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**SEASONAL CLIMATE OUTLOOK FOR SOUTH ASIA
(August to November 2024)**

Highlights

- Currently, El Niño-Southern Oscillation (ENSO) neutral conditions are observed over the equatorial Pacific. The probability forecast further suggests a higher likelihood of La Niña conditions emerging around the September to November (SON) 2024 season.
- At present, neutral Indian Ocean Dipole (IOD) conditions are prevailing over the Indian Ocean. Most global climate models suggest that neutral IOD conditions are expected to persist through the remainder of the monsoon season. However, the latest MMCFS forecast indicates that the current neutral IOD conditions may shift to negative IOD conditions for a short span of time towards the end of the season and then again turn back into neutral IOD conditions.
- The probability forecast for precipitation for August –October (ASO) season indicates that enhanced probability of above normal precipitation is likely in most parts of South Asia except over extreme north, northeast and southeast of South Asia where below normal rainfall is likely to occur. The same for September – November (SON) indicates that above normal precipitation is likely in most parts of South Asia except over extreme northwest, extreme north and few parts of southeast of South Asia where below normal rainfall is likely to occur.
- In August and November, the country averaged monthly precipitation is likely to be normal to below normal for all the South Asian countries. In September, the country averaged monthly precipitation is likely to be normal to above normal for all the South Asian countries. In October, it is likely to be normal to above normal in all the south Asian countries except Maldives where it is likely to be below normal.
- Temperature probability forecast for ASO season indicates that enhanced probability of above normal temperatures is likely over most parts of South Asia except over some parts of Peninsular India where below normal temperatures are likely. The same for SON season indicates that enhanced probability of above normal temperatures is likely over most parts of South Asia except over some parts of west and west central parts of South Asia where probability of below normal temperatures is likely
- The country averaged monthly temperatures during August, September, October and November 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 July 2024, below-average sea surface temperatures (SSTs) were observed over the parts of the eastern Pacific Ocean, while above-average SSTs were seen across the western Pacific and near average SSTs in the east-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 June 2024, negative SST anomalies were seen over the central and western equatorial Pacific Ocean. Positive SST anomalies were seen over the eastern equatorial Pacific Ocean (Fig.1b). Currently, El Niño-Southern Oscillation (ENSO) neutral conditions are observed over the equatorial Pacific. The probability forecast further suggests a higher likelihood of La Niña conditions emerging around the September to November (SON) 2024 season. (Fig.2)

1.2 Sea Surface Temperatures over Indian Ocean

In July 2024, warmer-than-average SSTs were observed over most parts of the Indian Ocean (Fig.1a), including the Bay of Bengal and the Arabian Sea. Cooler than average SSTs were observed over a small region near western equatorial Indian Ocean. Compared to June 2024, cool SSTs were observed over the north Bay of Bengal, and warm SSTs were observed over the equatorial Indian Ocean and some parts of north Arabian Sea (Fig.1b). At present, neutral Indian Ocean Dipole (IOD) conditions are prevailing over the Indian Ocean. Most global climate models suggest that neutral IOD conditions are expected to persist through the remainder of the monsoon season. However, the latest MMCFS forecast indicates that the current neutral IOD conditions may shift to negative IOD conditions for a short span of time towards the end of the season and then again turn back into neutral IOD conditions (Fig.3).

