



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

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

May 2018

Highlights:

Currently, ENSO neutral conditions are present over equatorial Pacific Ocean and the latest MMCFS forecast indicates that these conditions are likely to continue till the end of the forecast period.

Currently, neutral IOD conditions are prevailing over equatorial Indian Ocean. MMCFS forecast indicates that negative IOD conditions are likely to develop during the monsoon season and likely to turn to neutral IOD conditions by OND season.

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

During April 2018, cool SST anomalies were observed over central to eastern equatorial Pacific Ocean (Fig.1a) and warm SST anomalies were observed over west equatorial Pacific Ocean. Negative SST anomalies were also observed over parts of southeast subtropical Pacific Ocean close to west coast of South America. Positive SST anomalies were observed over northwest Pacific Ocean as well as most parts of the north and south subtropical Pacific Ocean. As compared to the last month, increase in cooling of SSTs is seen over the northwest Pacific Ocean. However, cool SSTs over equatorial Pacific Ocean turned into warm SSTs during the current month. Cool SSTs were also observed over south subtropical Pacific Ocean near international dateline as compared to the last month (Fig.1b).

Normal SST anomalies were observed in the most parts of Arabian Sea and Bay of Bengal. Positive SST anomalies were observed over parts of west equatorial Indian Ocean while negative SST anomalies were observed over parts of east equatorial Indian Ocean (Fig.1a). During April, cooling of SSTs was observed over most parts of the equatorial Indian Ocean as well as over Arabian Sea and Bay of Bengal and warming of SSTs was observed over south west subtropical Indian Ocean near 15°S (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 May 2017 to April 2018 (Fig.2a) suggests that ENSO neutral conditions persisted till October 2017. From November 2017 to March 2018 La Niña conditions were prevailed. During April 2018, Niño 3.4 SST anomaly value is within the threshold of La Niña condition and currently, ENSO neutral conditions are present. Negative subsurface temperature anomalies were seen (with stronger magnitude) over parts of eastern Pacific Ocean (around thermocline depth) (Fig.2 b) around 100°W. The strong positive subsurface anomalies were observed in the west to central equatorial Pacific Ocean within 140°E 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 April 2018. Negative subsurface temperature anomalies (Fig. 2d) (stronger magnitude) were seen spread over the parts of eastern equatorial Indian Ocean at around thermocline depth.

