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Computer simulations of global climate change have long indicated the world's polar regions should show the first and severest signs of CO_2-induced global warming. If the models are correct, these signs should be especially evident since the second half of the 20th century, when approximately two-thirds of the modern-era rise in atmospheric CO_2 occurred and Earth's temperature supposedly rose, in the view of most climate alarmists, to a level unprecedented in the entire past millennium. In this review, we examine historic trends in Arctic glacier behavior to determine the credibility of current climate models with respect to their polar predictions.

In a review of "the most current and comprehensive research of Holocene glaciation," along the northernmost Gulf of Alaska between the Kenai Peninsula and Yakutat Bay, Calkin *et al*. (2001)[1] report there were several periods of glacial advance and retreat over the past 7000 years. Over the most recent of those seven millennia, there was a general retreat during the Medieval Warm Period that lasted for "at least a few centuries prior to A.D. 1200." Then came three major intervals of Little Ice Age glacial advance: the early 15th century, the middle 17th century, and the last half of the 19th century. During these very cold periods, glacier equilibrium-line altitudes were depressed from 150 to 200 m below present values, as Alaskan glaciers "reached their Holocene maximum extensions."

Scientists report that "ice-core records from the Canadian High Arctic islands indicate that the generally negative glacier mass balances observed over the past 50 years … have probably been typical of Arctic glaciers since the end of the Little Ice Age," when the magnitude of anthropogenic CO_2 emissions was a whole lot less than it has been from 1950 onward.

Subsequent to this time, as the planet emerged from the depths of the Little Ice Age, the mass balance records of the 18 Arctic glaciers with the longest observational histories were studied by Dowdeswell *et al*. (1997)[2]. Their analysis showed that over 80% of the glaciers displayed negative mass balances over the periods of their observation, as would logically be expected for glaciers emerging from the coldest part of the past millennium. Nevertheless, the scientists report that "ice-core records from the Canadian High Arctic islands indicate that the generally negative glacier mass balances observed over the past 50 years [when the vast majority of the CO_2 resulting from human

1 http://www.co2science.org/articles/V4/N36/C2.php.

2 http://www.co2science.org/articles/V3/N30/C1.php.

activities entered the atmosphere] have probably been typical of Arctic glaciers *since the end of the Little Ice Age* [italics added]," when the magnitude of anthropogenic CO_2 emissions was a whole lot less than it has been from 1950 onward.

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Such observations suggest that these Arctic glaciers are not experiencing *any* adverse effects of anthropogenic CO_2 emissions. In fact, Dowdeswell *et al*. say "there is no compelling indication of increasingly negative balance conditions which might, *a priori*, be expected from anthropogenically induced global warming." Quite to the contrary, they report that "almost 80% of the mass balance time series also have a *positive* trend, toward a *less* negative mass balance [italics added]." Thus, although most Arctic glaciers continue to lose mass, as they have probably done since the end of the Little Ice Age, they are losing smaller amounts each year, in the mean, which is hardly what one would expect in the face of what climate alarmists say is happening to Earth's climate.

Other glacier observations that run counter to climate model predictions are discussed by Mackintosh *et al*. (2002)[3], who concentrated on the 300-year history of the Solheimajokull outlet glacier on the southern coast of Iceland. In 1705, this glacier had a length of about 14.8 km; and by 1740 it had grown to 15.2 km in length. Thereafter, it began to retreat, reaching a minimum length of 13.2 km in 1783. Rebounding rapidly, however, the glacier returned to its 1705 position by 1794; and by 1820 it equaled its 1740 length. This maximum length was maintained for the next half-century, after which the glacier began a slow retreat that continued to about 1932, when its length was approximately 14.75 km. Then it wasted away more rapidly, reaching a second minimum-length value of approximately 13.8 km about 1970, whereupon it began to *rapidly expand*, growing to 14.3 km by 1995.

The current position of the outlet glacier terminus is by no means unusual. In fact, it is about midway between its maximum and minimum positions of the past three centuries. It is also interesting to note that the glacier has been *growing* in length since about 1970. In addition, Mackintosh *et al*. report that "the recent advance (1970-1995) resulted from a combination of cooling and enhancement of precipitation."

