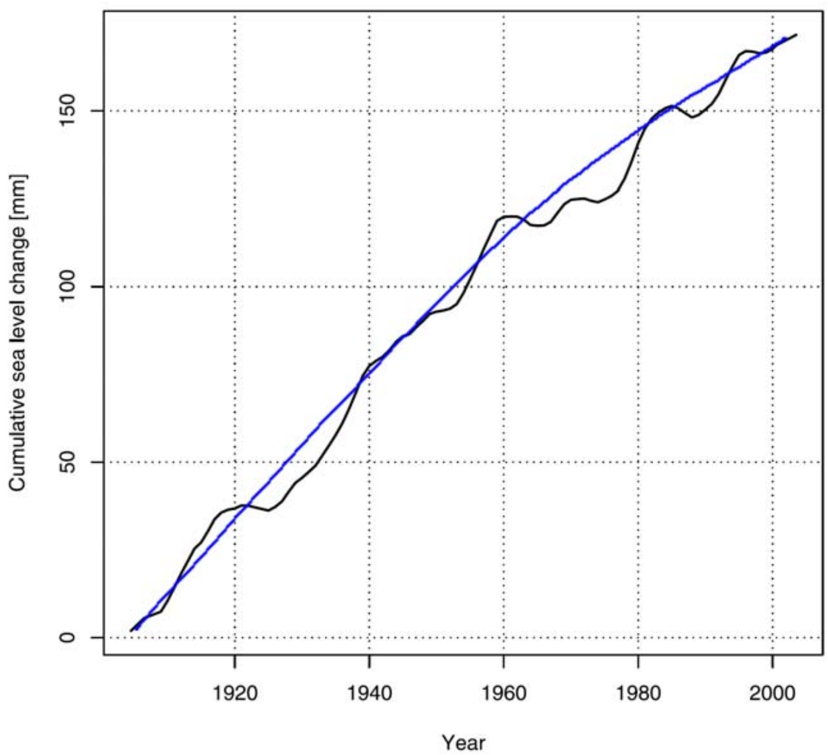
SEA LEVEL RISING DECLINING NOT ACCELERATING

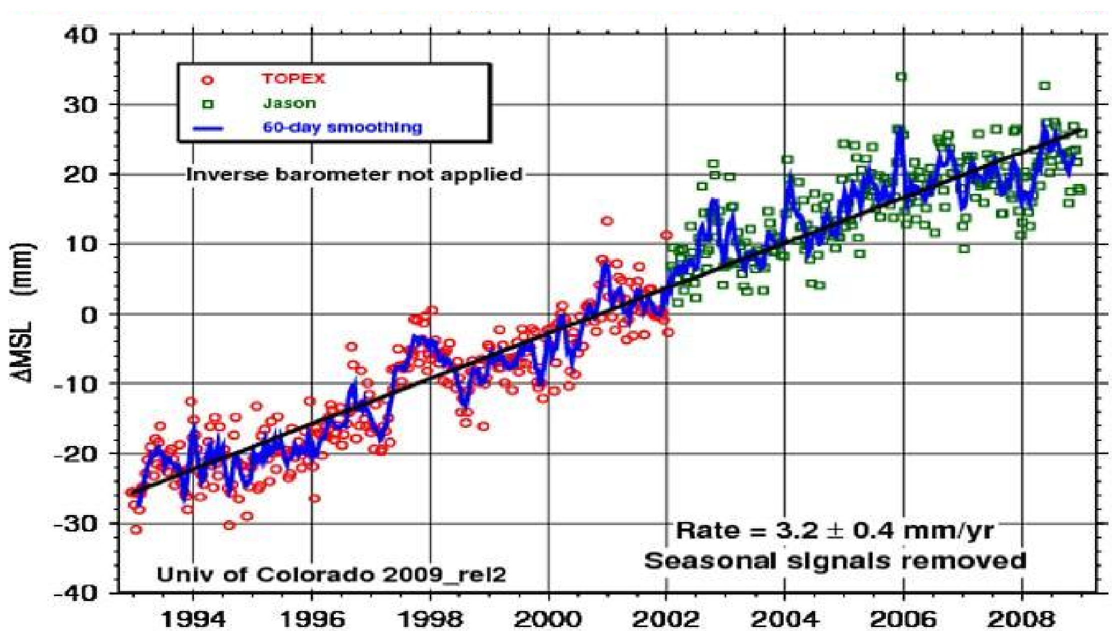
There are numerous recent peer review papers and a satellite data set that finds this is not true and in fact that the sea level rises have slowed in recent decades, most dramatically in the past few years as the oceans have cooled and contracted.

