Microwave dielectric constant properties of arid soli in the 0.3-3 GHz frequency range

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Abstract

Soil moisture plays the important role in environmental science such hydrology, agriculture, meteorology, etc. Arid soils occupy around 12% of the Earth's ice-free land area. Aridisols are used mainly for range, wildlife, and recreation, because of the dry climate in which they are found. There are several methods to measurement the soil moisture in field and in laboratory experiment such as the dielectric constant and microwave remote sensing, the time domain reflectance (TDR) and gravimetric method. A dielectric constant is the ratio of the capacitance of a material to that of a vacuum also known as the relative permittivity, it response is combined of two parts of real (e') and imaginary (e''), which describe the wave velocity and energy losses. In microwave soil moisture remote sensing determining the soil moisture by measured the value of dielectric constant is important, because the emissivity and back scattering coefficient of soil at each frequency is simulated and then driving the soil moisture on ground surface using satellite data. The dielectric constant depends on the type of material as well as its moisture state. The purpose of the study presented in this paper is to develop expressions for characterizing of the relative dielectric constant of arid soils in the 0.3-1.3-GHz frequency range and it interaction between soil moisture content, soil type and land cover and its application to PALSAR data. The study area is located in arid area of Iran in northern part of central desert. In this study the first tried to took the field sample from top soil (0-15 cm) in homogeneous area in land unit map which provided in environmental GIS data base in arid region of Iran, and then measurement the dielectric constant at microwave remote sensing laboratory. For investigation the characteristics and behaviors of dielectric constant of arid soil with variety of moisture content and soil fraction in 0.3 – 3 GHz frequency range. The measurement of dielectric constant down in 3 steps by change the moisture constant of samples in the natural soil, dried soil and saturated soil. Thus, all data analyzed by integrated to other geo physical data such as land cover and soil type and soil salinity. The result of dielectric constant properties has shown the soil type after the moisture content has most affected on the constant and then soil salinity. Land cover also has good agreement by dielectric constant in change step of soil moisture content even in same soil type, for example sparse vegetation and bare land both was in clay soil type but sparse vegetation recorded higher dielectric constant than bare soil. For soil salinity observed the in same soil type and moisture content saline soil has shown higher constant. Finally by correlation model apply to statistical back scattering model in L band ALOS data in FBD mode (HH, HV polarization) and retrieving the volumetric soil moisture in study area. This work step of research is going on and trying to improving the statistical back scattering model in various land cover and soil type.

Key words: dielectric constant, microwave remote sensing, soil moisture, arid soil.