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SEASONAL CLIMATE OUTLOOK FOR SOUTH ASIA

(May to August 2024)

Highlights

- The strength of El Niño conditions weakened since beginning of the year and currently weak El Niño conditions are observed over equatorial Pacific. The latest MMCFS forecast indicates that El Niño conditions are likely to weaken further during the upcoming season and turn to ENSO neutral thereafter. The model also indicates likely development of the La Niña conditions during the latter part of the monsoon season.
- At present, neutral Indian Ocean Dipole (IOD) conditions are prevailing over the Indian Ocean. The latest MMCFS forecast indicates that the neutral IOD conditions are likely to develop during the monsoon season.
- The probability forecast for precipitation for May – July (MJJ) and June – August (JJA) indicates that enhanced probability of above normal precipitation is likely in most parts of South Asia except over extreme north, extreme east, northeast and southeast of South Asia where it is likely to experience below normal rainfall.
- In May, the country averaged monthly precipitation is likely to be normal to above normal for all South Asian countries except Myanmar where it is likely to be below normal. In June, it is likely to be normal to above normal for all the countries except Bangladesh, Bhutan and Myanmar where it is likely to be below normal. In July and August, it is likely to be normal to above normal for all the countries.
- Temperature probability forecast for MJJ and JJA seasons indicates that enhanced probability of above normal temperatures is likely over most parts of South Asia except over north along the plains of Himalayas where probability of below normal temperature is likely.
- The country averaged monthly temperatures during May, June, July and August 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

During April 2024, warmer than normal sea surface temperatures (SSTs) were observed across the central and east-central Pacific Ocean and the northern and southern extra-tropical Pacific region (Fig.1a). However, cooler than normal SSTs were observed over a small region of eastern equatorial Pacific and some parts of Southern Pacific Ocean. As compared to March 2024, negative SST anomalies were observed over central and eastern equatorial Pacific region and positive SST anomalies were observed over the western parts of the Pacific Ocean (Fig.1b). The latest MMCFS forecast indicates that El Niño conditions are likely to weaken further during the upcoming season and turn to ENSO neutral thereafter. The model also indicates likely development of the La Niña conditions during the latter part of the monsoon season (Fig.2).

1.2 Sea Surface Temperatures over Indian Ocean

In April 2024, warmer than normal SSTs were observed over most parts of the Indian Ocean (Fig.1a) including Bay of Bengal and Arabian Sea. As compared to March 2024, cool SSTs were observed over western Indian Ocean and warm SSTs were observed over eastern equatorial Indian Ocean, Bay of Bengal and some part of north Arabian Sea (Fig.1b). The latest MMCFS forecast indicates that the neutral IOD conditions are likely to develop during the monsoon season. (Fig.3).

