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Wide-area mapping of snow water equivalent by Sentinel-1&2 data

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The mapping of snow physical properties over large mountain areas of remote areas is an important topic in both climatological studies and hydrological models where the effects of snow melting are modeled and used to forecast extreme flood events. Usually, these models are run using in-situ measurements of snow which are expensive and statistically not representative of the spatial distribution of snow properties due to slope orientation of terrain, local terrain morphology and height as well as vegetation cover.
In this work we investigate the use of data acquired by Sentinel-1 and 2 missions using a C-band SAR and multispectral sensor, respectively. The Sentinel-1 SAR data are processed to estimate the Snow Water Equivalent (SWE) using both the radar amplitude and the output of the SAR interferometry processing. Both approaches need in-situ data to process SAR data and calibrate SWE estimates.
The use of SAR amplitude to estimate the SWE is well established and the basic idea is that the radar signal backscattered by snow is related to the SWE so, after modeling the relationship between these two quantities at the site of in-situ measurements this relationship can be used to map the SWE at all site where the SAR amplitude information is available. The physical principle used by SAR interferometry is that of phase delay due to propagation in a non-dispersive medium. This implies that the snow is supposed to be dry in order to allow the propagation of the SAR signal. Sentinel-2 images have been used to get land-use maps and identify areas covered by vegetation. Finland has been chosen as a study region with in-situ measurements acquired thanks to the availability of rich database of in-situ measurements of SWE. Sentinel data used in this work have been acquired starting from November 2015.

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