Earth System Science Organization (ESSO)
Ministry of Earth Sciences (MoES)
India Meteorological Department

WMO Regional Climate Centre

(Demonstration Phase)

Pune, India

SEASONAL CLIMATE OUTLOOK FOR SOUTH ASIA

(October 2017 to January 2018)

- Currently cool ENSO neutral conditions are prevailing over the Pacific Ocean. The latest forecast from the coupled model indicates these conditions in Pacific Ocean likely to turn to borderline / weak La Niña conditions during early part of the next year.

- The spatial pattern of forecasted precipitation anomalies using September initial conditions for 2017 OND and NDJ seasons indicate below normal precipitation likely for Afghanistan, Pakistan and northern parts of India and normal precipitation over most parts of remaining south Asian region with slight variation in the monthly scale.

- In general, the country averaged monthly precipitation is likely to be below normal for Afghanistan, Nepal and Pakistan for all the months. Normal to above normal monthly precipitation is likely for Bangladesh, Bhutan, India and Myanmar for the months, October and November while for the months, December and January it is likely to be below normal . The country averaged monthly precipitation for Sri Lanka is likely to be normal to above normal for all the forecasted months.

- The forecasted mean temperature anomalies for 2017 OND and NDJ seasons both indicates that it is likely to be positive over the most parts of the South Asian countries. However, parts of northern South Asian region to have ≥1.0^{o}C temperature anomalies for OND as well as NDJ seasons.

- The country averaged monthly mean temperature anomaly forecast indicates above normal temperatures over all the South Asian countries for the months October to January.

1. Important Global Climate Factors

1.1 Sea Surface Temperatures over the Pacific Ocean

During September 2017, below average SST anomalies were observed over the east and central equatorial Pacific Ocean (Fig.1) and positive SST anomalies were observed over west and north-west Pacific Ocean. Positive SST anomalies were also observed over subtropical Pacific Ocean. As compared to the last month (August 2017) cooling of SSTs is observed over the parts of east and east-central equatorial Pacific Ocean and warming of SSTs over west and north-west Pacific Ocean. Warm SST anomaly area over subtropical North Pacific Ocean is seen to be increased while area over subtropical South Pacific Ocean is seen to be decreased as compared to the last month. As per the observations (Fig.2), cool ENSO neutral conditions are prevailing during September. The latest forecast from the monsoon mission coupled forecasting system (MMCFS) indicates that these conditions in Pacific Ocean likely to turn to borderline / weak La Niña conditions during early part of the next year.

