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

(January to April 2023)

- The La Niña conditions are prevailing over the equatorial Pacific region. The latest MMCFS forecast indicates that that the current La Niña conditions are likely to weaken during January-March season and to reach cold ENSO neutral conditions thereafter.

- The neutral IOD conditions are prevailing over the Indian Ocean. The latest MMCFS forecast indicates that the neutral IOD conditions are likely to continue during the upcoming seasons.

- The probability forecast for precipitation for January – March (JFM) indicates that an enhanced probability of below normal precipitation is likely over most parts of South Asia except over some parts of west and most parts of south of South Asia, where the enhanced probability of above normal precipitation is likely. The same for February - April (FMA) indicates that enhanced probability for below normal precipitation is likely over most parts of South Asia except over a few areas of west, south, and most parts of northeast and southeast of South Asia where above normal precipitation is likely.

- The country averaged monthly precipitation during January and February 2023 is likely to be normal to below normal for all south Asian countries except Sri Lanka where it is likely to be above normal. In March and April, the country averaged monthly precipitation is likely to be normal for all the countries.

- Temperature probability forecast for JFM season indicates that below normal temperatures are likely over most parts of South Asia except over the plains of Himalayas and northeast and southeast of South Asia where above normal temperatures are likely. The temperature probability forecast for FMA season indicates the enhanced probability for above normal temperatures over most parts along the plains of Himalayas, east, northeast and southeast of South Asia. Rest of South Asia is likely to have below normal temperatures.

- The country averaged monthly temperatures during January and February 2023, are likely to be normal to below normal for all the countries except Bangladesh, Bhutan, and Myanmar. The country averaged monthly temperatures during March and April 2023, are likely to be normal to above normal for all the countries except Maldives and Sri Lanka.

1. Important Global Climate Factors

1.1 Sea Surface Temperatures over the Pacific Ocean

During December 2022 cooler than normal SSTs were observed across the central and eastern tropical Pacific Ocean and warmer than normal SSTs were observed in the far western tropical Pacific Ocean (Fig.1a). Warmer than normal SSTs were also observed over the extra-tropical regions of the north and the south Pacific Ocean. Also, warm SST anomalies were observed over most parts of the northern Pacific Ocean. As compared to the last month, warming of SST anomalies were observed over some parts of equatorial and north Pacific Ocean as well on south Pacific Ocean (Fig.1b). Cooling of SST anomalies are observed over some parts of north and west Pacific Ocean. The La Niña conditions are prevailing over the equatorial Pacific region. The latest MMCFS forecast indicates that that the current La Niña conditions are likely to weaken during January-March season and to reach cold ENSO neutral conditions thereafter (Fig. 2).

1.2 Sea Surface Temperatures over Indian Ocean

Normal to warmer than normal SSTs were observed over most parts of Arabian Sea and Bay of Bengal (Fig.1a). Normal to cooler than normal SSTs were observed over the south of central and equatorial Indian Ocean. As compared to the last month, warming of SST anomalies were observed over north Indian Ocean especially over the north Arabian Sea and Bay of Bengal whereas cooling of SST anomalies was observed over the eastern equatorial Indian Ocean (Fig. 1b). The neutral IOD conditions are prevailing over the Indian Ocean. The latest MMCFS forecast indicates that the neutral IOD conditions are likely to continue during the upcoming seasons (Fig.3).

