Earth System Science Organization (ESSO)
Ministry of Earth Sciences (MoES)
India Meteorological Department
WMO Regional Climate Centre
(Demonstration Phase)
Pune, India
<u>SEASONAL CLIMATE OUTLOOK FOR SOUTH ASIA</u>

(December to March 2018)

- Currently, ENSO neutral conditions are prevailing over equatorial Pacific Ocean. The latest forecast from the monsoon mission coupled forecasting system (MMCFS) indicates ENSO neutral conditions are likely to continue during the forecast period.

- The spatial pattern of forecasted precipitation anomalies using November initial conditions for DJF indicates positive precipitation anomalies are likely over parts of south peninsula, north India, parts of north Pakistan, most parts of Afghanistan, Bangladesh and Myanmar and whole of Sri Lanka. However, negative precipitation anomalies are likely over rest of the South Asian region. Forecast for JFM season suggests positive precipitation anomalies over most parts of north Afghanistan, Bangladesh, Myanmar, parts of northeast and north India and Sri Lanka. On the other hand most parts of India, Pakistan, Nepal and Bhutan are likely to have negative precipitation anomalies.

- In general, the country averaged monthly precipitation is likely to be normal to above normal for Afghanistan and Myanmar and is likely to be normal to below normal for Bhutan and India during all the months from December to March. However, the country averaged monthly precipitation is likely to be above normal during December and below normal during rest of the months for Nepal and Pakistan. For Bangladesh and Sri Lanka it is likely to be normal to above normal for all the months from December to March except January for Bangladesh and February for Sri Lanka where it is likely to be below normal.

- Temperature anomaly forecast for DJF and JFM 2018 seasons indicates positive temperature anomalies are likely over most parts of South Asia for both the seasons.

- The country averaged monthly mean temperature anomaly forecast indicates normal to above normal temperatures are likely during most of the forecasted months for all South Asian countries from December to March.

1.   Important Global Climate Factors

1.1   Sea Surface Temperatures over the Pacific Ocean

During November 2018, warm SST anomalies were observed over most parts of equatorial Pacific Ocean and cool SST anomalies were observed over parts of southeast equatorial Pacific Ocean (Fig.1). Positive SST anomalies were observed over parts of northwest Pacific Ocean as well as most parts of the north and south subtropical Pacific Ocean. Also, increase in warming of SSTs is seen over the eastern parts of equatorial Pacific Ocean during November 2018. As compared to the last month, negative SST anomalies which were observed off the west coast of South America in October 2018 have changed into positive SST anomalies in the November 2018. Currently, ENSO neutral conditions are prevailing over equatorial Pacific Ocean. The latest forecast from the monsoon mission coupled forecasting system (MMCFS) indicates ENSO neutral conditions are likely to continue during the forecast period.
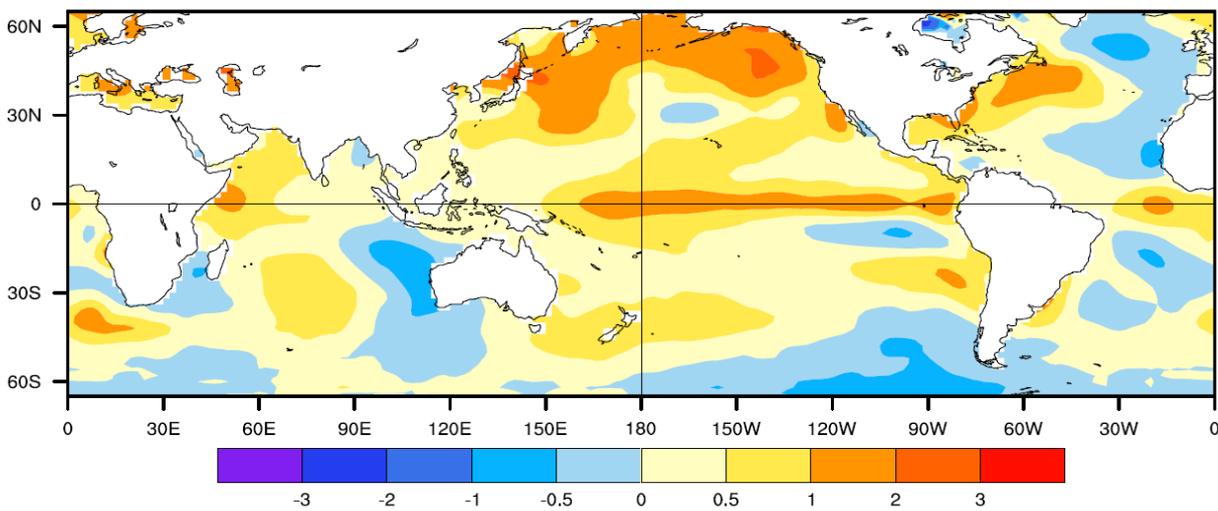
Average SST Anomalies
NOVEMBER 2018

Fig.1: Average SST anomalies (^{0}C) for November 2018. (Data source: ERSSTv5, NOAA).

