Growing-Season Soil Moisture Prediction in Regional and Global Models

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Introduction

- Soil moisture prediction in week-month advance is challenging
- Such sub-seasonal scale falls in the (acknowledge) gap between short-term weather forecast and long-term climate projection.
- Here we evaluate the prediction skills of atmosphere-land surface coupled models in sub-seasonal scale under various settings.

Outline

Simulations/forecast

- Weekly, monthly, and 10-year

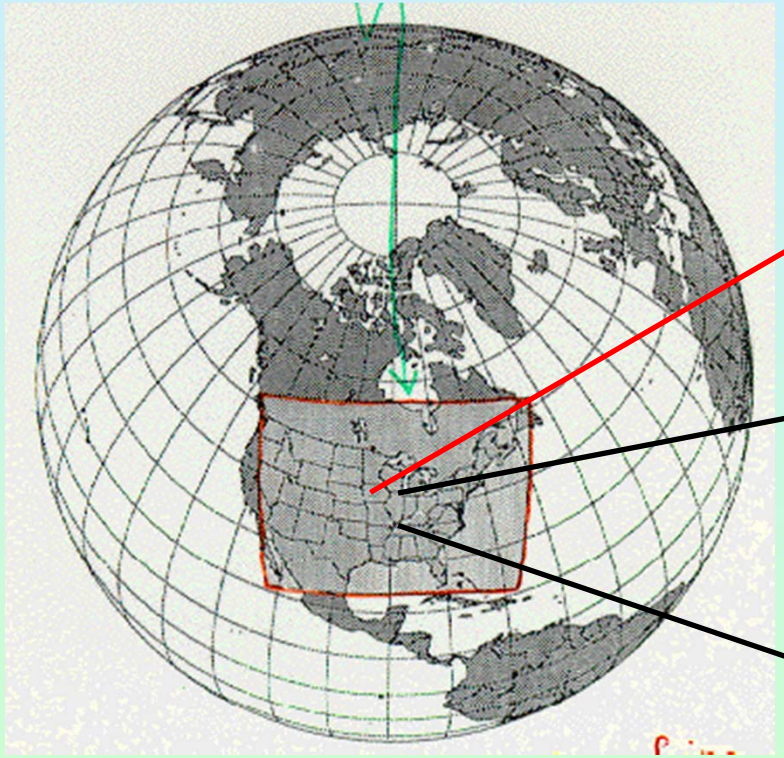
Evaluation:

- ISU Agricultural Experimental Station, Ames, Iowa (93.63°W,42.03°N)
- Illinois Climate Network – soil data (19 sites)