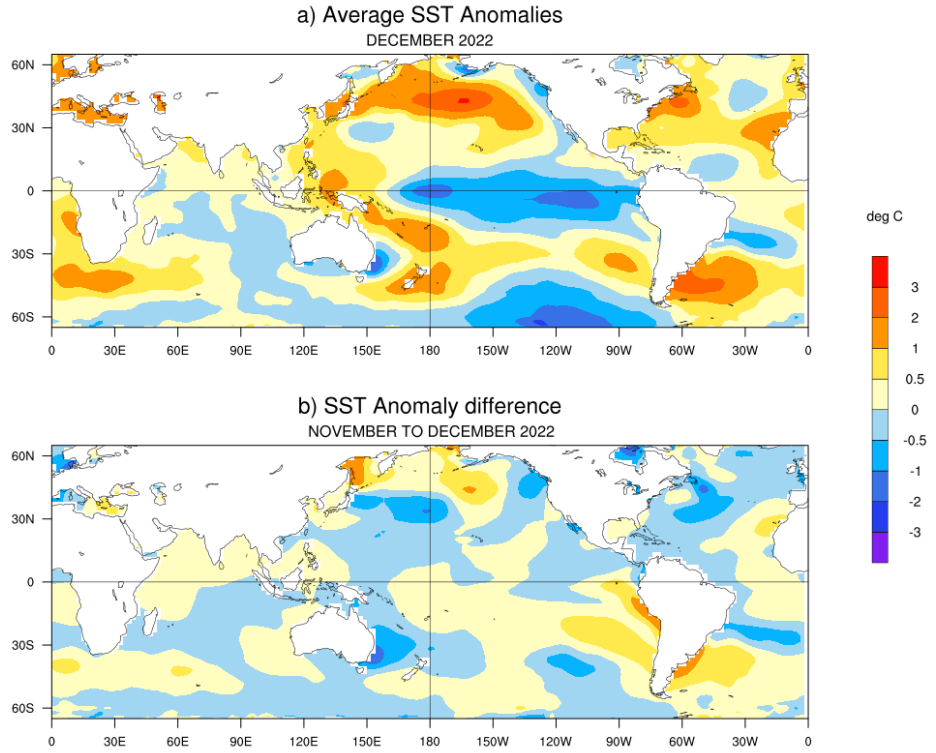

Fig.1: (a) Sea surface temperature (SST) anomalies (ºC) during December 2022 and (b) changes in the SST anomalies (ºC)) from November 2022 to December 2022. SSTs were based on the ERSSTv5, NOAA, and anomalies were computed with respect to 30-year (1981-2010) long term mean.

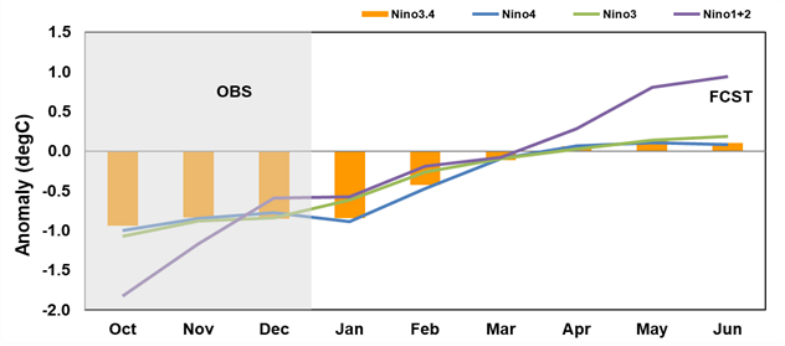

Fig.2: Time series of monthly area-averaged SST anomalies (°C) in the 4 Niño regions. ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF corrected anomaly forecast for the next 6 months.

