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SEASONAL CLIMATE OUTLOOK FOR SOUTH ASIA

(June to September 2022)

- Currently, La Niña conditions are prevailing over the equatorial Pacific region. The latest MMCFS forecast indicates that the La Niña conditions are likely to continue throughout the forecast period. Other climate models are also indicating enhanced probability for La Niña conditions during the upcoming season.
- The probability forecast for precipitation for JJA indicates that enhanced probability for below normal precipitation is likely over some parts of the extreme northwest, extreme north and southeast Asia and enhanced probability of above normal precipitation is likely over rest of South Asia. The same for JAS indicates that enhanced probability for below normal precipitation is likely over some parts of extreme northwest, extreme north, east and southeast of South Asia and enhanced probability of above normal precipitation over rest of South Asia
- In general, the country averaged monthly precipitation is likely to be normal to above normal for all the months viz. June to September 2022 for all the countries except Afghanistan. Afghanistan is likely to have below normal precipitation in June and above normal precipitation in rest of the months.
- The probability forecast for temperature for JJA season indicates that enhanced probability for below normal temperatures are likely over most parts of South Asia except over some parts of northwest, west and few parts of northeast peninsular region of South Asia where moderate probability of above normal temperatures are likely. The same for JAS season indicates that most of the northwest, south peninsular region, northeast and southeast region of South Asia are likely to experience enhanced to moderate probability of above normal temperatures and most parts of north along the plains of Himalayas, central and some parts of southeast Peninsular India are likely to experience below normal temperatures
- In general, the country averaged monthly temperatures during June to September are likely to be normal to above normal for Afghanistan, Bhutan and Maldives. Nepal and Sri Lanka are likely to be below normal for June and July and normal to above normal in August and September. Bangladesh, India and Myanmar are likely to be below normal in June and normal to above normal in July, August and September.

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 May 2022 cooler than normal SSTs were observed across the central, eastern, and south eastern tropical Pacific Ocean, and warmer than normal SSTs were observed over west 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. As compared to the last month, cooling of SST anomalies were observed over the equatorial eastern Pacific Ocean (Fig.1b) and warming of SST anomalies were observed over north subtropical Pacific Ocean. Currently, La Niña conditions are prevailing over the equatorial Pacific region. The latest MMCFS forecast indicates that the La Niña conditions are likely to continue throughout the forecast period. Other climate models are also indicating enhanced probability for La Niña conditions during the upcoming season (Fig.2).

1.2 Sea Surface Temperatures over Indian Ocean

In the north Indian Ocean, warm SST anomalies were observed over the most parts of the Arabian Sea and Bay of Bengal. Also, there were positive SST anomalies observed over most parts of the south Indian Ocean (Fig. 1a). As compared to the last month, cooling of SST anomalies were observed over the most parts of north Indian Ocean and maximum cooling were observed head Bay of Bengal and northeast Arabian Sea (Fig. 1b). At present neutral IOD conditions are present over the Indian Ocean and the latest MMCFS forecast indicates that the negative IOD conditions are likely to develop during the upcoming season (Fig. 3).

