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

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

July 2018

Highlights:

Currently, ENSO neutral conditions are prevailing over equatorial Pacific Ocean and the latest MMCFS forecast indicates that ENSO neutral conditions are likely to persist through the monsoon season and weak El Niño conditions are likely to develop at the end of the monsoon season or thereafter.

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

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

During June 2018, cool SST anomalies were observed over southeast equatorial Pacific Ocean (Fig.1a) and warm SST anomalies were observed over west equatorial Pacific Ocean. Positive SST anomalies were observed over 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 most parts of the tropical Pacific Ocean (Fig.1b). Also, cool SSTs over north subtropical Pacific Ocean turned into warm SSTs during the current month. However, cooling of SSTs is seen increased over the northwest Pacific Ocean as compared to the last month. The area of cool SSTs is widened 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 June, cooling of SSTs was observed over most parts of the Arabian Sea, Bay of Bengal and just south of equatorial Indian Ocean. And warming of SSTs was observed over south west subtropical Indian Ocean near 60^{o}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 July 2017 to June 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 June 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 160^{o}W to 100^{o}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 June 2018. Negative subsurface temperature anomalies (Fig. 2d) (stronger magnitude) were seen spread over the parts of western and 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.

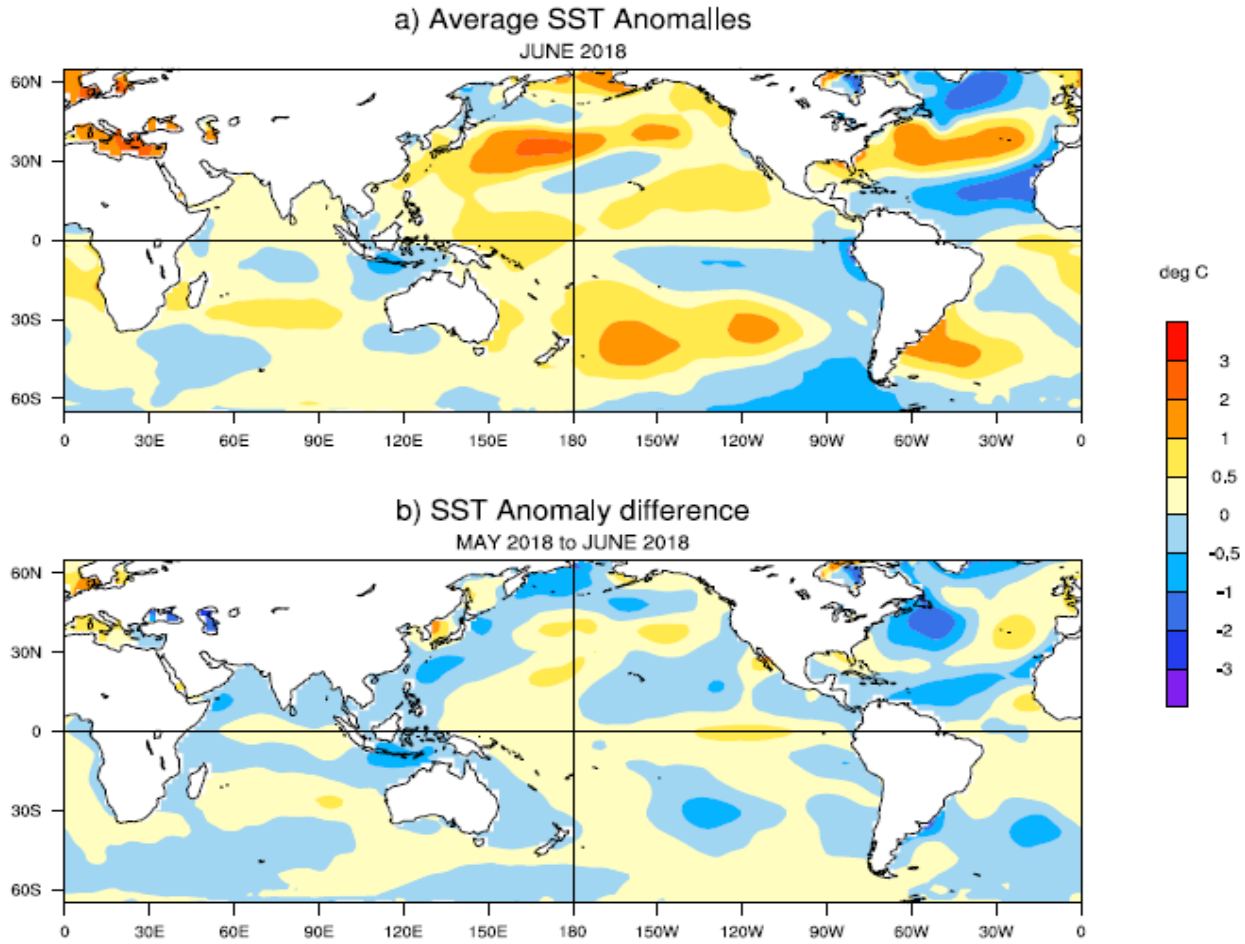

Fig.1: **(a)** Sea surface temperature (SST) anomalies (^{o}C) during June, 2018 and, **(b)** changes in the SST anomalies (^{o}C) from May 2018 to June 2018. SSTs were based on the ERSSTv5, NOAA and anomalies were computed with respect to 30-year (1981-2010) long term mean ERSSTv5, NOAA.