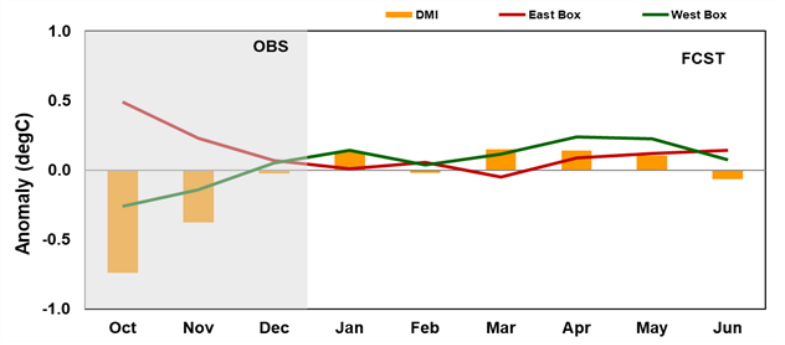

Fig.3: The time series of the monthly area-averaged SST anomaly Indices (°C) over west equatorial Indian Ocean (WEI) & east equatorial Indian Ocean (EEI) along with Dipole Mode Index (DMI=WEI-EEI) representing Indian Ocean Dipole (IOD). ERSSTv5 observed anomaly for the last 3 months and MMCFS model PDF 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 of December 2022 is shown in (Fig.4). Negative OLR anomalies (enhanced convection, blue shading) were observed over some parts of southeast Arabian sea and most parts of Bay of Bengal, equatorial and tropical regions of east Indian Ocean, maritime continent, south western Pacific Ocean. Negative OLR anomalies were also present in tropical regions of north and south Pacific Ocean near dateline. Positive OLR anomalies (suppressed convection, orange/red shading) were observed over equatorial and tropical regions of west Indian Ocean, equatorial regions of west and central Pacific Ocean near dateline, and parts of South America.

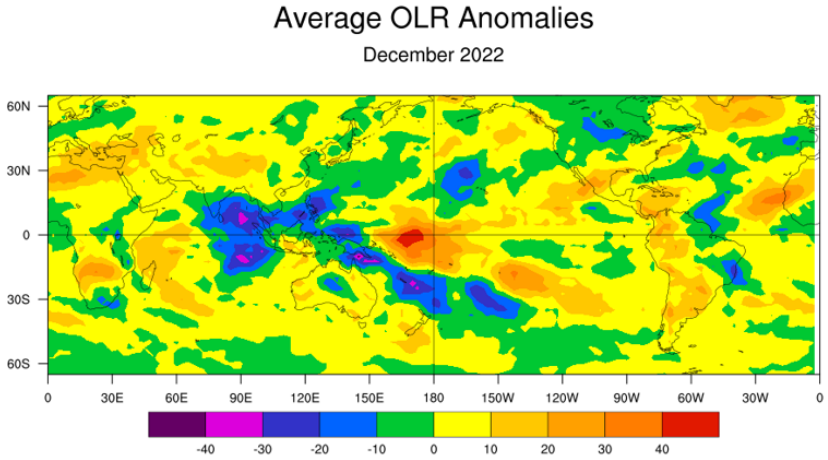

Fig.4: Outgoing Long Wave Radiation (OLR) Anomaly (W/m^2) for December 2022 (Data source: NCEP-NOAA)

1.4 Snow Cover Area over the Northern Hemisphere (NH)

During December 2022, the NH snow cover area (43.56 million Sq. km) was less than the 1991-2020 normal by 0.71 million Sq. km (Fig. 5). Eurasian Snow cover area (26.12 million Sq. km) was 1.25 million Sq. km less than the 1991-2020 normal and was having less area under snow in December 2022 compared to December 2021. North America snow cover area of 17.44 million sq. Km was more by 0.54 million Sq. Km with respect to 1991-2020 normal.

