

Probabilistic Post-processing of Temperature Forecasts for Heatwave Predictions in India

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Sakila Saminathan, Subhasis Mitra
Indian Institute of Technology Palakkad, India

TEMPERATURE FORECAST

- Analysis of temperature forecasts and methodology for post-processing forecast of length and reliability.
- The forecast reliability for temperature forecast is analyzed using the concept of reliability.
- The GCM forecast bias, systematic bias, and random error are analyzed using post-processing.
- Post-processing of temperature forecasts.

STUDY AREA & DATA USED

- Study Area: India
- Data Source: NCEP-NCAR Reanalysis
- Data Period: 1979-2019
- Data Resolution: 2.5° x 2.5°
- Data Type: Daily
- Data Format: NetCDF
- Data Access: Open Access

METHODOLOGY

RAW DATA → DATA QUALITY CHECK → DATA CLEANING → DATA ANALYSIS → POST-PROCESSED DATA

RESULTS AND DISCUSSION

Bar charts showing the number of heatwave days per year for different regions in India. The maps show the spatial distribution of heatwave days across India.

CONCLUSION

- The probabilistic approach is found to be more reliable than the traditional approach.
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ACKNOWLEDGEMENT & REFERENCE

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Sakila Saminathan, Subhasis Mitra

Indian Institute of Technology Palakkad, India



PRESENTED AT:



TEMPERATURE FORECAST

- Reliable air temperature forecasts are necessary for mitigating the effects of droughts and Heatwaves.
- The numerical weather prediction(NWP) model provides temperature forecast for short to medium range time scales (1-7 days).
- The NWP forecasts have significant biases associated and therefore need post-processing.
- Post-processing of temperature forecasts using probabilistic approaches are lacking in India.

OBJECTIVE:

1. Post-processing of Global Ensemble Forecast System (GEFS) and European Centre for Medium Range Weather Forecasts (ECMWF) temperature forecasts using two probabilistic techniques, namely, Bayesian model averaging(BMA) and Nonhomogeneous gaussian regression (NGR).
2. Skill assesment of GEFS and ECMWF NWP models raw and post-processed temperature forecasts at short to medium range time scales (1-7 days).
3. Assessing the implication of probabilistic post-processing Tmax forecast towards forecast enhancement of heatwaves (HW) in India.

STUDY AREA & DATA USED

STUDY AREA:

