Proceedings of the 22nd Annual Conference
Integrated Water Resources Planning
for the 21st Century
Water Resouces Planning and Management Division
American Society of Civil Engineers
May 7-11, 1995, Cambridge, Massachusetts
Papes 771-774

Water Resources Management with the NWS Water Resources Forecasting System (WARFS)

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Abstract

The Water Resources Forecasting System (WARFS) is managed within the Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Weather Service (NWS), Office of Hydrology. WARFS is an operational program providing for the modernization of hydrologic forecasting services across the Nation. Preparation for WARFS national implementation activities have begun within the upper Mississippi River basin.

Introduction

Deaths and economic losses resulting from The Great Flood of 1993 and our Nation's floods and droughts of 1994 have heightened the need for improved predictions to support flood/drought management and damage mitigation (NWS, 1994). Furthermore, the allocation of water among competing demands (e.g. fisheries, irrigation, hydropower and municipalities) looms as a national problem that requires improved water quantity forecasts for sustainable development. For these needs, the National Weather Service (NWS) is preparing for national implementation of the advanced Water Resources Forecasting System (WARFS).

The NWS has the mission to provide river and flood forecasts and warnings for the protection of life and property, and to provide hydrologic forecast information for economic and environmental well being. In support of this mission, the NWS operates thirteen

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regionally based River Forecast Centers (RFCs) across the Nation. The RFCs typically issue stage forecasts for only 1, 2, and 3 days into the future at most of its 4000 forecast points and crest forecasts out to about 1 week for a few selected forecast points. WARFS, including Extended Streamflow Prediction (ESP) enhancements, will provide for analyses of streamflow trace ensembles within specified future time windows, objectively couple meteorological/climatological forecasts in the ensemble analysis, provide for a variety of probabilistic analyses of ensembles, and package probabilistic streamflow forecast products with extended lead times (out to several months). Thereby, WARFS will provide river forecasts which not only account for precipitation already on the ground but also will probabilistically account for estimates of future precipitation.

Forecasting System Advancements

WARFS provides an advanced hydrologic prediction system as it is coupled with: 1) NOAA's current scientific and operational infrastructure, including the NWS River Forecast System (NWSRFS, Fread, et. al., 1991); 2) National Weather Service (NWS) modernization technologies (Friday, 1994), especially NEXRAD (NEXt Generation Weather RADar - WSR-88D) and AWIPS (Advanced Weather Interactive Processing System); and 3) cooperative and supportive partnerships with other government agencies, universities, and the private sector. WARFS, including ESP enhancements, will take advantage of all these program relationships by building on the technological and information framework they provide.

WARFS is an integrated real-time modeling and data management/analysis system which includes provisions for the use of historical hydrologic/hydrometeorologic data and meteorological/climatological forecasts for input to ESP simulations (Figure 1). As indicated above, implementation of WARFS services builds upon the NWSRFS and NWS modernization technologies and is divided into three interdependent functional requirement areas: Integrated Data Management and Analysis, Advanced Hydrologic/ Hydraulic Modeling, and Advanced Product Packaging/ Dissemination. ESP is the portion of NWSRFS which produces probabilistic forecasts out to several months. WARFS probabilistic forecasts not only will greatly improve the capability of emergency managers and water facility managers to take timely and effective actions to mitigate the