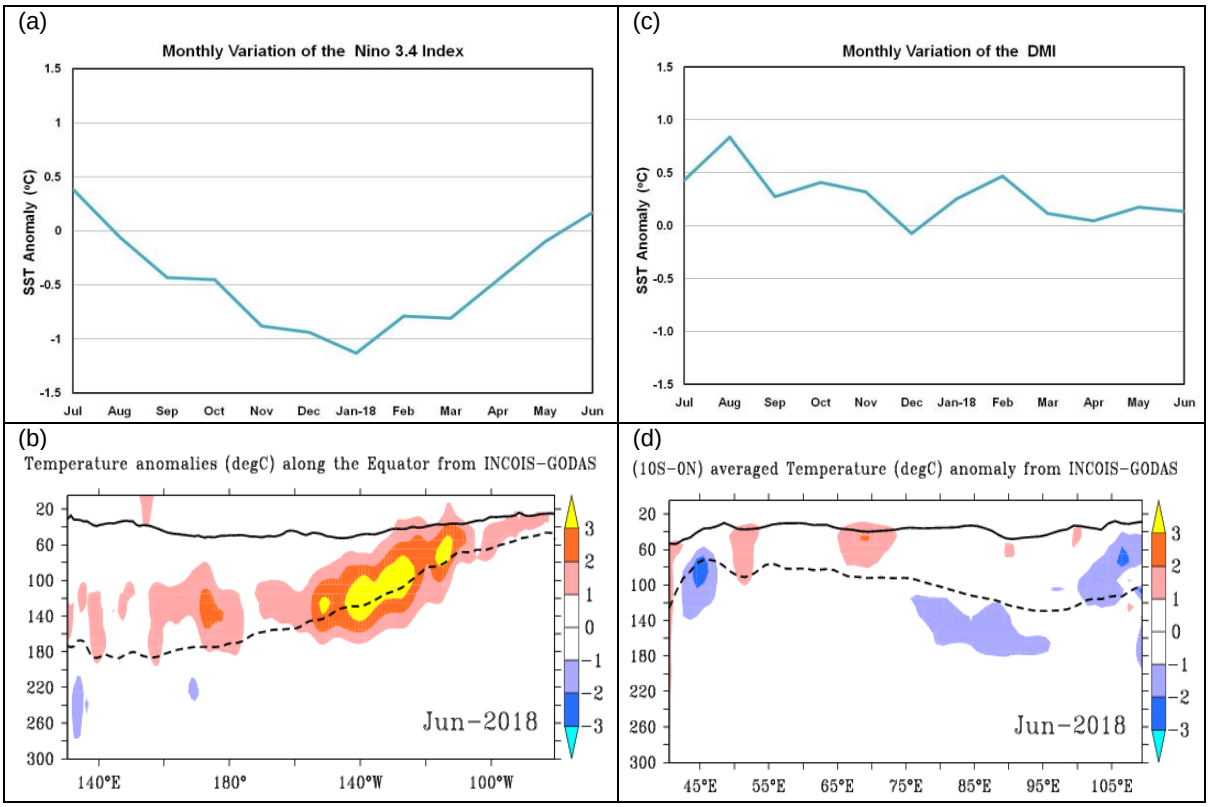

Fig.2: **(a)** Monthly variation of Niño 3.4 SST index anomaly for the last 12 months and **(b)** equatorial depth-longitude section of ocean temperature anomalies in the equatorial (5^{o}S-5^{o}N) Pacific Ocean for the month of June, 2018. **(c)** Same as (a) but for Dipole Mode Index (DMI). **(d)** **S**ame as (b) but for the tropical Indian Ocean (10^{o}S-Eq). The anomalies were computed using base period of 1981-2010, Data Source:ERSSTv5, NOAA. The solid dark line is the 20^{o}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 June 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 normal SSTs (or near zero SST anomalies) are likely over most parts of the central to eastern equatorial Pacific Ocean up to ASO season. However, from SON season onwards warm SST anomalies are likely over most parts of the equatorial Pacific Ocean. North-western Pacific Ocean is likely to have normal SSTs for most of the forecasted seasons. The latest MMCFS forecast indicates that current ENSO neutral conditions are likely to persist through the monsoon season and weak El Niño conditions are likely to develop at the end 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 weak negative IOD conditions are likely to develop during the JAS season and likely to persist till SON season and weaken thereafter (Fig.4b).

