# Disentangling soil moisture and precipitation coupling over India from a compound flood risk assessment perspective

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Compound event research has gained significant momentum over the past few years. Traditionally risk assessment studies considered either one climatic driver or process at a time. However, it is now being recognised that it is the combination of multiple drivers and their statistical dependencies that lead to aggravated, non-linear impacts. In the present work, we expanded flood risk assessment to include the multi-hazard scenario of preconditioning of extreme precipitation events by soil moisture excess anomalies. Event Coincidence Analysis (ECA) and an extremal tail dependence measure, having its roots in Extreme Value Theory (EVT), are employed to investigate this coupling nature between SM and P over India. The datasets used include GLDAS-2.2 CLSM model products for soil moisture and GPM IMERG V06 for gridded rainfall data. The overarching goal of the research was to identify hotspots for SM-P coupling over India and its emerging changing pattern over the period 2004 to 2020. The increase in such preconditioned hotspots matches perfectly with the reported increase of flood-prone districts over India. ECA results were compared with the probabilistic extreme value approach, and a similar pattern was observed in both. The increase in hotspots from 2004 to 2020 matches the observed increase in flood-prone districts reported by earlier studies. We also used the trigger coincidence rate to identify areas where soil moisture anomalies can trigger extreme precipitation. The seasonal variations in precursor coincidence rates are observed to be the same as those usually expected due to changing atmospheric circulation patterns. Our results will complement the traditional flood risk assessment studies and have implications for better understanding the dynamic, ever-evolving nature of compound preconditioned flooding events worldwide.

***Keywords – compound event, SM-P Coupling, flash flood risk, India, ECA, EVT***