# Extreme Snowmelt in Northern Greenland During Summer 2008

PAGE 391

Extreme snowmelt occurred during summer 2008 over the northern part of the Greenland ice sheet, according to the analysis of microwave data recorded by the Special Sensor Microwave Imager (SSM/I) on board the F13 satellite of the U.S. Defense Meteorological Satellite Program (DMSP). New records of the number of melting days were also observed over large portions of the same areas (letters A and B in Figure 1).

Anomalies of the 2008 number of melting days (i.e., the difference between the 2008 number of melting days and the 1979–2007 average) are reported in Figure 1. In 2008, melting in northern Greenland lasted up to 18 days longer than previous maximum values, and the melting index (i.e., the number of melting days × the area subject to melting) was 3 times greater than the 1979–2007 average, with $1.545 \times 10^6$ square kilometers × days. Also of noticeable value are 2008 anomalies observed along Greenland's west coast, with melting over this area lasting up to 5–10 days longer than the average (letter C in Figure 1).

Unlike in 2007, snowmelt over the whole Greenland ice sheet in 2008 was not significant at high elevations. Melt extent in 2008 was, however, above the 1979–2007 average, with the 2008 updated melt extent trend of approximately 16,000 square kilometers per year.

Results obtained with SSM/I are consistent with the outputs of the regional climate model Modèle Atmosphérique Régional (MAR). The 2008 MAR-modeled runoff is 88% higher than the 1979–2007 mean and is close to the 2007 value. Low modeled snowfall (13% below the 1979–2007 mean) and high runoff values suggest that the 2008 modeled surface mass balance (SMB = SF – E – R, where SF is snowfall, E is evaporation including surface water fluxes from a frozen surface (sublimation and deposition) and from a melting surface (evaporation and condensation), and R is runoff, defined as the liquid water production (including melt and rainfall) minus the meltwater retention) could be negative for the second year in a row. Coherent with both SSM/I and MAR, the SMB anomaly for 2008 derived from ground observations in southwestern Greenland was not exceptional, at 4% above the long-term mean. Unfortunately, no SMB measurements are available over those areas where new records were set. Nevertheless, the analysis of ground measurements carried out by automatic weather stations of the World Meteorological Organization indicates that 2008 surface/air maximum temperatures, averaged for the period of June through August, were above the average (1979–2007) by up to 3°C, with new records set at several stations located close to those areas where snowmelt record is observed.

Interestingly, the region where extreme snowmelt and maximum temperature positive anomalies in 2008 occurred experienced other noticeable events during the summer of 2008, including several episodes of ice shelf breakup along the northern coast of Ellesmere Island and the loss of 29 square kilometers of ice from the Petermann Glacier along the northwestern coast of Greenland. Understanding how the different events are connected requires an interdisciplinary collaborative effort aimed at observing the Arctic as an integrated system. In this sense, the consistency of satellite-, model-, and ground-based results poses the basis for a more robust analysis and synthesis tool.

—MARCO TEDESCO, City College of New York, New York; NASA Goddard Space Flight Center, Greenbelt, Md.; and University of Maryland Baltimore County, Baltimore; E-mail: mtedesco@sci.ccny.cuny.edu; XAVIER FETTWEIS, University of Liège, Liège, Belgium; and MICHIEL VAN DEN BROEKE, RODERIK VAN DE WAL, and PAUL SMEETS, Utrecht University, Utrecht, Netherlands

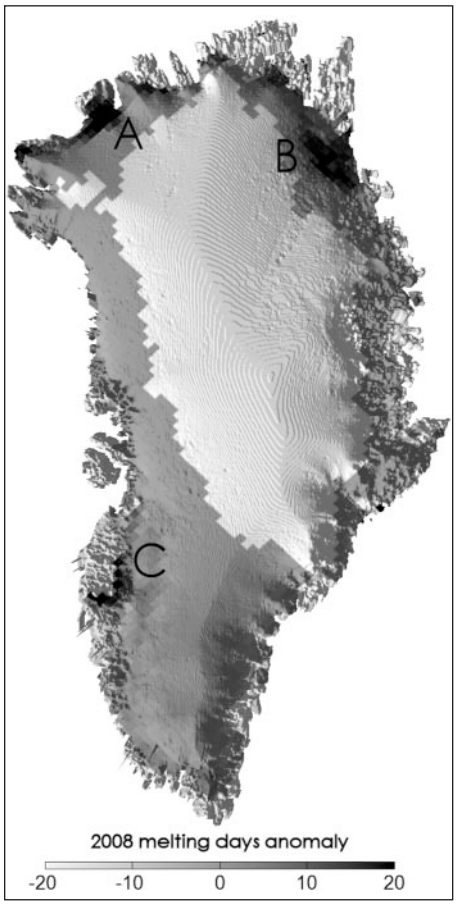


*Fig. 1. The 2008 number of melting days anomaly (i.e., the 2008 melting days minus the 1979–2007 average). Black areas in northern Greenland indicate where extreme melting occurred and new records were set. White color corresponds to no melting. A color version of this figure is available at http://forum.sci.ccny.cuny.edu/Members/mtedesco/cryosenslab/greenland2008melting.*