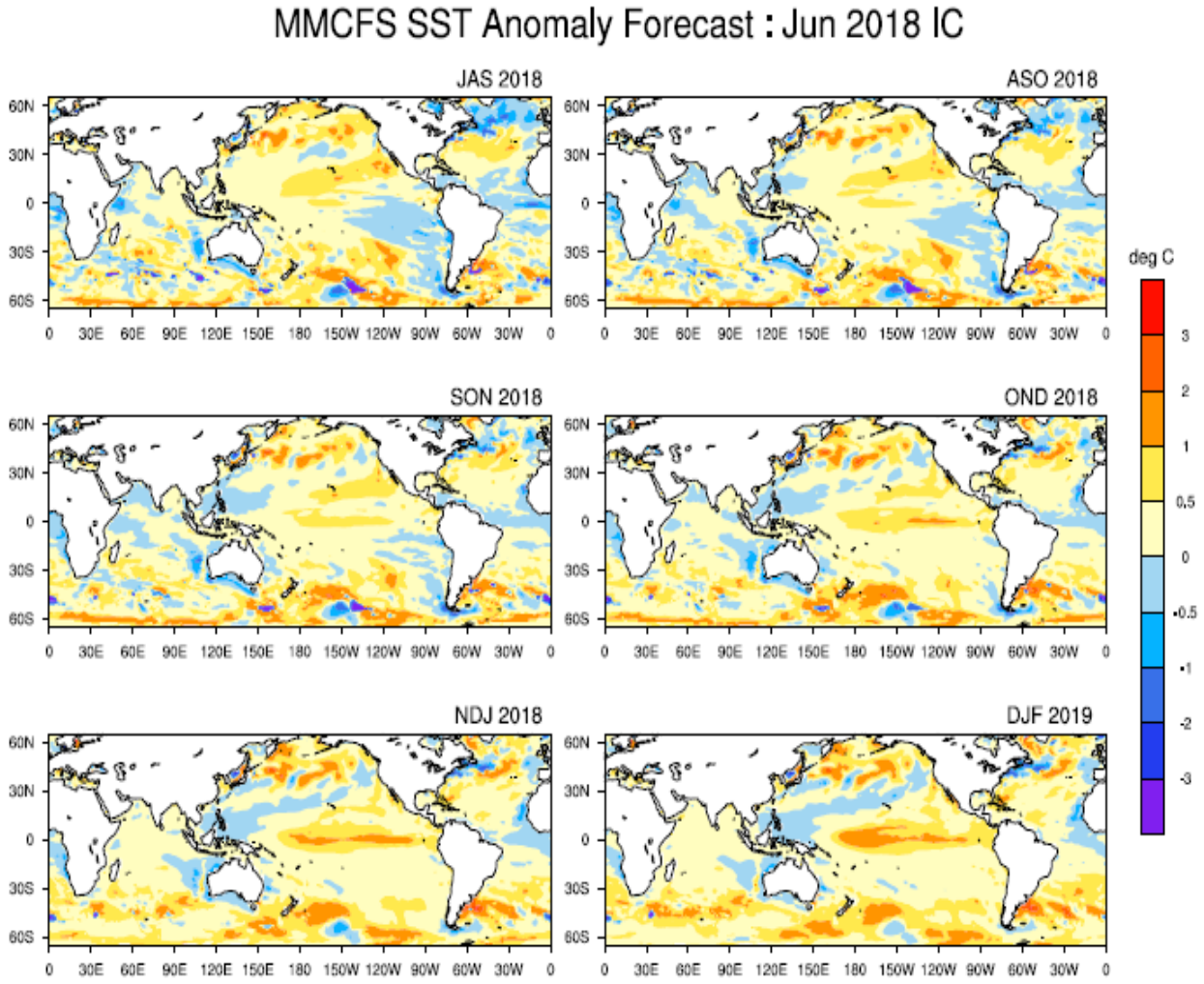

Fig.3: Forecasted Seasonal mean SST anomalies for 3 monthly seasons, (a) July to September (JAS), (b) August to October (ASO), (c) September to November (SON), (d) October to December (OND), (e) November to January (OND) and (f) December to February (DJF) (Model bias correction base period: 1999-2010;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

