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June 2008 extreme flooding in Eastern Iowa: Precipitation analyses

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In June of 2008 severe flooding occurred in Easter Iowa in the United States. The city of Cedar Rapids was flooded by a record flood, with discharge reaching five times the average annual flood level. The economic losses were in billions of dollars, the University of Iowa campus alone suffered some $250M in damages to its infrastructure. Several factors contributed to the severity of the floods: significant snowfall during the preceding winter; a number of intense spring storms visiting the region; and the interplay between the rainfall timing and the topology of the river drainage network. The authors focus this presentation on the precipitation aspect of the floods. In their analyses they use rain gauge, radar, and satellite data. They analyze rainfall frequency based on historical data to put the 2008 in proper perspective. They use the recently upgraded NEXRAD super resolution radar data as well as the three-hourly TMPA satellite product. Historical and real-time data collected during the floods show that small basins in the region experienced mild flooding conditions with small return periods («50-years), while large basins experienced extraordinary flooding conditions (»100-years). The individual storms that preceded the flood were not extraordinarily large; rather, the week prior to the flood was characterized by a series of storm systems that successively hit the region. This observation suggests the hypothesis that extreme flooding conditions in locations draining large basins can be created by consecutive "ordinary" storms rather than by extraordinarily large storms that have been the focus of previous studies. Current analyses linking storm return periods to flood return periods do not account for the possibility that large floods can be created by consecutive storms. The authors performed a series of numerical simulations that show that the rainfall totals observed in June do not account for the extreme flooding that was observed, instead the timing of the individual events was compounded by the topology of the river network draining the landscape. This result highlights the need for a more precise understanding of the changes in rainfall patterns in the presence of climate change. Our simulations indicate that large basins are more sensitive to how rainfall falls over the basin rather than to the total amount of rainfall.