Methodology of Prediction of Heat Waves

Heat wave is predicted based on:-

- Synoptic analysis
- Climatological analysis.
- Consensus guidance from various regional and global numerical prediction models including WRF, GFS, GEFS, NCUM, UMEPS, UM Regional etc.
- Dynamical statistical techniques.

Temporal & Spatial Scales of Heat Wave Warnings:

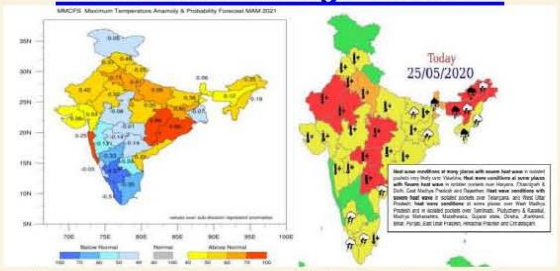
Seasonal Outlooks: Meteorological Sun-division wise anomalies of maximum and Minimum Temperatures for next 3 months issued in beginning of March & April.

Extended Range Forecasts: Meteorological sub-division wise spatial maps for bias corrected Maximum and Minimum Temperatures and their anomalies are issued every Thursday with validity of 2 weeks.

Medium Range Forecasts: Colour coded warnings for 36 Meteorological sub-divisions and ~ 739 districts issued daily for upto 5 days.

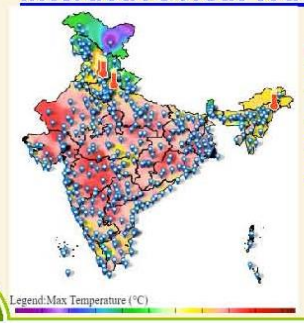
City Forecasts for ~ 470 cities/towns: Quantitative forecast for Maximum and Minimum Temperatures and Heat waves is issued daily with validity upto 5 days.

Heat Wave Warnings Products



Seasonal Outlook Medium Range Forecast

Interactive Heat Wave warning map



URL:- http://imdgeospatial.imd.gov.in/Min_Temperature/#3/47.64/211.46

Impact based Forecast of Heat Waves

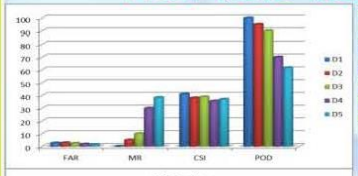
Warning	Impact	Suggested Actions
Nil	Comfortable temperatures	No cautionary action required
Heat wave conditions at district level, likely to persist for 2 days	Heat is tolerable for general public but moderate health concern for vulnerable people e.g. infants, elderly, people with chronic diseases.	Avoid heat exposure
i. Severe heat wave conditions likely to persist for 2 days. ii. With varied severity, heat wave is likely to persist for 4 days or more.	Increased likelihood of heat illness symptoms in people who are either exposed to sun for a prolonged period or doing heavy work. High health concern for vulnerable people e.g. infants, elderly, people with chronic diseases.	Avoid heat exposure– keep cool. Avoid dehydration
i. Severe heat wave likely to persist for more than 2 days. ii. Total number of heat/severe heat wave days likely to exceed 6 days.	Very high likelihood of developing heat illness and heat stroke in all ages.	Extreme care needed for vulnerable people.

Warning Dissemination mechanism:

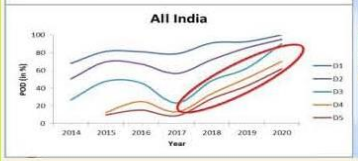
- Email to Ministries of Home Affairs, Health, National, State & District Disaster Management Authorities, Chief Secretaries/Health Secretaries of states, Health Officers at states & districts, Indian Railway, Road transport etc. .
- Social Media: Facebook (www.facebook.com/India.Meteorological.Department) & Twitter handles of IMD (@Indiametdept) and NDMA and WhatsApp Groups.
- Electronic and Print media warnings are disseminated.
- National and regional IMD websites (https://mausam.imd.gov.in).
- Multi-media messages every Thursday (www.youtube.com/channel/UC_qxTReoq07UVARm87CuyQw).

Heat Waves Warning Skills of IMD

Heat wave warning skill



High heat wave warning skill during 2020, Probability of Detection (PoD) is between 100 to 60% between Day 1 to Day 5.



High improvement in skill scores specifically from Day 3 to Day 5.

Heat Wave Warning Services
India Meteorological Department
Ministry of Earth Sciences
Government of India

Vision

- No heat wave should go undetected and unpredicted.
- Heat wave warnings to be issued with reasonable accuracy and sufficient lead period to enable public and disaster managers to minimize loss of life and property.

