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Real-time Flood Forecasting for River Crossings

Executive Summary

This project seeks to develop tools and frameworks that would allow for the easy transfer and implementation of technologies for flood inundation forecasting and prediction at arbitrary locations in the river network of the four sponsoring states. The Iowa Flood Center (IFC) has developed a real-time flood forecasting and information dissemination system called IFIS. The system complements the operational forecasting issued by the NWS. At its core is a continuous rainfall-runoff model based on landscape decomposition into hillslopes and channel links. Rainfall conversion to runoff is modeled through soil moisture accounting at hillslopes. Channel routing is based on a nonlinear representation of water velocity that considers the discharge amount as well as the upstream drainage area. Mathematically, the model represents a large system of ordinary differential equations organized to follow river network topology. The IFC also developed an efficient numerical solver suitable for high-performance computing architecture. The solver allows the IFC to update forecasts every 15 min for over 1,000 Iowa communities. The input to the system comes from a radar-rainfall algorithm, developed in-house, that maps rainfall every 5 min with high spatial resolution. The algorithm uses Level II radar reflectivity and other polarimetric data from the Weather Surveillance Radar-1988 Dual-Polarimetric (WSR-88DP) radar network. A large library of flood inundation maps and real-time river stage data from over 200 IFC "stream-stage sensors" complement the IFC information system. The system communicates all this information to the general public through a comprehensive browser-based and interactive platform.

Findings & Outputs

Drs. Krajewski and Mantilla have developed graphical user interfaces for a comprehensive model evaluation that allows for testing model performance in new regions. They have developed methodologies for rapid model implementation and parameterization, the extension of the domain of rainfall product, and techniques for data assimilation to insure high quality flood forecasts.

Impacts & Benefits

Flooding continues to be the most impactful natural disaster in terms of lives, damage to property, and travel time due to road closures. An efficient, dynamic, and precise system for forecasting floods will provide Departments of Transportation the ability to prepare and react to sudden flooding conditions that impact the transportation system. These researchers are developing technologies to transfer scientific ideas into actionable tools and information.

Funding Sources & Amount

US Department of Transportation: \$147,887

UI Dept. of Civil & Environmental Engineering: \$148,074

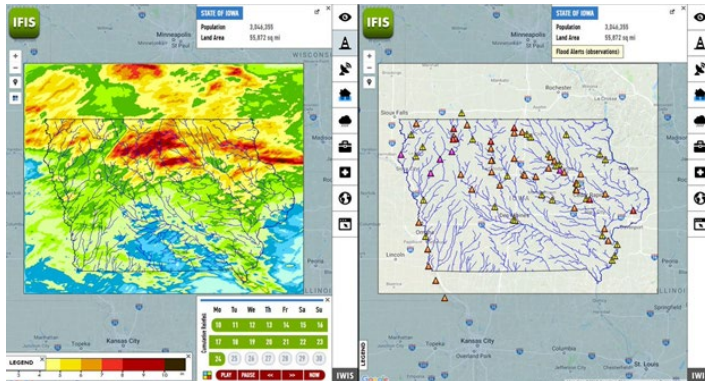
Total: \$295,961

For More Information:

Phase I: http://matc.unl.edu/research/research_project.php?researchID=536

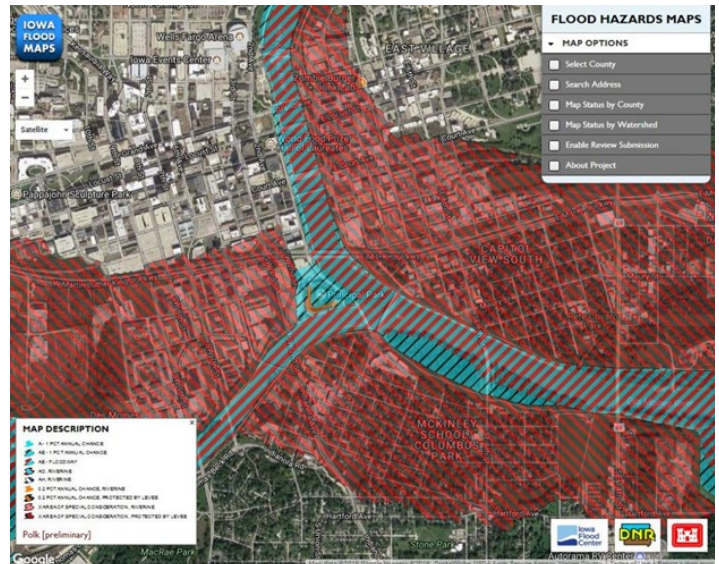
Phase II: http://matc.unl.edu/research/research_project.php?researchID=569

The Iowa Flood Center: <https://iowafloodcenter.org/>



Left: The Iowa Flood Information System (IFIS) is an online platform that communicates flood-related information to communities in Iowa (left panel: cumulative precipitation; right panel: current flooding conditions).

Right: Interactive inundation map showing flood hazard areas (0.2% annual inundation zone also known as the 500-year floodplain).



Principal Investigator



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Dr. Witold Krajewski is the Rose & Joseph Summers Chair of Water Resources Engineering at the University of Iowa. He is also a professor in the Department of Civil and Environmental Engineering and research engineer at IIHR—Hydroscience & Engineering. In 2009, he was appointed Director of the Iowa Flood Center. Dr. Krajewski received MS (1976) and PhD (1980) degrees from Warsaw University of Technology, Poland, in environmental engineering and water resources systems. Dr. Krajewski's scientific interests concern measuring, modeling, and forecasting precipitation using radar and satellite remote sensing.



Co-Principal Investigator



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Dr. Ricardo Mantilla has been an assistant professor at the University of Iowa since 2014. He is also a research engineer for the Iowa Flood Center at IIHR—Hydroscience & Engineering, where he helped develop a statewide flood forecasting system. He is one of the architects of HidroSig, a GIS developed by the Water Resources Department at the Universidad Nacional de Colombia. Currently, Dr. Mantilla is developing a more specialized version of the software, which he calls CUENCAS. This new application will deal specifically with river networks and include tools for geomorphologic analysis, data organization, and flow simulations.



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