Meteorological and land surface Models

- Regional model WRF/MM5 and RegCM
- Global GSF

GCM/RCM meteorological model domains and soil moisture sites

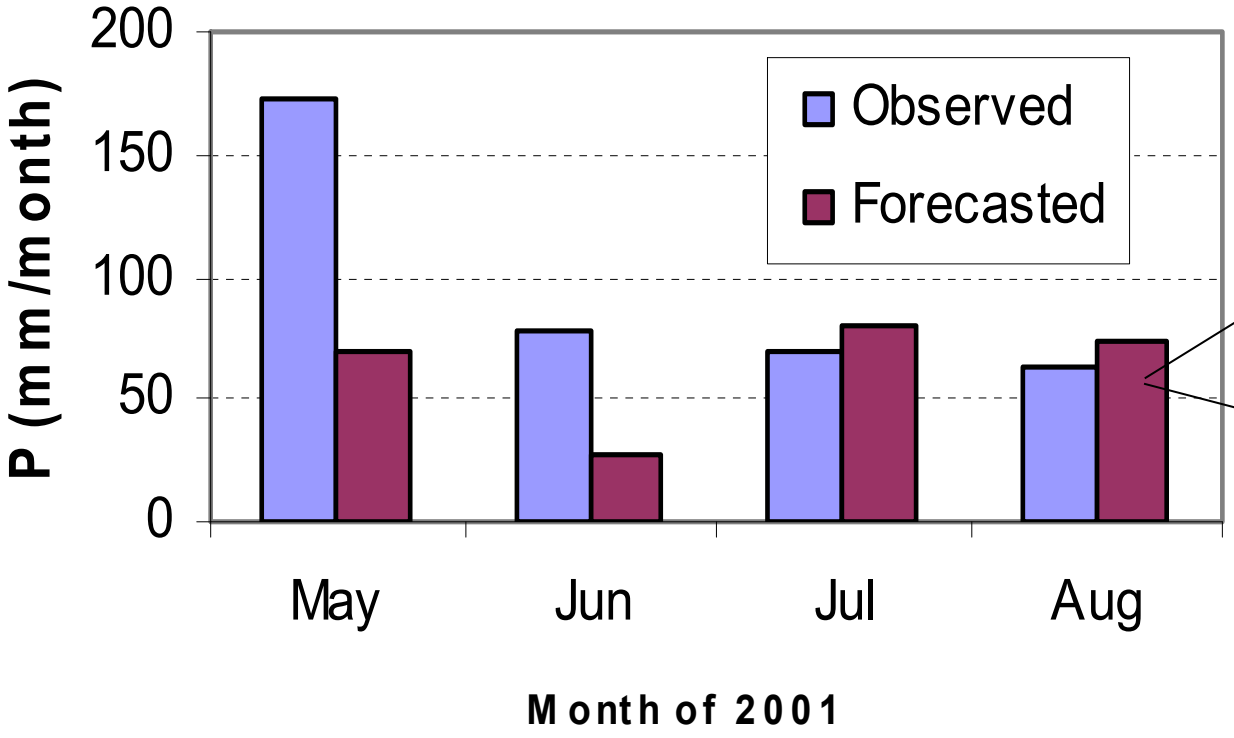


ISU agricultural expt. station

http://www.meteor.iastate.edu/gccourse/model/basic/images/image13.gif

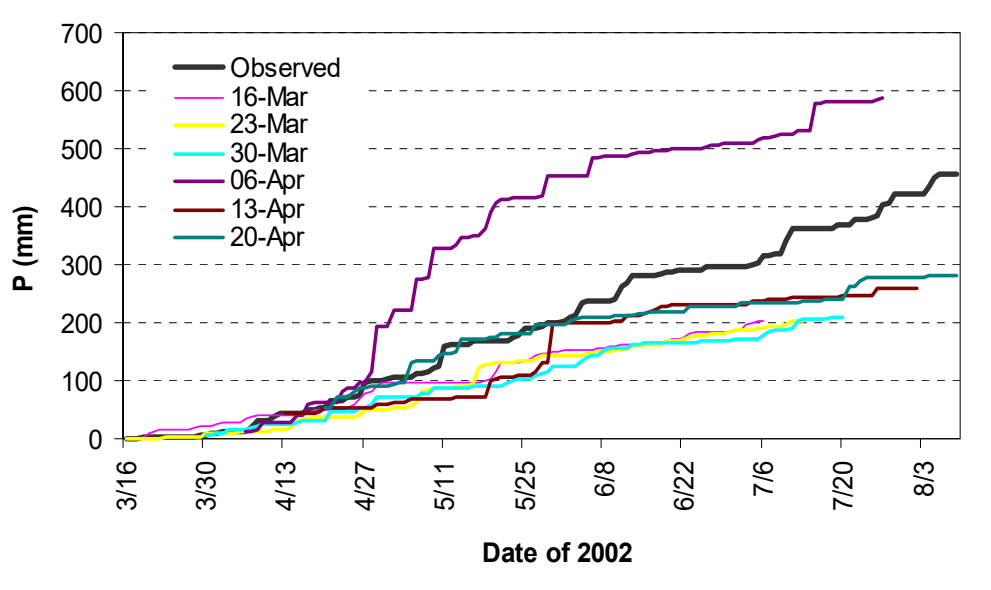
https://farms.ag.iastate.edu/

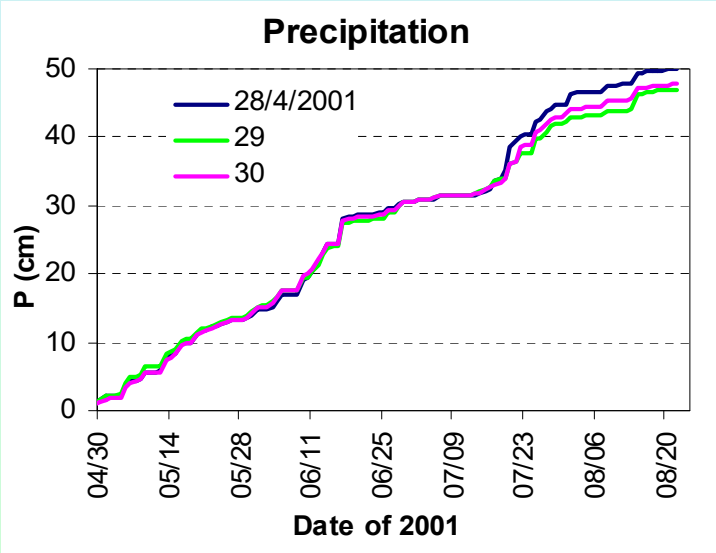
Illinois Climate Network: soil data

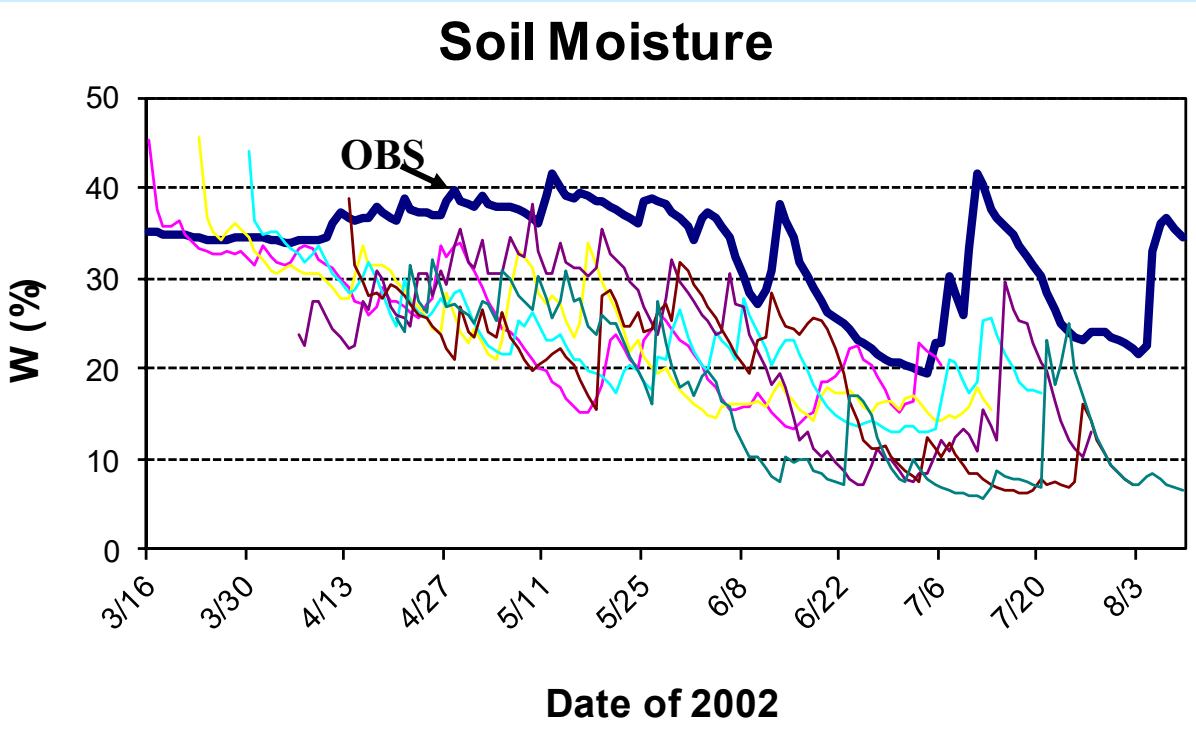


Validation of the 2001 growing-season precipitation prediction (averaged over Iowa).

