

Retrieval of Snow Water Equivalent using Combined Microwave Active and Passive Observations

JIYUE ZHU¹, LEUNG TSANG¹, DO-HYUK “DK” KANG^{2,3}, AND EDWARD KIM²

ABSTRACT

Recently, a volume scattering approach for retrieving snow water equivalent (SWE) has been applied to three sets of airborne SnowSAR data (including 2011 and 2012 campaigns in Finland; 2013 campaign in Canada). It has achieved root-mean-square error (RSME) below 30 mm of SWE and correlation coefficients above ~0.64. In this paper, we apply the original method by including three more channels of data, the third Ku-band at ~13 GHz and radiometer observations at Ku- (~19 GHz) and Ka- (~37 GHz) bands, to form an active and passive combined method for the SWE retrieval. Introducing low Ku-band helps to alleviate the background scattering effects which is coincident with the snow mission concept of the Canadian Space Agency (CSA). Brightness temperatures (T_b) from radiometer observations are utilized to estimate the priori scattering albedo (effective grain size, one of two unknowns in the retrieval) of snow for locating the best snow parameters. The proposed combined algorithm is validated against Finland ESA NoSREx data 2009-2013 and NASA SnowEx 2017 datasets. The SnowEx 2017 winter campaign deployed both the airborne SnowSAR and the ground-based a scatterometer from the University of Waterloo to acquire radar measurements at X- and Ku-band. The T_b data applied are extracted from AMSR2 satellite observations. The NoSREx datasets include both ground-based radar measurements of X- and dual Ku- bands and radiometer observations of Ku- and Ka-bands. The RSME of the retrieval performance are below 20 mm for thin snow and less than 10% of total SWE for thick snow. The correlation coefficients are above 0.82.

¹ Department of Electrical Engineering and Computer Science, University of Michigan, Ann Arbor, MI, USA

² NASA Goddard Space Flight Center, Greenbelt, MD, USA

³ ESSIC, University of Maryland, College Park, MD, USA