



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

**El Niño Southern Oscillation (ENSO) and
Indian Ocean Dipole (IOD)
Bulletin**

September 2018

Highlights:

Currently, ENSO neutral conditions are prevailing over equatorial Pacific Ocean and the latest MMCFS forecast indicates there is possibility of development of weak El Niño conditions during OND season or thereafter.

Currently, neutral IOD conditions are prevailing over equatorial Indian Ocean. MMCFS forecast indicates that neutral IOD conditions are likely to persist during SON season and weak negative IOD conditions are likely to develop thereafter.

1. Current Sea Surface Temperature (SST) Conditions over Pacific & Indian Oceans

During August 2018, cool SST anomalies were observed over east equatorial Pacific Ocean (Fig.1a) and warm SST anomalies were observed over west and central equatorial Pacific Ocean. Positive SST anomalies were observed over some parts of northwest Pacific Ocean as well as most parts of the north and south subtropical Pacific Ocean. Negative SST anomalies were also observed off the west coast of South America. As compared to the last month, increase in cooling of SSTs is seen over the parts of central to eastern parts of the tropical Pacific Ocean (Fig.1b). However, cool SSTs over west equatorial Pacific Ocean turned into slightly warm SSTs during the current month. Cooling of SSTs is seen to be decreased over the northwest Pacific Ocean as compared to the last month. The area of cool SSTs is narrowed near Maritime Continent as compared to the last month.

Normal SST anomalies were observed in the most 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 (Fig.1a). During August, cooling of SSTs was observed over most parts of the Arabian Sea and Bay of Bengal. Also, cooling of SSTs was observed over parts of south subtropical Indian Ocean (Fig.1b) as compared to the last month.

1.1. El Niño Southern Oscillation (ENSO) conditions over the Pacific Ocean

The monthly time series of Niño3.4 SST anomalies for the last 12 months i.e. from September 2017 to August 2018 (Fig.2a) suggests that ENSO neutral conditions persisted till October 2017. From November 2017 to March 2018 La Niña conditions were prevailed. Since April 2018, La Nina conditions turned into ENSO neutral conditions and continued in August 2018. Currently, ENSO neutral conditions are prevailing. The positive subsurface anomalies were observed over most parts of the equatorial west and central Pacific Ocean (Fig.2 b) (at around thermocline depth) with highest magnitudes centred around 140°W.

1.2. Indian Ocean Dipole (IOD) conditions over the Indian Ocean

The DMI index for the last 12 months suggests that (Fig. 2c) prevailing weak positive IOD conditions from the month of October 2017 turned into neutral IOD conditions in the month of November 2017 and continued till January 2018, which reached to the threshold of positive IOD conditions during the month of February. Again it turned into neutral IOD conditions in March and continued up to June 2018. In July, it reached to the threshold of positive IOD conditions temporarily but in subsequent month of August, it has weakened into neutral IOD conditions. Currently, neutral IOD conditions are prevailing. Negative subsurface

temperature anomalies (Fig. 2d) (stronger magnitude) were seen over the parts of eastern equatorial Indian Ocean and positive subsurface temperature anomalies were seen spread over the parts of central Indian Ocean at around thermocline depth.