- Indian Subcontinent

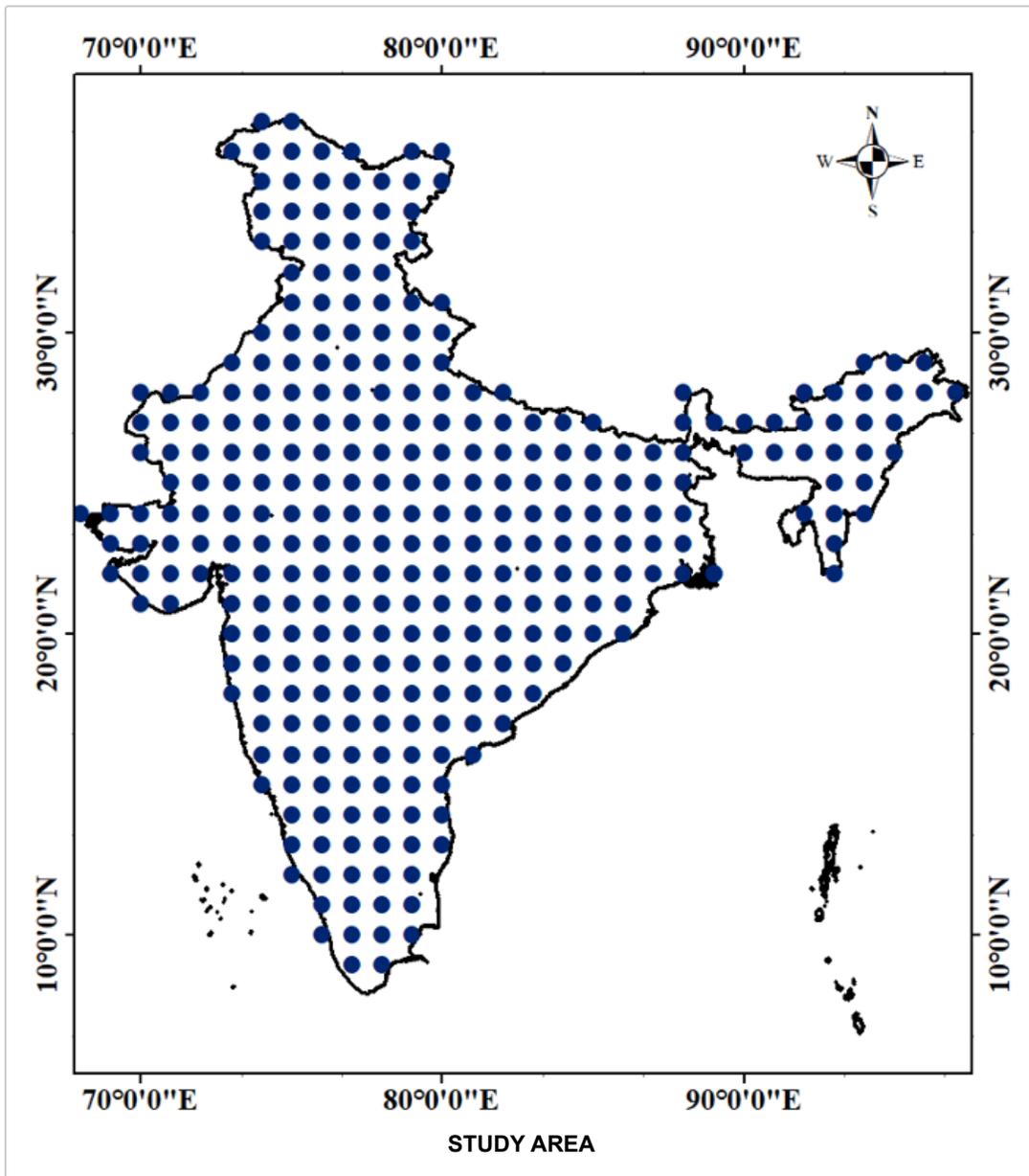
DATA USED:

Forecast Data:

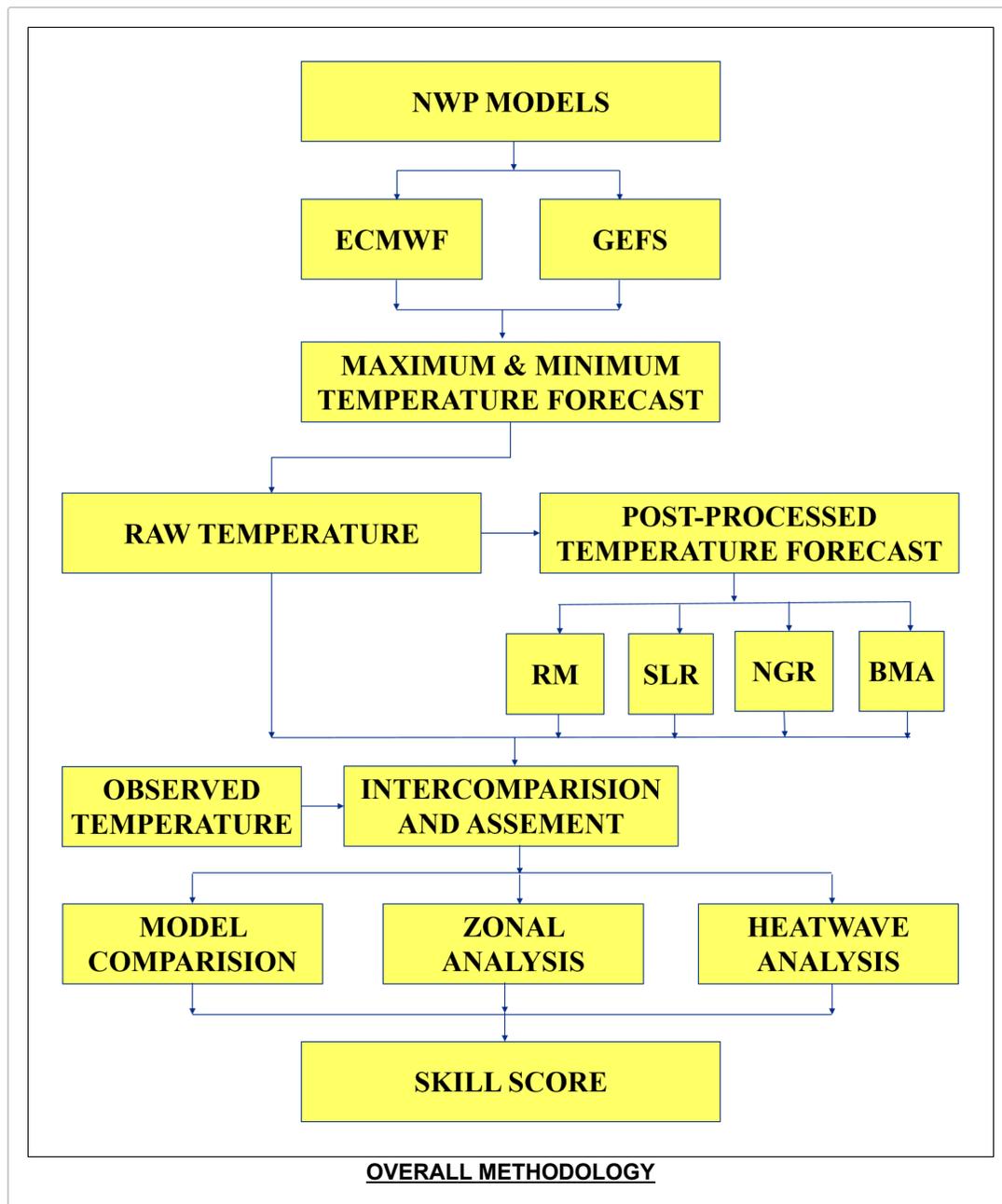
- European Centre for Medium Range Weather Forecasts [ECMWF]
- Global Ensemble Forecast System [GEFS]

Observed Data:

- India Meteorological Department [IMD]
- National Oceanic and Atmospheric Administration [NOAA]
- Spatial Resolution: $1^\circ \times 1^\circ$
- Temporal Resolution: Daily.
- Lead Days: One to Seven.