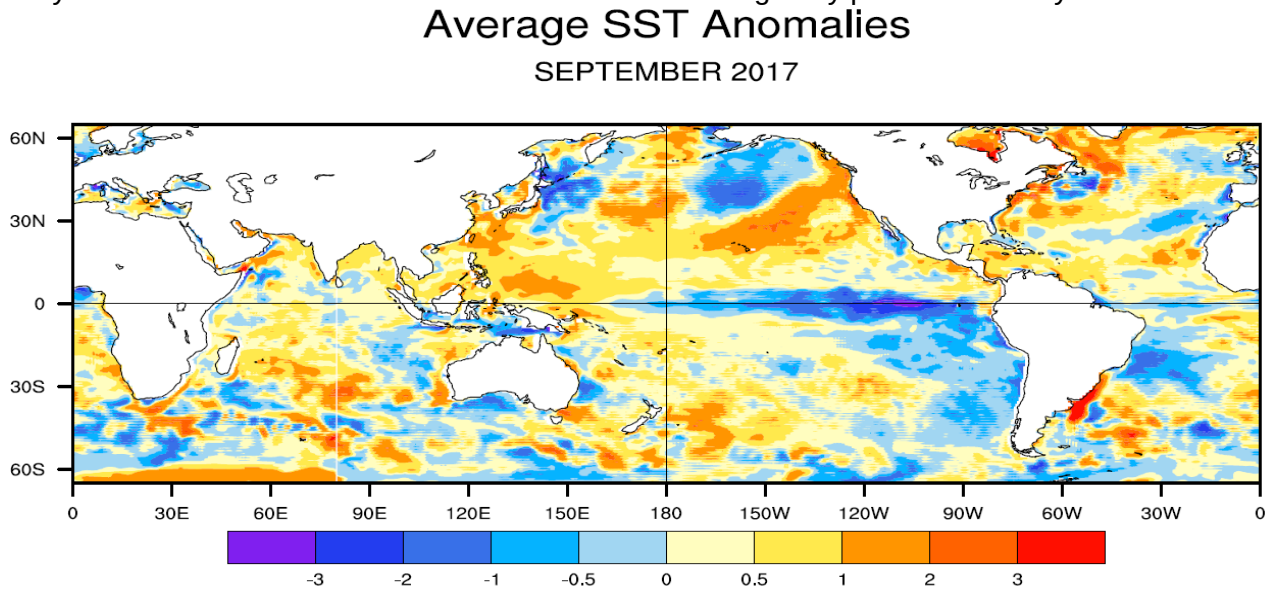

Fig.1: Average SST anomalies (^{0}C) for September 2017. (Data source: INCOIS-GODAS).

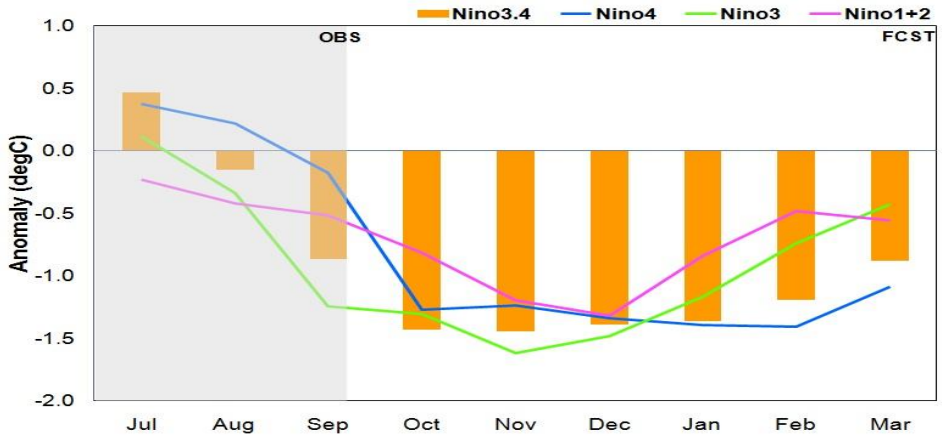

Fig.2: Time series of monthly area-averaged SST anomalies (°C) in the 4 Niño regions. Observed anomaly for the last 3 months (Source: INCOIS-GODAS) and MMCFS model PDF corrected anomaly forecast for the next 6 months.

