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Electromagnetic backscattering model for snowpack adapted to X-band and Ku-band SAR satellite data

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The remote sensing of the Earth's environment has undergone a major development during recent decades with the parcitipation of many airborne and spaceborne radars from the space agencies around the globe. The advantages of the new generation of radar systems with high resolution image, short revisit time provide the possibility of characterization and monitoring the evolution of the cryoshpere. In particular, the new X-band and in the near future, Ku-band SAR systems allow the better study of snowpack, which has remained a challenge for a long time due to the lack of high frequency radar data. In this paper, we propose an adaptation of the radiative transfer model initially realised by Longepe et. al. [1] to estimate the total backscattering coefficient of electromagnetic wave on snowcover area. Snow is a complexe environment consists of ice particles, air and liquid water. The snowpack therefore has a large variability of physical and geometrical properties such as density, humidity, form and size of grain, etc. The characterization of a snow layer is related to the possibility of modeling the electromagnetic (EM) scattering theories. Several EM wave models were developed in order to take into account the different backscattering mechanisms. These models allow the identification of the EM-sensitive properties of snowpack. As a part of this work, a multilayer EM model based on the radiative transfer equation has been introduced. The model, which was adapted to high frequency band SAR (X-band and Ku-band), has been used and furthermore will be optimised using the data from TerraSAR-X in dual-pol channel (HH and HV). Additionally, a number of snowpack stratigraphy profiles measured during different missions, along with ground-base radar data in various frequency bands are also put to use. Some first results have been obtained from applying the initial data of the measure in-situ into the model. An agreement has been verified between the model output and the radar's data. The model will then be tested on data provided from CROCUS, a unidimensional model of snow evolution developed by MeteoFrance. This work has been funded by GlaRiskAlp, a European project (2010-2013) on glacial hazards in the Western Alps and MeteoFrance, the French national meteorological service. Radar data was provided by German Aerospace Center (DLR). Measured data was realised by IETR (University of Rennes 1), Gipsa-lab (INP-Grenoble) and MeteoFrance. [1] N.Longepe, "Apport de l'Imagerie SAR Satellitaire en Bandes L et C pour la Couvert Neigeux". PhD thesis, UniversitÈ de Rennes 1, 2008.