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Experimental testing and validation of P-band bi-static remote sensing of soil moisture in 137-138MHz range

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ABSTRACT

Remote sensing using readily available communication signal transmitted by ORBCOMM satellites at very high frequency (VHF) range (137-138MHz) is a promising method for detecting the root zone soil moisture content. The radio wave reflectivity of soil is strongly correlated to soil moisture content. Therefore, if we were able to measure the reflectivity, we might be able to estimate the soil moisture content. In this preliminary study, we analyze direct signal data from the satellites to investigate and verify communication channels in frequency range of interest and their characteristics (bandwidth, pattern, etc.). The analysis of direct signal data is also used for calibrating signal collection systems and compensating for the subtle differences of systems. After comparing the satellite geometry and spectrum from raw signal, we verified that ORBCOMM has 13 channels in our frequency range of interest. It was also verified that among these 13 channels, the channel with center frequency at 137.56MHz is a public channel shared by all satellites and is not suitable for reflectivity computation in that multiple satellites could be in sight by our antenna and the signal reflecting region cannot be determined. In our long duration (~12 hours) analysis, we observed the visible duration and period of the satellites. Conclusively, using ORBCOMM communication signal for sensing the soil moisture is viable. Further study is needed to build up model that relates soil moisture content to reflectivity and a lot of technical issues need to be resolved.

KEYWORDS

Soil moisture content, VHF, ORBCOMM, remote sensing