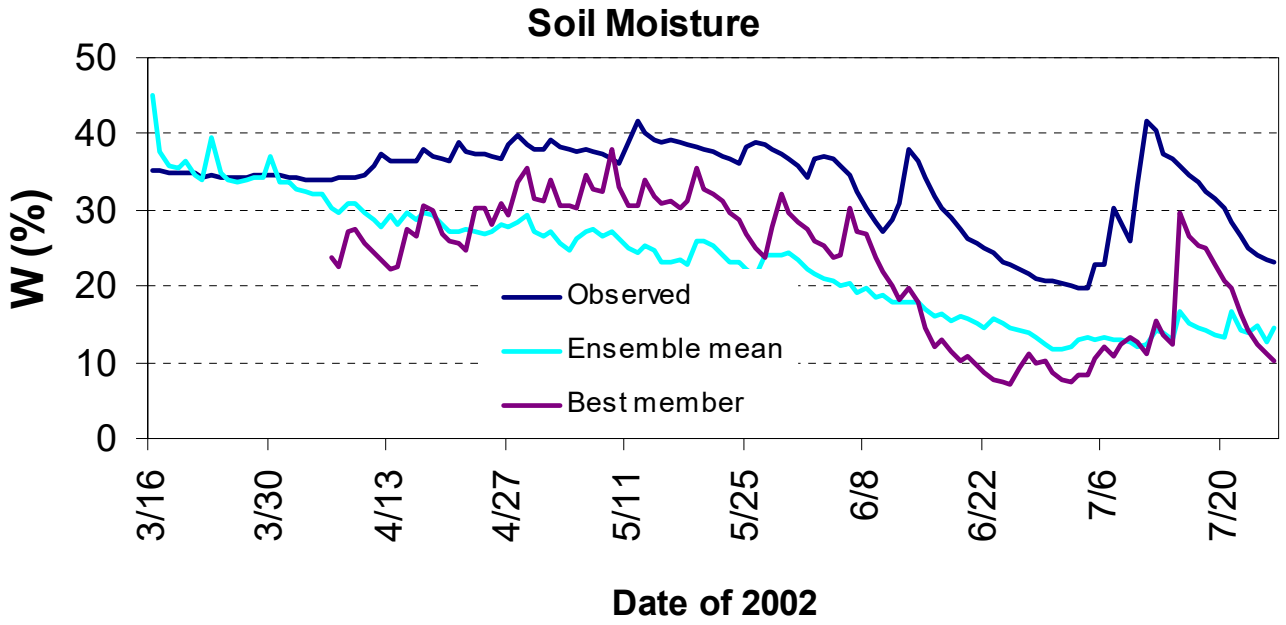
Observed and forecasted cumulative precipitation averaged over Iowa (initialized at week/day lag)



