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Remote Sensing of Soil Moisture using S-band Signals of Opportunity: Model Development and Experimental Validation

Marvin Jesse and James Garrison
Department of AAE, Purdue University

Benjamin Nold
Department of ECE, Purdue University

ABSTRACT

Root zone soil moisture (RZSM) is a vital aspect in meteorology, hydrology, and agriculture. There are currently some methods in passive and active remote sensing at L-band, but these methods are limited to a sensing depth of approximately 10 cm. Observing RZSM (water in the top meter of soil) will require lower frequencies, thus presenting significant difficulties for a spaceborne instrument, because of the required antenna size, the presence of radio-frequency interference (RFI), and competition for spectrum allocations (in the case of active radar). Bistatic radar using Signal of Opportunity (SoOp) (e.g. digital satellite transmitters) provides an opportunity for remote sensing using powerful signals, which already occupies bands allocated for communications.

Recently, a tower experiment has been conducted at Purdue Agronomy Center for Research and Education (ACRE). Linearly polarized measurements were made over bare soil, observing a strong reflected signal. Corn is being planted on the field and measurements will be made throughout the growing season. These measurements focus on measuring the soil properties, such as the weight and dielectric constant, as well as the vegetation characteristics.

KEYWORDS

Remote sensing, Signals of Opportunity, S-band, Signal processing, Fresnel coefficients, Soil moisture, Polarization, Aliasing