

Ministry of Earth Sciences (MoES)

India Meteorological Department

Seasonal Outlook for the Temperatures during the 2017 Cold Weather Season (December 2016 – February 2017)

Highlights

- Country averaged mean land surface air temperature during 2016 till October was significantly above normal (0.90°C from 1961-90 normal). The year 2016 is likely to end up as one of the warmest years since 1901.
- During the coming Cold Weather Season (December 2016 to February 2017), warmer than normal maximum and minimum temperatures are likely in all the meteorological sub-divisions of the country and warmest temperature anomalies are likely in majority of the subdivisions from northwest & northeast India.
- Below normal cold wave (CW) conditions are very likely over core cold weather zone (North India) during the 2016/2017 Cold Weather Season.

1. Background

The country experiences cold weather primarily during December to February. During this season, many parts of the country experience cold wave conditions (days with abnormally cooler temperatures) with many adverse consequences. Abnormally below normal temperatures can have devastating effects on human health, water supply and power generation and outage. In an average, about 780 deaths particularly of homeless people take place due to cold waves during each year. Several deaths were also reported in North India during the 2015/16 winter season, the country averaged seasonal mean temperatures during the 2015/16 winter season (December to February) with anomaly of +01.30°C was warmest ever winter season since 1901. The country averaged pre-monsoon season (March-May) mean temperature was also significantly warmer than normal with anomaly of +1.25°C, which was second warmest ever spring season since 1901. Warmer than normal winter and spring seasons also resulted in the country averaged temperatures over India over the period January to October to be significantly warmer than normal in line with the warmer than normal global climate observed during the period. The annual mean land surface air temperature averaged over the country during 2016 till October is +0.9°C above the 1961-1990 average and 2016 is likely to end up as one of the warmest years since 1901.

Analysis of minimum temperature data over the country during the last four decades suggests decreasing trends in the frequency and duration of cold waves in many parts of the country in tune with the decreasing trends in cold waves observed over many other parts of the world. One of the reasons behind the decreasing trend in the cold waves is the global warming. However, the ocean conditions over the equatorial Indian and Pacific oceans also contribute to the year to year variability of cold waves over the country.

India Meteorological Department (IMD), Ministry of Earth Sciences had for the first time issued a seasonal outlook for the temperatures during the hot weather season (April to June) this year (2016) which could successfully indicate the observed above normal temperature pattern over the country. In the same way, IMD has now prepared a seasonal outlook for the 2016/2017 winter temperatures over the country based on predictions using an ocean-atmosphere coupled climate model. In addition, IMD will issue cold wave alerts and warnings valid for next 15 days based on the same model regularly during the season.

1. The Coupled Dynamical Forecast System

Under the Monsoon Mission, the Indian Institute of Tropical Meteorology (IITM), Pune, Ministry of Earth Sciences has been developing a state-of-the-art coupled climate model for generating monsoon forecasts. The model has a spatial resolution of about 38 km and improved modules of model physics. The model was used to prepare the subdivision scale temperature forecast for the 2016 hot weather season (April to June) over the country. The analysis has shown that the model has also useful skill for predicting seasonal temperatures during the cold weather Season (December to February) over India. Therefore, this climate model was used to prepare an outlook for the 2016 winter temperatures. The model climatology was prepared using retrospective forecasts generated for 27 years (1982-2008) based on the October initial conditions. The forecast for the 2016 cold weather season was prepared using 27 ensemble member forecasts.

2. ENSO conditions in the Pacific Ocean

The warm neutral ENSO conditions over equatorial Pacific that prevailed till June turned to cool neutral conditions thereafter. Currently, the SST conditions over equatorial Pacific suggest border line La Nina conditions. The latest forecast from Monsoon Mission coupled model forecasting system indicates strong probability (90%) of neutral ENSO conditions to return back during the cold weather season (DJF). Many other global models forecast indicate cool neutral conditions to prevail during the season.

3. Forecast for the 2017 Cold Weather Season (December to February)

Fig.1, Fig.2 & Fig.3 show the forecast for the subdivision-wise averaged maximum, minimum and mean temperature anomalies (departures from the long term normal) respectively over India for the 2017 cold weather season (December 2016 to February 2017). The forecast indicates that during the 2016/2017 cold weather season, temperatures (mean, maximum and minimum) in all the sub-divisions are likely to be warmer than normal.

The season averaged maximum temperatures of most of the subdivisions from northwest India and northeast India are likely to be warmer than normal by $\geq 0.5^{\circ}\text{C}$ with averaged maximum temperatures over Jammu & Kashmir, west Rajasthan, and Delhi, Haryana & Chandigarh to be warmer by $\geq 1^{\circ}\text{C}$. The remaining subdivisions are likely to be warmer than normal by $< 0.5^{\circ}\text{C}$.

The season averaged minimum temperatures of Uttarakhand, sub-Himalayan west Bengal & Sikkim, Telangana, and 3 subdivisions (Konkan & Goa, coastal Karnataka and Kerala) are likely to be warmer than normal by $< 0.5^{\circ}\text{C}$ and that of the remaining subdivisions are likely to warmer than normal by $\geq 0.5^{\circ}\text{C}$ with one subdivision (west Rajasthan) likely to be warmer than normal by $\geq 1^{\circ}\text{C}$.

The season averaged mean temperatures of all the subdivisions (except Himalayan west Bengal & Sikkim) north of Peninsular India are likely to be warmer than normal by $\geq 0.5^{\circ}\text{C}$ with three subdivisions from northwest India, namely, Jammu & Kashmir, west Rajasthan, and Delhi, Haryana & Chandigarh to be warmer by $\geq 1^{\circ}\text{C}$. Most of the subdivisions from Peninsular India are likely to be warmer than normal by $< 0.5^{\circ}\text{C}$.