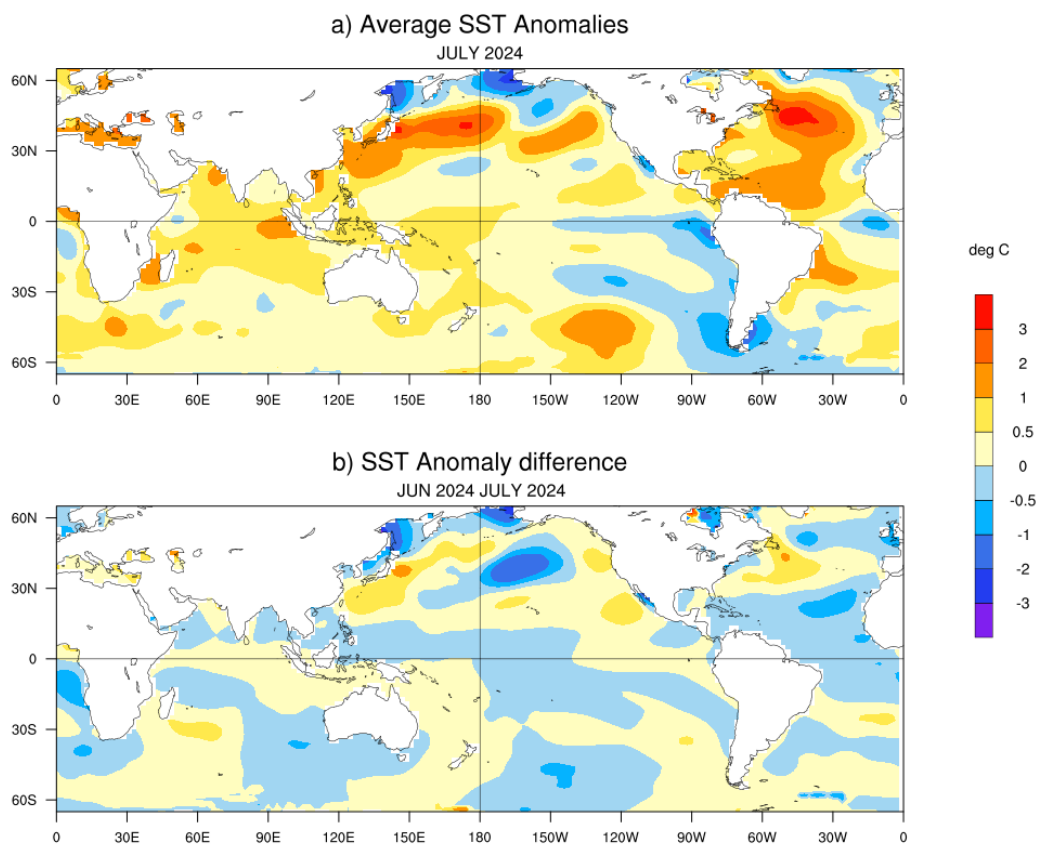


Fig.1(a) Sea surface temperature (SST) anomalies (°C) during July 2024 and (b) changes in the SST anomalies (°C) from June to July 2024. SSTs were based on the ERSSTv5, NOAA, and anomalies were computed with respect to 30-year (1991-2020) long term mean.

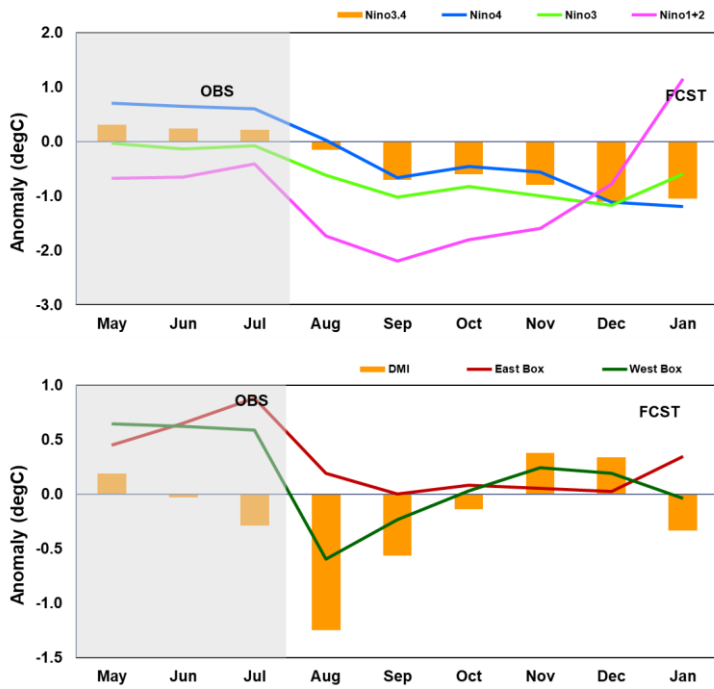


Fig.2: Time series of monthly area-averaged SST anomalies (°C) in the 4 Niño regions. ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF corrected anomaly forecast for the next 6 months.