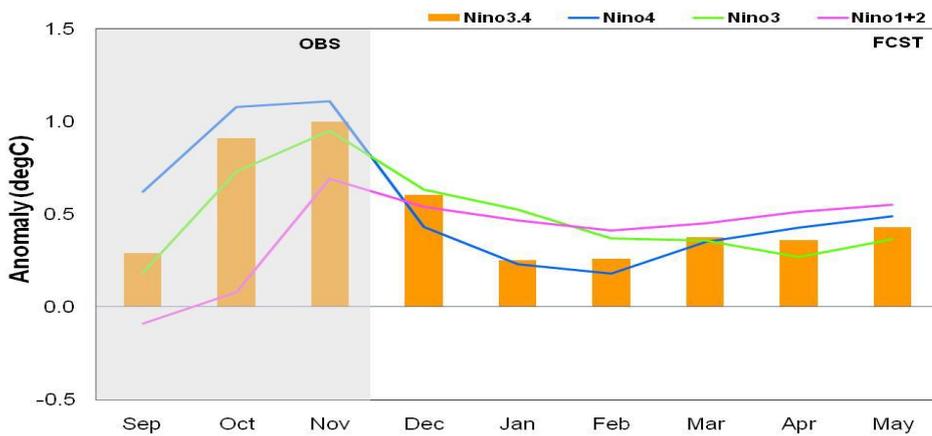**Fig.2:** Time series of monthly area-averaged SST anomalies (°C) in the 4 Niño regions. Observed anomaly for the last 3 months (Source: ERSSTv5 NOAA) and MMCFS model PDF corrected anomaly forecast for the next 6 months.
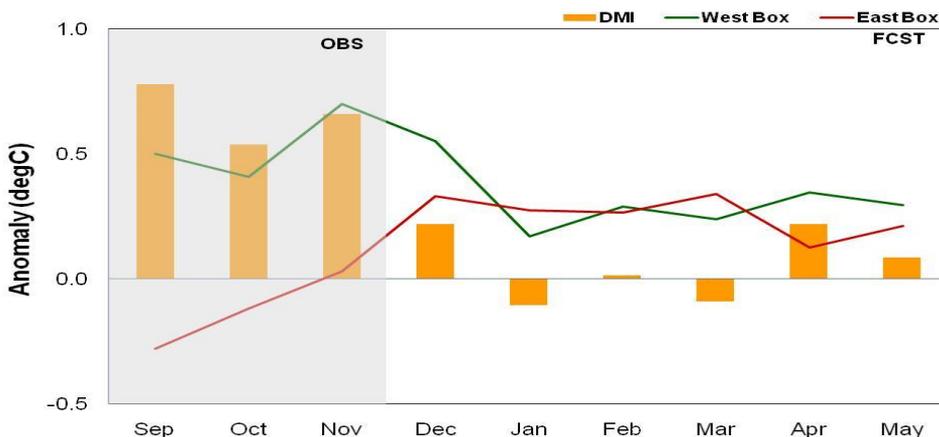

Fig.3: The time series of the monthly area-averaged SST anomaly Indices (°C) over west equatorial Indian Ocean (WEI) & east equatorial Indian Ocean (EEI) along with Dipole Mode Index (DMI=WEI-EEI) representing Indian Ocean Dipole (IOD). Observed anomaly for the last 3 months (Source: ERSSTv5 NOAA) and MMCFS model PDF corrected anomaly forecast for the next 6 months.