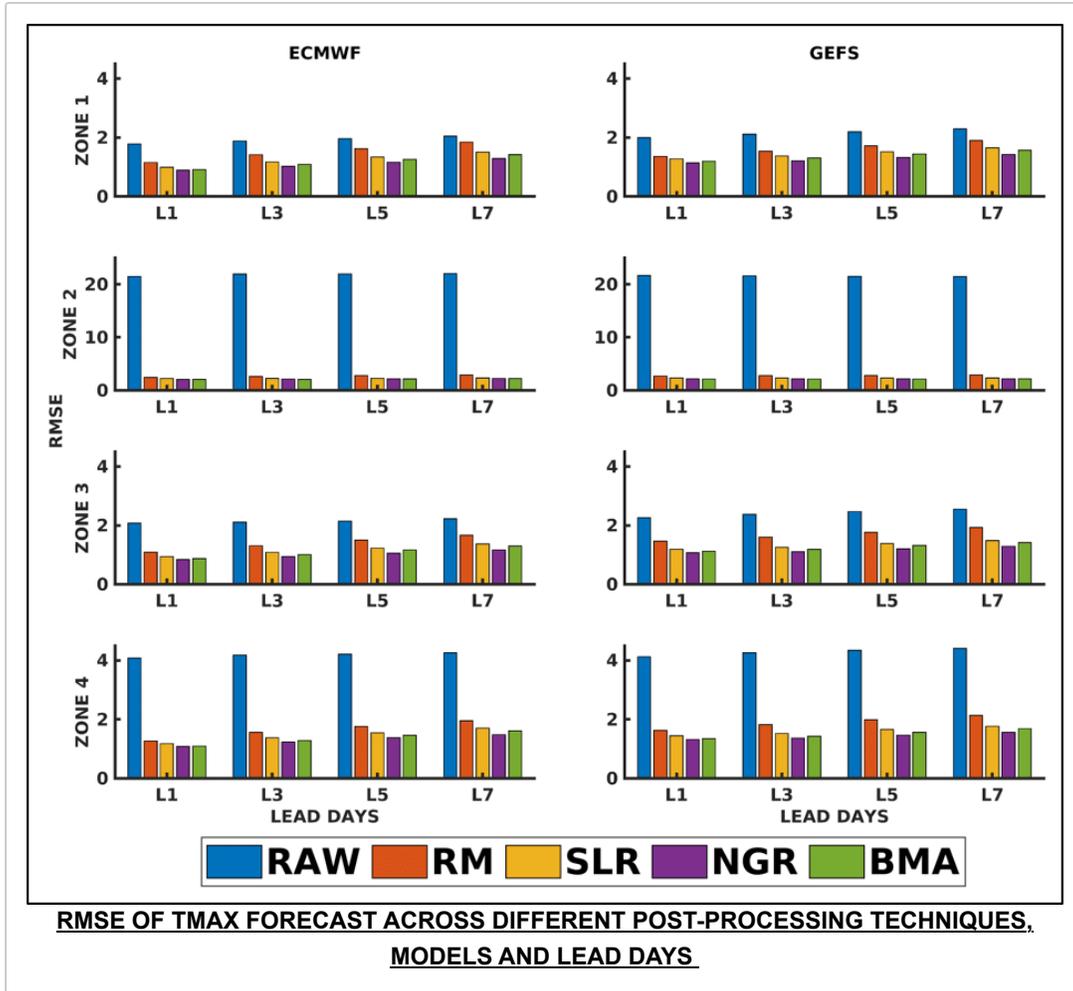


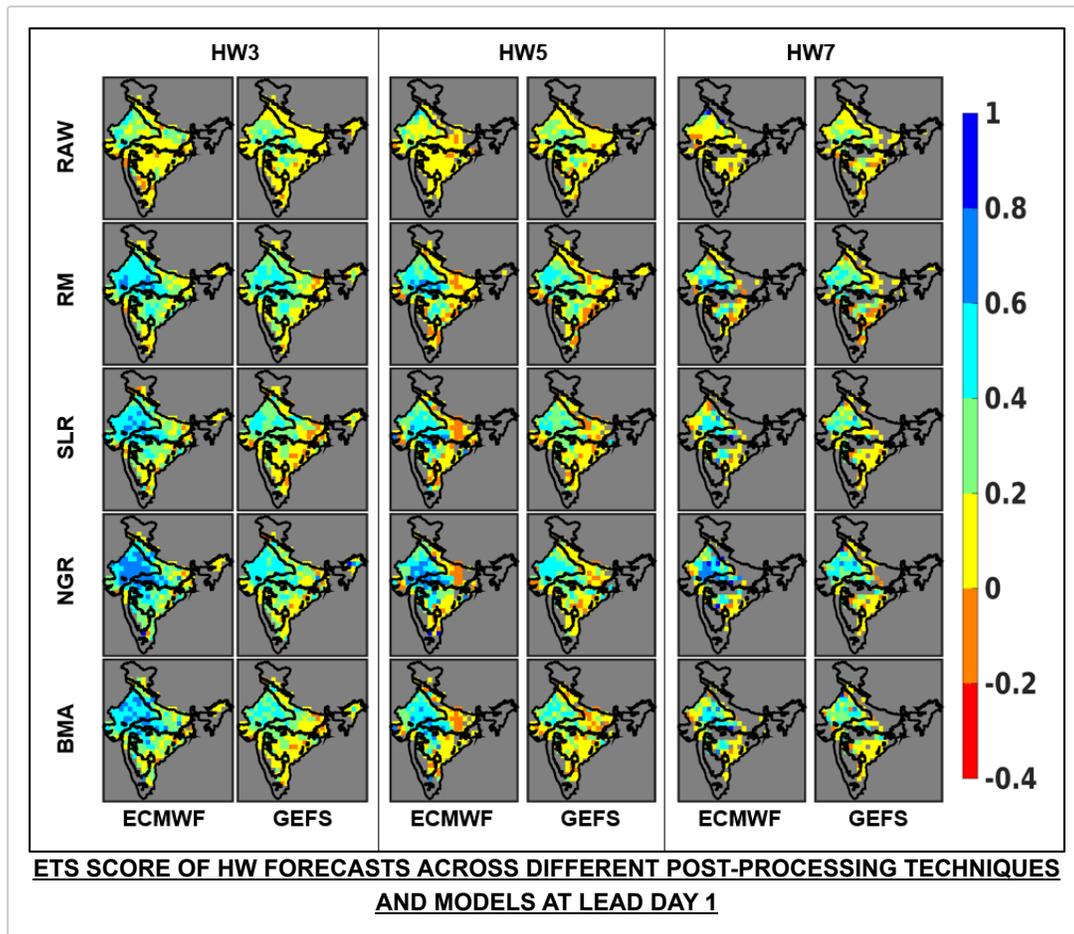
METHODOLOGY



- The ECMWF, GEFS NWP maximum and minimum temperature forecast variables are extracted at short to medium range time scale
- The models maximum and minimum temperature forecast forecast is Post-processed using Nonhomogenous Gaussian Regression and Bayesian Model Averaging.
- The post-processed and raw forecast forecast has been assessed for different zones across different NWP models.
- The implication of probabilistic post-processing Tmax forecast towards enhancement of heatwaves (HW) in India was also carried out.

RESULTS AND DISCUSSION





- Post-processed Tmax forecasts revealed that the NGR approach considerably enhanced the HW prediction skill in India, especially in the northwestern and central Indian regions, considered highly prone to HW.

CONCLUSION

- The probabilistic approaches considerably enhance the temperature predictions across India except the Himalayan regions.
- Probabilistic techniques comprehensively outperform the traditional post-processing techniques such as the running mean and simple linear regression.
- The NGR performs better than the BMA across all regions and is able to provide highly skillful temperature forecasts at higher lead times as well.
- Post-processed Tmax forecasts revealed that the NGR approach considerably enhanced the HW prediction skill in India, especially in the northwestern and central Indian regions, considered highly prone to HW.
- The findings of this study will be useful in developing enhanced HW early warning and prediction systems in India.

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FUTURE WORK:

- Post-processing of forecast using machine learning techniques.
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AUTHOR INFO

First Presenting Author

Name: Sakila Saminathan

Email:

101814002@smail.iitpkd.ac.in

Affiliation: Department of Civil Engineering, Indian Institute of Technology Palakkad, Kerala, India

