



**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 2017**

**High Lights:**

Currently ENSO neutral conditions are prevailing over equatorial Pacific and the latest MMCFS forecast indicates that there is a chance that these conditions may likely to turn to weak La Niña / La Niña conditions during end of the year.

Currently neutral IOD conditions are prevailing over equatorial Indian Ocean. MMCFS forecast indicates, these conditions are likely to continue for the coming forecasted seasons.

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

During August 2017, negative SST anomalies were observed over east and central equatorial Pacific Ocean (Fig.1a). Negative SST anomalies were also observed over north of North subtropical Pacific Ocean and south of eastern South subtropical Pacific Ocean. Positive SST anomalies were observed over west and northwest Pacific Ocean as well as over subtropical Pacific Ocean. SST anomaly difference from July to August (Fig.1b) also shows cooling of SSTs over most parts of east and central equatorial Pacific Ocean and warming of SSTs over northwest Pacific Ocean. However, it is observed that, warm SST anomaly area over subtropical South Pacific Ocean is seen to be increased while area over subtropical North Pacific Ocean is seen to be decreased as compared to the last month.

In most parts of Arabian Sea and Bay of Bengal, warmer than normal SST anomalies were observed, however, cooler than normal SST anomalies (Fig.1a) were also observed over some parts in small patches. It is observed that, over southwest tropical Indian Ocean relatively warmer anomalies were observed along a latitudinal zone of 15°S-30°S. Positive SST anomalies which were observed (in July 2017) over the south of the equatorial Indian Ocean now (in August 2017) turned to negative SST anomalies (Fig.1b), and the cool SST anomalies which were observed over the northern parts of Indian Ocean during July 2017 have reduced in their area in the current month (August 2017). In August cooling of SSTs was observed over eastern parts of Indian Ocean.

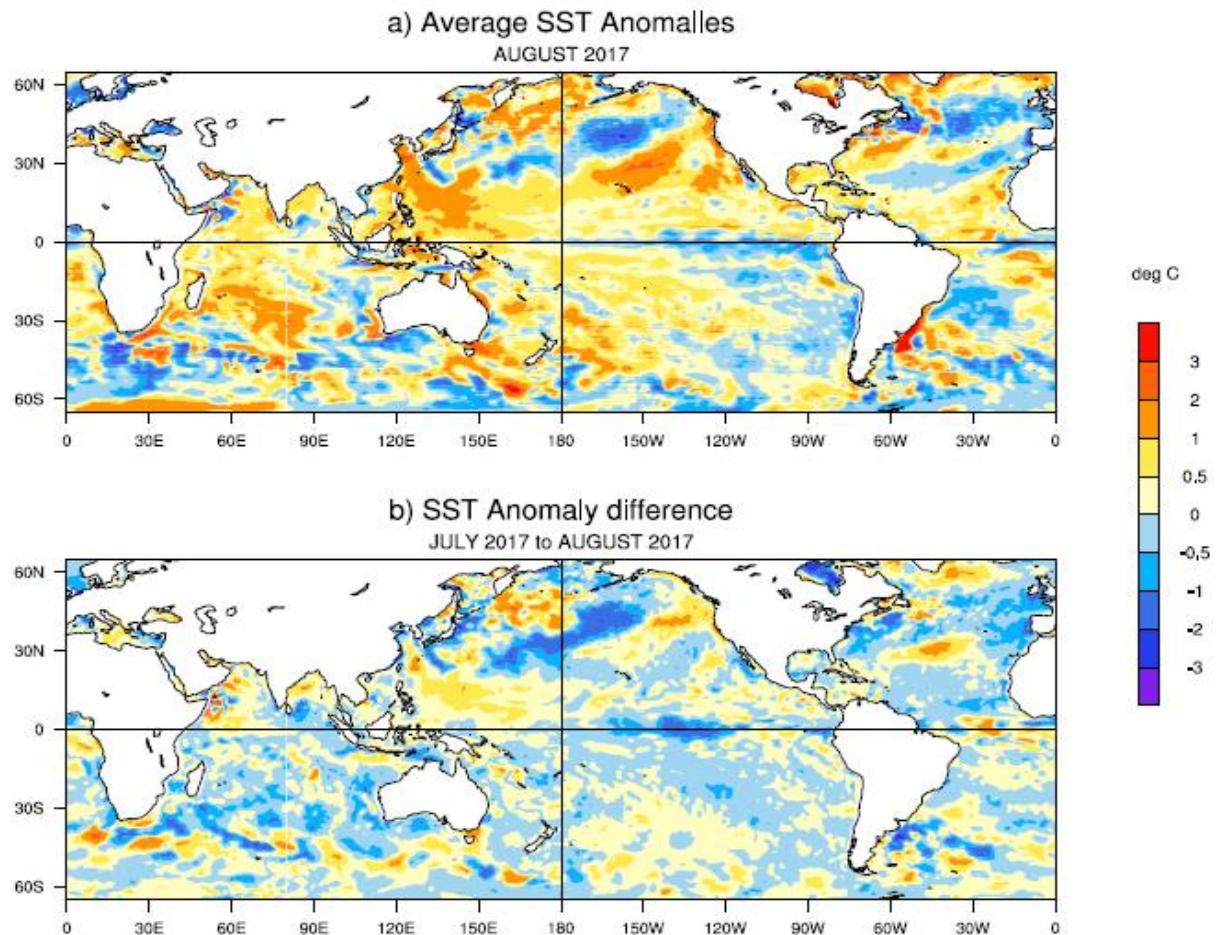
**1.1. El Niño Southern Oscillation (ENSO) conditions over the Pacific Ocean**

