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SEASONAL CLIMATE OUTLOOK FOR SOUTH ASIA
(January to April 2025)

Highlights

- Over the equatorial Pacific Ocean, weak La Niña conditions are present and are expected to persist through the first quarter of 2025 (January to March). After that, a transition to ENSO-neutral conditions is likely.

- Near-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 JFM season.

- The probability forecast for precipitation for JFM and FMA seasons indicate that enhanced probability of below normal precipitation is likely in most parts of northwest, west, north along the plains of Himalayas, central and east of South Asia and enhanced probability of above normal precipitation is likely in some parts of Peninsular India, northeast and southeast of South Asia.

- In January, the country averaged monthly precipitation is likely to be normal to above normal for Afghanistan, India, Maldives, Myanmar, Pakistan and Sri Lanka and likely to be below normal for Bangladesh, Bhutan and Nepal. In February, the country averaged monthly precipitation is likely to be normal to above normal for Myanmar and Sri Lanka and below normal for all the other countries of South Asia. In March, it is likely to be below normal to normal for Afghanistan, Nepal and Pakistan and normal to above normal for all the other south Asian countries. In April, the country averaged monthly precipitation is likely to be normal to above normal for all the South Asian countries.

- Temperature probability forecast for JFM and FMA seasons indicate that enhanced probability of above normal temperatures is likely over most parts of South Asia.

- The country averaged monthly temperatures during January, February, March and April are likely to be normal to above normal for all South Asian countries.

1. Important Global Climate Factors

1.1 Sea Surface Temperatures over the Pacific Ocean

In December 2024, sea surface temperatures (SSTs) were below average in most of the central and east-central Pacific Ocean. Equatorial SSTs were near to above average across the western Pacific Ocean (Fig.1a). Warmer than average SSTs were observed over the extra-tropical Pacific region, while cooler than average SSTs were observed in parts of the southern the extra-tropical Pacific region. Compared to November 2024, negative SST anomalies were present over the western equatorial Pacific Ocean, the central equatorial Pacific Ocean, and around the Maritime Continent. Positive SST anomalies were observed over the east-central and eastern equatorial Pacific Ocean. Cool SST anomalies were observed over the higher latitudes of the North Pacific Ocean and some parts of the South Pacific Ocean (Fig.1b). Over the equatorial Pacific Ocean, weak La Niña conditions are present and are expected to persist through the first quarter of 2025 (January to March). After that, a transition to ENSO-neutral conditions is likely. (Fig.2)

1.2 Sea Surface Temperatures over Indian Ocean

In December 2024, equatorial SSTs were above average across most of the northern and eastern Indian Ocean, including the north Arabian Sea and the Bay of Bengal (Fig. 1a). Compared to November 2024, cooler than normal SSTs were observed across the Indian Ocean, Arabian Sea, and Bay of Bengal (Fig. 1b). The latest MMCFS forecast indicates that the neutral IOD conditions are likely to continue for the next JFM season. (Fig.3).

