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Radarsat-2 full polarimetry capabilities for dry and wet snow analysis at C-band in Alpine regions

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This study objective is to estimate snow properties in Alpine regions using full polarimetry capabilities of Radarsat2 for wet and dry snow monitoring. The potential of SAR data for wet snow (surface) is nowadays clearly demonstrated and mapping by means of SAR has already been achieved since ERS-1 images. Whereas the estimation of dry snow covers location and physical properties of snow pack still remains a challenge. This study is focused on the advantages of RADARSAT-2 in fully polarimetric mode at C-band for snow properties retrieval. Radarsat-2 imaging mode is standard Quad Polarisation: nominal swath width 25 km, ground resolution 5m (Fine). Descending orbits (05:42 am) are used to be phased with field measurements on representative snow test-sites, added with automatic snow stations network data. This project was run for winter 2009 and 2010 over an experimental river basin located in the French Alps (N 44°.15' / E 7°.15'), well documented and already used for precedent SAR projects. This mountain area is characterized by a strong topography involving shadowing and layover effects.

Ancillary data (DEM, optical images) are re-projected into SAR topology to preserve phase information (polarimetric parameters). Local Incidence Angles are given by "NEST" ESA Toolbox and polarimetric decomposition given by "PolSARPro" ESA software. Radarsat-2 benefits are focused on temporal evolution of polarimetric parameters (entropy, alpha). Temporal variations are stronger in spring than winter due to Liquid Water Content in wet snow.

At C-band, dry snow is a low attenuation medium and only slightly affects the backscattered signal amplitude. We apply a three-step method developed by our consortium (Martini et al., 2006). It demonstrated the capabilities of full polarimetry information to observe in an efficient way dry snow covers in strong topography conditions, with or without vegetation areas. First step is dedicated to image classification into bare surfaces and forest from summer data sets (clustering). Each media is then processed separately. The presence of snow is then detected over bare surfaces by means of a new optimisation method, based on a Polarimetric Contrast Variation Enhancement (PCVE). Snow covered forests are analysed from summer to winter variations of polarimetric decomposition scores (H, alpha). Merged discrimination results are finally analysed through a quantitative estimation of the detection performance. Optical images (Landsat ETM, Spot) close to each SAR registration (winter and summer) are used for snow cover validation using Aster DEM for geo-location. Then, snow physical parameters as LWC are validated by snow metamorphism model (Crocus).