1.2   Sea Surface Temperatures over Indian Ocean

Normal to warmer than normal SST anomalies were observed over the parts of Arabian Sea and Bay of Bengal. However, positive SST anomalies were observed over parts of west and central Indian Ocean and negative SST anomalies were observed over parts of east Indian Ocean near east head Bay of Bengal and Maritime Continents (Fig.1). During November, warming of SSTs was observed over most parts of the Arabian Sea and Bay of Bengal. However, cooling of SSTs was observed over and around parts of south west and south east subtropical Indian Ocean as compared to the last month. At present, positive IOD conditions are observed over Indian Ocean. The latest forecast from the coupled monsoon mission model indicates present positive IOD conditions are likely to turn into neutral IOD conditions during DJF season and neutral IOD conditions are likely to persist.

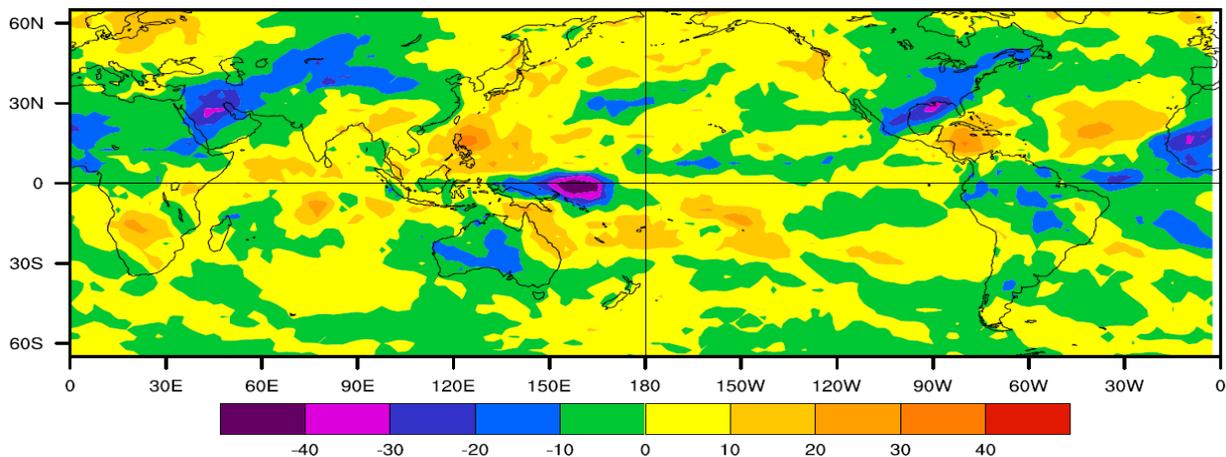## Average OLR Anomalies
November 2018

Fig.4: Convective (OLR) Anomaly (W/m^2) Pattern over the Asia Pacific Region for November 2018 (Data source: NCEP-NOAA)

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

The Outgoing Long wave Radiation (OLR) anomaly of November 2018 is shown in (Fig.4). Negative OLR anomalies (enhanced convection, blue shading) were observed over some parts of northwest and north India, parts of north Arabian Sea and eastern parts of Bay of Bengal and also observed over parts of west south subtropical Indian Ocean. The negative OLR anomalies were also observed over west equatorial Pacific Ocean, most parts of north and south subtropical Pacific Ocean and Australia in November 2018. While the positive OLR anomalies (suppressed convection, red shading), were present over most parts of India (south, central, east and northeast India), parts of Arabian Sea and Bay of Bengal and equatorial Indian Ocean, and over and around equatorial Pacific Ocean during November 2018. Positive OLR anomalies were also observed over parts of Maritime Continents and southern parts of Africa. Negative OLR anomalies were observed over most parts of north Africa and North and South Americas.

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

The November 2018, NH snow cover area (37.77 million Sq. Km) was more than the 1981-2010 normal by 3.81 million Sq. km. Eurasian Snow cover area (22.05 million Sq. Km) was 1.58 million Sq. km more than the 1981-2010 normal and was having more area under snow in November 2018 as compared with November 2017 (2.75 million Sq. km less than 1981-2010 normal). North America snow cover area of 15.72 million sq. Km was more by 2.23 million Sq. Km and Canada snow cover of 9.97 million Sq. Km was 1.32 million Sq. km more than the 1981-2010 normal. (Data Source: Rutgers University Climate Lab).

1.5. Madden Julian Oscillation (MJO):

During initial part of the week first of November 2018, MJO emerged through Western Hemisphere and Africa (phase 1) and then it travelled to Indian Ocean (phase 2 and 3) respectively with moderate signal. Then during second and third week of the month it moved into Maritime Continent (phase 4 and 5) respectively with strong signal and then it moved into Western Pacific (phase 6 and 7) with moderate signal and towards the end of the month, it remerged into Western Hemisphere and Africa (phase 8) with subdued signal. (Data Source: http://www.bom.gov.au/climate/mjo/).

