Collaborative Drought Monitoring and Seasonal Drought Prediction in CPPA

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Under sponsorship of the Climate Prediction Program of the Americas (CPPA) in the NOAA Climate Program Office (NCO), several government and university partners have come together to develop and apply hydrometeorological data assimilation and prediction suites for monitoring and prediction of hydrologic states (soil moisture, snowpack, streamflow), with an emphasis on drought. The data assimilation and prediction suites embrace multiple models in both coupled (atmosphere/land or atmosphere/land/ocean) and uncoupled modes (land only). The forecast range emphasized thus far has been seasonal time scales (2-12 months), in order to provide longer lead times for drought mitigation efforts. Intraseasonal (2-6 weeks) and medium-range (1-2 weeks) forecast ranges will be additionally emphasized in later phases of the project.

The coupled drought monitors are based on A) the NCEP 28-year (1979-2006) North American Regional Analysis System (NARR) and its daily realtime extension known as the Regional Climate Data Assimilation System(R-CDAS) and B) the NCEP-DOE Global Reanalysis 2 (GR2) and its realtime extension known as the Climate Data Assimilation System 2 (CDAS-2). The uncoupled drought monitors are based on two realtime configurations of the North American Land Data Assimilation System (NLDAS), which both execute multiple land models and which differ in the source, historical length and spatial resolution of their companion retrospective analyses (50+ years in one configuration, 10+ years in another with extension to 27+ years imminent). We will present examples of why it is important to apply multiple land models in an ensemble approach to drought monitoring.

The realtime coupled seasonal drought prediction is based on the NCEP coupled atmosphere/land/ocean Climate Forecast System (CFS), from which NCEP each month delivers 60-62 members of 9-month forecasts. From the multi-decade hindcasts of the NCEP CFS, bias correction and downscaling techniques have been developed for hydrometeorological applications. Additionally, the multi-decade hindcasts of other climate forecast systems of other centers, such as those in the DEMETER project, have been assessed to demonstrate the additional seasonal prediction skill gained by utilizing multiple independent climate models. The NCEP Climate Test Bed (CTB) is presently promoting initiatives to allow the realtime application of multiple seasonal climate forecast models from several centers.

As a means to improve CFS seasonal predictions through improved land surface physics and land-surface initialization, extensive multi-decade seasonal prediction experiments with the CFS have been carried out with two different land models in CFS and two different sources of CFS initial land states. We will show results illustrating how crucial it is to produce optimal initial land states by means of using the same land surface model in the land data assimilation system as used in the land component of the CFS.

As a complement to CFS global model dynamical predictions, CPPA is launching an experiment to test the value added to CFS seasonal prediction skill by executing multiple Regional Climate Models (RCMs) in seasonal prediction mode (including 22 years of hindcasts) driven by CFS forecasts of lateral boundary conditions and global SST.

In uncoupled mode, the bias-corrected and downscaled ensemble land surface predictions of precipitation and temperature from the CFS are being applied to a high resolution version of the VIC hydrology model across the CONUS domain on the NLDAS grid. Initiatives are underway to extend this CFS application to multiple land models (VIC, Noah, Mosaic, SAC and CLM) and to augment the CFS down-scaled land surface forecasts with downscaled seasonal forecasts from other climate prediction systems of other centers.

In a different and complimentary uncoupled seasonal forecast approach, the official tercile-formatted seasonal predictions of precipitation and temperature of the Climate Prediction Center (CPC) are being empirically converted to ensemble seasonal land surface forcing of the VIC hydrology model, to provide an empirically-based complement to the dynamically driven VIC seasonal forecasts cited above.

Lastly, the CPC is constructing a drought monitoring and prediction web site to bring together in one central site all of the above uncoupled and coupled hydrometeorological monitoring and prediction tools, with an emphasis on drought monitoring and prediction.