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

(September to December 2023)

Highlights

- Currently, moderate El Niño conditions are prevailing over the equatorial Pacific and the sea surface temperatures (SSTs) are above average over most of the equatorial Pacific Ocean. The latest MMCFS forecast indicates that El Niño conditions are likely to continue up to the first quarter of next year.

- The positive IOD conditions are observed over the Indian Ocean and the latest MMCFS forecast indicates positive IOD conditions are likely to continue up to end of this year.

- The probability forecast for precipitation for September – November (SON) indicates enhanced probability of above normal precipitation in extreme northwest, northeast and south Peninsular regions and enhanced probability of below normal precipitation in north, west, central, east and north peninsular regions of South Asia. The same for October–December (OND) indicates that enhanced probability of above normal precipitation is likely over most parts of South Asia except over some parts of north Peninsular regions and central parts of South Asia where enhanced probability of below normal precipitation is likely.

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

- Temperature probability forecast for SON and OND 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 September, October and December is likely to be normal to above normal for all south Asian countries. In November, 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 August 2023, warmer than normal SSTs were observed over most of the equatorial Pacific Ocean (Fig.1a). Warmer than normal SSTs were also observed over most of the northern extra-tropical regions. Compared to the previous month, there is an increase in the warming of SSTs in the central and eastern equatorial Pacific Ocean (Fig.1b), along with cooler SST anomalies observed over the western equatorial 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 Indian Ocean

In August 2023, warm SST anomalies were observed over most parts of the Indian Ocean, with a stronger magnitude in the western Indian Ocean (Fig.1a). In the north Indian Ocean, warm SST anomalies are observed over most parts of the Arabian Sea. Compared to the previous month, warmer SSTs are observed over western parts of the equatorial Indian Ocean and cooler SSTs are observed over north Arabian Sea and eastern equatorial Indian Ocean (Fig. 1b). The latest MMCFS forecast indicates positive IOD conditions are likely to continue up to end of this year. (Fig.3).

