Downscaling of Advanced Microwave Scanning Radiometer (AMSR-E) Soil Moisture Using Thermal Sensors and a Physically-Based Model

C. Hsu[1], R. Zamora[2], L.E. Johnson[3] and T. Schneider[2]

[1]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309; 303-497-6526, E-mail: chsu700@yahoo.com
[2]NOAA Earth System Research Laboratory, Boulder, CO 80305
[3]University of Colorado in Denver, Denver, CO 80202

A deterministic approach for downscaling 25 km resolution AMSR-E daily soil moisture data was developed from 1 km resolution Moderate Resolution Imaging Spectroradiometer (MODIS) data. The downscaling relationship was built on creating an association between soil evaporative efficiency and near surface soil moisture through a physically-based scaling function. This function was created by bringing together soil properties, a Von Karman wind turbulence model, and aerodynamic resistance to form a semi-empirical parameter. For the soil property, percent clay and bulk density was extracted from Soil Survey Geographic (SSURGO) data to infer published lab findings for application. Aerodynamic resistance was calculated from wind speed measurements at wind gage height given soil roughness. A vegetation index and surface temperature data derived from MODIS was used to estimate soil temperature and, subsequently, to calculate soil evaporative efficiency. In this process, MODIS was used to downscale low resolution microwave derived soil moisture to the 1-km resolution. To account for the lower soil moisture sensitivity of the MODIS surface temperature and the poor capability of AMSR-E to differentiate soil and vegetation signals, saturated hydraulic conductivity values extracted from the SSURGO database were used to explore its association with soil moisture dynamics in the drying phase.

The research site encompasses the Babocomari River and Walnut Gulch River watersheds in Arizona. The soil moisture data from the NOAA Hydrometeorology Testbed soil moisture network and from the USDA Walnut Gulch Experiment Watershed are being used for model validation.

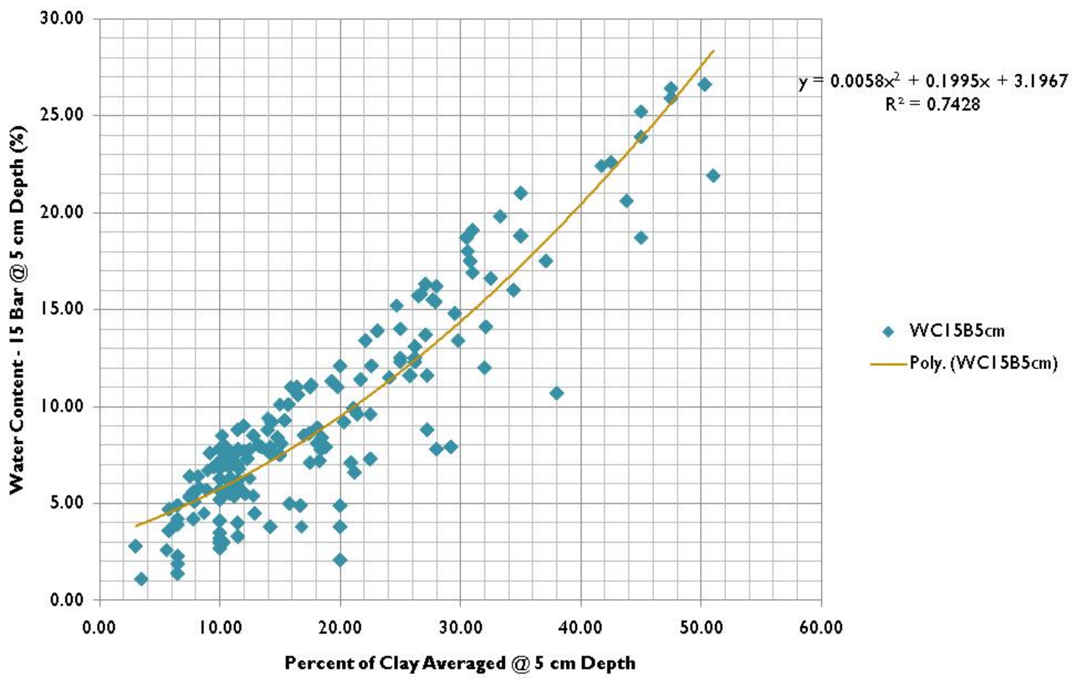

Figure 1. Percent Clay is found to be strongly related to water content averaged at 5-cm depth. Published laboratory experimental data for soils having different Bulk Density and Percent Clay were used to support the downscaling procedure.