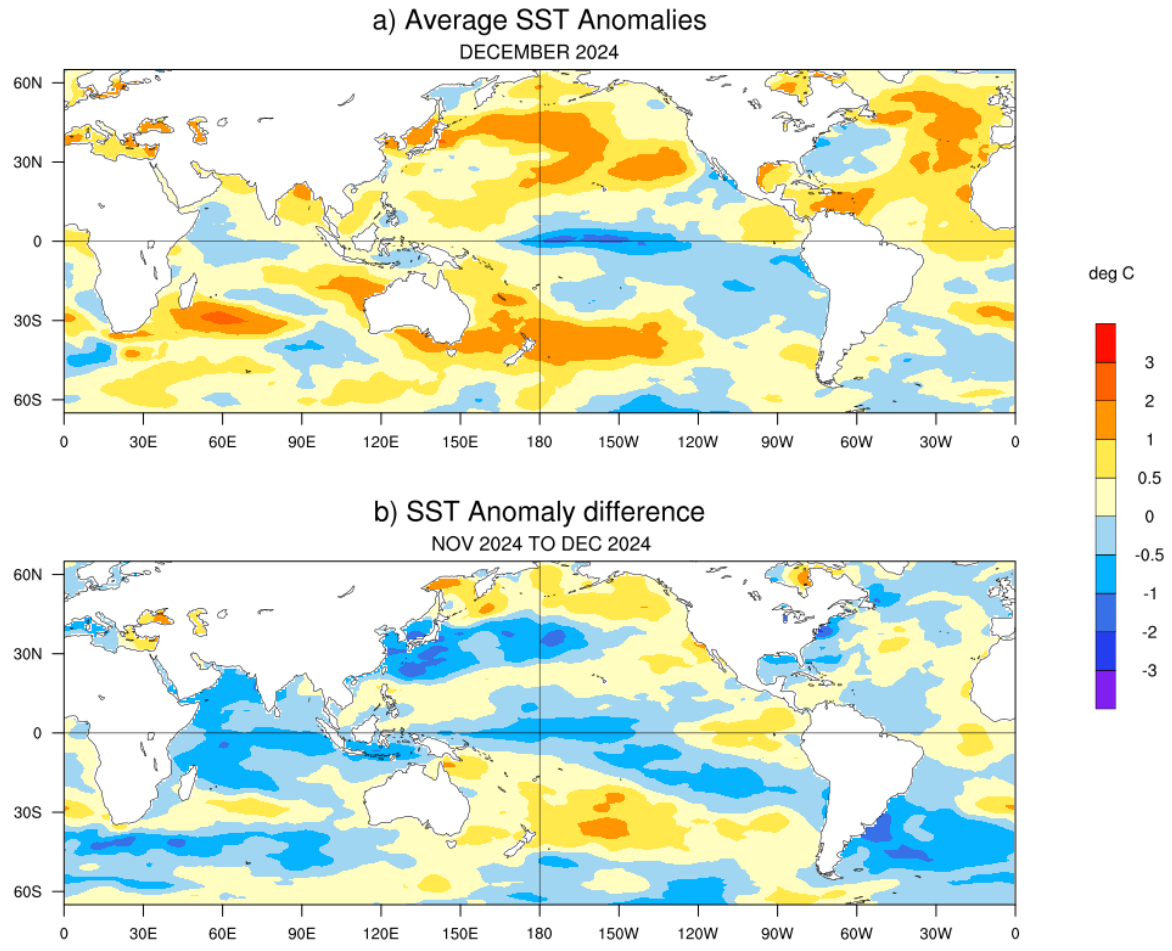

Fig.1: (a) Sea surface temperature (SST) anomalies (^{0}C) during December 2024 and (b) changes in the SST anomalies (^{0}C) from November to December 2024. SSTs are based on the COBE-SST 2, from NOAA, and anomalies are computed with respect to 30-year (1991-2020) long term mean.

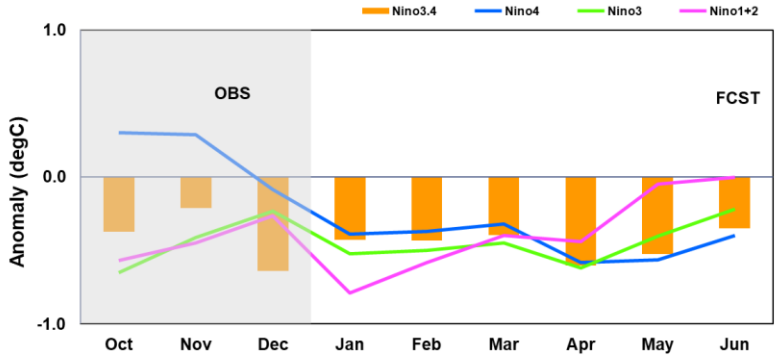

Fig.2: Time series of monthly area-averaged SST anomalies (°C) in the 4 Niño regions. ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF corrected anomaly forecast for the next 6 months.

