Combined Active and Passive Measurements of Snow, Bare and Vegetated Soils Microwave Reflective and Emissive Characteristics by K_a-Band, Combined Scatterometer-Radiometer System

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1. INTRODUCTION

The retrieval of surface parameters from microwave remote-sensing data requires accurate models for the relationship between the desired geophysical parameters of a target and the observed quantities. As natural surfaces generally are described as random functions, the modeling should involve both electromagnetic and stochastic aspects. Therefore, for an unambiguous and accurate retrieval of land snow cover and soil moistures and classification of soil vegetation a wider set of independent measurements and a synergy of various sensors are welcomed. Since, microwave signals backscattered from and emitted by the soil surface are partially decorrelated from each other and in practice may be considered as independent variables, the synergetic application of microwave radar and radiometer observations represents special interests. For it successful implementation it is important and suitable to develop multi-band complex of polarimetric, combined radar-radiometer systems and to perform multi-frequency, polarimetric, microwave, active-passive combined measurements of snow, bare and vegetated soils under well controlled conditions. On the basis of the acquired data, it will be possible to validate and to improve reflective (scattering) and radiative transfer models, and to develop new methods and algorithms providing the possibility to reach high precision in snow and soil moistures retrieval. Unfortunately, at present time, similar investigations have been carried out only partially [1-4].

In this paper the results of simultaneous and spatially coincident measurements of snow, bare and vegetated soils microwave reflective (radar backscattering coefficient) and emissive (brightness temperature) characteristics angular dependences at 37GHz will be represented.

2. Ka-BAND, COMBINED SCATTEROMETER-RADIOMETER SYSTEM

For these measurements a Ka-band, combined scatterometer-radiometer system (CSRS) was used. The structure and operational features of the utilized system will be discussed in the paper too. The main characteristics of the microwave sensor are presented in the Table below [5,6]:

Central frequency - 37G	Horn antenna with a beamwidth - 7^0
Radar pulse duration - 25ns	Radar receivers noise factor - ~2dB
Radar pulse power - 30mW	Radiometer receiver's noise factor - ~3000K
Radar receiver's bandwidth - ~40MHz	Radar channel's sensitivity at 1s - ~0.1dB
Radiometer receivers bandwidth - ~1GHz	Radiometer Channel's sensitivity at 1s - ~0.3K

The principal peculiarities of the utilized device are its originality in spatio-temporally combining of functionality of microwave active-passive channels of observation, under the condition of short range sensing application of the system. The minimum operational range of the system's scatterometer is 4m, at a far zone condition of sensing.

3. A METHODOLOGY OF MEASUREMENTS AND CALIBRATION FACILITIES

The measurements were carried out from a stationary, quarter-circle shaped measuring platform of 6.5m of radius built over the experimental soil area of sizes of 10m x 3m. The CSRS set on the mobile buggy have smoothly moved along a quarter circle shaped path of the measuring platform. A drive mechanism of the buggy allows stop it at any point of the path along the platform and perform measurements under any angle of incidence from $0\text{-}80^0$. The platform allows research angular dependences of microwave reflective and emissive characteristics of the same area of the observed surface. The measurements were curried out under various conditions of soil and snow moistures, snow depth (thickness), vegetation and surface roughness parameters, snow, air and soil temperatures. In this paper a methodology of experiments' performance and field calibration of the measuring system and the measured results will be discussed too.

4. MEASURED DATA

The measurements of snow, bare and vegetated soils microwave characteristics angular peculiarities were carried out from 9 fixed positions of the buggy, corresponding to the angles of incidence from 80^0 to 0^0, by a step of 10^0. Measured data of the absolute values of snow, soil and vegetation covers radar backscattering coefficients and brightness temperatures (antenna temperatures) at various polarizations allowed estimate and research angular and polarization dependences of snow, bare and vegetated soils microwave characteristics. Angular measurements were carried out for various values of soil and snow moistures, soil and snow surface roughness parameters, soil, snow and air temperatures, snow depth, vegetation dryness, etc, at various atmospheric conditions.

A unique measured data of the changes of dry vegetated soil reflectance and emittance at 37GHz were obtained at an appearance of fire, under the angle of incidence 30^0 and at "vv" and "v" polarizations for radar and radiometric observations, respectively. The measurements were carried out for a while ~5min, when the fire destroyed entirely the vegetation.

5. REFERENCES

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