There is also a high probability (83%) of grid point minimum temperatures in the core CW zone during the 2016/2017 cold weather season to be above normal (**Fig.4**). Core Cold wave zone covers states of Jammu & Kashmir, Punjab, Himachal Pradesh, Uttarakhand, Delhi, Haryana, Rajasthan, Uttar Pradesh, Gujarat, Madhya Pradesh, Chhattisgarh, Bihar, Jharkhand, West Bengal, Orissa and Telangana and met subdivisions of Marathwada, Vidarbha, and Madhya Maharashtra.

This suggests occurrence of cold wave conditions in the core CW zone during the 2016/17 cold weather season is likely to be less than normal.

4. Extended Range Forecast Services for Cold Waves

From this season, IMD will also provide extended range forecasts (5 –day averaged forecasts for the next 15 days) of cold wave conditions over the country. This will be based on the Dynamical Extended Range Forecasting System developed by IITM Pune. The forecast will consist of probability of occurrence of cold and severe cold waves for the next 15 days updated every 5th day from 1st December, 2016 onwards. The forecasts will be made available through IMD, Delhi website (www.imd.gov.in).

Temperature Forecast: 2016 December – 2017

Maximum Temperature Anomaly

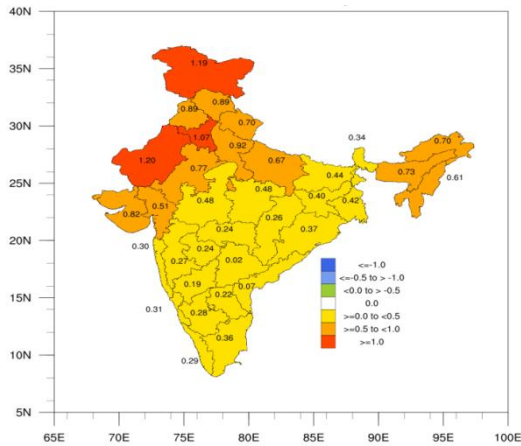


Fig.1. Minimum Temperature Anomaly forecast for the 2016/17 cold weather season (December-February).

Minimum Temperature Anomaly

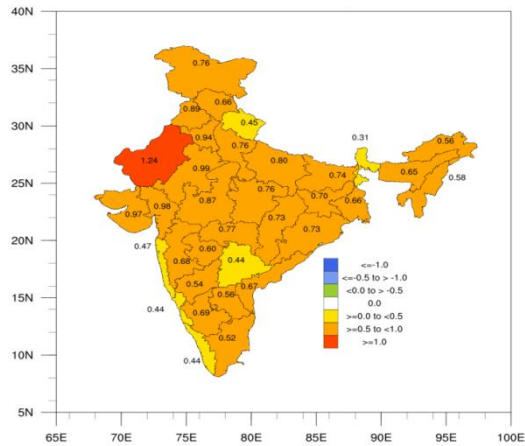


Fig.2. Maximum Temperature Anomaly forecast for the 2016/17 cold weather season (December-February).

Mean Temperature Anomaly

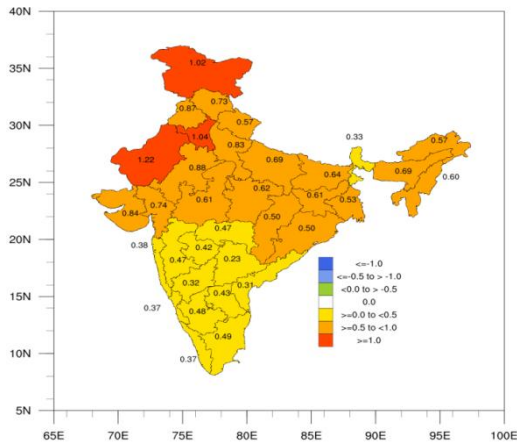


Fig.3. Mean Temperature Anomaly forecast for the 2016/17 cold weather season (December-February).

Probability Distribution of Grid Point Tmin in the Core Cold Wave Zone
:Climatology & Forecast for 2016/17 DJF

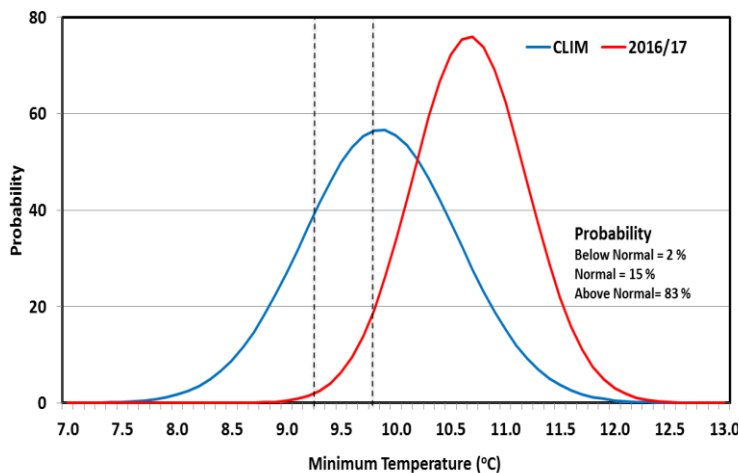


Fig.4. Climatological probability distribution of daily maximum temperatures during the cold weather season (December to February) over core cold wave zone (CCZ) is shown along with forecast probability distribution of the 2016/17 cold weather season.