



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

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

August 2018

Highlights:

Currently, ENSO neutral conditions are prevailing over equatorial Pacific Ocean and the latest MMCFS forecast indicates that there is possibility of development of weak El Niño conditions in the last part of the monsoon 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 most of the forecasted seasons.

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

During July 2018, cool SST anomalies were observed over eastern equatorial Pacific Ocean (Fig.1a) and warm SST anomalies were observed over western 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 warming of SSTs is seen over the central to eastern parts of the tropical Pacific Ocean (Fig.1b). Warm SSTs over north subtropical Pacific Ocean turned into cool SSTs during the current month. However, cooling of SSTs is seen to be increased 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 Indian Ocean and negative SST anomalies were observed over parts of East Indian Ocean (Fig.1a). During July, warming of SSTs was observed over most parts of the Arabian Sea, Bay of Bengal and equatorial Indian Ocean. And warming of SSTs was observed over parts of south subtropical Indian Ocean near 80°E (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 August 2017 to July 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 July 2018. The positive subsurface anomalies were observed over most parts of the equatorial Pacific Ocean (Fig.2 b) (at around thermocline depth) with highest magnitudes centred over 150°W to 110°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 positive IOD conditions turned to neutral IOD conditions in the month of September 2017 and continued up to July 2018. Negative subsurface temperature anomalies (Fig. 2d) (stronger magnitude) were seen spread over the parts of eastern equatorial Indian Ocean and positive subsurface temperature anomalies (weaker magnitude) were seen spread over the parts of central Indian Ocean at around thermocline depth.