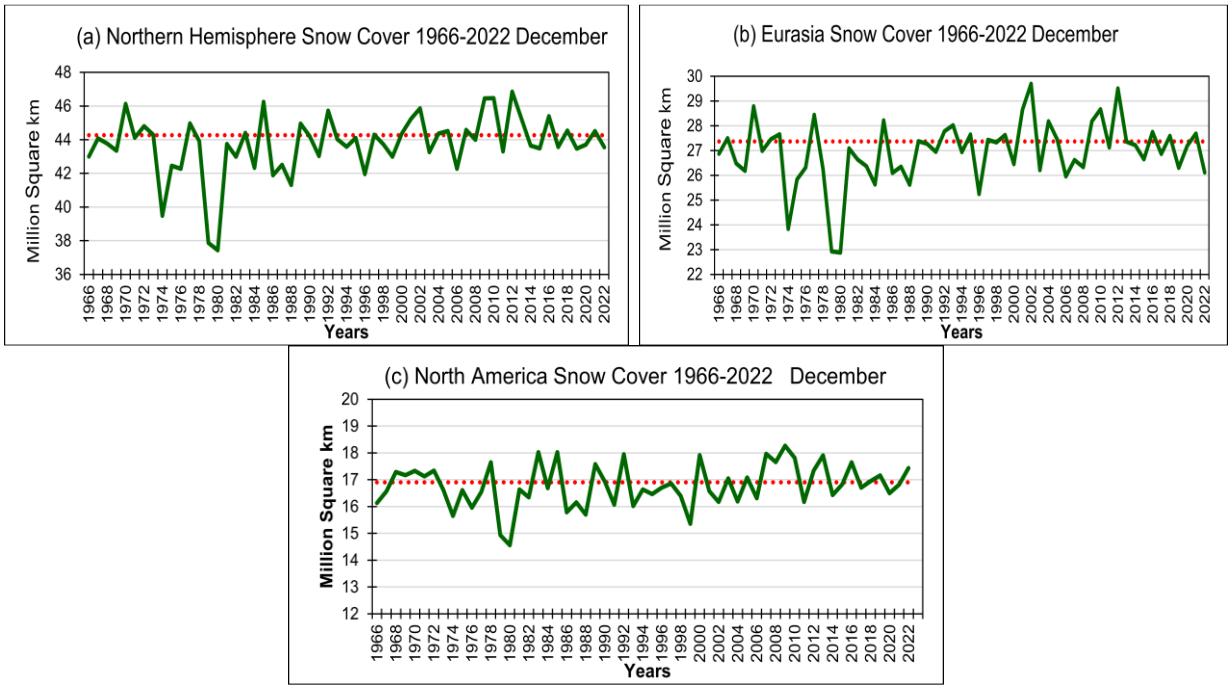

Fig.5. Snow cover area (million Sq. km) for the month of December during the period 1966-2022 (green solid lines) and normal value (1991-2022) (red dotted line) for (a) Northern Hemisphere (b) Eurasia and (c) North America. (Data Source: Rutgers University Snow Lab).

1.5. Madden Julian Oscillation (MJO)

During the first week of December 2022, the MJO propagated eastwards from phase 8 (West Hemisphere and Africa) to phase 3 (Indian Ocean) with reduced strength. Thereafter, in the second week it moved to phase 4 (Maritime continent) with reduced strength. In the third week it entered phase 3 and re-entered phase 4 with enhanced strength. In the fourth week it moved eastwards into phase 6 (Western Pacific). The MJO phase diagram illustrates the progression of the MJO through different phases, which generally coincide with locations along the equator around the globe.

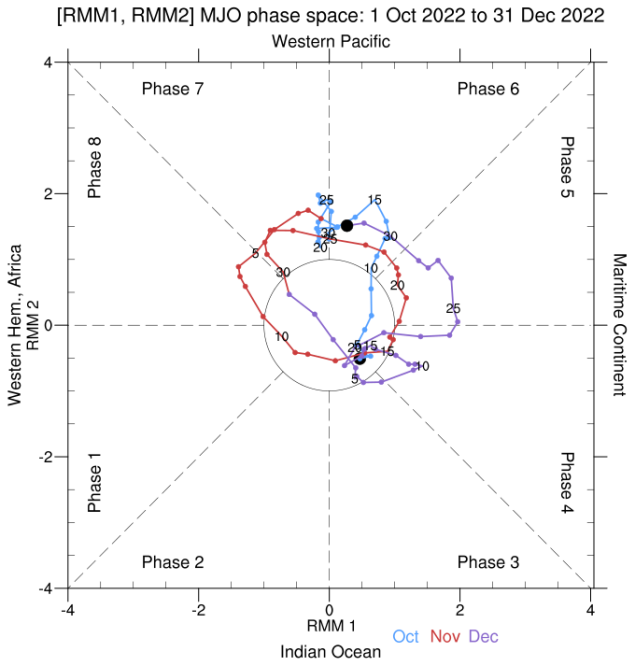

Fig.6. RMM phase diagram for Madden Julian Oscillation (MJO) for the period October to December 2022. (Data Source: http://www.bom.gov.au/climate/mjo/).

