



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

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

June 2017

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

During May 2017, cool SST anomalies were developed along the east equatorial Pacific Ocean extending towards its west. While cool SSTs around the date line were weakened. Positive SST anomalies were observed over north and south of equatorial east and east-central Pacific Ocean in small patches and also over subtropical Pacific Ocean over a larger area. On either side of these subtropical warm SST anomalies and over northwest Pacific, negative SST anomalies were observed. As compared to the last month (April 2017), the warm SST anomaly area has reduced over east and east-central equatorial Pacific Ocean and cool SST anomalies around the dateline have weakened. Warming tendency of SSTs over south and north of subtropical Pacific Ocean is seen to be increased as compared to the last month. SST anomaly difference from April to May (Fig.1b) show cooling of SSTs over the parts of eastern equatorial Pacific Ocean as well as towards the western Pacific Ocean and warmer SSTs over east-central equatorial Pacific Ocean. Cooling of SSTs was also observed over subtropical areas of Pacific Ocean in northern hemisphere.

Normal to warmer than normal SSTs were observed (Fig.1a) over most parts of the Arabian Sea, Bay of Bengal, and south of southwest equatorial Indian Ocean (relatively stronger warm anomalies) along a latitudinal zone of 15°S-30°S. Cool anomalies which were observed (in April 2017) over south of the equatorial Indian Ocean now (in May 2017) turned to warm SST anomalies in the west Equatorial Indian Ocean and cool SST anomalies are confined only in the east. The warm SST anomalies which were observed over the west Indian Ocean along subtropical south Indian Ocean during April 2017 has reduced in intensity in current month (May 2017). In May (Fig.1b), warming of SSTs was observed over most parts of the 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 July 2016 turned to ENSO neutral conditions in February 2017. Currently, (in May 2017), ENSO neutral conditions are prevailing. Positive subsurface anomalies were seen in the west equatorial Pacific Ocean (till thermocline depth) with some patches observed in the eastern Pacific Ocean (Fig.2 b). The Negative subsurface anomalies were observed in the central equatorial Pacific Ocean and around the date line.

1.2. Indian Ocean Dipole (IOD) Conditions over Indian Ocean

The DMI index for the last 12 months suggest that prevailing negative IOD conditions (Fig. 2c) turned to neutral IOD conditions by December 2016. Neutral IOD conditions were prevailed till March 2017. Since April 2017, weak positive IOD conditions are prevailing and continued in the current month (May 2017) also. Positive subsurface temperature (Fig. 2d) anomalies were observed in small patches over the eastern and far western equatorial

Indian Ocean and negative subsurface temperature anomalies were seen spread in over the parts of central to eastern equatorial Indian Ocean.