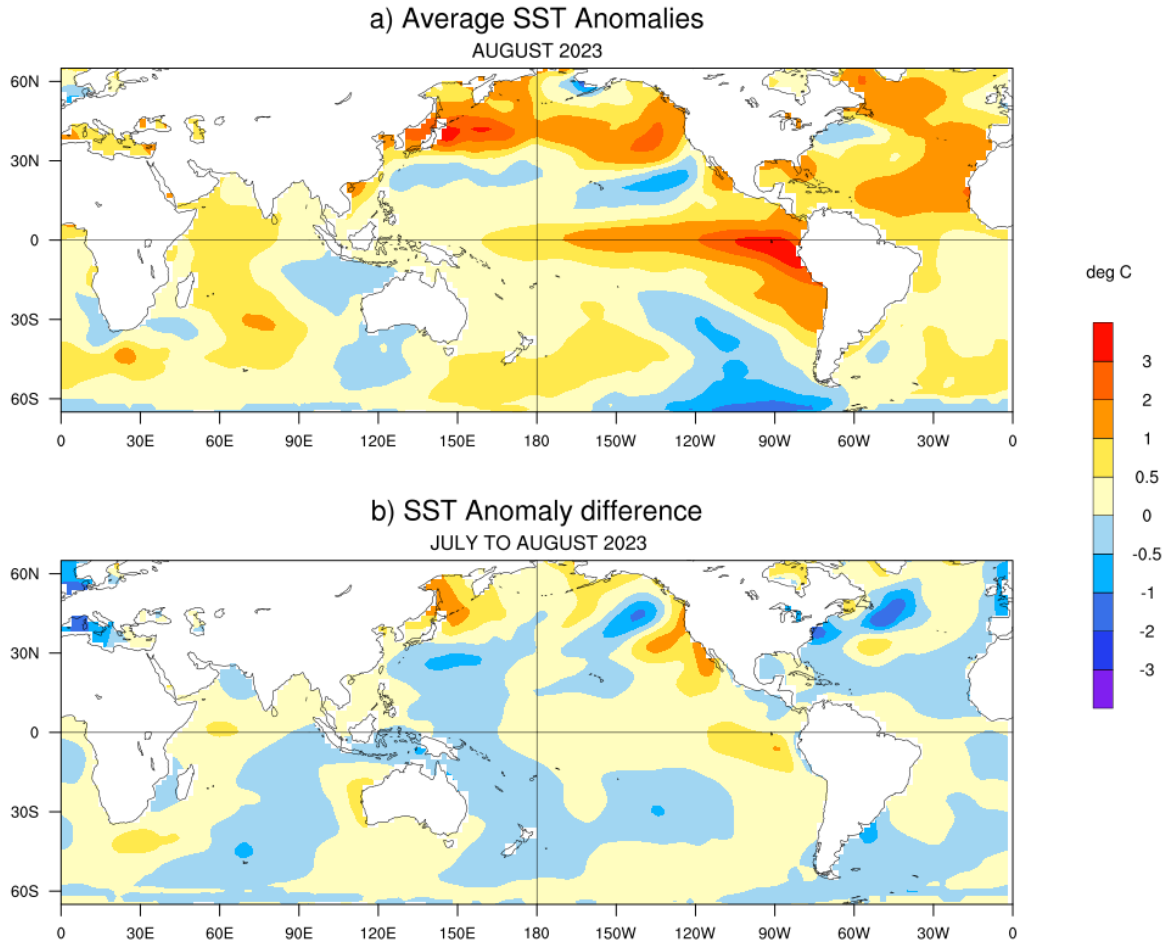

Fig.1(a) Sea surface temperature (SST) anomalies (ºC) during August 2023 and (b) changes in the SST anomalies (ºC) from July to August 2023. SSTs were based on the ERSSTv5, NOAA, and anomalies were computed with respect to 30-year (1991-2020) long term mean.

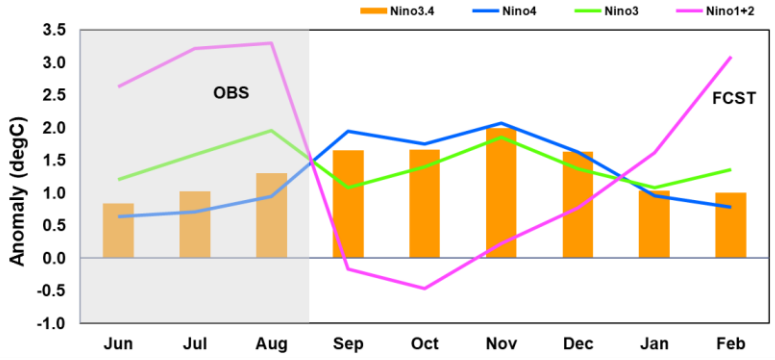

Fig.2: Time series of monthly area-averaged SST anomalies (°C) in the 4 Niño regions. ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF corrected anomaly forecast for the next 6 months.

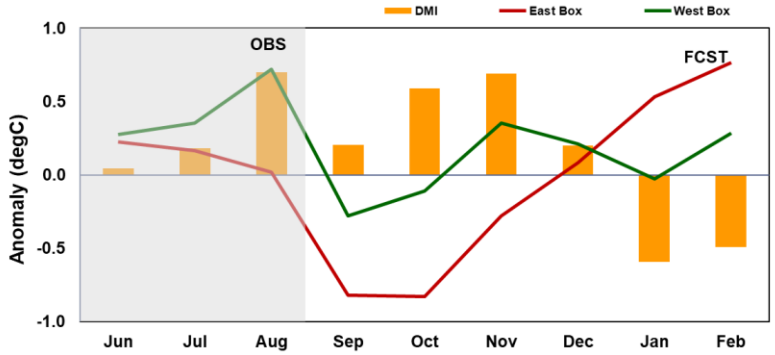

Fig.3: The time series of the monthly area-averaged SST anomaly Indices (°C) over west equatorial Indian Ocean (WEI) & east equatorial Indian Ocean (EEI) along with Dipole Mode Index (DMI=WEI-EEI) representing Indian Ocean Dipole (IOD). ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF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