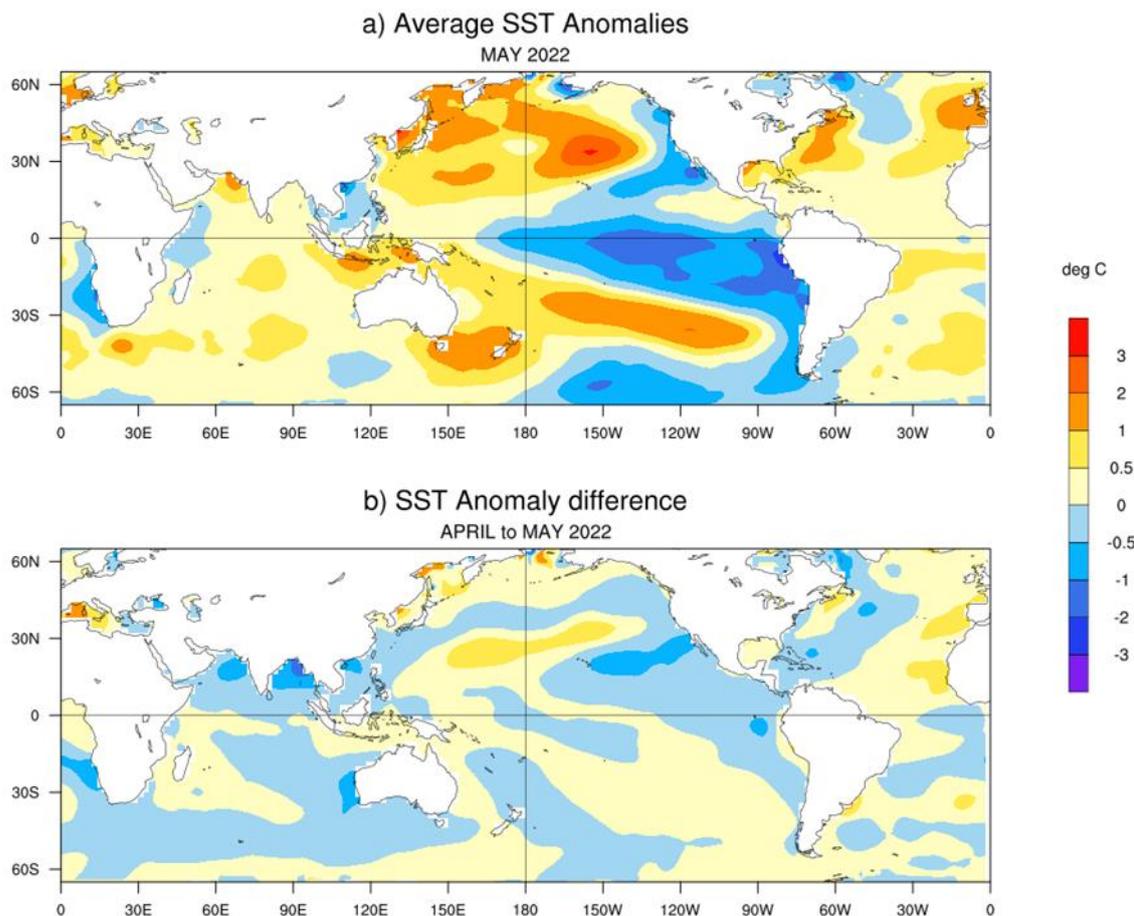


Fig.1: (a) Sea surface temperature (SST) anomalies ($^{\circ}\text{C}$) during May 2022 and (b) changes in the SST anomalies ($^{\circ}\text{C}$) from April 2022 to May 2022. SSTs were based on the ERSSTv5, NOAA, and anomalies were computed with respect to 30-year (1981-2010) long term mean.

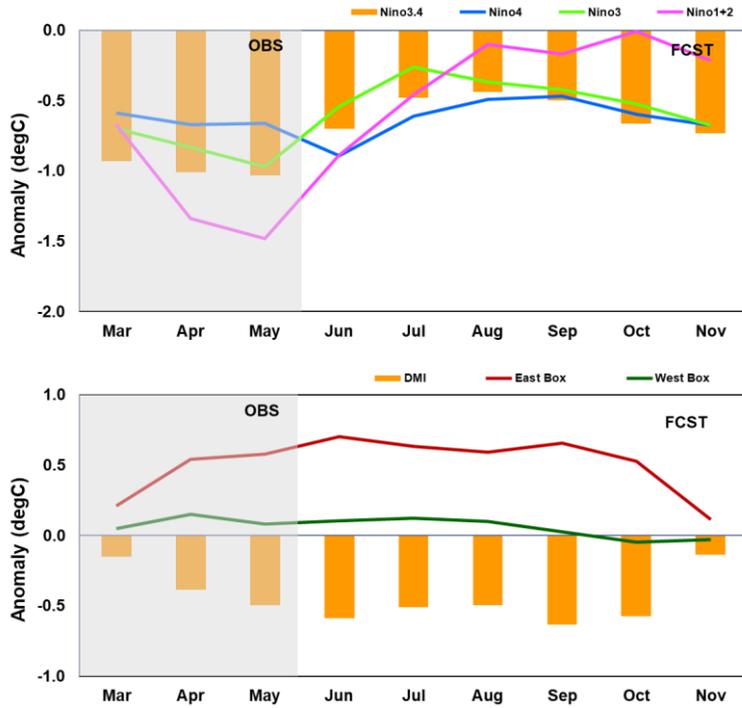


Fig.2: Time series of monthly area-averaged SST anomalies ($^{\circ}\text{C}$) in the 4 Niño regions. ERSSTv5 observed anomaly for the last 3 months and MMCF5 model PDF corrected anomaly forecast for the next 6 months.