Holgate (2007) calculated that the mean rate of global sea level rise was "larger in the early part of the last century (2.03 ± 0.35 mm/yr 1904-1953), in comparison with the latter part (1.45 ± 0.34 mm/yr 1954-2003)."

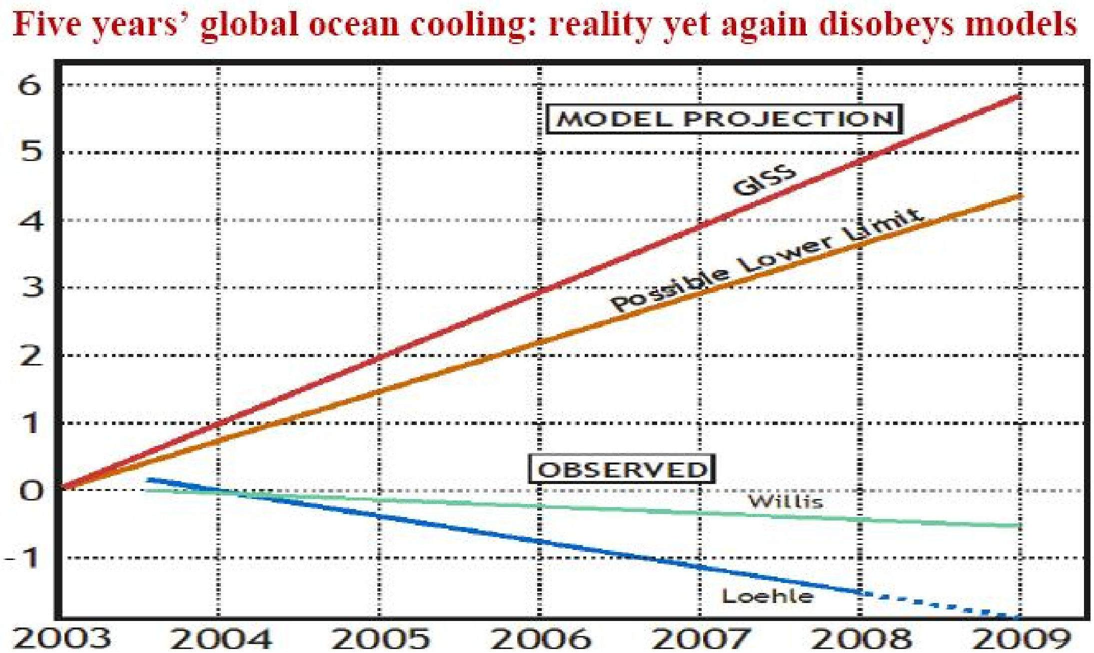
Idso noted with respect to the Holgate study "the century-long sea level history portrayed in the figure below is suggested by the blue curve we have fit to it, which indicates that mean global sea level may have been rising, in the mean, ever more slowly with the passage of time throughout the entire last hundred years, with a possible acceleration of that (declining) trend over the last few decades."



