Earth System Science Organization (ESSO)
Ministry of Earth Sciences (MoES)
India Meteorological Department
WMO Regional Climate Centre
Pune, India

SEASONAL CLIMATE OUTLOOK FOR SOUTH ASIA

(July to October 2023)

Highlights

- Currently, weak 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 end of this year.

- The neutral Indian Ocean Dipole (IOD) conditions 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 July – September (JAS) and August – October (ASO) indicates that enhanced probability of below normal precipitation is likely over most parts of northwest, west, north, central and east of South Asia and some parts of southeast and extreme south of South Asia while most parts of northeast and peninsular region are likely to experience enhanced probability of above normal precipitation.

- The country averaged monthly precipitation for the month of July and September are likely to be normal to above normal for all south Asian countries except Afghanistan and Pakistan where it is below normal. In August, it is likely to be normal to above normal for all the countries except Afghanistan, Bangladesh and Pakistan where it is likely to be below normal. In October, it is likely to be normal to above normal for all south Asian countries.

- Temperature probability forecast for JAS and ASO 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 and southeast Peninsular region where probability of below normal temperature is likely.

- The country averaged monthly temperatures during July to October is likely to be normal to above normal for all south Asian countries.

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1. Important Global Climate Factors

1.1 Sea Surface Temperatures over the Pacific Ocean

During June 2023, warmer than normal SSTs were observed across the east central and eastern Pacific Ocean (Fig.1a). Warmer than normal SSTs were also observed over the extra-tropical regions of the north Pacific Ocean and Cooler than normal SSTs were observed over the western Pacific Ocean. As compared to the last month, SSTs have warmed over central and eastern equatorial Pacific Ocean (Fig.1b) and that over the western equatorial Pacific Ocean have cooled. The latest MMCFS forecast indicates El Niño conditions are likely to continue up to the end of this year (Fig. 2).

1.2 Sea Surface Temperatures over Indian Ocean

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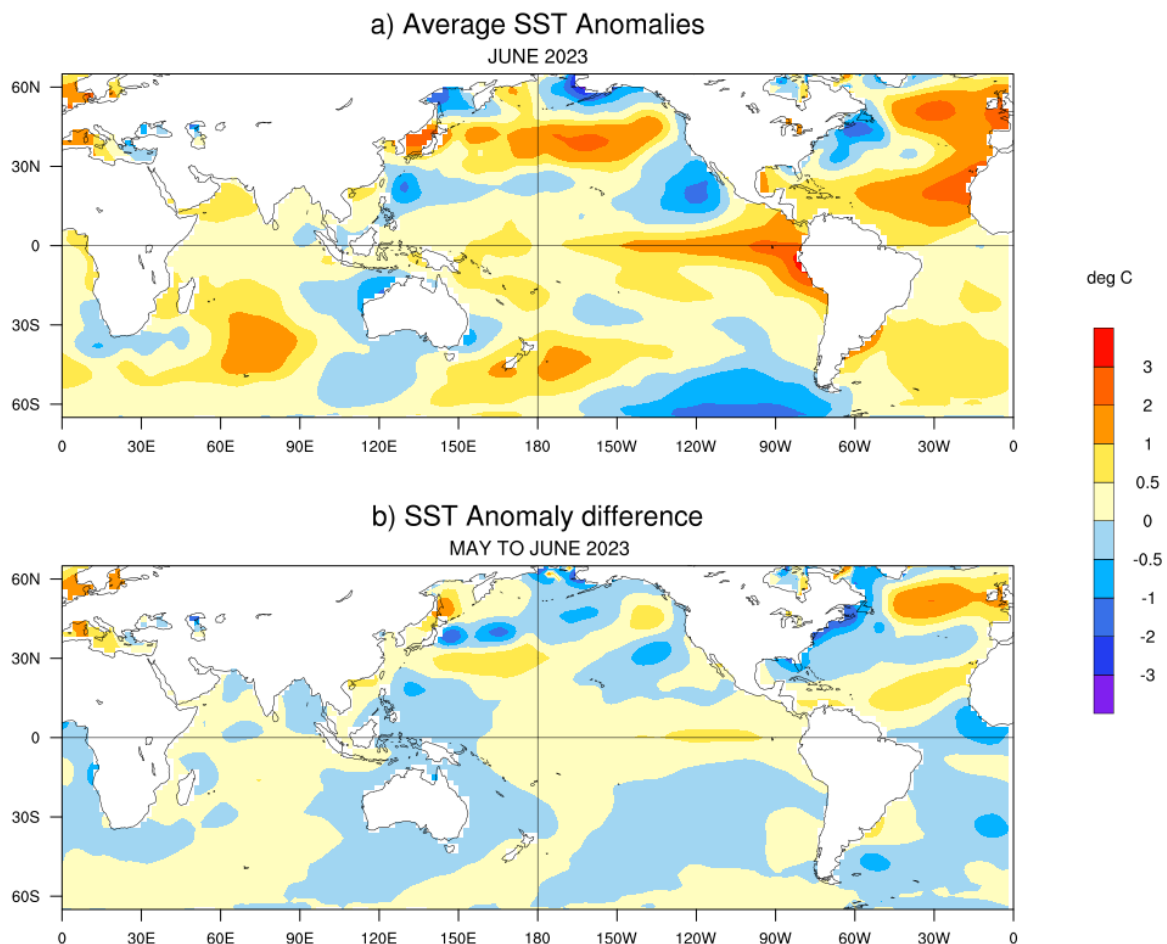

