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SEASONAL CLIMATE OUTLOOK FOR SOUTH ASIA
(October 2023 to January 2024)

Highlights

- Currently, Moderate El Niño conditions are prevailing over equatorial Pacific and the sea surface temperatures (SSTs) are above average over most of the equatorial Pacific Ocean. The latest MMCFS forecast indicates moderate to strong El Niño conditions are likely to continue during the upcoming season.

- The positive IOD conditions are observed over the Indian Ocean and the latest MMCFS forecast indicates positive IOD conditions are likely to continue until the end of this year.

- The probability forecast for precipitation for October – December (OND) indicates enhanced probability of above normal precipitation in northwest, north, west, west central, southeast and extreme south peninsular regions and enhanced probability of below normal precipitation in northwest, east and north eastern peninsular regions of South Asia. The same for November – January (NDJ) indicates that enhanced probability of above normal precipitation is likely over most parts of South Asia except over some parts of northeast regions where enhanced probability of below normal precipitation is likely.

- The country averaged monthly precipitation for the month of October is likely to be normal to above normal for all south Asian countries except Bangladesh, Bhutan, India and Nepal where it is below normal. In November, the country averaged monthly precipitation is likely to be normal to above normal for all the countries except Bangladesh and Bhutan where it is likely to be below normal. In December and January, it is likely to be normal to above normal for all south Asian countries.

- Temperature probability forecast for OND and NDJ seasons indicates that enhanced probability of above normal temperatures is likely over most parts of South Asia except over some parts of north along the Himalayan Plains where enhanced probability of below normal temperature is likely.

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

1. Important Global Climate Factors

1.1 Sea Surface Temperatures over the Pacific Ocean

During September 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. Compared to the previous month, there is an increase in the warming of SSTs in the central equatorial Pacific Ocean (Fig.1b), along with some cooler SST anomalies observed over the western and eastern equatorial 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 September 2023, Warm SST anomalies were observed over the Arabian Sea and western equatorial Indian Ocean (Fig.1a). However, cold SST anomalies were also observed over north Bay of Bengal and south equatorial Indian Ocean. Compared to the previous month, warming of SSTs were observed over north Arabian Sea and cooling of SSTs were observed over north Bay of Bengal and most parts of equatorial Indian Ocean. (Fig. 1b) The latest MMCFS forecast indicates positive IOD conditions are likely to continue until the end of this year (Fig.3).
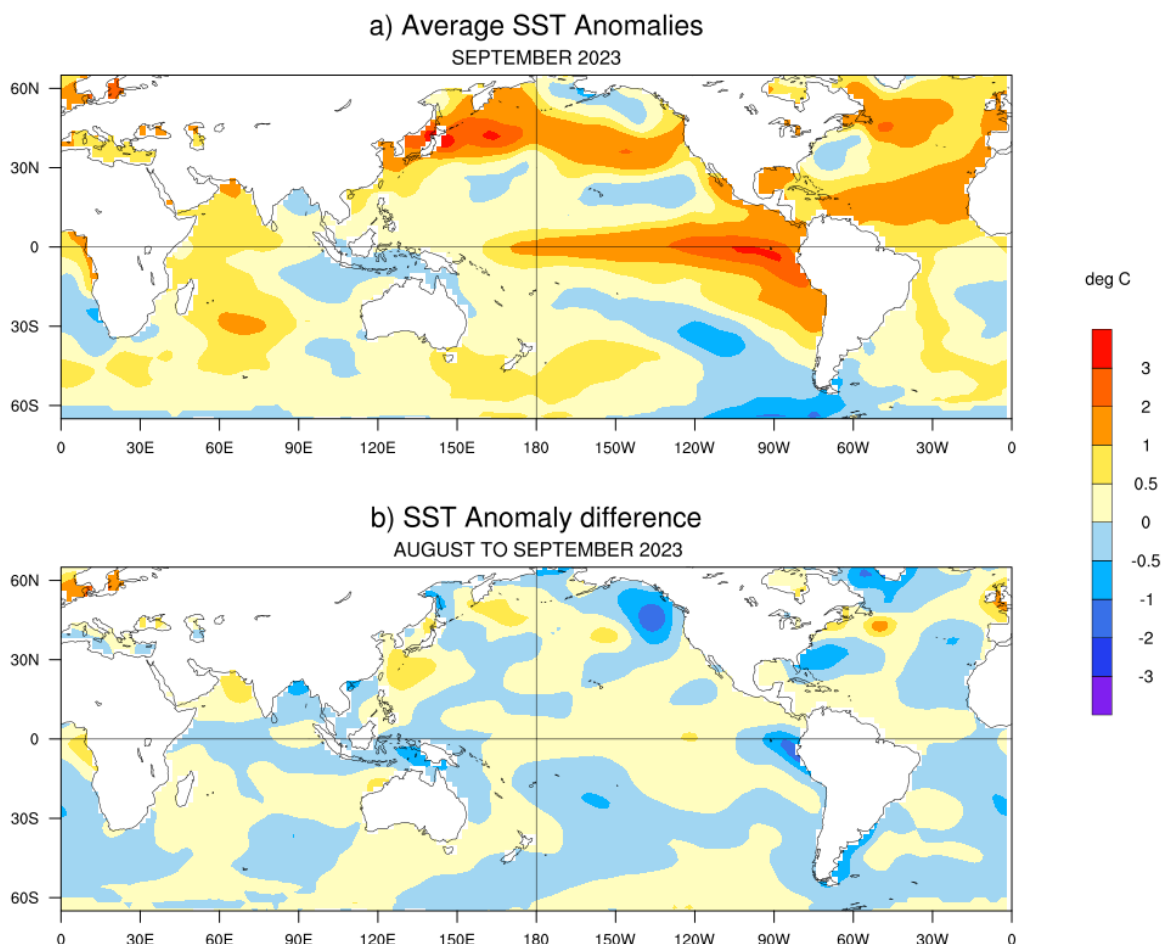

