Winter 2017/18 Campaign at The Davos-Laret Remote Sensing Field Laboratory:

Preparation and Installation of The Complex Measurement Setup

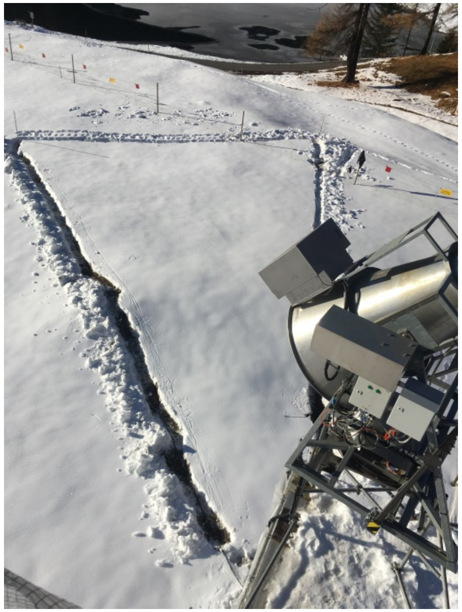
Mike Schwank, Reza Naderpour

Nov. 2017

Timeline

- 28.03.2017: Winter 2016/17 Campaign Over
- 20.10.2017: ELBARA comes back to WSL from FZJ
- 20.10.2017 until 16.11.2017: System test and improvement
- 17.11.2017: Transportation to Davos and Installation



Papers Based on 2016/17 Campaign

- Accepted for publication in MDPI's special issue on Snow Remote Sensing
- Impact factor: 3.74
- Upcoming two papers in 2017:

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Article

Davos-Laret Remote Sensing Field Laboratory: 2016/2017 Winter Season L-Band Measurements Data-Processing and Analysis

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Abstract: The L-band radiometry data and in-situ ground and snow measurements performed during the 2016/2017 winter campaign at the Davos-Laret remote sensing field laboratory are presented and discussed. An improved version of the procedure for the computation of L-band brightness temperatures from ELBARA radiometer raw data is introduced. This procedure includes a thorough explanation of the calibration and filtering including a refined radio frequency interference (RFI) mitigation approach. This new mitigation approach not only performs better than conventional "normality" tests (kurtosis and skewness) but also allows for the quantification of measurement uncertainty introduced by non-thermal noise contributions. The brightness temperatures of natural snow covered areas and areas with a reflector beneath the snow are simulated for varying amounts of snow liquid water content distributed across the snow profile. Both measured and simulated brightness temperatures emanating from natural snow covered areas and areas with a reflector beneath the snow reveal noticeable sensitivity with respect to snow liquid water. This indicates the possibility of estimating snow liquid water using L-band radiometry. It is also shown that distinct daily increases in brightness temperatures measured over the areas with the reflector placed on the ground indicate the onset of the snow melting season, also known as "early-spring snow".

Keywords: L-band radiometry; microwave remote sensing; snow liquid water; LS—MEMLS; ground permittivity; RFI; Davos-Laret

1. Introduction

Microwave remote sensing is preeminently suitable to achieve quantitative estimates of large-scale terrestrial state parameters. This is partially due to the high transparency of the atmosphere regardless of weather conditions, particularly within the low-frequency bands of the

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Article

Snow Wetness Retrieved from L-Band Radiometry

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Abstract: The present study demonstrates the successful use of the high sensitivity of L-band brightness temperatures to snow liquid water in the retrieval of snow liquid water content W_S from multi-angular L-band brightness temperatures. The emission model employed was developed from parts of the "microwave emission model of layered snowpacks" (MEMLS) coupled with components adopted from the "L-band microwave emission of the biosphere" (L-MEB) model. Two types of W_S retrievals were performed based on L-band brightness temperatures measured over i) areas with a metal reflector placed on the ground ("reflector area"$-T_{B,R}$), and ii) natural snow-covered ground ("natural area"$-T_{B,N}$). The reliable representation of temporal variations of snow moisture is demonstrated for both types of the aforementioned quasi-simultaneous retrievals. This is verified by the fact that both types of W_S retrievals indicate a dry snowpack throughout the cold winter period with frozen ground and air temperatures well below freezing, and synchronously respond to snowpack moisture variations during the early spring period. The robust and reliable performance of W_S retrieved from $T_{B,R}$, together with their level of detail, suggest the use of these retrievals as references to assess the meaningfulness of the W_S retrievals based on $T_{B,N}$. It is noteworthy that the latter retrievals are achieved in a two-step retrieval procedure using exclusively L-band brightness temperatures, without the need for in-situ measurements such as ground permittivity ε_G and snow mass-density ρ_S. The latter two are estimated in the first retrieval-step employing the well-established two-parameter (ε_G, ρ_S) retrieval scheme. The proposed and investigated two-step retrieval approach opens up the possibility of using airborne or spaceborne L-band radiometry to estimate (ε_G, ρ_S) and additionally snow wetness W_S as a new passive L-band data product.

