Prospects and status of forecasting monthly mean subregional rainfall during the Indian summer monsoon

Introduction

Forecasts of area averaged rainfall for the entire summer season, Indian summer monsoon rainfall (ISMR) are not very useful due to spatial heterogeneities and temporal variations of rainfall and limited skill of ISMR. There is a huge demand for frequent updates of rainfall forecasts for sectors such as agriculture, irrigation, water storage operation, flood and drought management, energy production etc which depends on information of accumulated rainfall over several weeks. The skill of subseasonal forecasts have improved in last many years due to developments in numerical weather forecasting such as improved estimates of atmosphere-ocean initial condition and representation of air-sea interactions in the model. However, the skill and predictability of subseasonal rainfall over different temporal and spatial scales is not known. In this study, we objectively finds the temporal and spatial scales at which S2S forecasts are most useful and analyze the external forcings which are responsible for inter-annual variability of monthly-mean rainfall.

Objectives

- **To identify the most useful temporal and spatial scales for S2S forecasting**
- **Find source of predictability of monthly-mean rainfall**

Which external forcings impact seasonal and monthly-mean rainfall ?

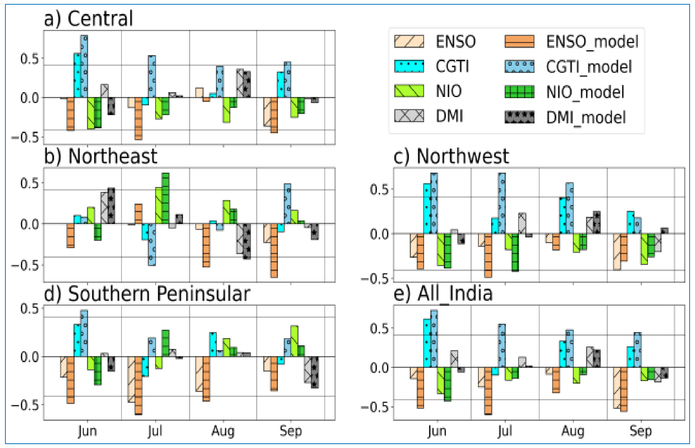

Fig 3. Correlations of monthly rainfall with ENSO, Circum-global Teleconnections(CGTI), north India Ocean (NIO) SSTs, and IO Dipole Mode Index (DMI)

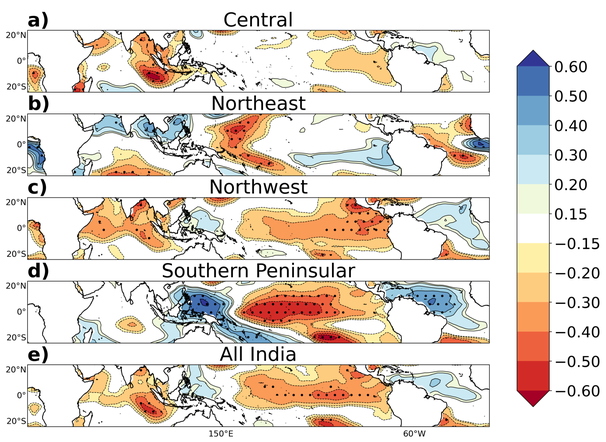

Fig 4. Correlations of tropical SSTs with regional rainfall averaged over JJAS

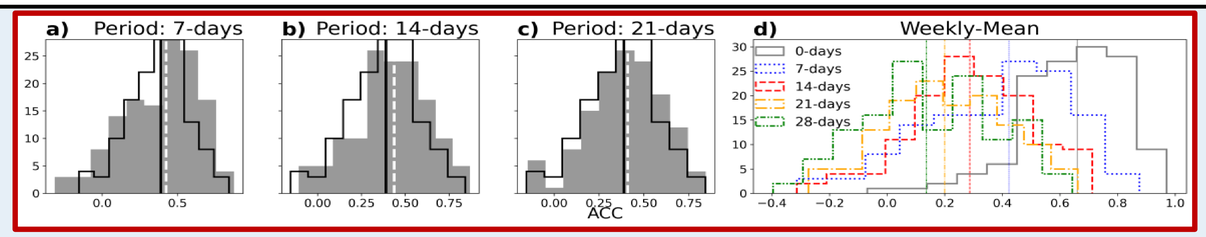

Fig 1. Distribution of skill at different averaging period (left) and leadtimes (right) over subdivisions

