Assessing Near Surface Soil Moisture Variability for Improved Sampling

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Abstract. Moisture in the soil is a critical characteristic for the growth of vegetation, hydrology, and atmospheric fluxes. Its variability can influence the biological and physical processes, and can make measurements for the ground-truth of remote sensing difficult. This remote sensing of near surface soil moisture is often with passive microwave, which is typically a 25 km pixel, so variability can be large. While an active microwave pixel is much finer, it often includes different soil types and even different landscapes. We used Time Domain Reflectometry (TDR) as an in-situ technique to measure soil moisture at a high resolution. This study uses soil moisture data collected at a 1-meter resolution with TDR from three 100-meter long transects near the Colorado State University Mountain Campus during May and June of 2016 and 2017, totaling 30 plot-days. Different methods were applied to subset each transect to compare the spatial and temporal soil moisture variability, in part to determine an optimal sampling strategy. These methods are 1) equal spacing sub-setting, which cuts a transect into equal-length segments and select the data points at the same position in each segment, 2) sequent sub-setting, which continually adds the next data point into selection, starting from one end of a transect, and 3) random sub-setting, which randomly selects data points from a transect. For an acceptable difference threshold from the mean of 5%, spacing sampling requires fewer measurements to obtain a reasonable estimation of the true mean than sequent and random sampling in most situations. Sequent and random sampling can also be efficient when the dispersion of data (measured by correlation of variance and autocorrelation) are low.