The Value of Optical and SAR Based Snow Products for Reconstructing SWE in a Snow Dominated Headwater Basin

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In many headwater basins snowpack plays an important role for seasonal water storage. The knowledge of the state of the snowpack is therefore crucial for managing water resources. In heterogeneous alpine terrain both modelling and measuring spatial distributions of snow water equivalent (SWE) is however challenging. Traditional methods of retrieving SWE have several drawbacks like a lack of representativeness, labor-intensity or discontinuity in time. Snow covered area can be retrieved operationally from remote sensing data but available water in terms of SWE can still vary substantially. Other issues emerge from the characteristics of the available sensors themselves. Medium resolution optical sensors like MODIS or Sentinel-3 have a daily repeat cycle but the retrieved fractional snow cover (FSC) maps can be still too coarse for spatially heterogeneous mountain regions. High resolution sensors like Landsat-8 or Sentinel-2 are suitable for retrieving FSC maps in complex terrain but with a limited repeat frequency. While all optical sensors are limited to clear sky conditions, Synthetic Aperture Radar (SAR) based sensors show the advantage of retrieving data regardless of atmospheric conditions. Recent sensors like Sentinel-1 are promising for hydrological applications as they combine high spatial resolution with a relatively high repeat frequency. The data can be processed to a wet snow covered area map (WSCA). The knowledge of the implications of the different remote sensing products for managing water resources is however limited. Therefore, a multi-objective model calibration approach is proposed to evaluate the use of medium resolution FSC, high resolution FSC and WSCA maps for reconstructing SWE. Results are evaluated in terms of predicting runoff at the basin outlet and in-situ snow measurements within the basin.