Fig.1(a) Sea surface temperature (SST) anomalies (°C) during June 2023 and (b) changes in the SST anomalies (°C) from May to June 2023. SSTs were based on the ERSSTv5, NOAA, and anomalies were computed with respect to 30-year (1981-2010) long term mean.
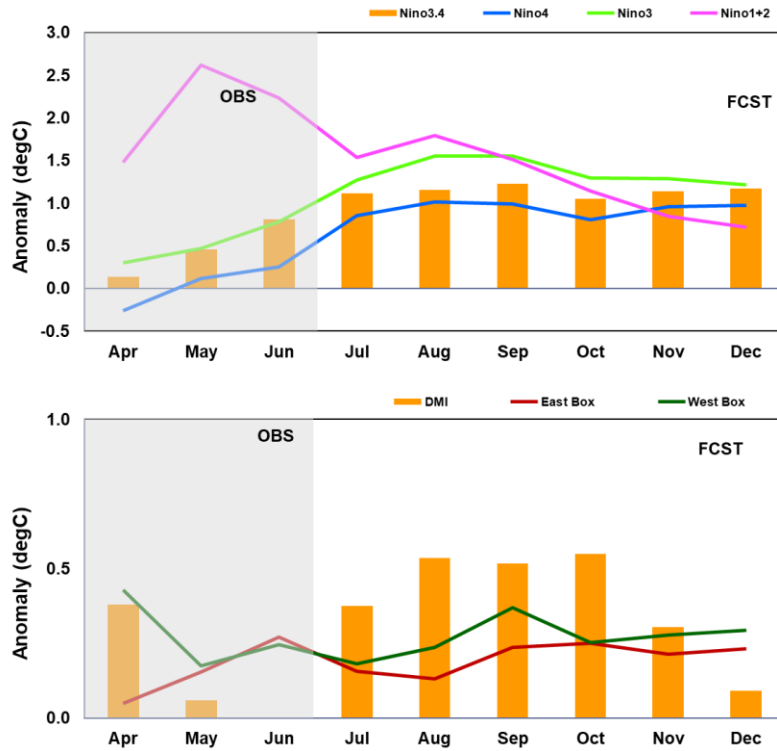
Fig.2: Time series of monthly area-averaged SST anomalies (°C) in the 4 Niño regions. ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF corrected anomaly forecast for the next 6 months.

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 June 2023 is shown in (Fig.4). Negative OLR anomalies (enhanced convection, blue shading) were observed over northwest of south Asia and parts of central and north Africa. Negative OLR anomalies were also observed over north and west central Arabian Sea, west central tropical Pacific Ocean and east equatorial Pacific Ocean. Positive OLR anomalies (suppressed convection, orange/red shading) were observed over most parts of central and northeast of South Asia, maritime continent and most parts of north and south America. Positive OLR anomalies were also observed over south east Arabian Sea, east Bay of Bengal, south equatorial Indian Ocean, south equatorial Pacific Ocean near dateline and north and south extra tropical Pacific Ocean.