Fig.3: The time series of the monthly area-averaged SST anomaly Indices ($^{\circ}\text{C}$) 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 MMCF5 model PDF corrected anomaly forecast for the next 6 months.

1.3 Convection (OLR Anomaly) Pattern over the Asia Pacific Region:

The Outgoing Long Wave Radiation (OLR) anomaly of May 2022 is shown in (Fig.4). Negative OLR anomalies (enhanced convection, blue shading) were observed over some parts of south western Arabian Sea, south Peninsular region, most parts of Bay of Bengal, south east Asia, south China sea and parts of Maritime Continent. Negative OLR anomalies were also present over both sides of date line in the tropical Pacific Ocean, eastern tropical Pacific Ocean and southwest tropical Pacific Ocean. Positive OLR anomalies (suppressed convection, orange/red shading) were observed over south of Japan, north Indian region, some parts of eastern Africa and north and south America. Positive OLR anomalies were present along most parts of western and central equatorial Pacific Ocean.

Average OLR Anomalies May 2022

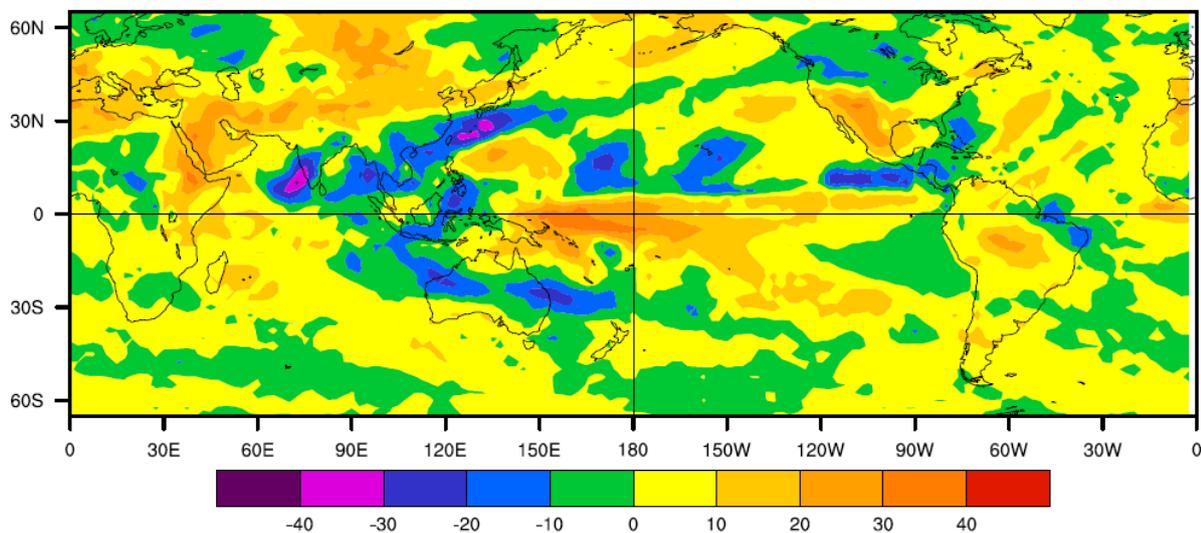


Fig.4: Outgoing Long Wave Radiation (OLR) Anomaly (W/m^2) for May 2022 (Data source: NCEP-NOAA)

1.4 Snow Cover Area over the Northern Hemisphere (NH):

The May 2022, NH snow cover area (17.95 million Sq. km) was less than the 1991-2020 normal by 0.27 million Sq. km (Fig. 5). Eurasian Snow cover area (8.6 million Sq. km) was 0.62 million Sq. km less than the 1991-2020 normal and was having more area under snow in May 2022 compared to May 2021. North America snow cover area of 9.4 million sq. Km was less by 0.36 million Sq. Km with respect to 1991-2020 normal.