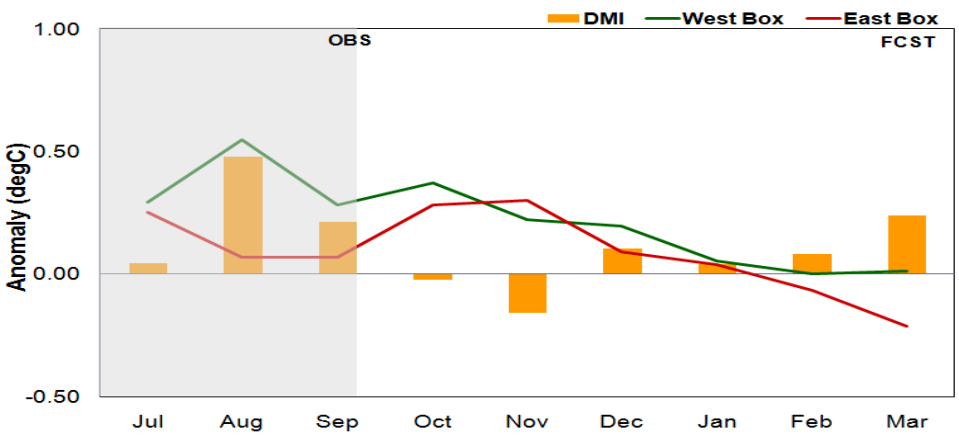

Fig.3: The time series of the monthly area-averaged SST anomaly Indices (°C) over west equatorial Indian Ocean (WEI) & east equatorial Indian Ocean (EEI) along with Dipole Mode Index (DMI=WEI-EEI) representing Indian Ocean Dipole (IOD). Observed anomaly for the last 3 months (Source: INCOIS-GODAS) and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

1.2 Sea Surface Temperatures over Indian Ocean

Warmer than normal SST anomalies were observed (Fig.1) over most parts of the Arabian Sea and Bay of Bengal, however, cooler than normal SST anomalies were also observed over some parts in small patches. Over southwest tropical Indian Ocean relatively warmer anomalies were observed along a latitudinal zone of 15°S-30°S. Negative SST anomalies which were observed (in August 2017) over the south of equatorial Indian Ocean now (in September 2017) continued to be negative and the warm SST anomalies which were observed over the northern parts of Indian Ocean during August 2017 have reduced in their area in the current month (September 2017). The Dipole Mode Index (DMI) during September 2017 shows neutral Indian Ocean Dipole (IOD) conditions (Fig.3). The latest forecast from the coupled model indicates that current IOD conditions over Indian Ocean likely to continue in the coming forecasted months.