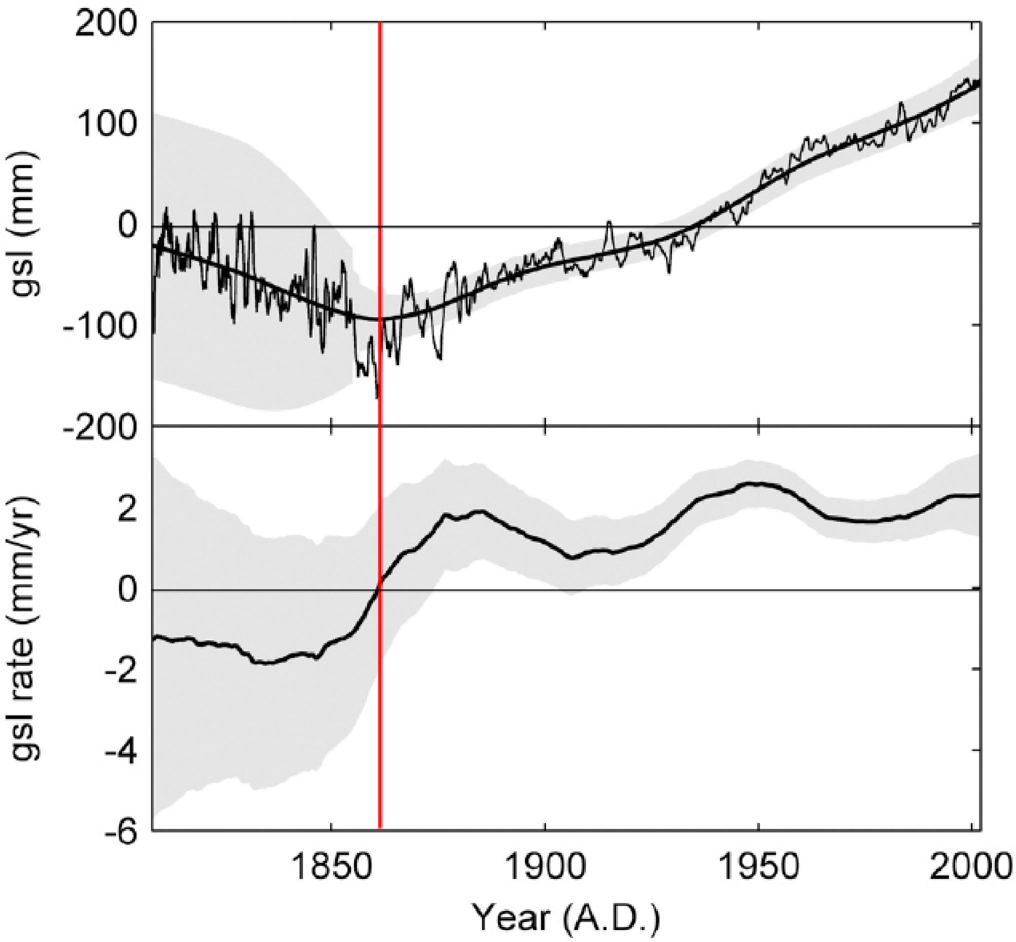
This is supported also by the sea levels as measured by Jason TOPEX.



This decline is consistent with cooling oceans as determined by Willis (2008) and most recently Loehle (2009).



Church *et al*. (2004) pointed out that with decadal variability in the computed global mean sea level, it is not possible to detect a significant increase in the rate of sea level rise over the period 1950-2000. Jevrejeva *et al*. (2006) say their findings show that "global sea level rise is irregular and varies greatly over time," noting that "it is apparent that rates in the 1920-1945 period are likely to be as large as today's." In addition, they report that their "global sea level trend estimate of 2.4 ± 1.0 mm/yr for the period from 1993 to 2000 matches the 2.6 ± 0.7 mm/yr sea level rise found from TOPEX/Poseidon altimeter data."



Wunsch et al (2004) noted "the advent of high-accuracy satellite altimetry has led to estimates that, since about 1993, global average sea level has been rising at a rate of 2.8 ± 0.4 mm/year." They thus suggest "it is desirable to buttress [this finding] through independent means," which is what they set out to do."Using about 2.1 x 10^{9} observations of many different types, all individually weighted, during the period 1992-2004 and a 1° horizontal resolution, 23-layer general circulation model," they derived estimates of "regional trends in global sea level." This analysis found "a global mean of about 1.6 mm/year, or about 60% of the pure altimetric estimate, of which about 70% is from the addition of freshwater." However, they note that there is "great regional variability in trend values, sometimes up to two orders of magnitude larger than the apparent spatial mean." The three researchers state that "at best, the determination and attribution of global-mean sea level change lies at the very edge of knowledge and technology," and that "it remains possible that the database is insufficient to compute mean sea level trends with the accuracy necessary to discuss the impact of global warming -- as disappointing as this conclusion may be." As a result, they conclude that the altimetry result is "currently untestable against in situ datasets."

Church et al.'s (2005) "best estimate" of the rate of globally-averaged sea level rise over the last half of the 20th century is 1.8 ± 0.3 mm yr^{-1}. They further note that "decadal variability in sea level is observed, but to date there is no detectable secular increase in the rate of sea level rise over the period 1950-2000." They also report that no increase in the rate of sea level rise has been detected for the entire 20th century, citing the work of Woodworth (1990) and Douglas (1992)."