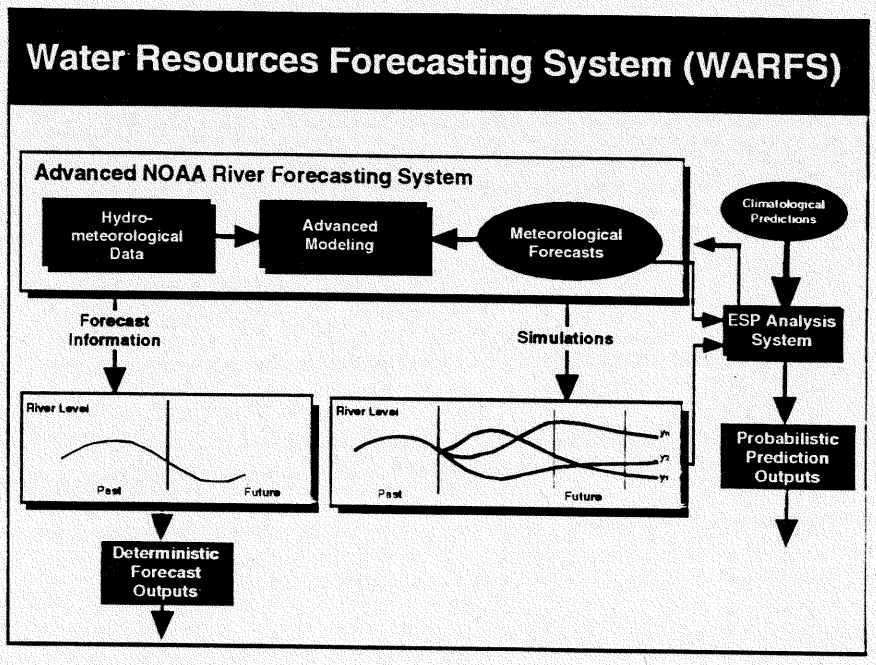

Figure 1. Schematic of the Water Resources Forecasting System (WARFS) integrated real-time modeling and data management/analysis system.

impact of major flood and drought situations, they also will provide better support for overall water resources management (e.g. better management of competing water demands between irrigation, fisheries, and hydropower). For example, the application of ESP on the Nile River has increased forecast lead time of the annual flood from two weeks to over three months with acceptable accuracy.

Current and Potential Implementation Activities

Preparation for WARFS National implementation activities have begun within the upper Mississippi River basin at the NWS North Central River Forecast Center, located in Minneapolis, Minnesota. Further implementation will expand to other parts of the Mississippi Basin, and begin in additional basins. These will include basins which are of critical economic and environmental importance. As these technologies are advanced, they may be shared with other countries through memoranda of agreement or through other technological exchange mechanisms as appropriate.

Summary

The Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), in partnership with other major cooperators, are now advancing their hydrologic forecasting technologies through the development and implementation of the Water Resources Forecasting System (WARFS). This effort is a key component in the *NOAA 1995-2005 Strategic Plan* (Baker, et.al., 1993) to improve prediction services for the Nation and to enhance NOAA's role in environmental prediction.

WARFS extended forecast lead times (up to several months) will allow for: more effective mitigation of extreme events (e.g. floods and droughts), improved operations of water resource facilities (e.g. irrigation and hydropower facilities), and enhanced ecosystem management (e.g. fisheries and wetlands management). As these advanced technologies are developed, DOC/NOAA/NWS can exchange them with other governments in order to help meet sustainable development needs. These exchanges may be executed through memoranda of agreements or through other technological exchange mechanisms as appropriate.

References

Baker, D. James; Douglas K. Hall, Diana H. Josephson, and Kathryn D. Sullivan, July 1993, *National Oceanic and Atmospheric Administration, 1995 - 2005 Strategic Plan*, NOAA, Washington D.C.

Fread, Danny L., George F. Smith, and Gerald N. Day, January 1991, "The Role of Real-Time Interactive Processing in Support of Water Resources Forecasting in the Modernized Weather Service," *Seventh International Conference on Interactive Information and Processing System for Meteorology, Hydrology, and Oceanography*, New Orleans, La. pages 294-298.

Friday, Elbert W. Jr., January 1994, "The Modernization and Associated Restructuring of the National Weather Service: An Overview," *Bulletin of the American Meteorological Society*, pgs. 43-52, Vol. 75, No. 1.

NWS, February 1994, *Natural Disaster Survey Report, The Great Flood of 1993*, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Washington, D.C.