Three years of ground-based L-band radiometry in the Alps: topography, vegetation and snow issues

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THREE YEARS OF GROUND-BASED L-BAND RADIOMETRY IN THE ALPS: TOPOGRAPHY, VEGETATION AND SNOW ISSUES

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1. INTRODUCTION

During the last three years, L-band microwave measurements were acquired in the French Alps near Grenoble using one of the three ELBARA radiometers lent by ESA. The main innovative character of the experiment was related to the large field of view (about 300 000 m² at 6dB) of the radiometer measurements due to the use of natural cliffs in the Vercors region, which provide a raised position more than 500 m above the target. Brightness temperature measurements were acquired every 30 minutes at five incidence angles as shown in Fig. 1. At the same time, in-situ soil moisture, soil temperature and atmospheric variables were obtained at various locations in the target areas. Finally, automatic pictures of the footprint area are taken every hour from the radiometer location to identify when and where snow occurs (Fig. 2). In this configuration, nearly all potential error sources of SMOS satellite measurement can be found at a smaller spatial scale (snow and freezing events, topography issues, footprint heterogeneity, vegetation, litter, dew,…). In this presentation, we will mainly focus on the impact of the topography, the snow and the vegetation water content.

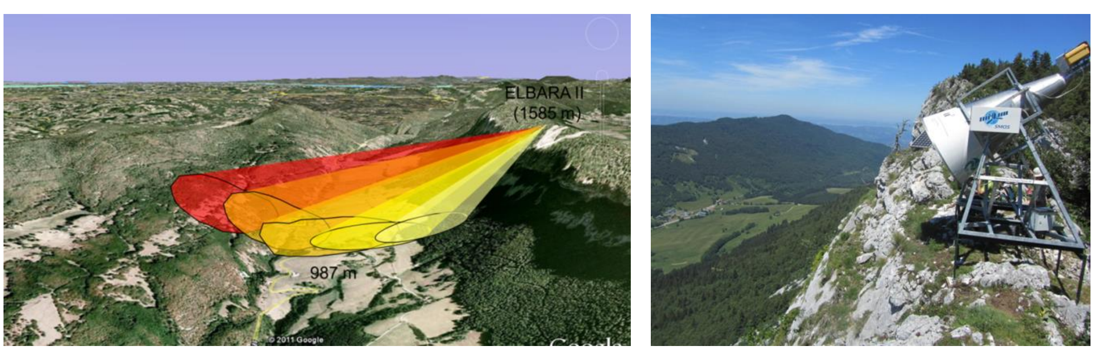

Figure 1: Design of the ELBARA experiment in the Vercors site. The radiometer is located at 1585 m looking at the studied area located at about 1000 m of altitude.

Figure 2 : Automatic hourly picture of the footprint area used to identify when and where snow is present

2. OBJECTIVE AND METHODOLOGY

The purpose of this communication is to present a comparison between observed brightness temperatures (ELBARA TB) and simulated TB from June 2011 to June 2014. In-situ measurements were used as inputs of the L-MEB model in order to provide simulated TB. The aim is to quantify the impact of the topography, to observe the effect of snow cover (including snow under forest) and to observe and detect soil freezing events.

3. TOPOGRAPHY ISSUE

Topography issue has been studied by various authors [1], [2]. In this study, to account for the topography, a laser scanning of the target area was obtained to compute a 1 m² digitalized elevation model (DEM). The DEM is used to accurately locate the different footprint (Fig.3) and to compute all incidence angles within each of the footprints. The topography impact on the brightness temperatures will be shown at the ELBARA scale and at the SMOS scale over the whole Vercors region (80x50 km²).

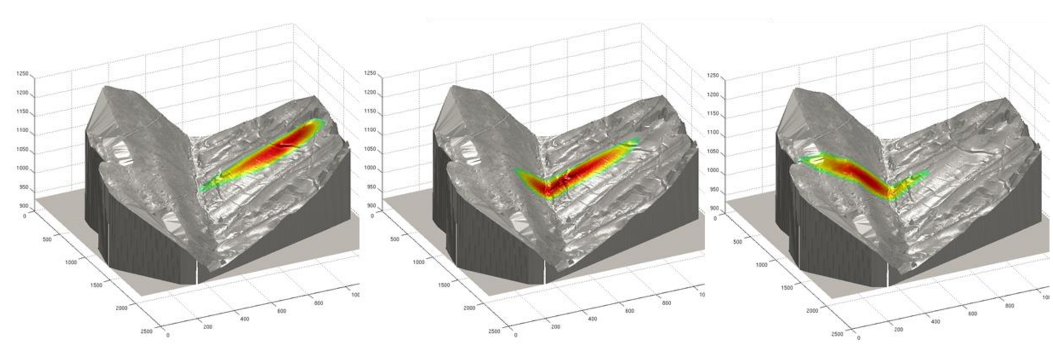

Figure 3: Digitalized elevation model of the target area obtained with a 3D laser scanning measurements. Three of the five footprints of the ELBARA radiometer are over-plotted in color.

4. VEGETATION EFFECT

The difference between the vertical and the horizontal polarization in passive microwave is known to be related to the density of the vegetation. An unexpected evolution of the Hpol-Vpol measurements was found showing a minimum difference in October-November each year whereas this maximum was expected in summer (fig.4). To investigate this point, vegetation water content measurements were done from April to November 2013 but were found to be unable to explain the ELBARA measurements. Further researches are currently underway.

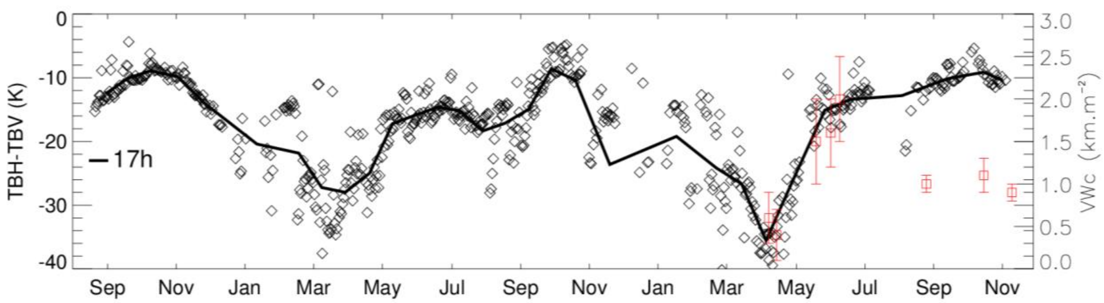

Figure 4 : Evolution of the ELBARA Hpol-Vpol measurements from August 2011 to November 2013. Pics in Oct-Nov can't be explained with vegetation water content measurements (red symbols, right axis).

5. SNOW EFFECT

Dry snow is known to have a relatively weak impact at L-band. However, some large discrepancies were observed between ELBARA measurements and simulated TB using the L-MEB model [3] coupled with the HUT snow radiative model [4]. Further researches are currently underway particularly trying other snow radiative transfer models. Snow events are recorded thanks to a new generation raingauge system; the Geonor T-200B series instrument as well as snow spatial distribution over the studied area derived from automatic pictures (see Fig.2). Concerning the snow properties (snow temperature, snow density, snow depth, grain size, …) we used outputs of the detailed CROCUS snow model from Météo-France.

6. REFERENCES

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