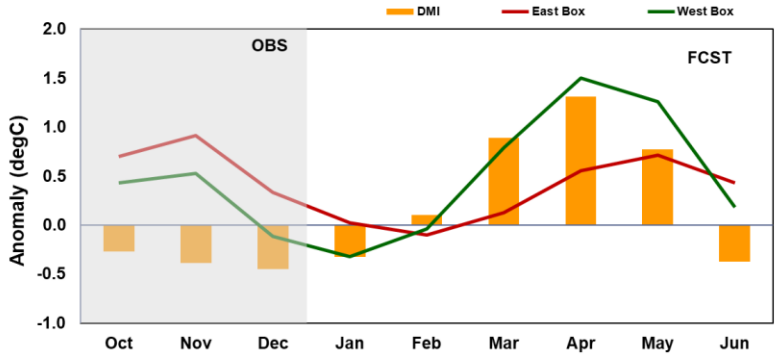

Fig.3: The time series of the monthly area-averaged SST anomaly Indices (°C) over west equatorial Indian Ocean (WEI) & east equatorial Indian Ocean (EEI) along with Dipole Mode Index (DMI=WEI-EEI) representing Indian Ocean Dipole (IOD). ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF 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 December 2024 is shown in (Fig.4). Negative OLR anomalies (enhanced convection, blue shading) were observed over most parts of Bay of Bengal, south east Indian Ocean, south China Sea. Negative OLR anomalies were also observed over maritime continent and central America. Positive OLR anomalies (suppressed convection, orange/red shading) were observed central and eastern Tropical Pacific Ocean. Positive OLR anomalies were also observed over some parts of Africa and Australia.

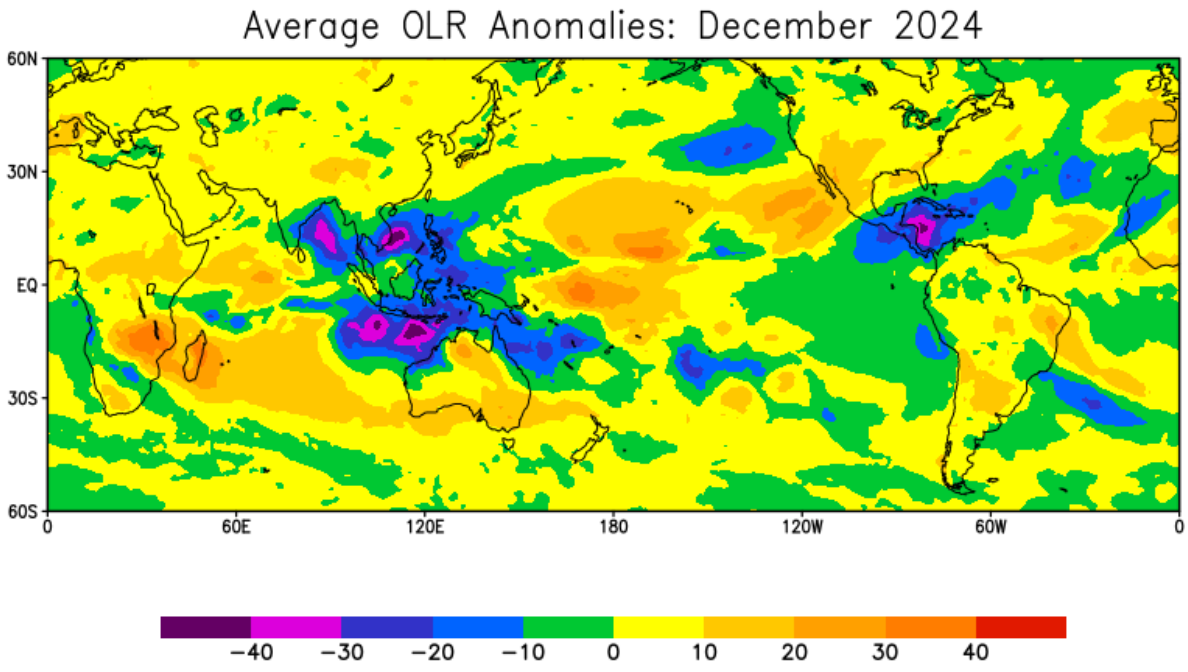

Fig.4: Outgoing Long Wave Radiation (OLR) Anomaly (W/m^2) for December 2024 (Data source: NCEP-NOAA)

1.4 Snow Cover Area over the Northern Hemisphere (NH)

During December 2024, the NH snow cover area (42.74 million Sq. km) was less than the 1991-2020 normal by 1.54 million Sq. km (Fig. 5). Eurasian Snow cover area (26.54 million Sq. km) was 0.82 million Sq. km less than the 1991-2020 normal. North America snow cover area of 16.19 million sq. km was less by 0.71 million Sq. Km with respect to 1991-2020 normal.

