



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

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

**October 2020**

**Highlights:**

Currently, weak La Niña conditions are prevailing over equatorial Pacific and SSTs are below normal over central and eastern equatorial Pacific. The latest MMCFS forecast indicates cooling of SSTs will most likely to continue and weak La Niña conditions likely to turn into moderate La Niña conditions during coming months and sustain till early part of the next year.

At present, neutral IOD conditions are observed over Indian Ocean and the latest MMCFS forecast indicates neutral IOD conditions likely to continue during the coming months.

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

During September 2020 cooler than normal SSTs were observed over central and eastern parts of the equatorial Pacific and warmer than normal SSTs were observed over most of the western equatorial Pacific Ocean (Fig.1a). Negative SST anomalies were observed over central and eastern part of south Pacific Ocean. Positive SST anomalies were observed over higher latitudes especially most parts of the north Pacific Ocean and central parts of south Pacific Ocean. As compared to the last month, cooling of SSTs is observed over most parts equatorial Pacific Ocean as well as parts from extreme North Pacific Ocean (Fig.1b). Warming of SSTs observed over some region of the higher latitudes of north Pacific Ocean.

Basin wide warming of SSTs was observed over Indian Ocean including most parts of Arabian Sea and Bay of Bengal. Negative SST anomalies were observed over a small region near western equatorial Indian Ocean. Negative SST anomalies were also observed over south of subtropical Indian Ocean near south east coast of Africa and near south west coast of Australia. Positive SST anomalies were observed near north west coast of Australia and maritime continent (Fig.1a). As compared to the last month, cooling of SSTs is observed over most parts of Indian Ocean. Warming of SSTs also observed over most part of South Indian Ocean. (Fig.1b).

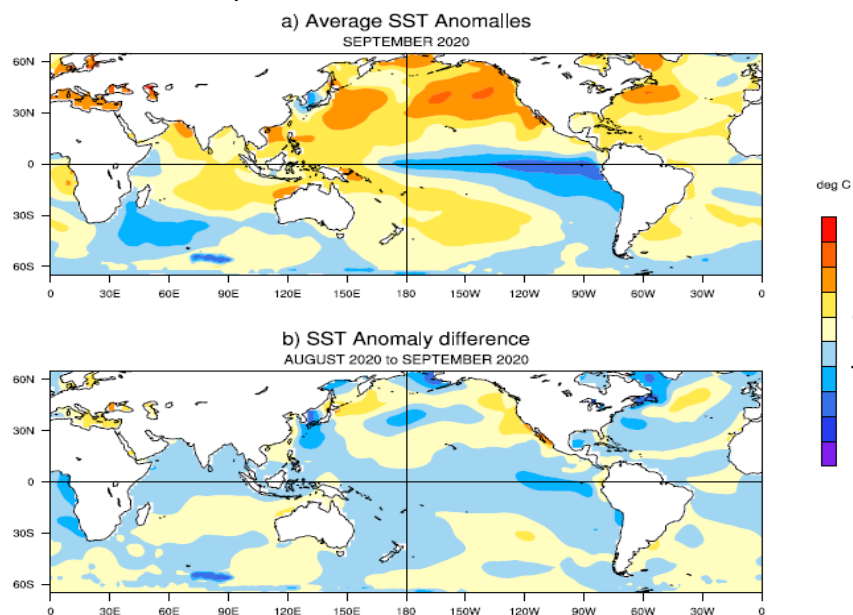
**1.1. El Niño Southern Oscillation (ENSO) conditions over the Pacific Ocean**

The monthly time series of Niño3.4 SST anomalies for the last 12 months from October 2019 to September 2020 is shown in Fig.2a. SST anomalies reached borderline/weak El Niño levels in the month of October 2019. Thereafter, not much changes observed in the SST anomalies over equatorial Pacific till April 2020. The cooling of SST anomalies was started in the equatorial Pacific Ocean during the subsequent month of May and was enhanced during June & July months of 2020. Since then Niño 3.4 SST anomalies were near to below average over the equatorial Pacific. In the month of August, SST anomaly has shown further cooling and crossed La Niña threshold. Currently, weak La Niña conditions are prevailing over the equatorial Pacific Ocean. Presently, the atmospheric circulation also responding to the cooling of SSTs in the Pacific Ocean and it is indicating La Niña Pattern. Positive subsurface anomalies were observed over western Pacific Ocean with strongest magnitude spread around 165°E (between isotherm and thermocline depth) (Fig.2b). The subsurface

