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SEASONAL CLIMATE OUTLOOK FOR SOUTH ASIA

(August to November 2023)

Highlights

- Currently, 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 El Niño conditions are likely to continue up to the first quarter of next year.

- The neutral Indian Ocean Dipole (IOD) conditions with very close to positive IOD threshold are prevailing over the Indian Ocean. The latest MMCFS forecast indicates a weak positive IOD conditions are likely to develop during the upcoming season.

- The probability forecast for precipitation for August – October (ASO) and September – November (SON) indicates that enhanced probability of below normal precipitation is likely over most parts of South Asia except over some parts of northwest, southeast and Peninsular region where enhanced probability of above normal precipitation is likely.

- The country averaged monthly precipitation for the month of August is likely to be normal to above normal for all south Asian countries except Afghanistan and Pakistan where it is below normal. In September, the country averaged monthly precipitation is likely to be normal to above normal for all the countries except Pakistan and Sri Lanka where it is likely to be below normal. In October, it is likely to be normal to above normal for Afghanistan, Bangladesh, Maldives, Myanmar and Sri Lanka and below normal for Bhutan, India, Nepal and Pakistan. In November, it is likely to be normal to above normal for all countries except Bangladesh, Bhutan and Nepal where it is likely to be below normal.

- Temperature probability forecast for ASO and SON 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 probability of below normal temperature is likely.

- The country averaged monthly temperatures during August, September and November is likely to be normal to above normal for all south Asian countries. In October, it is likely to be above normal for all the countries except Bhutan and Nepal where it is likely to be below normal.

1. Important Global Climate Factors

1.1 Sea Surface Temperatures over the Pacific Ocean

During July 2023, warmer than normal SSTs were observed over most of the equatorial Pacific Ocean (Fig.1a). Warmer than normal SSTs were also observed over the extra-tropical regions of the north and south Pacific Ocean. As compared to the last month, an increase in the warming of SSTs is seen over the central and eastern equatorial Pacific Ocean (Fig.1b) and also over the north Pacific Ocean. The latest MMCFS forecast indicates that El Niño conditions are likely to continue up to the first quarter of next year (Fig. 2).

1.2 Sea Surface Temperatures over the Indian Ocean

In the month of July 2023, warm SST anomalies were observed over the Indian Ocean, especially over the north Arabian Sea (Fig.1a). In the south Indian Ocean, warm SST anomalies are observed over the western part whereas cold SST anomalies are observed over the eastern part. As compared to the last month, warmer SSTs are observed over most parts of the equatorial Indian Ocean, and cooler SSTs are observed over the north Arabian Sea and some parts of the Bay of Bengal (Fig. 1b). The latest MMCFS forecast indicates weak positive IOD conditions are likely to develop during the upcoming season (Fig.3).

