Diagnostic Verification of 6-90 Day Ensemble Streamflow Predictions for AHPS

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Project Objective

For water resource managers, ensemble streamflow predictions represent one of the most significant products of the National Weather Service's (NWS) Advanced Hydrologic Prediction Services (AHPS). This project seeks to advance a distributions-oriented (DO) framework for verification of probability distribution forecasts derived from ensemble streamflow predictions. DO forecast quality measures provide a consistent diagnostic framework to quantify the relative sources of forecast skill, which would allow water managers to match decision tools to forecast attributes, and enable forecasters to target research, resources, and development efforts to the most valuable improvements. Expected outcomes from this research include: (1) a consistent framework for verifying probability distribution forecasts, which will be demonstrated through the evaluation and comparison of forecast quality of 6-90 day NWS AHPS ensemble streamflow forecasts for the North-Central and Ohio River Forecast Centers, and (2) a set of diagnostic verification tools for elucidating relevant forecast quality attributes, for the management and targeted improvement of forecasts systems, and interpretation of forecasts for their operational use.

Progress Report

Our efforts during this period have focused (1) development of a prototype online AHPS verification system, and (2) the generation of retrospective forecast verification data sets.

Development of a Prototype Online AHPS Verification System

To be able to explore the vast amount of forecast verification information for an RFC, and compare forecasts within an RFC, we have developed a web-based verification system for AHPS ensemble forecasts. The AHPS verification system has access to the entire verification data base of (1) retrospective ensemble streamflow traces, (2) processed ensemble forecasts (and observations) for a suite of variables, and (3) computed forecast quality measures for the ensemble products. The system can quickly display detailed forecast quality information for individual locations and forecast dates, or make custom plots comparing summary forecast quality measures at multiple sites or multiple basins within the domain of an RFC. Interactive exploration of the verification data base can provide forecasters with diagnostic information to identify pathways for improvement of the forecasting

system. Access to a forecast archive by potential users might also facilitate the use of operational forecasts, especially among water resources managers, by allowing them to study and adapt their decision-making process to the quality of the forecasts. The prototype system for the NCRFC currently has results for retrospective forecast issued for a test period from April through June, and is being expanded to cover the entire year.

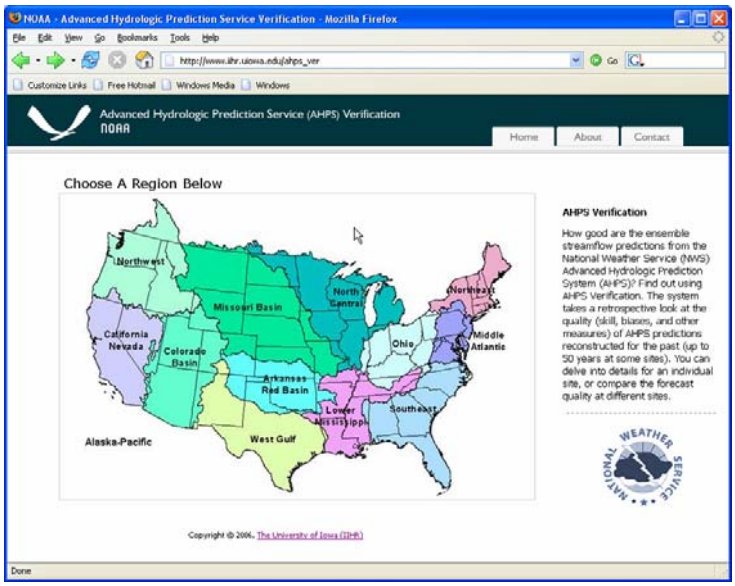

Figure 1: Web-based interactive system for forecast verification of AHPS ensemble streamflow predictions (http://www.iihr.uiowa.edu/ahps_ver).

Generation of Retrospective Forecast Verification Data Sets

We have developed programs and scripts, which work within the architecture of the operational NWSRFS system, to generate archives of forecasts and verification products for assessing ensemble streamflow predictions. With the help of the North Central River Forecast Center (NCRFC), the NWSRFS system and model configuration for the NCRFC was installed on a Linux machine at IIHR. The system has since been used to generate retrospective forecasts, for 1950 through 1999, for the majority of forecast groups within the NCRFC.

The generation of the archive has three components. First, for a selected forecast group, a set of scripts control the creation the hypertext command language (HCL) for extended streamflow forecast (ESP) simulations for a forecast date (e.g., April 1st) for the historical period (1950-1999), and then run NWSRFS to produce ensemble traces. The process is repeated at weekly forecasts intervals, producing an archive of ESP traces in their native format for the 52 forecast dates per year. Next, the traces are processed to generate a suite of ensemble forecast products, including those routinely issued operationally (e.g., weekly flow volumes, maximum flows). To facilitate verification analyzes, we combine an ensemble forecast with its corresponding observation by accessing the observed flow data for the forecast segment contained within the *calb* subsystem of NWSRFS. Finally, we apply the DO verification methods described by Bradley et al. [2004] to generate archive information and data plots that characterize the skill and identify systematic biases

for the ensemble streamflow forecast products. Because of the computational time required, the generation of archives of retrospective forecasts for the NCRFC is an ongoing activity

References

Bradley, A. A., S. S. Schwartz, and T. Hashino, Distributions-oriented verification of ensemble streamflow predictions, *Journal of Hydrometeorology*, 5(3), 532-545, 2004.