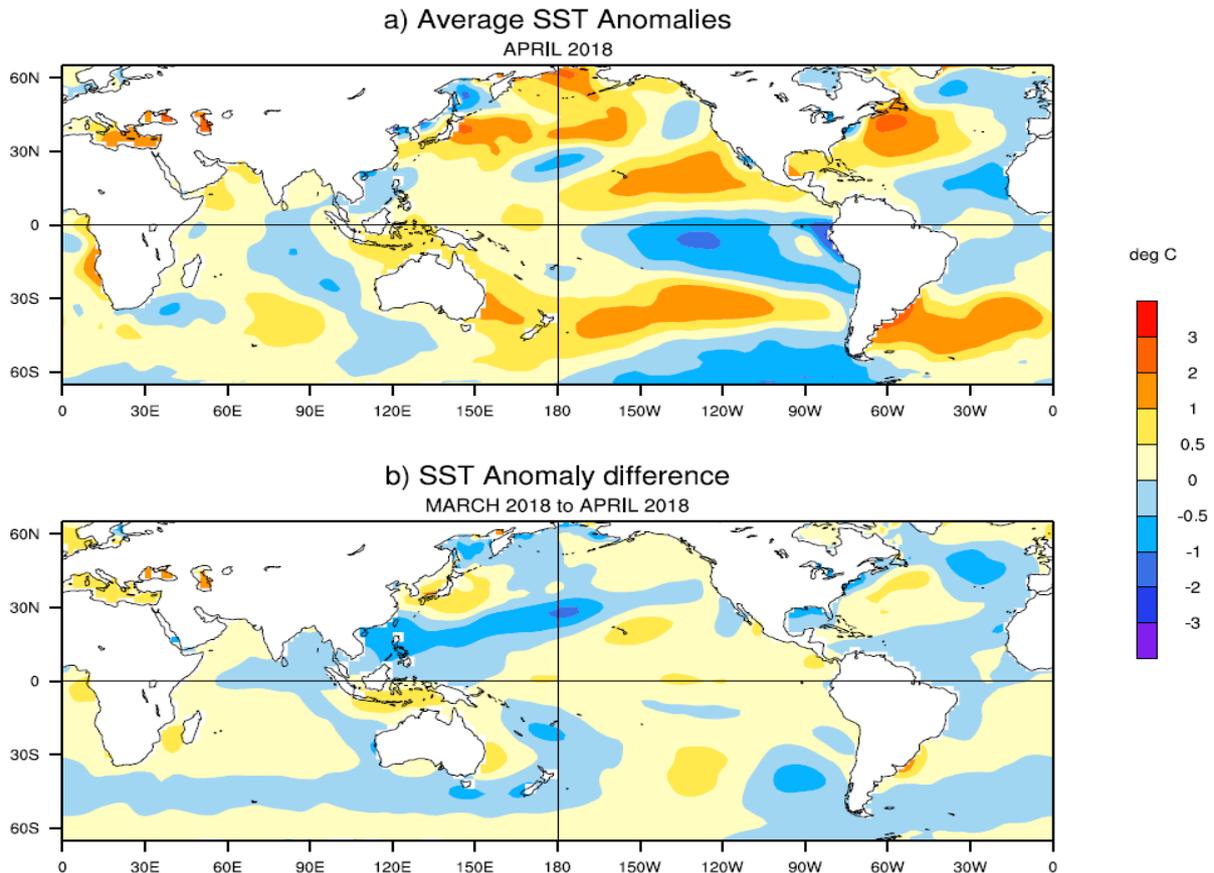


Fig.1: (a) Sea surface temperature (SST) anomalies ($^{\circ}\text{C}$) during April, 2018 and, (b) changes in the SST anomalies ($^{\circ}\text{C}$) from March 2018 to April 2018. SSTs were based on the ERSSTv5, NOAA and anomalies were computed with respect to 30-year (1981-2010) long term mean ERSSTv5,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

