EGU24-13683, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-13683
EGU General Assembly 2024

Testing four Sentinel (1 and 2) and MODIS Fractional Snow Cover products for the evaluation of five Alpine Cosmic Ray Neutron Sensing sites

Nora Krebs[1], Paul Schattan[1,2], Valentina Premier[3], Abraham Mejia-Aguilar[4], and Martin Rutzinger[1]
[1]Department of Geography, University of Innsbruck, Innsbruck, Austria
[2]Institute of Hydrology and Water Management (HyWa), University of Natural Resources and Life Sciences, Vienna , Austria
[3]Institute for Earth Observation, Eurac Research, Bolzano, Italy
[4]Center for Sensing Solutions, Eurac Research, Bolzano, Italy

Above-ground cosmic ray neutron sensing (CRNS) is an emerging technique for the investigation of dynamics in soil moisture, snow water equivalent (SWE), and vegetation at a spatial scale of several hectares. The measurement principle is based on the moderation of natural secondary cosmogenic neutrons by hydrogen atoms. On the earth surface hydrogen atoms are mainly bound in water molecules. However, at complex research sites the signal distinction between various water sources remains challenging. Especially in alpine terrain and at elevated topography, hydrological features are linked in an intricate patchwork, hampering signal discrimination. Satellite observations offer valuable complementary surface information and are commonly provided at a spatial resolution that meets the integrated footprint area of the CRNS detector. In this study we investigate if the interpretation of the CRNS signal can be enhanced by the use of remote sensing products. We compare three readily available fractional snow cover (FSC) products based on Sentinel (1 and 2) and MODIS and one reference FSC Sentinel-2 scene-based machine learning product at the approximate footprint resolution of CRNS, comprising a circular area of 250 m radius. The performance of all four products is assessed at five CRNS sites in the Austrian and Italian Alps that represent a variety of environmental properties, ranging from flat to steep topography, from low to high elevation and from sparse to abundant vegetation cover. At three sites, the presence and absence of snow can be validated by local snow height measurements. The analysis shows that remote sensing snow cover information can be extracted on around 80% of the analyzed days, demonstrating the use of FSC products for the estimation of snow cover duration and timing. Comparing the four products shows overall agreements and allows to deduce product-specific thresholds for the distinction of snow-covered and snow-free situations. Further, pairing remote FSC observations with neutron count measurements provides a first indication on the complexity of local hydrogen pool dynamics and consequent requirements on the calibration routine for ambient water monitoring with CRNS. We conclude that satellite-based FSC products can be used to fortify the choice of CRNS observation location and period prior to the detector installation and for a robust and viable first-order assessment of expected CRNS site conditions. Remote sensing FSC products and CRNS measurements hold complementary data that

can mutually benefit snow observations and should be explored further in the future.