White et al.(2005) concluded that their results confirmed earlier findings of "no significant increase in the rate of sea level rise during this 51-year period," i.e., over the last half of the 20th century, including the last two decades that are typically demonized by climate alarmists for their supposedly "unprecedented" rate of temperature increase.

SEA LEVEL RISES DUE TO PROJECTIONS OF MELTING ICECAPS

Of course, the alarmism about sea level rises relates to model forecasts of melting in Greenland and ideas that melting will take place in a major way in the West Antarctic near the peninsula.

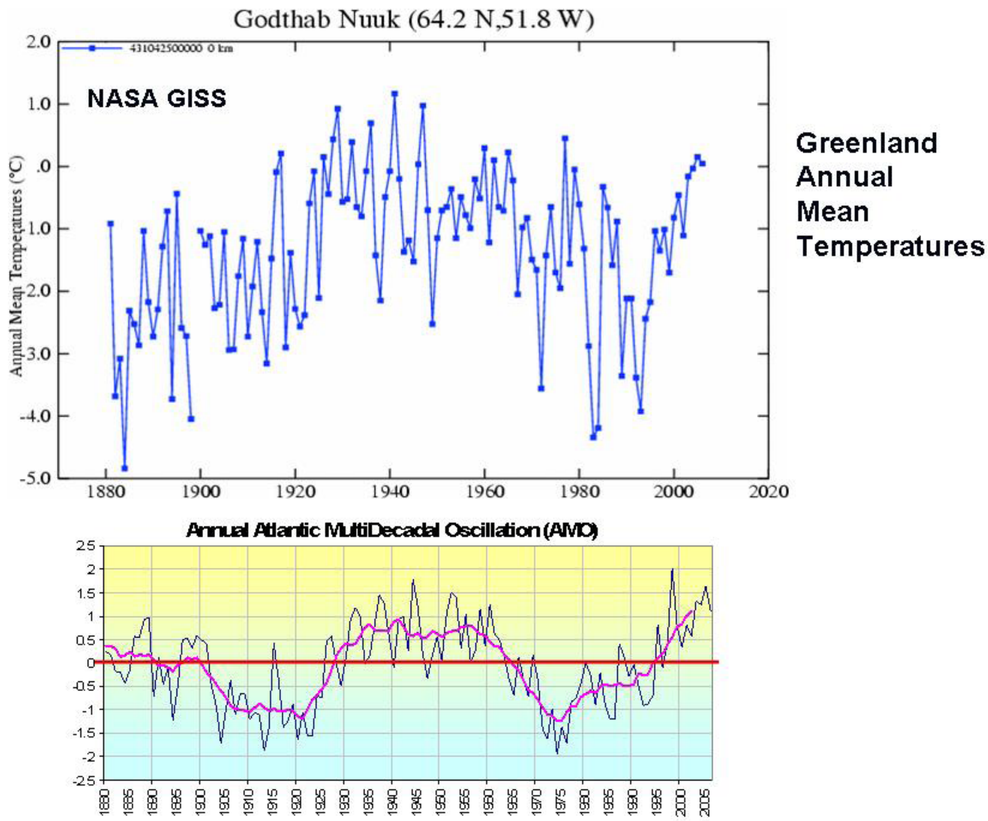
Greenland warming has not been remarkable and in fact, the current warming cycle fell short of the one in the 1930s to 1950s. Many recent studies have addressed Greenland mass balance. Using satellite radar altimetry Zwally *et al*. (2005) found that although "the Greenland ice sheet is thinning at the margins," it is "growing inland with a small overall mass gain," as previously described, and as has also been demonstrated by Johannessen *et al*. (2005), who found that "below 1500 meters, the elevation-change rate is -2.0 ± 0.9 cm/year, in qualitative agreement with reported thinning in the ice-sheet margins," but that "an increase of 6.4 ± 0.2 cm/year is found in the vast interior areas above 1500 meters." Spatially averaged over the bulk of the ice sheet, therefore, the net result, according to Johannessen *et al*. is a mean *increase* of 5.4 ± 0.2 cm/year, "or ~60 cm over 11 years, or ~54 cm when corrected for isostatic uplift," as we have also previously described.