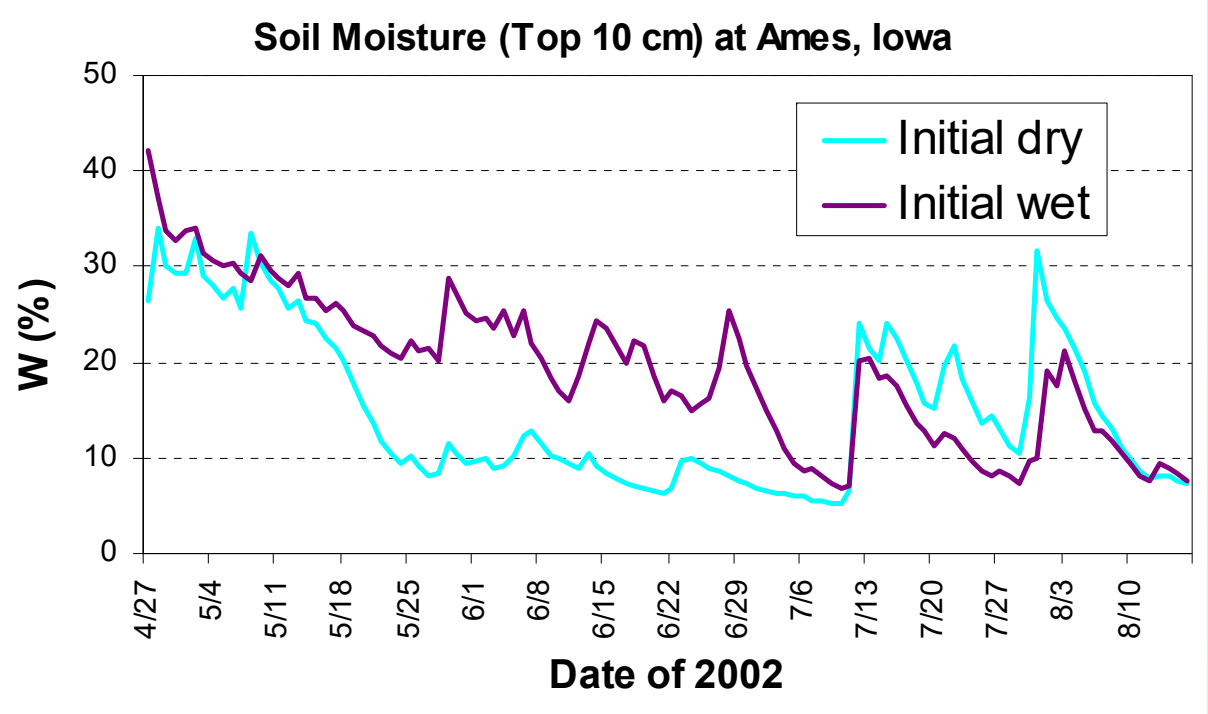


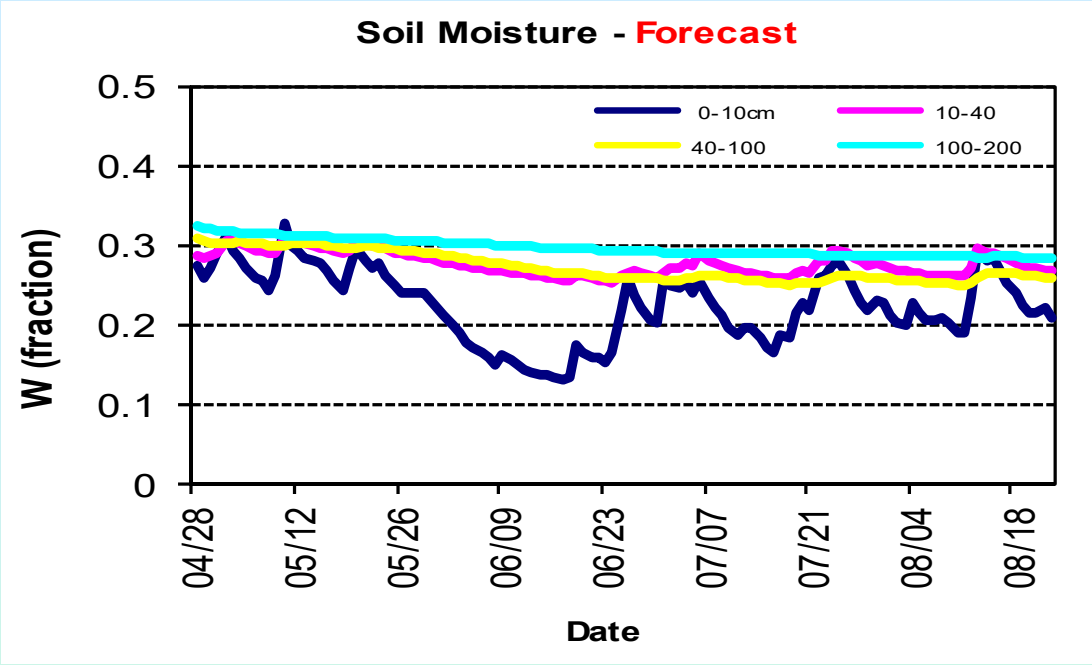


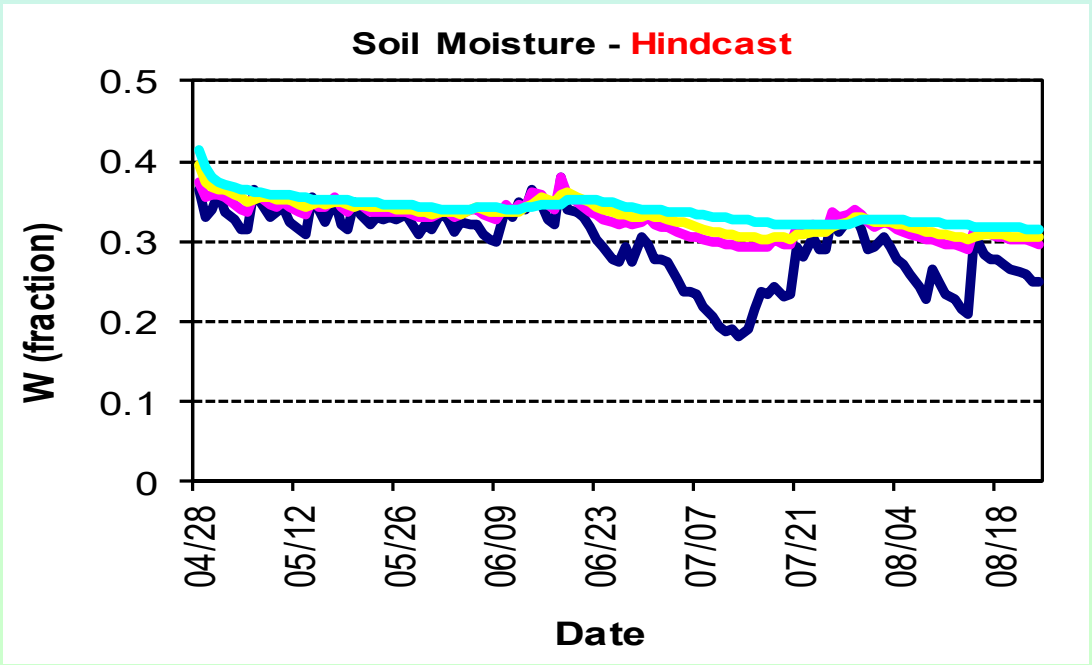
Forecated volumetric soil moisture in top 10-cm layer



