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Improving GEFS Weather Forecasts for Indian Monsoon with Statistical Downscaling

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Weather forecast has always been a challenging research problem, yet of a paramount importance as it serves the role of 'key input' in formulating modus operandi for immediate future. Short range rainfall forecasts influence a wide range of entities, right from agricultural industry to a common man. Accurate forecasts actually help in minimizing the possible damage by implementing pre-decided plan of action and hence it is necessary to gauge the quality of forecasts which might vary with the complexity of weather state and regional parameters. Indian Summer Monsoon Rainfall (ISMR) is one such perfect arena to check the quality of weather forecast not only because of the level of intricacy in spatial and temporal patterns associated with it, but also the amount of damage it can cause (because of poor forecasts) to the Indian economy by affecting agriculture Industry.
The present study is undertaken with the rationales of assessing, the ability of Global Ensemble Forecast System (GEFS) in predicting ISMR over central India and the skill of statistical downscaling technique in adding value to the predictions by taking them closer to evidentiary target dataset. GEFS is a global numerical weather prediction system providing the forecast results of different climate variables at a fine resolution (0.5 degree and 1 degree). GEFS shows good skills in predicting different climatic variables but fails miserably over rainfall predictions for Indian summer monsoon rainfall, which is evident from a very low to negative correlation values between predicted and observed rainfall. Towards the fulfilment of second rationale, the statistical relationship is established between the reasonably well predicted climate variables (GEFS) and observed rainfall. The GEFS predictors are treated with multicollinearity and dimensionality reduction techniques, such as principal component analysis (PCA) and least absolute shrinkage and selection operator (LASSO). Statistical relationship is established between the principal components and observed rainfall over training period and predictions are obtained for testing period. The validations show high improvements in correlation coefficient between observed and predicted data (0.25 to 0.55). The results speak in favour of statistical downscaling methodology which shows the capability to reduce the gap between observed data and predictions. A detailed study is required to be carried out by applying different downscaling techniques to quantify the improvements in predictions.