Average OLR Anomalies
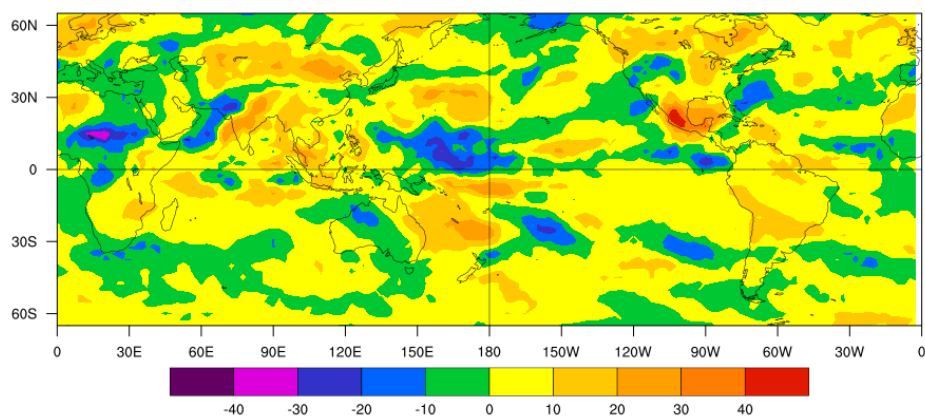### June 2023

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

1.4   Snow Cover Area over the Northern Hemisphere (NH)

During June 2023, the NH snow cover area (5.96 million Sq. km) was less than the 1991-2020 normal by 2.2 million Sq. km (Fig. 5). Eurasian Snow cover area (1.75 million Sq. km) was 1.1 million Sq. km less than the 1991-2020 normal. North America snow cover area of 4.2 million sq. km was less by 1.1 million Sq. Km with respect to 1991-2020 normal.
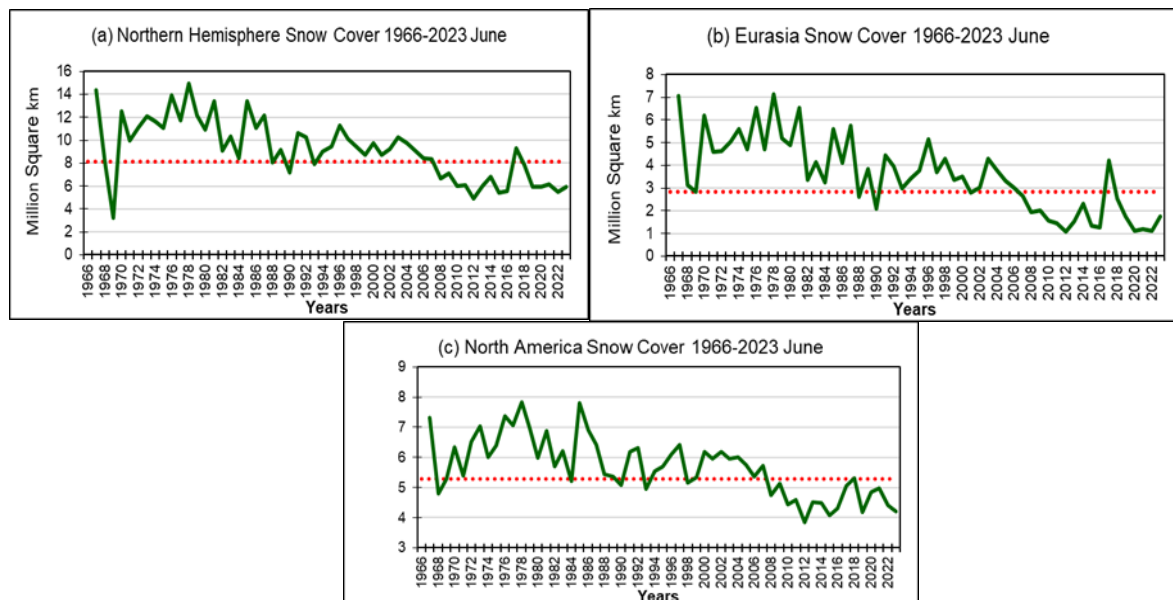

Fig.5. Snow cover area (million Sq. km) for the month of June during the period 1966-2023 (green solid lines) and normal value (1991-2020) (red dotted line) for (a) Northern Hemisphere (b) Eurasia and (c) North America. (Data Source: Rutgers University Snow Lab).

