Developing Virtual Soil Moisture Sensor (VSMS) Using Optical and Microwave Satellite Imagery for High Resolution Soil Moisture Mapping

A. K. M. Azad Hossain, Greg Easson and Robert Holt
University of Mississippi Geoinformatics Center
geasson@olemiss.edu

Goals

To develop a virtual soil moisture sensor to estimate, monitor and map surface soil moisture at high resolution through a combination of microwave and optical remote sensing data.

Project Overview

Soil moisture is an important hydrologic parameter in global land-atmospheric models. Remote sensing has been widely used to detect and monitor soil moisture for many years. However, mapping soil moisture at both high spatial and temporal resolution has not been possible due to lack of sensors with these combined capabilities. To overcome this issue we are conducting a research to develop a virtual soil moisture sensor (VSMS) for operational use in mapping soil moisture at high resolution. Selected parts of Nash Draw, in southeastern NM, has been selected as the field site to develop and test the application of the proposed VSMS.

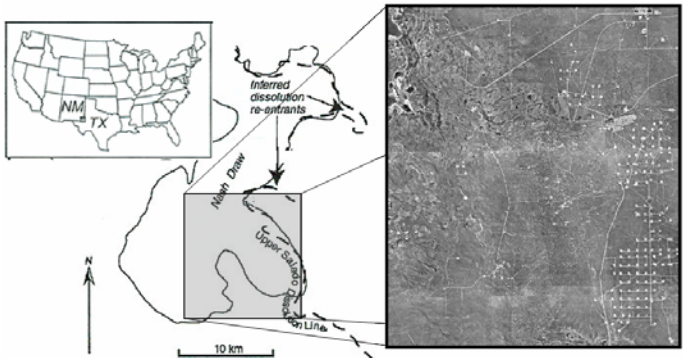

Figure 1: Study Site

Approach

We are conducting this research in a multistage approach. In the first stage we will estimation soil moisture (at 1 km spatial resolution) using Moderate Resolution Imaging Spectroradiometer (MODIS) data with Vegetation Index (VI)-Land Surface Temperature (LST) Triangle method (Universal Triangle method) in conjunction with the soil moisture estimated by Advance Microwave Scanning Radiometer (AMSR-E) on Aqua.

In the second stage we will estimate soil moisture (at 10 m spatial resolution) using Radarsat 1 fine imagery and near real-time field soil moisture measurements. After the successful completion of the first and second stage analyses we will generate our virtual soil moisture sensor (VSMS) using MODIS derived soil moisture and SAR derived soil moisture. We will evaluate the performance of VSMS by mapping the spatio-temporal variation of soil moisture in selected parts of Nash Draw.

