



**Technical Note**

**Rainfall and Temperature Forecast of Bhutan for 2020**  
**Winter Monsoon**  
**(December 2020 – February 2021)**



*Photo courtesy @ Ugyen Thinley, Flood Warning Site Office, NCHM, Thanza, Lunana*

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## **1. Background**

Seasonal forecasts generally consist of an outlook of precipitation and temperature for a particular region and the forecasts can be issued monthly throughout the year, or simply prioritizing to the rainy season (June to September) only. In most cases, the seasonal forecast is prepared as a 3-month average, and requires a monthly updates for each subsequent 3-month period. Reliable seasonal forecast, particularly for the rainy season is of great benefit to Agricultural sectoral as most of the people in Bhutan depend on Agriculture for the livelihood. However, proper interpretation, reliability of information and efficient dissemination of seasonal forecast is required.

The seasonal forecast is prepared using a statistical model called the Climate Predictability Tool (CPT). The rainfall and temperature forecasts for the 2020 winter season are prepared using the global observed Sea Surface Temperature (SST) data as the predictor and observed rainfall and temperature data of Bhutan as the predictant. The forecast is also based on the output/products and information from WMO's Long Range Producing Centers and forecast output from the South Asian Climate Outlook (SASCOF-18) which was held online on 23<sup>rd</sup> November, 2020 for winter season. In addition, global-scale climate phenomena such as ENSO and IODs were considered.

## **2. ENSO Conditions over the Pacific Ocean**

The El Niño/Southern Oscillation (ENSO) is one of the global scale climate phenomena having significant influence on the year-to-year variability of the winter precipitation as well as the surface temperatures over South Asia. The cool ENSO neutral conditions observed over the equatorial Pacific Ocean in the beginning of the year turned in to weak La Niña conditions by the end of August 2020. Currently, the SST conditions over equatorial Pacific suggest moderate La Niña conditions. Atmospheric conditions are also indicating La Niña conditions. The latest forecasts from global climate models indicate strong probability for La Niña conditions likely to continue during the winter season (DJF).

## **3. Conditions over the Indian Ocean**

In addition to ENSO conditions over the Pacific, other factors such as Indian Ocean sea surface temperatures have some influence on the climate variability of the region. Currently the SST conditions over equatorial Indian Ocean conditions over equatorial Indian Ocean suggest neutral Indian Ocean Dipole (IOD) conditions. Forecast from global climate models indicate strong probability of neutral IOD conditions to persist during the winter season (DJF).

## 4. Winter Seasonal Outlook from International and Regional Climate Centers

### 4.1 Precipitation

#### 4.1.1 WMO Lead Centers

Probabilistic multi-model ensemble forecast of all the GPCs of WMO forecast show below normal rainfall during DJF over Bhutan.

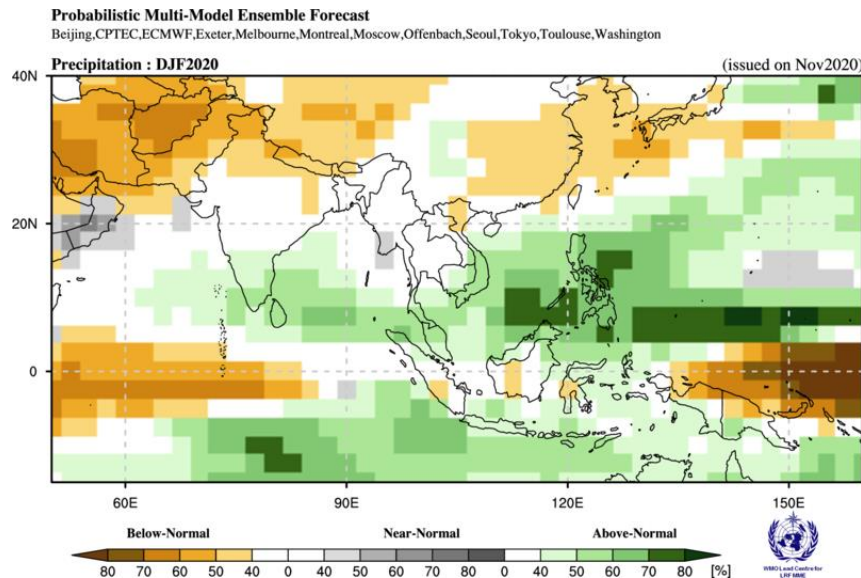


Figure 1: DJF 2020-21 precipitation forecast from all WMO GPCs.