However, interannual variability is very large, driven mainly by variability in summer melting and sudden glacier accelerations. Consequently, the short time interval covered by instrumental data is of concern in separating fluctuations from trends.

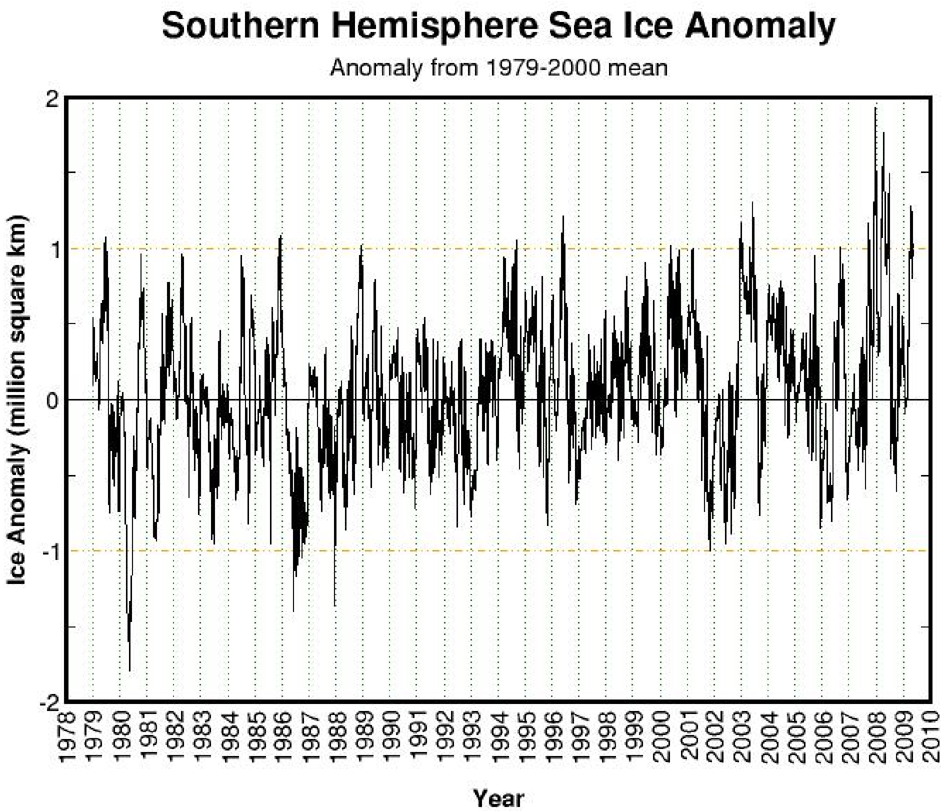
In a paper published in Science in February 2007, Dr Ian Howat of the University of Washington paper published online this afternoon by Science reports that two of the largest glaciers have suddenly slowed, bringing the rate of melting last year down to near the previous rate. At one glacier, Kangerdlugssuaq, "average thinning over the glacier during the summer of 2006 declined to near zero, with some apparent thickening in areas on the main trunk."

Dr. Howat went on to add "Greenland was about as warm or warmer in the 1930's and 40's, and many of the glaciers were smaller than they are now. This was a period of rapid glacier shrinkage world-wide, followed by at least partial re-expansion during a colder period from the 1950's to the 1980's. Temperatures indeed were warmer in the 1930s and 1940s in Greenland. They cooled back to the levels of the 1880s by the 1980s and 1990s before resuming a rise in the middle 1990s. The recent warming is not yet at the same level as that of the 1930s and 1940s.

The cyclical behavior of temperatures and of icecap advance and retreat relate to the same Atlantic Multidecadal Oscillation shown below the temperature plot for Godthab Nuuk in southwest Greenland. Note how closely the temperatures track with the AMO (which is a measure of the Atlantic temperatures 0 to 70N). It should be noted that Greenland was cooling and its icecap growing the entire period from the late 1950s to the middle 1990s even as Greenhouse gases rose steadily.



Antarctic ice has been expanded and reached record extent in 2007 and is currently not far behind.



Both Greenland and Antarctica lend no support for the acceleration of sea level rises. Observations agree. Sea level rises have not ACCELERATED as claimed.

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