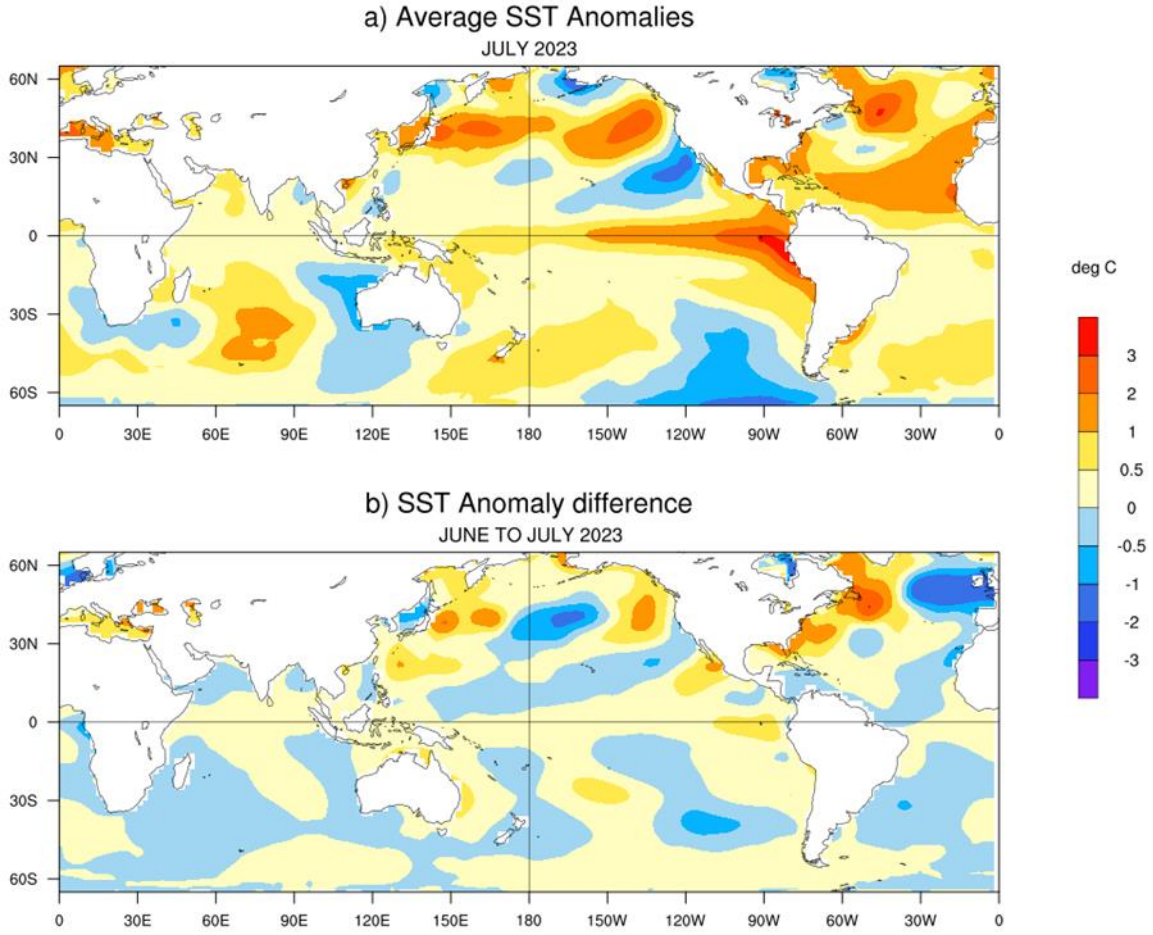

Fig.1(a) Sea surface temperature (SST) anomalies (°C) during July 2023 and (b) changes in the SST anomalies (°C) from June to July 2023. SSTs were based on the ERSSTv5, NOAA, and anomalies were computed with respect to 30-year (1981-2010) long-term mean.

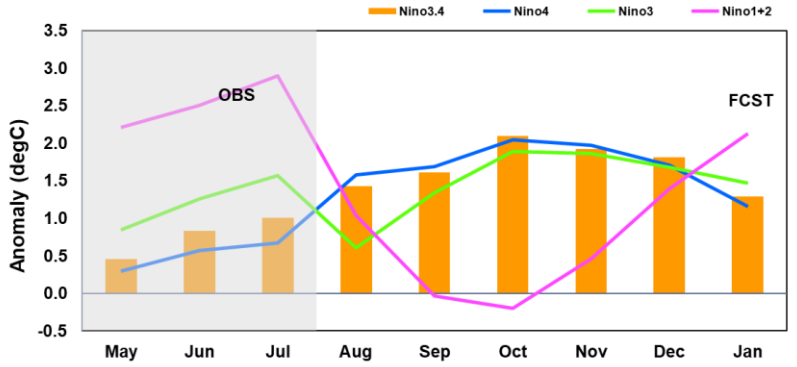

Fig.2: Time series of monthly area-averaged SST anomalies (°C) in the 4 Niño regions. ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF corrected anomaly forecast for the next 6 months.