2. Seasonal Outlook for South Asia

The outlook was prepared based on the forecast from 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 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 Anomaly:

The spatial pattern of seasonal forecasts for precipitation anomalies for the seasons December to February (DJF) 2018 and January to March (DJF) 2018 are given in the Figures 5a and 5b respectively. The forecast were prepared based on the November initial conditions. The forecasted precipitation anomalies for DJF season (Fig.5a) indicate positive precipitation anomalies are likely over parts of south peninsula, north India, parts of north Pakistan, most parts of Afghanistan, Bangladesh and Myanmar and whole of Sri Lanka. However, negative precipitation anomalies are likely over rest of the South Asian region (Nepal, Bhutan, southern Pakistan and Afghanistan, north Bangladesh, central Myanmar and most parts of India). Forecast for JFM (Fig.5b) season suggests positive precipitation anomalies are likely over most parts of north Afghanistan, Bangladesh, Myanmar, parts of northeast and north India and Sri Lanka. On the other hand most parts of India, Pakistan, Nepal and Bhutan are likely to have negative precipitation anomalies.

2.2. Temperature Anomaly:

The spatial pattern of seasonal forecasts for temperature anomalies for the seasons December to February (DJF) 2018 and January to March (JFM) 2018 are given in the Figures 6a and 6b respectively. Temperature anomaly forecast for DJF season (Fig 6a) indicates negative temperature anomalies over parts north India and positive temperature anomalies are likely over rest of the South Asian region. (Afghanistan, Pakistan, Bangladesh, Myanmar, Nepal, Bhutan, Sri Lanka and remaining parts of India). Temperature anomaly forecast for JFM season (6b) indicates positive temperature anomalies are likely over most of the South Asian region during JFM season.

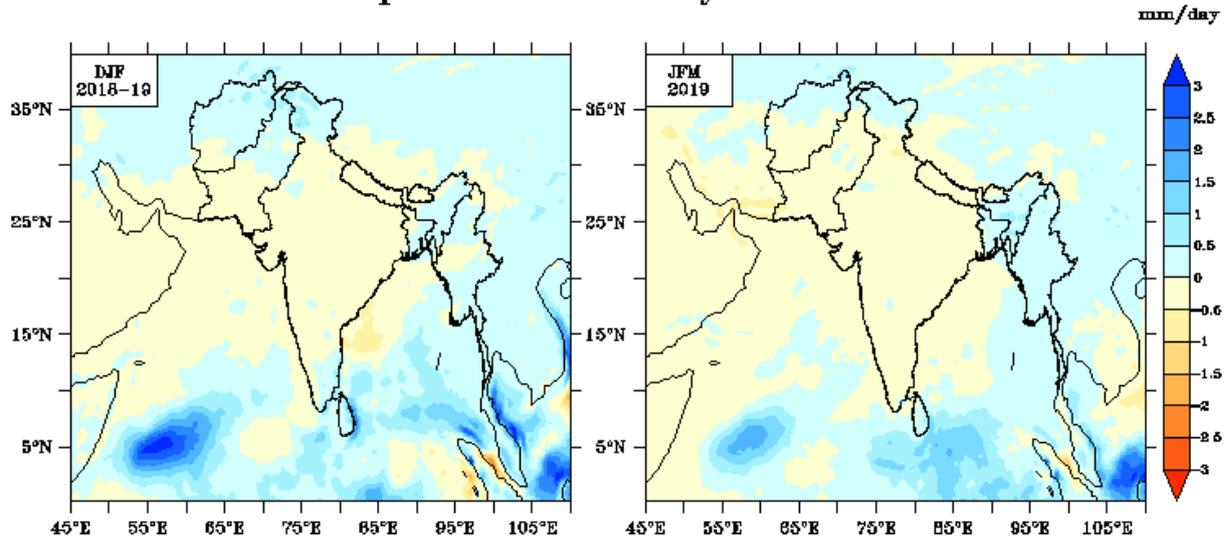## MMCFS Precipitation Anomaly Forecast

mm/day

Fig.5: Seasonal forecasts of precipitation anomalies (mm/day) for (a) DJF (left) and (b) JFM (right) based on Initial conditions of November 2018.