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 July 2024 is shown in (Fig.4). Negative OLR anomalies (enhanced convection, blue shading) were observed over North Indian Ocean (Arabian Sea and parts of Bay of Bengal) and south China Sea. Negative OLR anomalies were also observed over west, peninsular India and southeast part of South Asia. Positive OLR anomalies (suppressed convection, orange/red shading) were observed over central and eastern parts of South Indian Ocean, eastern parts of South Asia, parts of north tropical Pacific Ocean and north and south America.

Average OLR Anomalies: July 2024

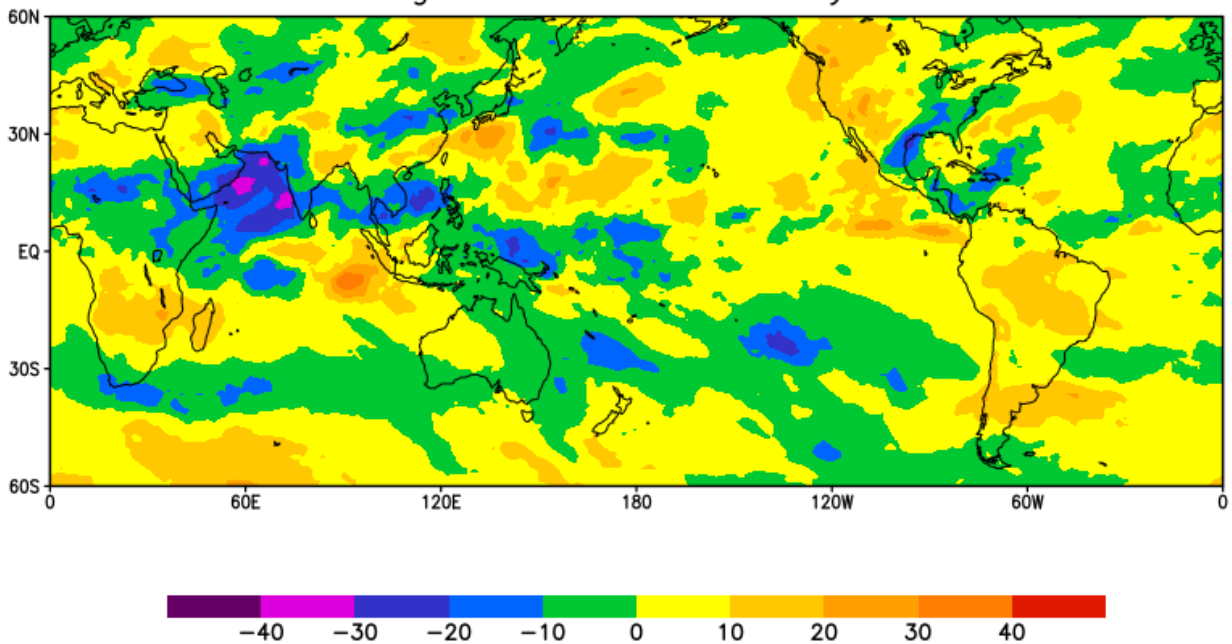


Fig.4: Outgoing Long Wave Radiation (OLR) Anomaly (W/m^2) for July 2024 (Data source: NCEP-NOAA)

1.4 Snow Cover Area over the Northern Hemisphere (NH)

During July 2024, the NH snow cover area (2.76 million Sq. km) was less than the 1991-2020 normal by 0.44 million Sq. km (Fig. 5). Eurasian Snow cover area (0.2 million Sq. km) was 0.29 million Sq. km less than the 1991-2020 normal. North America snow cover area of 2.55 million sq. km was less by 0.15 million Sq. Km with respect to 1991-2020 normal.