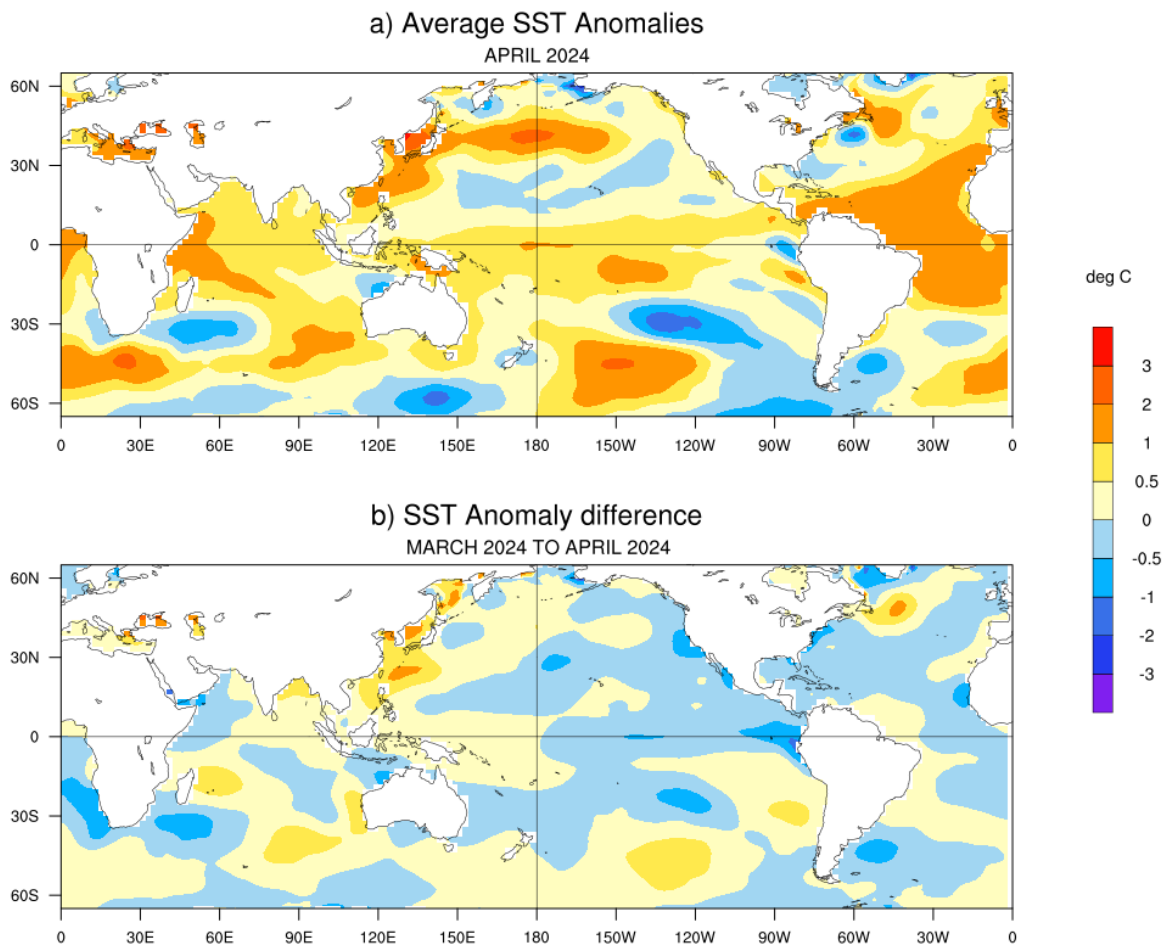


Fig.1(a) Sea surface temperature (SST) anomalies ($^{\circ}\text{C}$) during April 2024 and (b) changes in the SST anomalies ($^{\circ}\text{C}$) from March to April 2024. SSTs were based on the ERSSTv5, NOAA, and anomalies were computed with respect to 30-year (1991-2020) long term mean.

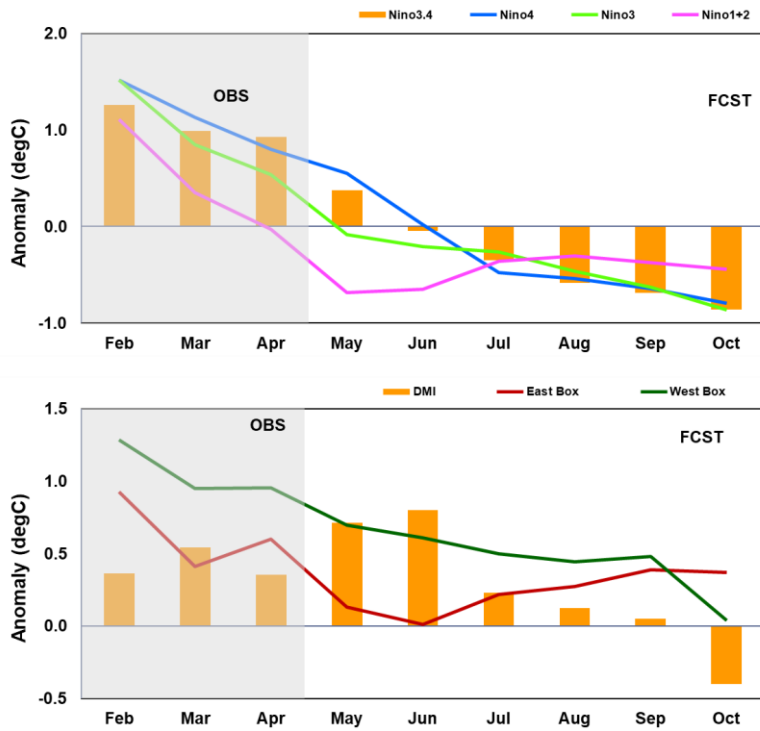


Fig.2: Time series of monthly area-averaged SST anomalies (°C) in the 4 Niño regions. ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF corrected anomaly forecast for the next 6 months.