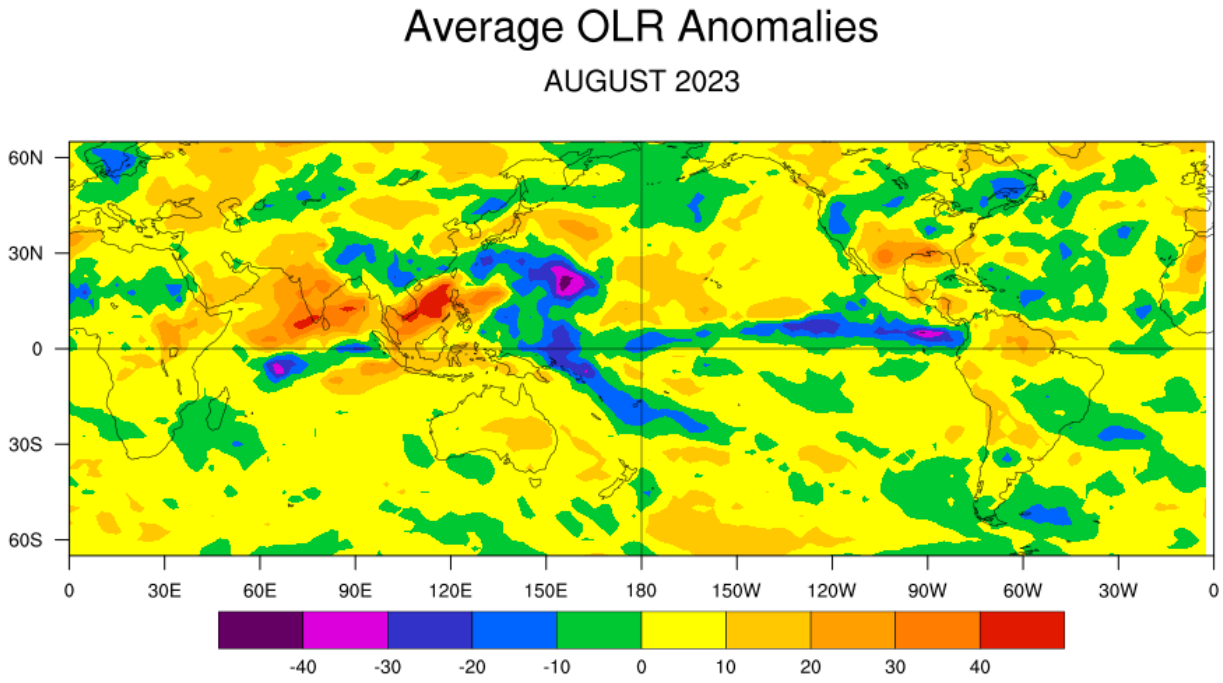

Fig.4: Outgoing Long Wave Radiation (OLR) Anomaly (W/m^2) for August 2023 (Data source: NCEP-NOAA)

1.4 Snow Cover Area over the Northern Hemisphere (NH)

During August 2023, the NH snow cover area (2.57 million Sq. km) was less than the 1991-2020 normal by 0.1 million Sq. km (Fig. 5). Eurasian Snow cover area (0.18 million Sq. km) was 0.1 million Sq. km less than the 1991-2020 normal. North America snow cover area of 2.4 million sq. km was less by 0.02 million Sq. Km with respect to 1991-2020 normal.

