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**SEASONAL CLIMATE OUTLOOK FOR SOUTH ASIA
(October 2024 to January 2025)**

Highlights

- The sea surface temperatures are below average in the eastern equatorial Pacific Ocean. Currently, neutral El Niño-Southern Oscillation (ENSO) conditions are observed over the equatorial Pacific. The probability forecast indicates a higher chance of La Niña conditions developing around the OND 2024 season and an enhanced probability of La Niña conditions until early next year.
- Above-average sea surface temperatures (SSTs) are currently seen across most of the Indian Ocean. Currently, neutral Indian Ocean Dipole (IOD) conditions are observed over the Indian Ocean. The latest MMCFS forecast indicates that the neutral IOD conditions are likely to continue for the next several months.
- The probability forecast for precipitation for OND season indicate that enhanced probability of above normal precipitation is likely in most parts of South Asia except over northwest, extreme north and some parts of southeast of South Asia where moderate probability of below normal precipitation is likely. The same for NDJ season indicates that enhanced probability of above normal precipitation is likely in most parts of South Asia except over northwest, north, central and some parts of southeast of South Asia where enhanced probability of below normal rainfall is likely to occur.
- In October, the country averaged monthly precipitation is likely to be normal to above normal for all the South Asian countries except Afghanistan where it is likely to be below normal. In November, the country averaged monthly precipitation is likely to be normal to above normal for all the South Asian countries except Afghanistan, Maldives and Pakistan where it is likely to be below normal. In December, it is likely to be normal to below normal in all the south Asian countries except Bangladesh where it is likely to be above normal. In January, the country averaged monthly precipitation is likely to be normal to below normal for all the South Asian countries except Sri Lanka where it is likely to be above normal.
- Temperature probability forecast for OND and NDJ seasons indicate that enhanced probability of above normal temperatures is likely over most parts of South Asia.
- The country averaged monthly temperatures during October, November, December and January are likely to be normal to above normal for all South Asian countries.

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

In September 2024, sea surface temperatures (SSTs) in the eastern Pacific Ocean were below average, while they were average to above average in the western and adjoining central Pacific (Fig.1a). Warmer than average SSTs were observed over some parts of the northern and southern extra-tropical Pacific region. Cooler than average SSTs were observed over parts of the south of the extra-tropical Pacific region. Compared to August 2024, negative SST anomalies were seen over the central and western equatorial Pacific Ocean. Positive SST anomalies were seen over the parts of the eastern most equatorial Pacific Ocean (Fig.1b). The probability forecast indicates a higher chance of La Niña conditions developing around the OND 2024 season and an enhanced probability of La Niña conditions until early next year. (Fig.2)

1.2 Sea Surface Temperatures over Indian Ocean

In September 2024, above-average sea surface temperatures (SSTs) were observed across most of the Indian Ocean, including the Bay of Bengal and the Arabian Sea (Fig. 1a). Compared to August 2024, cooler SSTs were observed in the northern Bay of Bengal and the Arabian Sea and eastern equatorial Indian Ocean in September 2024. In contrast, warmer SSTs were observed in the western and central equatorial Indian Ocean, as well as in parts of the Arabian Sea in September 2024 (Fig. 1b). The latest MMCFS forecast indicates that the neutral IOD conditions are likely to continue for the next several months. (Fig.3).

