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SEASONAL CLIMATE OUTLOOK FOR SOUTH ASIA

(November 2023 to February 2024)

Highlights

- Currently, the moderate to strong El Niño conditions are prevailing over equatorial Pacific and the sea surface temperatures (SSTs) are above average over most of the central and eastern equatorial Pacific Ocean. The latest MMCFS forecast indicates moderate to strong El Niño conditions are likely to continue during the upcoming season.
- Strong positive IOD conditions are observed over the Indian Ocean and the latest MMCFS forecast indicates positive IOD conditions are likely to weaken and turn to neutral by the end of this year.
- The probability forecast for precipitation November – January (NDJ) indicates enhanced probability of above normal precipitation in most parts of northwest, north, central and in some parts of northeast, southeast and extreme southern Peninsular regions and enhanced probability of below normal precipitation in west and northern Peninsular regions of South Asia. The same for December to February (DJF) indicates that enhanced probability of above normal precipitation is likely over most parts of South Asia except over some parts of western regions where enhanced probability of below normal precipitation is likely.
- The country averaged monthly precipitation for the month of November is likely to be normal to above normal for all south Asian countries except Bangladesh and Bhutan where it is likely to be below normal. In December and January, it is likely to be above normal for all the countries. In February, it is likely to be normal to above normal for Bangladesh, Bhutan, India and Myanmar and below normal for Afghanistan, Maldives, Nepal, Pakistan and Sri Lanka.
- Temperature probability forecast for NDJ and DJF seasons indicates that enhanced probability of above normal temperatures is likely over most parts of South Asia except over some parts of northwest and most parts of north along the Himalayan Plains where probability of below normal temperature is likely.
- The country averaged monthly temperatures during November and December is likely to be normal to above normal for all south Asian countries. In January it is likely to be normal to above normal for all countries except Afghanistan, Bhutan, Nepal and Pakistan where it is likely to be below normal. In February, it is likely to be normal to above normal for all south Asian countries except Bhutan and Nepal where it is likely to be below normal.

DISCLAIMER:

- (1) The long-range forecasts presented here are currently experimental and are produced using techniques that have not been validated.
- (2) The content is only for general information and its use is not intended to address particular requirements.
- (3) The geographical boundaries shown in this report do not necessarily correspond to the political boundaries.

1. Important Global Climate Factors

1.1 Sea Surface Temperatures over the Pacific Ocean

During October 2023, warmer than normal SSTs were observed over most of the equatorial Pacific Ocean (Fig.1a). Warmer than normal SSTs were also observed over most of the northern extra-tropical regions. As compared to the last month, warming of SSTs were observed over the central equatorial Pacific Ocean near the Date Line (Fig.1b) whereas cooling of SSTs was observed over the eastern equatorial eastern Pacific Ocean. Cooling of SSTs was also observed over some region of the higher latitudes of North Pacific Ocean. The latest MMCFS forecast indicates moderate to strong El Niño conditions are likely to continue during the upcoming season (Fig. 2).

1.2 Sea Surface Temperatures over Indian Ocean

In October 2023, warm SST anomalies were observed over the north Arabian Sea and western equatorial Indian Ocean (Fig.1a). However, cold SST anomalies were observed over eastern equatorial Indian Ocean. Compared to the previous month, cooling of SSTs were observed over north Arabian Sea and eastern equatorial Indian Ocean. However, warming of SSTs were observed over north Bay of Bengal and some parts of western equatorial Indian Ocean. (Fig. 1b). The latest MMCFS forecast indicates positive IOD conditions are likely to weaken and turn to neutral by the end of this year. (Fig.3).

