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Toward a coupled Hazard-Vulnerability Tool for Flash Flood Impacts Prediction

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Flash floods (FF) are high-impact, catastrophic events that result from the intersection of hydrometeorological extremes and society at small space-time scales, generally on the order of minutes to hours. Because FF events are generally localized in space and time, they are very difficult to forecast with precision and can subsequently leave people uninformed and subject to surprise in the midst of their daily activities (e.g., commuting to work). In Europe, FFs are the main source of natural hazard fatalities, although they affect smaller areas than riverine flooding. In the US, also, flash flooding is the leading cause of weather-related deaths most years, with some 200 annual fatalities. There were 954 fatalities and approximately 31 billion U.S. dollars of property damage due to floods and flash floods from 1995 to 2012 in the US.

For forecasters and emergency managers the prediction of and subsequent response to impacts due to such a sudden onset and localized event remains a challenge. This research is motivated by the hypothesis that the intersection of the spatio-temporal context of the hazard with the distribution of people and their characteristics across space and time reveals different paths of vulnerability. We argue that vulnerability and the dominant impact type varies dynamically throughout the day and week according to the location under concern. Thus, indices are appropriate to develop and provide, for example, vehicle-related impacts on active population being focused on the road network during morning or evening rush hours.

This study describes the methodological developments of our approach and applies our hypothesis to the case of the June 14th, 2010 flash flood event in the Oklahoma City area (Oklahoma, US). Social (i.e. population socio-economic profile), exposure (i.e. population distribution, land use), and physical (i.e. built and natural environment) data are used to compose different vulnerability products based on the forecast location and timing of the specific FF occurrence. Contingent index-based impact maps are then derived from the intersection of the hydro-meteorological indices with the exposure, sensitivity and/or coping capacity indices describing the infrastructure and people in the study area.