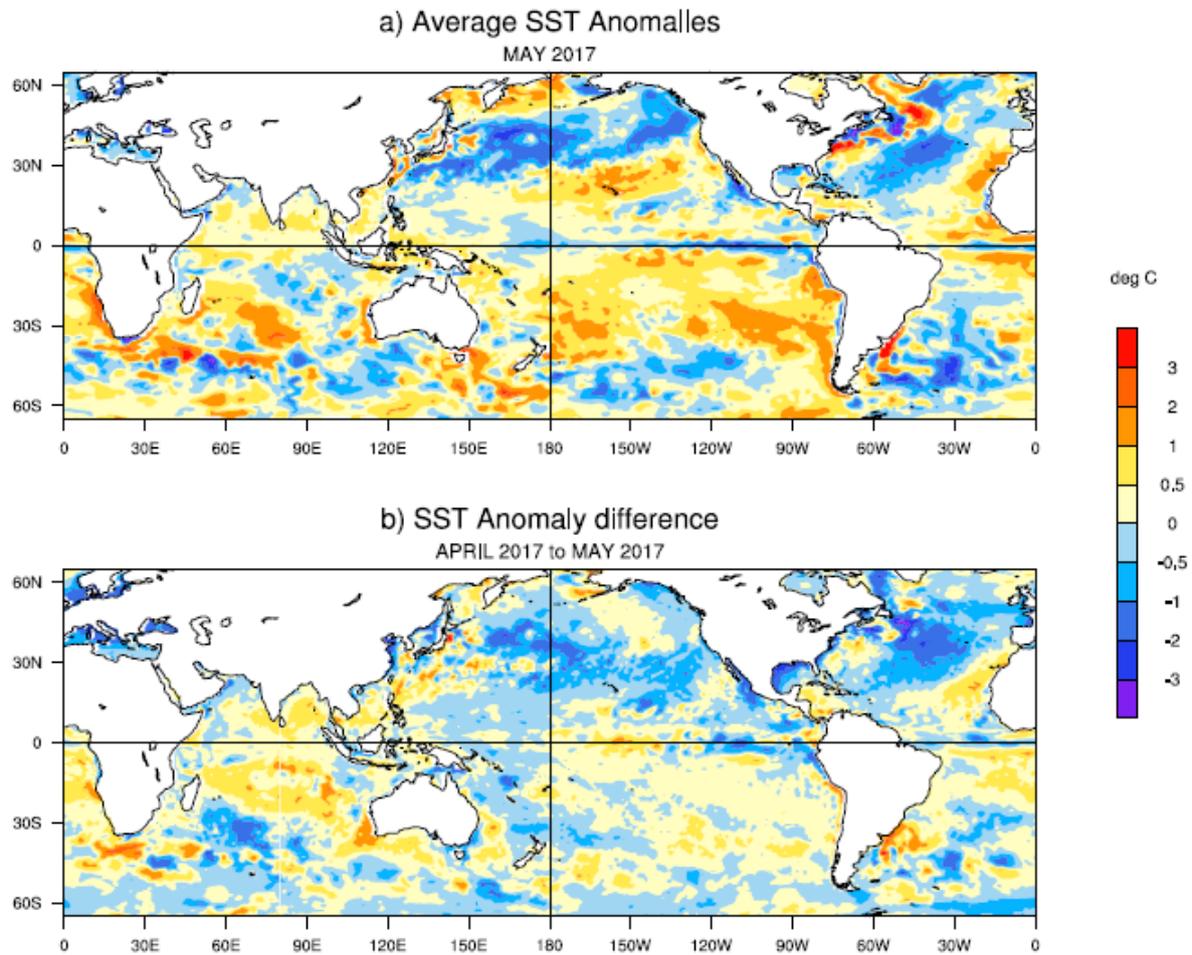


Fig.1: (a) Sea surface temperature (SST) anomalies ($^{\circ}\text{C}$) during May, 2017 and, (b) changes in the SST anomalies ($^{\circ}\text{C}$) from April 2017 to May 2017. SSTs were based on the INCOIS-GODAS analysis and anomalies were computed with respect to 30-year (1981-2010) mean NOAA OISST.