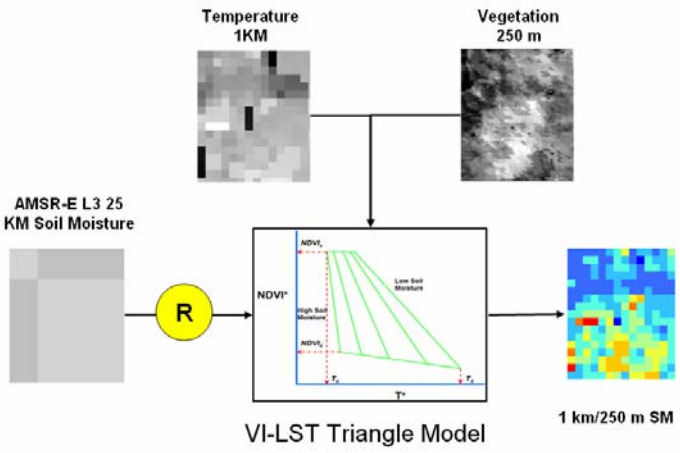

Figure 2: MODIS derived soil moisture estimation

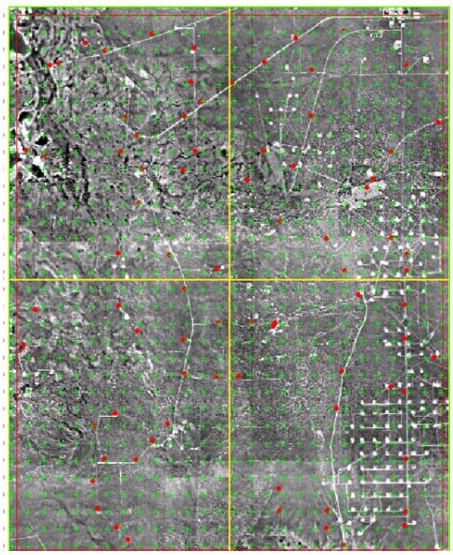

Figure 3. Distribution of collected soil sample locations

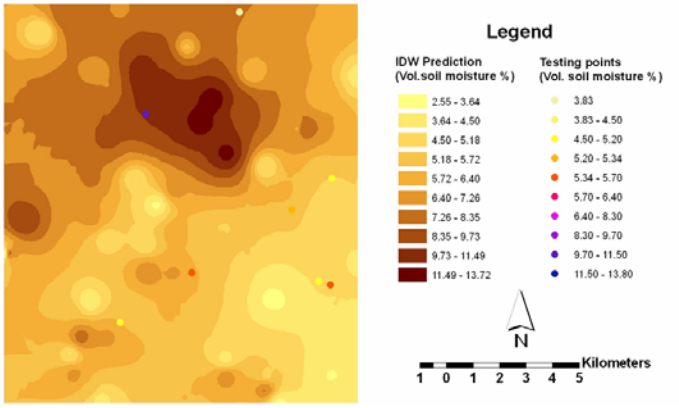

Figure 4. Soil moisture prediction surface

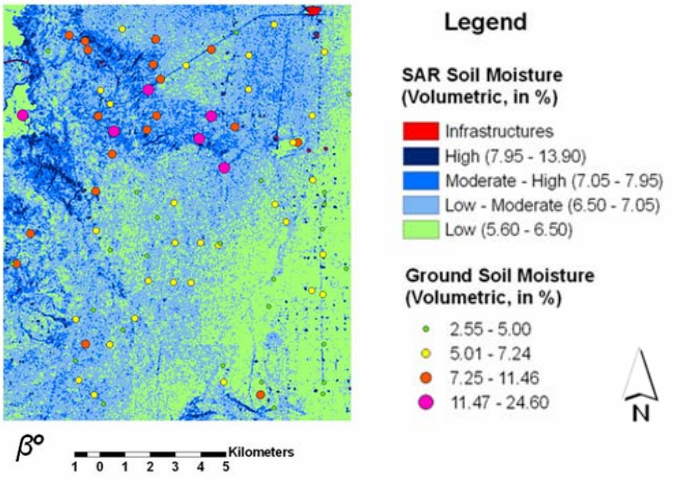

Figure 5. Soil moisture estimated by radar imagery

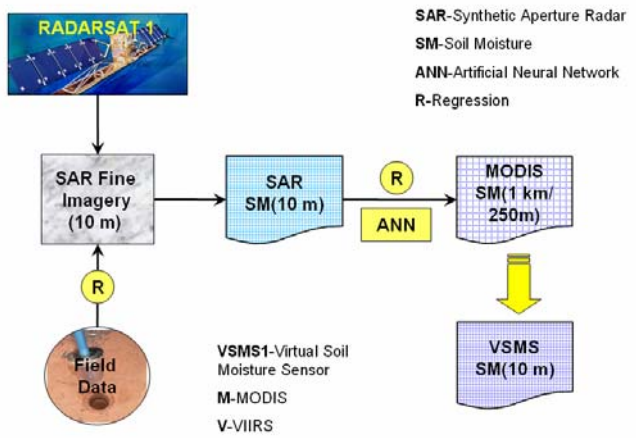

Figure 6. Generation of Virtual Soil Moisture Sensor

The MODIS based soil moisture estimation is completed (Figure 2) and radar based soil moisture estimation is in progress (Figure 6). There was not a strong relationship between the ground measured soil moisture and radar backscatter values by simple linear regression for the entire study site. So, the produced numerical model didn't produce ground representative soil moisture distribution. However, we found very strong relationship between soil moisture and backscatter values in the bare soil. We also found good agreement between soil moisture and backscatter values in most of the high and low moisture areas of the study site. However, comparison with the field derived soil moisture also indicates that other sensor parameters and terrain characteristics should be included in the numerical model for the whole study site to improve accuracy.

EXPECTED IMPACTS

Successful completion of this research would provide soil moisture data at 10 m spatial resolution daily, which would improve soil moisture studies significantly by enabling its uses at more local scale with better accuracy.

Collaborators

ITD-SSAI-SSC
Alaska Satellite Facility (ASF), Fairbanks, AL
Sandia National Laboratories, Carlsbad, NM
Dr. Dennis Powers, El Paso, TX

Contact Information

For more information please contact Greg Easson.
Email: ***geasson@olemiss.edu***
Phone: (662) 915-5995
www.mmri.olemiss.edu – *umgc@olemiss.edu*