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Multiple scale flood simulation in the Delaware River Basin: Hurricane Ivan

Luciana Kindl da Cunha (1,2), James Smith (1), and Mary Lynn (1)
(1) Princeton University, (2) Willis Research Network

Tropical cyclones shape the upper tail of flood peak distributions in the Delaware River Basin, as well as other major drainage basins of the eastern US. During Hurricane Ivan (Sept, 2004) peak flows ranking in the upper 10% of the peak flow distribution were observed in many sites. In this study we apply a fully-distributed, physically-based, and calibration-free hydrological model (CUENCAS) to simulate inland flooding caused by Ivan for basin scales ranging from one to thousands of square kilometers. As input to the hydrological model we use the Stage IV rainfall fields produced by The National Weather Service. Stage IV is a post-processed product based on the merging of radar and gauge rainfall data. We show that simulation uncertainties decrease as basin scales increase. Small basin hydrological simulations are strongly affected by rainfall space-time variability, hydrological response heterogeneities due to natural (infiltration and basin shape) and artificial basin properties (dams), and by input and model structural uncertainties. These small-scale heterogeneities and uncertainties are averaged out by the effect of the river network that links different areas in the basin and organizes flow transport. Consequently, good results are obtained for basins larger than 1,000 km^2.