



## **New Algorithm for SWE Extraction from Interferometric Data, for Satellite Radar Images**

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During the last few years, interest in the Earth's water resources has greatly increased. Indicators to quantify these resources are therefore becoming increasingly useful, in particular Snow Water Equivalent (SWE). Currently, this information is recorded precisely by automatic spot measurements. This new algorithm allows for a solution to reconstitute the increase of temporal SWE during the winter period, due to interferometric data. It takes into account a period of 11 days separating two dataset, which is the revisit time of the satellite Sentinel-1.

This algorithm uses a model stemming from identification. The model identification is obtained from temperature and precipitation data as input ( $u$ ), and Gamma Water Instrument (GWI) as measured output ( $y$ ). The coefficients obtained by identification on the first part of winter permit us to calculate the SWE during the complete snowfall period and to compare with GWI data. The Auto Regressive model with external inputs and parameters 5,3,1, also called ARX(5,3,1) presents a root mean square error of 9.99 mm during the complete snowfall season, with only 90 days of identification.

$$y(k) = -Ay(k - 1) + Bu(k - 1) + \eta(k)$$

The equation linking variation of SWE and variation of phase established by S. Leinss in [1] and our identified model allows us to know how many times the phase has been wrapped up. After unwrapping the phase we obtain the SWE. This algorithm has been tested using measurement data from the SnowScat Instrument of the NoSREx campaign [2] and shows great results both on winters 2009-2010 and 2010-2011. This algorithm opens new perspectives for the automatic calculation from interferometric data from satellite. Such a perspective can allow to spatialize the SWE for larger areas than what is done with punctually automatic measurements.

[1] S. Leinss, A. Wiesman, J. Lemmetyinen, and I. Hajnsek, "Snow water equivalent of dry snow measured by differential interferometry," *IEEE Journal*, vol. 8, august 2015.

[2] J. Lemmetyinen, A. Kontu, J. Pulliainen, A. Wiesmann, C. Werner, T. Nagler, H. Rott, and M. Heidinger, "Technical assistance for the deployment of an x- to ku-band scatterometer during the nosrex ii experiment," Final Report, ESA ESTEC Contract No. 22671/09/NL/JA., 2011.