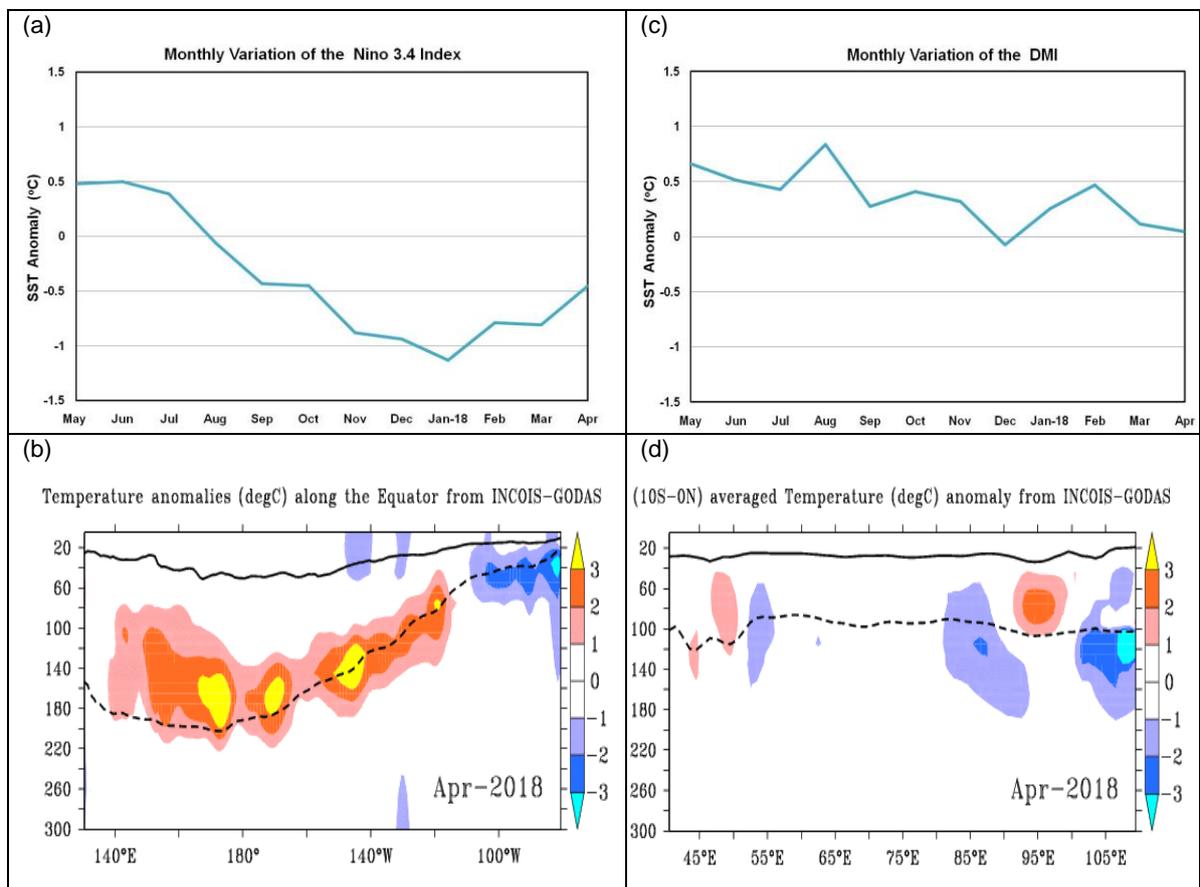


Fig.2: (a) Monthly variation of Niño 3.4 SST index anomaly for the last 12 months and (b) equatorial depth-longitude section of ocean temperature anomalies in the equatorial (5°S - 5°N) Pacific Ocean for the month of April, 2018. (c) Same as (a) but for Dipole Mode Index (DMI). (d) Same as (b) but for 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 April 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 forecasted 3-month season averaged SST anomalies (Fig.3) indicate normal to slightly cooler than normal SST anomalies are likely to continue along the central to eastern parts of the equatorial Pacific Ocean up to JAS season. However, from ASO season onwards normal SST anomalies are likely over most parts of equatorial Pacific Ocean. North-western Pacific Ocean is likely to have normal to warmer than normal SST anomalies for most of the forecasted seasons. The latest forecast indicates that current ENSO neutral conditions are likely to continue till the end of forecast period (Fig.4a). In the Indian Ocean, during most of the forecasted seasons, normal SST anomalies are likely in Arabian Sea and Bay of Bengal (Fig.3). Currently, neutral IOD conditions are prevailing over equatorial Indian Ocean. MMCFS forecast indicates that negative IOD conditions are likely to develop during the monsoon season and likely to turn to neutral IOD conditions by OND season (Fig.4b).