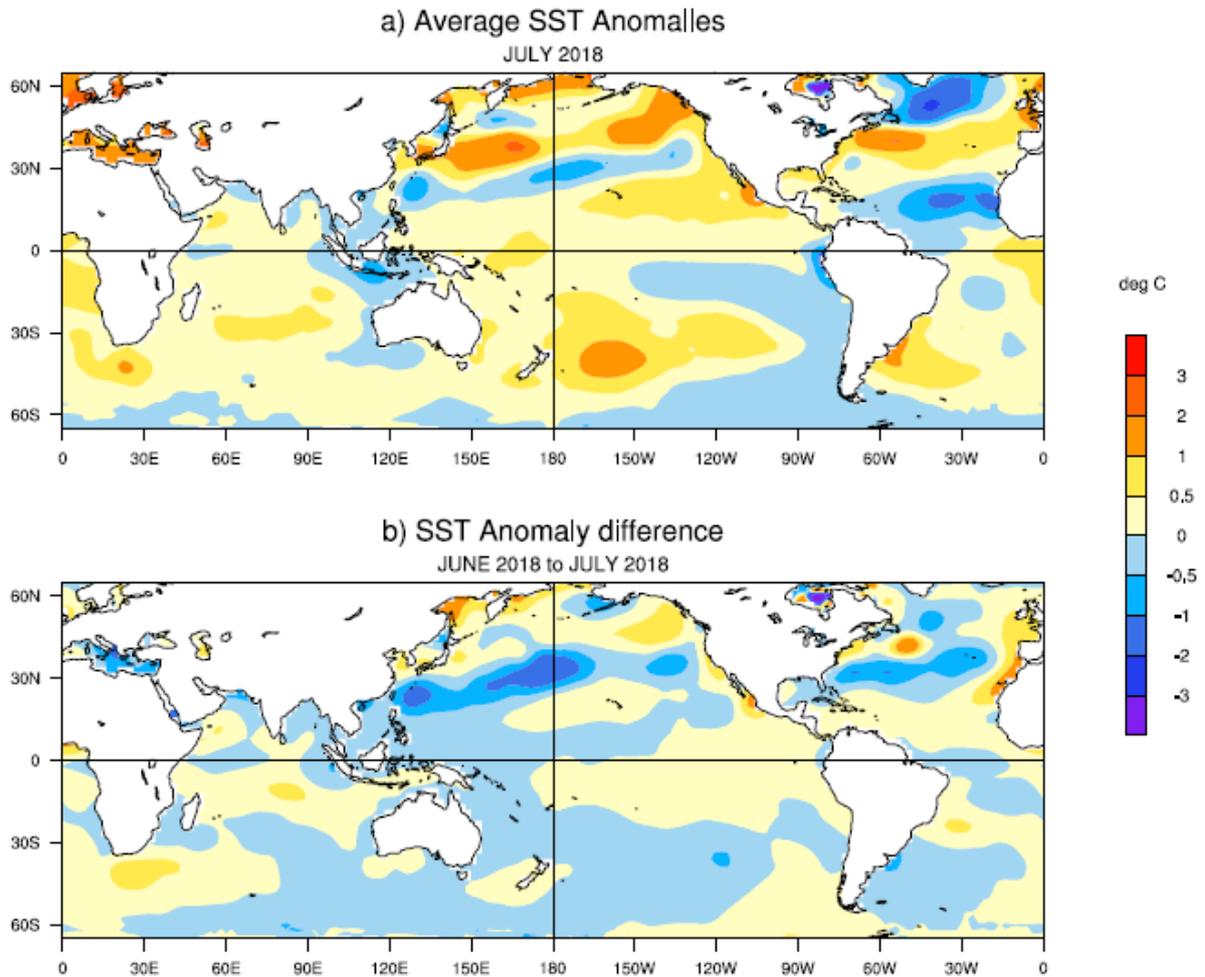


Fig.1: (a) Sea surface temperature (SST) anomalies ($^{\circ}\text{C}$) during July, 2018 and, (b) changes in the SST anomalies ($^{\circ}\text{C}$) from June 2018 to July 2018. SSTs were based on the ERSSTv5, NOAA and anomalies were computed with respect to 30-year (1981-2010) long term mean ERSSTv5,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