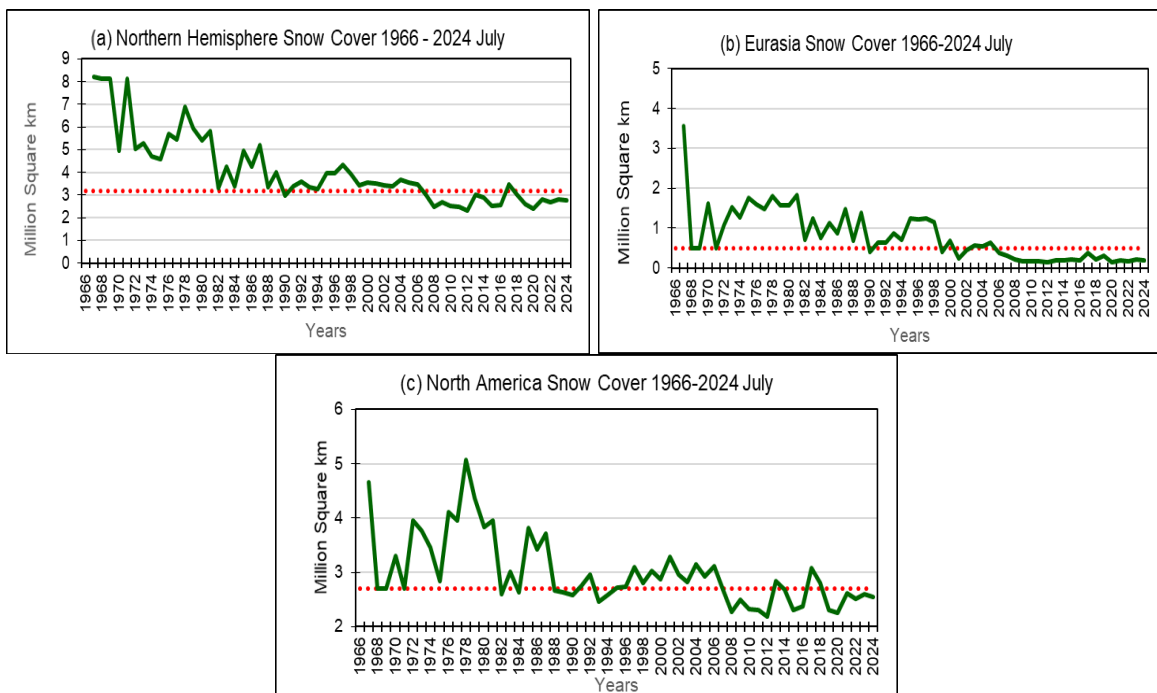


Fig.5. Snow cover area (million Sq. km) for the month of July during the period 1966-2024 (green solid lines) and normal value (1991-2020) (red dotted line) for (a) Northern Hemisphere (b) Eurasia and (c) North America. (Data Source: Rutgers University Snow Lab).

1.5 Madden Julian Oscillation (MJO)

During the first week of July 2024, MJO remained in phase 3 (Indian Ocean) with enhanced strength. It then moved eastwards to phase 4 (Maritime Continent) with reduced strength in the second week. In the third week it moved to phase 5 (Maritime Continent) and finally moved further eastwards to phase 8 (Western Hemisphere and Africa) in the last week 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.

