32nd URSI GASS, Montreal, 19-26 August 2017

Use of Microwave Signals of Opportunity for Root Zone Soil Moisture Retrieval

Mahta Moghaddam[1] and Amir Azemati[1]
[1] Microwave Systems, Sensors, and Imaging Lab (MiXIL)
Ming Hsieh Department of Electrical Engineering
University of Southern California
mahta@usc.edu

Extended Abstract

Quantifying stores of fresh water is of ever-increasing importance, because of the rapid increase in world population while the relatively small supplies of fresh water remain fixed at best. It is believed that only about 3% of the world's water is fresh water, but this amount is subject to uncertainty. Furthermore, the locations of much of the fresh water stores are not well known, especially those that are obscure and below the surface. Besides surface water (lakes and rivers), soil moisture, ground water, and snow are the principal stores of fresh water. The principle of microwave remote sensing has long been established as a means to quantify water resources because of the strong dependence of electromagnetic scattering in the microwave regime to the presence of water. But numerous technical challenges remain in developing an affordable and capable water observing system for pervasive and continuous observations. The traditional radar systems, though powerful and capable, are typically rather expensive to build and operate. In this talk, we focus primarily on quantifying soil moisture through the use of low-frequency (L-band and P-band) signals of opportunity (SoOP) such as GPS, FM radio, and Military Communication Satellites. We present an operations scenario for the opportunistic and shared use of the microwave spectrum to devise a novel soil moisture sensing systems. We present a bistatic microwave scattering model that can be used to simuilate scattering from vegetated terrain for SoOP at different frequencies. We then describe how the bistatic model is used to retrieve soil moisture from surface to the root zone from these bistatic observations using an optimization method. The capabilities of the bistatic retrieval method are compared to those of the conventional monostatic case.