Calibrating large scale satellite information on basis of data achieved in research catchments: A case study on basis of the NDSI threshold value.

Matthias Bernhardt[1], Stefan Härer[1], Matthias Siebers[2], Karsten Schulz[1]

1Institute for Water Management, Hydrology and Hydraulic Engineering (IWHW), University for life sciences (BOKU), 1190 Vienna, Austria
2 Commision for Glaciology, Bavarian Academy of Sciences and Humanities, 80539 Munich, Germany

Knowledge about the current snow cover extent is essential for characterising energy and moisture fluxes at the earth surface. The snow-covered area (SCA) is often approximated by using optical satellite information in combination with the normalized-difference snow index (NDSI) with its standard threshold of 0.4. However, when evaluated for the local scale the spatio-temporal representativeness of this fixed threshold is questionable and can be seen as a major source of uncertainty in remotely sensed SCA. A comprehensive quantitative analysis is however still missing. Here, we use local snow cover maps derived from ground-based photography to continuously calibrate the NDSI threshold values ($NDSI_{thr}$) of Landsat satellite images at two European mountain sites between 2010 and 2015. Both sites, the Research Catchment Zugspitzplatt (RCZ, Germany) and the Vernagtferner area (VF, Austria), are high alpine and located within a single Landsat scene. Nevertheless, the long-term analysis of the $NDSI_{thr}$ demonstrated that the $NDSI_{thr}$ at these sites are different to each other, to the standard threshold of 0.4 and not correlated between these sites. Additionally, it was shown that large uncertainties, up to 42.8%, exist in satellite snow cover maps in case the 0.4 threshold is used. Finally, a calibrated quadratic polynomial model accounting for seasonal threshold dynamics is presented. It minimizes the SCA uncertainties at the calibration site VF by 50% in the evaluation period. And if the model is applied at RCZ and simply corrected for the different rock reflectances, the error is still reduced by about 35%.