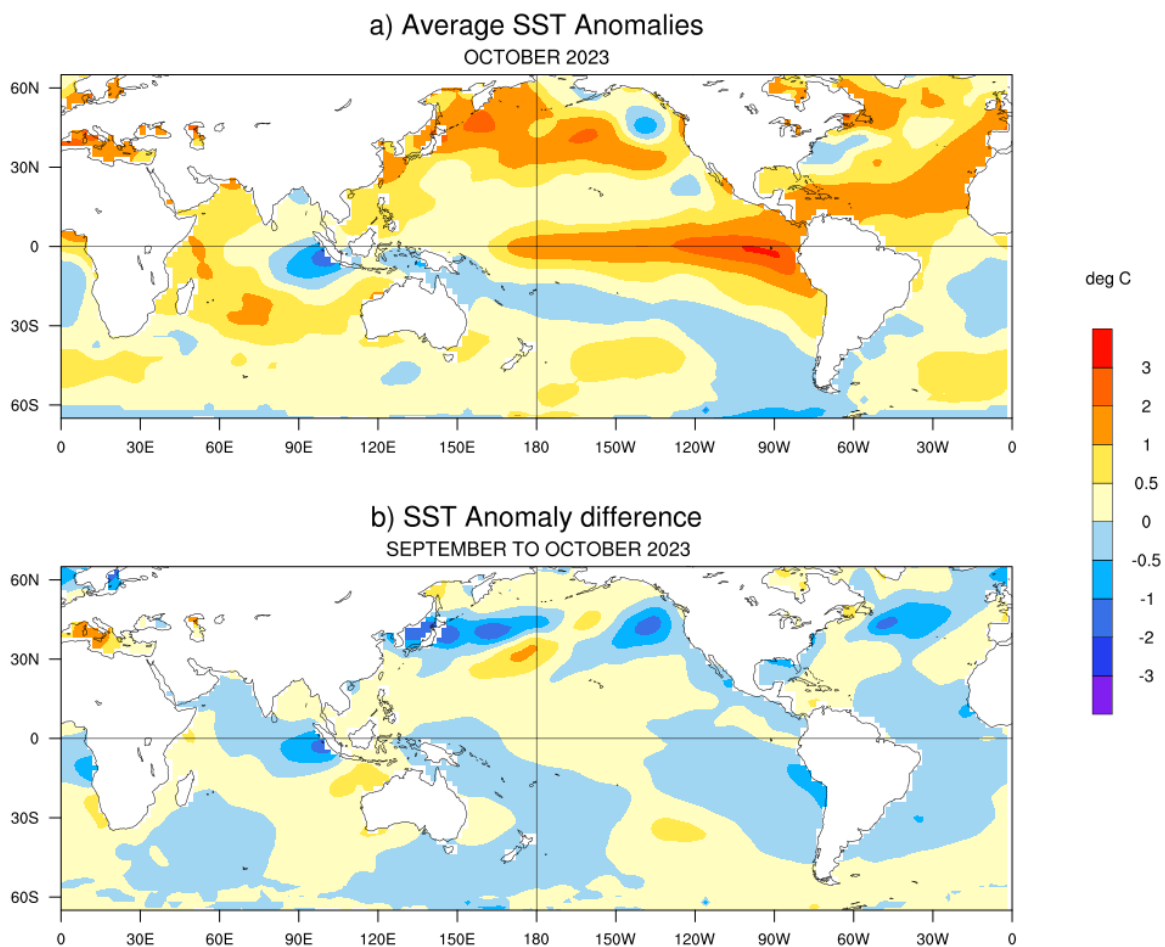


Fig.1(a) Sea surface temperature (SST) anomalies ($^{\circ}\text{C}$) during October 2023 and (b) changes in the SST anomalies ($^{\circ}\text{C}$) from September to October 2023. SSTs were based on the ERSSTv5, NOAA, and anomalies were computed with respect to 30-year (1991-2020) long term mean.