MMCFS Temperature Anomaly Forecast
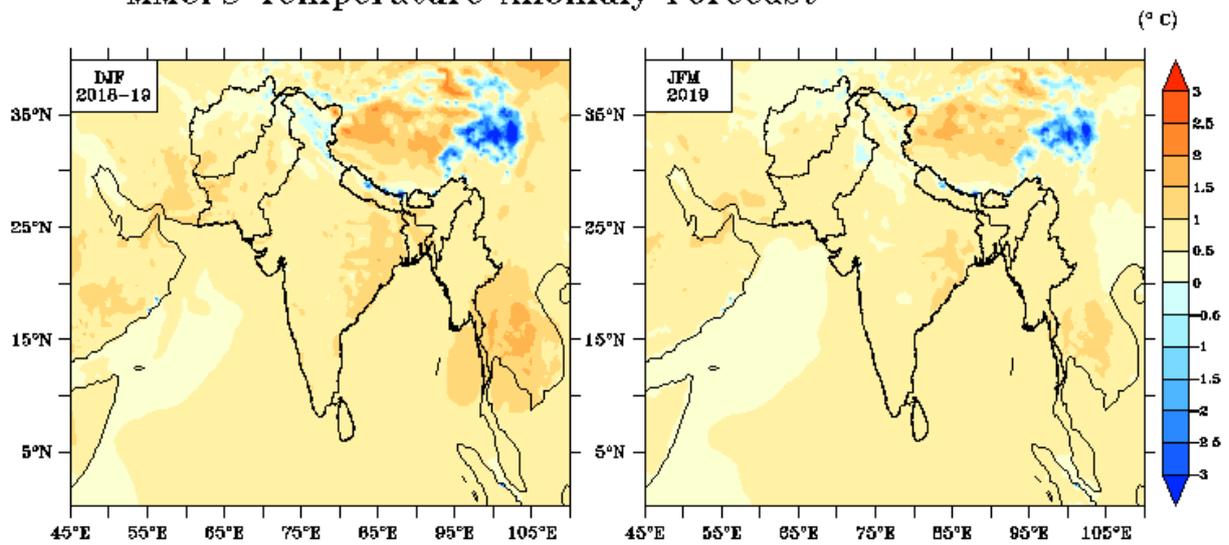
(°C)

Fig. 6: Seasonal mean temperature anomalies (°C) for (a) DJF (left) and (b) JFM (right) based on Initial conditions of November 2018.

3.   Forecast Outlook for the Country Averaged Monthly Precipitation and Temperature

The model forecast for monthly precipitation and temperature for the next four months (from December to March) averaged over the 8 south Asian countries viz., Afghanistan, Bangladesh, Bhutan, India, Myanmar, Nepal, Pakistan and Sri Lanka is shown in the Figures 7 & 8 respectively. 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 December, the country averaged monthly precipitation is likely to be above normal for Afghanistan, Nepal, Pakistan and Sri Lanka, and it is likely to be normal for Bangladesh, Bhutan, India and Myanmar (Fig.7). In January, the country averaged monthly precipitation is likely to be below normal for Bangladesh, Bhutan, India, Nepal and Pakistan and normal for Afghanistan, Myanmar and Sri Lanka. In February, the country averaged monthly precipitation is likely to be above normal for Afghanistan, Bangladesh and Myanmar, below normal for Nepal, Pakistan and Sri Lanka, and normal for Bhutan and India. In March, the country averaged monthly precipitation is likely to be above normal for Bangladesh, Myanmar and Sri Lanka, it is likely to be below normal for Pakistan and normal for Afghanistan, Bhutan, India and Nepal.

In general, the country averaged monthly precipitation is likely to be normal to above normal for Afghanistan and Myanmar and is likely to be normal to below normal for Bhutan and India during all the months from December to March. However, the country averaged monthly precipitation is likely to be above normal during December and below normal during rest of the months for Nepal and Pakistan. For Bangladesh and Sri Lanka it is likely to be normal to above normal for all the months from December to March except January for Bangladesh and February for Sri Lanka where it is likely to be below normal.