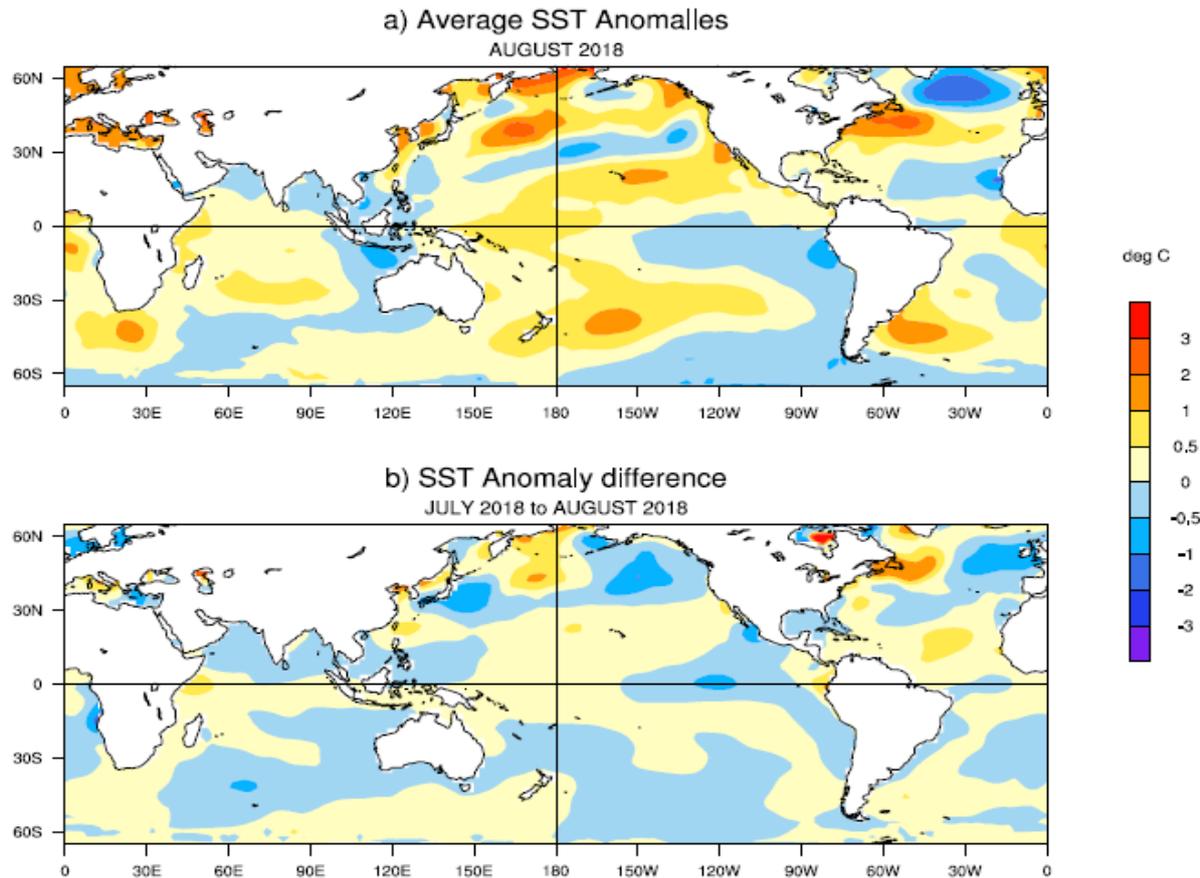


Fig.1: (a) Sea surface temperature (SST) anomalies ($^{\circ}\text{C}$) during August, 2018 and, (b) changes in the SST anomalies ($^{\circ}\text{C}$) from July 2018 to August 2018. SSTs were based on the ERSSTv5, NOAA and anomalies were computed with respect to 30-year (1981-2010) long term mean ERSSTv5, NOAA.