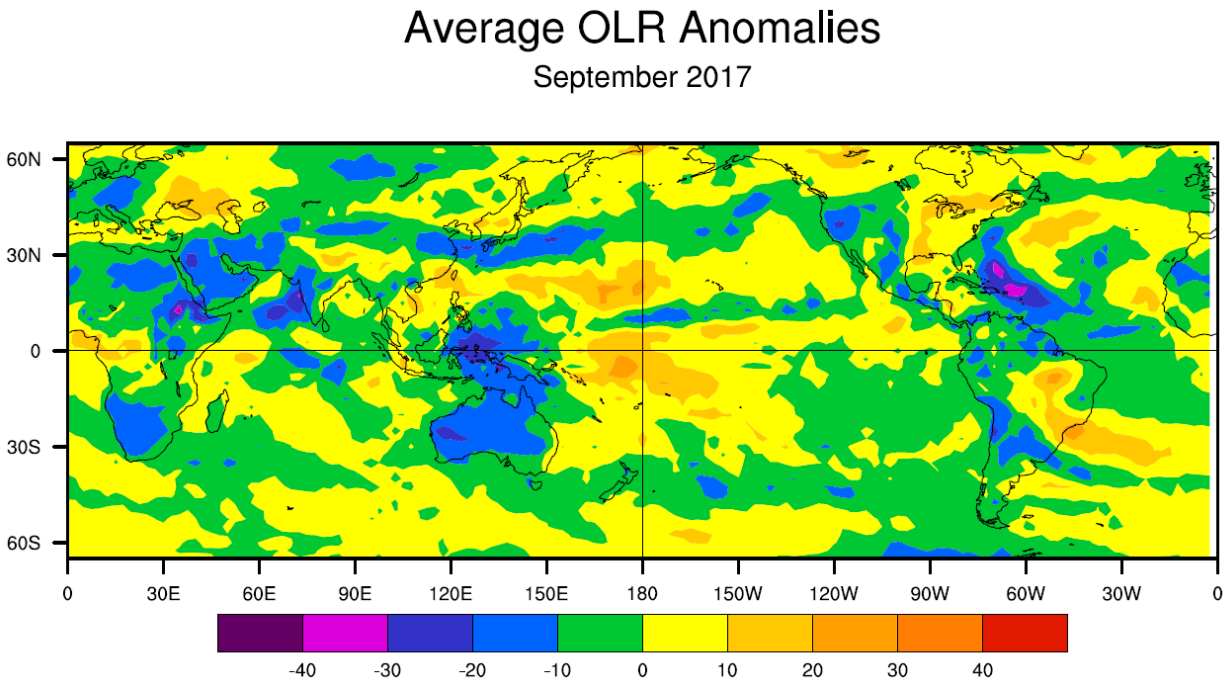

Fig.4: Convective (OLR) Anomaly (W/m^2) Pattern over the Asia Pacific Region for September 2017 (Data source: NCEP-NOAA)

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

The Outgoing Long wave Radiation (OLR) anomaly of September 2017 is shown in (Fig.4). Negative OLR anomalies (enhanced convection, blue shading) were observed over most parts of India and over parts of Arabian Sea and Bay of Bengal. The negative OLR anomalies were also observed over equatorial Indian Ocean and over south of equatorial Indian Ocean, Maritime Continent and Australia in September 2017. While the positive OLR anomalies (suppressed convection, red shading), were present over parts of west Pacific Ocean around date line and along equatorial Pacific Ocean in September 2017. Negative OLR anomalies were observed over North and South America and parts of south and north subtropical Pacific Ocean and Africa.

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

The September 2017, NH snow cover area (6.15 million Sq. Km) was more than the 1981-2010 normal by 0.916 million Sq. km. Eurasian Snow cover area (2.142 million Sq. Km) was 0.616 million Sq. km more than the 1981-2010 normal and was having more area under snow in September 2017 as compared with September 2016 (0.163 million Sq. km more than 1981-2010 normal). North America snow cover area of 4.01 million sq. Km was more by 0.3

million Sq. Km and Canada snow cover of 1.61 million Sq. Km was 0.212 million Sq. km more than the 1981-2010 normal. (Data Source: Rutgers University Climate Lab).

1.5. Madden Julian Oscillation (MJO):

During first week in September 2017 MJO was weak over Maritime continent which moved very fast and emerged in Indian Ocean (phase 3) with a slight increase in amplitude by mid of September. Later in September month MJO moved from Maritime continent to Western Pacific and was stationary till end of September month over Western Pacific with weak amplitude. (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 October to December (OND) 2017 and November to January (NDJ) 2017 are given in the Figures 5a and 5b respectively. The forecast were prepared based on the September initial conditions. The forecasted precipitation anomalies for OND season (Fig.5a) indicate positive precipitation anomalies are likely over south peninsula and east and north east India, south-eastern parts of Nepal, Bhutan, Bangladesh, most parts of Myanmar and western parts of Sri Lanka. However, negative precipitation anomalies are likely over rest of the South Asian region (Afghanistan, Pakistan, central and northern parts of Nepal, parts of east Myanmar and parts of north and northwest India). Forecast for NDJ (Fig.5b) season suggests positive precipitation anomalies are likely over north-east India and parts of peninsular India, Bangladesh, western parts of Sri Lanka and parts of Myanmar. On the other hand Afghanistan, Pakistan, central and northern parts of India are likely to have negative precipitation anomalies.

2.2. Temperature Anomaly:

The spatial pattern of seasonal forecasts for temperature anomalies for the seasons October to December (OND) 2017 and November to January (NDJ) 2017 are given in the Figures 6a and 6b respectively. The forecasted temperature anomalies for OND season (Fig 6a) indicate positive temperature anomalies are likely over most parts of the South Asia region. Temperature anomaly forecast for NDJ season (Fig 6b) indicates near normal temperature anomalies over south of 15^{o}N latitude of South Asian region and warmer than normal temperature anomalies over most parts of the remaining South Asian region. In general, positive ($\geq 1.0^{o}$C) temperature anomalies are likely over parts of Afghanistan and Pakistan and extreme north India, for both the forecasted seasons (OND and NDJ).