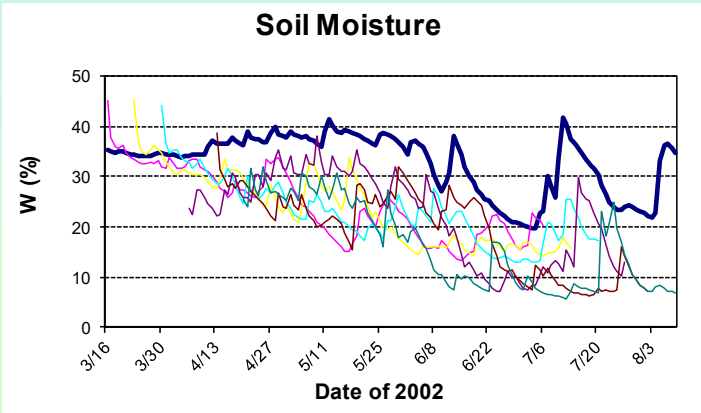
Effect of soil moisture initialization



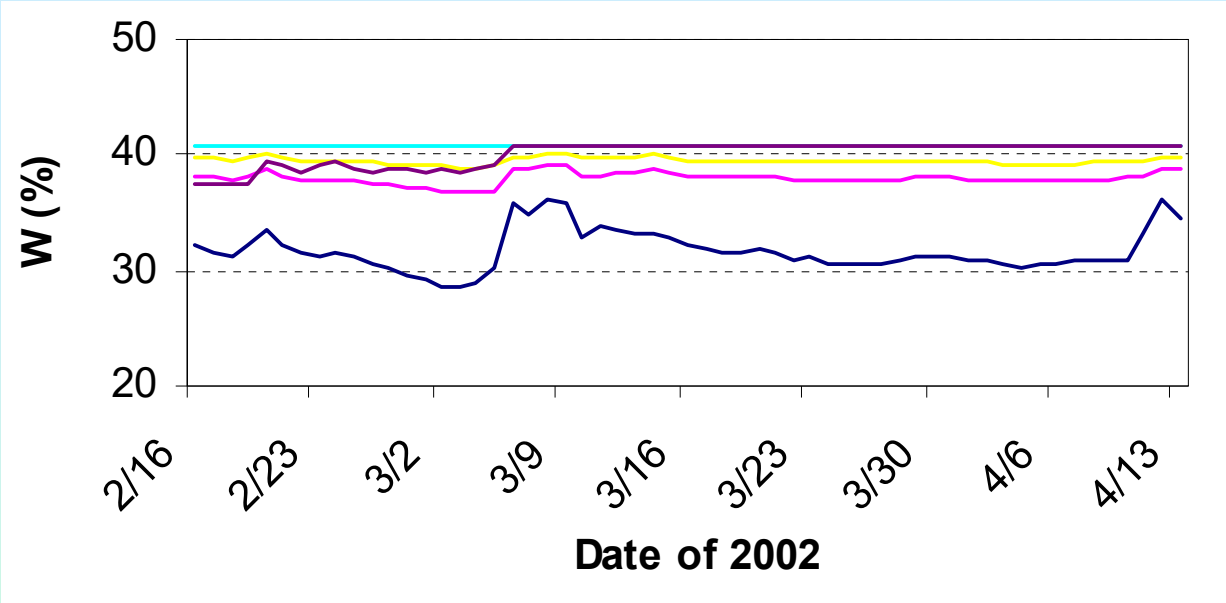




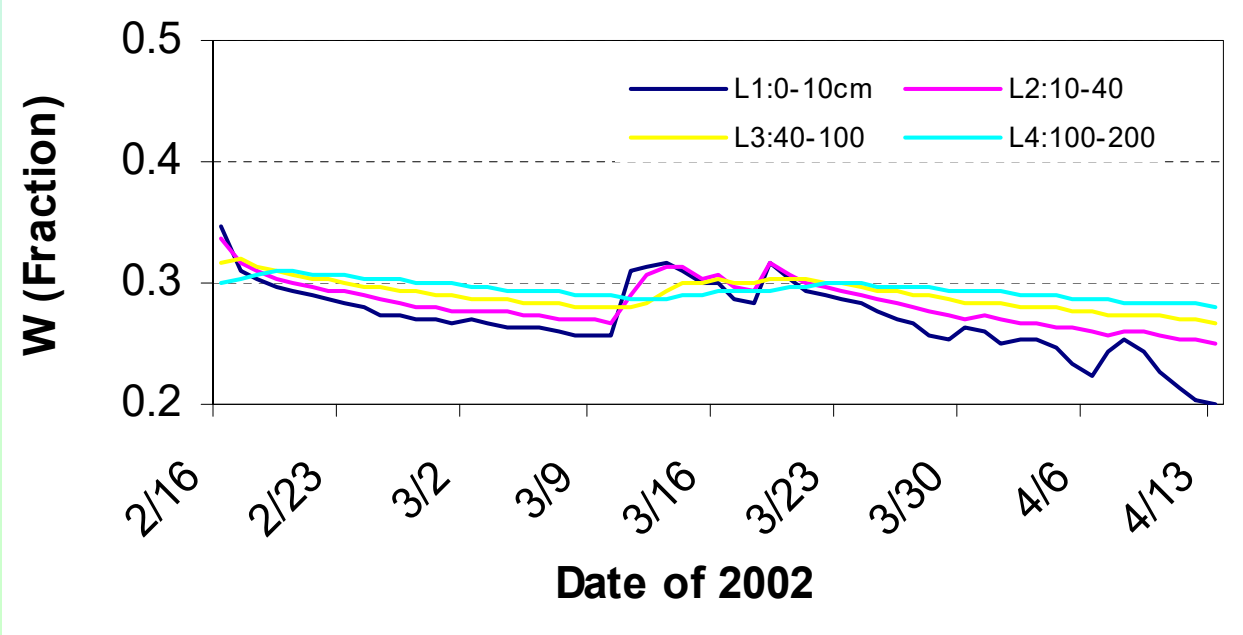
Comparison of forecast vs. hindcast soil moisture at Ames, IA