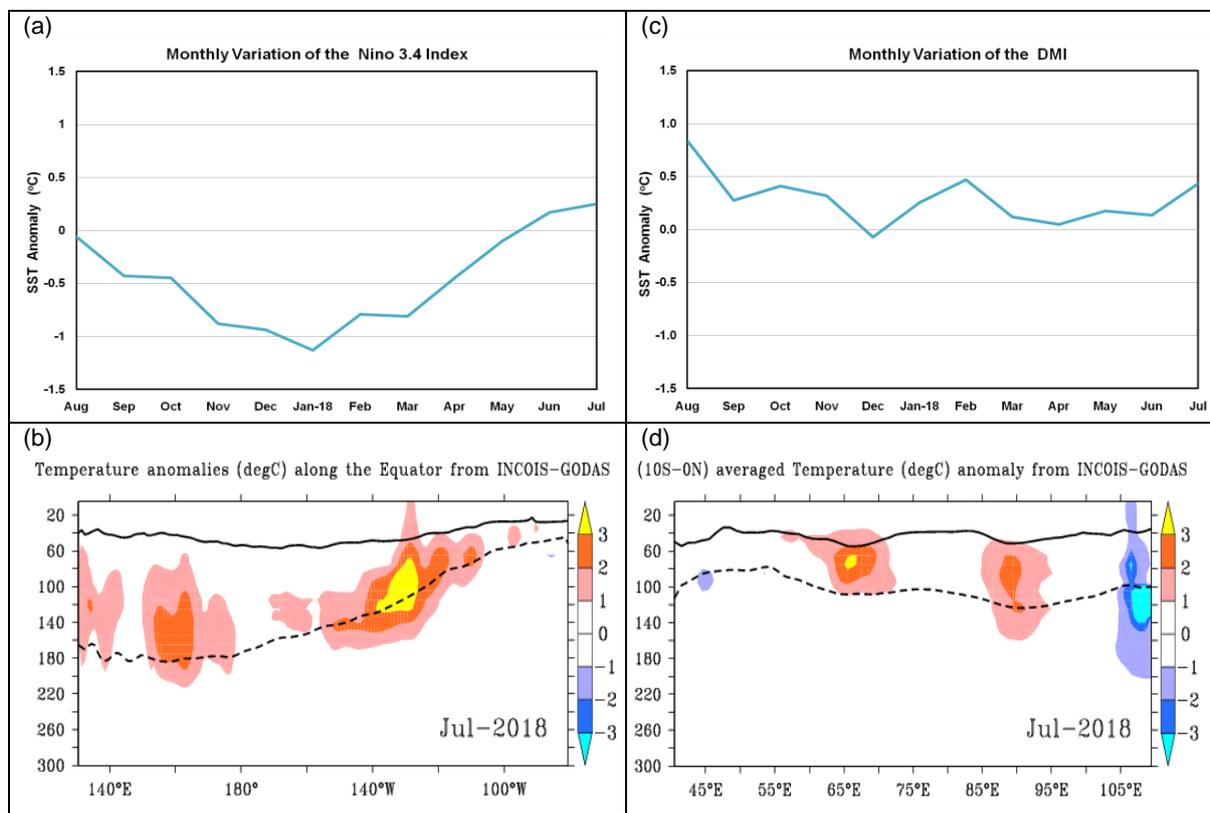
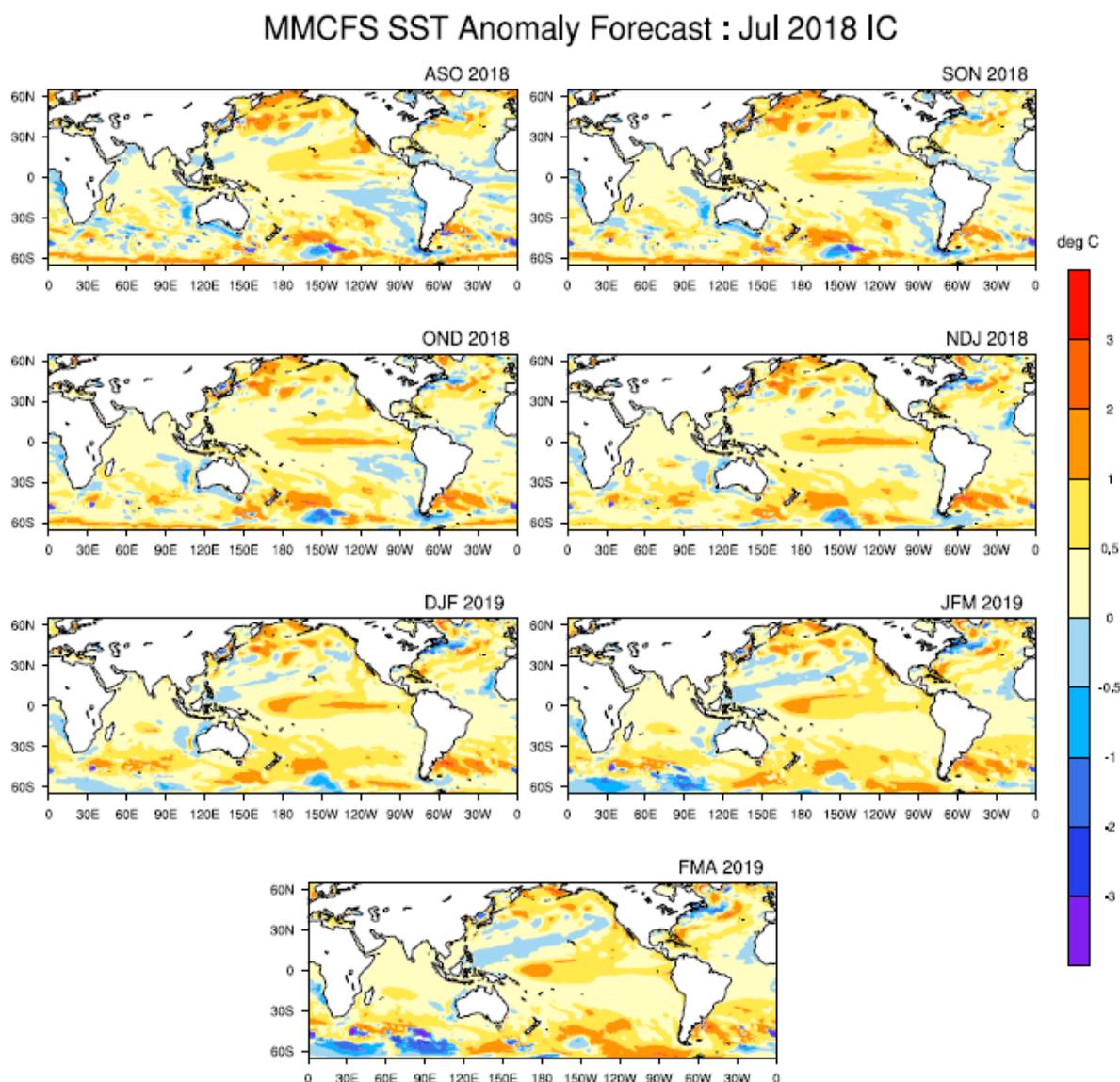