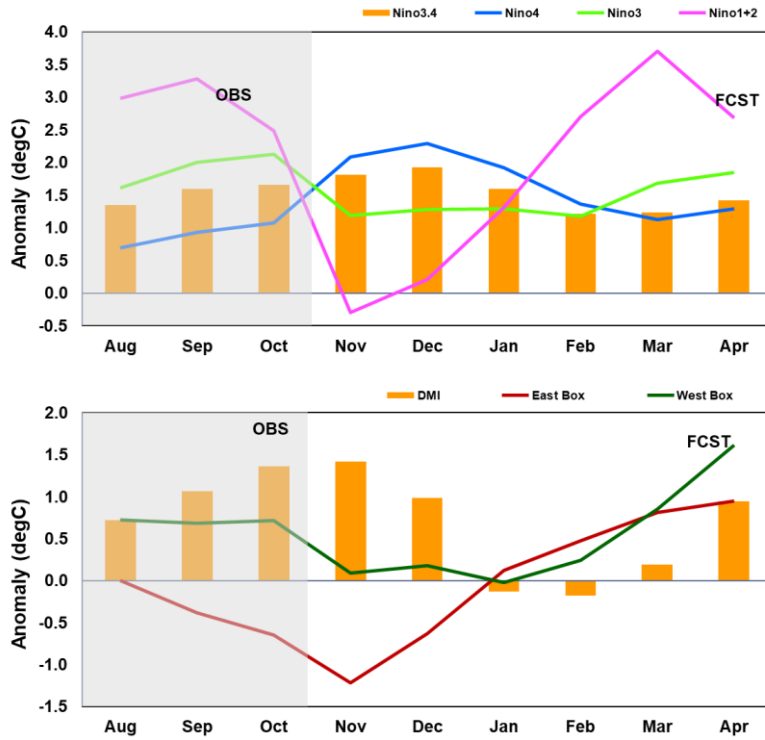


Fig.2: Time series of monthly area-averaged SST anomalies (°C) in the 4 Niño regions. ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF corrected anomaly forecast for the next 6 months.

Fig.3: The time series of the monthly area-averaged SST anomaly indices (°C) over west equatorial Indian Ocean (WEI) & east equatorial Indian Ocean (EEI) along with Dipole Mode Index (DMI=WEI-EEI) representing Indian Ocean Dipole (IOD). ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF corrected anomaly forecast for the next 6 months.

1.3 Convection (OLR Anomaly) Pattern over the Asia Pacific Region

The Outgoing Longwave Radiation (OLR) anomaly during October 2023 is shown in (Fig.4). Negative OLR anomalies (enhanced convection, blue shading) were observed over western Indian Ocean, eastern south Asian region and eastern and central equatorial Pacific Ocean. Positive OLR anomalies (suppressed convection, orange/red shading) were observed over central Arabian Sea and central parts of India, central Bay of Bengal, east Indian Ocean, maritime continent, adjoining western Pacific Ocean and north Tropical Pacific Ocean. Positive OLR anomalies were also observed over most parts of Indian region, Australia and south America.