Fig.1(a) Sea surface temperature (SST) anomalies (°C) during September 2023 and (b) changes in the SST anomalies (°C) from August to September 2023. SSTs were based on the ERSSTv5, NOAA, and anomalies were computed with respect to 30-year (1991-2020) long term mean.
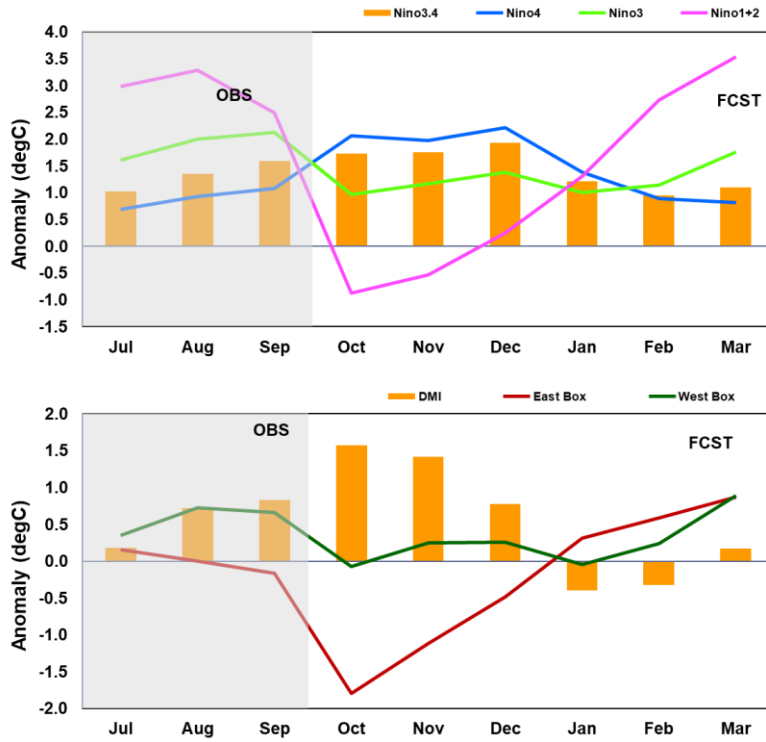
Fig.2: Time series of monthly area-averaged SST anomalies (°C) in the 4 Niño regions. ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF corrected anomaly forecast for the next 6 months.

