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Geospatial attribution of extreme rainfall and urban expansion in India using fuzzy clustering

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A growing intensification of rainfall-derived floods and temperature driving heat and cold waves have increased worldwide human fatalities and financial losses in the past decades. At the same time, urban land-use expansion in response to population growth and reallocation of resources to cities around the world are increasing physical and socioeconomic vulnerabilities to such extreme events. India's burgeoning urban population growth from ∼26 million in 1900 to ∼277 million in 2011 coincides with increasing trends of extreme rainfall in urban regions. This work aims to regionalize the influence of extreme rainfall across urban areas in India. The regionalization of extreme rainfall in urban areas could benefit design of resources management strategies, according to clustered cities in response to extreme rainfall. We hypothesized that clustering parameters such as the partition coefficient (PC) and entropy (PE), reflecting the complexity of relationships built from extreme precipitation-related variables and the robustness of the clusters formed, and urban-related variables (like city size and population density) can indicate a geospatial attribution between both of them. To test our hypothesis, three different clustering methods (i.e. Fuzzy c-means, Gustafson-Kessel and Subtractive) were applied to different combinations of seven climate extreme indices [i.e. extreme precipitation; very extreme precipitation; precipitation days (P>10mm & P>20mm); monthly maximum precipitation; cumulative wet days; precipitation intensity) and location indicators (i.e. latitude, longitude)] for urban regimes of India. Furthermore, PC and PE were also used as metrics of performance of the methods. We expect to identify the optimum number of clusters based on the least PE and the highest PC. Then, a predominant urban area and population size will be associated with each regionalization, evidencing the influence of extreme precipitation across urban areas in India. Preliminary results showed that Fuzzy c-means method outperformed the other two methods.