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Using P-band Signals of Opportunity Radio Waves for Root Zone Soil Moisture Remote Sensing

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ABSTRACT

Retrieval of Root Zone Soil Moisture (RZSM) is important for understanding the carbon cycle for use in climate change research as well as meteorology, hydrology, and precision agriculture studies. A current method of remote sensing, GNSS-R uses GPS signals to measure soil moisture content and vegetation biomass, but it is limited to 3-5 cm of soil penetration depth. Signals of Opportunity (SoOp) has emerged as an extension of GNSS-R remote sensing using communication signals. P-band communication signals (370 MHz) will be studied as an improved method of remote sensing of RZSM. P-band offers numerous advantages over GNSS-R, including stronger signal strength and deeper soil penetration. A SoOp instrument was installed on a mobile antenna tower in a farm field at Purdue University in West Lafayette, IN. An additional half-wave dipole antenna, as well as corresponding modifications to the experiment's front-end box, was included to capture horizontally-polarized reflected P-band signals throughout a corn growth season. By measuring the reflected signal power off the soil over time, soil moisture and above-ground biomass can be measured. Soil moisture and vegetation biomass change the soil's dielectric reflection coefficient and thus affect its reflectivity properties. It is expected that there will be strong correlation between reflected signal strength and soil moisture. Data will be compared against soil moisture measurements from in-situ soil sensors. The data obtained will be used to verify existing analytical soil moisture and above-ground biomass models. In addition, these results will be used to build an airborne and/or space-based remote sensing instrument.

KEYWORDS

Remote Sensing, SoOp, Soil Moisture, Instruments, P-Band