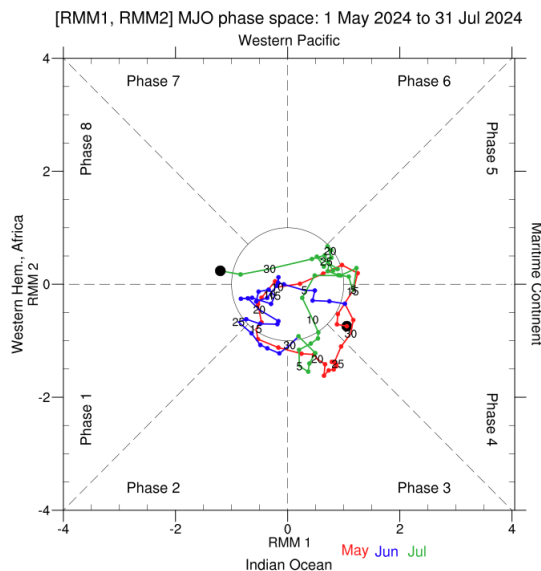


Fig.6. RMM phase diagram for Madden Julian Oscillation (MJO) for the period May to July 2024. (Data Source: <http://www.bom.gov.au/climate/mjo/>).

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 August to October 2024 (ASO) and September to November 2024 (SON) are given in the Figures 7a and 7b respectively. The forecast is prepared based on the July initial conditions. The probability forecast for precipitation for ASO season indicates that enhanced probability of above normal precipitation is likely in most parts of South Asia except over extreme north, northeast and southeast of South Asia where below normal rainfall probability is likely. The same for SON season indicates that above normal precipitation is likely in most parts of South Asia except over extreme northwest, extreme north and few parts of southeast of South Asia where below normal rainfall is likely to occur.

