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High resolution drought monitoring and seasonal forecasting for the USA

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An experimental real time drought monitoring and seasonal forecasting system has been developed for the USA. High resolution fields of hydrologic variables are generated from land surface model simulations and are used to represent agricultural and hydrologic drought severity. The system comprises three parts: a 50-yr retrospective simulation that forms a drought climatology; a real time monitoring component that updates hydrologic fields daily; and a forecast component that currently makes seasonal forecasts on a monthly basis using ensemble (probabilistic) forecast techniques with lead times up to 9 months. The soil moisture fields from these simulations are used as an index of drought, which has been used to analyze drought variation over the past 50 years.

The soil moisture data are derived from 1/8th degree simulations of the land surface water budget over the conterminous USA using the Variable Infiltration Capacity (VIC) land surface hydrologic model. The VIC model simulates the land surface water and energy budgets, including cold-season processes and includes parameterizations for sub-grid variability of precipitation and infiltration, elevation banding and vegetation tiling. Central to the system is the construction of a 50-yr drought climatology based on soil moisture fields extracted from long-term (1950-1999) simulations driven by observation based meteorological forcings. Monthly statistical distributions for soil moisture over the whole model soil column are developed for each model grid cell, and drought severity is represented as percentiles of the soil moisture distribution. Data from this retrospective simulation provide a climatology against which the state of drought at any chosen time can be deduced.

Near real-time monitoring is achieved by updating hydrologic fields every day, at a lag of 1 to 2 days to real time. The meteorological forcing data are derived from the

North American Land Data Assimilation System (NLDAS) real time forcing product which combines gauge, radar, and remote sensing products. Current conditions for soil moisture and other fields (evaporation, snow cover and basin streamflow) are available on the web.

The current forecast system uses the seasonal forecast from the NCEP Climate Forecast System (CFS). 60-member ensemble forecasts of precipitation and temperature from CFS are bias corrected and downscaled to 1/8 degree via a Bayesian merging technique. The initial condition of the land surface is derived from the NLDAS forced real time simulations. The long-term climatology, derived from the 50-year simulation, serves as a reference for the real time monitoring and forecasts, by removing the difference between model climatology and "actual observations". Seasonal hindcasts of soil moisture and other variables are being assessed for their skill in replicating historic data, which is highly dependent on the skill of the precipitation and temperature forecasts. Improved forecast skill can be obtained by adding information derived from observed teleconnections and improved downscaling methods. The flexibility of the forecast system will enable other climate forecast products and hydrologic models to be incorporated in the future and there is potential to extend to global monitoring.