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Multi-model seasonal forecasting of global drought onset

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As a natural phenomenon due to climate variability, drought is a significant source of social and economic damages. It has caused more than US$210 billion losses since 1980 in the USA alone. The devastating impact of drought on local populations through food insecurity and famine is more severe in the developing world such as Africa. Establishing a global drought early warning system is therefore indispensible to drought mitigation and risk management. In this presentation, we use a dynamical seasonal climate-land surface hydrologic modeling system to provide drought forecast, and assess its skill for drought onset over global major river basins.

Based on the joint probability distribution between observations and model hindcasts, we bias correct the monthly precipitation and temperature forecasts from multiple climate forecast models, downscale them to a daily time scale, and use them to drive the Variable Infiltration Capacity (VIC) land surface hydrologic model to produce a set of seasonal hydrologic hindcasts globally at 1 degree resolution. The hindcasts are initiated on the 1st of each calendar month during 1982-2009 and run out to 6 months with 20 ensemble members. The bias-corrected precipitation and VIC generated soil moisture are used to calculate meteorological and agricultural drought indices respectively. Currently, based on the SPI6 meteorological drought analysis, we found that for the drought onset forecast at 0 month lead (continuous dry conditions for the first 3 months), the model with a high hit rate sometimes also has a high false alarm ratio, while the model with the lowest false alarm ratio does not necessarily produce a good hit rate, indicating the difficulty for producing a reliable drought onset forecast. The multi-model ensemble produces a more reliable forecast than individual models, and the optimized ensemble can enhance the skill further. However, low hit rate for the drought onset (less than 10-30%) commonly exists across all models for the forecasts at 1 month lead. Therefore, it is very difficult for the climate models to predict a neutral condition in the first month, and then dry conditions for the following 3 months. The drought-SST relationship from the models and observations are being investigated. Experiment for the hydrologic hindcast is still ongoing, and the generated soil moisture will be used to provide the drought onset forecast and analysis in a more integrative perspective.