Fig.2: (a) Monthly variation of Niño 3.4 SST index anomaly for the last 12 months and (b) equatorial depth-longitude section of ocean temperature anomalies in the equatorial (5°S - 5°N) Pacific Ocean for the month of July, 2018. (c) Same as (a) but for Dipole Mode Index (DMI). (d) Same as (b) but for 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 July 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 central to eastern equatorial Pacific Ocean up to DJF season. However, from JFM season onwards warm SST anomalies are likely to decrease over the eastern Pacific region and likely to persist only in central parts of the equatorial Pacific Ocean. Also, from DJF season onwards cool SSTs are likely over western Pacific Ocean. North-western Pacific Ocean is likely to have normal SSTs for most of the forecasted seasons. The latest MMCFS forecast indicates that there is possibility of development of weak El Niño conditions in the last part of the monsoon season or thereafter (Fig.4a). In the Indian Ocean, during most of the forecasted seasons, near zero SST anomalies are likely in Arabian Sea and Bay of Bengal (Fig.3). However, cool (or negative) SST anomalies are likely over eastern Indian Ocean off the west coast of Australia. Currently, neutral IOD conditions are prevailing over equatorial Indian Ocean. MMCFS forecast indicates that neutral IOD conditions are likely to persist during most of the forecasted months (Fig.4b).