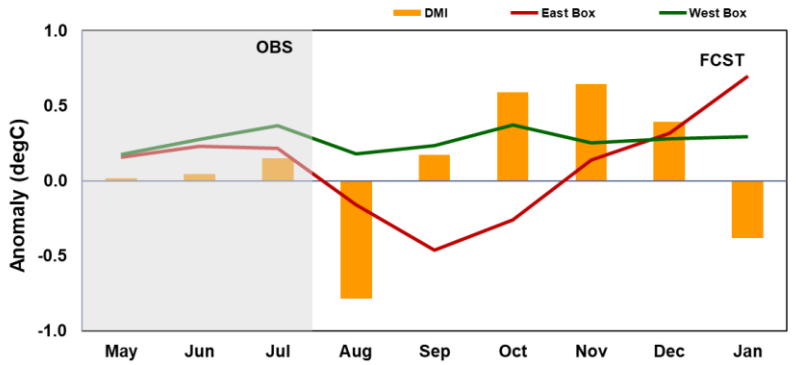

Fig.3: The time series of the monthly area-averaged SST anomaly Indices (°C) over west equatorial Indian Ocean (WEI) & east equatorial Indian Ocean (EEI) along with Dipole Mode Index (DMI=WEI-EEI) representing Indian Ocean Dipole (IOD). ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF 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 2023 is shown in (Fig.4). Negative OLR anomalies (enhanced convection, blue shading) were observed over northwest and west of south Asia. Negative OLR anomalies were also observed over the west-central Bay of Bengal, most of the equatorial Pacific Ocean, and the south extra-tropical Pacific Ocean. Positive OLR anomalies (suppressed convection, orange/red shading) were observed over most parts of the east and northeast of South Asia, parts of Africa, and north and South America. Positive OLR anomalies were also observed over most parts of the tropical Indian Ocean and some parts of the north and south tropical Pacific Ocean.

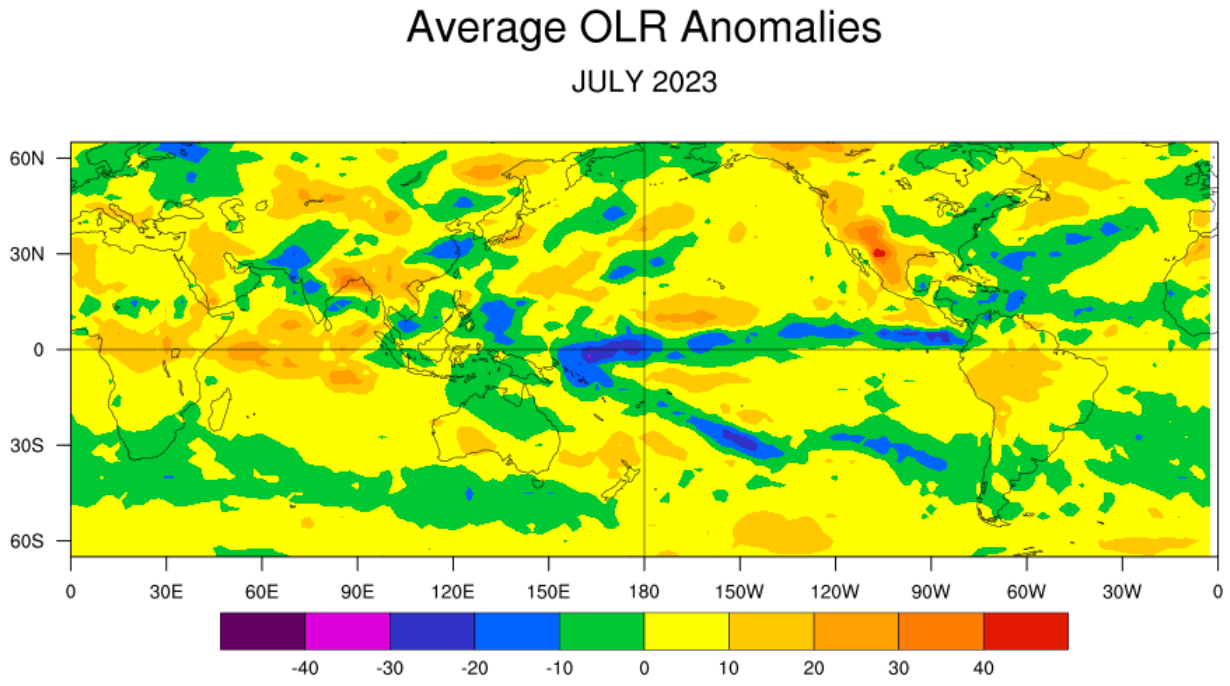

Fig.4: Outgoing Long Wave Radiation (OLR) Anomaly (W/m^2) for July 2023 (Data source: NCEP-NOAA)

