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Early forecasting of Indian Summer Monsoon: case study 2016

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The prior knowledge of dates of onset and withdrawal of monsoon is of vital importance for the population of the Indian subcontinent. In May 2016 before monsoon season, India recorded its highest-ever temperature of 51C. Hot waves have decimated crops, killed livestock and left 330 million people without enough water. At the end of monsoon season the floods in Indian this year have also broken previous records. Severe and devastating rainfall poured down, triggering dams spilling and floods. Such extreme conditions pose the vital questions such as: When will the monsoon come? When will the monsoon withdraw? More lead time in monsoon forecast warning is crucial for taking appropriate decisions at various levels - from the farmer's field (e.g. plowing day, seeding) to the central government (e.g. managing water and energy resources, food procurement policies).
The Indian Meteorological Department issues forecasts of onset of monsoon for Kerala state in South India on May 15-th. It does not give such predictions for the other 28 states of the country. Our study concerns the central part of India.
We made the monsoon forecast using our recently developed method which focuses on Tipping elements of the Indian monsoon [1]. Our prediction relies on observations of near-surface air temperature and relative humidity from both the ERA-40 and NCEP/NCAR reanalyses. We performed both of our forecasts for the onset and withdrawal of monsoon for the central part of India, the Eastern Ghats (20N,80E).
We predicted the monsoon arrival to the Eastern Ghats (20N,80E) on the 13th of June with a deviation of +/-4 days. The prediction was made on May 6-th, 2016 [2], that is 40 days in advance of the date of the forecast. The actual monsoon arrival was June 17-th. In this day near-surface air temperature and relative humidity overcame the critical values and the monsoon season started, that was confirmed by observations of meteorological stations located around the EG-region.
We forecasted the monsoon withdrawal from the Eastern Ghats on the 5th of October with a deviation of +/-5 days. We delivered this prediction on July 27-th, 2016 [3], namely 70 days in advance. The date of the actual start of monsoon withdrawal was October 10th. In this day relative humidity began to decrease. Then it passed the 80 percent threshold, and a transition back to a monsoon became impossible, meteorological stations registered it also.
We emphasize that our forecasts of the monsoon onset and withdrawal were delivered for 40 and 70 days in advance respectively, and both of our forecasts lie within our prediction interval. Hence, this year we proved that such early prediction of the monsoon timing is possible.

[1] Stolbova, V., E. Surovyatkina, B. Bookhagen, and J. Kurths (2016): Tipping elements of the Indian monsoon: Prediction of onset and withdrawal. Geophys. Res. Lett., 43, 1–9 [doi:10.1002/2016GL068392]
[2]https://www.pik-potsdam.de/news/press-releases/indian-monsoon-novel-approach-allows-early-forecasting?set_language=en
[3] https://www.pik-potsdam.de/kontakt/pressebuero/fotos/monsoon-withdrawal/view