In another study from Iceland, Bradwell *et al*. (2006)[4] examined the link between late Holocene fluctuations of Lambatungnajokull (an outlet glacier of the Vatnajokull ice cap of southeast Iceland) and variations in climate, using geomorphological evidence to reconstruct patterns of glacier fluctuations and using lichenometry and tephrostratigraphy to date glacial landforms created by the glacier over the past four centuries. Based on their analysis, the authors report "there is a particularly close correspondence between summer air temperature and the rate of ice-front recession of Lambatungnajokull during periods of overall retreat," and that "between 1930 and 1950 this relationship is striking." They also state that "ice-front recession was

[3] http://www.co2science.org/articles/V5/N34/C1.php.
[4] http://www.co2science.org/articles/V9/N26/C2.php.

greatest during the 1930s and 1940s, when retreat averaged 20 m per year." Thereafter, they say the retreat "slowed in the 1960s," and they report "there has been little overall retreat since the 1980s."

The researchers also report that "the 20th-century record of reconstructed glacier-front fluctuations at Lambatungnajokull compares well with those of other similar-sized, non-surging, outlets of southern Vatnajokull," including Skaftafellsjokull, Fjallsjokull, Skalafellsjokull and Flaajokull. In fact, they find that "the pattern of glacier fluctuations of Lambatungnajokull over the past 200 years reflects the climatic changes that have occurred in southeast Iceland and the wider region."

With respect to that wider region, Sharp and Wang (2009)[5] analyzed the timing of annual melt onset and freeze-up, and the duration of the summer melt season on the large glaciers and ice caps of Svalbard [Norway], Novaya Zemlya [Russia], and Severnaya Zemlya [Russia] for the 2000-04 period," after which they used "regression relationships between melt season duration and annual (June + August) mean 850-hPa air temperature over each region from the NCEP-NCAR Reanalysis to predict the annual melt duration for each year in the 1948-2005 period."

According to the two researchers, with respect to all discrete five-year periods (pentads) between 1950 and 2004, "the 2000-04 pentad has the second longest mean predicted melt duration on Novaya Zemlya (*after 1950-54*), and the third longest on Svalbard (*after 1950-54* and 1970-74) and Severnaya Zemlya (*after 1950-54* and 1955-59) [italics added]," which findings clearly reveal the earlier 1950-54 pentad experienced the longest melt season of the past 55 years on all three of the large Eurasian Arctic ice caps.

Additional evidence that the Arctic's glaciers are not responding to human-induced warming in quite the manner as predicted by the models comes from the study of Zeeberg and Forman (2001)[6], who analyzed 20th-century changes in glacier terminus positions on north Novaya Zemlya -- a Russian island located between the Barents and Kara Seas in the Arctic Ocean -- providing a quantitative assessment of the effects of temperature and precipitation on glacial mass balance. The results of their study showed a significant and accelerated post-Little Ice Age glacial retreat in the first and second decades of the 20th century. By 1952, however, the region's glaciers had experienced between 75 to 100%

The results of their study showed a significant and accelerated post-Little Ice Age glacial retreat in the first and second decades of the 20th century. By 1952, however, the region's glaciers had experienced between 75 to 100% of their net 20th-century retreat; and during the next 50 years, the recession of over half of the glaciers stopped, while many tidewater glaciers actually began to advance.

[5] http://www.co2science.org/articles/V12/N13/C2.php.

[6] http://www.co2science.org/articles/V4/N16/C1.php.

of their net 20th-century retreat; and during the next 50 years, the recession of over half of the glaciers stopped, while many tidewater glaciers actually began to advance.

These glacial stabilizations and advances were attributed by the authors to observed increases in precipitation and/or decreases in temperature. For the four decades since 1961, for example, weather stations on Novaya Zemlya show summer temperatures were 0.3 to 0.5°C colder than they were over the prior 40 years, while winter temperatures were 2.3 to 2.8°C colder than they were over that earlier period. These observations, the authors say, are "counter to warming of the Eurasian Arctic predicted for the twenty-first century by climate models, particularly for the winter season."