The country averaged monthly mean temperature anomaly forecast (Fig.8) indicates normal to above normal temperatures are likely during most of the forecasted months for all South Asian countries from December to March.
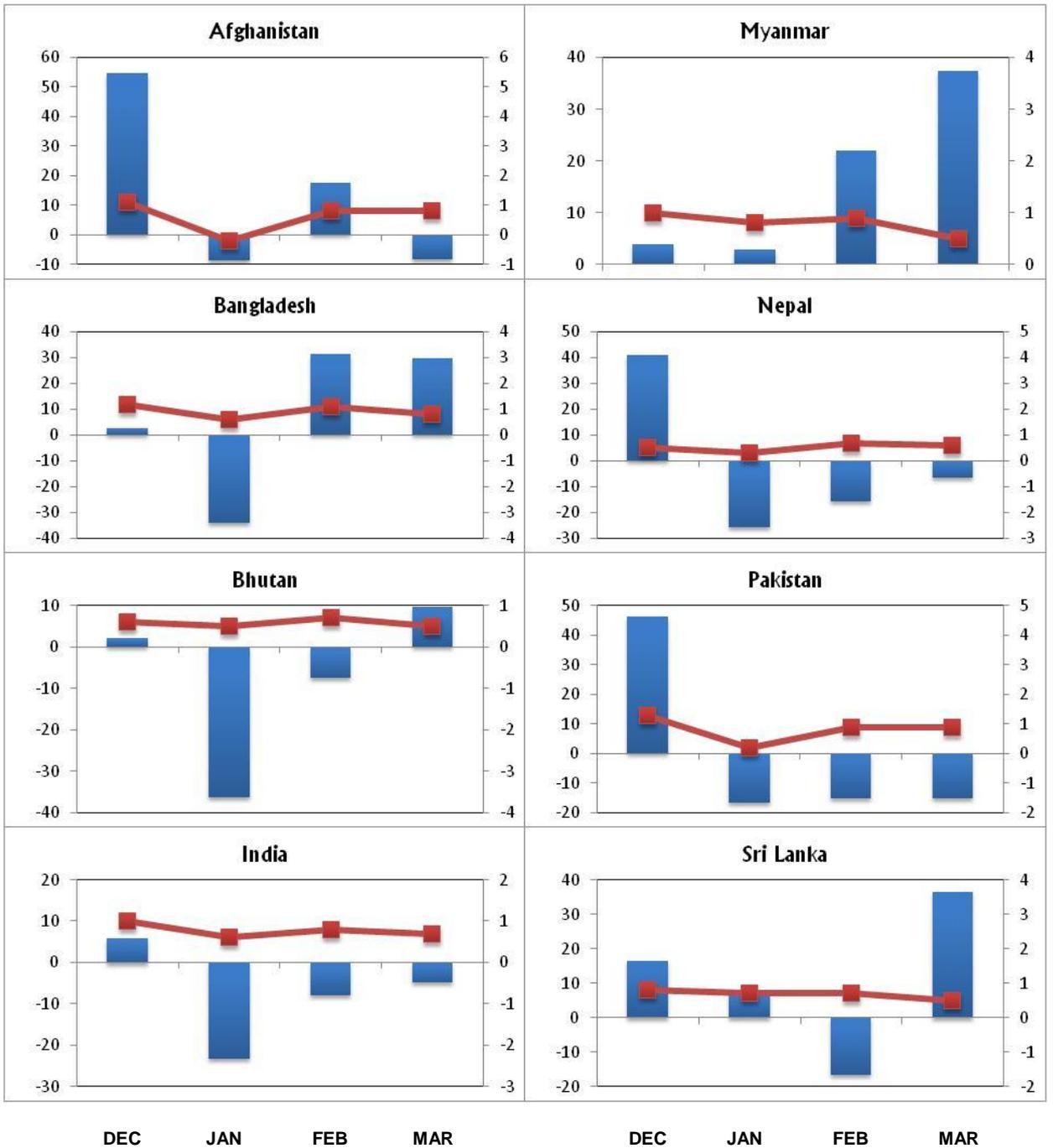
DEC   JAN   FEB   MAR   **DEC   JAN   FEB   MAR**

Fig.7: Monthly country averaged rainfall forecast expressed as percentage departures (%) during December to March, 2018. (The normal range for country averaged monthly precipitation is taken as -10% to +10%).
(Left Vertical Axis Scale)

 PRECIPITATION

Fig.8: Monthly country averaged temperature anomaly (°C) forecast during December to March, 2018. (The normal range for country averaged monthly temperature is taken -0.25°C to +0.25°C).
(Right Vertical Axis Scale)

 TEMPERATURE