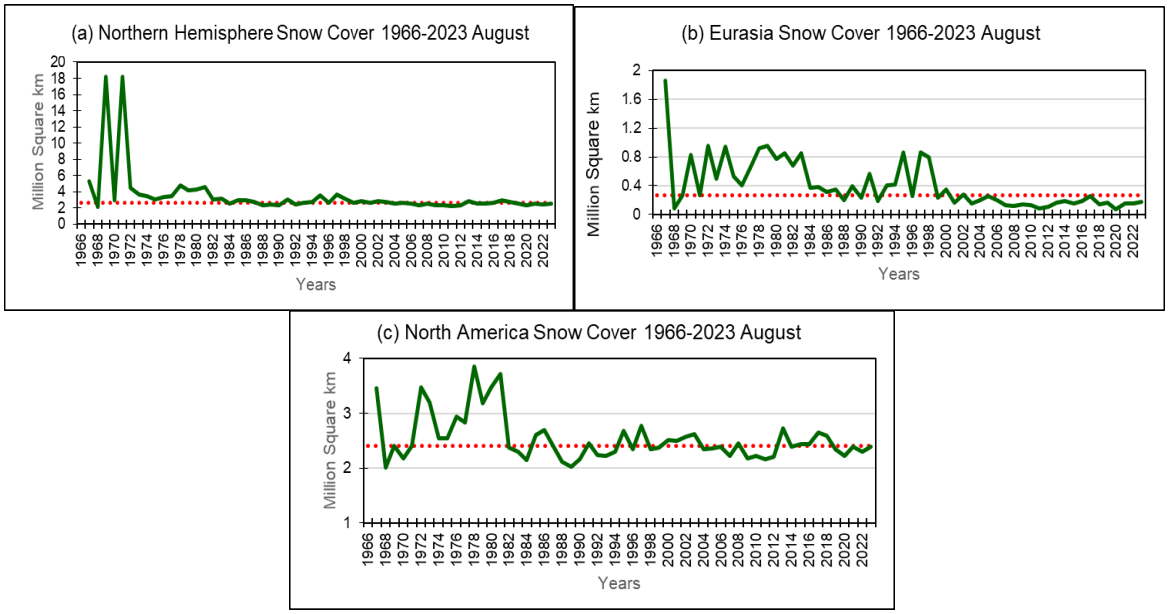

Fig.5. Snow cover area (million Sq. km) for the month of August during the period 1966-2023 (green solid lines) and normal value (1991-2020) (red dotted line) for (a) Northern Hemisphere (b) Eurasia and (c) North America. (Data Source: Rutgers University Snow Lab).

1.5. Madden Julian Oscillation (MJO)

During the first 3 weeks of August 2023, MJO remained in phase 1 (Western Hemisphere and Africa) and then moved to phase 2 (Indian Ocean) in the last week. The strength of MJO was strong 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.

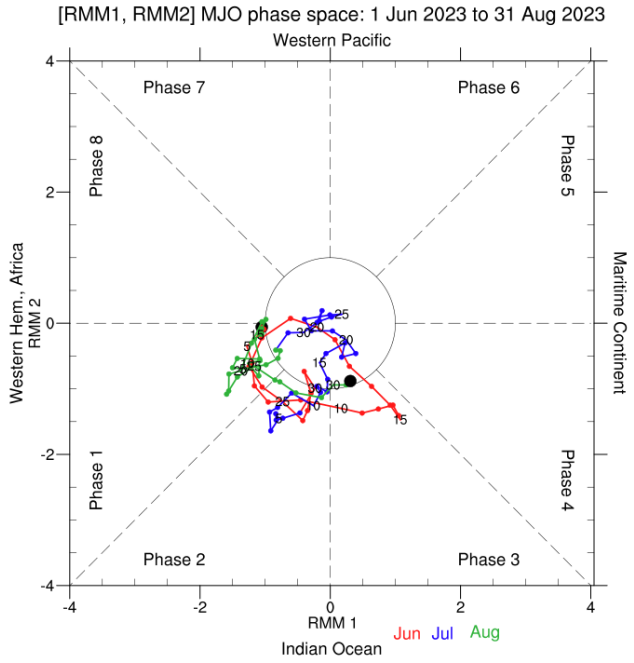

Fig.6. RMM phase diagram for Madden Julian Oscillation (MJO) for the period June to August 2023. (Data Source: http://www.bom.gov.au/climate/mjo/).