1.5.   Madden Julian Oscillation (MJO)

During the first fortnight of June 2023, the MJO propagated eastwards from phase 8 (Western Hemisphere and Africa) to phase 3 (Indian Ocean) with increased strength. In the third week it recurved and entered phase 1 with reduced strength and then moved eastward to phase 2 (Indian Ocean) in the fourth week. The MJO phase diagram illustrates the progression of the MJO through different phases, which generally coincide with locations along the equator around the globe.
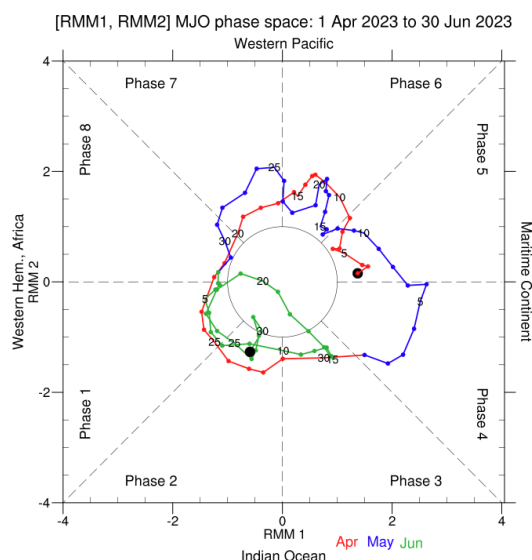

Fig.6. RMM phase diagram for Madden Julian Oscillation (MJO) for the period April to June 2023. (Data Source: http://www.bom.gov.au/climate/mjo/).

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 July to September 2023 (JAS) and August to October 2023 (ASO) are given in the Figures 7a and 7b respectively. The forecast is prepared based on the June initial conditions. The probability forecast for precipitation for JAS and ASO indicates that enhanced probability of below normal precipitation is likely over most parts of northwest, west, north, central and east of South Asia and some parts of southeast and extreme south of South Asia while most parts of northeast and peninsular region are likely to experience enhanced probability of above normal precipitation.
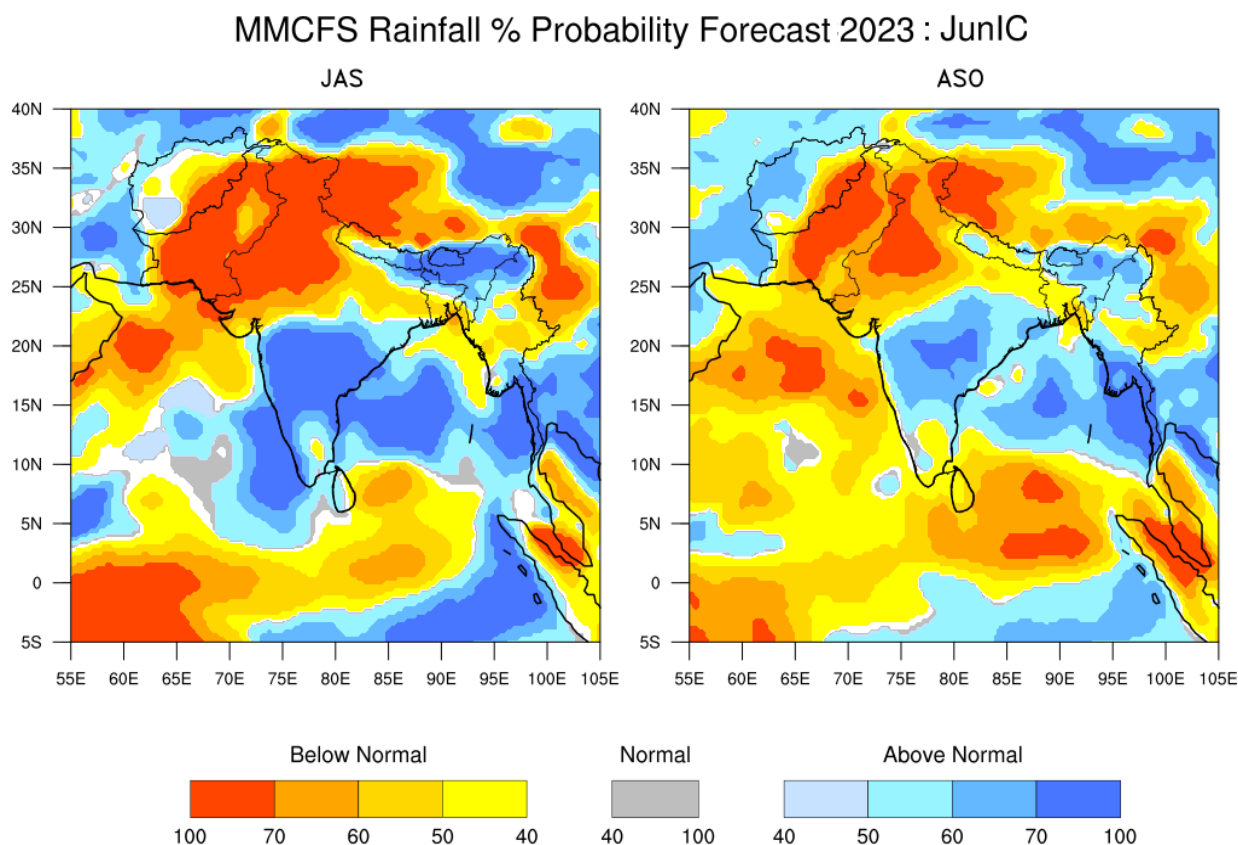

