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Statistical-Dynamical Drought Forecast within Bayesian Networks and Data Assimilation: How to Quantify Drought Recovery

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Drought forecasting is vital for resource management and planning. Both societal and agricultural requirements for water weigh heavily on the natural environment, which may become scarce in the event of drought. Although drought forecasts are an important tool for managing water in hydrologic systems, these forecasts are plagued by uncertainties, owing to the complexities of water dynamics and the spatial heterogeneities of pertinent variables. Due to these uncertainties, it is necessary to frame forecasts in a probabilistic manner. Here we present a statistical-dynamical probabilistic drought forecast framework within Bayesian networks. The statistical forecast model applies a family of multivariate distribution functions to forecast future drought conditions given the drought status in the past. The advantage of the statistical forecast model is that it develops conditional probabilities of a given forecast variable, and returns the highest probable forecast along with an assessment of the uncertainty around that value. The dynamical model relies on data assimilation to characterize the initial land surface condition uncertainty which correspondingly reflect on drought forecast. In addition, the recovery of drought will be examined. From these forecasts, it is found that drought recovery is a longer process than suggested in recent literature. Drought in land surface variables (snow, soil moisture) is shown to be persistent up to a year in certain locations, depending on the intensity of the drought. Location within the basin appears to be a driving factor in the ability of the land surface to recover from drought, allowing for differentiation between drought prone and drought resistant regions.