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 September to November 2023 (SON) and October to December 2023 (OND) are given in the Figures 7a and 7b respectively. The forecast is prepared based on the August initial conditions. The probability forecast for precipitation for SON indicates enhanced probability of above normal precipitation in extreme northwest, northeast and south Peninsular regions and enhanced probability of below normal precipitation in north, west, central, east and north peninsular regions of South Asia. The same for OND indicates that enhanced probability of above normal precipitation is likely over most parts of South Asia except over some parts of north Peninsular regions and central parts of South Asia where enhanced probability of below normal precipitation is likely.

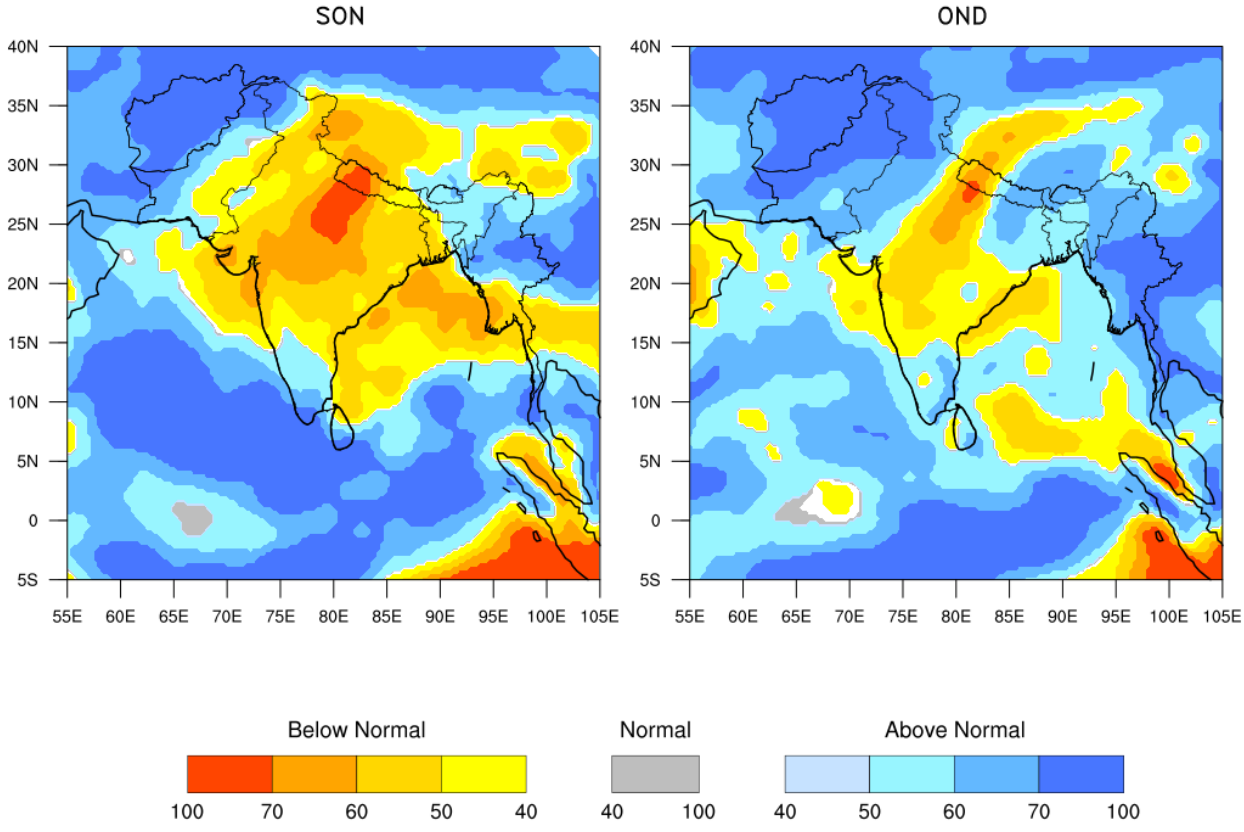

Fig.7: Seasonal probability (%) forecasts of precipitation for (a) SON 2023 (left) and (b) OND 2023 (right) based on initial conditions of August 2023.The white colour indicates climatological probability.

2.2. Temperature Probability Forecast*:*

The probability forecasts for temperature for the season September to November 2023 (SON) and October to December 2023 (OND) are given in the Figures 8a and 8b respectively. The forecast is prepared based on the August initial conditions. Temperature probability forecast for SON season (Fig. 8a) and OND 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.

