



## RECENT CRYOSPHERIC ANOMALIES OBSERVED BY SATELLITE SCATTEROMETER

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Anomalous conditions over Arctic sea ice, over the Greenland ice sheet, and over the Alaskan permafrost region have occurred over the past decade. With coverage of Arctic regions as frequently as twice per day, the SeaWinds scatterometer on the QuikSCAT satellite (QSCAT) provides an excellent capability to monitor the cryospheric change. We will present cryospheric anomalies recently observed by QSCAT. Algorithms have been developed to map sea ice classes, extent, melt area, and to assess melt timing. QSCAT results show minimal ice extent in the last four summers (2002-2005) consecutively. The latest QSCAT map of sea ice extent on the fall equinox (22 September 2005) reveals that sea ice was significantly reduced as compared to that in the previous year, especially in the East Siberian Sea and the Laptev Sea. QSCAT maps of sea ice classes on the spring equinoxes (21 March 2000-2005) indicate a large change in the distribution pattern of first-year and multi-year ice. The boundary between these ice classes retreated furthest north over the Beaufort Sea in 2005. An anomalous shift in Arctic sea ice distribution occurred in the fall and winter 2005. Comparing sea ice in November-December in 2004 and in 2005 shows that multi-year sea ice in 2005 was significantly pushed toward the west Arctic with a decrease of about 700,000 km<sup>2</sup>, a surface area larger than the State of Texas in the United States. The sea ice distribution change should be accounted in forecasting another possible minimal Arctic ice extent in summer 2006. Anomalous conditions are observed on the Greenland ice sheet both in snowmelt and in snow accumulation. QSCAT analysis for 1999 to 2005 reveal the extreme melt extent in 2002, and a significant increase in melt season length over several areas of the Greenland ice sheet in

2003. Results from QSCAT algorithm to detect the ice layer formation reveal extensive areas of ice layer formed by the 2002 melt. The attenuation of QSCAT backscatter signature is used to derive snow accumulation on the ice sheet. QSCAT results capture the extreme snowfall in mid-April 2003, which deposited more than 0.5 m of snow in a day at the NASA South-East Station in the Greenland Climate Network (GC-Net). Large-scale QSCAT results show an anomalous increase of snow accumulation rate over the southeast region of Greenland during the 2002-2003 season. QSCAT data show the shortest melt season in 2004, verified by GC-Net data at ETH/CU Camp, and detect peculiar snowmelt during wintertime in Greenland in 2005. QSCAT results reveal a record increase in the snow accumulation rate on the Greenland ice sheet including the west flank in January-March 2005 with an estimate of 565 km<sup>3</sup> of total snow accumulation volume. The record snow anomaly is verified by GC-Net snow measurements, showing the largest snow accumulation rate in the first half of 2005 ever recorded in the past decade since the inception of the GC-Net. QSCAT data over six years reveal an anomalously long warm season in 2002 at the Tunalik borehole location in Alaska, which significant impacts the permafrost active layer. These recent cryospheric anomalies occurred on ocean, land, and ice sheet over regional and Arctic-wide scales suggest a significant Arctic change that may profoundly impact the overall Arctic environment.