#### 4.1.2 International Research Institute for Climate and Society (IRI)

The IRI forecast indicates below normal rainfall during DJF over Bhutan.

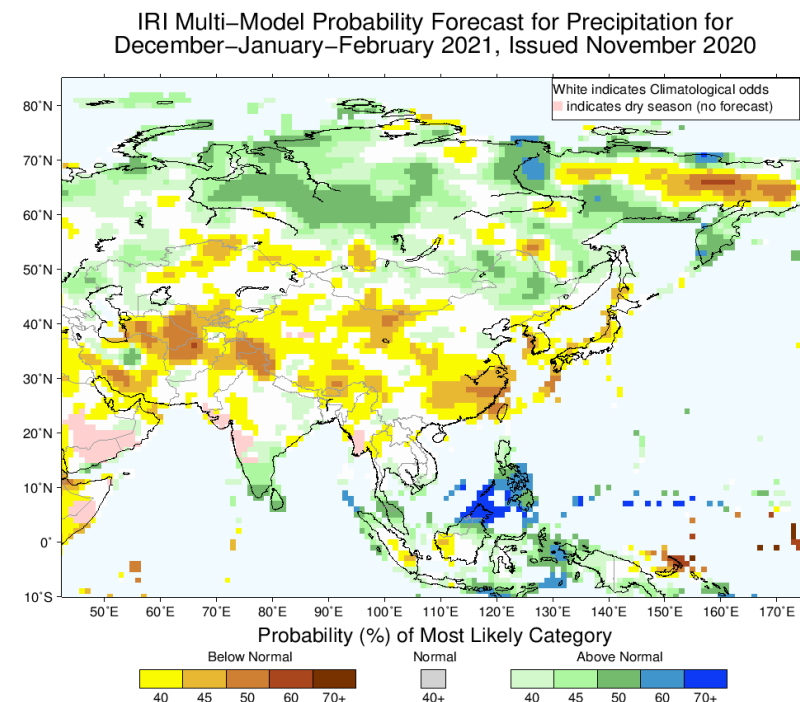


Figure 2: DJF 2020-21 Precipitation forecast from IRI

### 4.1.3 ECMWRF Seasonal Forecast

The ECMWRF forecast indicates below normal rainfall during DJF over Bhutan.

#### Precipitation - SEAS5

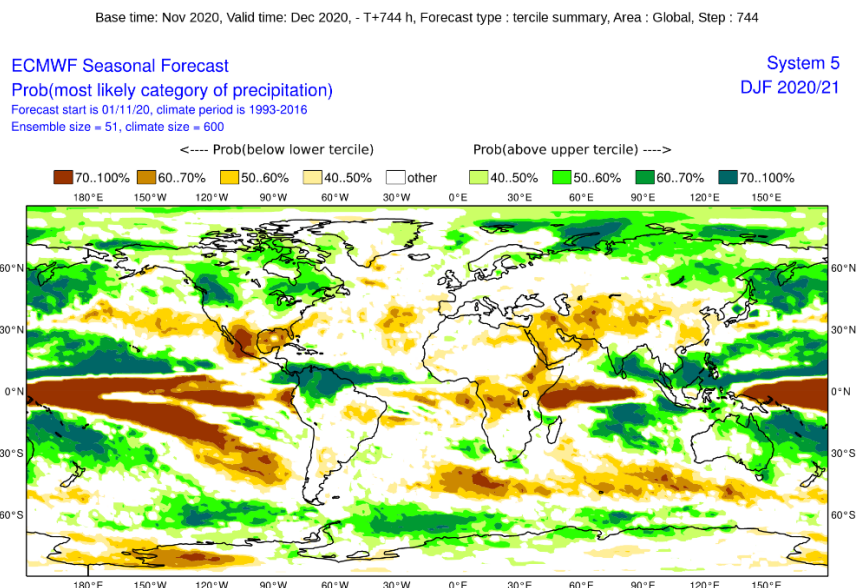


Figure 3: DJF 2020-21 Precipitation forecast from ECMWRF

### 4.1.4 Precipitation forecast from NCHM using CPT

The CPT forecast indicates below normal rainfall during DJF.