The monthly time series of Niño3.4 SST anomalies for the last 12 months (Fig.2a) suggest that the borderline/ weak La Niña conditions prevailed since mid of the year 2016 turned to ENSO neutral conditions in February 2017. Currently, (in August 2017), ENSO neutral conditions are prevailing. The atmospheric conditions over the Pacific also continue to indicate ENSO neutral conditions. Positive subsurface anomalies were seen in the east-central equatorial Pacific Ocean (weaker magnitude) and in the extreme west equatorial Pacific Ocean (till thermocline depth) (Fig.2 b). The strong negative subsurface anomalies at around the dateline were observed in the central equatorial Pacific Ocean.

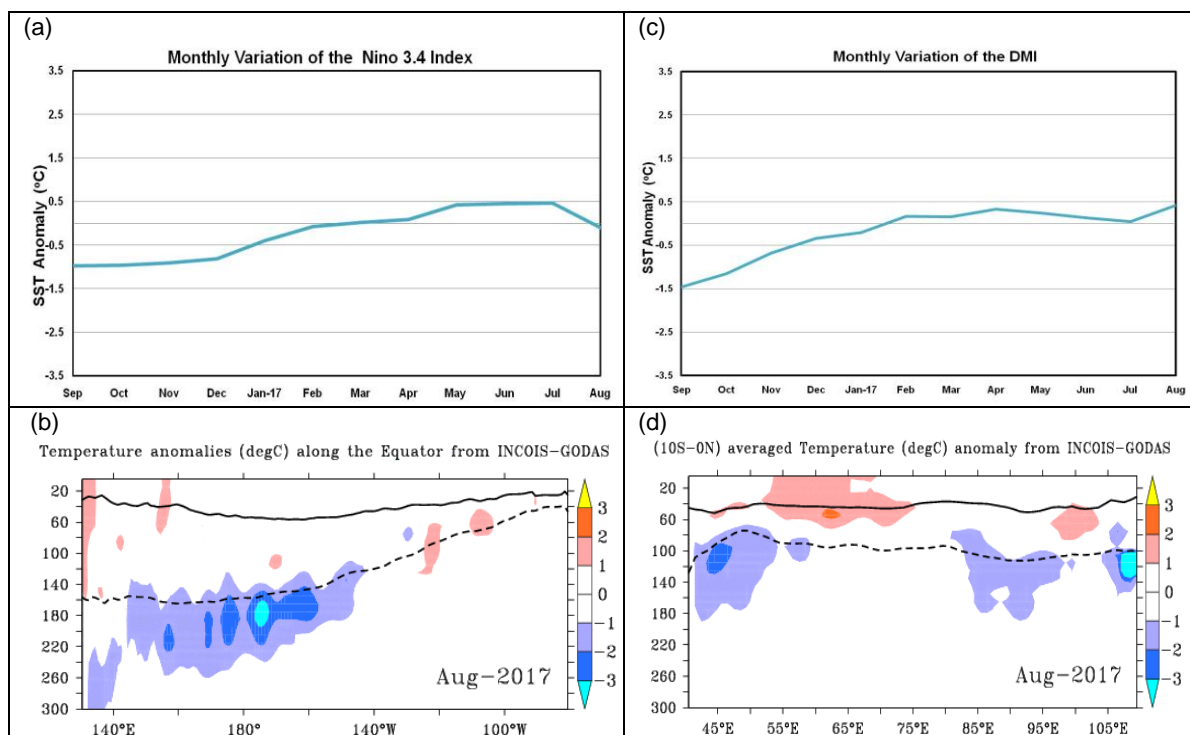
**1.2. Indian Ocean Dipole (IOD) conditions over the Indian Ocean**

