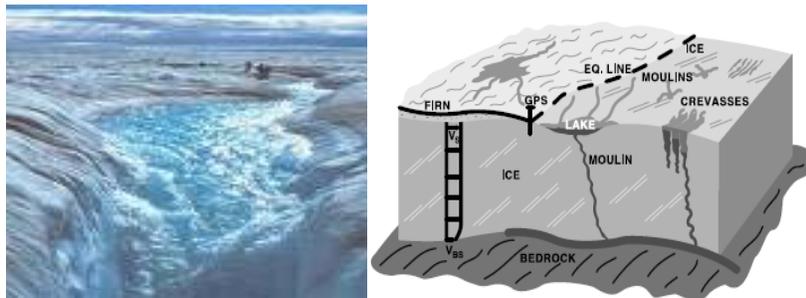


XIV. Greenland and Sea-Level Rise

AIT: “These pools [of meltwater on the top of the Greenland glacier] have always been known to occur, but the difference now is that there are many more of them covering a far larger area of the ice...they are exactly the same kind of meltwater pools that...scientists observed on top of the Larsen-B ice shelf in the period before its sudden and shocking disappearance...this meltwater is now believed to keep sinking all the way down to the bottom, cutting deep crevasses and vertical tunnels that scientists call ‘moulins.’ When the water reaches the bottom of the ice, it lubricates the surface of the bedrock and destabilizes the ice mass, raising fears that the ice mass will slide more quickly toward the ocean. (AIT, p. 192)

Comment: To illustrate these points, Gore presents a photograph and a diagram from a study of “moulins” by Zwally et al. (2002), published in the journal *Science*.¹ See the images below.

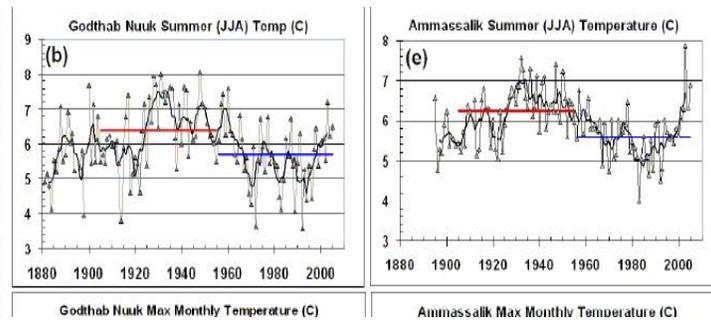


Photograph and diagram of a “moulin”

Source: Zwally et al. (2002)

The study found that moulins accelerate glacial movement in Greenland in the summertime, but only by a few percent. For example, glacial flow in 1998 increased from 31.3 cm/day in winter to 40.1cm/day in July, falling back to 29.8 cm/day in August, increasing annual glacial movement by 4.7 meters. Were it not for satellite sensing systems, nobody would even notice!

Moulins in numbers equal to or surpassing those observed today probably occurred during the first half of the 20th century, with no major loss of grounded ice. Chylek et al. (2006) examined temperature data from the only two weather stations in Greenland with a century-long measurement record that also covered the decade from 1995 to 2005, Godthab Nuuk on the west and Mamassalik on the east coast of southern Greenland.² See the Figure below.



Greenland summers were warmer in the 1920s-1940s; moulins were probably more abundant.

Source: Chylek et al. (2006)

Chylek et al. found that, “Almost all decades between 1915 and 1965 were warmer or at least as warm as the 1995 to 2005 decade...suggesting the current warm Greenland climate is not unprecedented and that similar temperatures were a norm in the first half the 20th century.” The researchers also found “no statistically significant difference between the average temperature from the 1905 to the 1955 period and 1955 to 2005 period,” the only difference being that summertime (JJA) average temperatures were *warmer* at both stations during the 1905-1955 period. Further, although the decade 1920-1930 was as warm as the decade 1995-2005, the rate of warming was “50% higher” during the earlier decade.

Chylek et al. conclude that recent glacier acceleration in Greenland, as observed by Rignot and Kanagaratnam (2006),³ “has probably occurred previously. There should have been the same or more extensive acceleration during the 1920-1930 warming as well as during the Medieval Warm period in Greenland ... when Greenland temperatures were generally higher than today.”