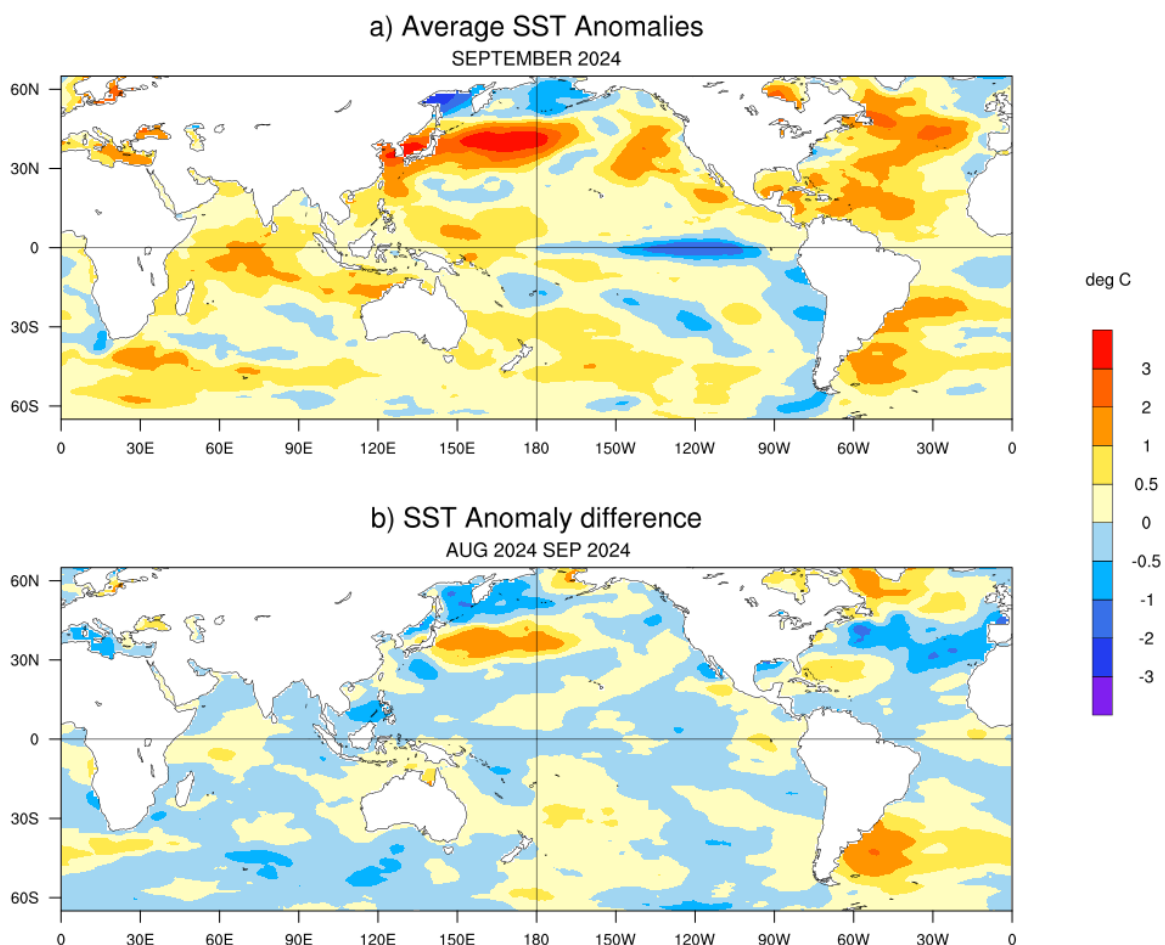


Fig.1: (a) Sea surface temperature (SST) anomalies (0C) during September 2024 and (b) changes in the SST anomalies (0C) from August 2024 to September 2024. SSTs are based on the COBE-SST 2, from JMA, and anomalies are computed with respect to 30-year (1991-2020) long term mean.

