The Use of an Automated Nowcasting System to Forecast Flash Floods in an Urban Watershed

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ABSTRACT

Flash flooding represents a significant hazard to human safety and a threat to property. Simulation and prediction of floods in complex urban settings requires high-resolution precipitation estimates and distributed hydrologic modeling. The need for reliable flash flood forecasting has increased in recent years, especially in urban communities, because of the high costs associated with flood occurrences. Several storm nowcast systems use radar to provide quantitative precipitation forecasts that can potentially afford great benefits to flood warning and short-term forecasting in urban settings. In this paper, the potential benefits of high-resolution weather radar data, physically based distributed hydrologic modeling, and quantitative precipitation nowcasting for urban hydrology and flash flood prediction were demonstrated by forcing a physically based distributed hydrologic model with precipitation forecasts made by a convective storm nowcast system to predict flash floods in a small, highly urbanized catchment in Denver, Colorado. Two rainfall events on 5 and 8 July 2001 in the Harvard Gulch watershed are presented that correspond to times during which the storm nowcast system was operated. Results clearly indicate that high-resolution radar-rainfall estimates and advanced nowcasting can potentially lead to improvements in flood warning and forecasting in urban watersheds, even for short-lived events on small catchments. At lead times of 70 min before the occurrence of peak discharge, forecast accuracies of approximately 17% in peak discharge and 10 min in peak timing were achieved for a 10 km^2 highly urbanized catchment.

1. Introduction

Hydrologic modeling of urban flood potential has witnessed an upsurge in interest recently (e.g., Ogden et al. 2000; Lee and Heaney 2003; Zhang and Smith 2003) because the hydraulic properties of these areas, such as large expanses of impervious areas, smoothed and compacted land surfaces, and modification of natural flow paths, create conditions suitable for reduced infiltration, storage, and friction losses, creating conditions favorable to high-peak flow responses. The probability of flooding from a given storm is typically higher in urban areas (e.g., Konrad and Booth 2002); a striking example is that on the same evening of the flash flood that devastated Fort Collins, Colorado, on 27 July 1997, a more intense storm occurred in rural Colorado with no reported injuries or significant damage (M. Kelsch 2003, personal communication). Simulation and prediction of floods in complex urban settings requires distributed precipitation estimates and distributed hydrologic modeling.

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