# Snow Water Equivalent Retrieval Using Synthetic Aperture Radar (SAR) Interferometry

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In this work we investigate the use of SAR interferometry (InSAR) to derive SWE maps using spaceborne C-band SAR data. The main objective is to reduce the impact of model inversion on the SWE estimation [1] and, at the same time, provide an alternative procedure to derive the SWE using SAR data.

The physical principle used in SAR interferometry relies on phase delay occurring due to the propagation in a non-dispersive medium. This implies that the snow is assumed to be dry in order to allow the propagation of the SAR signal. Furthermore, the fact that the SWE estimation is based on the measurement of a phase delay implies that phase contributions due to topography and propagation in the atmosphere should be properly identified and corrected. A precise Digital Elevation Model (DEM) of the area is used to model and remove the phase delay due to the topography modulation of the interferometric signal. The mitigation of atmospheric phase delay can be done by using external data such as Numerical Weather Models (NWMs) [2] or delay measurements provided by the Global Navigation Satellite System (GNSS) receivers or passive satellite sensors [3]. Concerning the occurrence of terrain displacements, due to different geological phenomena, it is assumed that they are negligible within the short temporal baseline between the two SAR images used to generate the interferograms. The proposed methodology provides a direct estimate of the snow depth which is then used to derive the SWE. The knowledge of the SWE at several reference locations is needed, provided by either in-situ measurements or other remote sensing techniques. These in-situ data are used to calibrate InSAR estimates of SWE since the phase measurements are needed to be unwrapped both in time and space. In this work we present the first results obtained using C-band Sentinel-1 SAR images acquired over Finland between November 2015 and May 2016.

[1] H. Rott, C. Duguay, P. Etchevers, R. Essery, I. Hajnsek, G.Macelloni, E. Malnes, J. Pulliainen, “Report for Mission Selection CoReH20”, European Space Agency, Nordwijk, The Netherlands, 2012.

[2] G. Nico, R. Tomé, J. Catalão, and P. Miranda, “On the use of the WRF model to mitigate tropospheric phase delay effects in SAR interferograms,” IEEE Transactions on Geoscience and Remote Sensing, 49(12), 4970–4976, 2011.

[3] P. Mateus, G. Nico, R. Tomé, J. Catalão, and P. Miranda, “Experimental study on the atmospheric delay based on GPS, SAR interferometry and numerical weather model data,” IEEE Transactions on Geoscience and Remote Sensing, 51(1), 6–11, 2013.