Impact of temporal & spatial averaging on skill

The impact of increasing the leadtime is far greater than increasing the averaging period. The correspondence between distribution of skills at different averaging period suggests that skill of monthly-mean rainfall depends highly on the information in first week of verification period. There is large heterogeneity in the skill at grid-point or subdivisional level. The high skill over homogeneous regions benefits from the coherence in rainfall characteristics.

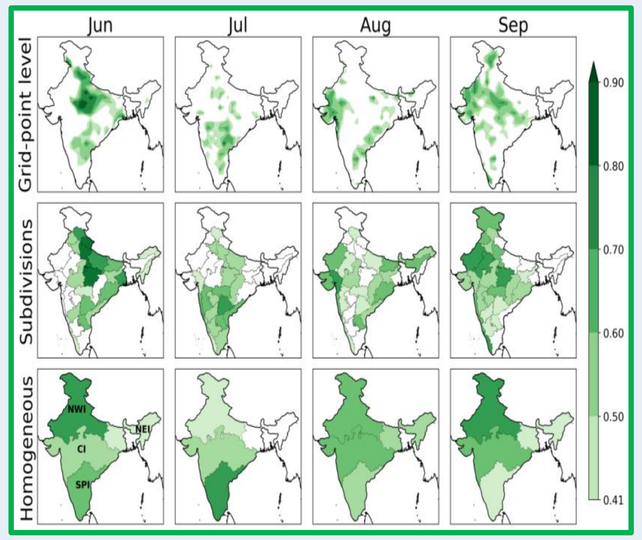

Fig 2. Monthly-mean skill at different spatial extents

Impact of influence of external forcing on seasonal and monthly-mean rainfall

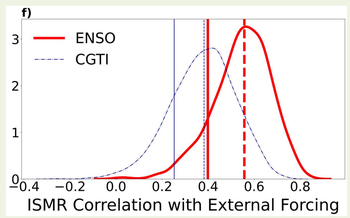

Fig 5 Distribution of ACC of ISMR with ENSO and CGTI computed using 2000 samples of 23-year timeseries randomly generated from the period 1960-2020

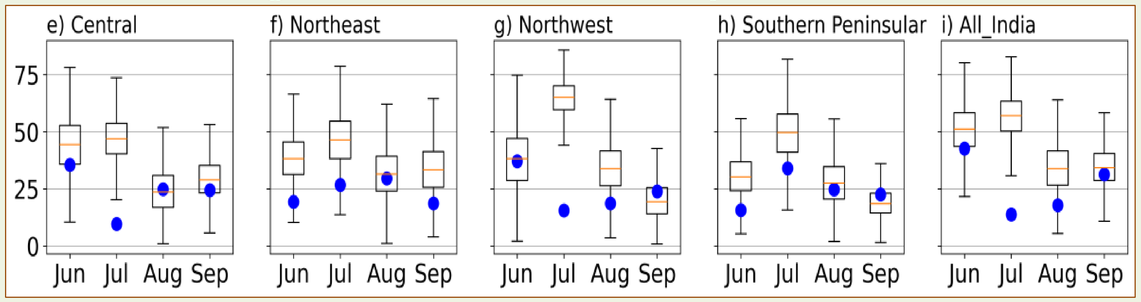

Fig 6. Percentage of monthly-mean rainfall variability that can be explained by external forcings for model (boxplot) and observed teleconnections (blue circles)

Externally forced variability (EFV) is as large as 40% of total variability of monthly-mean rainfall over some regions. This can be compared with 35-40% of ENSO-ISMR. Compared to reforecast period, there is evidence of even higher dependence of rainfall on external forcings. High predictability is seen for regions having high externally driven variability. Good correspondence between observed and simulated EFV is indicative of good skill of monthly-mean rainfall.

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