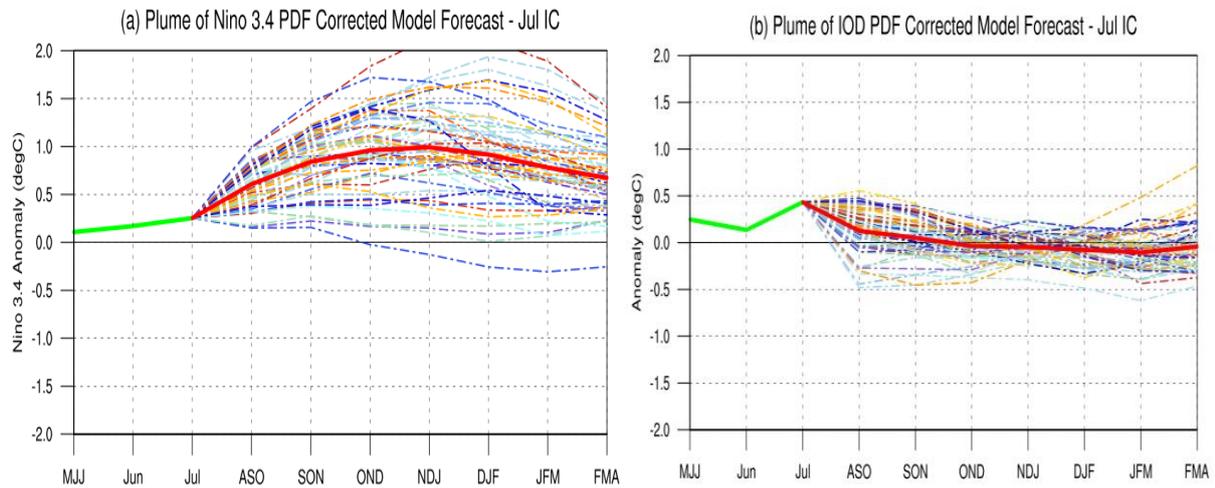


Fig.4: Plume of (a) Niño 3.4 SST anomalies, (b) Indian Ocean Dipole Mode Index forecasted by high resolution CFSv2. The forecasts were PDF corrected for bias and variance. The solid green line is the observed SST anomaly (ERSSTv5, NOAA) and solid red line is the ensemble SST anomaly forecast mean of 56 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

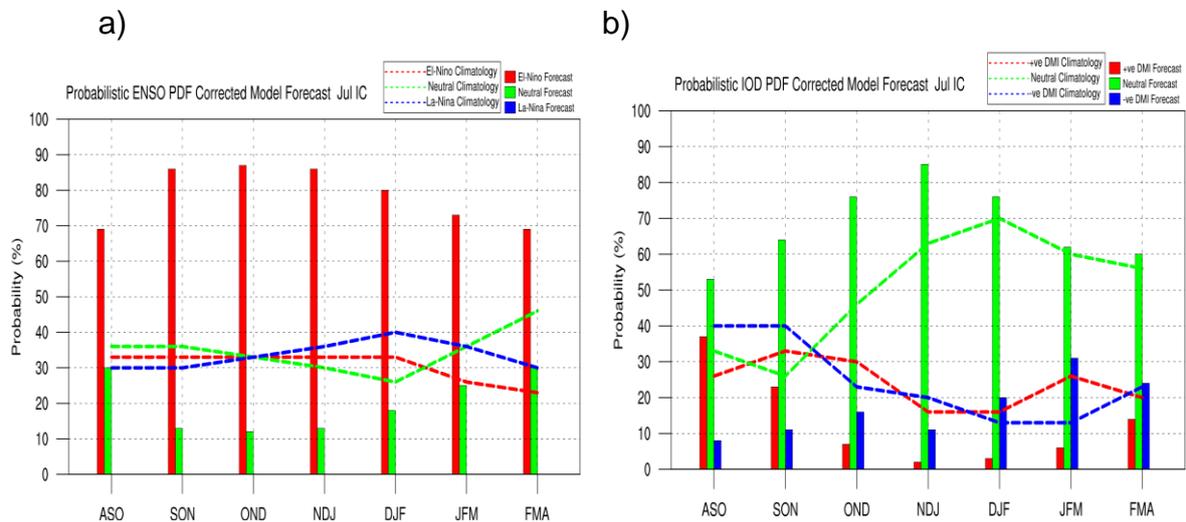


Fig.5: Probability forecast along with climatological probabilities of (a) Niño 3.4 and (b) Indian Ocean Dipole Mode Index from high resolution MMCFS. Data source for Climatology probabilities: NOAA Extended Reconstructed SST V5. Criteria used for Probabilistic ENSO Forecast: ≤ -0.5 La Niña, >0.5 to <-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 maximum probability is likely for El Niño conditions during most of the forecasted seasons. However, during SON, OND and NDJ seasons, probability for El Niño conditions is likely above 80% and thereafter decreases gradually till the end of forecast period.

The probability forecast for IOD (Fig.5b) indicates maximum probability for neutral IOD conditions during most of the forecasted seasons.