Nearby on the island of Nordaustlandet in northeastern Svalbard, high-accuracy ice-surface elevation measurements of the largest ice cap in the Eurasian Arctic, Austfonna, were made with the Airborne Topographic Mapper 3 (Krabill *et al*., 2000) in 1996 and 2002. Upon finding significant elevation differences between the two measurement times, Bamber *et al*. (2004)[7] analyzed meteorological and sea-ice records from adjacent regions in an attempt to find a logical explanation for what their elevation measurements revealed.

Results indicated that the central and highest-altitude area of the ice cap, which comprises 15% of its total area, "increased in elevation by an average of 50 cm per year between 1996 and 2002," while "to the northeast of this region, thickening of about 10 cm per year was also observed." They further note that the highest of these growth rates represents "as much as a 40% increase in accumulation rate (Pinglot *et al*., 2001)." Upon analysis of ancillary sea-ice and meteorological data, the authors conclude that the best explanation for the dramatic increase in ice cap growth over the six-year study period was a large increase in precipitation caused by a concomitant reduction in sea-ice cover in this sector of the Arctic.

One way of characterizing the phenomenon described by Bamber *et al*. is to say that it represents the transference of ice from the top of the sea (in this case, the Barents Sea) to the top of adjacent land (in this case, the Austfonna ice cap). And what has been observed to date may very well represent but the *beginning* of this phenomenon, for the authors indicate in the conclusion of their paper that projected changes in Arctic sea-ice cover "will have a significant impact on the mass-balance of land ice around the Arctic Basin over at least the next 50 years," which result is far different from what the models currently anticipate.

In prefacing their study of Svalbard glacier dynamics, Humlum et al. (2005)[8] note that state-of-the-art climate models predict "the effect of any present and future global climatic change will be amplified in the polar regions as a result of feedbacks in which variations in the extent of glaciers, snow, sea ice and permafrost, as well as atmospheric greenhouse gases, play key roles." However, they say that Polyakov *et al*. (2002a,b) have "presented updated observational trends and variations in Arctic climate and sea-ice cover during the twentieth century, which do not support the modeled polar amplification of surface air-temperature changes observed by surface stations at lower latitudes," and that "there is reason, therefore,

7 http://www.co2science.org/articles/V7/N30/C1.php.
8 http://www.co2science.org/articles/V8/N43/C3.php.

to evaluate climate dynamics and their respective impacts on high-latitude glaciers." Consequently, they did just that for the Archipelago of Svalbard, focusing on Spitsbergen (the Archipelago's main island) and the Longyearbreen glacier located in its relatively dry central region at 78°13'N latitude.

In reviewing what was already known about the region, Humlum *et al*. report that "a marked warming around 1920 changed the mean annual air temperature (MAAT) at sea level within only 5 years from about -9.5°C to -4.0°C," which change, in their words, "represents the most pronounced increase in MAAT documented anywhere in the world during the instrumental period." Then, they report that "from 1957 to 1968, MAAT dropped about 4°C, followed by a more gradual increase towards the end of the twentieth century."

With respect to the Longyearbreen glacier, their own work revealed it "has increased in length from about 3 km to its present size of about 5 km during the last c. 1100 years," and they say that "the meteorological setting of *non-surging* [italics added] Longyearbreen suggest this example of late-Holocene glacier growth represents a widespread phenomenon in Svalbard and in adjoining Arctic regions," which they describe as a "development towards cooler conditions in the Arctic" that "may explain why the Little Ice Age glacier advance in Svalbard usually represents the Holocene maximum glacier extension."

Considering the findings reported in the studies above, observations from high northern latitudes, where CO_2-induced global warming is supposed to be most evident, provide little evidence for that dreaded phenomenon. In fact, they suggest that nothing out of the ordinary is occurring there at all, presenting a situation where the predictions of today's best climate models fail to conform to reality.

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