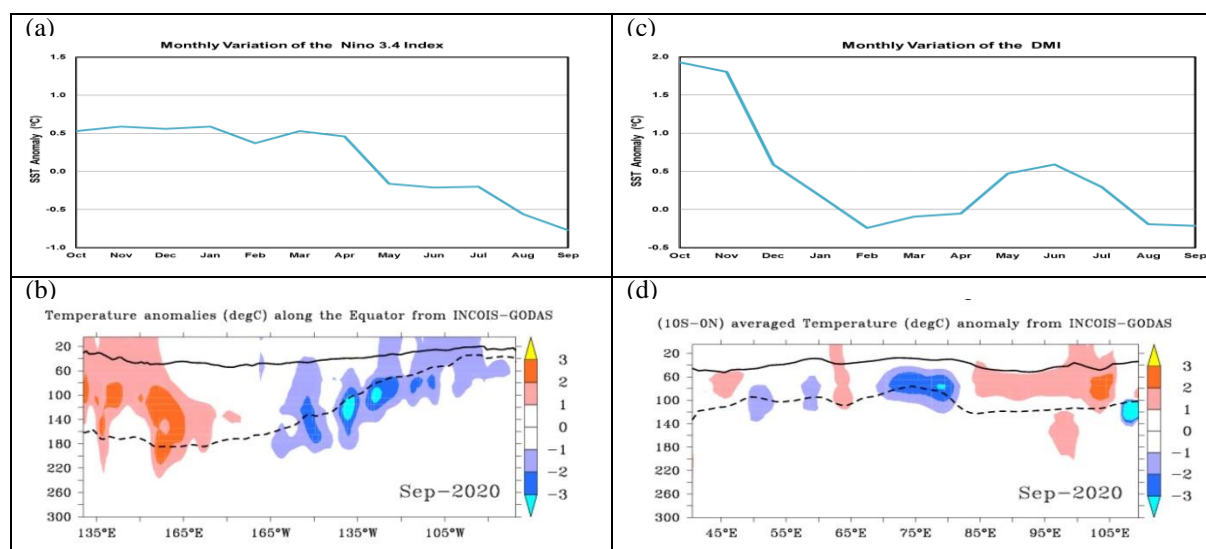
temperature anomalies were negative over the central and eastern Pacific Ocean with strongest magnitude observed below the thermocline depth.

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

The DMI index for the last 12 months suggests that (Fig. 2c) positive IOD conditions continued till the month of December 2019 and weakened later and turned into neutral IOD conditions by January 2020 and continued till April. During May 2020, weak positive IOD conditions were observed and started decreasing their strength during July 2020. The DMI has remained below the average and neutral IOD conditions were observed during August month. At present neutral IOD conditions are prevailing over Indian Ocean. Positive subsurface temperature anomalies (Fig. 2d) were seen over east and some parts of central equatorial Indian Ocean with stronger magnitude around 105°E in between 20°C isotherm and thermocline depth. Negative subsurface temperature anomalies were seen over a central region as well as over a small pocket over western and extreme eastern Indian Ocean.



**Fig.1:** (a) Sea surface temperature (SST) anomalies (°C) during September, 2020 and (b) changes in the SST anomalies (°C) from August 2020 to September 2020. SSTs were based on the ERSSTv5, NOAA and anomalies were computed with respect to 30-year (1981-2010) long term mean ERSSTv5, NOAA.



