



Heatwave Monitoring and Forecast Using Excess Heat Factor Index (Background Information)

Heatwaves are a significant cause of environmental and health hazards. This bulletin has two major components:

- Heatwave Index Monitoring over the Indian region
- Prediction of Heatwave index for the next two days (48hrs) using an LSTM-based framework.

Heatwave Indices: We choose the **Excess Heat Factor (EHF)** index based on previous studies (Nairn & Fawcett (2015); Rohini et al. (2016) along with the maximum temperature (Tmax). These indices are defined in the panel below:

(i) Excess heat signature index:

$$EHI_{sig}(i) = \frac{T_i + T_{i-1} + T_{i-2}}{3} - T_{95}$$

T_{95} is the 95 percentiles of mean Temperature for the day “ i .”

(ii) Heat Stress index:

$$EHI_{accl,i} = \left[\frac{T_i + T_{i-1} + T_{i-2}}{3} \right] - \left[\frac{T_{i-3} + \dots + T_{i-32}}{30} \right]$$

where the nomenclature is the same as earlier.

(iii) Excess heat Factor index:

$$EHF_i = \max(1, EHI_{accl,i}) \times EHI_{sig,i}$$

A positive value of the EHF (>0) indicates the extreme heatwave-like condition.

Panel-1: The panel defines the heatwave indices used in this study. It is based on Temperature (T) for the day “ i ”

Data: This bulletin is prepared based on IMD Daily gridded maximum and minimum temperature data.

References

Nairn JR, Fawcett RJB. The Excess Heat Factor: A Metric for Heatwave Intensity and Its Use in Classifying Heatwave Severity. *International Journal of Environmental Research and Public Health*. 2015; 12(1):227-253.

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Narkhede, N., Chattopadhyay, R., Lekshmi, S., Guhathakurta, P., Kumar, N., and Mohapatra, M.: An empirical model-based framework for operational monitoring and prediction of heatwaves based on temperature data, *Model. Earth Syst. Environ.*, <https://doi.org/10.1007/s40808-022-01450-2>, 2022.

Rohini, P., Rajeevan, M., and Srivastava, A. K.: On the Variability and Increasing Trends of Heat Waves over India, *Sci. Rep.*, 6, 26153, <https://doi.org/10.1038/srep26153>, 2016.

(a) Heatwave Monitoring over Indian Region

Excess Heat Factor (EHF) index provides an estimate of excess temperature based on last 30 days excess and last three days extreme.

Interpretation of EHF: Regions with EHF > 0.0 are to be monitored for heatwave type of situations (**Figure 1** in Bulletin).

(b) EHF Tendency over Indian Region

The tendency of EHF for any day ‘ i ’ over each grid point is calculated as:

$$EHF\ Tendency(i) = \frac{EHF(i) - EHF(i - 2)}{2}$$

Interpretation of EHF Tendency: The regions with an increasing tendency of EHF and the Tmax ≥ 40.0 °C (if exist) should be monitored for heatwave type of conditions (**Figure 2** in Bulletin).

(c) Prediction of EHF based on an LSTM Model

The EHF index for the next two days are forecasted over the Indian region based on a LSTM model (Narkhede et al., 2022).

Interpretation of Prediction: The regions with EHF > 0.0 are shaded (orange red colour) and these regions should be watchful for the next two days for heatwave type of conditions (**Figure 3** in Bulletin).