Average OLR Anomalies: October 2023

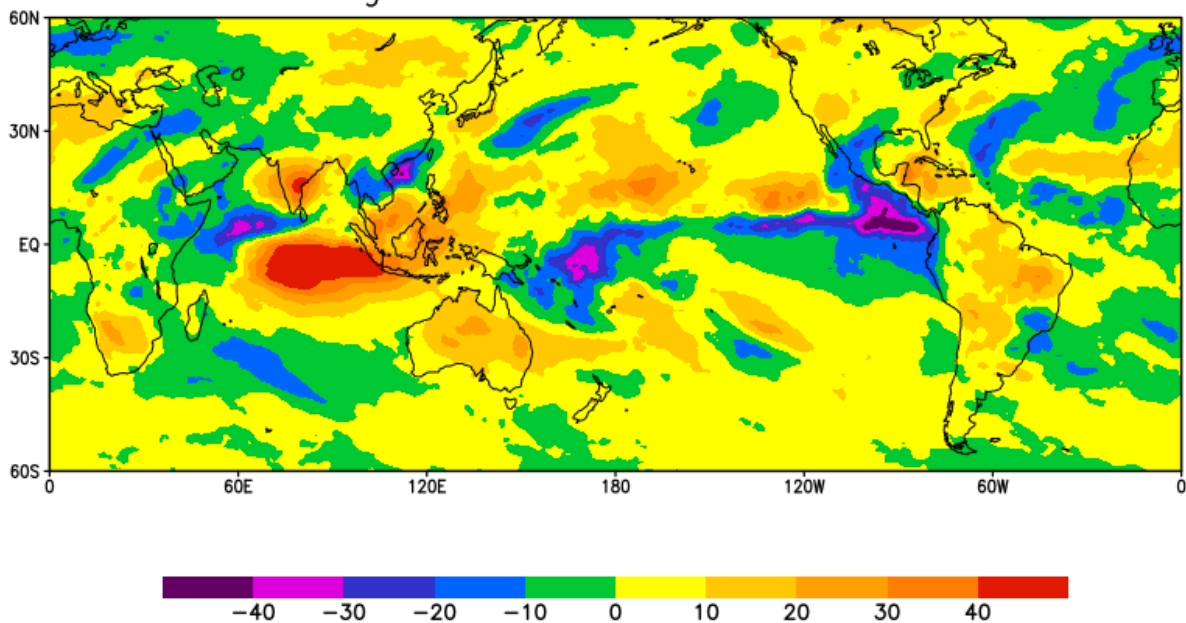


Fig.4: Outgoing Long Wave Radiation (OLR) Anomaly (W/m^2) for October 2023 (Data source: NCEP-NOAA)

1.4 Snow Cover Area over the Northern Hemisphere (NH)

During October 2023, the NH snow cover area (18.73 million Sq. km) was less than the 1991-2020 normal by 0.4 million Sq. km (Fig. 5). Eurasian Snow cover area (10.58 million Sq. km) was 0.104 million Sq. km less than the 1991-2020 normal. North America snow cover area of 8.15 million sq. km was less by 0.33 million Sq. Km with respect to 1991-2020 normal.

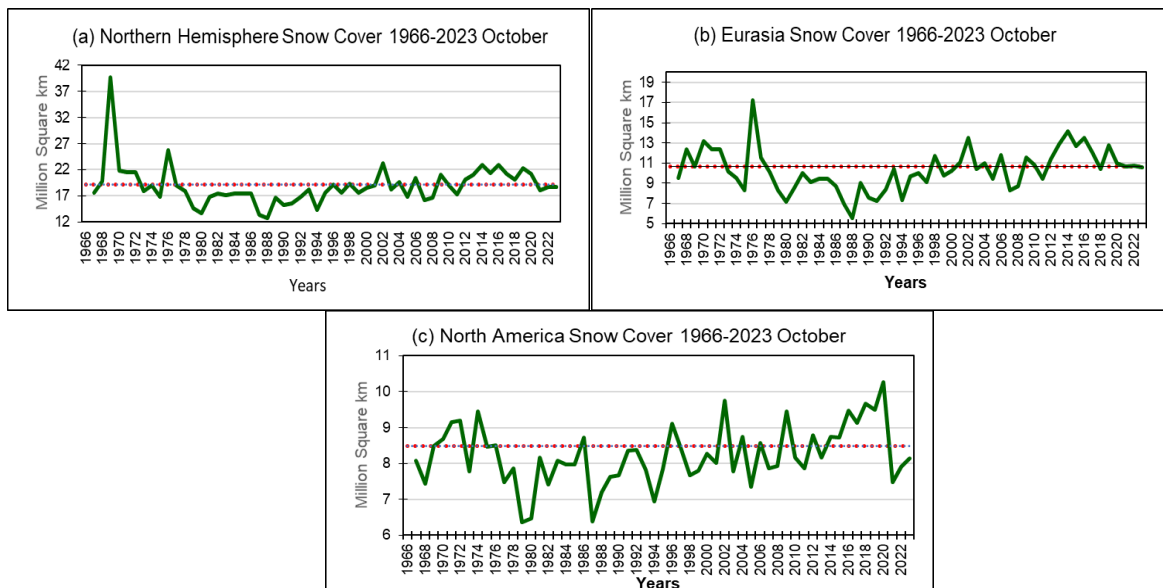


Fig.5. Snow cover area (million Sq. km) for the month of October during the period 1966-2023 (green solid lines) and normal value (1991-2020) (red dotted line) for (a) Northern Hemisphere (b) Eurasia and (c) North America. (Data Source: Rutgers University Snow Lab).