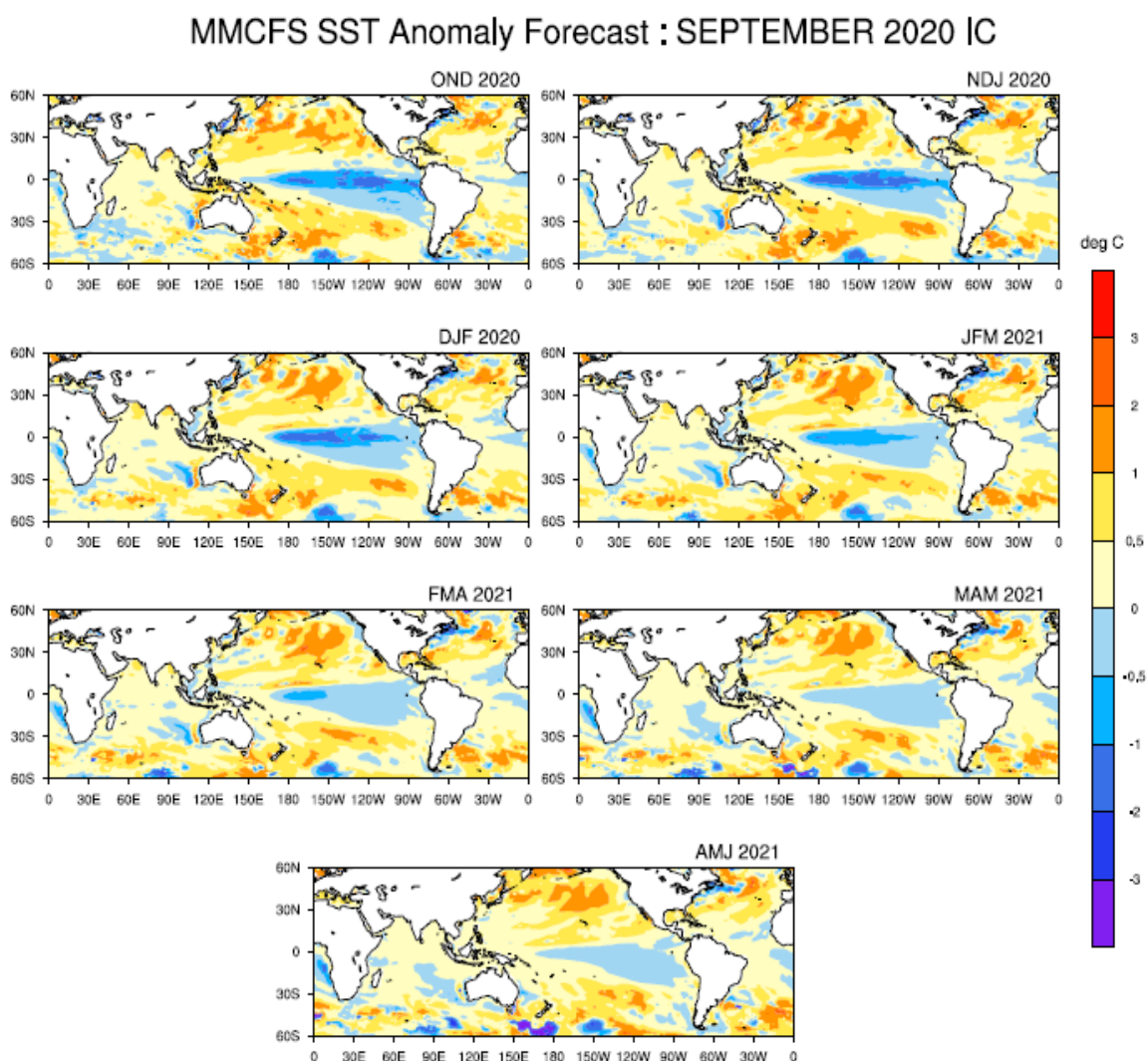
**Fig.2:** (a) Monthly variation of Niño 3.4 SST index anomaly for the last 12 months and (b) equatorial depth-longitude section of ocean temperature anomalies in the equatorial (5°S-5°N) Pacific Ocean for the month of September, 2020. (c) Same as (a) but for Dipole Mode Index (DMI). (d) Same as (b) 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

