Progress on Identifying Mechanisms of US Drought Initiation, Persistence and Recovery using Observations, Reanalysis and Climate Model Data

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Drought is the costliest natural hazard in the US. While forecasts and real-time assessments of drought offer the potential to mitigate drought impacts, our ability to predict the onset, development and recession of drought is insufficient. The reasons for this are the lack of data about large scale variability and more importantly, insufficient understanding of hydrologic and weather mechanisms that lead to drought initiation, persistence and recovery. The generally poor predictive ability of seasonal climate models to forecast drought reflects this. While there is a large body of research related to climate processes and drought mechanisms, they tend to focus on after the establishment of the drought conditions. In general, precipitation variability and drought occurrence are driven by a combination of variability of advected atmospheric moisture and the strength of local recycling, but the question remains as to the relative influence of each. For the central US, the remotely advected component is observed to be larger than the local component, with the Pacific (Gulf of Mexico) as the winter (summer) moisture source, but this will be differ regionally. At larger scales, SSTs may influence drought occurrence and forms the basis for seasonal climate forecasts. But even when observed SSTs are used in seasonal forecast models, the skill in precipitation is low. Inclusion of land surface wetness, makes some improvements for some models in some areas indicating that our understanding, and our ability to model, the mechanisms of drought initiation, persistence and recovery are weak.

The project focus is based on considerations of the large scale atmospheric-land water budgets and the synthesis of existing datasets, and consists of the following tasks: *1. Evaluate drought occurrence* and their space-time evolution using observation driven simulations of 20th century land hydrology. *2. Evaluate land-atmosphere water budgets and moisture sources* for US regions from observational, reanalysis and remote sensing derived datasets. *3. Identify/classify the precursors to drought* in terms of the land-atmosphere water budgets and how they diverge from their climatological mean and the likelihood of drought initiation given atmospheric moisture sources and soil moisture anomalies. *4. Investigate mechanisms for drought maintenance* by using analytical models of recycling to explore the role of local and remote reinforcement of drought. *5. Identify conditions for drought recovery*. Concurrent analysis of drought events and moisture advection will be used to identify what conditions are necessary to recover from drought. *6. Assessment of predictive tools.* Using the previously identified relationships we will evaluate how well seasonal hindcasts of the NCEP Climate Forecast System are able to replicate the mechanisms for drought initiation, maintenance and recovery. The poster will report on the progress towards these tasks.