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 April 2024 is shown in (Fig.4). Negative OLR anomalies (enhanced convection, blue shading) were observed over northwest and central parts of South Asia, west and central equatorial Indian Ocean, maritime continent and parts of south tropical Pacific Ocean. Positive OLR anomalies (suppressed convection, orange/red shading) were observed over peninsular India, Bay of Bengal and adjoining Thailand and south China sea. Positive OLR anomalies were also present in central and east tropical Indian Ocean and parts of east equatorial Pacific Ocean.

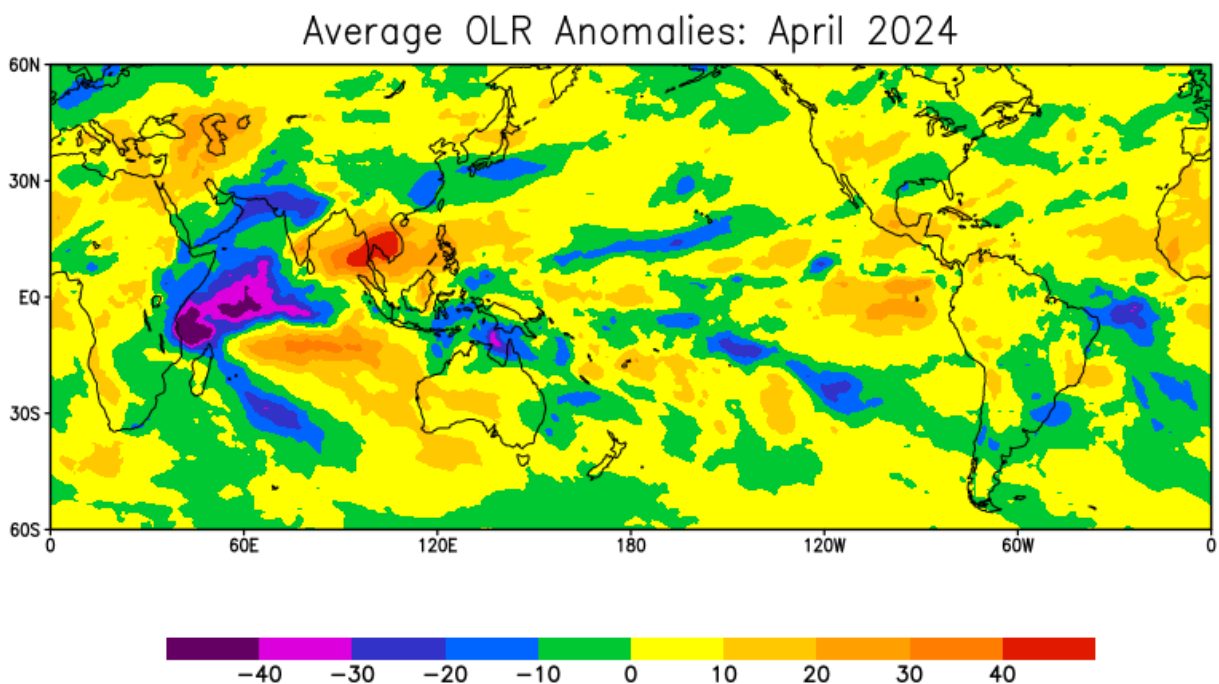


Fig.4: Outgoing Long Wave Radiation (OLR) Anomaly (W/m^2) for April 2024 (Data source: NCEP-NOAA)

1.4 Snow Cover Area over the Northern Hemisphere (NH)

During April 2024, the NH snow cover area (27.81 million Sq. km) was less than the 1991-2020 normal by 2.11 million Sq. km (Fig. 5). Eurasian Snow cover area (15.86 million Sq. km) was 0.9 million Sq. km less than the 1991-2020 normal. North America snow cover area of 11.95 million sq. km was less by 1.22 million Sq. Km with respect to 1991-2020 normal.