The DMI index for the last 12 months suggest that prevailing negative IOD conditions (Fig. 2c) turned to neutral IOD conditions by early 2017. Neutral IOD conditions prevailed till March 2017. Since April 2017, weak positive IOD conditions were prevailing which turned to neutral IOD conditions in the month of June 2017 and continued thereafter. In the current month (August 2017), neutral IOD conditions are present. Positive subsurface temperature

(Fig. 2d) anomalies were observed in small patches over the east and west equatorial Indian Ocean and negative subsurface temperature anomalies were seen spread over the parts of western and eastern (stronger magnitude) equatorial Indian Ocean at thermocline depth.



**Fig.1:** (a) Sea surface temperature (SST) anomalies ( $^{\circ}\text{C}$ ) during August, 2017 and, (b) changes in the SST anomalies ( $^{\circ}\text{C}$ ) from July 2017 to August 2017. SSTs were based on the INCOIS-GODAS analysis and anomalies were computed with respect to 30-year (1981-2010) mean NOAA OISST.

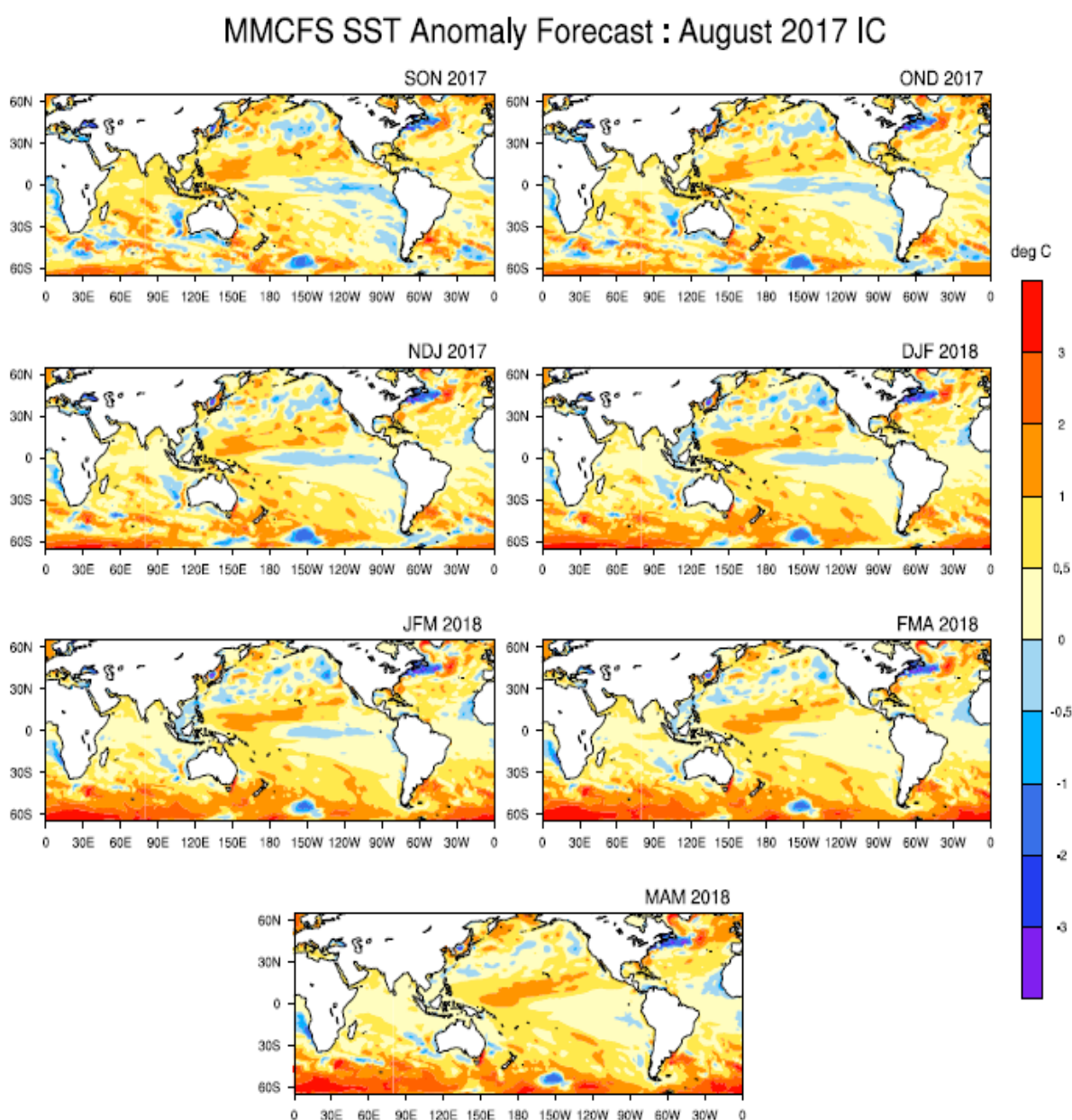


**Fig.2:** (a) Monthly variation of Niño 3.4 SST index anomaly for the last 12 months and (b) equatorial depth-longitude section of ocean temperature anomalies in the equatorial ( $5^{\circ}\text{S}$ - $5^{\circ}\text{N}$ ) Pacific Ocean for the month of August 2017. (c) Same as (a) but for Dipole Mode Index (DMI). (d) Same as (b) but for the tropical Indian Ocean ( $10^{\circ}\text{S}$ -Eq). The anomalies were computed using base period of 1981-2010. The solid dark line is the  $20^{\circ}\text{C}$  isotherm and the dashed line is thermocline depth. Data Source: INCOIS-GODAS

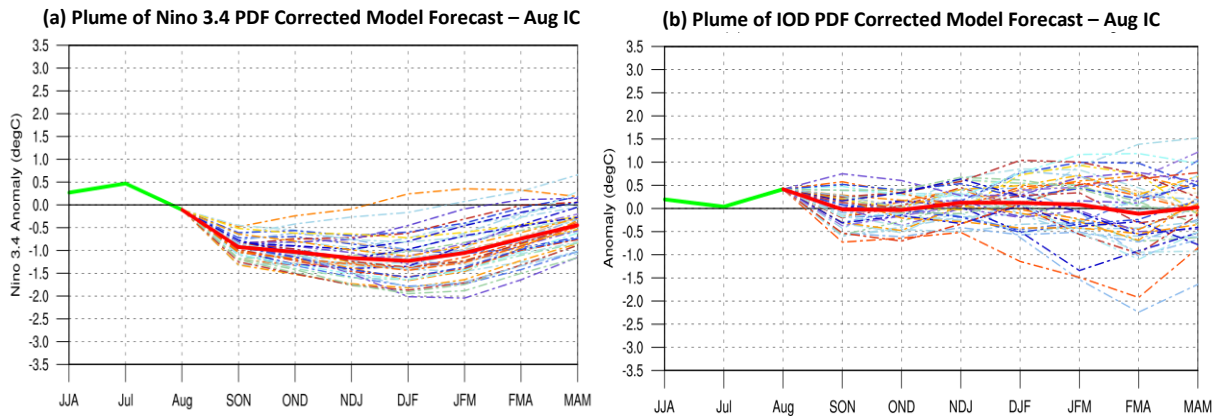
## 2. ENSO & IOD Forecast

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 2017 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 1981-2010 climatology.

