Growing-Season Soil Moisture Prediction in Regional and Global Models

Zaitao Pan

Dept. of Earth & Atmospheric Sci.
Saint Louis University
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.
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

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

ISU agricultural expt. station

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

Soil Moisture (Top 10 cm) at Ames, Iowa

Date of 2002

W (%)
Comparison of forecast vs. hindcast soil moisture at Ames, IA
Validation of soil moisture forecast at Ames

Observed

Forecast
Growing season soil moisture budget at Ames, Iowa - 2016

GFS forecast - weekly

Precipitation - 2016

Evapotranspiration 2016
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.