ABSTRACT

Pignotti, Garett W. M.S.E., Purdue University, August 2012. Characterizing Remotely Sensed Soil Moisture Over an Agricultural Catchment. Major Professor: Melba Crawford.

As global population and subsequent demand on the provisioning services of natural systems continue to rise, it becomes increasingly important to identify creative and pragmatic solutions to meet these needs while minimizing environmental degradation. Of particular importance are agricultural ecosystems, among the most widespread anthropogenically driven and managed systems. Soil moisture is critical to characterizing many atmospheric, hydrologic, and land-surface interactions relevant to monitoring and modeling such systems. However, soil moisture is spatially and temporally highly variable, and is thus challenging to measure in a meaningful, representative manner with point based *in situ* sensors. Alternatively, remote sensing in the microwave region of the electromagnetic spectrum is capable of providing all weather, day/night gridded global soil moisture measurements. Unfortunately the spatial resolution of standard passive microwave based products is too coarse (~40 km) for most hydrologic applications (1-10 km). One approach to overcome this limitation is to combine soil moisture maps with fine scale ancillary remote sensing data to downscale soil moisture data products.

This research focused on evaluating two variants of a downscaling algorithm applied to soil moisture products derived from data acquired by the SMOS (Soil Moisture and Ocean Salinity) satellite over a sensor network in the Upper Cedar Creek Watershed in northeastern Indiana. Results in this region indicated that while the accuracy of standard SMOS products does not meet the stated mission objectives (0.068 m^3/m^3 vs 0.04 m^3/m^3), derivative downscaled data did

not degrade root mean square difference nor correlation with *in situ* measurements. Additionally, potential deficiencies in the downscaling models were identified. Overfitting was detected in one approach, and both models were inadequate for tracking temporal variations associated with vegetation data. A qualitative evaluation of within network variability and auxiliary soil moisture data sources was also performed.

Comparison of remotely sensed data to ground networks provided insight into sensor derived response over a heterogeneous area and the potential for exploiting such relations. By refining downscaling approaches, it should be possible to better resolve the scale at which soil moisture processes act. Specific to agricultural applications, accurate soil moisture estimations can improve yield prediction, forecast drought and floods, and help to improve water management practices.