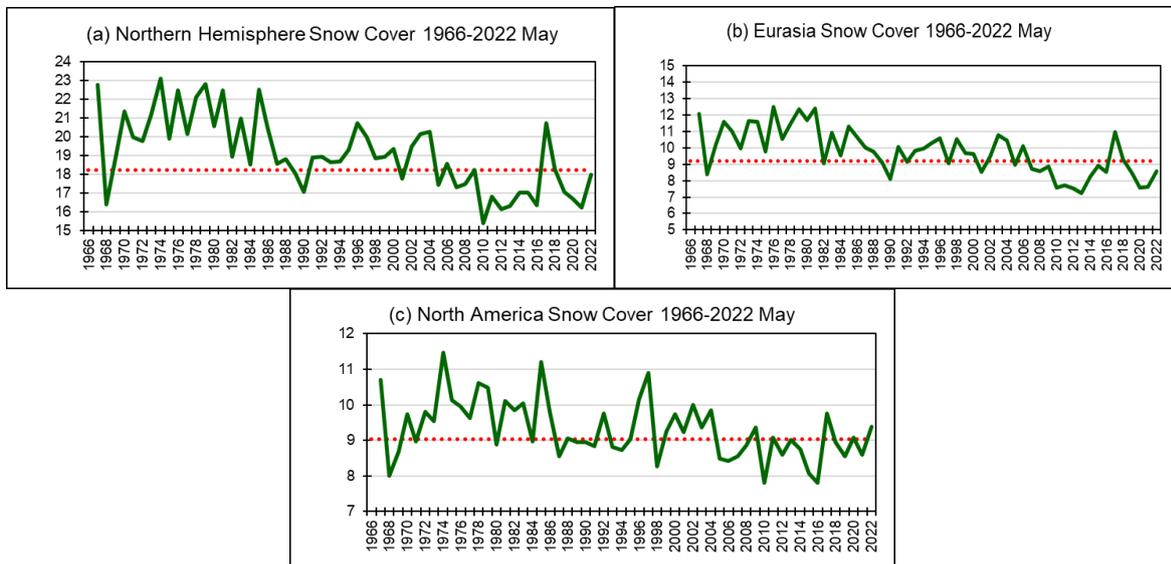


Fig.5. Snow cover area (million Sq. km) for the month of May during the period 1966-2022 (green solid lines) and normal value (1991-2020) (red dotted line) for (a) Northern Hemisphere (b) Eurasia and (c) North America. (Data Source: Rutgers University Snow Lab).

1.5 Madden Julian Oscillation (MJO):

During the first week of May 2022, the MJO was in Indian Ocean (Phase 2) with enhanced strength. It moved from Indian Ocean to maritime continent (Phase 4 and 5) then to western Pacific (Phase 6 and 7) and entered West Hemisphere and Africa (Phase 8 and 1) with reduced strength in the second and third week of May. In the fourth week it moved again into Western Pacific with enhanced strength. The MJO phase diagram illustrates the progression of the MJO through different phases, which generally coincide with locations along the equator around the globe.

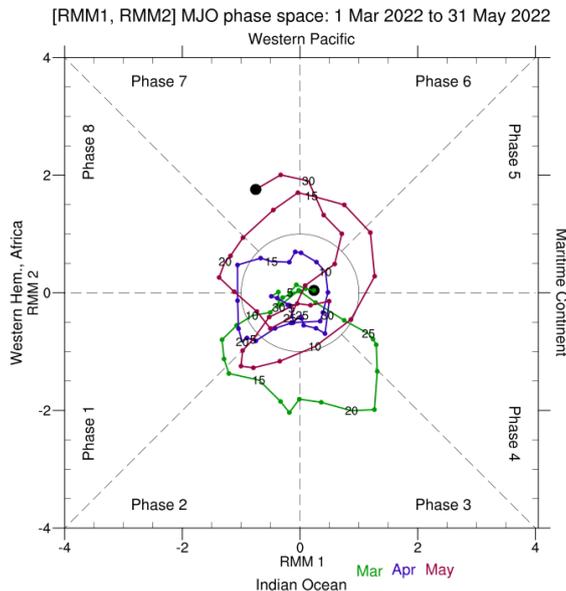


Fig.6. RMM phase diagram for Madden Julian Oscillation (MJO) for the period 3 May 2022 to 11 June 2022. (Data Source: <http://www.bom.gov.au/climate/mjo/>).