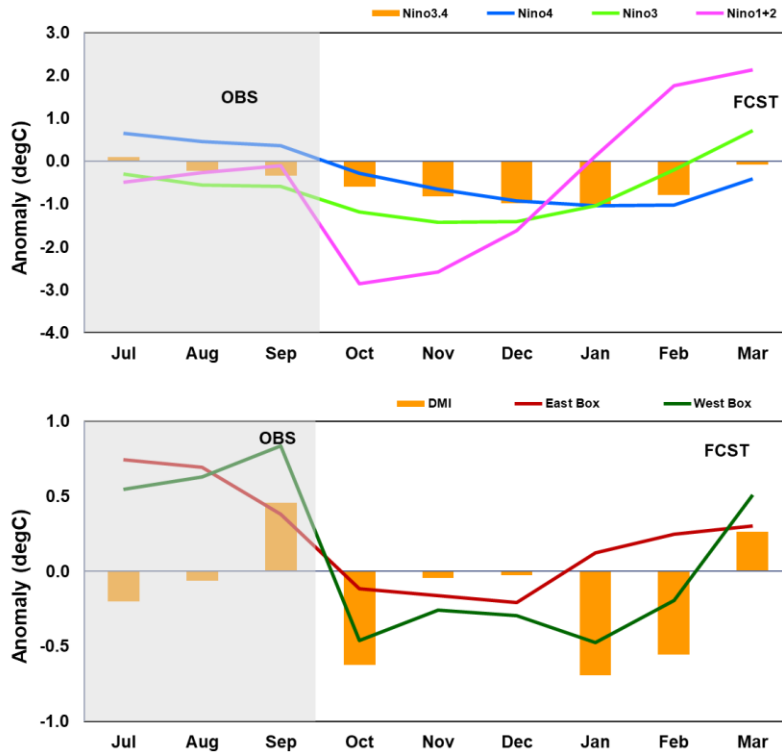


Fig.2: Time series of monthly area-averaged SST anomalies (°C) in the 4 Niño regions. ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF corrected anomaly forecast for the next 6 months.

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 2024 is shown in (Fig.4). Negative OLR anomalies (enhanced convection, blue shading) were observed over south China Sea. Negative OLR anomalies were also observed over north, northwest and northeast parts of South Asia. Positive OLR anomalies (suppressed convection, orange/red shading) were observed over Arabian sea, south Bay of Bengal, north tropical Pacific Ocean, South Peninsular India and North and South America.

Average OLR Anomalies: September 2024

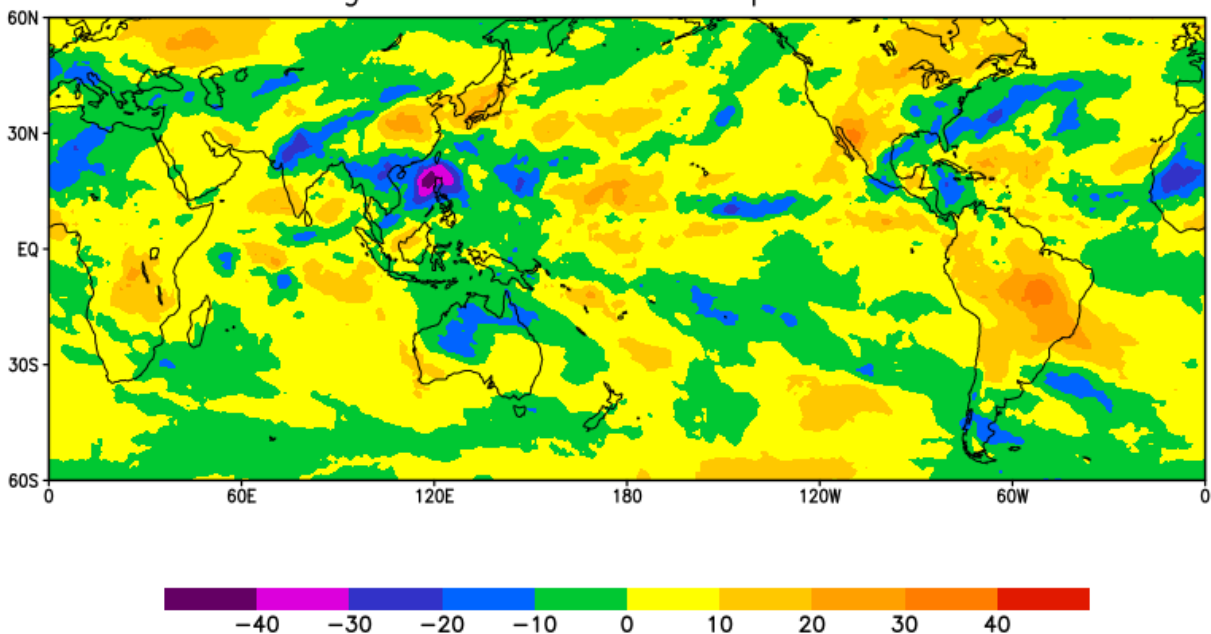


Fig.4: Outgoing Long Wave Radiation (OLR) Anomaly (W/m^2) for September 2024 (Data source: NCEP-NOAA)

1.4 Snow Cover Area over the Northern Hemisphere (NH)

During September 2024, the NH snow cover area (4.94 million Sq. km) was less than the 1991-2020 normal by 0.57 million Sq. km (Fig. 5). Eurasian Snow cover area (1.88 million Sq. km) was 0.244 million Sq. km more than the 1991-2020 normal. North America snow cover area of 3.06 million sq. km was less by 0.81 million Sq. Km with respect to 1991-2020 normal.

