# Multi-year soil moisture predictability in the Community Earth System Model-Decadal Prediction-Large Ensemble (CESM-DP-LE) Experiments

Author: Sanjiv Kumar (Auburn University)

Soil moisture predictability on seasonal to decadal (S2D) continuum timescales over North America is examined from the Community Earth System Modeling (CESM) experiments. The effects of ocean and land initializations are disentangled using two large ensemble datasets – initialized and uninitialized experiments from the CESM. We find that soil moisture has significant predictability on S2D timescales despite limited predictability in precipitation. On sub-seasonal to seasonal timescales, precipitation variability is an order of magnitude greater than soil moisture, suggesting land surface processes, including soil moisture memory, reemergence, land-atmosphere interactions, transform a less predictable precipitation signal into a more predictable soil moisture signal. However, when averaged annually, both precipitation and soil moisture show similar predictability that is significant over multiple years suggesting predictability from ocean-atmosphere teleconnections on those timescales. Both these predictability attributes for soil moisture, either on a sub-seasonal to seasonal or yearly timescale, contribute to its predictability on S2D timescales and potential application for long-term drought forecasting. We demonstrate that land surface initialization significantly improves soil moisture prediction over S2D timescales, and provides a scientific basis for developing observationally-constrained land surface initialization for decadal prediction experiments.