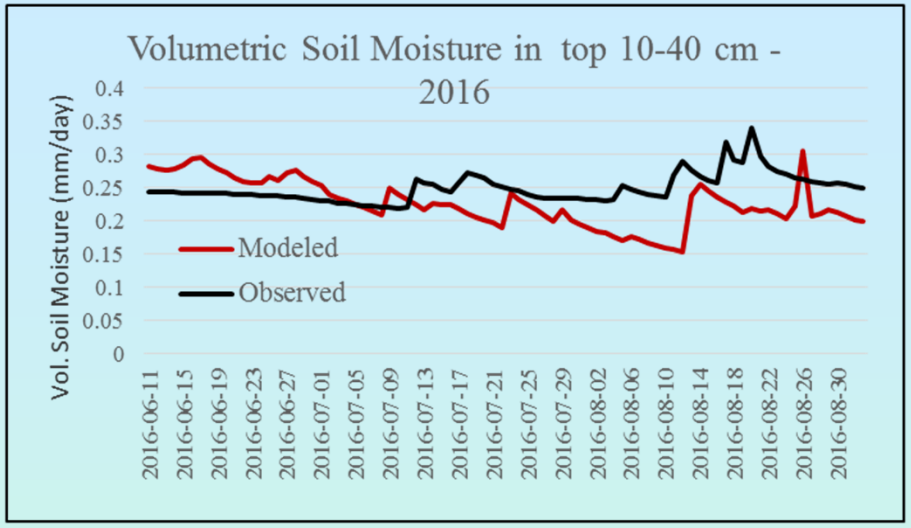
Validation of soil moisture forecast at Ames