The forecasted 3-month season averaged SST anomalies (Fig.3) indicate negative SST anomalies are likely to remain along the central and eastern equatorial Pacific Ocean till JFM season and turn into positive SST anomalies during FMA season. However, over western equatorial Pacific Ocean, positive SST anomalies are likely during most of the forecasted seasons. The forecast indicates there is a possibility that prevailing ENSO neutral conditions are likely to turn to be a weak La Niña condition during SON and likely to continue thereafter for most of the forecasted seasons (Fig.4a). In the Indian Ocean, positive SST anomalies are likely in Arabian Sea and Bay of Bengal. Over the most parts of equatorial Indian Ocean (except far south-eastern Indian Ocean) positive SST anomalies are likely for all the forecasted seasons (Fig.3). The present neutral IOD conditions are likely to continue for the coming forecasted seasons (Fig.4b).

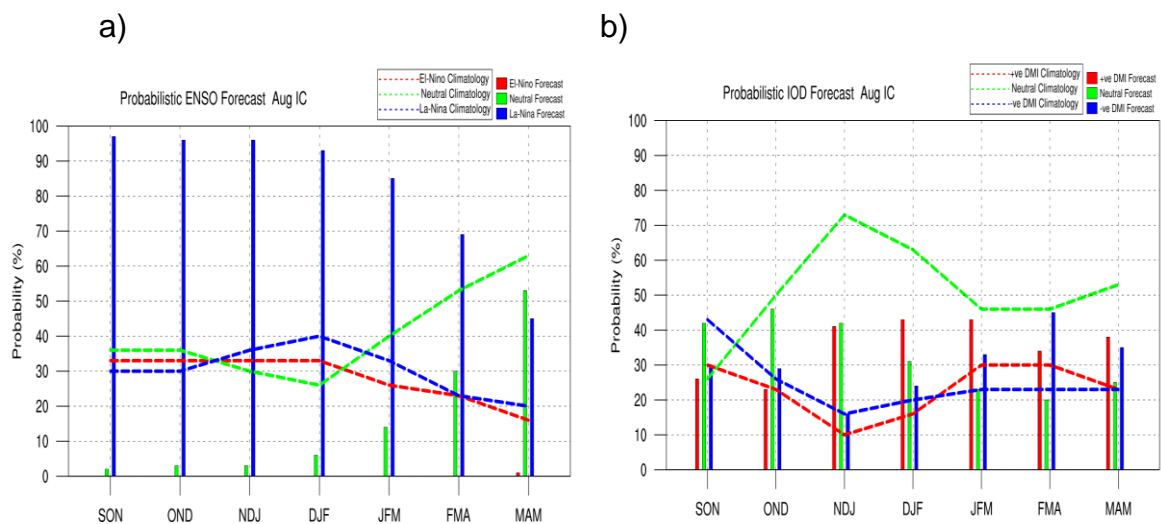


**Fig.3:** Forecasted Seasonal mean SST anomalies for 3 monthly seasons, (a) September through November (SON), (b) October to December (OND), (c) November to January (NDJ), (d) December to February (DJF) (e) January to March (JFM) (f) February to April (FMA) and (g) March to May (MAM).



**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 (INCOIS-GODAS) and solid red line is the ensemble SST anomaly forecast mean of 55 members (CFSv2). The individual ensemble member forecasts are shown in light dotted lines of different colours.

### Probability Forecast for Niño 3.4 and 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 MMCFSv2. Data source for Climatology probabilities: NOAA Extended Reconstructed SST V4b. Criteria used for Probabilistic ENSO Forecast:  $\leq -0.5$  La Niña,  $>0.5$  to  $<-0.5$  neutral,  $\geq 0.5$  El Niño. Criteria used for Probabilistic DMI Forecast:  $\leq -0.2$  negative DMI,  $>0.2$  to  $<-0.2$  neutral,  $\geq 0.2$  positive DMI.

The probability forecast for ENSO (Fig.5a) indicates (>90%), a possibility to develop a La Niña condition during SON season [El Niño/La Niña is declared when the threshold (0.5/-0.5) of SST anomalies in the Niño 3.4 region for a minimum of 5 consecutive overlapping seasons of three months running mean], which gradually reduces to about 45% during MAM 2018. The probability for neutral ENSO conditions is likely to increase from JFM to MAM seasons.

The probability forecast for IOD (Fig.5b) indicates probability (41%), of neutral IOD condition for SON and OND seasons which is climatologically significant. From NDJ to JFM, probability of positive IOD condition increases. Further seasons like FMA and MAM, negative IOD condition are more likely.