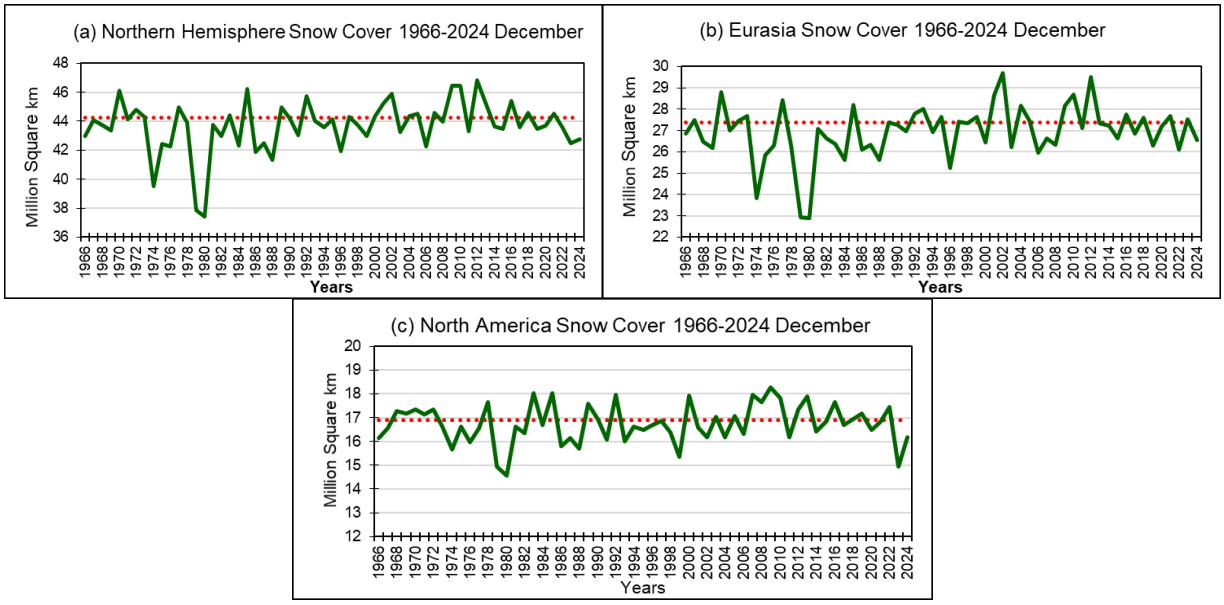

Fig.5. Snow cover area (million Sq. km) for the month of December during the period 1966-2024 (green solid lines) and normal value (1991-2020) (red dotted line) for (a) Northern Hemisphere (b) Eurasia and (c) North America. (Data Source: Rutgers University Snow Lab).

1.5. Madden Julian Oscillation (MJO)

During the first fortnight of December 2024, MJO moved from phase 4 (Maritime continent) to phase 5 (Maritime continent) with enhanced strength. It then moved eastwards to phase 7 (Western Pacific) with enhanced strength in the second fortnight. The MJO phase diagram illustrates the progression of the MJO through different phases, which generally coincide with locations along the equator around the globe.