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 June to August 2022 (JJA) and July to September 2022 (JAS) are given in the Figures 7a and 7b respectively. The forecast is prepared based on the May initial conditions. The probability forecast for precipitation for JJA (Fig.7a) indicates that enhanced probability for below normal precipitation is likely over some parts of the extreme northwest, extreme north and southeast Asia and enhanced probability of above normal precipitation is likely over rest of the South Asia. The same for JAS (Fig.7b) indicates that enhanced probability for below normal precipitation is likely over some parts of extreme northwest, extreme north, east and southeast of South Asia and enhanced probability of above normal precipitation over rest of South Asia (white colour indicates climatological probability).

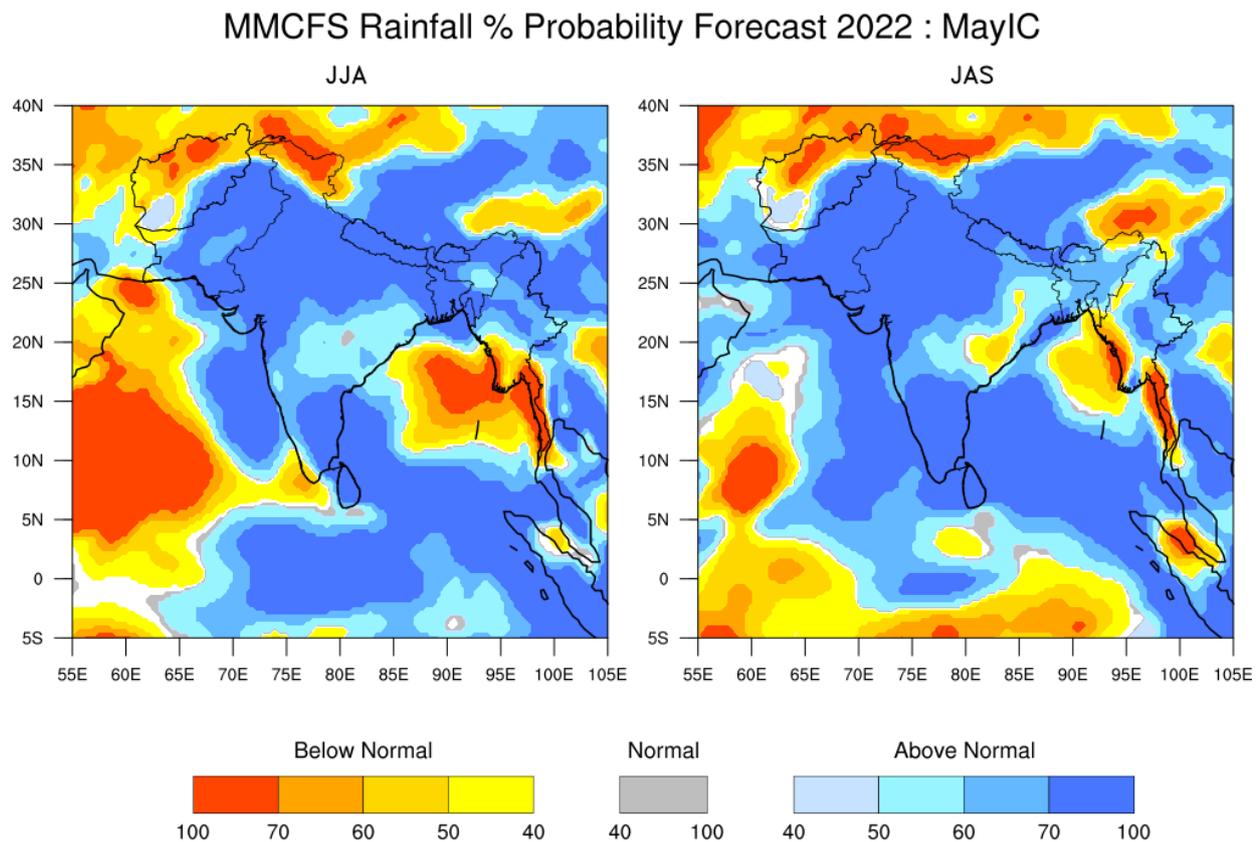


Fig.7: Seasonal probability (%) forecasts of precipitation for (a) JJA 2022 (left) and (b) JAS 2022 (right) based on initial conditions of May 2022.

