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Inter-comparison of optical and microwave remote sensing derived snow products and ground validation

M. Tedesco (1), J. R. Wang (2), R. J. Kelly (1), D. K. Hall (3)

(1) UMBC - NASA Goddard Space Flight Center, Greenbelt, MD , USA, (2) NASA Goddard Space Flight Center, Instrumentation Sciences Branch, Greenbelt, MD, USA, (3) NASA Goddard Space Flight Center, Cryospheric Sciences Branch, Greenbelt, MD, USA

Snow affects the hydrological, meteorological and climatological cycles through its effects on land surface albedo, the net radiation balance, and boundary layer stability with most of the Earth's snow-covered areas located in the Northern Hemisphere. Satellite remote sensing represents an efficient tool for mapping the extent of hemispheric snow-covered area (SCA) and for estimating snow hydrology parameters (such as snow water equivalent and snow depth) over large areas where, otherwise, it would be difficult if not impossible. Optical remote sensing offers the advantage of high spatial resolution but it is limited by the presence of clouds and solar illumination. Microwave signals are not affected by clouds and sun illumination but data are collected at a coarser spatial resolution. In this study we compare 1) optical data on snow covered area collected by the Moderate-Resolution Imaging Spectroradiometer (MODIS) with microwave brightness data collected by the Advanced Microwave Scanning Radiometer for EOS (AMSR-E), both flying on board the AQUA satellite, launched on May 2002 and 2) snow depth values retrieved by using the AMSR-E data with those ones measured on ground by automatic stations (SNOTEL). The area of interest Sierra Nevada in the western United States and the period of interest ranges between October 2003 and January 2005. The SCA estimates from MODIS data are compared with those from AMSR-E data using the 19 and 37 GHz brightness temperatures. The observed differences between the optical and microwave approaches are discussed. An analysis on the errors due to forest cover fraction, re-sampling procedures and atmospheric effects is carried out. The sensitivity of microwaves to shallow snow cover is also discussed and a comparison between retrieved and measured snow depth is performed for those areas where ground data are available.