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 September 2023 is shown in Fig.4. Negative OLR anomalies (enhanced convection, blue shading) were observed over some parts of south east Arabian Sea, west Indian Ocean, central Bay of Bengal, most regions of equatorial Pacific Ocean and some regions of southern Pacific Ocean. Negative OLR anomalies were also observed over central and eastern Indian regions. Positive OLR anomalies (suppressed convection, orange/red shading) were observed over central and eastern tropical Indian ocean and some parts of east Pacific Ocean. Positive OLR anomalies were also observed over some southern regions of North America.
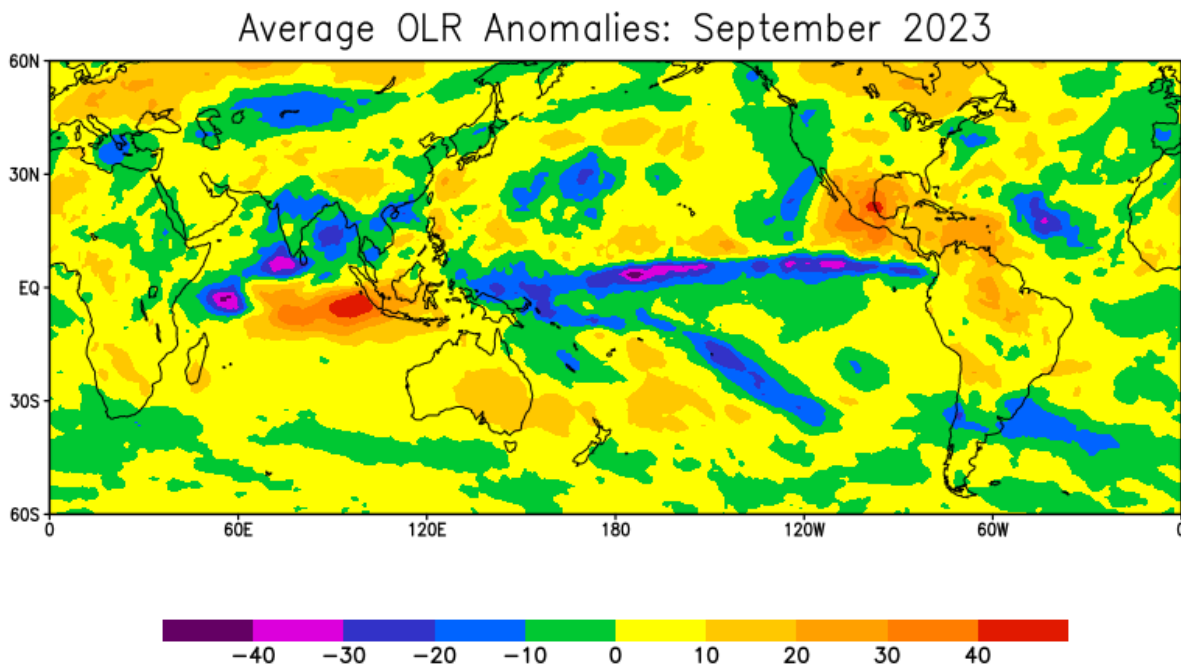

Fig.4: Outgoing Long Wave Radiation (OLR) Anomaly (W/m^2) for September 2023
(Data source: NCEP-NOAA)

