Assessing Timing Errors in Hydrologic Predictions Using the Cross Wavelet Transform Technique

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Abstract to be submitted to AGU 2009 Fall Meeting (San Francisco, December 14-18)

Session H02: Reconciling Models with Data and Complexity: Evaluation, Diagnosis and Correction of Model Structural Errors

Errors in hydrologic predictions comprise both timing (or phase) errors and amplitude errors that may originate from different sources of uncertainties and are often time and scale dependent. Arguably, a distinction between amplitude and timing errors can provide useful diagnostic information that will guide targeted model improvements. However, traditional hydrologic model evaluation based on measures like root mean square error (RMSE) and Nash-Sutcliffe efficiency (NSE) integrates errors over time and often does not make distinctions between different types of errors, which can sometimes lead to model "equifinality". In this presentation, we discuss recent progress made in the U.S. National Weather Service (NWS) on characterizing timing errors in hydrologic predictions using the cross-wavelet transform (XWT) technique. The XWT technique transforms model prediction time series and the corresponding observations into a two-dimensional scale-time space and provides information on scale-dependent localized timing differences between the two time series. Initial results from applying XWT to streamflow simulations and forecasts in a number of test basins in the United States will be presented, along with discussions on how timing error information can be used to diagnose model deficiencies.