

SNOW AND ICE SENSING USING SYNTHETIC APERTURE RADAR (SAR) SATELLITE DATA

The digital economy group at University of Vaasa is investigating the possibility of snow sensing on open ground, forests, and vegetation using SAR data. The goal of the study is to develop future methods for near real time monitoring of snow and ice accretion.

The satellite data acquired from Sentinel-1 constellation of Copernicus program for different seasons.

The result confirms snow detection on selected land covers between autumn and winter.

INTRODUCTION

This study uses satellite images (SAR data) from September to November and extract signal strengths on different land covers. The selected region of interest (ROI) is Lokka, which is located in the northern part of Finland shown in Picture 1. There are five land covers classified in the ROI including closed forest, open forest, herbaceous vegetation, herbaceous wetland, and water bodies. The signal strength of RADAR fluctuates due to the presence of snow on land covers. This fluctuation can be interpreted as snow sensing.

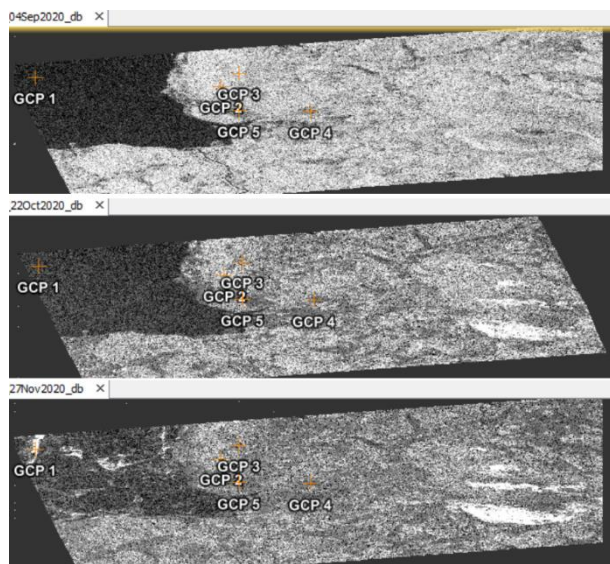


Picture 1. Region of interest (<https://earth.google.com/>).

Picture 1 shows the region (Lokka) taken into consideration for snow sensing. Google earth engine is used to project the image. However, SAR data is shown in grey scale, which is Sentinel-1 image acquired from European space agency's program Copernicus access hub. The minimum and maximum backscattering coefficient of SAR data shown on the left side. The area is approximately 180 km² with classified land covers taken from Copernicus global land service. The daily weather data is collected from Finnish meteorological institute (FMI), which provides air temperature, ground temperature, precipitation, and snow depth. The FMI data is considered as the source of ground information, which reveals whether snow can be detected on land covers in order to interpret the polarimetric fluctuations correctly.

FEATURE EXTRACTION

In this study, there are three SAR images used to extract polarimetric data for the duration of September to November shown in Picture 2. These images are classified as the period before first snowfall (September), the period after first snowfall (October), and the period of constant snow covers (November). The pre-processing of the data packages include thermal noise removal, calibration, and terrain correction. Ground control points (GCP) are selected with respect to the classified land covers acquired from Copernicus land monitoring service (global land cover).

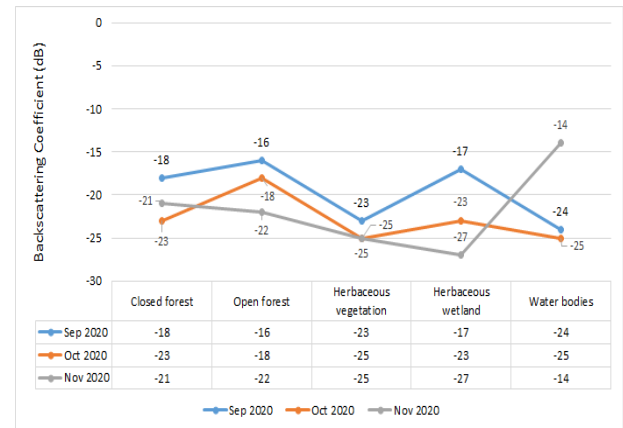


Picture 2. Sentinel-1 images from September-November 2020.

RESULT

The temporal variations of selected GCPs are recorded using cross-polarization data. The weather data from local weather station is used as a reference to ground information. This data contains snow depth, which assumed to reflect the presence of snow on land covers. The fluctuations of backscattering coefficient

on selected GCPs are illustrated in Picture 3. The temporal variations of the signal show a decrease on closed forest, open forest, vegetation, and wetland due to the presence of wet snow. However, the signal strengthens on water bodies due to possible ice formation.



Picture 3. Temporal variation of backscattering coefficient.

The goal of snow sensing using satellite data is to identify snow/ice formation on global land and sea covers. The research group is exploring the implementation of machine learning on different applications of snow/ice detection. The temporal estimations of these applications transform into datasets, which train various machine-learning models to predict future snow/ice formation.

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