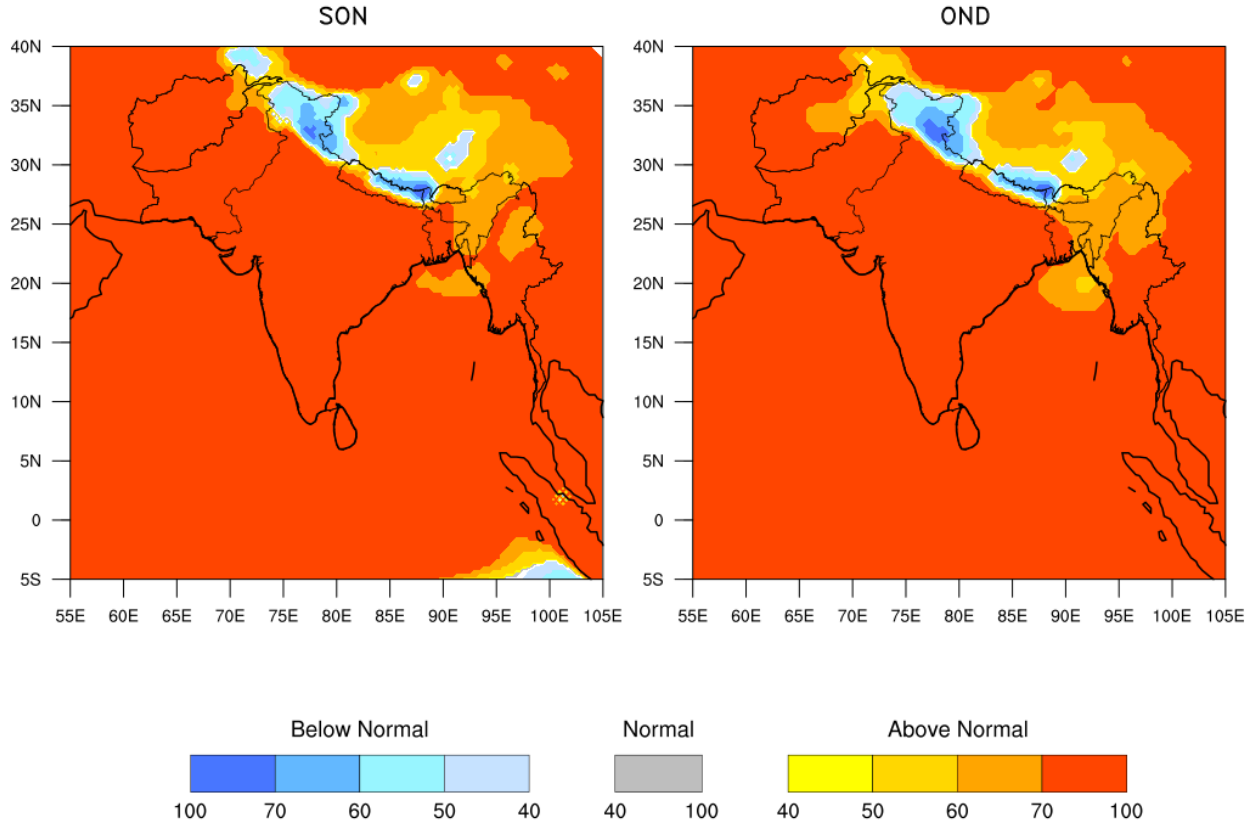

Fig. 8: Probability (%) forecast for the seasonal mean temperature for (a) SON 2023 (left) and (b) OND 2023 (right) based on initial conditions of August 2023. The white colour indicates climatological probability.

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

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

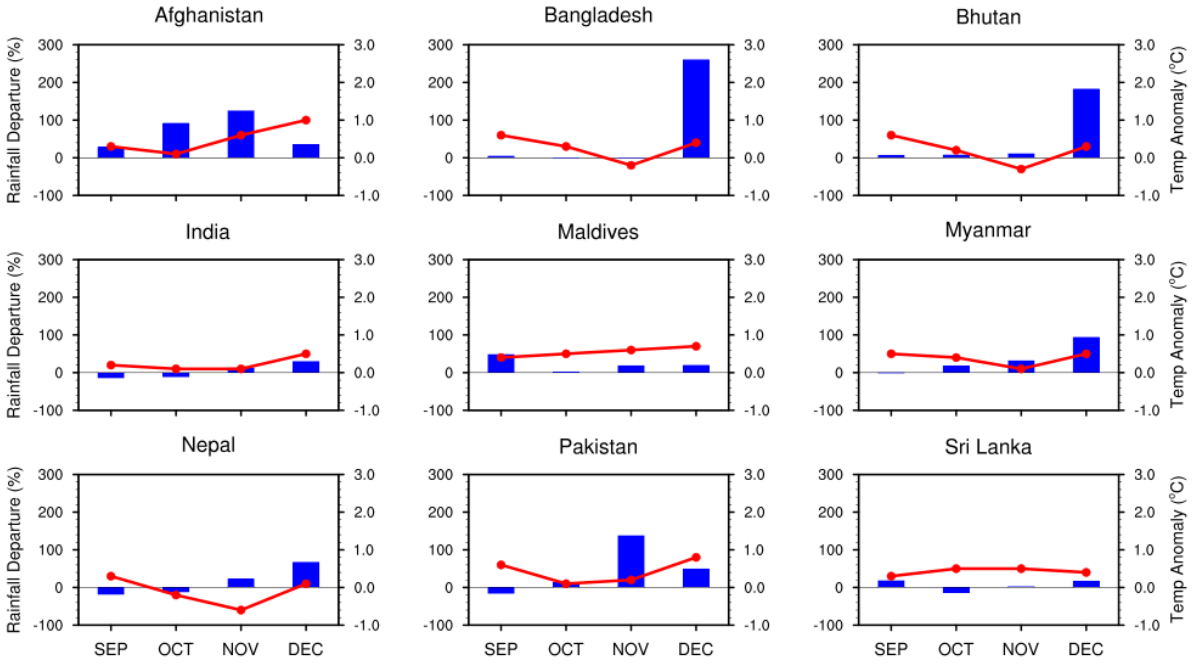

Fig. 9: Monthly country averaged rainfall forecast expressed as percentage departures (%) and Monthly country averaged temperature anomaly (°C) forecast during September to December 2023. Here, the normal range for country averaged monthly precipitation is taken as -10% to +10% (Left Vertical Axis Scale for Precipitation indicated in blue shaded bars) and the normal range for country averaged monthly temperature is taken -0.25ºC to +0.25ºC (Right Vertical Axis Scale for Temperature indicated in red coloured lines).