1.5 Madden Julian Oscillation (MJO)

During the first fortnight of October 2023, MJO propagated from phase 5 (Maritime Continent) to phase 7 (Western Pacific) with reduced strength. In the third week it moved from phase 7 to phase 8 (Western Hemisphere and Africa) with enhanced strength. In the last week it remained in phase 8 with reduced strength. The MJO phase diagram illustrates the progression of the MJO through different phases, which generally coincide with locations along the equator around the globe.

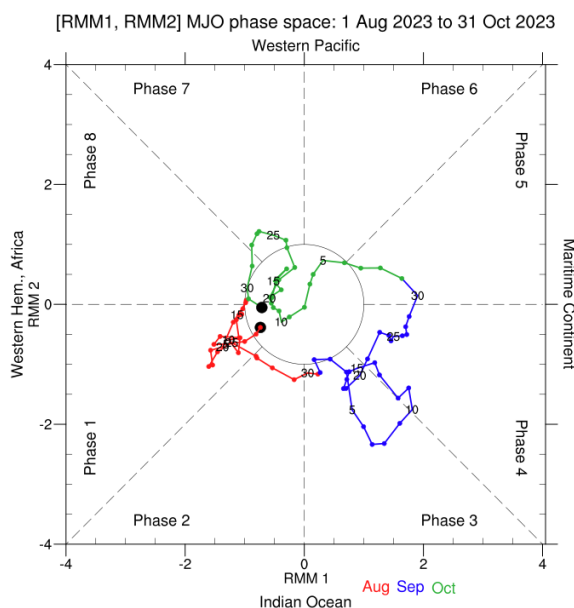


Fig.6. RMM phase diagram for Madden Julian Oscillation (MJO) for the period August to October 2023. (Data Source: <http://www.bom.gov.au/climate/mjo/>).

2. Seasonal Outlook for South Asia

The seasonal outlook was prepared based on the forecast from Monsoon Mission Coupled Forecasting System (MMCFS). The model is a fully coupled ocean-atmosphere-land model. The atmospheric component of CFSv2 is Global Forecast System (GFS) with spectral resolution of T382 (approximately 38 km) and 64 hybrid vertical levels and the ocean component is Geophysical Fluid Dynamics Laboratory (GFDL) Flexible Modelling System (FMS) Modular Ocean Model version.

2.1. Precipitation Probability Forecast:

The probability forecasts for precipitation for the seasons November 2023 to January 2024 (NDJ) and December 2023 to February 2024 (DJF) are given in the Figures 7a and 7b respectively. The forecast is prepared based on the October initial conditions. The probability forecast for precipitation for NDJ indicates enhanced probability of above normal precipitation in most parts of northwest, north, central and in some parts of northeast, southeast and extreme southern Peninsular regions and enhanced probability of below normal precipitation in west and northern Peninsular regions of South Asia. The same for NDJ indicates that enhanced probability of above normal precipitation is likely over most parts of South Asia except over some parts of western regions where enhanced probability of below normal precipitation is likely.