1.4   Snow Cover Area over the Northern Hemisphere (NH)

During September 2023, the NH snow cover area (5.35 million Sq. km) was less than the 1991-2020 normal by 0.2 million Sq. km (Fig. 5). Eurasian Snow cover area (1.71 million Sq. km) was 0.07 million Sq. km more than the 1991-2020 normal. North America snow cover area of 3.65 million sq. km was less by 0.22 million Sq. Km with respect to 1991-2020 normal.
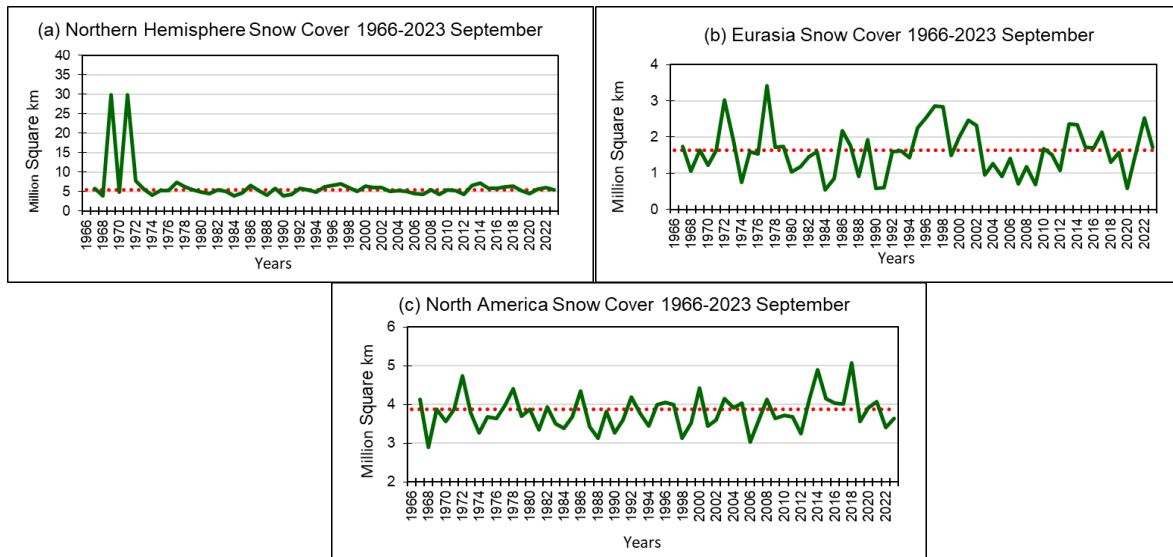

Fig.5. Snow cover area (million Sq. km) for the month of September during the period 1966-2023 (green solid lines) and normal value (1991-2020) (red dotted line) for (a) Northern Hemisphere (b) Eurasia and (c) North America. (Data Source: Rutgers University Snow Lab).

1.5.   Madden Julian Oscillation (MJO)

During the entire month of September 2023, MJO mostly remained in phase 3 (Indian Ocean) and 4 (Maritime Continent) and then moved to phase 5 (Maritime Continent) in the last few days of the month. The strength of MJO was moderate to strong during the entire month. The MJO phase diagram illustrates the progression of the MJO through different phases, which generally coincide with locations along the equator around the globe.
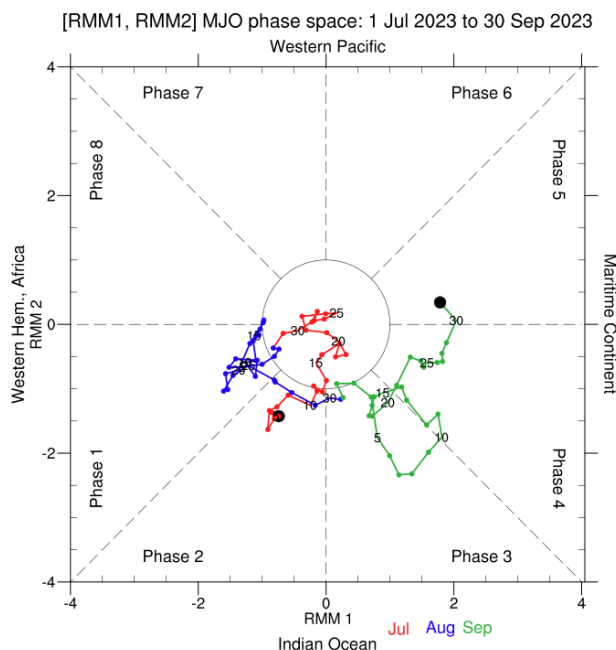