Mission

- To monitor, predict and provide Impact based forecast and risk based warning.
- Heat hazard analysis.
- Support implementation of heat action plan.
- Research and Development of tools and technology to improve heat wave forecasting and warning.

Heat Wave:-

- Qualitatively, heat wave is a condition of air temperature which becomes fatal to human body when exposed.
- Quantitatively, it is defined based on the temperature thresholds over a region in terms of actual temperature or its departure from normal.

Criteria for declaration of Heat Wave:-

- Heat wave is considered when Maximum Temperatures are ≥ 40°C for plains, ≥ 37°C for coastal stations and ≥ 30°C for Hilly regions.

Based on Maximum Temperature Departure from Normal

- Heat Wave: Departure between 4.5°C to 6.4°C.
- Severe Heat Wave: Departure > 6.4°C

Based on Maximum Temperature

- Heat Wave: Max. Temperature ≥ 45°C
- Severe Heat Wave: Max. Temperature ≥47°C

Warm Night:

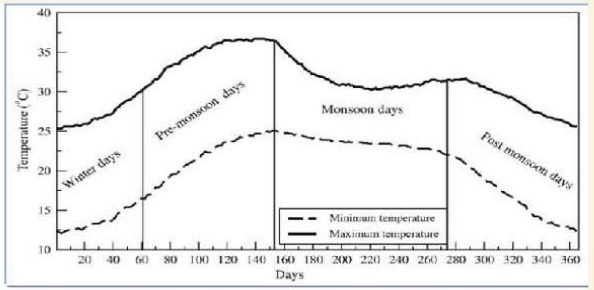
- Considered when Maximum Temperatures ≥ 40°C and departures of Minimum Temperatures from normal are as follows:
- Warm Night: Departure between 4.5°C to 6.4°C.
- Very Warm Night: Departure > 6.4°C.

Heat Index & Heat Discomfort

- Heat index is the combination of air temperature and relative humidity & is a measure of how hot it really feels when relative humidity is factored in with the actual air temperature.
- Heat Discomfort: is determined by a combination of meteorological (temperature, Relative Humidity, wind, direct sunshine), social/cultural (clothing, occupation, accommodation) and physiological (health, fitness, age, level of acclimatization) factors.

Climatology of Heat Waves

➔ The high Temperatures start building over central India in April and spreads northwards during May. Due to southwest monsoon onset during June, high temperatures are mostly seen over northwest India.

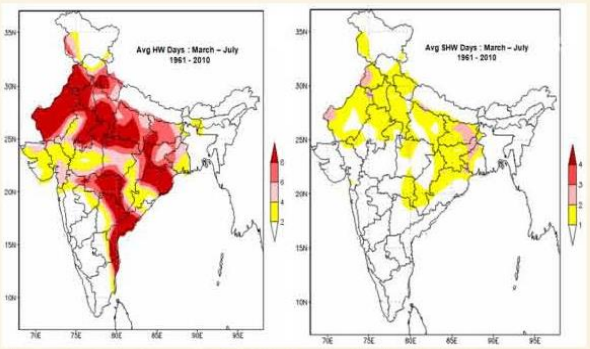


Annual cycle of All-India daily maximum and minimum temperatures

➔ Month of May experiences maximum number of Heat wave days along with maximum spatial coverage.

➔ Maximum heat wave events during summer season are seen over northwest and plains of north India and also over eastern and central India.

➔ Number of heat wave days ranges from 1-2 weeks and severe heat wave days upto 1 week over heat core zone of the country.



Number of HW days & SHW days during the hot weather season (March-July) over India (pai et.al)

Causes of Heat Waves

- A heat wave is formed due to static high pressure at upper atmosphere.
- This generates hot mass of air and traps more heat due to reduction in convection currents.
- This air mass accumulated heat and humidity causing abnormally high temperatures.
- Other factors for heat waves are:-

➔ Transportation / Prevalence of hot dry air over a region.

➔ Absence of moisture in the upper atmosphere.

➔ The sky should be practically cloudless.

➔ Large amplitude anti-cyclonic flow over the area.

Monitoring of Heat Waves

Heat wave is monitored with:

➔ Surface Observatories.

➔ Upper Air Observations.

➔ Satellite Observations.

Climatology of maximum temperature is prepared for period 1981-2010.

Based on actual temperature and its departure from normal, IMD declares heat wave over the region as per criteria of Heat Waves.

IMD: (Three Tier heat wave Forecasting)

Level	Responsibility
	NATIONAL
NWFC	Met Subdivision Forecasting & Warning, Guidelines Developmental work.
	REGIONAL
RMC (06)	District-wise Forecasting/warning, other Forecasts.
	LOCAL
MC (21)	District-wise Forecasting/warning, other Forecasts.