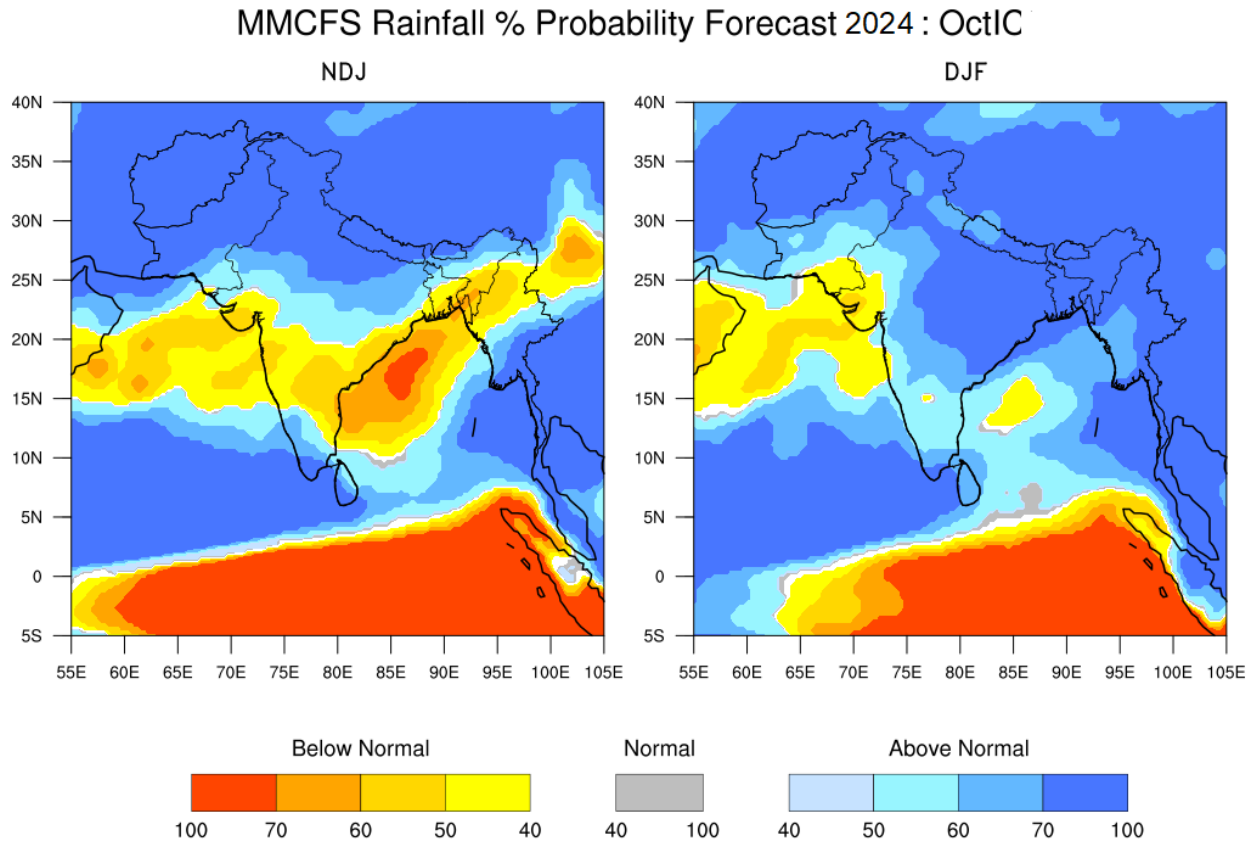


Fig.7: Seasonal probability (%) forecasts of precipitation for (a) NDJ 2024 (left) and (b) DJF 2024 (right) based on initial conditions of October 2023. The white colour indicates climatological probability.

2.2. Temperature Probability Forecast:

The probability forecasts for temperature for the season November 2023 to January 2024 (NDJ) and December 2023 to February 2024 (DJF) are given in the Figures 8a and 8b respectively. The forecast is prepared based on the October initial conditions. Temperature probability forecast for NDJ season (Fig. 8a) and DJF season (Fig.8b) indicates that enhanced probability of above normal temperatures is likely over most parts of South Asia except over some parts of northwest and most parts of north along the Himalayan Plains where probability of below normal temperature is likely.