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 2023 (JFM) and February to April 2023 (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 (Fig.7a) indicates that enhanced probability of below normal precipitation is likely over most parts of South Asia except over some parts of west and most parts of south of South Asia. where enhanced probability of above normal precipitation is likely. The same for FMA (Fig 7b) indicates that enhanced probability for below normal precipitation is likely over most parts of South Asia except over few areas of west, south and most parts of northeast and southeast of South Asia where above normal precipitation is likely.

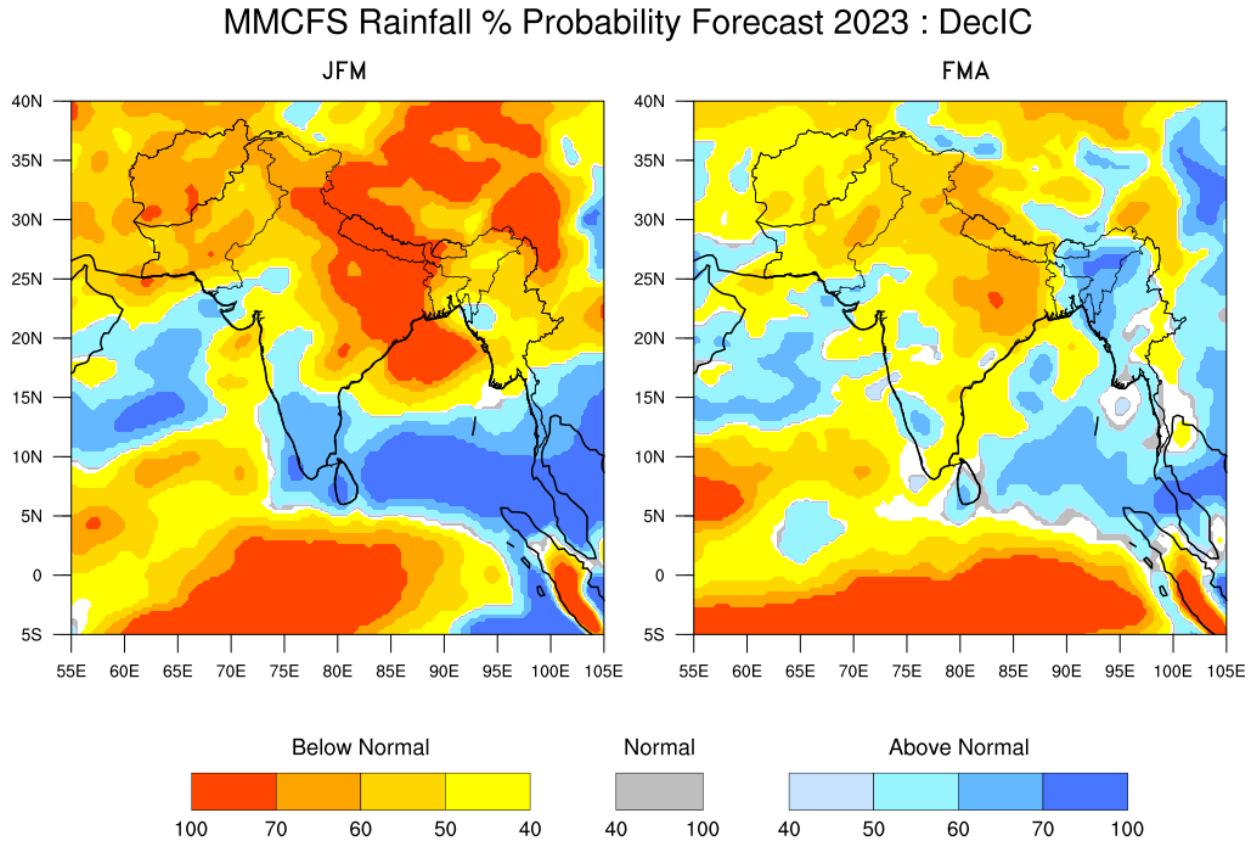

Fig.7: Seasonal probability (%) forecasts of precipitation for (a) JFM 2023 (left) and (b) FMA 2023 (right) based on initial conditions of December 2022. The white colour indicates climatological probability.

