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The history of HEPEX – a community of practice in hydrologic prediction

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HEPEX (Hydrologic Ensemble Prediction Experiment) began in 2004 at a workshop at the European Center for Medium range Weather Forecasts, which was jointly organized with the US National Weather Service and the European Commission. Over nearly 15 years, it has connected the research community, operational forecasters, users, practitioners and decision makers, and facilitated the exchange of ideas, data, methods and experiences. It has grown to an international community of over 450 registered members. It has helped spur a wider operational adoption of probabilistic and ensemble techniques in different hydrological applications, with focus on flood forecasting (up to a few days), drought and longer range prediction (from sub-seasonal to seasonal forecasting). Notable examples include the EFAS project (European Flood Awareness System, now operational service), the HEFS (Hydrologic Ensemble Forecast Service) implemented more formally in the US for sub-daily flood forecasts to seasonal streamflow outlooks in the 2010s, and the creation of a new interactive website for community exchange in 2013.

HEPEX has brought several contributions to the hydrological sciences and operational practices. It has fostered a view of hydrological prediction as a transdisciplinary science, linking disciplines such as meteorology, hydrology, statistics, remote sensing and more recently, decision theory, water economics and social science for forecast communication and use. It has contributed to establishing an integrative view of the hydrological forecasting system, where monitoring, data assimilation, hydro-meteorological models, pre- and post-processing techniques, communication products, expert knowledge and decision support systems are connected. Success stories have been documented in special editions of journals, reports and, most recently, the HEPEX handbook. Additionally, the community is actively sharing knowledge through its website and blog (www.hepex.org).

Here, we outline a brief timeline of the history of ensemble prediction, which resulted in the setup of HEPEX, starting from the early research on atmospheric predictability and uncertainty in the 1960-70s, through the development of ensemble prediction methods for monthly to seasonal predictions in hydrology and meteorology in the US and UK in the 1980s, the development of the first medium-range (up to 10 days) operational weather ensemble prediction systems at ECMWF and NCEP in the 1990s, the first runs of EFAS with numerical weather ensemble predictions in 2005, up to the most recent developments on seamless prediction systems, ensemble short-range and nowcasting systems, coupled Earth systems and Global multi-model forecasting. The recognition of tradeoffs among different paradigms in hydrological forecasting is emphasized, and the transition from the first model-based, traditional “human-in-the-loop” flood forecasting approaches to more automated, “over-the-loop” probabilistic-based approaches and coupled NWP-hydrological modeling systems.

Despite the initial focus on medium-range forecasting, HEPEX has been able to embrace a wide range of spatial and temporal scales. Today, model-based ensemble predictions are investigated for flash flood nowcasting and up to the long-range (several months) forecasting of water resources, and over spatial scales from small to large river systems controlled by different processes. Finally, it is important to note that HEPEX has always been an unfunded/volunteer effort – perhaps the longest in the history of hydrometeorological forecasting.