Observed

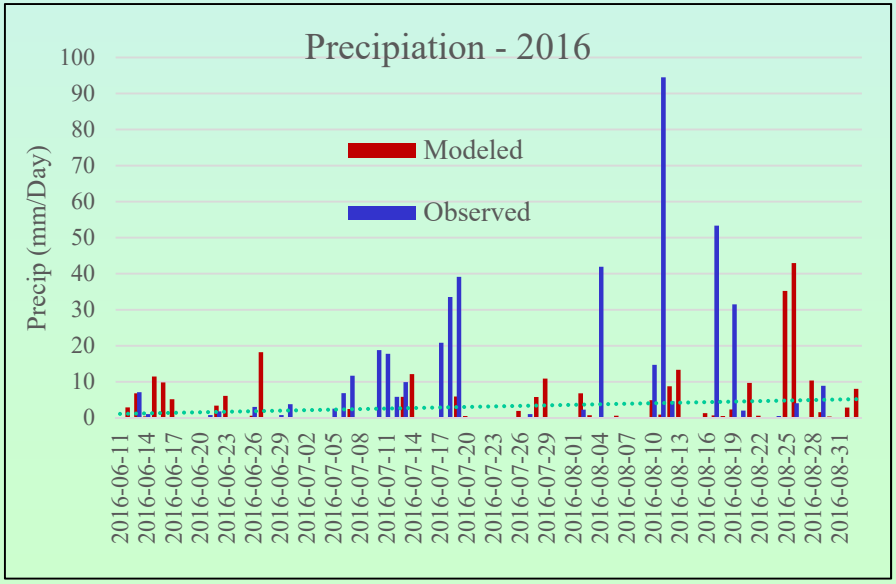


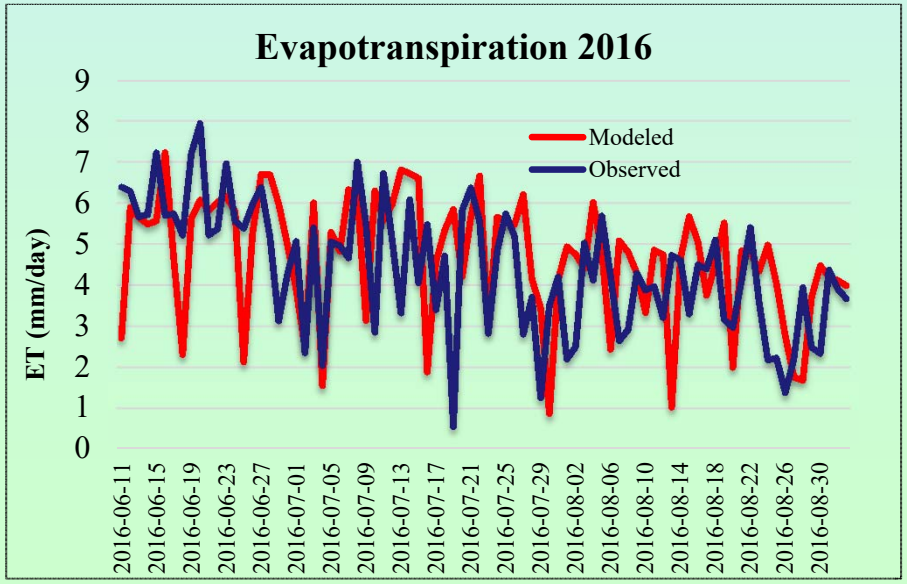
Forecast

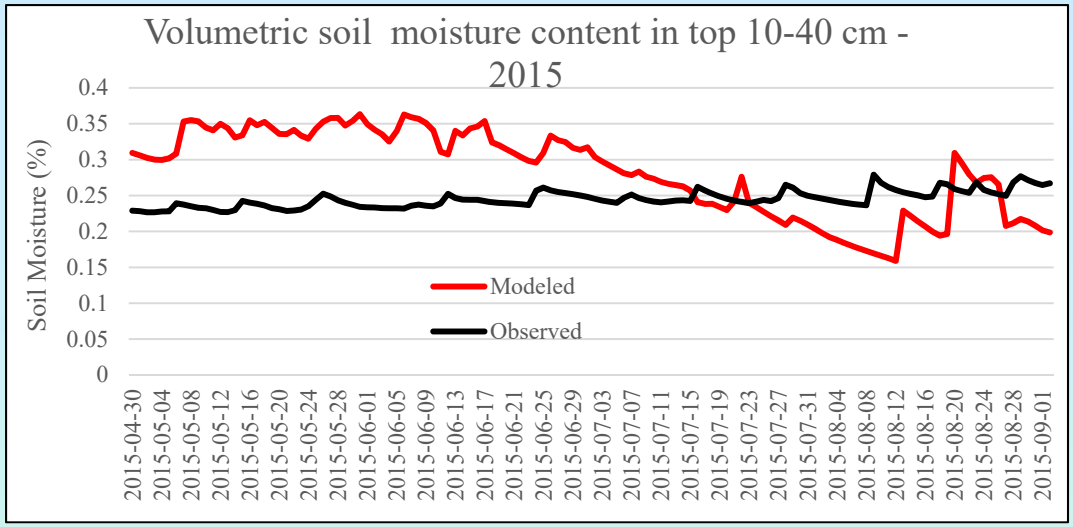


GFS forecast - weekly

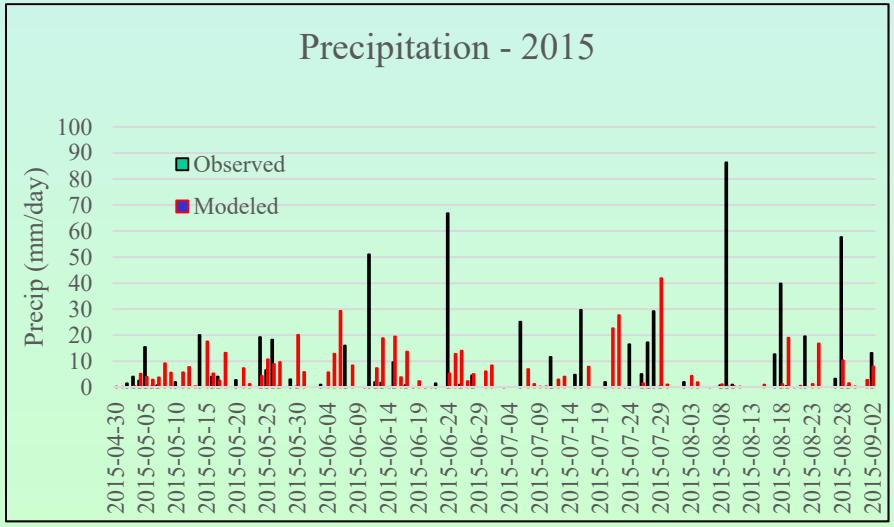
Growing season soil moisture budget at Ames, Iowa - 2016