2.2. Temperature Probability Forecast*:*

The probability forecasts for temperature for the season January to March 2023 (JFM) and February to April 2023 (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 season (Fig. 8a) indicates that below normal temperatures are likely over most parts of South Asia except over the plains of Himalayas and northeast and southeast of South Asia where above

normal temperatures are likely. Temperature probability forecast for FMA season (Fig.8b) indicates enhanced probability for above normal temperatures over most parts along the plains of Himalayas, east, northeast and southeast of South Asia.. Rest of South Asia is likely to have below normal temperatures.

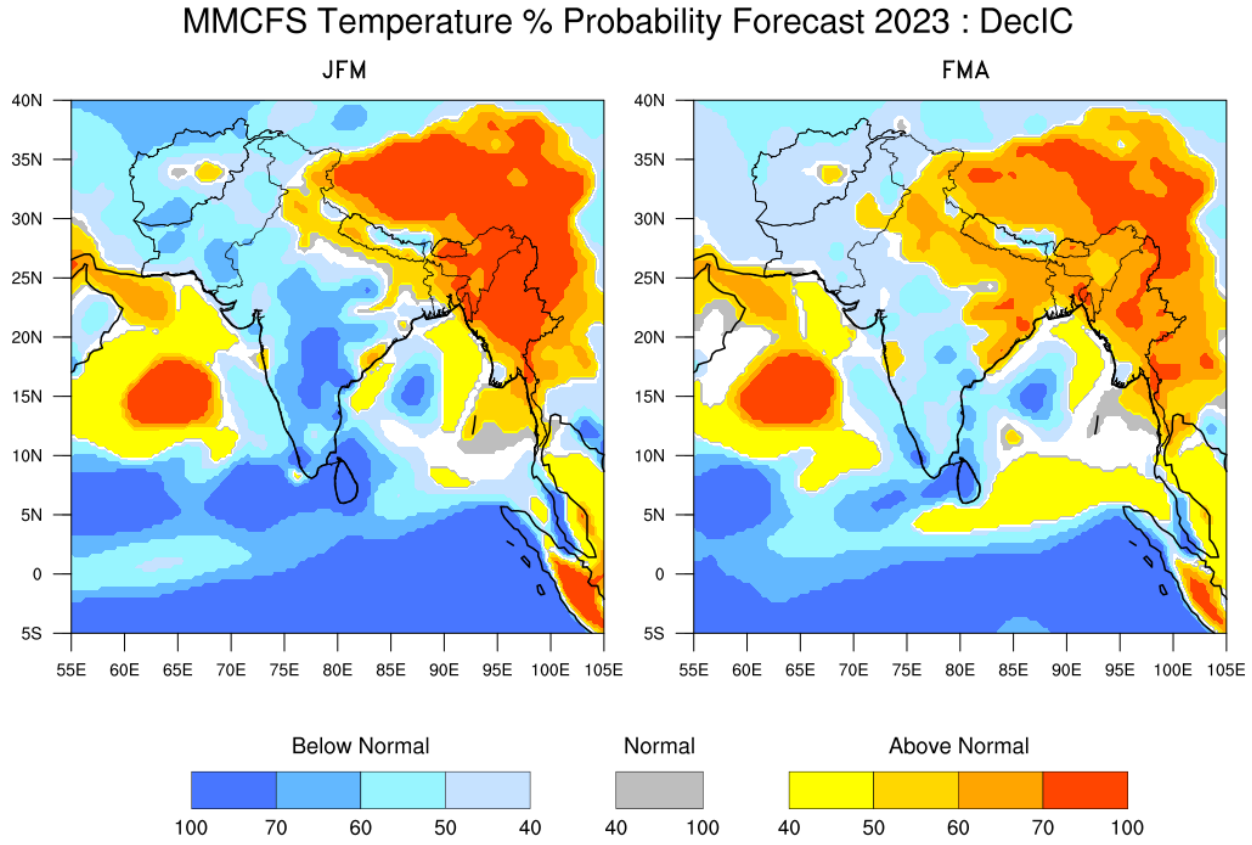

Fig. 8: Probability (%) forecast for the seasonal mean temperature for (a) JFM 2023 (left) and (b) FMA 2023 (right) based on initial conditions of December 2022. The white colour indicates climatological probability.