(a) (b)

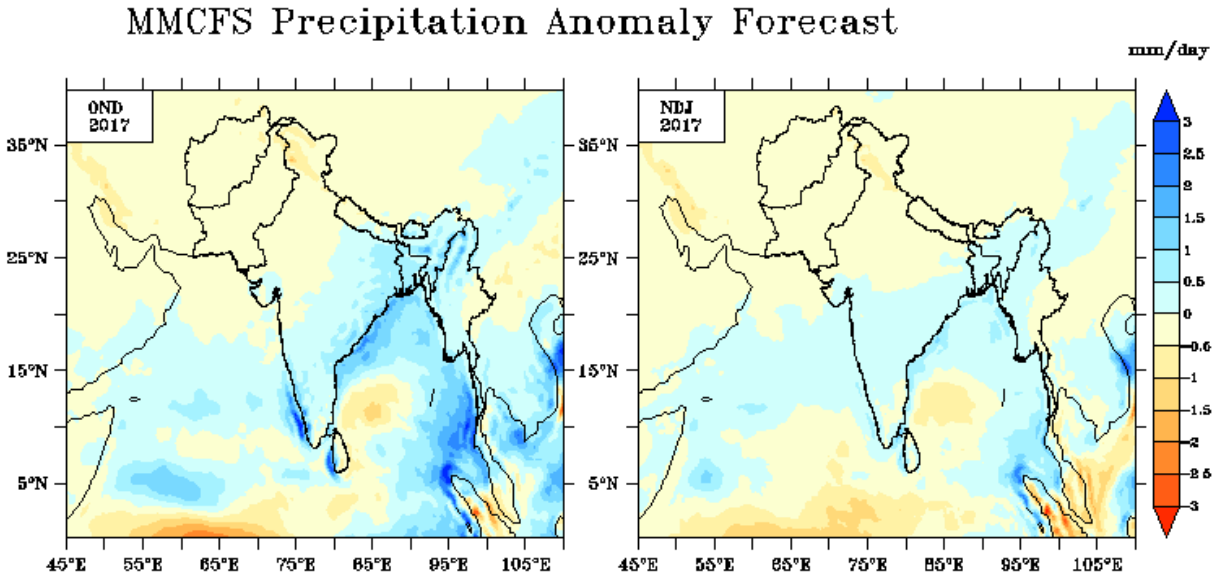

Fig.5: Seasonal forecasts of precipitation anomalies (mm/day) for (a) OND (left) and (b) NDJ (right) based on Initial conditions of September 2017.

(a) (b)