1.4 Snow Cover Area over the Northern Hemisphere (NH)

During July 2023, the NH snow cover area (2.81 million sq. km) was less than the 1991-2020 normal by 0.4 million sq. km (Fig. 5). Eurasian Snow cover area (0.22 million sq. km) was 0.27 million sq. km less than the 1991-2020 normal. North American snow cover area of 2.59 million sq. km was less by 0.11 million sq. Km with respect to 1991-2020 normal.

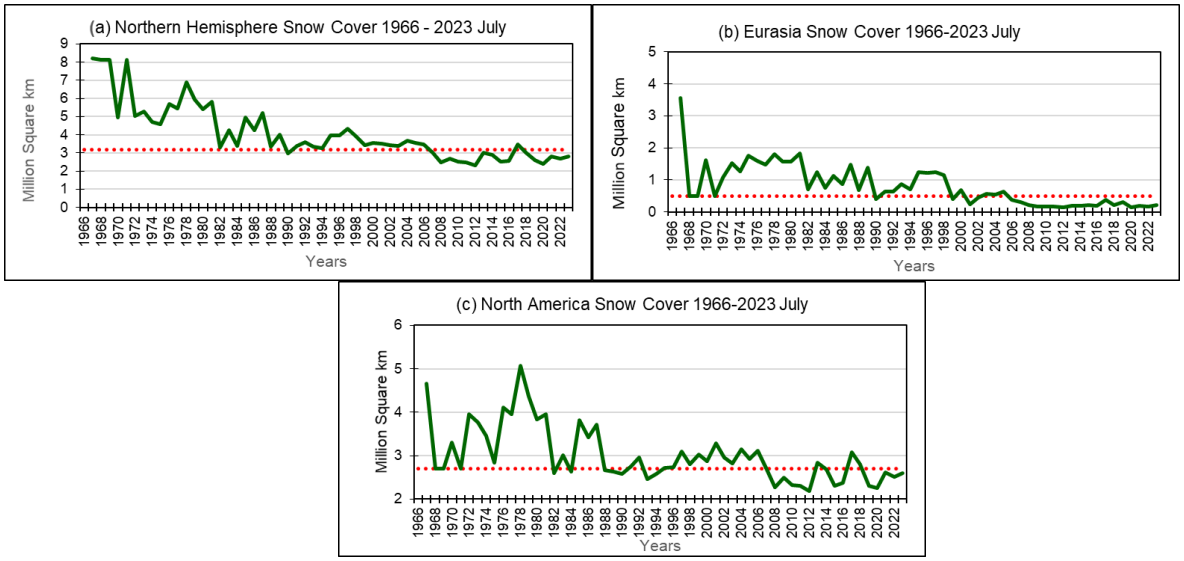

Fig.5. Snow cover area (million Sq. km) for the month of July during the period 1966-2023 (green solid lines) and normal value (1991-2020) (red dotted line) for (a) Northern Hemisphere (b) Eurasia and (c) North America. (Data Source: Rutgers University Snow Lab).

1.5. Madden Julian Oscillation (MJO)

During the first three weeks of July 2023, MJO remained in phase 2 and phase 3 (Indian Ocean) and then recurved and entered phase 1 (Western Hemisphere and Africa) in the last week. The strength of MJO was weak 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.

