Improving Forecasts for Water Management

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Recent advances in seasonal to interannual hydroclimate predictions provide an opportunity for developing a proactive approach toward water management. This motivated a recent AGU Chapman Conference (see program details at http://chapman.agu.org/watermanagement/). Approximately 85 participants from the United States, Oceania, Asia, Europe, and South America presented and discussed the current state of successes, challenges, and opportunities in seasonal to interannual hydroclimate forecasts and water management, and a number of key messages emerged.

The first day centered on a major success of the last decade, which was raising the seasonal forecast skill of dynamical climate models to meet that of traditional statistical methods. However, predicting climate extremes remains a vexing challenge. In this regard, effective statistical methods to enhance the skills in extremes prediction are necessary. To this end, for example, ensemble approaches provide useful spread information and shifts in probability density functions, which can be exploited to characterize the probability of extremes. However, it is impossible to eliminate forecast variance; thus, scientists must develop methods that contend with uncertainty as well as variability and change. Streamflow forecasting discussions celebrated the significant strides made in operational forecasting and the commensurate rise of hydrometeorological forecasting services around the globe as well as advances in supporting techniques such as model assessment, data assimilation, and verification. Ironically, this rise coincides with the declining federal support for hydrometeorological monitoring and research, a concern noted by conference participants.

The second day focused on the use of seasonal hydroclimate forecasts in water management applications and drew on insights from representatives from the private sector, the U.S. Army Corps of Engineers; the Bureau of Reclamation, hydropower sector; and academia. Their perspectives emphasized that forecasts are a critical input to management decisions, though managers also survey a wide array of information beyond forecasts. In some systems, the connection between forecasts and water decision is indeterminate, whereas in others (typically larger, multistakeholder settings) the linkage between inflow forecasts and reservoir releases may be highly prescribed. A lack of operational flexibility can be a hurdle for the adoption of low-skilled or frequently changing forecasts. Forecast "busts" for events large enough to have real impacts but smaller than "acts of God" can have career-scale consequences for water managers, leading to user avoidance of forecasts. Discussion also emphasized that forecast skill measures have lukewarm acceptance, and users prefer expressing verification metrics in intuitive terms (e.g., using categorical metrics such as "hit rate" for correct predictions).

The final day brought insights from water utilities, which provided an end-user perspective on forecast issues such as the lead times for forecast usage, critical/desired forecast variables, forecast communication strategies, and other institutional factors. For regions strongly influenced by the El Niño–Southern Oscillation (ENSO) (e.g., Florida), the forecast lead times are often seasonal because many utilities with mixed water sources (desalination vs. groundwater) can benefit from skillful ENSO forecasts. Where climate forecast signals are less skillful (e.g., in the Midwest), the useful forecast lead times are shorter (i.e., weekly to subseasonal), and weather-to-climate forecasts become input for effective integration of water supplies. Panelists also noted that seasonal climate forecasts can trigger risk minimization (e.g., spill reduction), but water demand prediction receives less attention. Forecasts for additional variables such as turbidity, water temperature, and nutrient loadings would be valuable, but developing new models for such variables poses significant challenges due to limited data availability.

The key success of the conference was in bringing forecast producers (climate scientists and hydrologists) and forecast consumers (water managers and policy planners) together to evaluate the current science and practice of seasonal to interannual hydroclimatic forecasting for water management. The end-to-end, diverse assembly of participants stressed that continued support for research and data collection is critical to improve forecasting science, models, and services. Many agreed that a comprehensive, multidisciplinary, multinational assessment of various hydroclimatic forecast applications would have value to both private and public water sectors as well as to the general public.

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