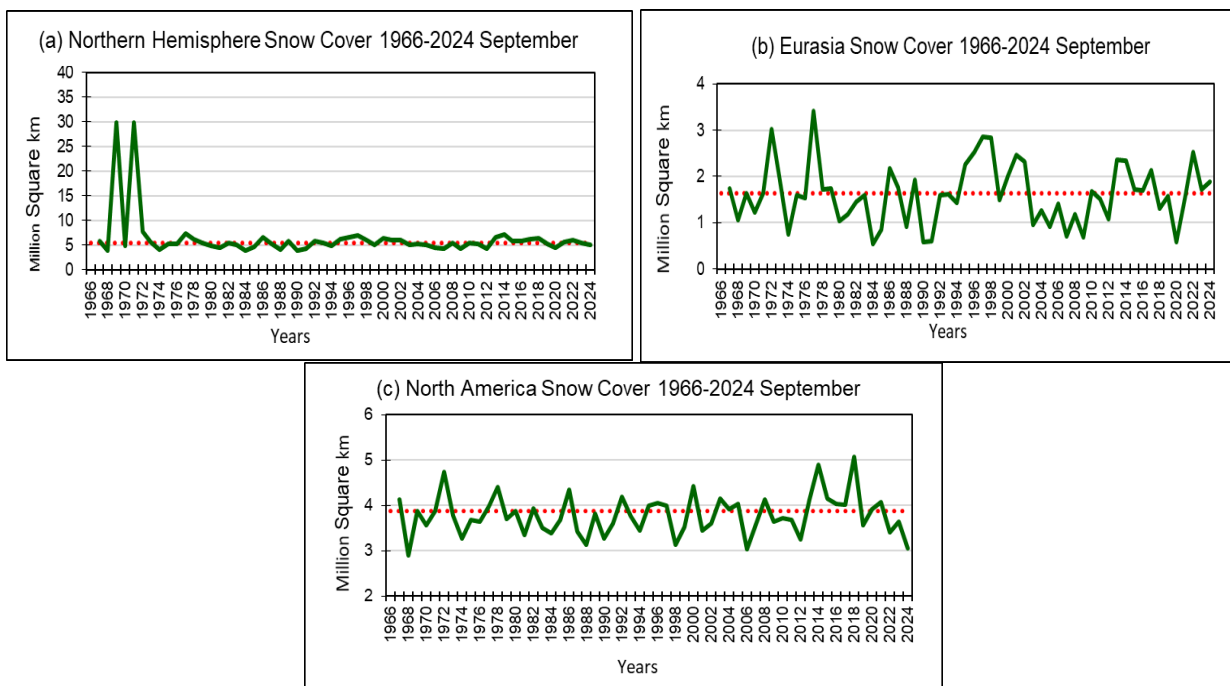


Fig.5. Snow cover area (million Sq. km) for the month of September during the period 1966-2024 (green solid lines) and normal value (1991-2020) (red dotted line) for (a) Northern Hemisphere (b) Eurasia and (c) North America. (Data Source: Rutgers University Snow Lab).

1.5 Madden Julian Oscillation (MJO)

During the first fortnight of September 2024, MJO moved from phase 4 to phase 5 (Maritime continent) with increased amplitude. It then moved eastwards to phase 6 (Western Pacific) with enhanced strength in the third week. In the fourth week it moved further eastwards and reached phase 1 (Western Hemisphere and Africa) with increased strength by the end of the 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.