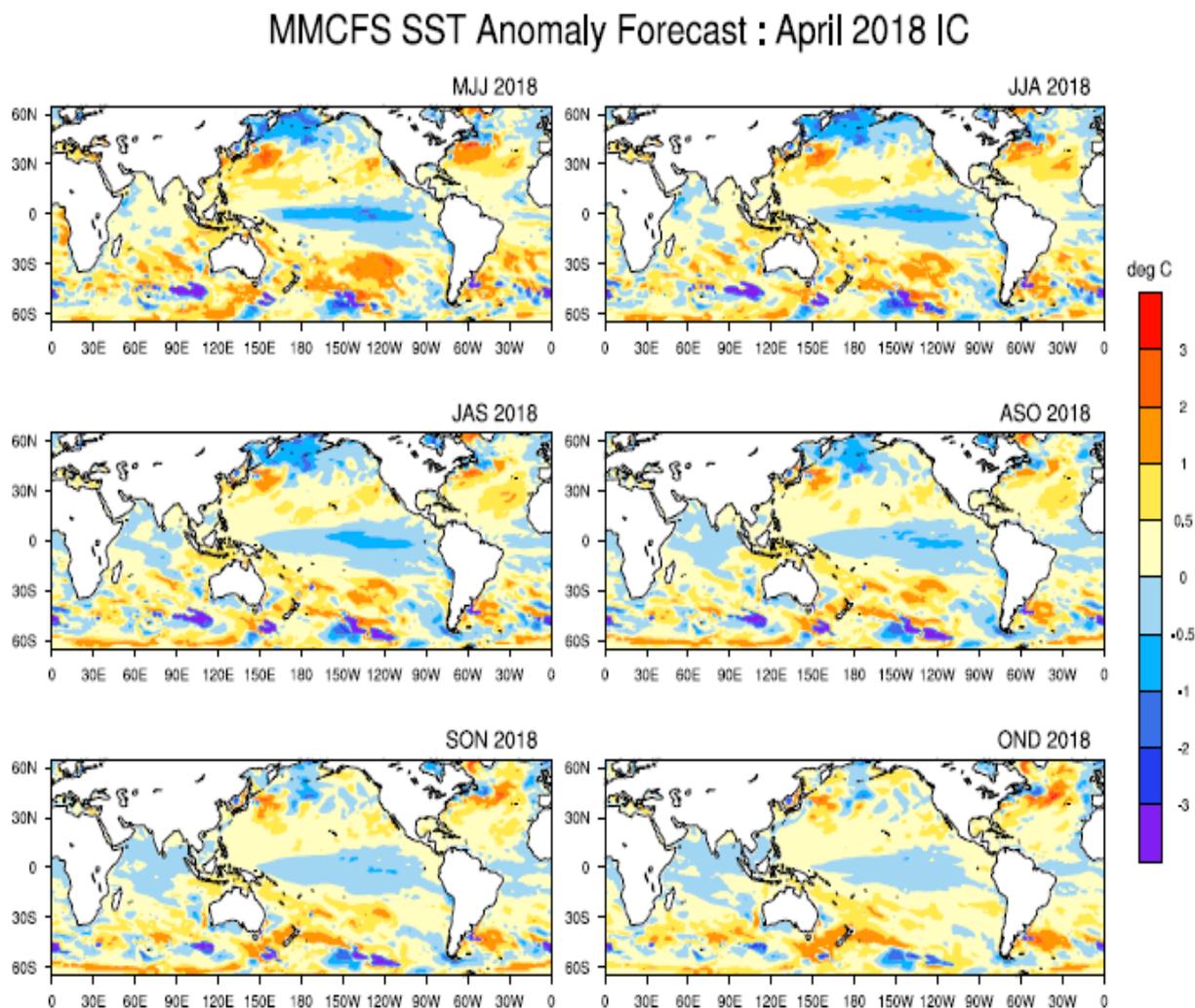


Fig.3: Forecasted Seasonal mean SST anomalies for 3 monthly seasons, (a) May to July (MJJ), (b) June to August (JJA), (c) July to September (JAS), (d) August to October (ASO), (e) September to November (SON), (f) October to December (OND) (Model bias correction base period: 1999-2010; Climatology base period: 1982-2010).

