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Urban Growth Causes Significant increase in Extreme Rainfall – A modelling study

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World's urban centers are growing rapidly causing the impact of extreme rainfall events felt much more severely due to relatively well unerstood phenomena like decreased infiltration and flow resistance. However, an increasing set of evidence (e.g. heavy rainfall event observed at Nerima, central part of Tokyo metropolitan area, on 21 July 1999) suggest that the extreme rainfall, the driving force itself increases as a result of the microclimatic changes due to urban growth. Urban heat islands(UHI) due to heat anomalies of urban sprawl act as virtual mountains resulting in a local atmosphere more conducive for heavy rainfall.

In this study, we employ a popular mesoscale atmoshperic model to numerically simulate the UHI induced rainfall enhancement. Initial idealized experiments conducted under trophical atmospheric conditions indicated that the changes in landuse due to significant urban growth will indeed cause more intense rainfall events. This is largely due to increased convective breakup, causing a favourable situation for convective cloud systems.

Five historical heavy rainfall events that caused floods in five urban centres (Dhaka, Mumbai, Colombo, Lyon and Taipei) were selected from historical records. Numerical simulations were setup to assertain what would be the amount of rainfall if the same large-scale atmospheric situations (forcings) occured under a hypothetical situation of doubled urbanization level these events. Significant increases (upto 50%) of extreme rainfall was indicated for many of the events. Under major assumptions, these simulations were used to estimate the anticipated changes in the Intensity-Duration-Frequency (IDF). The magnitude of the 30min event with 25 year return period increased by about 20 percent.

Without considering any changes in the external forcing the urban growth alone could cause very significant increase in local rainfall.