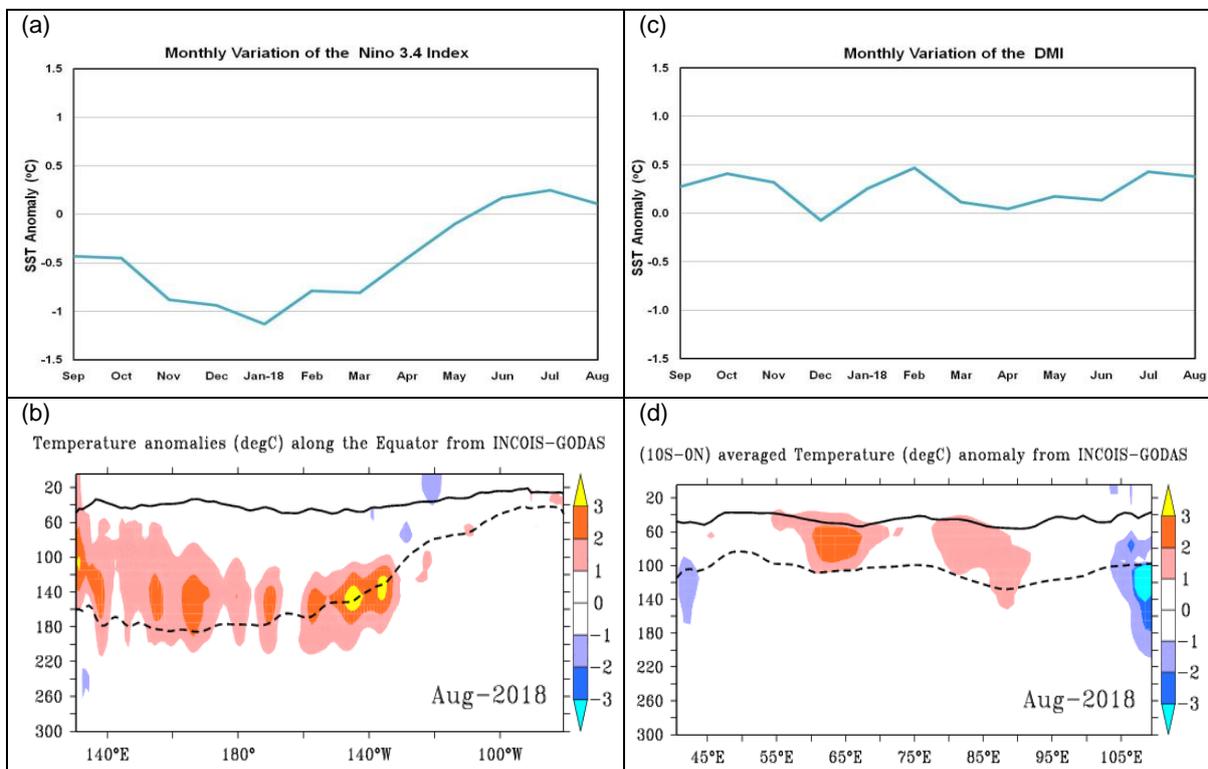


Fig.2: (a) Monthly variation of Niño 3.4 SST index anomaly for the last 12 months and (b) equatorial depth-longitude section of ocean temperature anomalies in the equatorial (5°S - 5°N) Pacific Ocean for the month of August, 2018. (c) Same as (a) but for Dipole Mode Index (DMI). (d) Same as (b) but for the tropical Indian Ocean (10°S -Eq). The anomalies were computed using base period of 1981-2010, Data Source:ERSSTv5, NOAA. The solid dark line is the 20°C isotherm and the dashed line is thermocline depth, Data Source: INCOIS-GODAS.

2. ENSO & IOD Forecast

The SST forecast were prepared using the high resolution Monsoon Mission Coupled Forecast System (MMCFS) (AGCM T382L64; 38 km and OGCM 25 km in tropics) based on the 2018 August initial conditions. The initial conditions for the model runs were obtained from ESSO-INCOIS and ESSO-NCMRWF analysis. Probability density function (PDF) bias correction was applied on the forecasts of Niño3.4 index (Fig.4a) and DMI (Fig.4b) based on hindcasts for the period 1999-2008 and anomalies were calculated based on 1982-2008 climatology.

The 3-month season averaged SST anomaly forecast (Fig.3) indicate that warmer than normal SST anomalies are likely over most parts of the equatorial Pacific Ocean from OND to DJF season. However, from JFM season onwards warm SST anomalies are likely to decrease over the central Pacific region and likely to continue only in western and eastern parts of the equatorial Pacific Ocean. Also, from DJF season onwards slightly cool SSTs are likely over north west Pacific Ocean. The latest MMCFS forecast indicates that there is possibility of development of weak El Niño conditions during OND season or thereafter (Fig.4a). In the Indian Ocean, during most of the forecasted seasons, near zero SST anomalies are likely in Bay of Bengal and cool SST anomalies likely in Arabian Sea (Fig.3). Cool (or negative) SST anomalies are likely over eastern Indian Ocean off the west coast of Australia. MMCFS forecast indicates that neutral IOD conditions are likely to persist during SON season and weak negative IOD conditions are likely to develop thereafter (Fig.4b).

