EGU2020-5617, updated on 02 Dec 2021
https://doi.org/10.5194/egusphere-egu2020-5617
EGU General Assembly 2020

A Novel Perspective on Mapping Snow Cover Under Forest Canopy With Sentinel-2 Multispectral Optical Satellite Sensor Over Black Forest Germany

Arnab Muhuri
Professorship in Hydrology and Climatology, Institute of Geography, Heidelberg University, Neuenheimer Feld 348, 69120 Heidelberg, Germany (arnab.muhuri@uni-heidelberg.de)

Previous investigations have reported that the performance of the traditional snow cover mapping algorithms based on the Normalized Difference Snow Index (NDSI), derived from a multispectral optical airborne/spaceborne sensor, significantly degrades on transitioning from non-forested to forested landscapes. The thick canopy cover in forested landscapes obscures both the upwelling and the downwelling radiance and hence impairs the detection of the underlying snow cover on the forest floor via NDSI thresholding due to the shift in the apparent threshold. Although NDSI has been reported to be an ineffective index for extracting snow information from forested areas, this investigation presents contrary views. A novel perspective is introduced on exploiting the temporal NDSI-NDVI statistics for extracting snow information under the canopy, as has been also reported important in the past literature when considered together, to reconstruct the actual snow cover scenario over the mixed landscape, comprising both forested areas of varying densities and open vegetation-free patches. The Black Forest (Schwarzwald) is a large forested mountainous terrain at about 200-1500 m above sea level situated in the Federal State of Baden-Württemberg in the southwest corner of Germany. The region is bounded by the Rhine river valley to the west and south stretching in an oblong manner with a length of about 160 km and breadth of up to 50 km. The Black Forest consists of approximately 80% coniferous (spruce, fir, and pine) and 20% deciduous (beech, birch, and oak), with about 70% of the region under forest cover. Seasonal snowmelt water and natural springs originating in this region sources major European rivers like the Danube and the tributaries of the Rhein like the Murg and the Neckar. Therefore, it is essential to monitor snow accumulation under the canopy to accurately forecast and investigate the influence of the snowmelt runoff in such major catchments. One of the test sites is situated in the Murg catchment at Hundseck near the town of Baden-Baden at the north-western border of the Black Forest mountain range. This investigation employs Sentinel-2 multispectral optical data from the previous season in order to test the proposed approach. The proposed method is tested with the European Space Agency's open-access Sentinel-2 multispectral optical satellite data, over the Hundseck test site in the Black Forest. The snow extent map is validated with the Normalized Difference Forest Snow Index (NDFSI), which was proposed as an alternative for NDSI to map the canopy underlying snow in evergreen forests. The proposed algorithm is simple and computationally frugal. Temporal NDSI-NDVI statistics in conjunction with mathematical

morphological operation has resulted in significant improvement in the detection of under canopy snow cover. It is noteworthy that the performance of the algorithm inherently shows a dependence on the forest LAI. An improvement of more than 50% is achieved in the under-canopy snow cover mapping. A priori knowledge regarding the LAI of forests will enable adaptive tuning of the algorithm locally for better performance under dense canopy conditions.