PILOT PROJECT FOR A HYBRID ROAD-FLOODING FORECASTING SYSTEM ON SQUAW CREEK

Tech Transfer Summary

In this study we investigated the enhancements in performance that river stage information collected by a distributed network of bridge mounted sonic sensors in the Squaw Creek basin provides for a distributed flood-forecasting model CUENCAS-HM.

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RESEARCH PROJECT TITLE
Pilot project for a hybrid road-flooding forecasting system on Squaw Creek

SPONSOR
Iowa Highway Research Board
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BACKGROUND

According to the National Weather Service, more than half of the fatalities attributed to flash floods are people swept away in vehicles when trying to cross an intersection that is flooded. Efforts are underway to improve prediction of the likelihood of roads to be inundated after heavy storms, however, the rapid rise of waters on small and medium size creeks requires accurate forecasting capabilities that are beyond the current state-of-the-art. This pilot project provides a test bed for a new generation of modeling technology geared towards improved forecasting capabilities.

OBJECTIVE

The long-term goal, and the umbrella for this pilot project, is to create a real-time road-flood forecasting system that is reliable enough to produce actionable predictions for state and local agencies responsible for maintaining road safety during extreme flooding events. The proposed flood forecasting system combines real-time stream level observations using bridge mounted sonic sensors (Fig. 1) developed by the Iowa Flood Center with the newly developed distributed hydrologic models CUENCAS-HM.

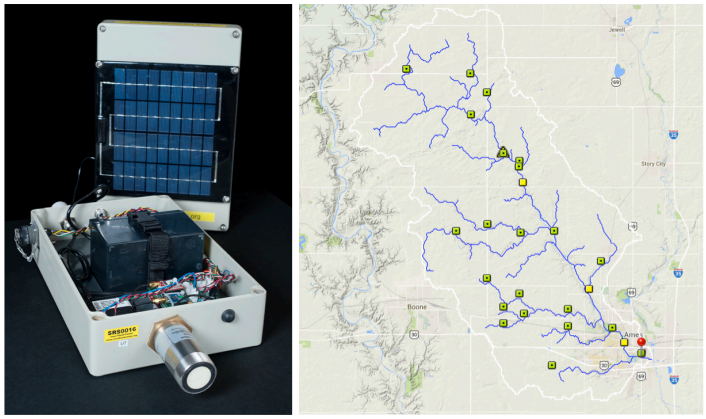

Figure 1. An example of the sonic sensor and location of instruments installed in the Squaw Creek watershed.

RESEARCH DESCRIPTION

The distributed hydrological model CUENCAS has been implemented for the Squaw Creek basin to test the predictability of flooding in small tributaries in the catchment. The long-term goal, and the umbrella for this pilot project, is to create a real-time road-flood forecasting system that is reliable enough to produce actionable results for state and local agencies responsible for maintaining road safety during extreme flooding events. The novel aspect of this objective is that the model can produce simultaneous predictions for all road crossings including those that cross small creeks draining basins as small as 1 sq. mile.

A network of 25 sonic-sensors in the Squaw Creek has been installed to test the modeling framework capabilities. The instruments (shown in Fig. 2) were built and installed during the spring and summer of 2012 and they serve a double purpose. First, they provide real-time information of site-specific stream conditions that can be visualized in the Iowa Flood Information System (IFIS), and second; they collect information that is used to validate the predictions made by CUENCAS-HM.

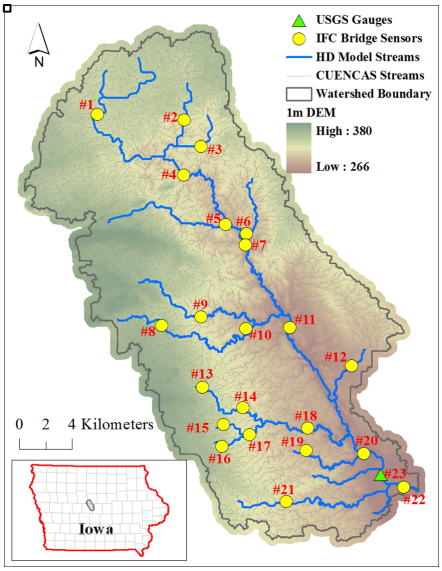

Figure 2. Squaw Creek basin upstream from Ames, Iowa showing the location of sonic-sensors.

MODELING RESULTS

Hydrographs simulated by the CUENCAS-HM were compared with observed streamflow provided by the USGS for the flood event that occurred on May 2013 (Fig. 3). Typically a comparison at the basin outlet serves as validation of the model capabilities.

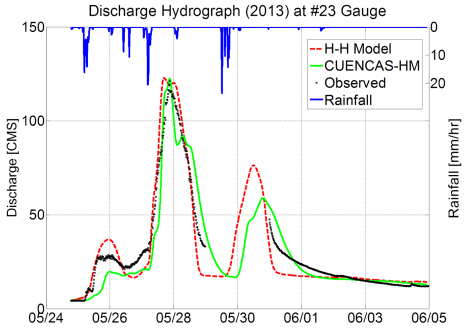

Figure 3. Simulated and observed discharge hydrographs at control point #23 in the Squaw Creek basin upstream from Ames, IA for a flood event that occurred in May, 2013.

However, a more comprehensive test of the model predictions is performed here by comparing predictions at internal locations with observations made by the newly installed sonic sensors (Fig. 4)

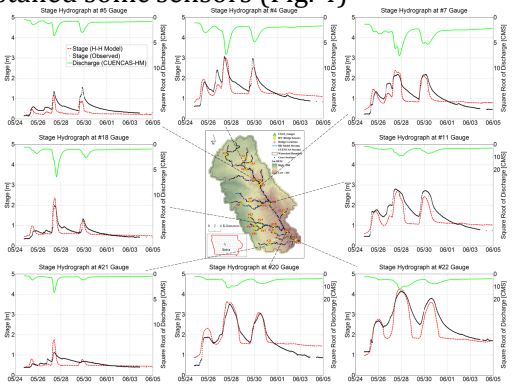

Figure 4. Simulated and observed stage hydrographs at 8 control points in the Squaw Creek basin.

KEY RESULTS

1) 22 sonic sensors were deployed in the Squaw Creek basin.

2) We have demonstrated that the predictions made by the hydrological model at internal locations in the basins are as accurate as the predictions made at the outlet of the basin.