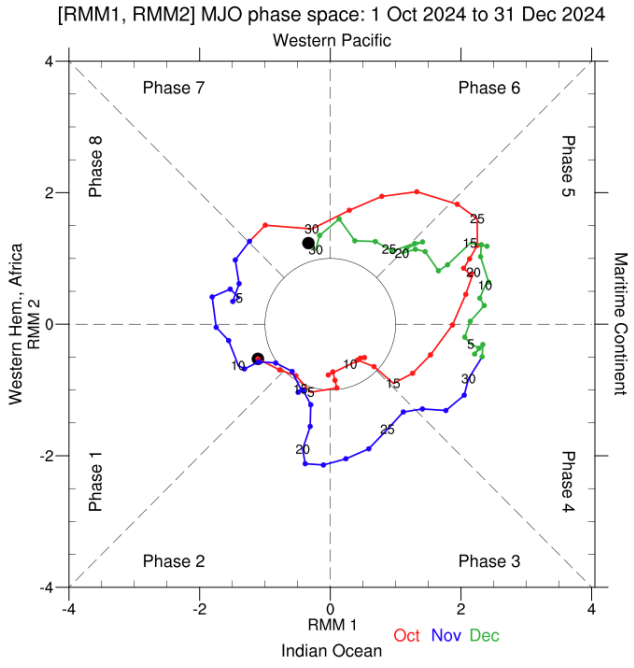

Fig.6. RMM phase diagram for Madden Julian Oscillation (MJO) for the period October to December 2024. (Data Source: http://www.bom.gov.au/climate/mjo/).

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 January to March 2025 (JFM) and February to April 2025 (FMA) are given in the Figures 7a and 7b respectively. The forecast is prepared based on the December initial conditions. The probability forecast for precipitation for JFM and FMA seasons indicate that enhanced probability of below normal precipitation is likely in most parts of northwest, west, north along the plains of Himalayas, central and east of South Asia and enhanced probability of above normal precipitation is likely in some parts of Peninsular India, northeast and southeast of South Asia.

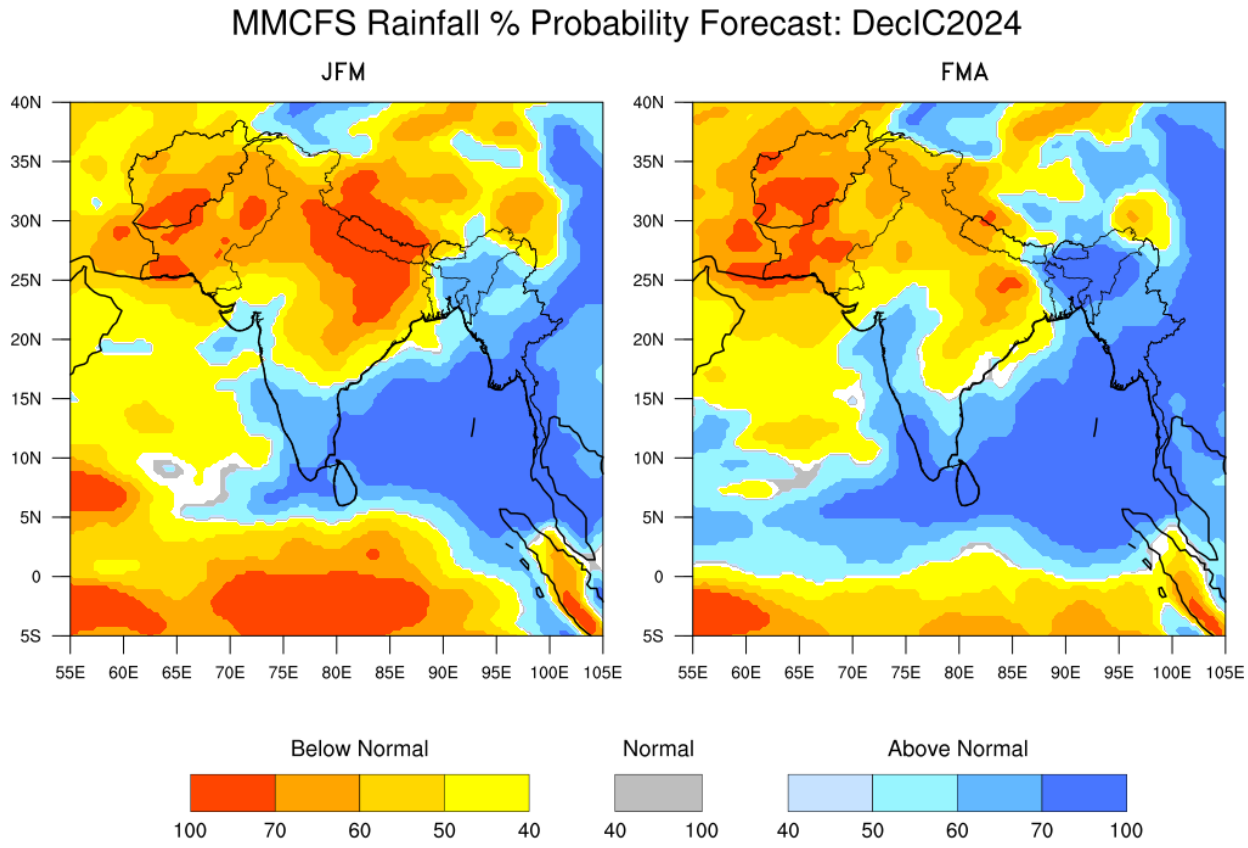

Fig.7: Seasonal probability (%) forecasts of precipitation for (a) JFM 2025 (left) and (b) FMA 2025 (right) based on initial conditions of December 2024.The white colour indicates climatological probability.