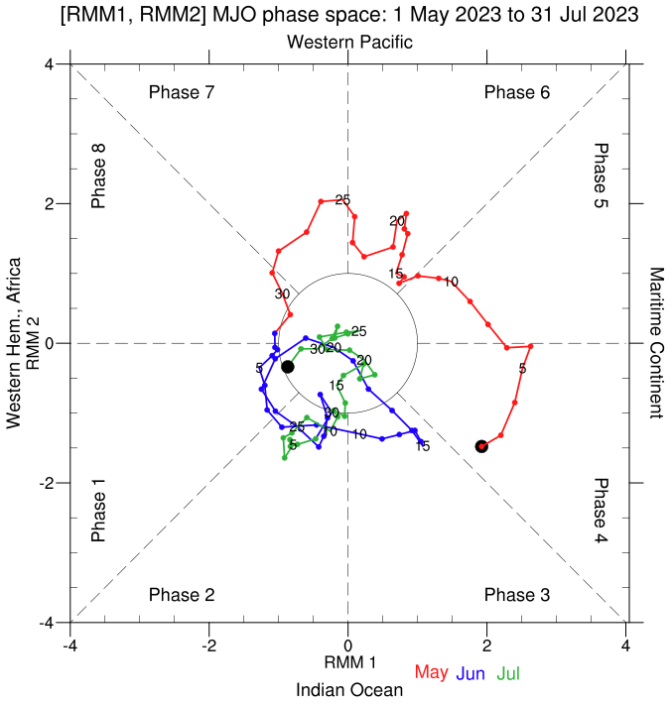

Fig.6. RMM phase diagram for Madden Julian Oscillation (MJO) for the period May to July 2023. (Data Source: http://www.bom.gov.au/climate/mjo/).

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 August to October 2023 (ASO) and September to November 2023 (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 and SON indicates that enhanced probability of below normal precipitation is likely over most parts of South Asia except over some parts of northwest, southeast and Peninsular region where enhanced probability of above normal precipitation is likely.