AIT: “If Greenland melted or broke up and slipped into the sea—or if half of Greenland and half of Antarctica melted or broke up and slipped into the sea, sea levels worldwide would increase by between 18 and 20 feet. Tony Blair’s advisor, David King is among the scientists who have been warning about the potential consequences of large changes in these ice shelves. At a 2004 conference in Berlin, he said: ‘The maps of the world will have to be redrawn.’” Gore then presents 10 pages of before-and-after ‘photographs’ showing what 20 feet of sea level rise would do to the world’s major coastal communities. (AIT, p. 196)

Comment: “The Greenland ice sheet cannot slip into the sea,” as one reviewer explains, “since it is resting in a bowl-shaped depression produced by its own weight, surrounded by mountains which permit only limited glacier outflow to the sea.”⁴ Also, as noted above, there is no evidence that “moulins” are destabilizing the ice sheet.

How long would it take to melt half of Greenland? A modeling study reviewed by the IPCC found that a sustained 5.5°C warming of Greenland would melt about half the glacier and increase sea level by 3 meters “over a thousand years.”⁵

NASA's Gavin Schmidt, a co-founder of RealClimate.Org, was hard pressed to defend Gore's apocalyptic scenario when asked about it by *Salon* magazine.⁶ According to *Salon*, Schmidt believes a 20-foot rise in sea level is plausible "in the long run—the very long run." How long, *Salon* asked? "Maybe 1,000 years," said Schmidt. "There's some uncertainty about how quickly that could happen," he continued, "but Gore was very careful not to say this is something that is going to happen tomorrow." Nice try. Gore failed to say that a 20-foot sea-level rise would *not* happen the *Day After Tomorrow*.⁷ Worse, Gore implied that a collapse of the ice sheets could happen in our lifetime when he counted up all the millions of people living in Beijing, Shanghai, Calcutta, and Bangladesh who would be "displaced, "forced to move," or "have to be evacuated" (pp. 204-206).

Nobody knows how warm Greenland is going to be over the next thousand years. We do have data on the net rate of ice mass loss in Antarctica and Greenland. Greenland's glaciers are thinning at the edges and thickening in the interior. If the gains are subtracted from the losses, the net volume of ice lost during 2003 to 2005 was ~101 gigatons a year.⁸ At that rate, Greenland is contributing 0.28 mm of sea-level rise per year—about one inch per century.

Zwally et al. (2005) used satellite altimetry to examine ice mass changes in Greenland, East Antarctica, and West Antarctica during 1992-2002.⁹ They found a combined sea-level-rise-ice-loss-equivalent rate of 0.05 mm per year. At that rate, comments the Center for the Study of Carbon Dioxide and Global Change, "it would take a full millennium to raise global sea level by just 5 cm, and take fully 20,000 years to raise it a single meter."¹⁰

¹ Zwally, H.J., W. Abadalati, T. Herring, K. Larson, J. Saba, and K. Steffan. 2002. Surface Melt-Induced Acceleration of Greenland Ice-Sheet Flow. *Science* 297: 218-222.

² Chylek, P., M.K. Dubey, and G. Lesins. 2006. Greenland Warming of 1920-1930 and 1995-2005. *Geophysical Research Letters*, 33, L11707, doi:10.1029/2006GL026510, <http://www.agu.org/pubs/crossref/2006/2006GL026510.shtml>.

³ Rignot, E. and P. Kanagaratnam. 2006. Changes in the Velocity Structure of the Greenland Ice Sheet. *Science* 311: 986-990.

⁴ Wm. Robert Johnston, "Falsehoods in Gore's An Inconvenient Truth," <http://www.johnstonsarchive.net/environment/gore.html>.

⁵ IPCC, *Climate Change 2001: The Scientific Basis*, p. 678.

⁶ Katherine Mieszkowsky, "Did Al Gore Get the Science Right?" *Salon*, June 10, 2006, http://www.salon.com/news/feature/2006/06/10/truths/index_np.html.

⁷ "The Day After Tomorrow" is the title of the 2004 sci-fi disaster movie about global warming, <http://www.thedayaftertomorrow.com/>.

⁸ Luthcke, S.B., H.J. Zwally, W. Abdalati, D.D. Rowlands, R.D. Ray, R.S. Nerem, F.G. Lemoine, J.J. McCarthy, and D.S. Chinn. 2006. Recent Greenland Ice Mass Loss by Drainage System from Satellite Gravity Observations, <http://www.Scienceexpress.org>, 19 October 2006, pp. 1-5.

⁹ Zwally, H.J., M.B. Giovinetto, J. Li, H.G. Cornejo, M.A. Beckley, A.C. Brenner, J.L. Saba, and D. Yi. 2005. Mass changes of the Greenland and Antarctic ice sheets and shelves and contributions to sea-level rise: 1992-2002. *Journal of Glaciology* 51: 509-527.

¹⁰ <http://www.co2science.org/scripts/CO2ScienceB2C/articles/V9/N10/C2.jsp>