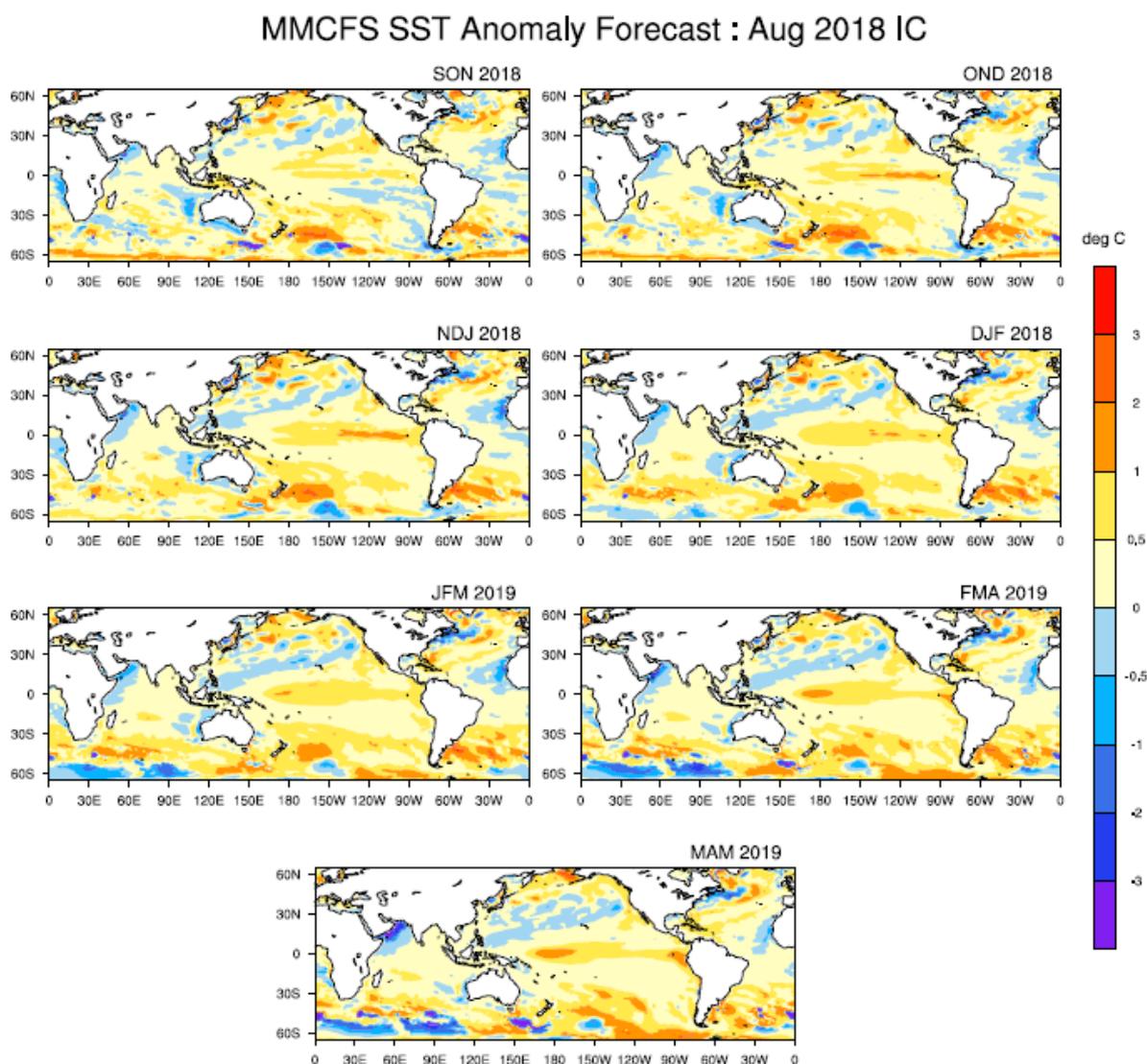


Fig.3: Forecasted Seasonal mean SST anomalies for 3 monthly seasons, (a) September to November (SON), (b) October to December (OND), (c) November to January (OND), (d) December to February (DJF), (e) January to March (JFM), (f) February to April (FMA) and (g) March to May (MAM) (Model bias correction base period: 1999-2010; Climatology base period: 1982-2010).