Fig.7: Seasonal probability (%) forecasts of precipitation for (a) JAS 2023 (left) and (b) ASO 2023 (right) based on initial conditions of June 2023. The white colour indicates climatological probability.

2.2.   **Temperature Probability Forecast***:*

The probability forecasts for temperature for the season July to September 2023 (JAS) and August to October 2023 (ASO) are given in the Figures 8a and 8b respectively. The forecast is prepared based on the June initial conditions. Temperature probability forecast for JAS season (Fig. 8a) and ASO 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 and southeast Peninsular region where probability of below normal temperature is likely.

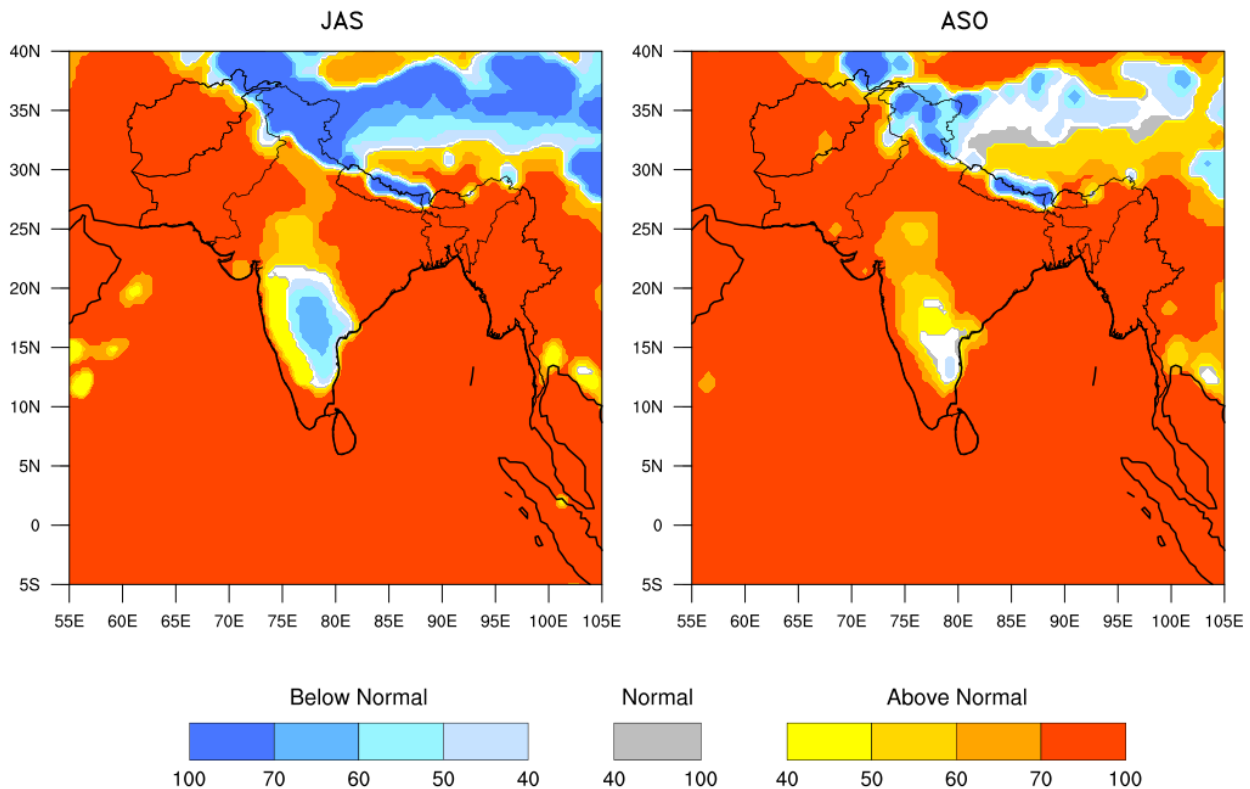## MMCFS Temperature % Probability Forecast 2023 : JunIC

