Evaluation of CFSv2 for seasonal hydrologic forecasting

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National Centers for Environmental Prediction (NCEP) has upgraded its operational seasonal forecast system with Climate Forecast System version 2 (CFSv2), which provides potential opportunities and many implications to the hydrologic forecast community. A preliminary evaluation of CFSv2 for precipitation and surface air temperature shows significant improvement from CFSv1 for month-1 forecasts. In order to investigate whether or how much of the improvements from climate forecast model propagate into seasonal hydrologic predictions, we downscale the precipitation and temperature reforecasts from CFSv1 and CFSv2 to 1/8 degree over the conterminous United States by using a Bayesian method, and the downscaled fields are then used to drive the VIC land surface model to provide ensemble hydrologic reforecasts, with initial hydrologic conditions from offline simulations. As compared with Ensemble Streamflow Prediction (ESP) that is based on random selection of historical forcings, CFSv1 and CFSv2 provide more accurate probabilistic streamflow forecasts in the first three months measured by the Ranked Probability Skill Score (RPSS), and CFSv2 achieves more skillful streamflow forecasts than CFSv1. The Relative Operating Characteristic (ROC) diagrams show that CFSv2 outperforms ESP and CFSv1 for discriminating low and high flows in the month-1 forecast. Forecasted soil moisture is validated against offline simulation for drought analysis in terms of drought area, duration and severity. However, the improvements for hydrologic forecasting are less than those for precipitation and temperature, indicating the role of initial conditions and the necessity of re-downscaling hydrologic forecasting results. We also test the CFSv2-based seasonal hydrologic forecast over Africa, and are toward developing a global hydrologic forecast system. As many seasonal forecast results are becoming available, we evaluate CFSv2 with EUROSIP models. CFSv2 has comparable results to the ECMWF model, and they can complement each other in different locations of CONUS that stimulates a multi-model ensemble. By analyzing the National Multi-Model Ensemble (NMME) data that is being archived by IRI, CFSv2 and NASA-GMAO are the most skillful models in terms of precipitation and surface air temperature. A number of deterministic or probabilistic methods such as Principal Component Analysis (PCA), conditional distribution, Bayesian merging and clustering (etc.) are being tested to construct an optimal combination of climate forecast models beyond a simple arithmetic average method, and identify the contribution of CFSv2 to the NMME.