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An improved technique for snowmelt detection (1978 – 2006) over the Greenland Ice Sheet using microwave brightness temperature daily variations

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Greenland is fundamental climatologically as a center of cooling, hydrologically, as a large storage area, and, from a hazard perspective, because it produces large quantities of icebergs, to name a few examples. Snowmelt detection is important because ,differently from dry snow, wet snow has a relatively low albedo at visible and near-infrared spectral bands, absorbing more incoming solar radiation than dry snow. Moreover, an increased melt can provide a vapor source for cloud formation, which, in turn, will increase the down-welling longwave radiation. In addition, recent studies show that the presence of melting snow enhances glacial sliding by migration of surface meltwater to the ice-bedrock interface.

In this study, we report, for the first time, a technique based on diurnal amplitude variations (DAV) for mapping the areal extent of melting snow in Greenland for the period 1978 - 2006 by using brightness temperatures at $\sim$ 19 GHz, horizontal polarization, or $\sim$ 37 GHz, vertical polarization measured by the Scanning Multichannel Microwave Radiometer (SMMR) and by the Special Sensor Microwave/Imager (SSM/I) radiometer. In contrast to the techniques proposed so far, the use of both ascending and descending passes enhances the sensitivity of the technique to the daily melting cycle. Moreover, the separate use of multiple frequencies permits the study of melting involving different depths and having different intensities. These last two points are major advantages of the DAV-based technique with respect to those proposed in the lit-

erature so far. Results of a comparative analysis between the results obtained with the technique here proposed and those obtained using techniques reported in the literature making use of different approaches (e.g., XPGR) or a different sensor (QuikSCAT) are reported. Extreme melting events are identified and discussed together with the temporal trend of surface snowmelt for the period 1977 - 2006. Finally, we apply the DAV-based technique to the Greenland Ice Sheet divided in areas describing drainage systems (DS) defined by surface slopes and climatology, and then further sub-divided into areas with elevation above and below 2000 m.