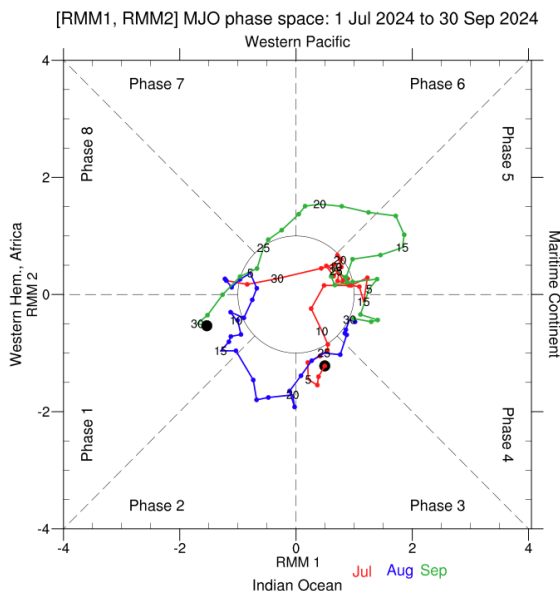


Fig.6. RMM phase diagram for Madden Julian Oscillation (MJO) for the period July to September 2024. (Data Source: <http://www.bom.gov.au/climate/mjo/>).

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 2024 (OND) and November 2024 to January 2025 (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 season indicate that enhanced probability of above normal precipitation is likely in most parts of South Asia except over northwest, extreme north and some parts of southeast of South Asia where moderate probability of below normal precipitation is likely. The same for NDJ season indicates that enhanced probability of above normal precipitation is likely in most parts of South Asia except over northwest, north, central and some parts of southeast of South Asia where enhanced probability of below normal rainfall is likely to occur.

