Geophysical Research Abstracts, Vol. 7, 09960, 2005
SRef-ID: 1607-7962/gra/EGU05-A-09960

Studying the Soil Moisture Heterogeneity with Models

for Active and Passive Microwave Remote Sensing

A. Timchenko
Institute for Radiophysics and Electronics of National

Academy of Sciences of Ukraine, Kharkov, Ukraine

(timchenko@ire.kharkov.ua / Fax: 380 577 441 105 / Phone: 380 577 448 560)

Soil moisture is a key parameter in numerous environmental studies, including meteorological and climatic forecasts. Recent emphases on microwave remote sensing of soil moisture are moving toward a combination of active and passive remote sensing measurements. Promising techniques for soil moisture retrieving is dual-polarized radiometer with multi look angles at L-band. From point of view of the novel techniques possibilities it is important to develop theoretical models that adequately describe the scattering from land surface for active and passive remote sensing and could be served as a base for soil moisture retrieving. The important reason which should be accounted for adequately interpretation of the remotely sensed data is the heterogeneities of the soil moisture distribution in depth.

To address the challenges outlined above, we developed theoretical models for solving a problem of scattering by random rough surface to calculate emissivity and radar cross section. The models are based on the unified approach that allows unified presentation of medium parameters and surface roughness for both active and passive remote sensing.

To consider the scattering from a semi-transparent rough boundary with homogeneous or inhomogeneous medium below we applied the formalism of the functions that are similar to the Greens functions. The resulting expressions produce a general form of the Kirchhoff approximation appropriate to the solution for scattering from rough boundary and inhomogeneous medium. The corresponding solution for the

more simple case of a rough surface bounding homogeneous medium was developed by A.K.Fung (IEM model). The applied approximation allows adequately describing the scattering process at L-band. To characterize the effects of surface roughness the exponential correlation function is applied since as it has been shown the correct description of roughness observed in experiment can be achieved with this function. The inhomogeneous moisture profile is presented as a function, whose parameters variation allow us to account for the natural distribution of the soil moisture content, and, at the same time, obtain the analytical solution for the scattering field.

A series of numerical calculations for various soil moisture profiles have been made. The numerical results of emissivities and radar cross sections are presented at L-band and at multiple incident angles.

From the formulation and numerical results, we found that the behavior of the brightness temperature is a strong function of the changes in values and profile of the dielectric permittivity and, consequently, is a function of the soil water distribution in depth. It was appeared that essential features in emissivities for different polarizations can be observed especially for the functions with a steep gradient. Relative impact on the brightness temperature values is smaller for vertical polarization than for horizontal one. At the same time the dependence of radar cross section are less sensible to the heterogeneity of the medium than emissivity. However, the corresponding processing of the scattered signal with weighting function is resulted in the decreasing the surface roughness impact and dependence of the scattered signal from near-surface water profile becomes pronounced. In general, it has been shown that the heterogeneity can strongly influences the brightness temperature behavior.