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 January to April 2023) averaged over the 9 south Asian countries viz., Afghanistan, Bangladesh, Bhutan, India, Maldives, Myanmar, Nepal, Pakistan and Sri Lanka is 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 and February 2023, the country averaged monthly precipitation is likely to be normal to below normal for all south Asian countries except Sri Lanka (Fig.9) where it is likely to be above normal. In March and April, the country averaged monthly precipitation is likely to be normal for all the countries.

The country averaged monthly temperatures during January and February 2023, are likely to be normal to below normal for all the countries except Bangladesh, Bhutan, and Myanmar. The country averaged monthly temperatures during March and April 2023, are likely to be normal to above normal for all the countries except Maldives and Sri Lanka.

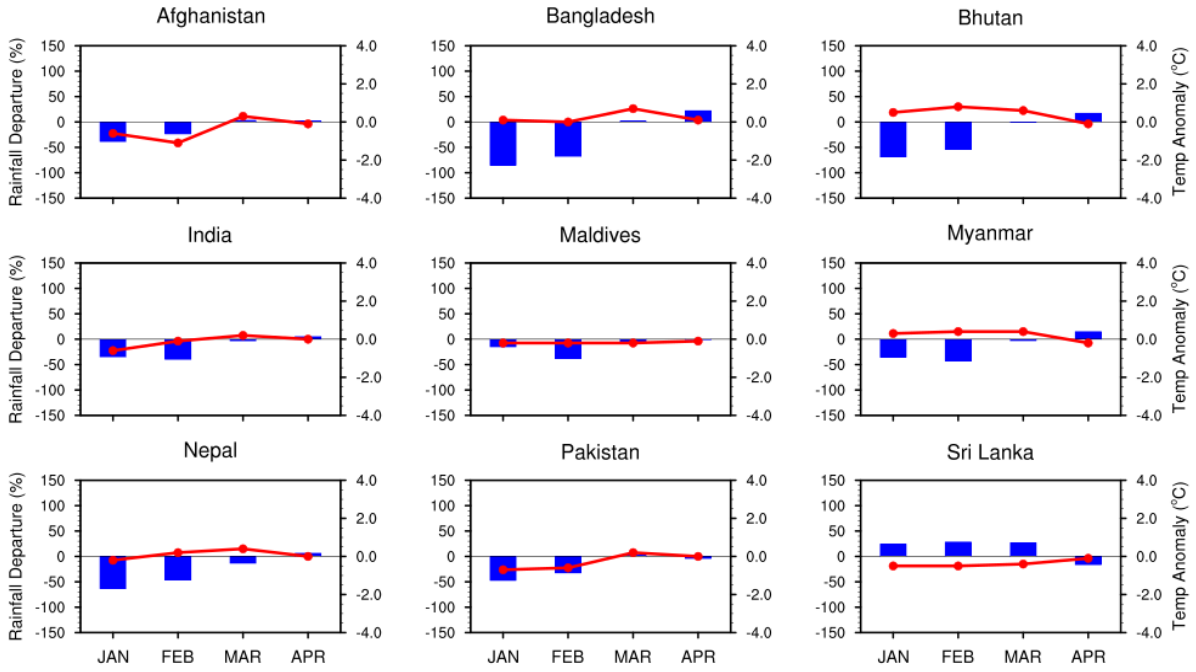

Fig. 9: Monthly country averaged rainfall forecast expressed as percentage departures (%) and Monthly country averaged temperature anomaly (°C) forecast during January to April 2023. Here, the normal range for country averaged monthly precipitation is taken as -10% to +10% (Left Vertical Axis Scale for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