Fig.6. RMM phase diagram for Madden Julian Oscillation (MJO) for the period July to September 2023. (Data Source: http://www.bom.gov.au/climate/mjo/).

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 October to December 2023 (OND) and November to January 2024 (NDJ) are given in the Figures 7a and 7b respectively. The forecast is prepared based on the September initial conditions. The probability forecast for precipitation for OND indicates enhanced probability of above normal precipitation over northwest, north, west, west central, southeast and extreme south peninsular regions and enhanced probability of below normal precipitation in northeast, east and north eastern 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 northeast regions where enhanced probability of below normal precipitation is likely.
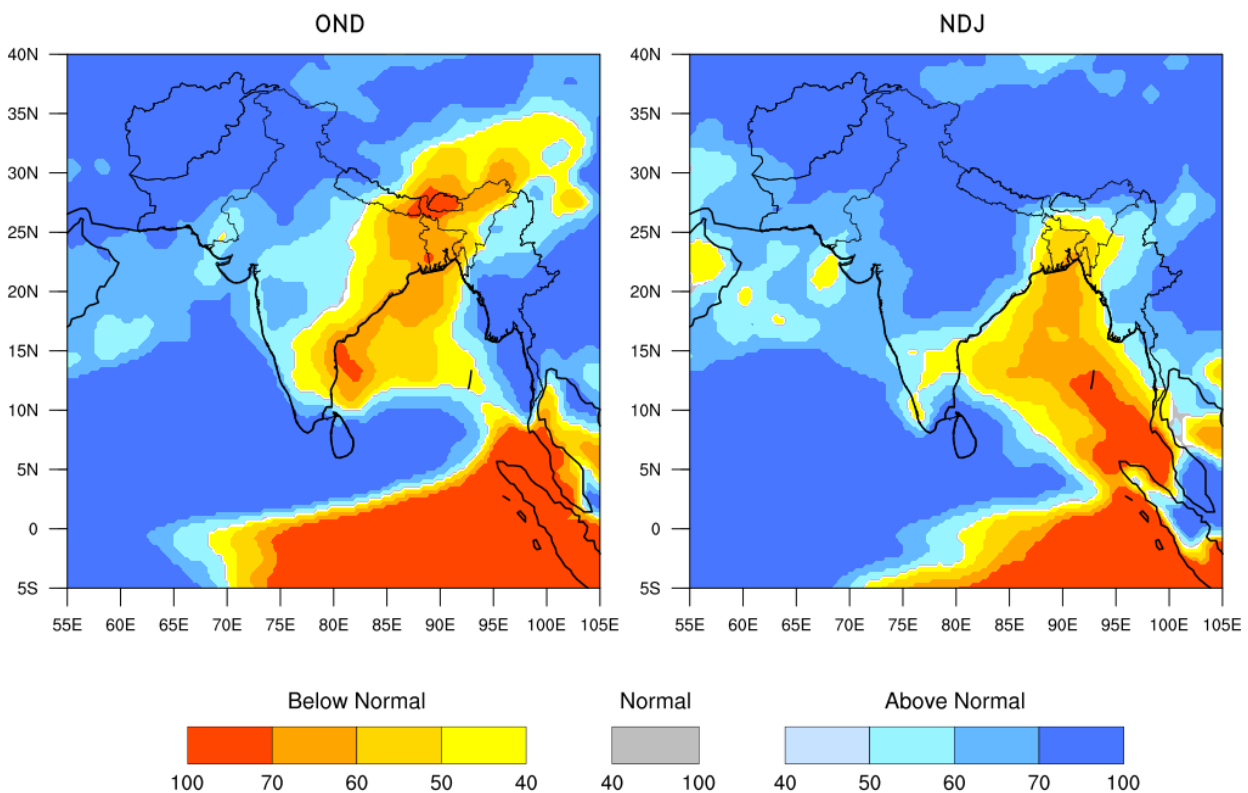