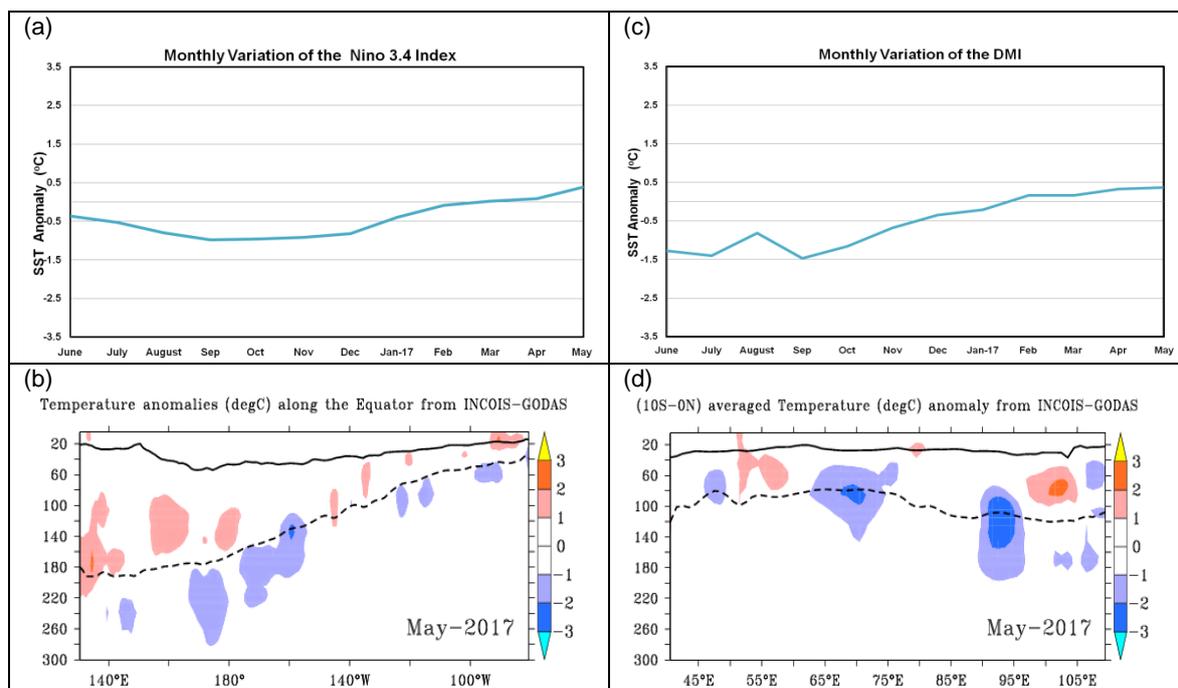


Fig.2: (a) Monthly variation of Niño 3.4 SST index anomaly for the last 12 months and (b) equatorial depth-longitude section of ocean temperature anomalies in the equatorial (5°S - 5°N) Pacific Ocean for the month of May 2017. (c) Same as (a) but for Dipole Mode Index (DMI). (d) Same as (b) but for the tropical Indian Ocean (10°S -Eq). The anomalies were computed using base period of 1981-2010. 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 2017 May 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 develop along the eastern equatorial Pacific Ocean and likely to continue till ASO season and turn into neutral SST anomalies through SON season and likely to continue thereafter. However, over central and western equatorial Pacific Ocean positive SST anomalies are likely to develop during all the forecasted seasons. The prevailing ENSO neutral conditions are likely to continue through OND season (Fig.4a) till early next year. In the Indian Ocean, normal SSTs are likely in Arabian Sea and Bay of Bengal. Over the equatorial Indian Ocean warm SST anomalies are likely for all the forecasted seasons (Fig.3). The present weak positive IOD conditions are likely to continue through JJA and then turn to neutral IOD conditions (Fig.4b).