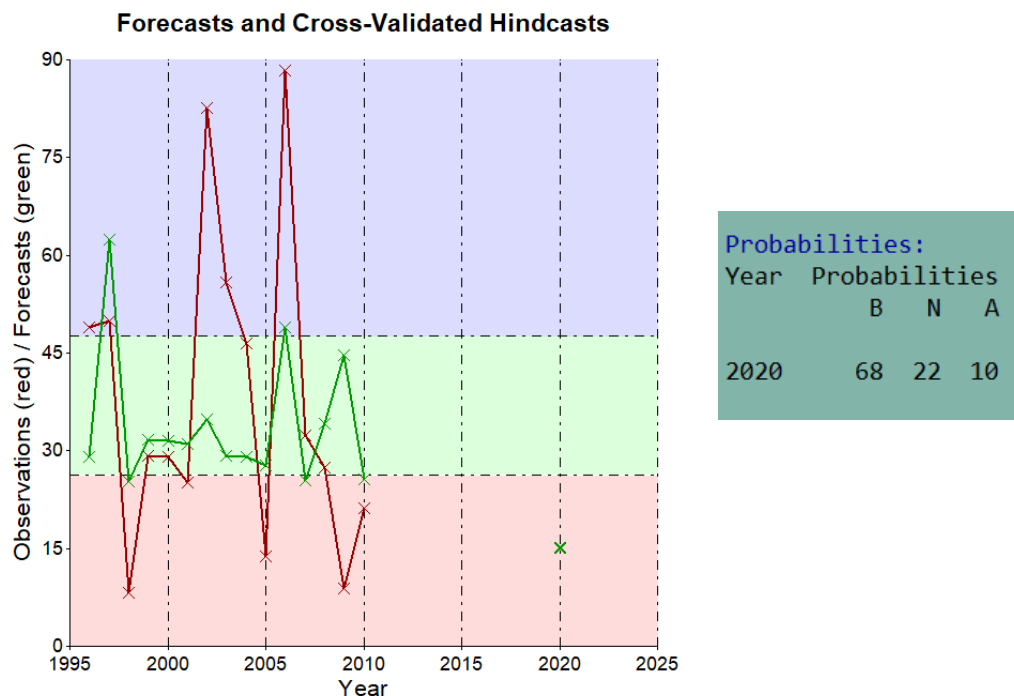


Figure 4: DJF 2020-21 Precipitation forecast from CPT



## 4.2 Temperature

### 4.2.1 WMO Lead Centers

Probabilistic multi-model ensemble forecast of all the GPCs of WMO forecast show above normal temperature during DJF over Bhutan.

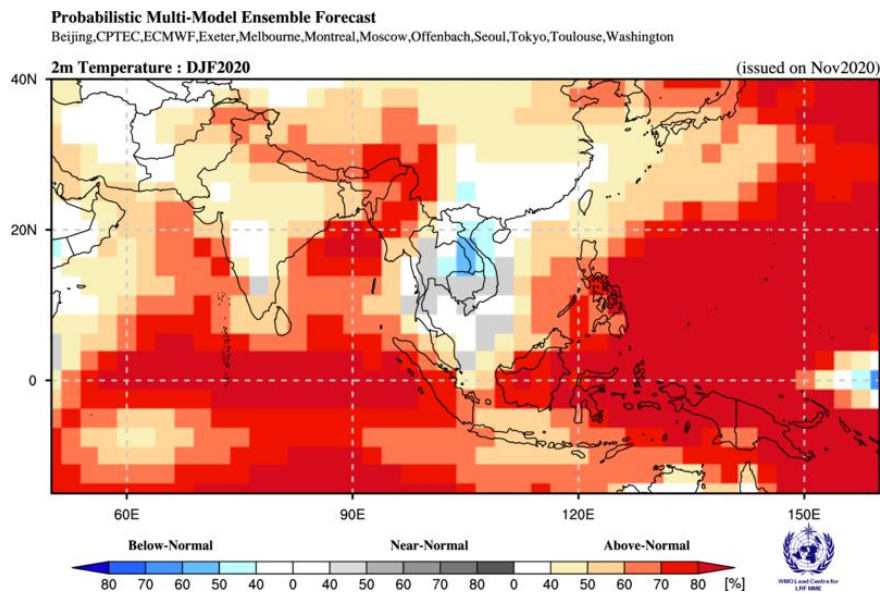


Figure 6: DJF 2020-2021 temperature forecast from WMO GPCs.