Fig.7: Seasonal probability (%) forecasts of precipitation for (a) OND 2023 (left) and (b) NDJ 2024 (right) based on initial conditions of September 2023.The white colour indicates climatological probability.

2.2.   Temperature Probability Forecast:

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

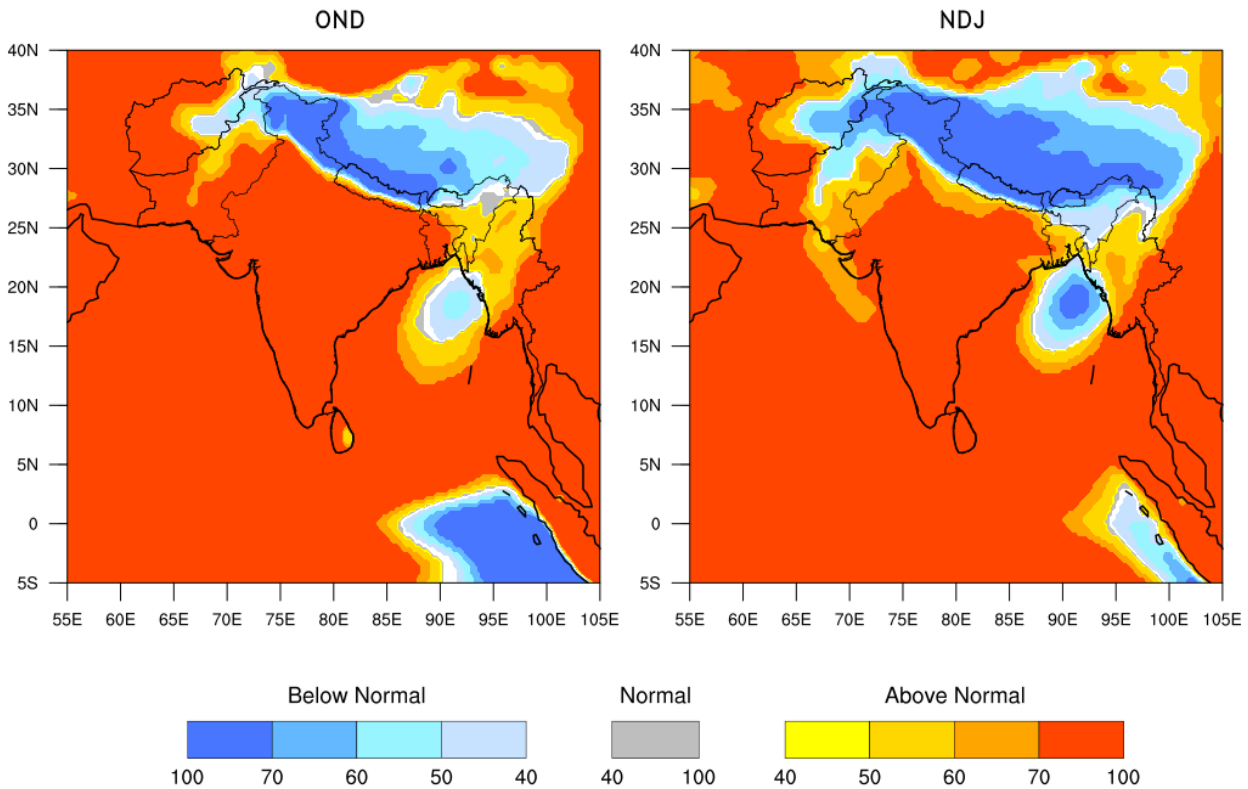## MMCFS Temperature % Probability Forecast 2023 : SepIC