MMCFS Rainfall % Probability Forecast: Sep1C2024

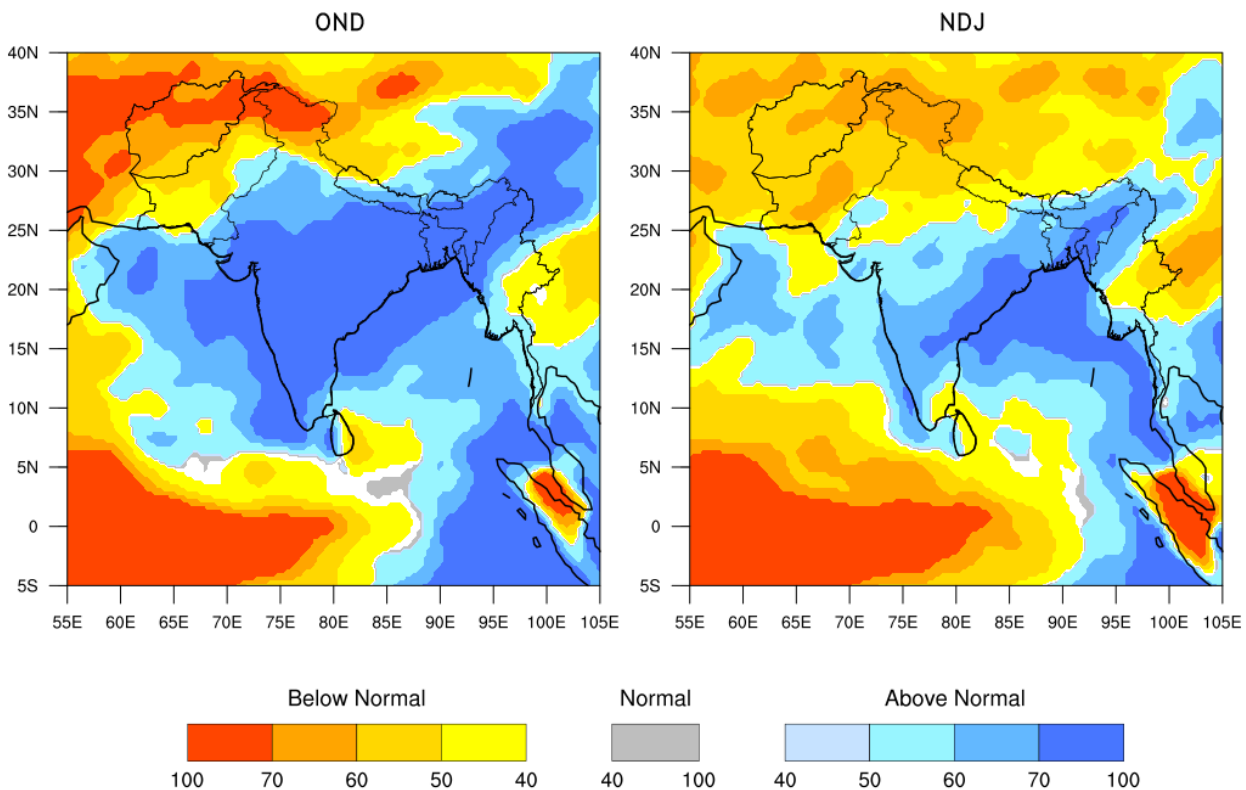


Fig.7: Seasonal probability (%) forecasts of precipitation for (a) OND 2024 (left) and (b) NDJ 2024-25 (right) based on initial conditions of September 2024. The white colour indicates climatological probability.

2.2. Temperature Probability Forecast:

The probability forecasts for temperature for the season October to December 2024 (OND) and November 2024 to January 2025 (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 and NDJ seasons indicate that enhanced probability of above normal temperatures is likely over most parts of South Asia.

MMCFS Temperature % Probability Forecast : SepIC 2024

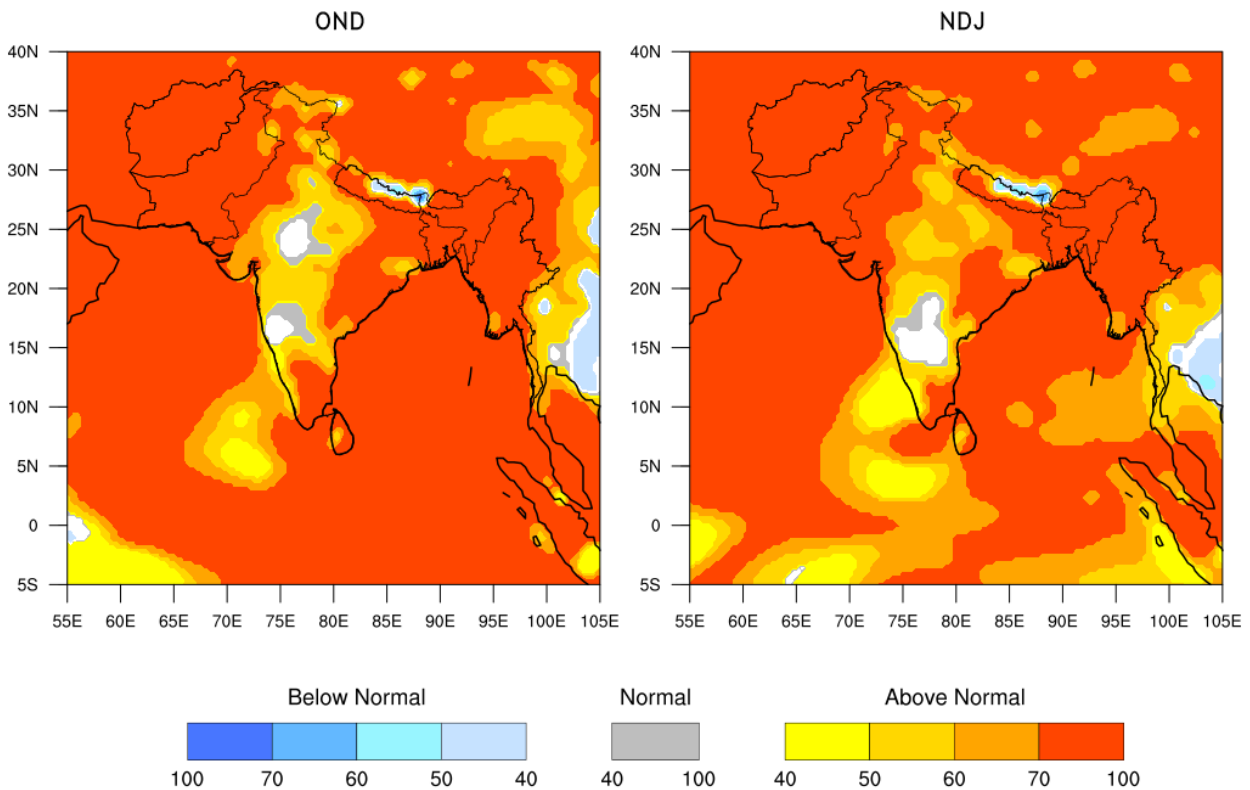


Fig. 8: Probability (%) forecast for the seasonal mean temperature for (a) OND 2024 (left) and (b) NDJ 2024-25 (right) based on initial conditions of September 2024. The white colour indicates climatological probability.

