The Use of Remote-Sensing Based Multi-Sensor Quantitative Precipitation Estimates in Deriving Extreme Precipitation Frequencies: Implications for Flash Flood Monitoring

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Flash flood monitoring and prediction systems are typically based on the use of rainfall or streamflow thresholds for determining occurrences. The floods identified through these systems are subject to various flood sources of uncertainties including rainfall estimation errors, streamflow prediction errors, model structural issues, and errors in defining a flood event. The current study focuses on the first source of uncertainty and its effect on deriving important climatological characteristics of extreme rainfall. Examples of such characteristics are rainfall amounts with certain Average Recurrence Intervals (ARI) or Annual Exceedance Probability (AEP), which are highly valuable for hydrologic and civil engineering design purposes. Despite the availability of gauge-based precipitation frequencies estimates (PFE) (e.g., NOAA Atlas 14 and its various volumes for the U.S), it is of interest to examine the utility of PFE information derived from remote-sensing based (e.g., radar and satellite) multi-sensor precipitation estimates (MPE) and how it can meet the needs to evaluate the flood severity. MPE technologies have made spatially and temporally distributed quantitative precipitation estimates (QPE) available in an operational environmental compared to rain gauges. The current study will investigate the potential use of MPE estimates in deriving ARIs to characterize two recent flooding events which occurred in Egypt and USA: (1) Alexandria (Egypt, October 2015) flash flooding event using spatially-distributed satellite-based MPE and (2) Louisiana (USA, August 2016) historic floods using radar-based the MPE product of Next-Generation Radar (NEXRAD), operated by the US National Weather Service (NWS). The frequency analysis will be performed using extreme rainfall data, expressed in terms of Annual Maximum precipitation Series (AMS) and using different frequency estimation approaches, including at-site and regional-based estimation methods. Through this assessment, the following research questions are presented: (a) exploring the use of MPEs for deriving PFEs that could be used as thresholds for detecting extreme rainfall amounts with substantial flash flood potentials; (b) effect of uncertainties present in MPE rainfall estimation algorithms on the derived PFEs; (c) sampling effects due to the typically short records of MPE products; and (d) effect of the frequency estimation methodology adopted.