Fig. 8: Probability (%) forecast for the seasonal mean temperature for (a) OND 2023 (left) and (b) NDJ 2024 (right) based on initial conditions of September 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 October 2023 to January 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 October 2023, the country averaged monthly precipitation is likely to be normal to above normal for all south Asian countries except Bangladesh, Bhutan, India and Nepal where it is below normal (Fig.9). In November, the country averaged monthly precipitation is likely to be normal to above normal for all the countries except Bangladesh and Bhutan where it is likely to be below normal. In December and January, it is likely to be normal to above normal for all south Asian countries.

The country averaged monthly temperatures during October is likely to be normal to above normal for all south Asian countries except Sri Lanka where it is likely to be below normal. In November, it is likely to be above normal for all the countries. In December, 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. In January, it is likely to be normal to above normal for all south Asian countries except Afghanistan, Bhutan, Nepal and Pakistan where it is likely to be below normal.
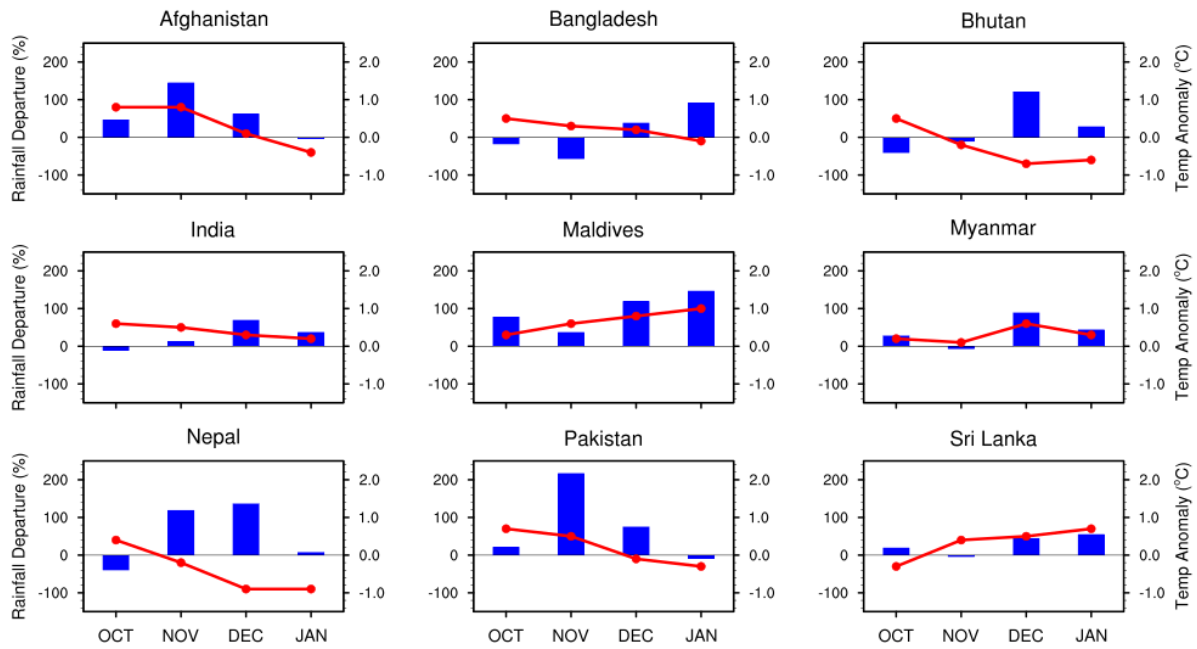
Fig. 9: Monthly country averaged rainfall forecast expressed as percentage departures (%) and Monthly country averaged temperature anomaly (°C) forecast during October 2023 to January 2024. Here, the normal range for country averaged monthly precipitation is taken as -10% to +10% (Left Vertical Axis 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).