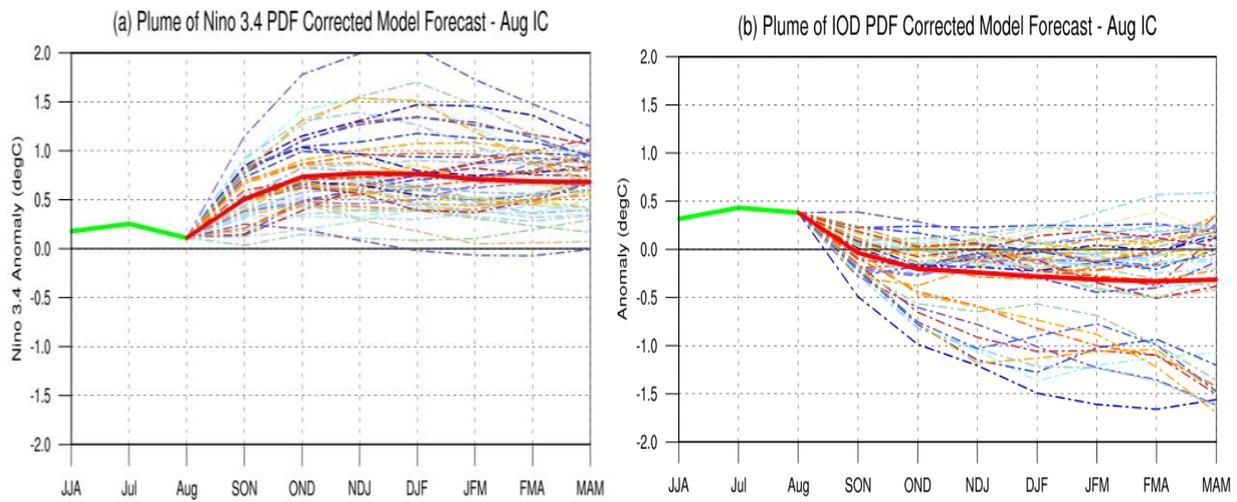


Fig.4: Plume of (a) Niño 3.4 SST anomalies, (b) Indian Ocean Dipole Mode Index forecasted by high resolution CFSv2. The forecasts were PDF corrected for bias and variance. The solid green line is the observed SST anomaly (ERSSTv5, NOAA) and solid red line is the ensemble SST anomaly forecast mean of 48 members (MMCFS). The individual ensemble member forecasts are shown in light dotted lines of different colours.

Probability Forecast for Niño 3.4 and India Ocean Dipole Mode Index

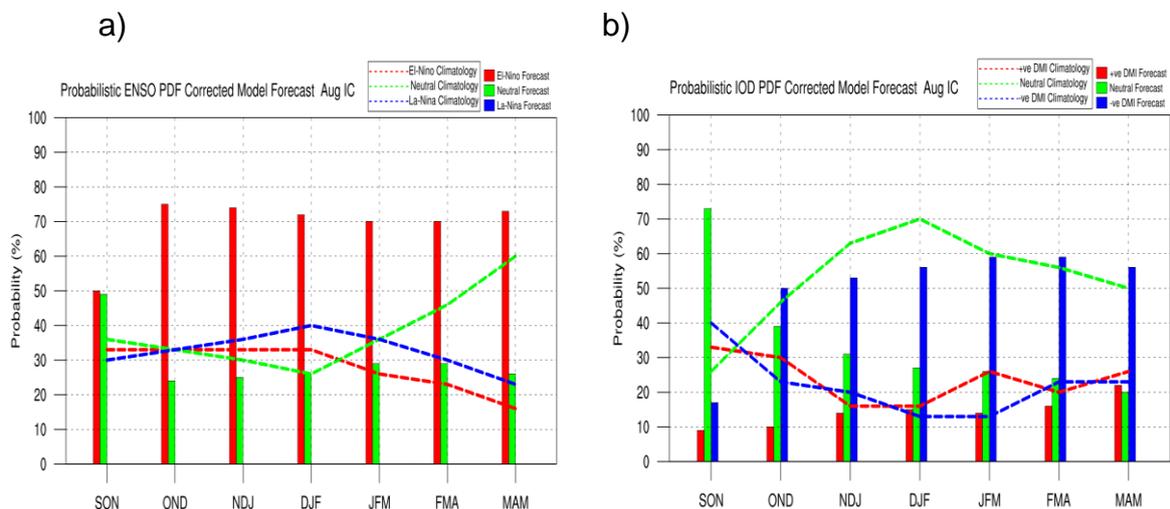


Fig.5: Probability forecast along with climatological probabilities of (a) Niño 3.4 and (b) Indian Ocean Dipole Mode Index from high resolution MMCFS. Data source for Climatology probabilities: NOAA Extended Reconstructed SST V5. Criteria used for Probabilistic ENSO Forecast: ≤ -0.5 La Niña, >0.5 to <-0.5 neutral, ≥ 0.5 El Niño. Criteria used for Probabilistic DMI Forecast: ≤ -0.2 negative DMI, >0.2 to <-0.2 neutral, ≥ 0.2 positive DMI.

The probability forecast for ENSO (Fig.5a) indicates equal probability is likely for ENSO neutral and El Niño conditions during SON season. However, maximum probability for El Niño conditions is likely during most of the forecasted seasons after SON season.

The probability forecast for IOD (Fig.5b) indicates maximum probability for neutral IOD conditions during SON season. However, probability for negative IOD conditions is likely to increase thereafter.