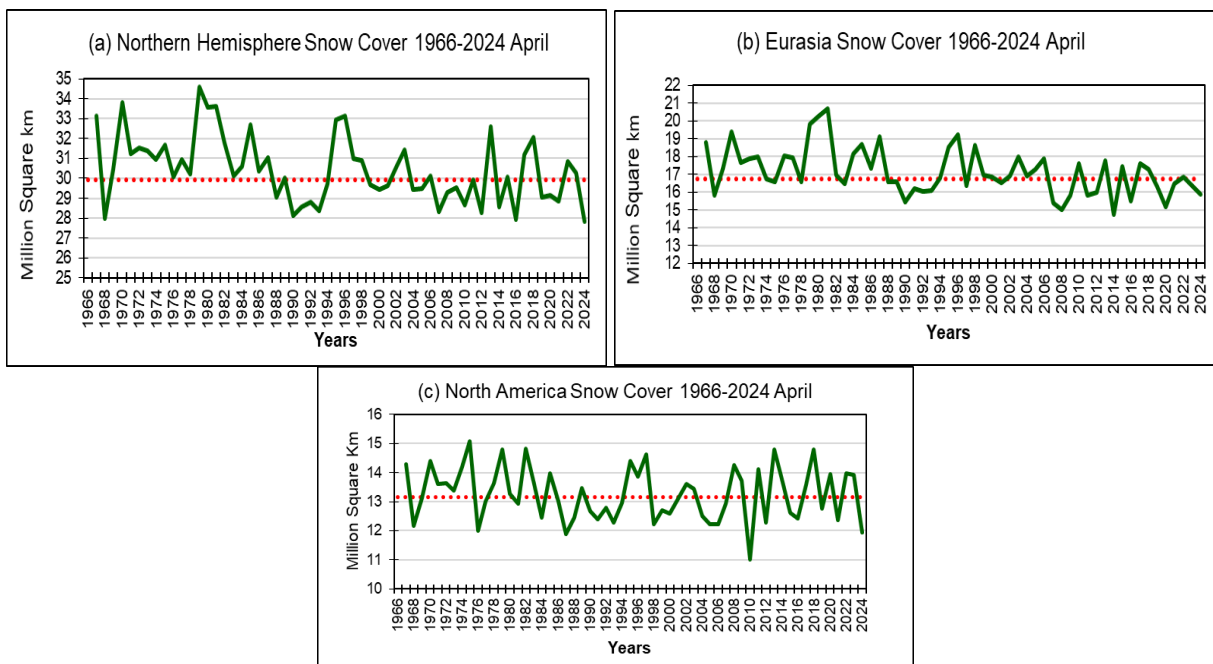


Fig.5. Snow cover area (million Sq. km) for the month of April during the period 1966-2024 (green solid lines) and normal value (1991-2020) (red dotted line) for (a) Northern Hemisphere (b) Eurasia and (c) North America. (Data Source: Rutgers University Snow Lab).

1.5 Madden Julian Oscillation (MJO)

During the first week of April 2024, MJO moved from phase 1(Western Hemisphere and Africa) to phase 3 (Indian Ocean). with increased strength. In the next 3 weeks it remained subdued in phase 2 and 3 (Indian Ocean). The MJO phase diagram illustrates the progression of the MJO through different phases, which generally coincide with locations along the equator around the globe.