2.2. Temperature Probability Forecast*:*

The probability forecasts for temperature for the season January to March 2025 (JFM) and February to April 2025 (FMA) are given in the Figures 8a and 8b respectively. The forecast is prepared based on the December initial conditions. Temperature probability forecast for JFM and FMA seasons indicate that enhanced probability of above normal temperatures is likely over most parts of South Asia.

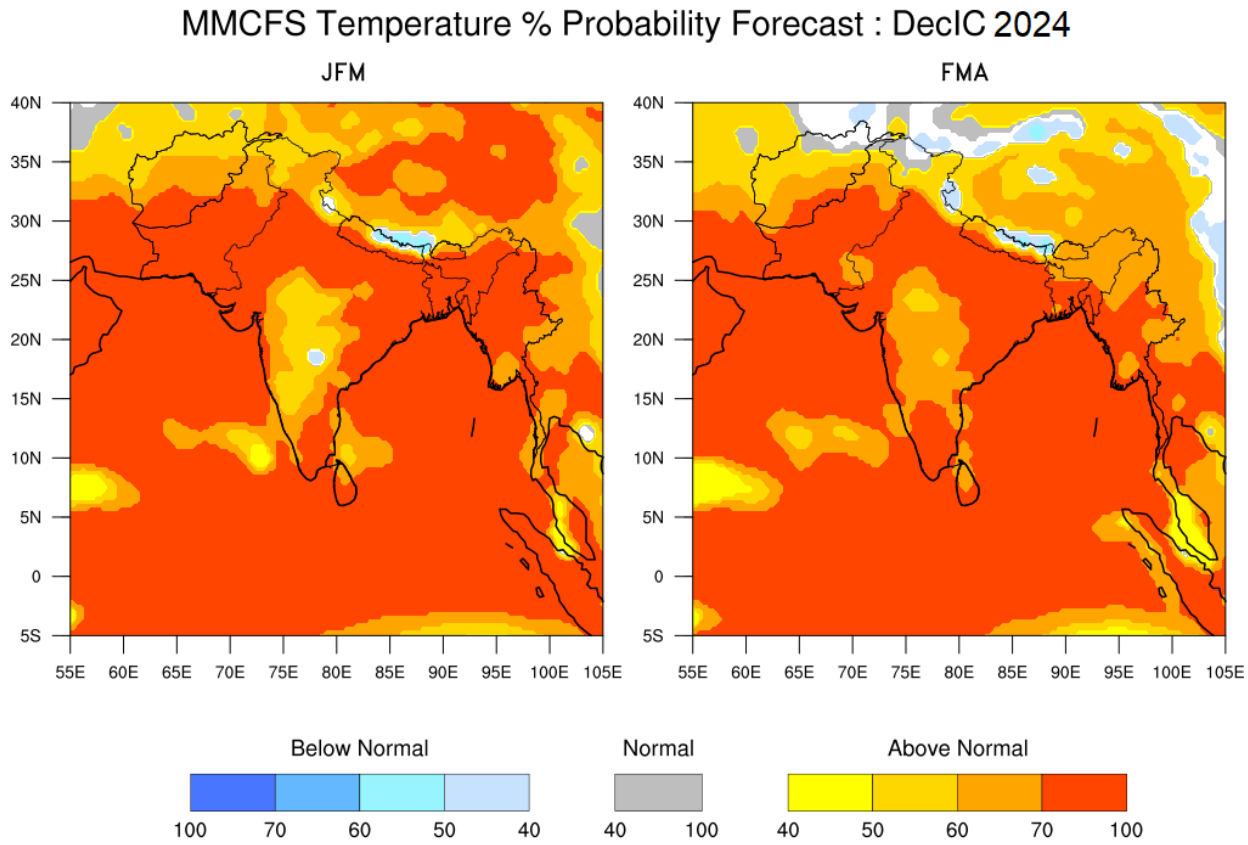

Fig. 8: Probability (%) forecast for the seasonal mean temperature for (a) JFM 2025 (left) and (b) FMA 2025 (right) based on initial conditions of December 2024. The white colour indicates climatological probability.

