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Snow Water Equivalent Retrieval using Ku- band SCATSAT-1 Scatterometer Data for Northwest Himalayas

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Space borne microwave radars have great application in monitoring seasonal snow cover changes regardless of the cloud cover and day-night conditions. The presence or absence of snow cover has very significant impact on the water and energy balance of Earth. Accurate estimation of snow extent and snow water equivalent (SWE) act as an input in many studies like snowmelt runoff estimation and water balance studies. The scope and effectiveness of optical and microwave satellite images in snow studies has been well demonstrated in last 30 years. SCATSAT-1 satellite was launched on 26th September 2016 in continuation with the Oceansat-2 scatterometer mission. SCATSAT-1 carries a Ku-band pencil beam scatterometer that acquires data in a conical fashion in HH and VV polarizations. The scatterometer provides global high resolution (2.25 km spatial resolution) images. It has been demonstrated by previous studies that Ku-band is more sensitive to the volume properties of snowpack in comparison to L and C band. Backscattering from the snowpack depends on sensor parameters such as frequency, polarisation, incidence angle and terrain properties such as surface roughness, snow density, snow depth, snow wetness and snow grain size. There is a significant correlation between the backscatter coefficient values and Snow Water Equivalent (SWE) as shown in literature. In the present study, SCATSAT-1 daily images pertaining to months of December 2016 to February 2018 were acquired for the retrieval of change in weekly Snow Water Equivalent (ΔSWE). ΔSWE was retrieved using the single layer radiative transfer model, which is based on the change detection technique by using ground observed or validated land surface model or satellite based SWE in relationship to temporal change in radar backscatter. For the calculation of ΔSWE, the reference observed data was considered as the AMSR daily global SWE. Based on the calculated SWE, interpolated weekly maps for the time period was generated for Northwest Himalayas. MODIS Snow Cover Daily L3 product of 500 m Grid maps were used for creation of the snow mask. The results on comparison show a good correlation between the satellite/ground based and retrieved ΔSWE. Observed data at Kothi weather station, Manali, India shows the maximum snow depth in the study period was 0.85 m on January 13 2017, whereas in the year 2018 highest snow depth was only 0.32 m. The SCATSAT-1 retrieved maximum ΔSWE was 700 mm in 1st to 2nd week of January 2017 while it changed by only 220 mm during same time 2018.