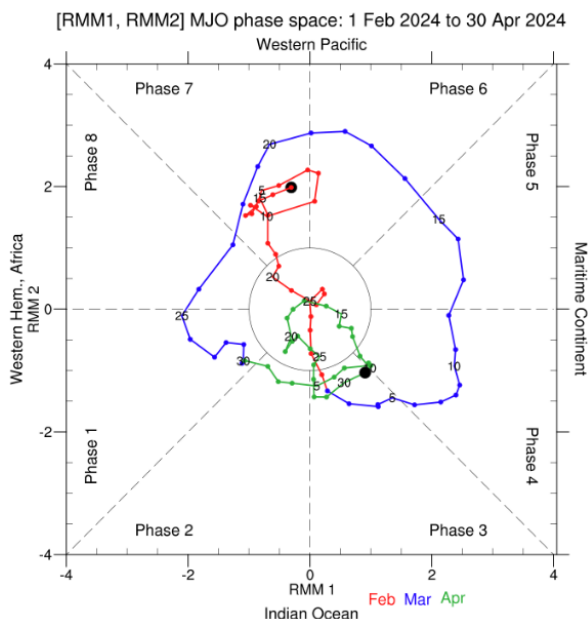


Fig.6. RMM phase diagram for Madden Julian Oscillation (MJO) for the period February to April 2024. (Data Source: <http://www.bom.gov.au/climate/mjo/>).

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 May to July 2024 (MJJ) and June to August 2024 (JJA) are given in the Figures 7a and 7b respectively. The forecast is prepared based on the April initial conditions. The probability forecast for precipitation for MJJ and JJA seasons indicates that enhanced probability of above normal precipitation is likely over most parts of South Asia except over extreme north, extreme east, northeast and southeast of South Asia where it is likely to experience below normal rainfall.