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 December 2024 to March 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 January, the country averaged monthly precipitation is likely to be normal to above normal for Afghanistan, India, Maldives, Myanmar, Pakistan and Sri Lanka and likely to be below normal for Bangladesh, Bhutan and Nepal. In February, the country averaged monthly precipitation is likely to be normal to above normal for Myanmar and Sri Lanka and below normal for all the other countries of South Asia. In March, it is likely to be below normal to normal for Afghanistan, Nepal and Pakistan and normal to above normal for all the other south Asian countries. In April, the country averaged monthly precipitation is likely to be normal to above normal for all the South Asian countries.

The country averaged monthly temperatures during January, February, March and April are likely to be normal to above normal for all South Asian countries.

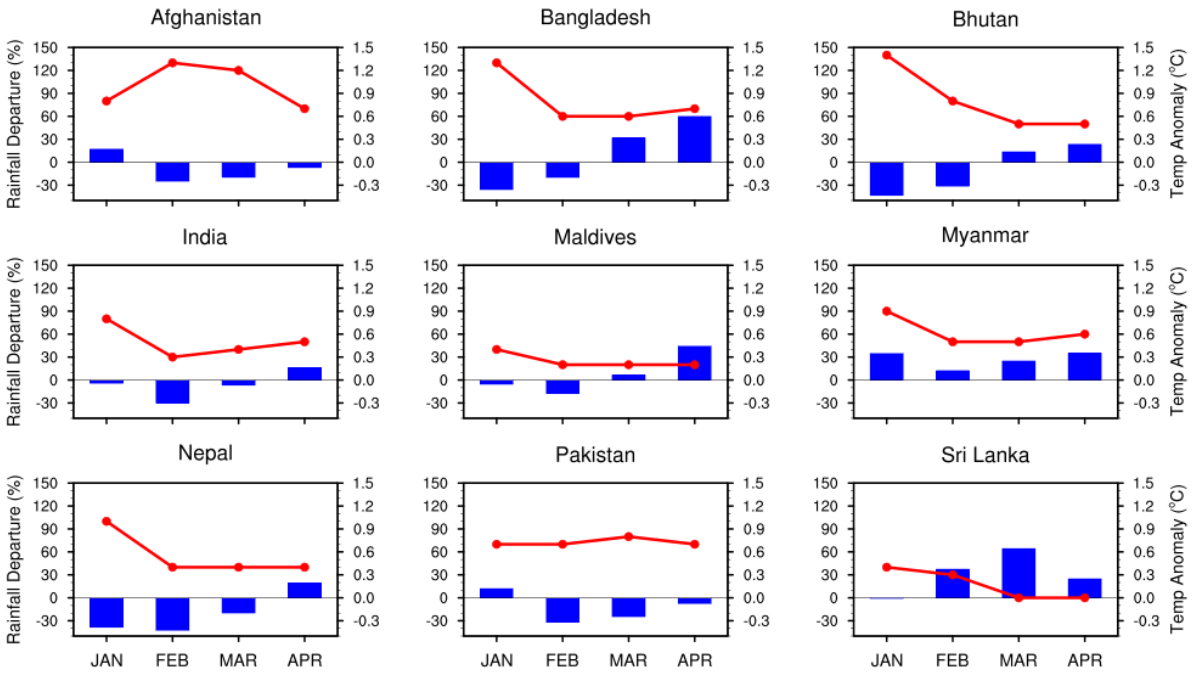

Fig. 9: Monthly country averaged rainfall forecast expressed as percentage departures (%) and Monthly country averaged temperature anomaly (°C) forecast during January to April 2025. Here, the normal range for country averaged monthly precipitation is taken as -10% to +10% (Left Vertical Axis Scale for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