2.2. Temperature Probability Forecast:

The probability forecasts for temperature for the season June to August 2022 (JJA) and July to September 2022 (JAS) are given in the Figures 8a and 8b respectively. The forecast is prepared based on the May initial conditions. Temperature probability forecast for JJA season indicates that enhanced probability for below normal temperatures are likely over most parts of South Asia except over some parts of northwest, west and few parts of northeast peninsular

region of South Asia where moderate probability of above normal temperatures are likely. The same for JAS season indicates that most of the northwest, south peninsular region, northeast and southeast region of South Asia are likely to experience enhanced probability of above normal temperatures and most parts of north along the plains of Himalayas, central and some parts of southeast Peninsular India are likely to experience below normal temperatures (white colour indicates climatological probability).

MMCFS Temperature % Probability Forecast 2022 : MayIC

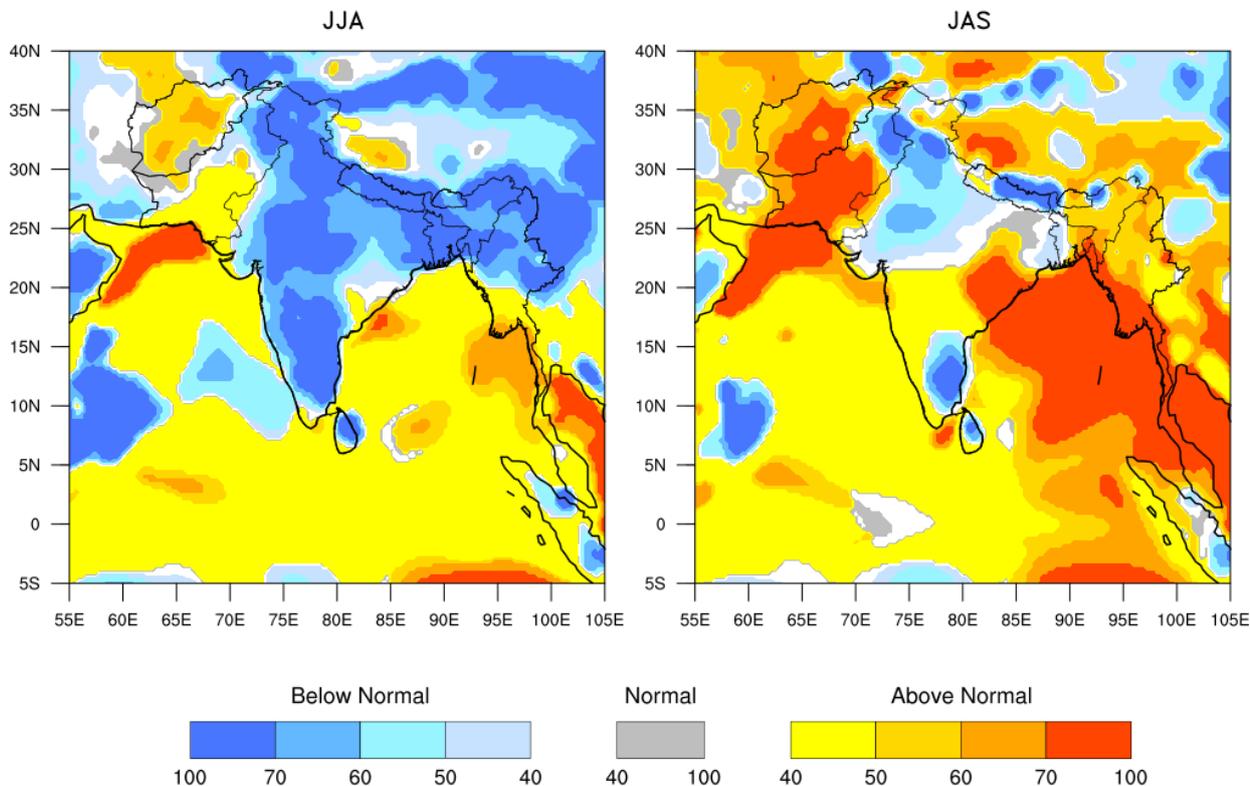


Fig. 8: Probability (%) forecast for the seasonal mean temperature for (a) JJA 2022 (left) and (b) JAS 2022 (right) based on initial conditions of May 2022.

