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Advance in Forecasting Indian Monsoon Onset and Withdrawal: Evidence from Retrospective to Prospective Evaluation

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More than 1.35 billion people in India rely on the Indian summer monsoon for water to drink, to irrigate crops and to raise livestock. Although the rainy season happens annually between June and September, the time of monsoon season's onset and withdrawal varies within a month from year to year. Such variability strongly affects agricultural production. In particular, for planning the agriculture cycle, farmers need to know one month in advance when the monsoon arrives. However, official monsoon forecast is delivered two weeks before monsoon onset and for Kerala only - a state in South India. Other states receive the information in the frame of operational weather forecast 2 - 5 days in advance. There is no forecast of withdrawal date at all due to lack of methodology. The worst situation is in central India, which suffering from severe drought before the monsoon starts. A new approach of forecasting monsoon for central India [1] promises considerable progress by showing that an accurate forecast of onset and withdrawal is possible to deliver more than one month in advance.
The new approach relies upon the recently discovered feature of monsoon: at the onset of monsoon, some atmospheric variables (in particular, in near-surface air temperature, relative humidity) pass a critical threshold. There is a similar feature at monsoon withdrawal. The critical conditions appear first in the area of the Eastern Ghats (EG), and then it propagates towards to North Pakistan (NP), the areas are defined as Tipping Elements of the Indian Summer Monsoon. The forecast for monsoon is performed for central India (EG) using data from NP area. The forecast relies on analysis of near-surface air temperature, and relative humidity from both the ERA-40 and NCEP/NCAR re-analyzes.
The results from the Tipping element approach confirm that the methodology allows forecasting the monsoon retrospectively (over the period 1951-2015) [1], as well as for the future. Thus, successful predictions for upcoming monsoon for 2016, 2017 and 2018 [2] have validated the accuracy of the methodology and proved that such early prediction of monsoon timings is possible.
The new methodology offers three key advances of monsoon forecasting: (i) predicting monsoon timing in central India where prediction has never been made, (ii) predicting the date of the upcoming monsoon onset for 40 days in advance, that is unprecedently early; (iii) forecasting withdrawal date for 70 days in advance, that is a new kind of extraordinary early forecast and the only one available in India. Altogether, it is a significant achievement in the atmospheric sciences with great practical importance for the population of India.
The new methodology opens new possibilities for regional monsoon forecasting and can be extended for other parts in India and around the globe.

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[1] Stolbova, V., E. Surovyatkina, B. Bookhagen, and J. Kurths (2016): Tipping elements of the Indian monsoon: Prediction of onset and withdrawal. GRL 43, 1–9 [doi:10.1002/2016GL068392]
[2] https://www.pik-potsdam.de/services/infodesk/forecasting-indian-monsoon