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 2024 to January 2025) 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, the country averaged monthly precipitation is likely to be normal to above normal for all the South Asian countries except Afghanistan where it is likely to be below normal. In November, the country averaged monthly precipitation is likely to be normal to above normal for all the South Asian countries except Afghanistan, Maldives and Pakistan where it is likely to be below normal. In December, it is likely to be normal to below normal in all the south Asian countries except Bangladesh where it is likely to be above normal. In January, the country averaged monthly precipitation is likely to be normal to below normal for all the South Asian countries except Sri Lanka where it is likely to be above normal.

The country averaged monthly temperatures during October, November, December and January are likely to be normal to above normal for all South Asian countries.

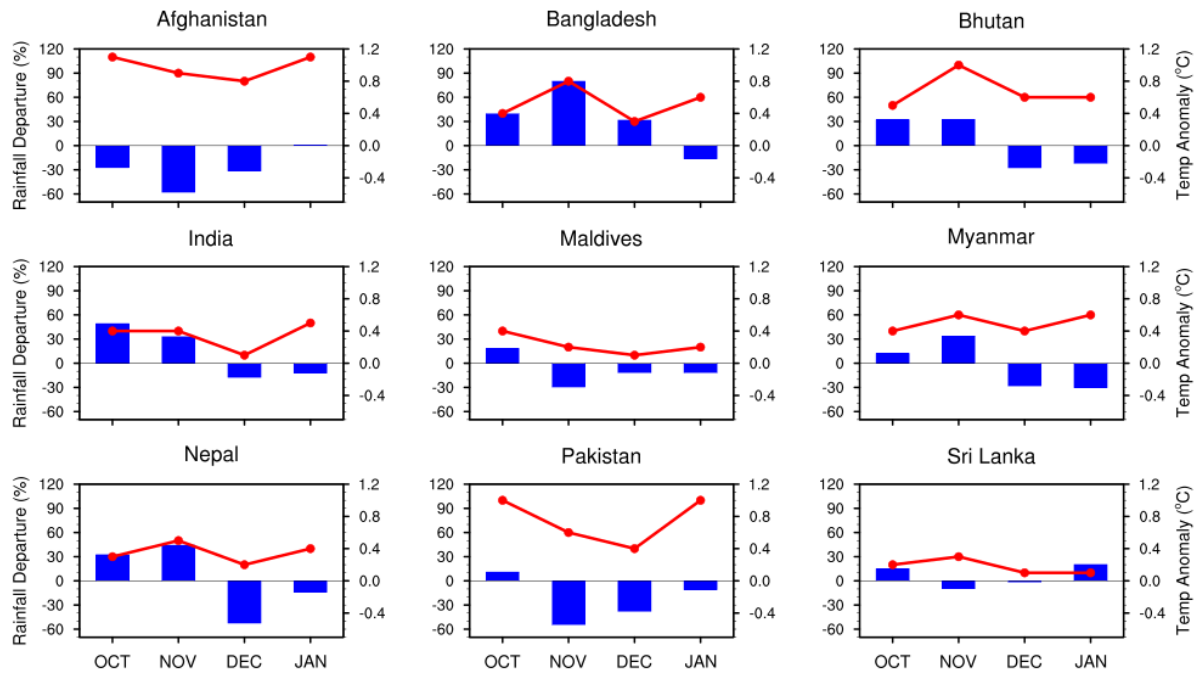


Fig. 9: Monthly country averaged rainfall forecast expressed as percentage departures (%) and Monthly country averaged temperature anomaly (°C) forecast during October 2024 to January 2025. Here, the normal range for country averaged monthly precipitation is taken as -10% to +10% (Left Vertical Axis 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).