Co-Author

Name: Subhasis Mitra

Email:

szm0048@tigermail.auburn.edu

Secondary Email:

smitra@iitpkd.ac.in

Affiliation: Department of Civil Engineering, Indian Institute of Technology Palakkad, Kerala, India

TRANSCRIPT

ABSTRACT

Reliable air temperature forecasts are necessary for mitigating the effects of droughts and Heatwaves. The numerical weather prediction (NWP) model forecasts have significant biases associated and therefore need post-processing. Post-processing of temperature forecasts using probabilistic approaches are lacking in India. In this study, we post-process the Global Ensemble Forecast System (GEFS) and European Centre for Medium Range Weather Forecasts (ECMWF) NWP model temperature forecasts for short to medium range time scales (1-7 days) using two probabilistic techniques, namely, Bayesian model averaging (BMA) and Nonhomogeneous gaussian regression (NGR). The post-processing techniques are evaluated for temperature (maximum and minimum) predictions across the Indian region. Results show that the probabilistic approaches considerably enhance the temperature predictions across India except the Himalayan regions. These techniques also comprehensively outperform the traditional post-processing techniques such as the running mean and simple linear regression. The NGR performs better than the BMA across all regions and is able to provide highly skillful temperature forecasts at higher lead times as well. Further, the study also assesses the implication of probabilistic post-processing Tmax forecast towards forecast enhancement of heatwaves (HW) in India. Post-processed Tmax forecasts revealed that the NGR approach considerably enhanced the HW prediction skill in India, especially in the northwestern and central Indian regions, considered highly prone to HW. The findings of this study will be useful in developing enhanced HW early warning and prediction systems in India.

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