Evaluation of Medium-Range Maximum Temperature Forecasting Skill over India Using the MoES Grand Ensemble (MGE)

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Introduction

Ensemble Prediction Systems (EPS) represent a significant advancement in weather forecasting, enabling the assessment of forecast uncertainties and enhancing forecast accuracy and skill, especially for higher lead times (Molteni et al., 2001; Buizza et al., 2005). Eventhough ensembles are usually underdispersive (Buizza and Palmer, 1998; Leutbecher, 2018). The proper reconstruction of ensemble spread could enhance the improved representation of uncertainities. While increasing the number of ensemble members or enhancing the resolution are potential solutions (Weyn and Durran, 2018), they may also lead to higher computational costs. The use of multi model ensembles (MME) is a practical solution in this regard. MME-derived forecasts have demonstrated increased accuracy and dependability compared to their separate constituent models (Krishnamurti et al. 2000; Krishnamurti et al. 2009). The development of a grand ensemble from various ensembles has been the subject of numerous research. Recent studies by Dube et al. (2024) and Mamgain et al. (2024) have also demonstrated comparable improved skill over India in such a research employing two high resolution global EPSs.

Methodology

An MoES Grand Ensemble (MGE) consisting of 42 members was created by combining two operational ensemble forecast models in India: the NCMRWF Ensemble Prediction System (NEPS) with 22 members (Mamgain et al., 2018) and the Global Ensemble Forecast System (GEFS) with 20 members, run by the Indian Institute of Tropical Meteorology (Deshpande et al., 2020). This study represents the first evaluation of Tmax forecasts from the MoES Grand Ensemble (MGE) over India. The Tmax forecasts from the MGE, along with those from its constituent models (NEPS and GEFS), were assessed over three summer seasons (March-May) (2019,2020,2022) using standard verification metrics, such as the Continuous Ranked Probability Score (CRPS) and the Brier Skill Score. The study focused on the northwestern part (Fig.1) of the country, which experiences higher maximum temperatures.

Results

The CRPS have shown remarkable improvement for Tmax forecasts from MGE compared to NEPS and GEFS for all the the three summer seasons (Fig.2). NEPS performed better than GEFS from the CRPS over the study domain. Brier skills score estimated for Tmax > 40 ^{o}C

also exhibited noticeable improvement in BSS for MGE Tmax forecasts compared to NEPS and GEFS for all the seasons.

Future Work

A further extension of the study will involve assessing forecast skill using reliability and ROC analysis. Additionally, plans include expanding the study to other regions and implementing bias correction for the MGE Tmax forecasts.

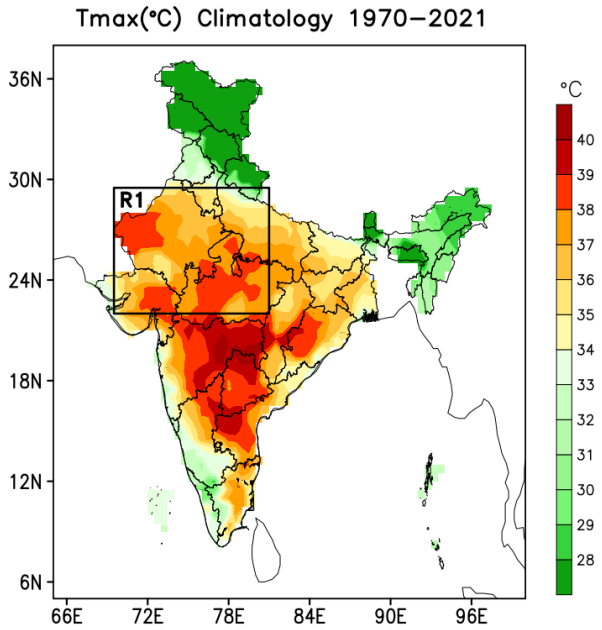

Fig.1 Study region

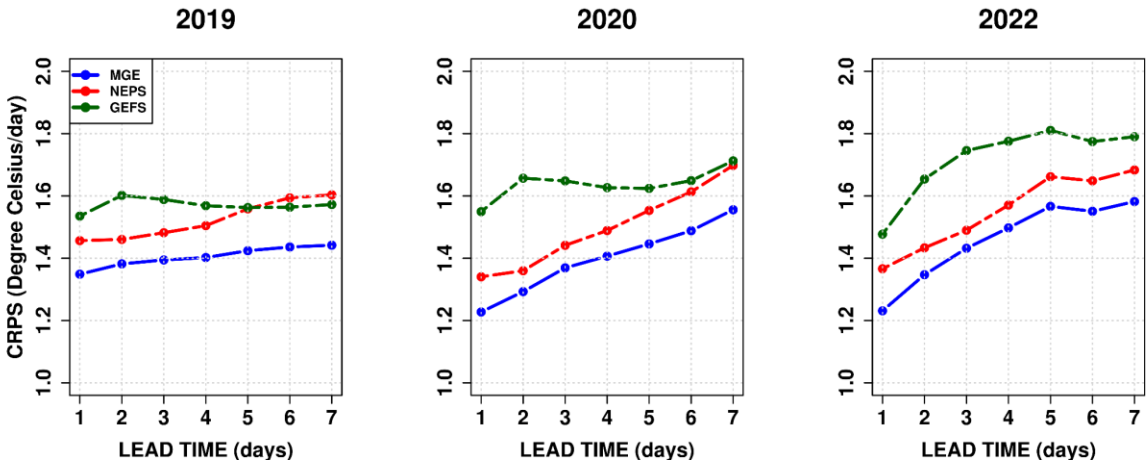

Fig.2 Continuous ranked probabilistic score of Tmax forecasts for three seasons

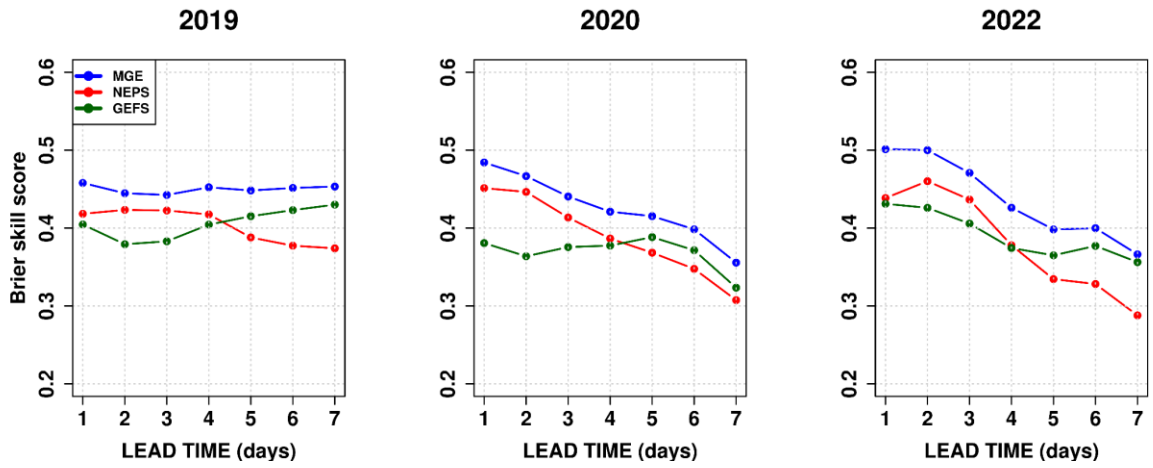

Fig.3 Brier Skill Score of Tmax > 40 ºC

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