MMCFS Temperature % Probability Forecast 2024 : OctIC

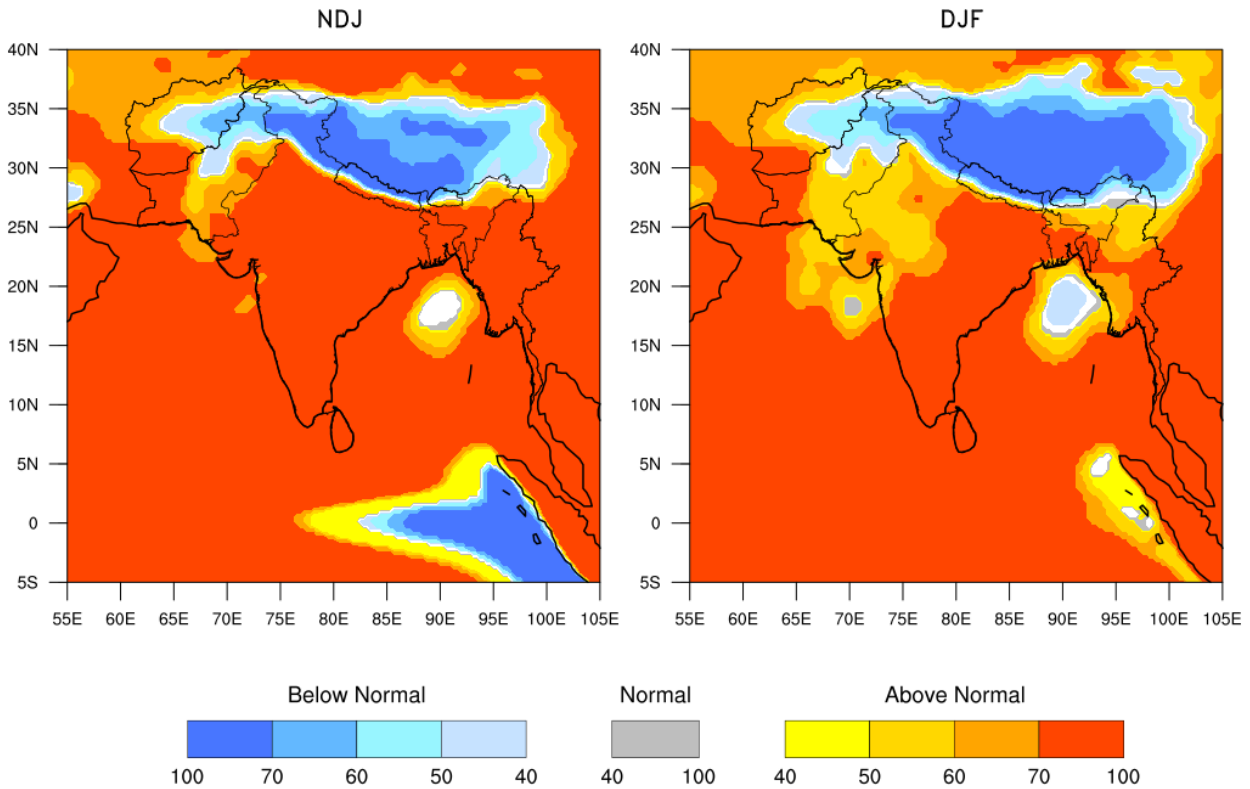


Fig. 8: Probability (%) forecast for the seasonal mean temperature for (a) NDJ 2024 (left) and (b) DJF 2024 (right) based on initial conditions of October 2023. The white colour indicates climatological probability.

3. Forecast Outlook for the Country Averaged Monthly Precipitation and Temperature

The MMCFS model forecast for monthly precipitation and temperature for the next four months (from November 2023 to February 2024) averaged over the 9 south Asian countries viz., Afghanistan, Bangladesh, Bhutan, India, Maldives, Myanmar, Nepal, Pakistan and Sri Lanka were shown in the Figures 9. The monthly rainfall anomaly is expressed as percentage departure from Long Period Model Average (LPMA) and monthly temperature anomaly is expressed in degree Celsius.