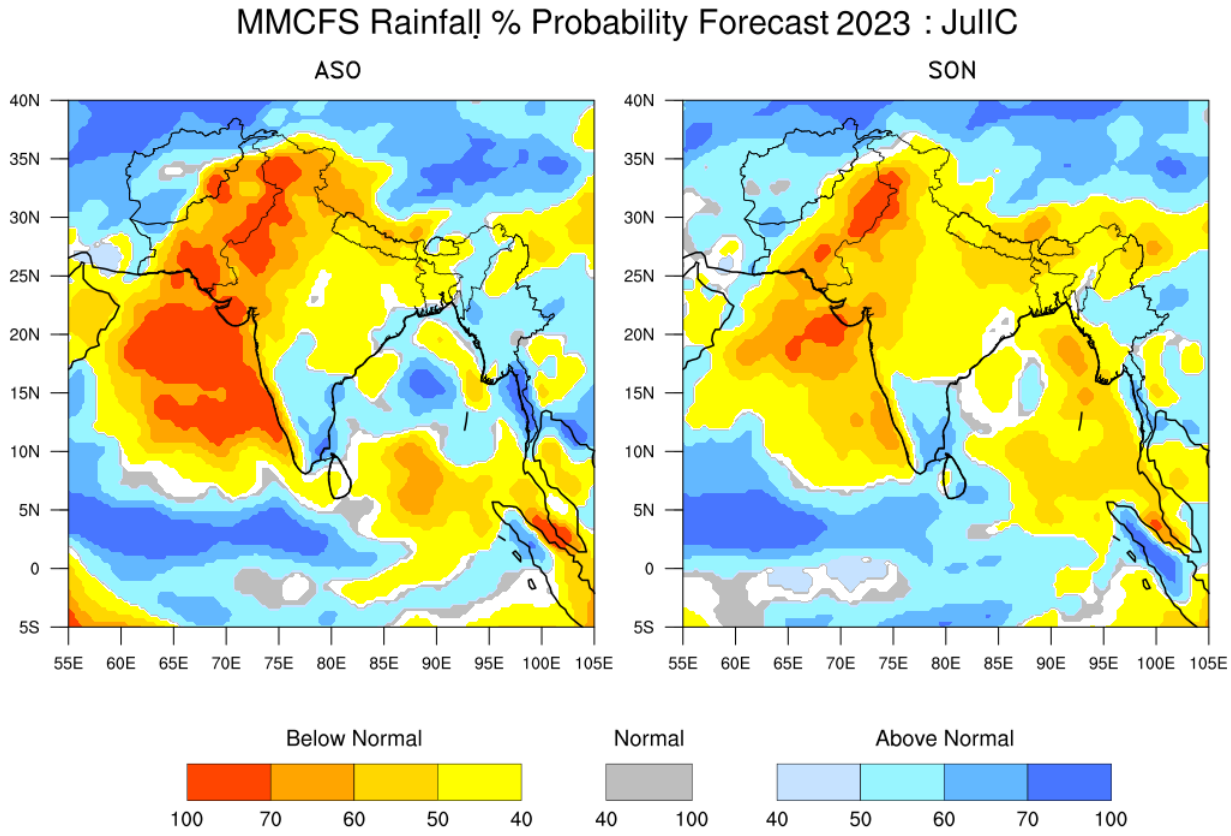

Fig.7: Seasonal probability (%) forecasts of precipitation for (a) ASO 2023 (left) and (b) SON 2023 (right) based on initial conditions of July 2023.The white colour indicates climatological probability.

2.2. Temperature Probability Forecast*:*

The probability forecasts for temperature for the season August to October 2023 (ASO) and September to November 2023 (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 (Fig. 8a) and SON 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 probability of below normal temperature is likely.

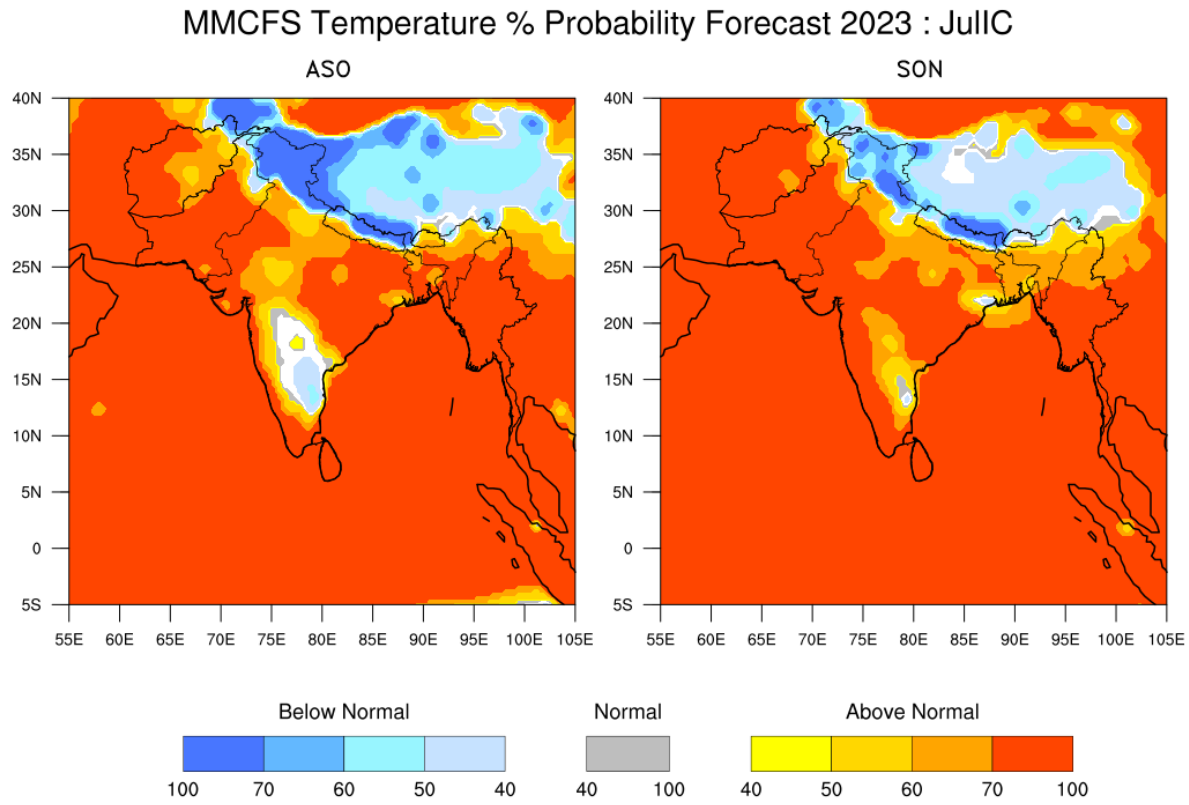

Fig. 8: Probability (%) forecast for the seasonal mean temperature for (a) ASO 2023 (left) and (b) SON 2023 (right) based on initial conditions of July 2023. The white colour indicates climatological probability.