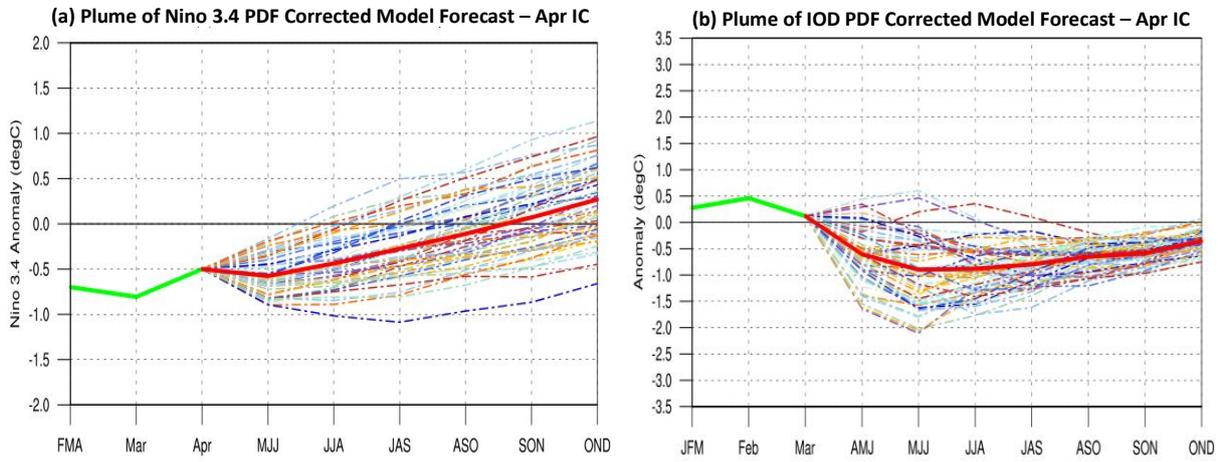


Fig.4: Plume of (a) Niño 3.4 SST anomalies, (b) Indian Ocean Dipole Mode Index forecasted by high resolution CFSv2. The forecasts were PDF corrected for bias and variance. The solid green line is the observed SST anomaly (ERSSTv5, NOAA) and solid red line is the ensemble SST anomaly forecast mean of 51 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

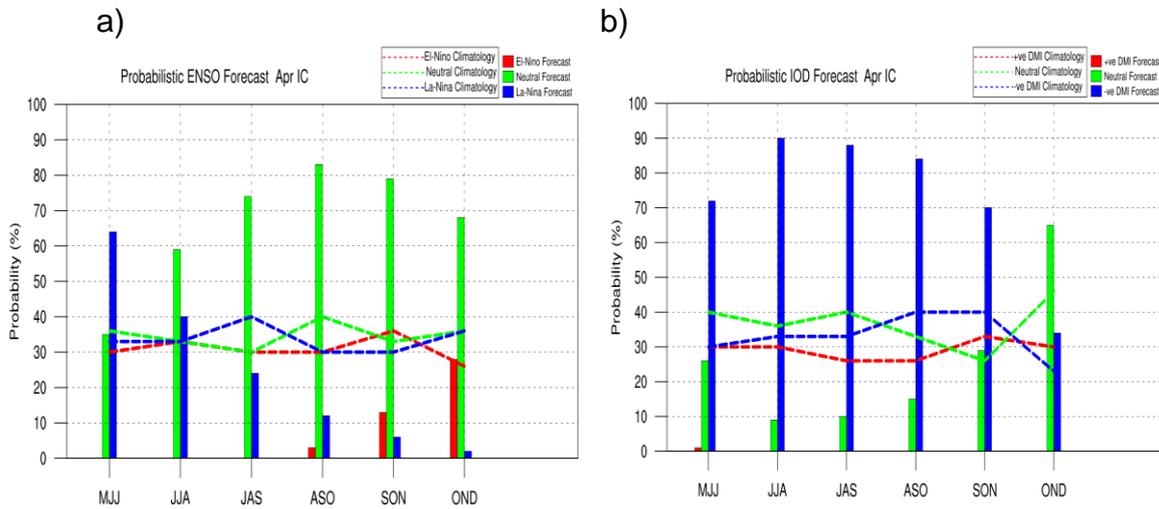


Fig.5: Probability forecast along with climatological probabilities of (a) Niño 3.4 and (b) Indian Ocean Dipole Mode Index from high resolution MMCFS. Data source for Climatology probabilities: NOAA Extended Reconstructed SST V5. Criteria used for Probabilistic ENSO Forecast: ≤ -0.5 La Niña, >0.5 to <-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 for ENSO neutral conditions is likely for most of the forecasted seasons.

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