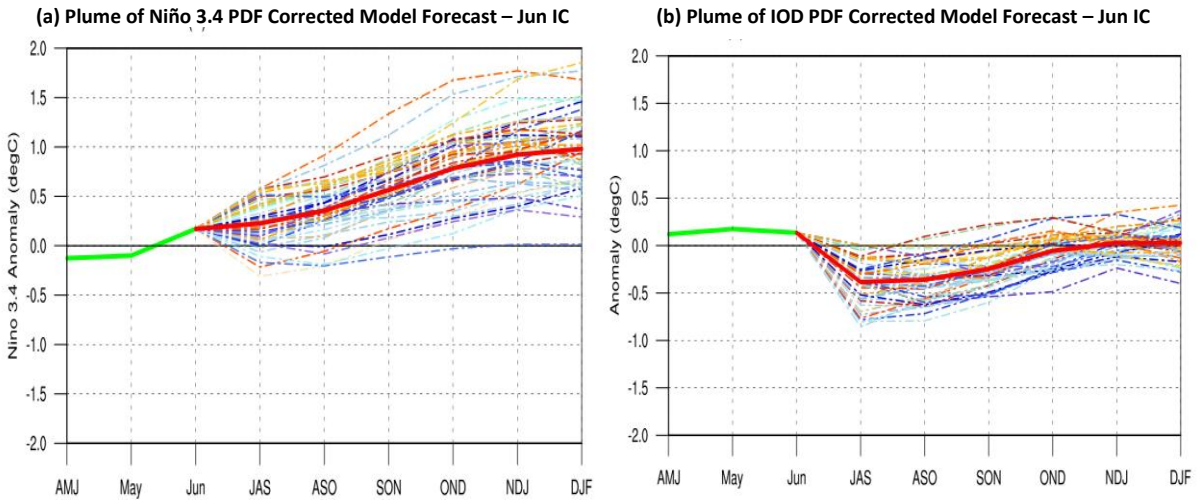

Fig.4: Plume of **(a)** Niño 3.4 SST anomalies, **(b)** Indian Ocean Dipole Mode Index forecasted by high resolution CFSv2. The forecasts were PDF corrected for bias and variance. The solid green line is the observed SST anomaly (ERSSTv5, NOAA) and solid red line is the ensemble SST anomaly forecast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

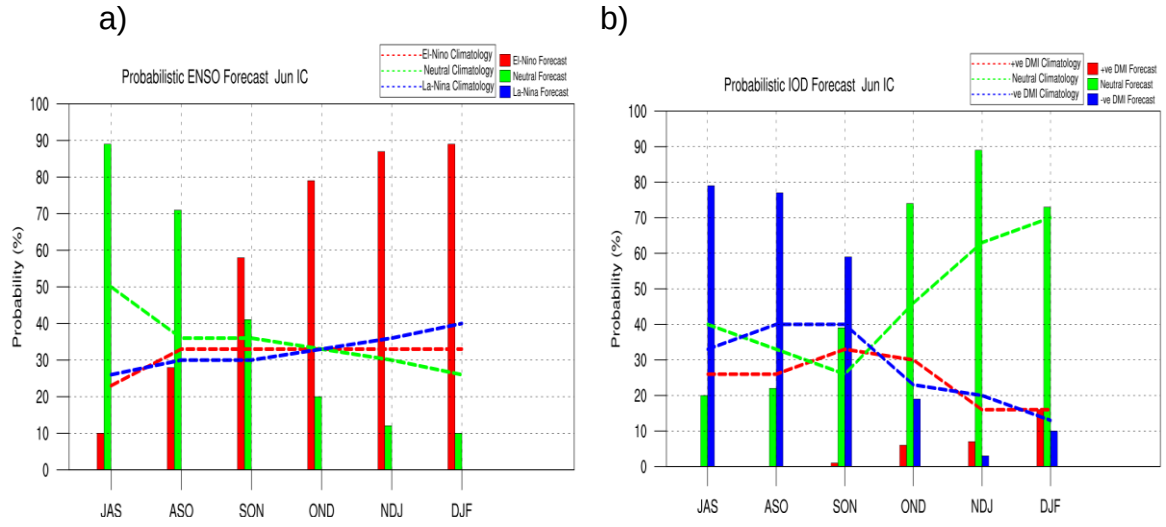

Fig.5: Probability forecast along with climatological probabilities of **(a)** Niño 3.4 and **(b)** Indian Ocean Dipole Mode Index from high resolution MMCFS. Data source for Climatology probabilities: NOAA Extended Reconstructed SST V5. Criteria used for Probabilistic ENSO Forecast: ≤ -0.5 La Niña, >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 during JAS and ASO seasons. However, from SON season onwards probability for El Niño conditions is highest and above 50% till the end of forecast period.

The probability forecast for IOD (Fig.5b) indicates maximum probability for negative IOD conditions during JAS to SON seasons. From OND season onwards neutral IOD conditions have highest probability till the end of forecast period.