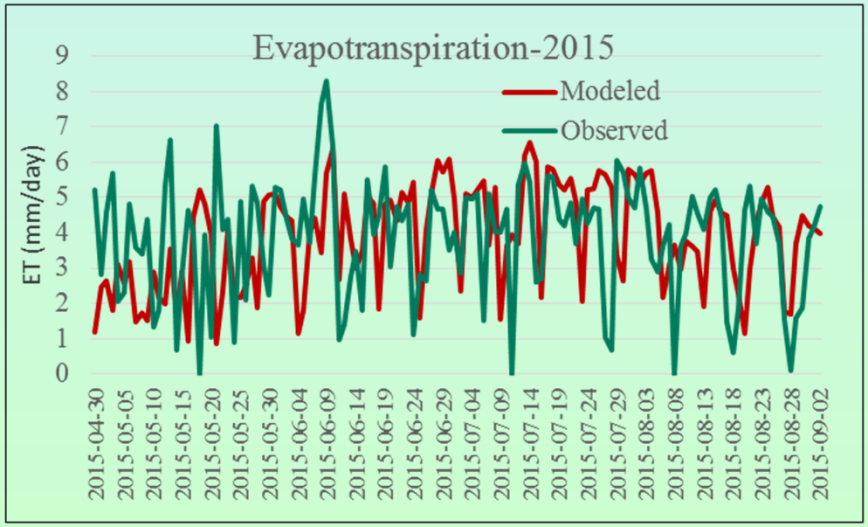




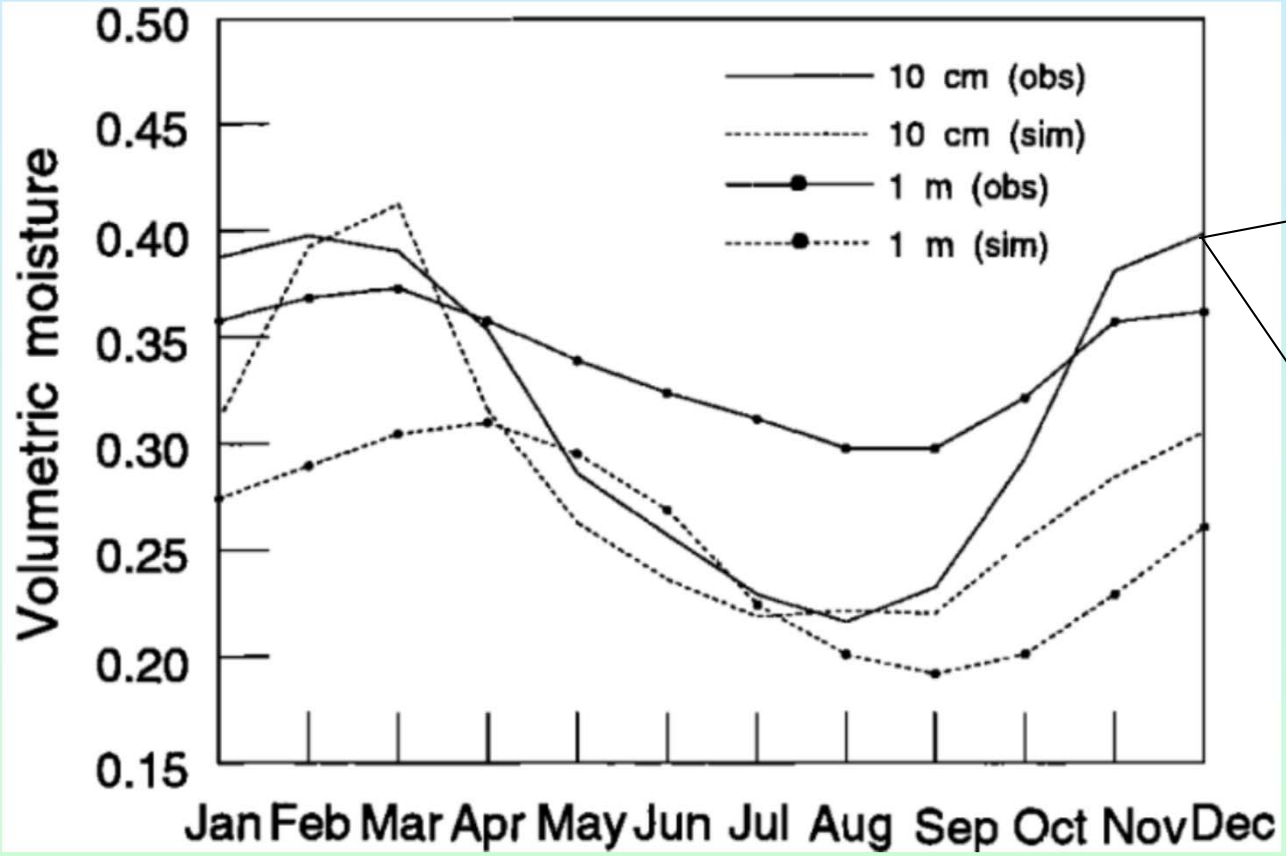


Growing season soil moisture budget at Ames, Iowa - 2015



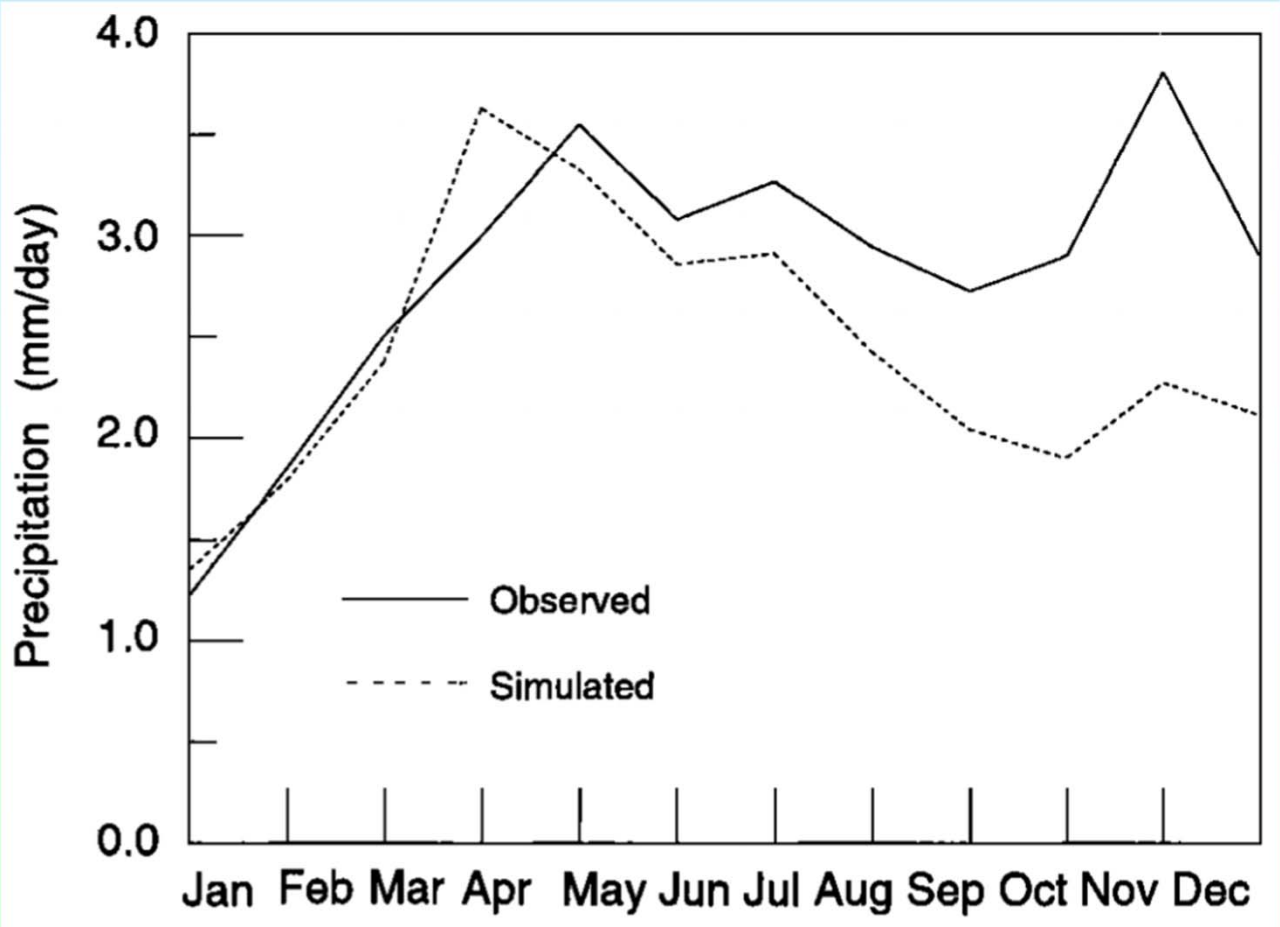


Ten-year continuous simulation (1979-1988) – soil moisture



Annual composite of observed and simulated monthly volumetric soil moisture for 1981-1988 averaged over 19 observing sites in Illinois .RegCM2 simulation using initial and boundary conditions from the NCEP/NCAR reanalysis.

Ten-year continuous simulation (1979-1988) - precipitation



Summary & Discussions

- Soil moisture forecast/simulation skills of Regional/global models are examined over weekly-decadal scales.
- Weekly ensembles can predict soil moisture better than single member (week).
- Evapotranspiration is predicted better than precipitation whose temporal variability is too small due to model's "drizzling issue"
- Spring soil drying down is captured well, but fall recharge is not.