In November 2023, the country averaged monthly precipitation is likely to be normal to above normal for all south Asian countries except Bangladesh and Bhutan where it is likely to be below normal (Fig.9). In December and January, it is likely to be above normal for all the countries. In February, it is likely to be normal to above normal for Bangladesh, Bhutan, India and Myanmar and below normal for Afghanistan, Maldives, Nepal, Pakistan and Sri Lanka.

The country averaged monthly temperatures during November and December is likely to be normal to above normal for all south Asian countries. In January it is likely to be normal to above normal for all countries except Afghanistan, Bhutan, Nepal and Pakistan where it is likely to be below normal. In February, it is likely to be normal to above normal for all south Asian countries except Bhutan and Nepal where it is likely to be below normal.

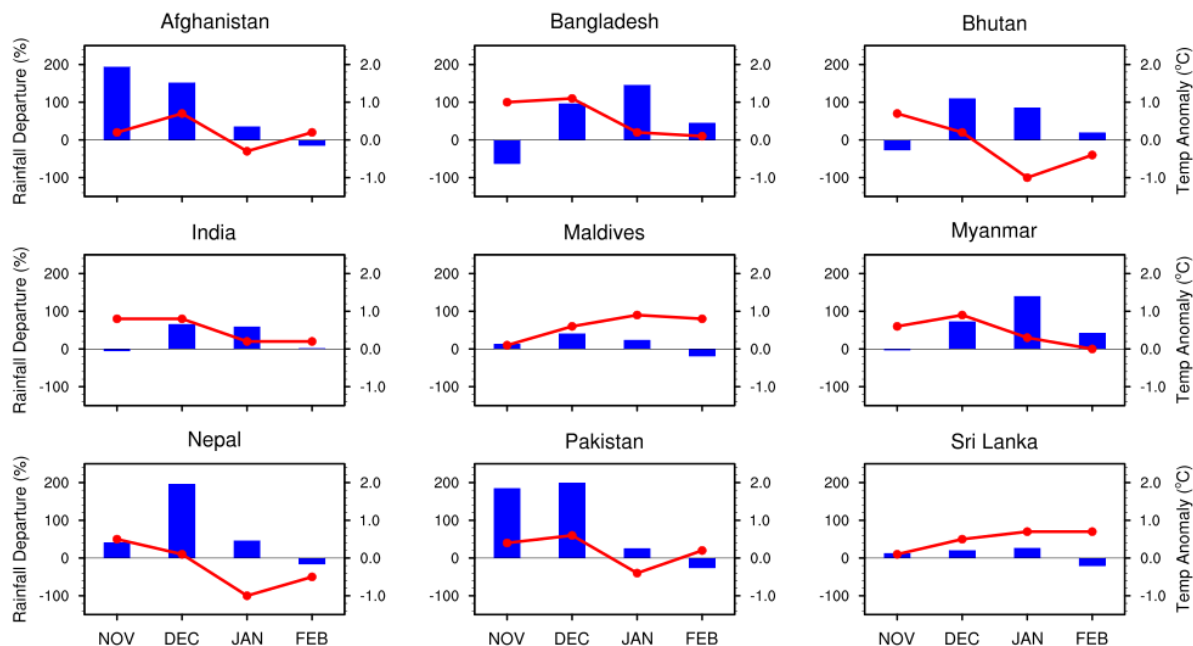


Fig. 9: Monthly country averaged rainfall forecast expressed as percentage departures (%) and Monthly country averaged temperature anomaly (°C) forecast during November 2023 to February 2024. Here, the normal range for country averaged monthly precipitation is taken as -10% to +10% (Left Vertical Axis Scale for Precipitation indicated in blue shaded bars) and the normal range for country averaged monthly temperature is taken -0.25°C to +0.25°C (Right Vertical Axis Scale for Temperature indicated in red coloured lines).