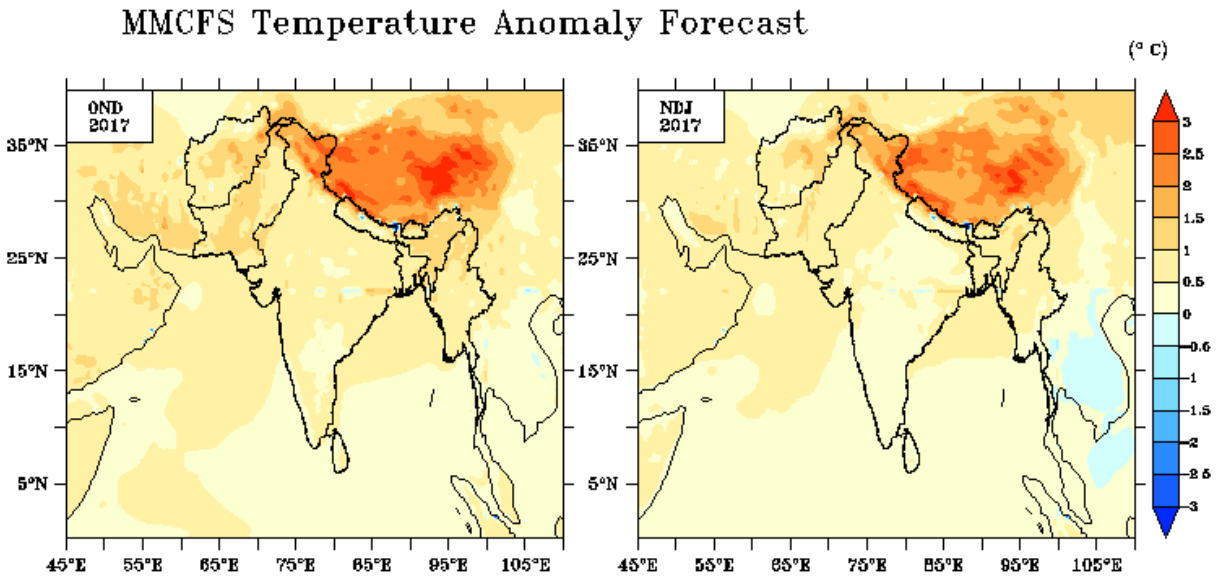

Fig. 6: Seasonal mean temperature anomalies (^{o}C) for (a) OND (left) and (b) NDJ (right) based on Initial conditions of September 2017.

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 October to January) 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 October, the country averaged monthly precipitation is likely to be below normal for Afghanistan and Pakistan, above normal for Bangladesh, Bhutan and India, and normal for all other south Asian countries (Fig.7). In November, the country averaged precipitation is likely to be below normal for Afghanistan and Pakistan, above normal for Bangladesh, India and Myanmar and normal for rest of the South Asian countries. In December, the country averaged precipitation is likely to be below normal for Afghanistan, Bangladesh, Bhutan, India, Myanmar, Nepal and Pakistan, above normal is likely for Sri Lanka. In January, Bangladesh, Bhutan, India, Myanmar, Nepal and Pakistan are likely to have below normal precipitation, Afghanistan and Sri Lanka are likely to receive normal monthly precipitation.

In general, the country averaged monthly precipitation is likely to be below normal for Afghanistan, Nepal and Pakistan for all the months. Normal to above normal monthly precipitation is likely for Bangladesh, Bhutan, India and Myanmar for the months, October and November while for the months, December and January it is likely to be below normal . The country averaged monthly precipitation for Sri Lanka is likely to be normal to above normal for all the forecasted months.

The country averaged monthly mean temperature anomaly forecast (Fig.8) indicates above normal temperatures over all the South Asian countries for all the months October to January.

