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Seasonal prediction of Indian summer monsoon precipitation using multiple models

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Skilful rainfall predictions from sub-seasonal to seasonal time scale are crucial for India due to the impact of monsoon rainfall on Indian agriculture, river systems, livelihood and economy of the country. In this work, we examine the seasonal prediction capabilities of some of the best available coupled climate models for predicting Indian summer monsoon precipitation. We use seasonal precipitation hindcasts from eight different predictions systems collated under Climate Historical Forecast Project (CHFP). Individual models show a large range in the skill at seasonal lead times. Some models show correlation skill as high as 0.6, while others show low skill. The skill of these systems is found to be strongly related to the errors in El-Nino Southern Oscillation (ENSO)-monsoon teleconnections but are only weakly related to mean-state biases. Better skill in some hindcasts can be partly explained by their large ensemble size, however, this is significant only for ensembles with less than ten members. For more than ten members, skill converges rapidly with increasing ensemble size and asymptotes to its maximum achievable limit. The skill of seasonal monsoon rainfall predictions improves only marginally when using a multi-model ensemble (MME) mean, and some individual models are as skillful as the MME. The effect of spatial averaging on the skill is also examined and results show that the predictions averaged over a larger area than the verifying observations can yield higher skill due to the extended spatial coherence of rainfall variability. Finally, we examine the ENSO-monsoon relationship and confirm that this relationship is likely to be stationary, despite fluctuations in the observed relationship, which can simply be explained as sampling variability on an underlying stationary teleconnection between ENSO and the Indian monsoon.