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 August to November 2023) 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 2023, the country averaged monthly precipitation is likely to be normal to above normal for all south Asian countries except Afghanistan and Pakistan where it is below normal (Fig.9). In September, the country averaged monthly precipitation is likely to be normal to above normal for all the countries except Pakistan and Sri Lanka where it is likely to be below normal. In October, it is likely to be normal to above normal for Afghanistan, Bangladesh, Maldives, Myanmar and Sri Lanka and below normal for Bhutan, India, Nepal and Pakistan. In November, it is likely to be normal to above normal for all countries except Bangladesh, Bhutan and Nepal where it is likely to be below normal.

The country averaged monthly temperatures during August, September and November is likely to be normal to above normal for all south Asian countries. In October, it is likely to be above normal for all the countries except Bhutan and Nepal where it is likely to be below normal.

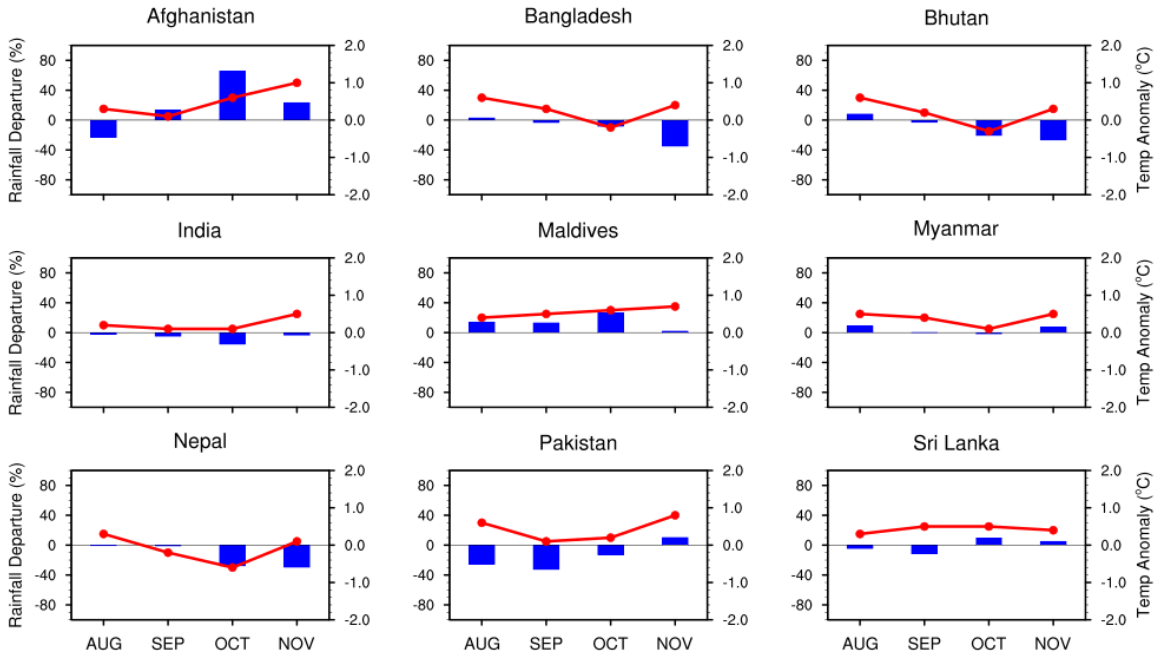

Fig. 9: Monthly country averaged rainfall forecast expressed as percentage departures (%) and Monthly country averaged temperature anomaly (°C) forecast during August to November 2023. Here, the normal range for country averaged monthly precipitation is taken as -10% to +10% (Left Vertical Axis Scale 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).