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Noah-MP Land Surface Model in Supporting Drought Forecast for Texas

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Improved hydrological parameterization in land surface models (LSMs) over the past decade has enabled us to simulate root-zone soil water availability, as a sophisticated approach for early detection of drought (Crow et al., 2012; Sheffield et al., 2012). The Noah LSM with multi-parameterization option (hence Noah-MP) developed in the Center for Integrated Earth System Science at The University of Texas at Austin (Niu et al., 2011) is one of such LSMs that can be applied for this purpose. To help reduce losses caused by future drought in Texas like the one in 2011, we use Noah-MP to create a drought forecasting system in near real-time using the meteorological forcing provided by North American Land Data Assimilation System (NLDAS), which has been increasingly used in drought monitoring (Mo et al., 2011; Sheffield et al., 2012). This framework is implemented through five steps: (1) Use 30 years of historical NLDAS meteorological forcing data (1981-2010) to drive Noah-MP, which produces historical runoff and soil moisture; (2) Update individual years of the 30 years of historical NLDAS forcing based on the CPC (Climate Prediction Center in NOAA National Weather Service) temperature prediction; (3) Adjust the specific humidity to keep the relative humidity unchanged; (4) Use the updated NLDAS meteorological forcing to drive Noah-MP; (5) Weight the 30 scenarios on the basis of the precipitation prediction. We conducted a forecast of soil moisture and runoff for May to July 2012 and later this forecast was validated by what actually happened. Results show that the real drought condition is close to the median forecast, which indicates Noah-MP is able to provide a range of possible drought condition forecasts. By continuously forecasting soil moisture and runoff, decision makers could make more reasonable policies.

Keywords: Texas drought, Noah-MP, land surface model, NLDAS, soil moisture