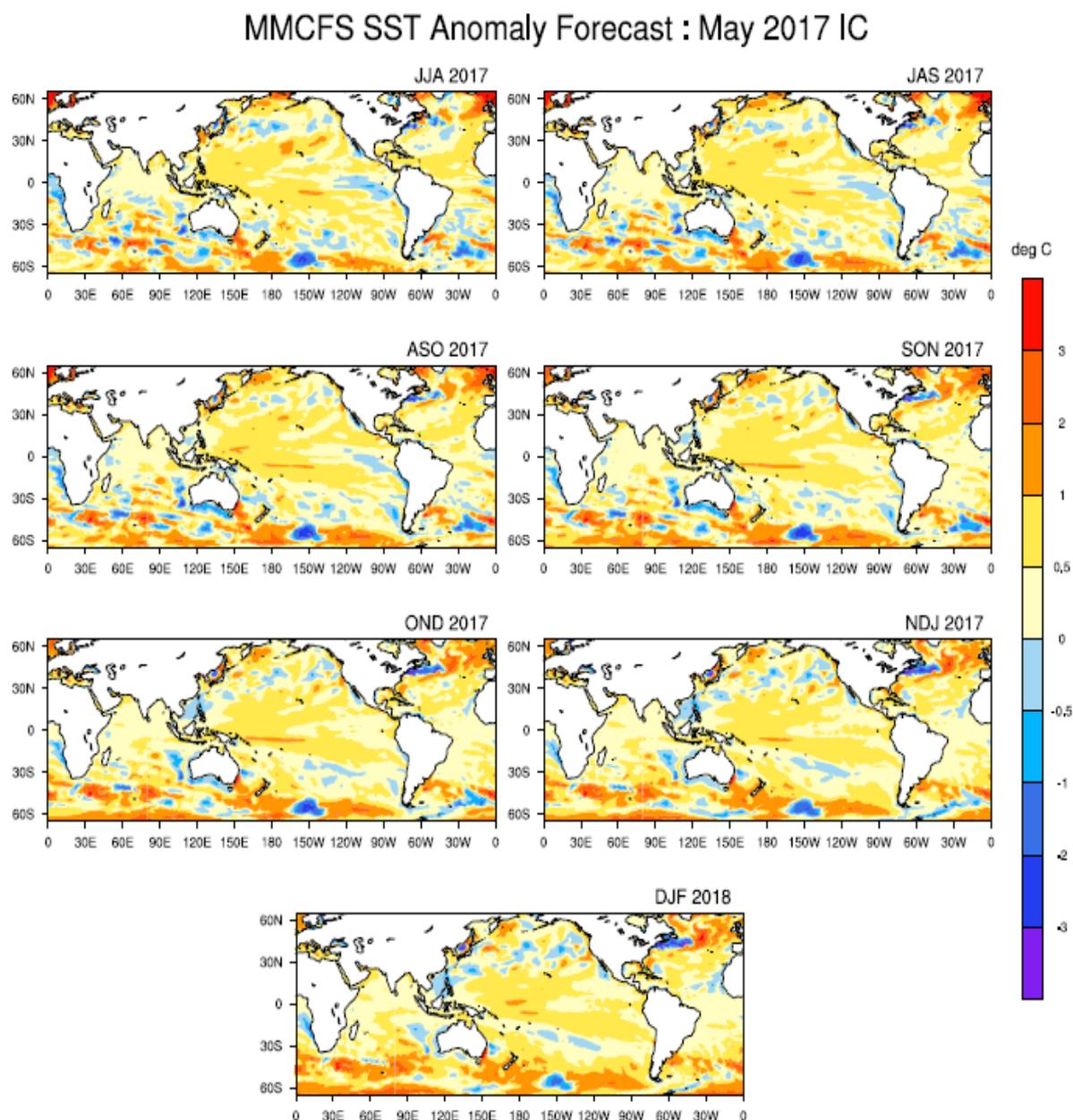


Fig.3: Forecasted Seasonal mean SST anomalies for 3 monthly seasons, (a) June through August (JJA), (b) July through September (JAS), (c) August through October (ASO), (d) September through November (SON), (e) October to December (OND), (f) November to January (NDJ) and (g) December to February (DJF).