### 4.2.2 International Research Institute for Climate and Society (IRI)

The IRI forecast show above normal temperature during DJF over Bhutan.

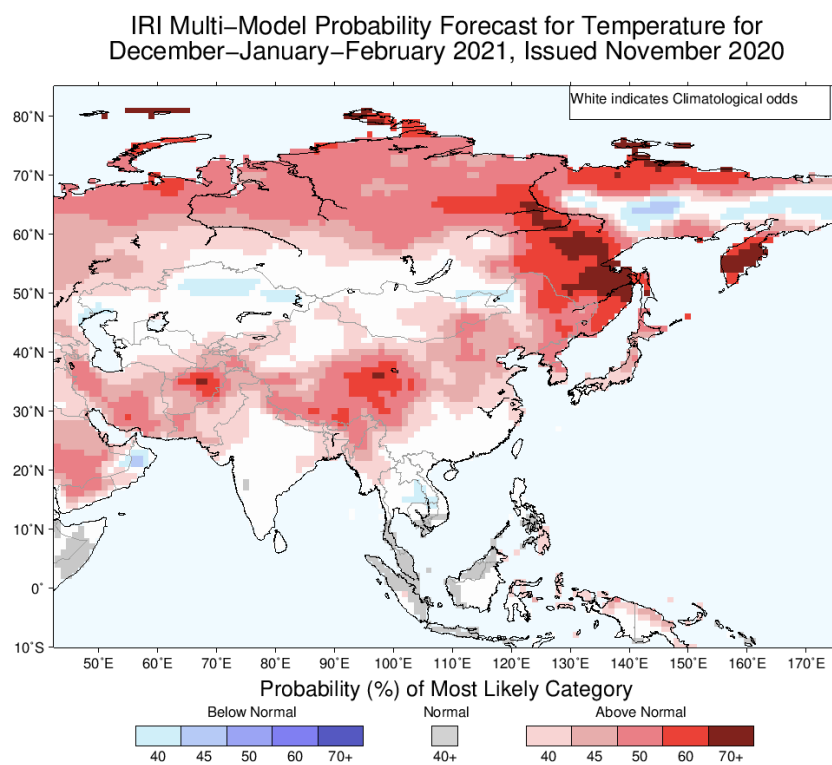


Figure 7: IRI DJF 2020-2021 temperature forecast

### 4.2.3 ECMWRF Seasonal Forecast

The ECMWRF forecast indicates above normal temperature during DJF over Bhutan.

#### 2m temperature - SEAS5

Base time: Nov 2020, Valid time: Dec 2020, - T+744 h, Forecast type: tercile summary, Area: Asia, Step: 744

ECMWF Seasonal Forecast

Prob(most likely category of 2m temperature)

Forecast start is 01/11/20, climate period is 1993-2016

Ensemble size = 51, climate size = 600

System 5

DJF 2020/21

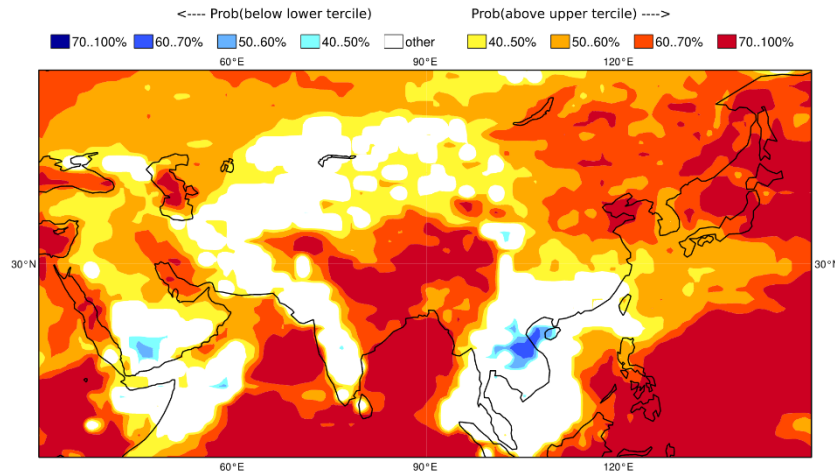


Figure 7: DJF 2020-2021 temperature forecast from ECMWRF

### 4.2.4 Temperature forecast from NCHM using CPT

The CPT forecast indicates above normal temperature during DJF.