MMCFS Rainfall % Probability Forecast : Jul IC 2024

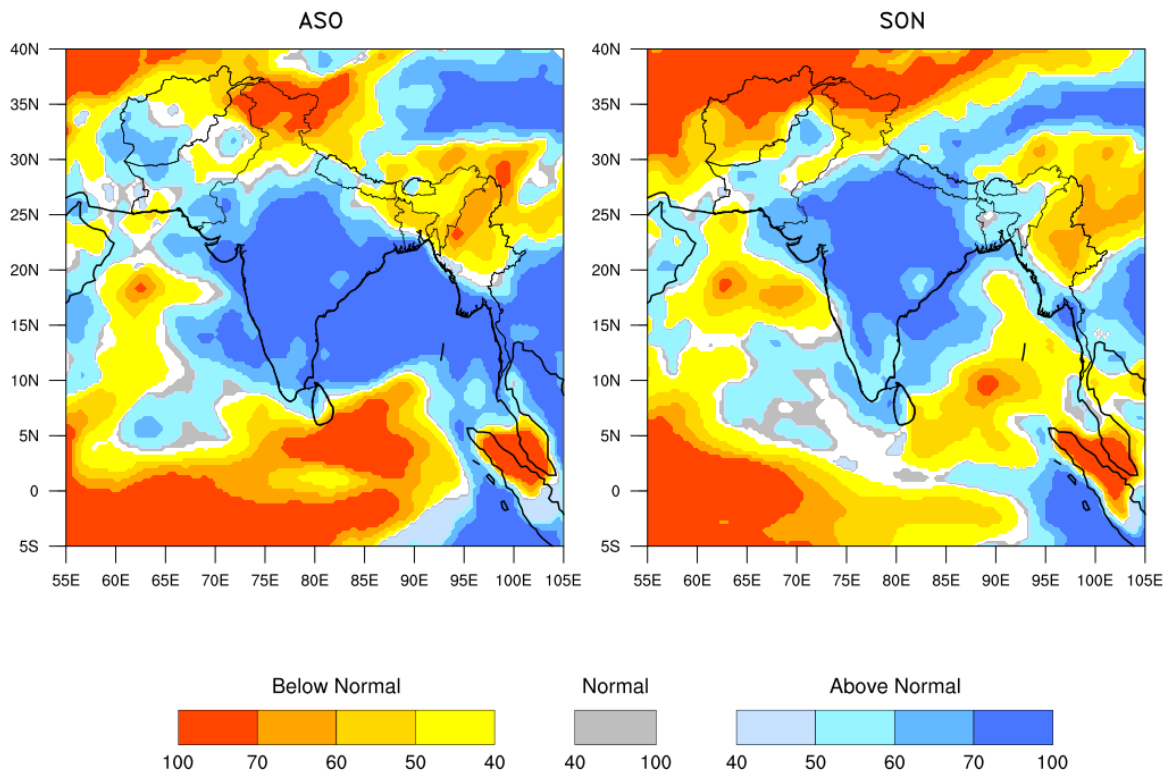


Fig.7: Seasonal probability (%) forecasts of precipitation for (a) ASO 2024 (left) and (b) SON 2024 (right) based on initial conditions of July 2024. The white colour indicates climatological probability.

2.2. Temperature Probability Forecast:

The probability forecasts for temperature for the season August to October 2024 (ASO) and September to November 2024 (SON) are given in the Figures 8a and 8b respectively. The forecast is prepared based on the July initial conditions. Temperature probability forecast for ASO season indicates that enhanced probability of above normal temperatures is likely over most parts of South Asia except over some parts of Peninsular India where below normal temperatures are likely. The same for SON season indicates that enhanced probability of above normal temperatures is likely over most parts of South Asia except over some parts of west and west central parts of South Asia where probability of below normal temperatures is likely.