Fig. 8: Probability (%) forecast for the seasonal mean temperature for (a) JAS 2023 (left) and (b) ASO 2023 (right) based on initial conditions of June 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 July to October 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 July and September 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 August, it is likely to be normal to above normal for all the countries except Afghanistan, Bangladesh and Pakistan where it is likely to be below normal. In October, it is likely to be normal to above normal for all south Asian countries.

The country averaged monthly temperatures during July to October is likely to be normal to above normal for all south Asian countries.
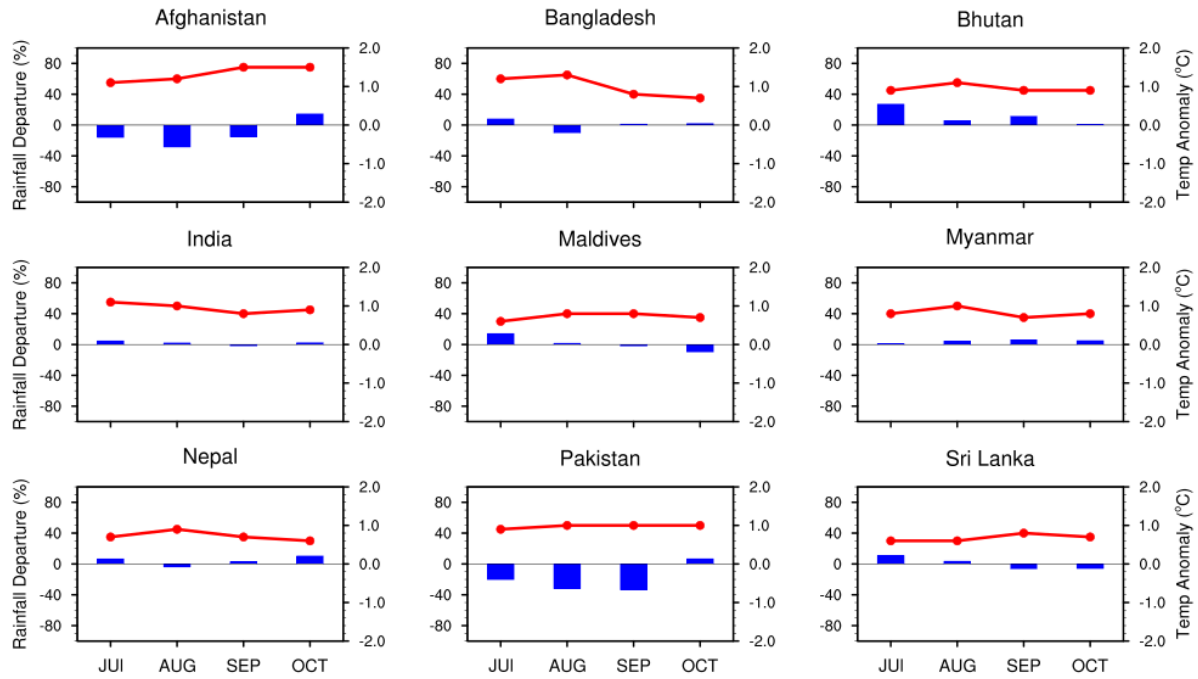
Fig. 9: Monthly country averaged rainfall forecast expressed as percentage departures (%) and Monthly country averaged temperature anomaly (°C) forecast during July to October 2023. Here, the normal range for country averaged monthly precipitation is taken as -10% to +10% (Left Vertical Axis Scale for 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).