



Changing Pattern of Indian Monsoon Extremes: Global and Local Factors

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Indian Summer Monsoon Rainfall (ISMR) extremes have remained a major topic of discussion in the field of global change and hydro-climatology over the last decade. This attributes to multiple conclusions on changing pattern of extremes along with poor understanding of multiple processes at global and local scales associated with monsoon extremes. At a spatially aggregate scale, when number of extremes in the grids are summed over, a statistically significant increasing trend is observed for both Central India (Goswami et al., 2006) and all India (Rajeevan et al., 2008). However, such a result over Central India does not satisfy field significance test of increase and no decrease (Krishnamurthy et al., 2009). Statistically rigorous extreme value analysis that deals with the tail of the distribution reveals a spatially non-uniform trend of extremes over India (Ghosh et al., 2012). This results into statistically significant increasing trend of spatial variability. Such an increase of spatial variability points to the importance of local factors such as deforestation and urbanization. We hypothesize that increase of spatial average of extremes is associated with the increase of events occurring over large region, while increase in spatial variability attributes to local factors. A Lagrangian approach based dynamic recycling model reveals that the major contributor of moisture to wide spread extremes is Western Indian Ocean, while land surface also contributes around 25-30% of moisture during the extremes in Central India. We further test the impacts of local urbanization on extremes and find the impacts are more visible over West central, Southern and North East India. Regional atmospheric simulations coupled with Urban Canopy Model (UCM) shows that urbanization intensifies extremes in city areas, but not uniformly all over the city. The intensification occurs over specific pockets of the urban region, resulting an increase in spatial variability even within the city. This also points to the need of setting up multiple weather stations over the city at a finer resolution for better understanding of urban extremes. We conclude that the conventional method of considering large scale factors is not sufficient for analysing the monsoon extremes and characterization of the same needs a blending of both global and local factors.

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