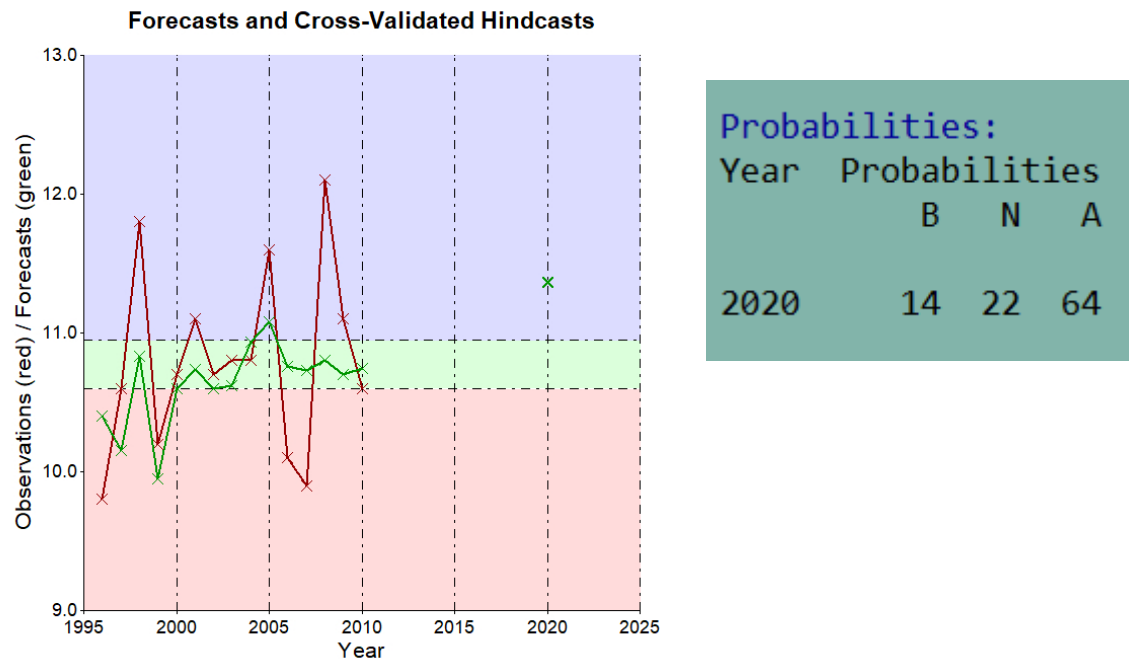


Figure 8: DJF 2020-2021 temperature forecast from CPT

## Conclusion

Based on the forecast of WMO GPCs, CPT and other global model forecast, the rainfall during the winter 2020 season will most likely be below normal and for the temperature, forecast will mostly be below normal during the winter season temperature be above normal. It is to be noted that the forecast is provided as an average across the country therefore, a slight deviations in the forecast are expected from the point or stations wise forecast.

## References:

- i. India Meteorological Department WMO Regional Climate Centre. (2020). *Consensus Statement on the Forecast for the Summer Season (June – September 2020) Precipitation and Temperatures over South Asia*, Pune, India.
- iii. WMO Lead Center for Long-Range Forecast Multi-Model Ensemble. (2020). Retrieved from [https://www.wmolc.org/seasonPmmeUI/plot\\_PMME](https://www.wmolc.org/seasonPmmeUI/plot_PMME)

## **Precipitation and Temperature Outlook for 2020-21 Winter Season**

The National Center for Hydrology and Meteorology releases the outlook for precipitation and temperature for the 2020 winter season, for the months of December 2020 to February 2021. The forecast was prepared using a statistical model (Climate Predictability Tool) with inputs such as the Global Sea Surface Temperature and Observed Data (Rainfall and Temperature) of Bhutan. For the temperature, the average of the maximum and minimum temperature was used. In addition, the outputs from the South Asian Seasonal Climate Outlook Forum (SASCOF-18), and the seasonal probabilistic multi-model ensemble of WMO Lead Centre for Long-Range Forecast were used.

### **Rainfall Forecast for 2020-21 Winter Season**

Normal is the average rainfall for winter (DJF) of Bhutan from 1996 to 2019. The winter rainfall for Bhutan during DJF 2020-21 will most likely be below normal.

### **Temperature Forecast for 2020-21 Winter Season**

The temperature forecast for Bhutan during DJF 2020-21 winter season will most likely to be above normal.