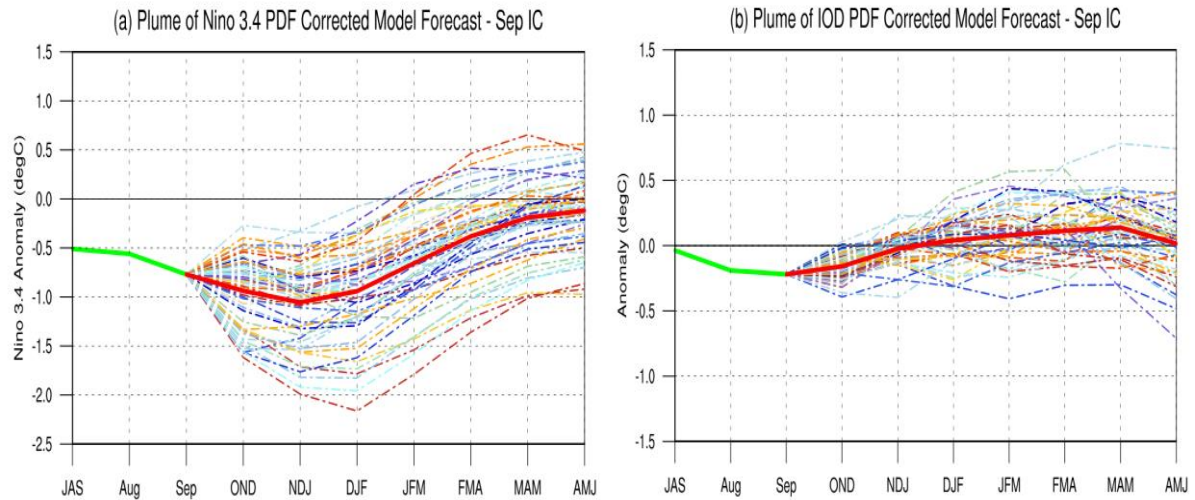
The SST forecast was prepared using the high resolution Monsoon Mission Coupled Forecast System (MMCFS) (AGCM T382L64; 38 km and OGCM 25 km in tropics) based on the 2020 September initial conditions. The initial conditions for the model runs were obtained from ESSO-INCOIS and ESSO-NCMRWF analysis. Probability 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) indicates that below normal SSTs are likely over most parts of equatorial Pacific Ocean for the entire forecast period. Normal to warmer than normal SSTs are likely over parts of north and over north west Pacific Ocean during most of the forecasted seasons. Currently, weak La Niña conditions are prevailing over equatorial Pacific and SSTs are below normal over central and eastern equatorial Pacific. The latest MMCFS forecast indicates cooling of SSTs will most likely to continue and weak La Niña conditions likely to turn into moderate La Niña conditions during coming months and sustain till early part of the next year (Fig.4a).

In the Indian Ocean, normal to warmer than normal SSTs are likely over Bay of Bengal and Arabian Sea during most of the forecasted seasons (Fig.3). At present, neutral IOD conditions are observed over Indian Ocean and the latest MMCFS forecast indicates neutral IOD conditions are likely to continue during the coming months (Fig.4b).

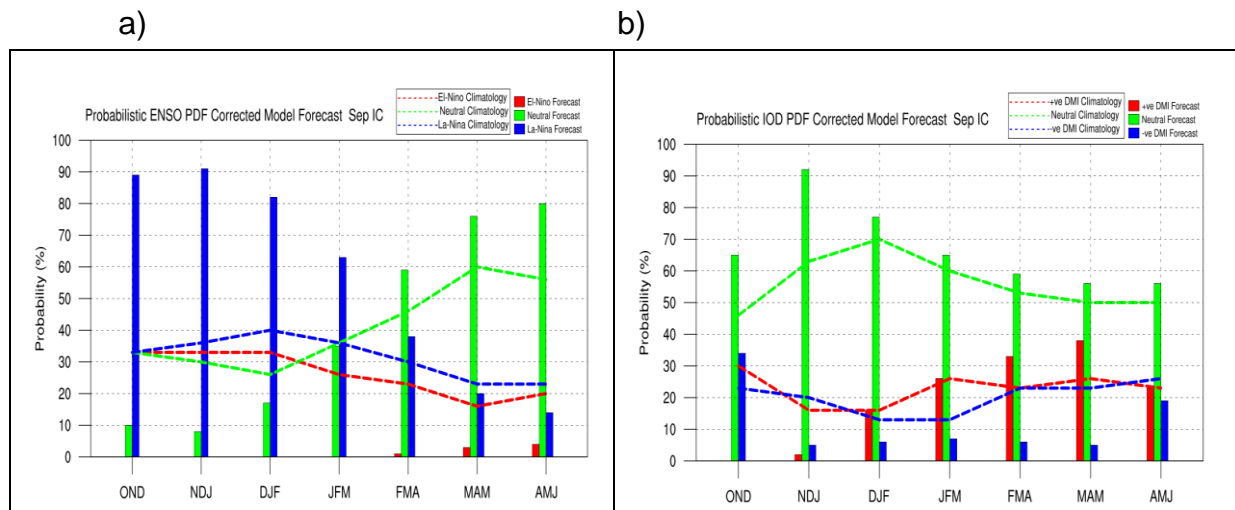


**Fig.3:** Forecasted Seasonal mean SST anomalies for 3 monthly seasons, (a) October to December (OND), (b) November to January (NDJ), (c) December to February (DJF), (d) January to March (JFM), (e) February to April (FMA), (f) March to May (MAM) and (h) April to June (AMJ) (Model bias correction base period: 1999-2008; Climatology base period:1982-2008).



**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 53 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:  $\leq -0.5$  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 enhanced probability for La Niña conditions during OND to JFM seasons. Enhanced probability for neutral ENSO conditions is predicted during remaining seasons.

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