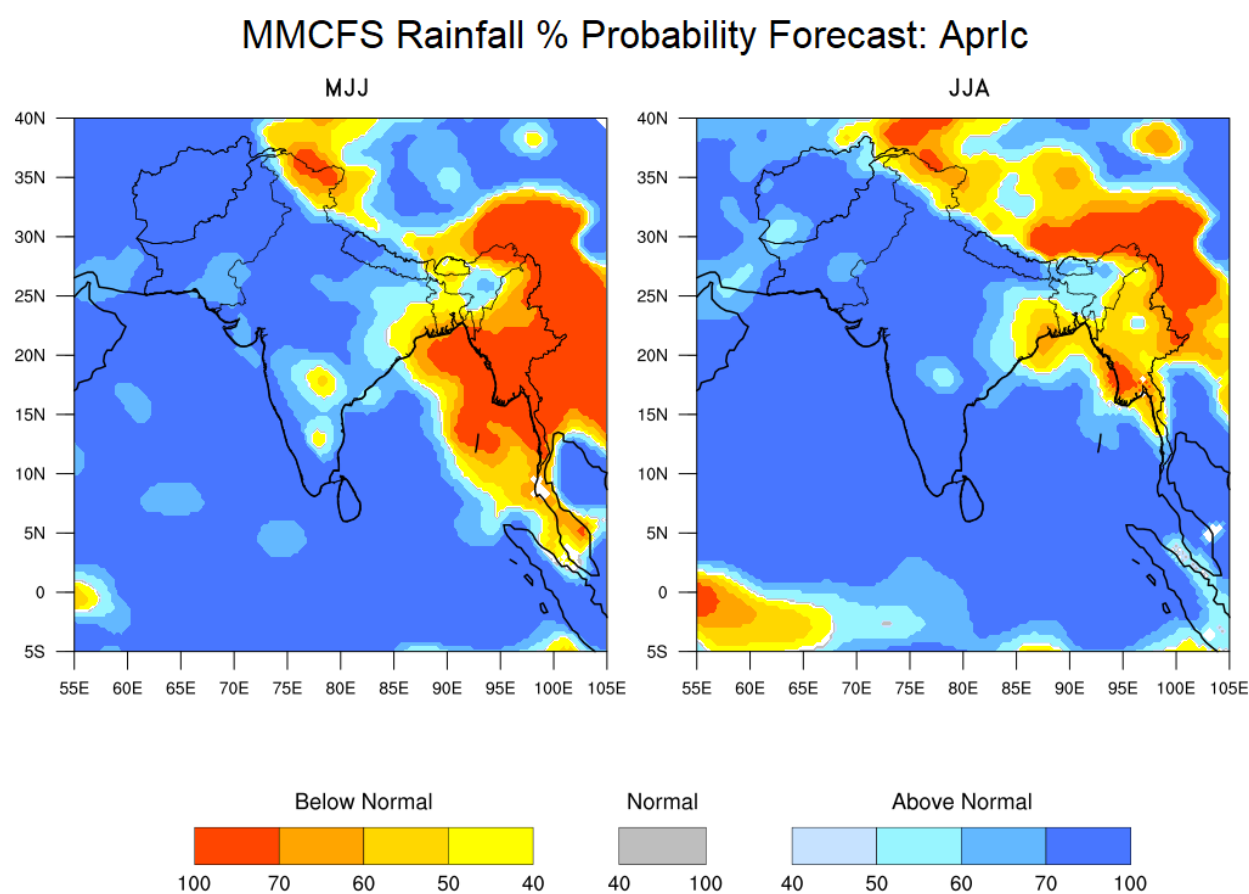


Fig.7: Seasonal probability (%) forecasts of precipitation for (a) MJJ 2024 (left) and (b) JJA 2024 (right) based on initial conditions of April 2024. The white colour indicates climatological probability.

2.2. Temperature Probability Forecast:

The probability forecasts for temperature for the season May to July 2024 (MJJ) and June to August 2024 (JJA) are given in the Figures 8a and 8b respectively. The forecast is prepared based on the April initial conditions. Temperature probability forecast for MJJ and JJA seasons indicates that enhanced probability of above normal temperatures is likely over most parts of South Asia except over north along the plains of Himalayas where probability of below normal temperatures is likely.