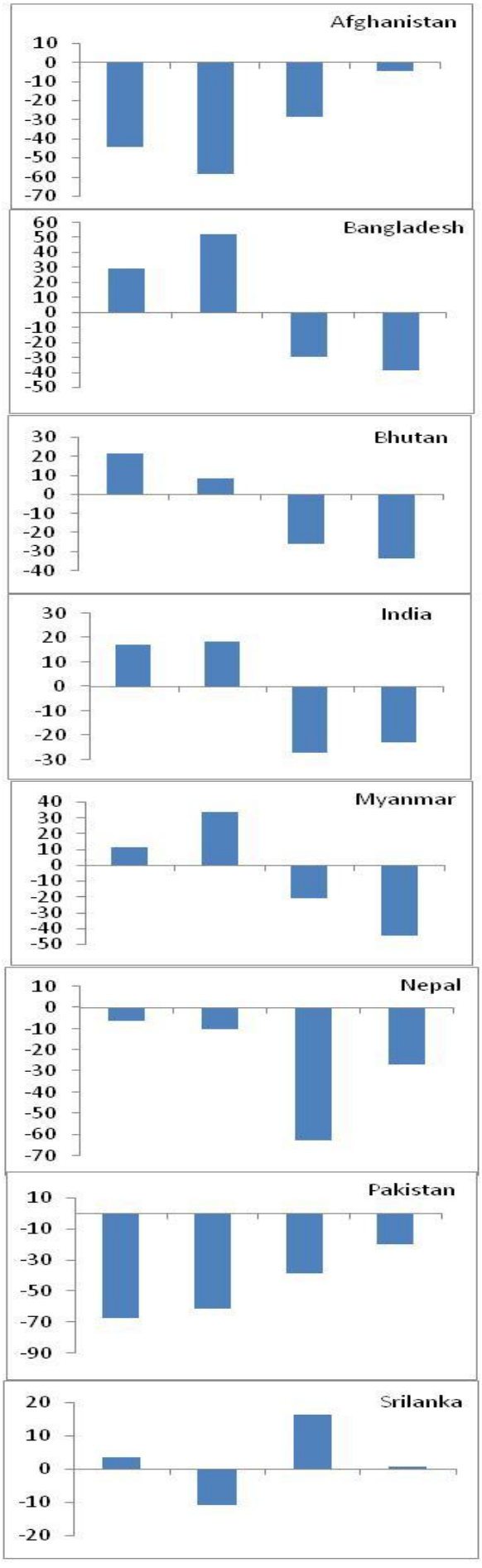

Fig.7: Monthly country averaged rainfall forecast expressed as percentage departures (%) during October to January, 2017. (The normal range for country averaged monthly precipitation is taken as -10% to +10%).

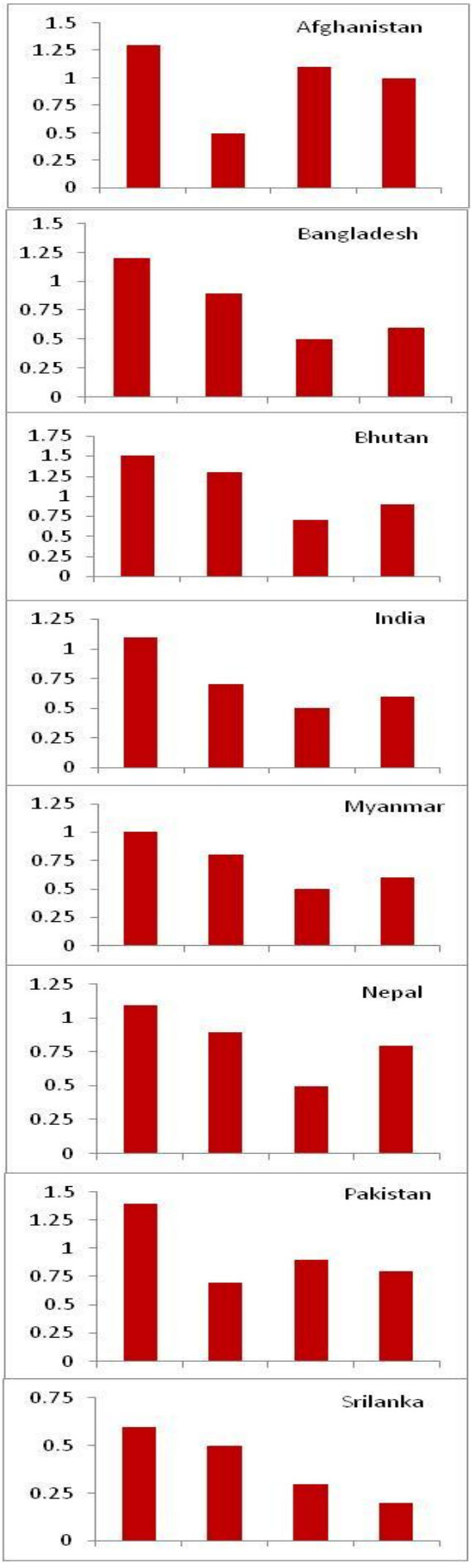

Fig.8: Monthly country averaged temperature anomaly (°C) forecast during October to January, 2017. (The normal range for country averaged monthly temperature is taken -0.25^{o}C to +0.25^{o}C).