Keywords: snow liquid water content, L-band radiometry, early spring snow, snow wetness, MEMLS, climate change

1. Introduction

Microwave remote sensing is a key tool in the assessment of terrestrial surface state parameters, for example, of the Cryosphere, which has been successfully applied to improve climate predictions

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Article

Snow Density and Ground Permittivity Retrieved from L-Band Radiometry: Melting Effects

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Abstract:

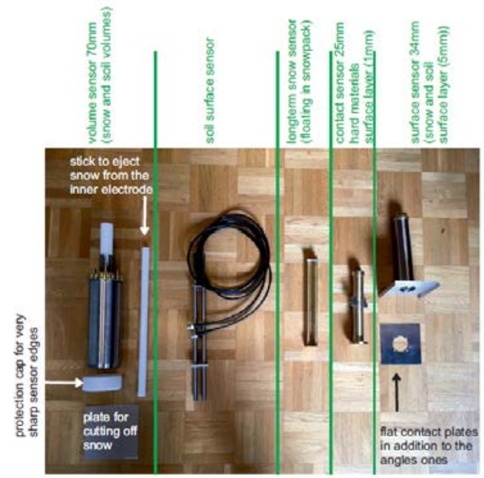
Keywords:

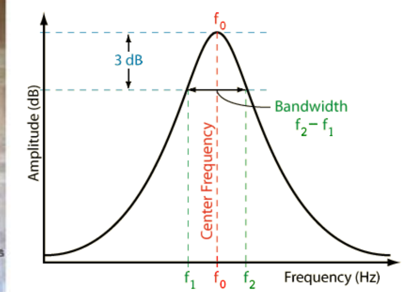
1. Introduction

Microwave remote sensing can provide necessary information on state parameters of the Cryosphere to quantify radiation, heat and mass fluxes through the terrestrial surface layer [1, 2], which are determinative for exchange rates of water between land and atmosphere. As a result, emerging microwave remote sensing techniques turned to a key method to obtain global-scale information on e.g. snow cover [3-5], vegetation optical depth [6, 7], ground freeze/thaw states [8-10], and soil moisture [11-13]. Availability of these recently observable state parameters improves forecasts of climate scenarios and the optimization of corresponding mitigation strategies. For instance, ground freeze/thaw and snow cover play a key role in hydrological, climatological and ecological processes in northern latitudes. Variations in their seasonal cycle have a major impact on the annual carbon balance [14, 15] and vegetation growth [16]. Snow qualities, such as density, influence the energy budget through albedo feedbacks [17], and control thermal insulation of the soil [18], which in turn affects river run-off in the northern hemisphere [19-21] and mountainous [22] regions. Beyond that, weather forecasts, environmental hazard warning, and food production benefit directly from microwave remote sensing data acquired with novel satellite missions. To mention a few of recent space missions dedicated to the observation of the Earth's water cycle, the European Space Agency (ESA) launched the second Earth explorer Soil Moisture and Ocean Salinity (SMOS) mission [12, 23, 24] in 2009, and the Soil Moisture Active Passive (SMAP) mission [25] was implemented by the National Aeronautics and Space Administration (NASA) in 2015.

What's New This Year?

- **The use of in-situ sensors for the measurements of complex dielectric permittivity of snow:** Leads to the measurement of snow liquid water content.
- **Remotely controlled heating system for MORA radiometer:** Avoid snow accumulation and consequent mechanical failure in elevation scan system
- **Additional five SMT-100 in-situ sensors:** More representative measurement of soil freeze/thaw state and temperature over the site.
- **One additional surveillance camera**
- **Plus other improvements…**








An exciting fruitful year …




in a glimpse!