THE EFFECT OF HETEROGENEOUS DIELECTRIC PROPERTIES OF THE SOIL ON THE BACKSCATTERED SIGNAL AT DIFFERENT FREQUENCIES

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The importance of polarimetric SAR for the estimation of geophysical soil parameters is highly evaluated. For short wavelengths the main contribution into backscattered signal is given by surface scattering at the rough air-soil boundary. The problem of scattering from the dielectric rough surface is sufficiently investigated. In this case the value of backscattered signal is affected by both – dielectric and geometric properties of the soil. At the low-frequency range, when penetration of electromagnetic waves into the soil body is high, the influence of subsurface soil layers on the backscattered signal can play a considerable role.

In this work the effect of dielectric inhomogeneities within the soil body on the scattering of low-frequency signal (P- and VHF-band) is examined. In order to model the scattering of the signal a three-dimensional finite-difference time-domain method (FDTD) is implemented. According to this method the body of the soil is divided into small (in comparison with the wavelength) cells. Applying the finite differentiating in time and space to the Maxwell's equations the values of electric and magnetic fields components are calculated in every cell. The process of electromagnetic field propagation is running in time. At given plane harmonic incidence wave the value of scattered field in the far zone can be calculated using Green's functions.

The inhomogeneities within the soil body are modeled by setting the values of permittivity and conductivity of each cell. The input parameters of the calculating program are the scale of inhomogeneities (correlation length) relative to the wavelength and the dispersion of fluctuations (variance). Distribution of mean soil moisture along the depth is also set. The magnitude of fluctuations of dielectric constant is proportional to the mean value of dielectric constant. In the following a Monte Carlo analysis for the ensemble of random media is performed.

Another part of the work is dedicated to the comparison of rough surface and volume scattering contributions depending on the wavelength.