MMCFS Temperature % Probability Forecast : Jul IC 2024

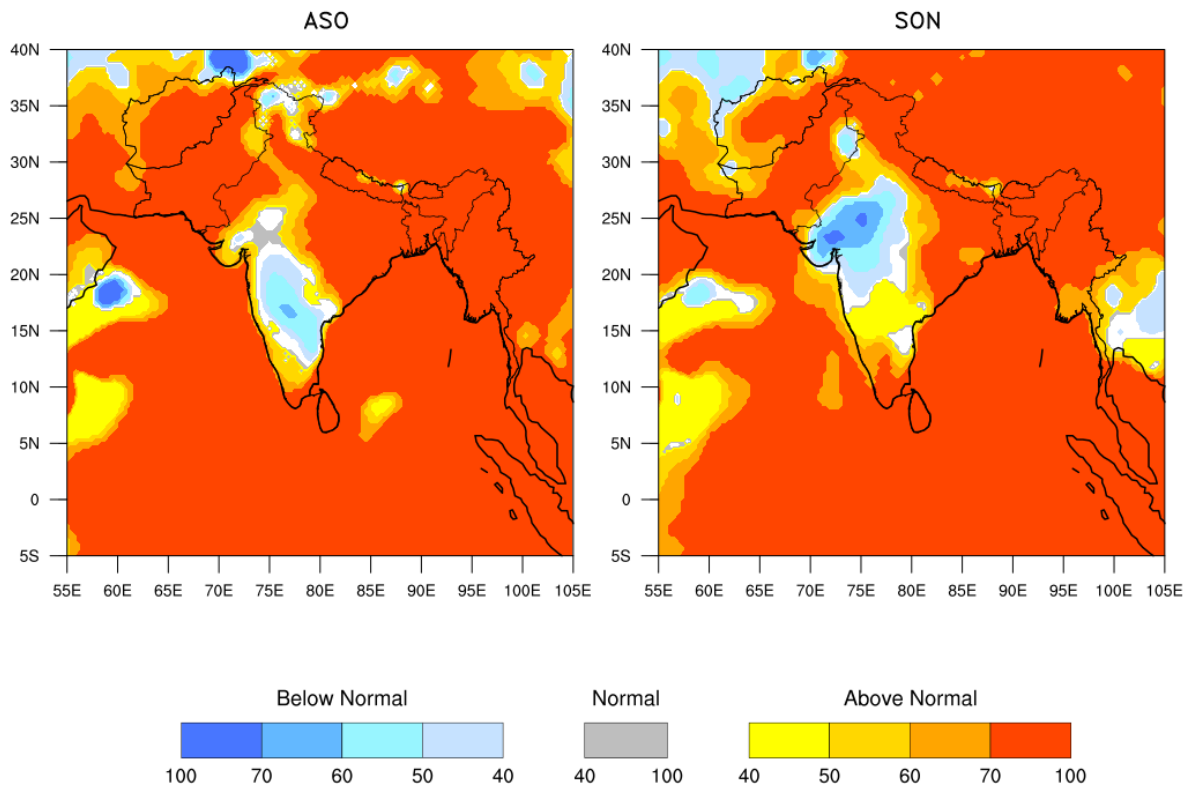


Fig. 8: Probability (%) forecast for the seasonal mean temperature for (a) ASO 2024 (left) and (b) SON 2024 (right) based on initial conditions of July 2024. The white colour indicates climatological probability.

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 August to November 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 August and November, the country averaged monthly precipitation is likely to be normal to below normal for all the South Asian countries. In September, the country averaged monthly precipitation is likely to be normal to above normal for all the South Asian countries. In October, it is likely to be normal to above normal in all the south Asian countries except Maldives where it is likely to be below normal.

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

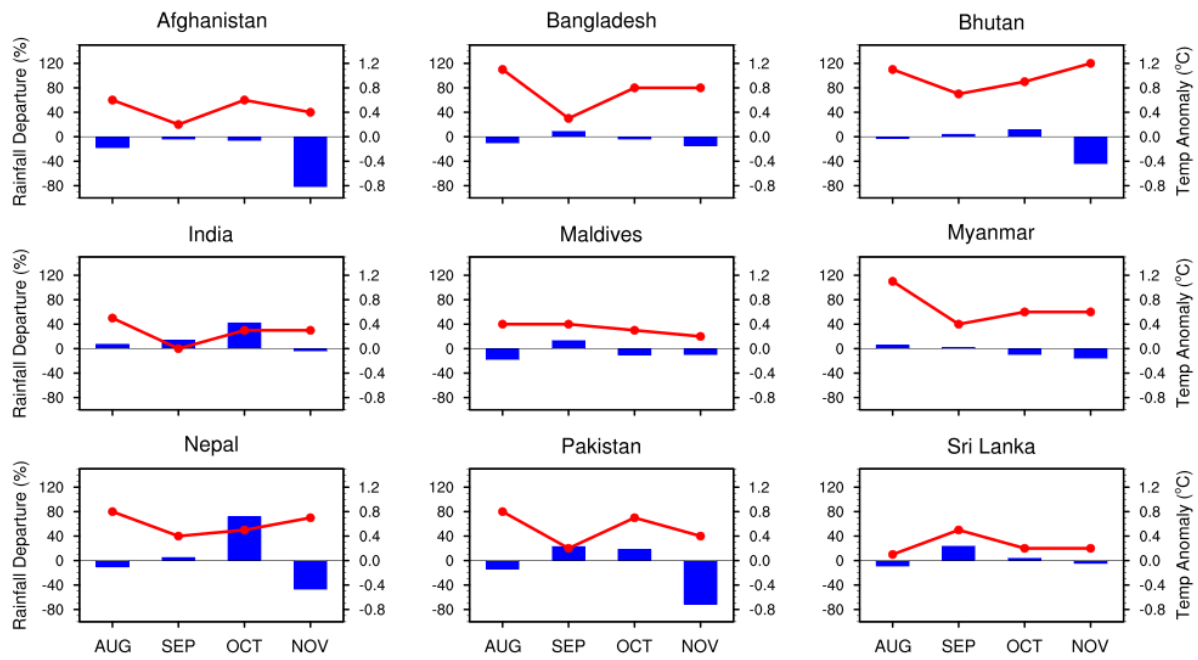


Fig. 9: Monthly country averaged rainfall forecast expressed as percentage departures (%) and Monthly country averaged temperature anomaly (°C) forecast during August to November 2024. Here, the normal range for country averaged monthly precipitation is taken as -10% to +10% (Left Vertical Axis Scale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