

Monsoon prediction: hits, misses and false alarms

Sulochana Gadgil and J. Srinivasan

In a recent letter¹, the skill of forecasts made by the atmospheric model Varsha, at the Flosolver Laboratory, CSIR-NAL was presented. The forecasts for all-India daily rainfall for June and July of 2012 and for the all-India rainfall anomaly (i.e. the difference between the prediction for all-India rainfall for the specific month and the mean prediction for that month) were presented along with the observations. The sign of the predicted anomalies was shown to be the same as that of the observed anomalies for each month. From this result, it was concluded that 'it is not correct to argue that atmospheric models in general do not have the skill of picking up the severe deficit in rainfall of the Indian summer monsoon'.

If one considers the prediction of the correct sign of the all-India rainfall anomaly (i.e. whether it will be above or below the mean) to be a correct forecast, the June rainfall prediction for deficit rainfall cited by Sinha¹ is a hit. Consider next the forecast based on the same model for September 2012 (Figure 1). In this case, for each day, the predicted rainfall was dwarfed by the observed and while a severe drought (32% deficit) was predicted, the all-India rainfall turned out to be 11% above the average. This is an example of a loud false alarm.

For an objective assessment of the skill of the forecasts by different atmospheric/coupled models (rather than a subjective assessment of the skill for a single season), retrospective predictions (or hindcasts), for several years in the past are necessary². Under a national atmospheric model inter-comparison project, retrospective predictions by five models, including Varsha, were generated for 1984–2004 and analysed³. It was found that in 8 out of the 20 years, Varsha predicted the wrong sign of the monsoon rainfall anomaly. Thus, if the model is to be used for monsoon prediction, considerable improvement is needed for achieving an adequate level of skill.

At present, forecasts generated by different dynamical and statistical models are given to the India Meteorological Department (IMD) as an input to make 'official' forecasts. Logically, the weight to be given to each of the available forecasts in generating the official forecast should be determined by an objective assessment of the skill of each model. The nature of biases of each model can also be assessed from the retrospective predictions so that an optimum combination of the forecasts can be used for generating the official forecast. Such a determination of the official forecast is

possible only when the institute/agency responsible for issuing the forecasts has detailed information on retrospective predictions, as is the case for example, the Climate Prediction Centre, the National Centres for Environmental Prediction, USA⁴. Only when detailed information of the retrospective predictions or at least the runs of the dynamical model for several years, are provided to IMD along with the forecast, will it be possible to adopt such an objective method for generating the official forecasts, which should lead to an improvement in the forecasts.

In our view, there is no reason to believe that atmospheric and coupled atmosphere–ocean models are incapable of predicting deficit monsoon. In fact, there has been a marked improvement in the skill of the models at different international centres since about 2004 (refs 5 and 6), with better representation of sub-grid scale physical processes and land surface processes, and we do expect monsoon predictions to improve substantially in the coming years.

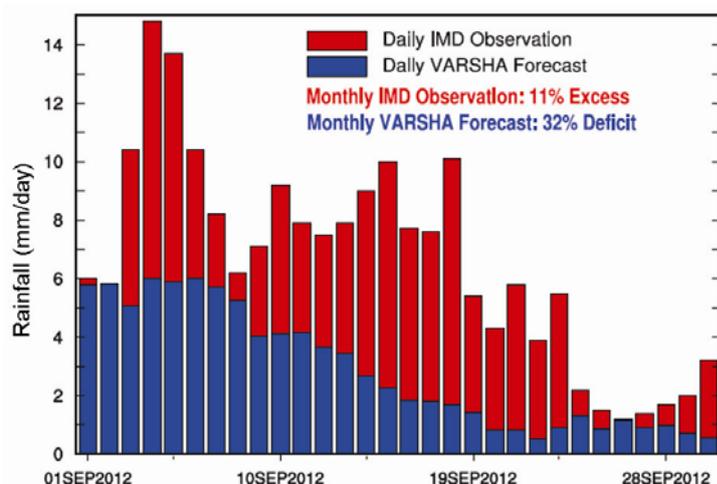


Figure 1. The daily rainfall predicted for September 2012 from a five-member ensemble of Varsha model (blue) and the observed daily rainfall (red) in September 2012.

1. Sinha, U. N., *Curr. Sci.*, 2012, **103**, 761–762.
2. Gadgil, Sulochana and Srinivasan, J., *Curr. Sci.*, 2005, **89**, 237–238.
3. Gadgil, Sulochana and Srinivasan, J., *Curr. Sci.*, 2011, **100**, 343–353.
4. Van den Dool, H. M., *Empirical Methods in Short-term Climate Prediction*, Oxford University Press, 2007.
5. Rajeevan, M., Unnikrishnan, C. K. and Preethi, B., *Climate Dyn.*, 2012, **38**, 2257–2274; doi:10.1007/s00382-011-1061-x.
6. Delsole, T. and Shukla, J., *Geophys. Res. Lett.*, 2012; <http://dx.doi.org/10.1029/2012GL051279>.

Sulochana Gadgil* is in the Centre for Atmospheric and Oceanic Sciences, and J. Srinivasan is in the Centre for Atmospheric and Oceanic Sciences and Divecha Centre for Climate Change, Indian Institute of Science, Bangalore 560 012, India.

*e-mail: sulogadgil@gmail.com