EMS7/ECAM8 Abstracts,
Vol. 4, EMS2007-A-00572, 2007
7th EMS Annual Meeting / 8th ECAM

Modified k-Nearest Neighbor Statistical Downscaling of the Warm Season Precipitation in the Core North America Monsoon Region

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The North American Monsoon (NAM) System is among the most complex systems known to science. This study developed a modified $\kappa-$nearest neighbor (KNN) statistical downscaling technique to improve forecasting skill beyond reproduction of persistence of the warm season convective climate in this region. This difficult problem outlined a clear need for regionalization of the precipitation climatology for this topographically complex region before KNN is used for predictions. Gridded precipitation data for July-August-September (JAS) in 1950-1998 is manipulated through Eigen-based techniques to yield three contiguous precipitation regions. The KNN procedure was applied to seven atmospheric circulation predictor variables from the NCEP medium-range forecast model (MRF) to downscale daily precipitation for each spatially coherent PC region (1979-1998). The Receiver Operating Characteristics (ROC) framework and the rank histogram were used sequentially to identify parsimonious and physically sound system forcings. All days within a 28-day temporal window

were centered on feature day. Both the feature vector and the window-defined data array were projected onto the Eigen space. One of these nearest neighbors in the temporal window was selected as the analog date according to a pre-determined kernel.

We evaluated the quality of downscaled product in terms of a standard suite of verification metric. These analyses indicate a substantial improvement and have demonstrated that the quality of downscaled ensemble is sensitive to many factors, including the downscaling domains, season definitions, model configurations, sets of MRF predictor variables and the window width. The system lacked skill in non JAS indicating that this algorithm was designed and calibrated for the monsoon precipitation regime. What remains difficult to conduct at this time is a thorough analysis of ensemble precipitation uncertainty from a few heterogeneously distributed observation stations in each PC region. The main limitation of this model is its inability to extrapolate beyond the observed record (although some resampling strategies may overcome this limitation). In the meantime, these results demonstrate an improved predictability of the NAM precipitation out to a lead time of 4-6 days using state-of-the-art ensemble forecasting systems. Additionally, our research has significantly enhanced the MRF ensemble forecasts by making them reliable for regional hydrologic applications.