MMCFS Temperature %Probability Forecast : Aprlc 2024

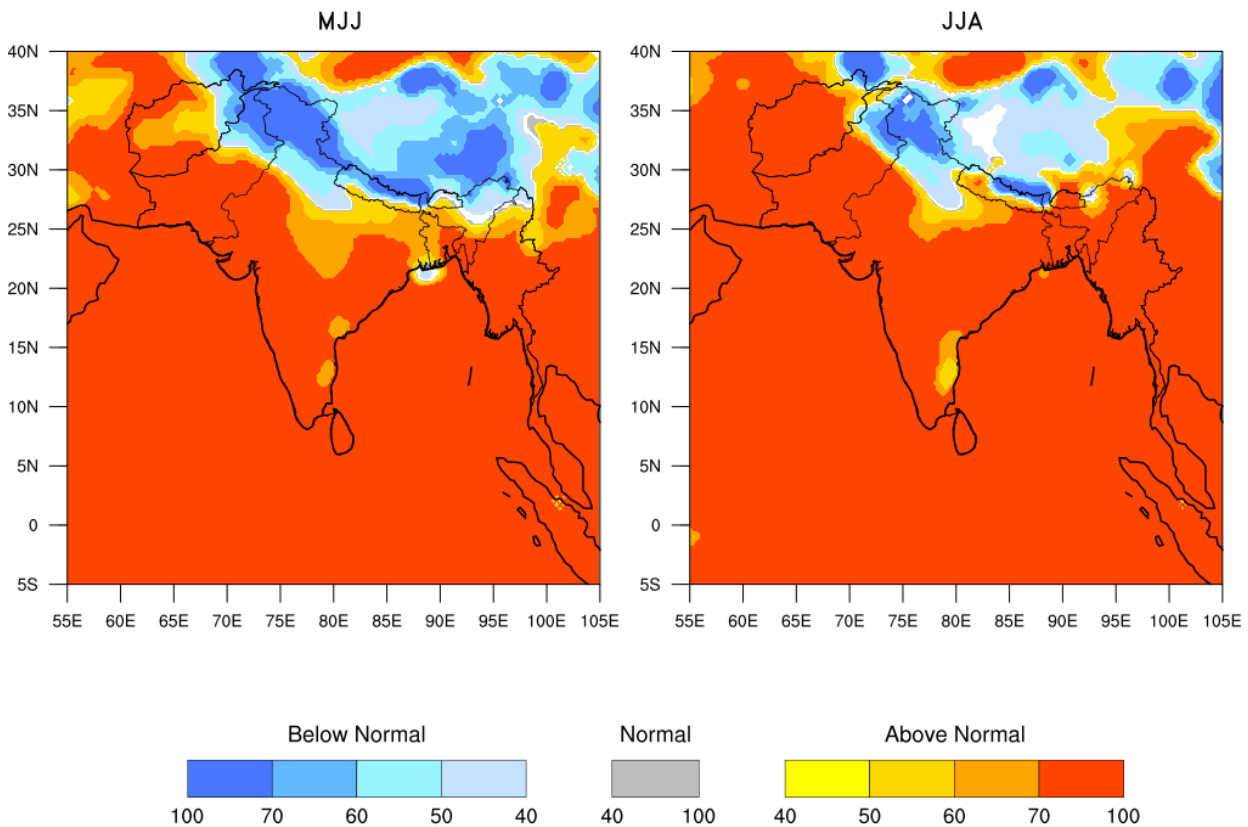


Fig. 8: Probability (%) forecast for the seasonal mean temperature for (a) MJJ 2024 (left) and (b) JJA 2024 (right) based on initial conditions of April 2024. The white colour indicates climatological probability.

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 May to August 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 May, the country averaged monthly precipitation is likely to be normal to above normal for all South Asian countries except Myanmar where it is likely to be below normal. In June, it is likely to be normal to above normal for all the countries except Bangladesh, Bhutan and Myanmar where it is likely to be below normal. In July and August, it is likely to be normal to above normal for all the countries.

The country averaged monthly temperatures during May, June, July and August are likely to be normal to above normal for all south Asian countries.

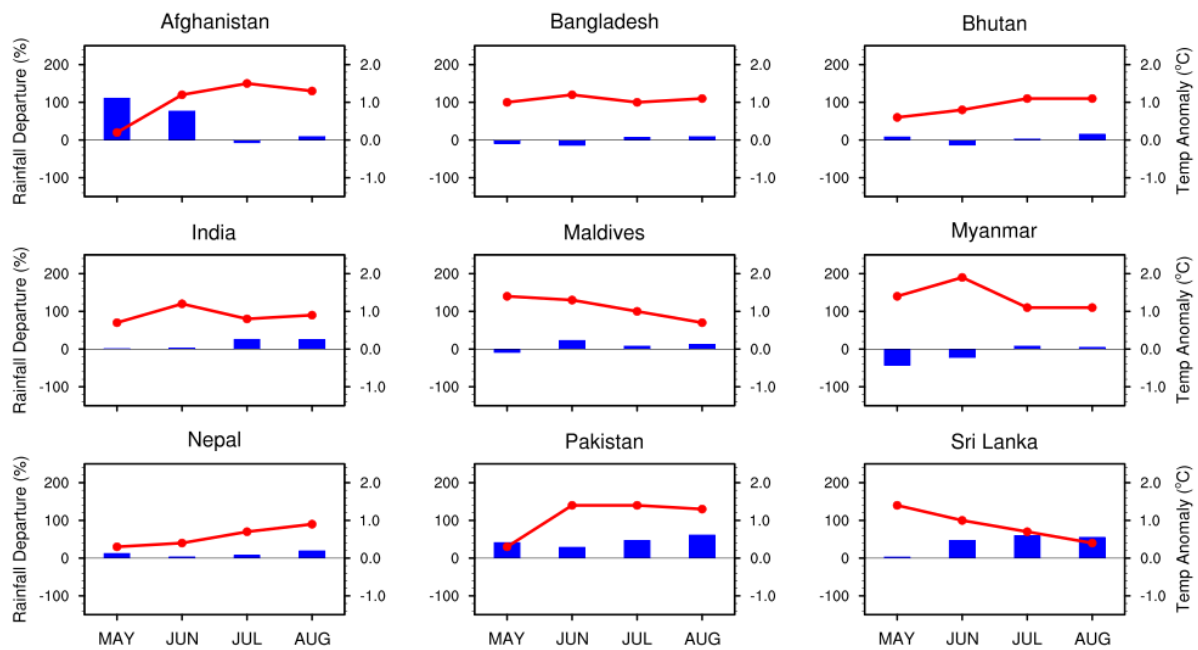


Fig. 9: Monthly country averaged rainfall forecast expressed as percentage departures (%) and Monthly country averaged temperature anomaly (°C) forecast during May to August 2024. Here, the normal range for country averaged monthly precipitation is taken as -10% to +10% (Left Vertical Axis Scale for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