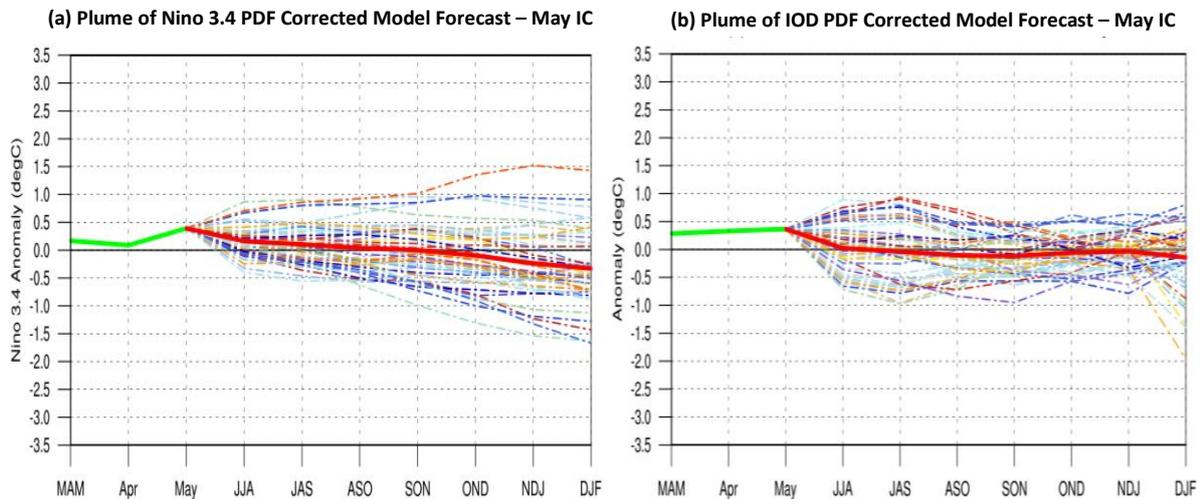


Fig.4: Plume of (a) Niño 3.4 SST anomalies, (b) Indian Ocean Dipole Mode Index forecasted by high resolution CFSv2. The forecasts were PDF corrected for bias and variance. The solid green line is the observed SST anomaly (INCOIS-GODAS) and solid red line is the ensemble SST anomaly forecast mean of 42 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

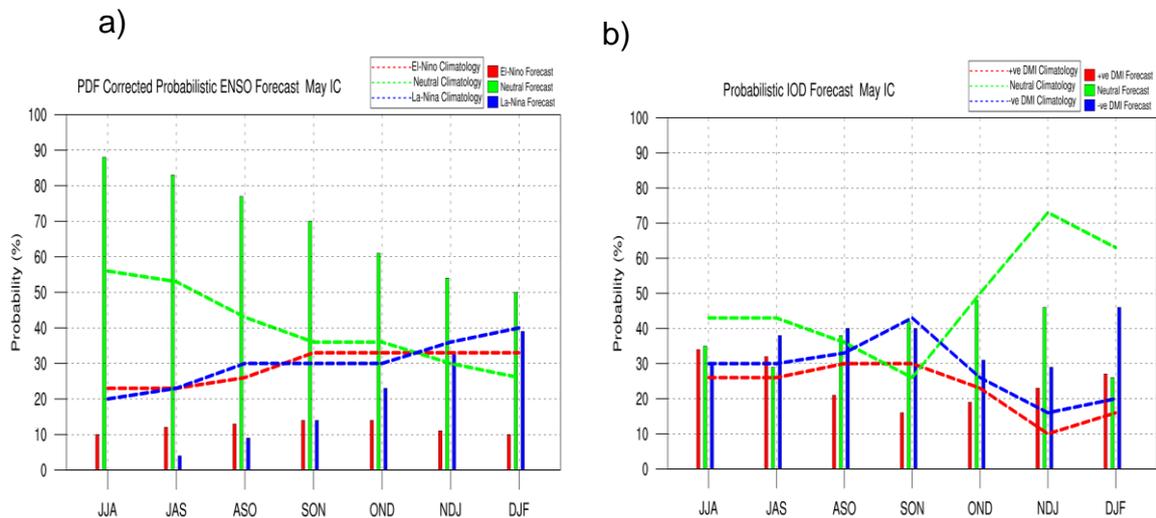


Fig.5: Probability forecast along with climatological probabilities of (a) Niño 3.4 and (b) Indian Ocean Dipole Mode Index from high resolution CFSv2. Data source for Climatological probabilities: NOAA Extended Reconstructed SST V4b. Criteria used for Probabilistic ENSO Forecast: ≤ -0.5 La Niña, >0.5 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 (Fig.5a) indicates high probability (>80%) of ENSO neutral conditions to continue during the monsoon season, which gradually reduce to about 50% during DJF 2018. The probability for development of an El Niño event is very small throughout the forecasted seasons.

The probability forecast (Fig.5b) indicates near climatological probabilities for the IOD conditions during throughout the forecast period.