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A novel approach for the predictability of the Indian Summer Monsoon onset

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The prediction of the Indian summer monsoon (ISM) onset is a vital question for more than one billion people on the Indian subcontinent. The correct forecast of the ISM onset is crucial for water supply of the farmer lands, and directly affects crop yields, employment and livelihood of the inhabitants of the Indian subcontinent. Despite numerous methods for the ISM onset forecasting, its predictability remains an open problem.

In this study, we consider evolution of the ISM on decadal, interannual and seasonal time scales, specifically focusing on abrupt transition to monsoon, marked by the ISM onset. We have developed a new method for predictability of the ISM onset using climate network theory, critical transition theory and analysis of observation data. First, applying climate network approach to surface air temperature, humidity and extreme precipitation over the Indian subcontinent, we reveal regions on the Indian subcontinent, which exhibit anomalous behavior prior to the critical transition – monsoon onset. Second, we analyze observational data in terms of precursors of critical transition, and detect areas on the subcontinent, which exhibit these precursors. Third, we compare obtained results with climatology of detected regions and uncover the origins of such anomalous behavior. Finally, demonstrate that obtained regions might be used as markers of upcoming critical transition, and based on it we formulate an indicator for the monsoon onset.