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 June to September 2022) 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 June, the country averaged monthly precipitation is likely to be normal to above normal for all countries except Afghanistan (Fig.9). For July, August and September months, the country averaged monthly precipitation is likely to be normal to above normal for all the countries.

In general, the country averaged monthly precipitation is likely to be normal to above normal for all the months viz. June to September 2022 for all the countries except Afghanistan. Afghanistan is likely to have below normal precipitation in June and above normal precipitation in rest of the months.

During June, the country averaged monthly temperatures are normal to above normal for all the countries except Bangladesh, India, Myanmar, Nepal and Pakistan where it is likely to be below normal. During July, it is likely to be normal to above normal for all the countries except Nepal and Sri Lanka where it is likely to be below normal. In August and September, it is likely to be normal to above normal all the countries.

In general, the country averaged monthly temperatures during June to September are likely to be normal to above normal for Afghanistan, Bhutan and Maldives. Nepal and Sri Lanka are likely to be below normal for June and July and normal to above normal in August and September. Bangladesh, India and Myanmar are likely to be below normal in June and normal to above normal in July, August and September.

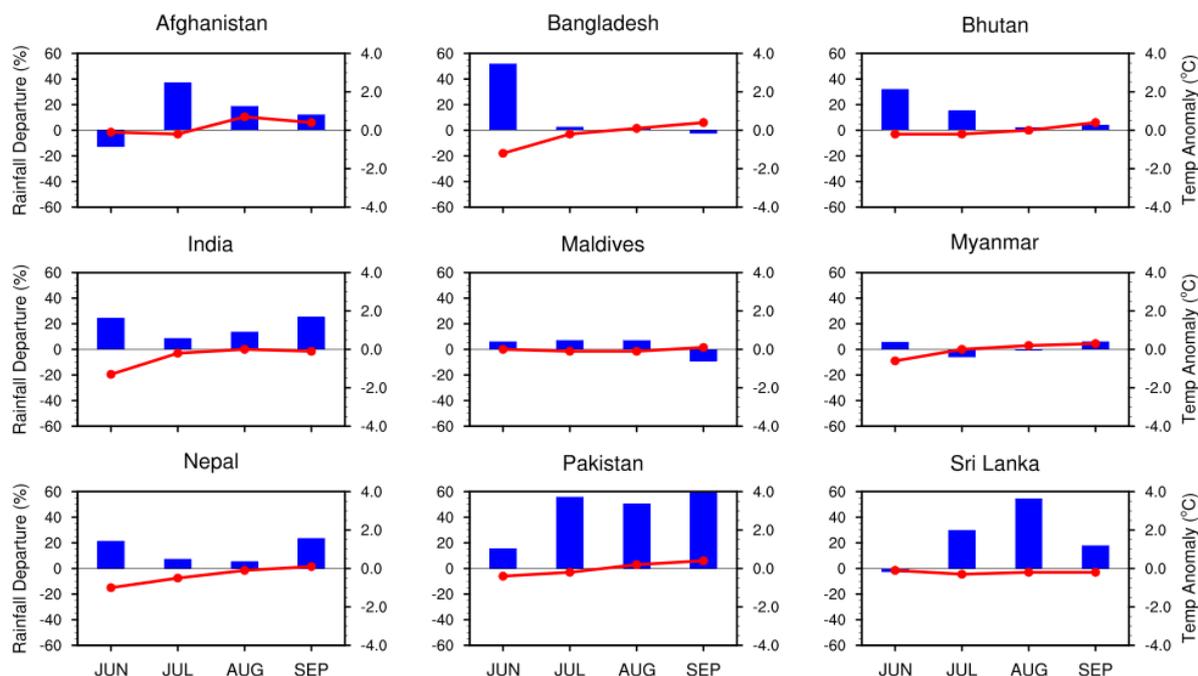


Fig. 9: Monthly country averaged rainfall forecast expressed as percentage departures (%) and Monthly country averaged temperature anomaly (°C) forecast during June to September 2022. Here, the normal range for country averaged monthly precipitation is taken as -10% to +10% (Left Vertical Axis Scale 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).