



**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 2020

Highlights:

Currently, ENSO-neutral conditions are prevailing over the equatorial Pacific Ocean. The latest MMCFS forecast indicates ENSO neutral conditions are most likely to continue during the entire forecast period. However, there is an increasing probability (more than climatological probability) is predicted for La Niña conditions during SON and OND seasons. At present, neutral IOD conditions are observed over Indian Ocean and the latest MMCFS forecast indicates neutral IOD conditions to turn into negative IOD conditions and are likely to continue till OND season.

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

During July 2020 warmer than normal SSTs were observed over most of the western equatorial Pacific and cooler than normal SSTs were observed over eastern parts of the equatorial Pacific Ocean (Fig.1a). Normal SSTs were observed over central parts near the international dateline. Positive SST anomalies were observed over higher latitudes especially most parts of the north Pacific Ocean and central parts of south Pacific Ocean. Negative SST anomalies were observed over eastern part of south Pacific Ocean. As compared to the last month, cooling of SSTs is observed over most parts of north and south Pacific Ocean as well as parts from central and eastern Pacific Ocean (Fig.1b). Warming of SSTs observed in some parts 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 parts of south of subtropical Indian Ocean near south east coast of Africa. Positive SST anomalies were observed near west coast of Australia and Indonesian region (Fig.1a). As compared to the last month, warming of SSTs is observed over northern parts of Indian Ocean especially Arabian Sea. Warming of SSTs also observed over eastern side of the south Indian Ocean and cooling of SSTs is seen over western side of the 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 August 2019 to July 2020 is shown in Fig.2a. ENSO-neutral conditions from August 2019 were continued till September 2019. October 2019 onwards, there was increase in SST anomalies over the equatorial Pacific Ocean and SST anomalies remained at borderline/weak El Niño levels till the month of April 2020. During the subsequent month of May cooling of SSTs is observed and continued thereafter. Since then (cool) ENSO neutral conditions were observed over equatorial Pacific Ocean. Currently, ENSO neutral conditions are observed over the Pacific. Presently, the atmospheric conditions are indicating ENSO-neutral pattern over the region. Negative subsurface anomalies were observed over small pockets of eastern equatorial Pacific. Positive subsurface anomalies were observed over western and some parts from eastern Pacific Ocean with strongest magnitude spread around 130°W (between isotherm and thermocline depth) (Fig.2b).

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 further 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 its strength during July 2020. At present neutral IOD conditions are prevailing over Indian Ocean. Positive subsurface temperature anomalies (Fig. 2d) were seen over extreme west and some parts of east equatorial Indian Ocean. Negative subsurface temperature anomalies were seen over a small pocket in east Indian Ocean with stronger magnitude around 80°E in between 20°C isotherm and thermocline depth.

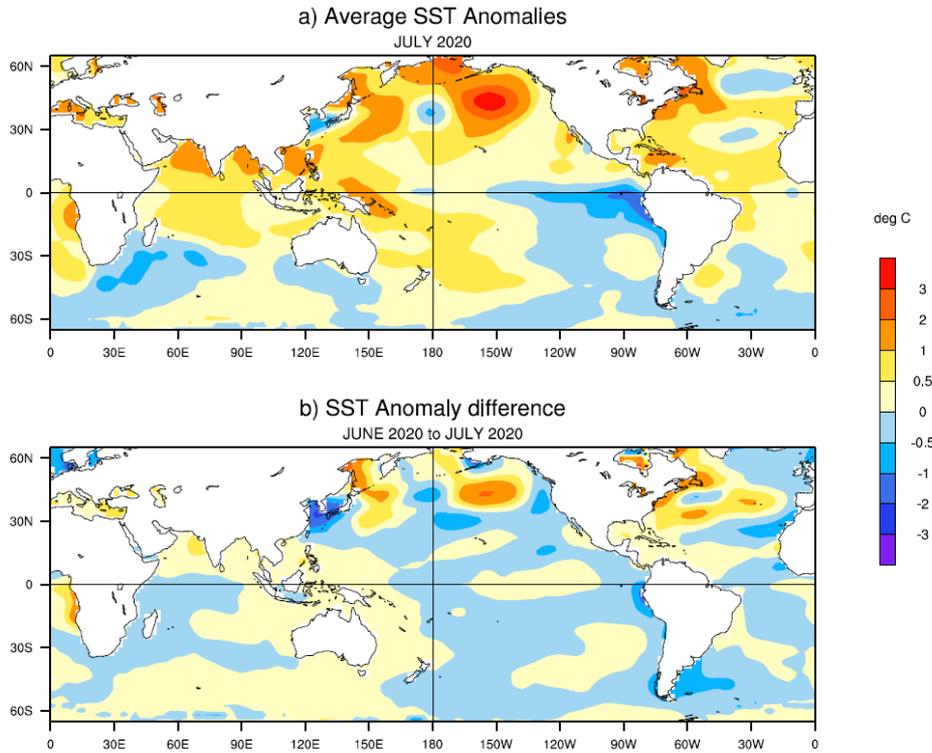


Fig.1: (a) Sea surface temperature (SST) anomalies (°C) during July, 2020 and **(b)** changes in the SST anomalies (°C) from June 2020 to July 2020. SSTs were based on the ERSSTv5, NOAA and anomalies were computed with respect to 30-year (1981-2010) long term mean ERSSTv5, NOAA.

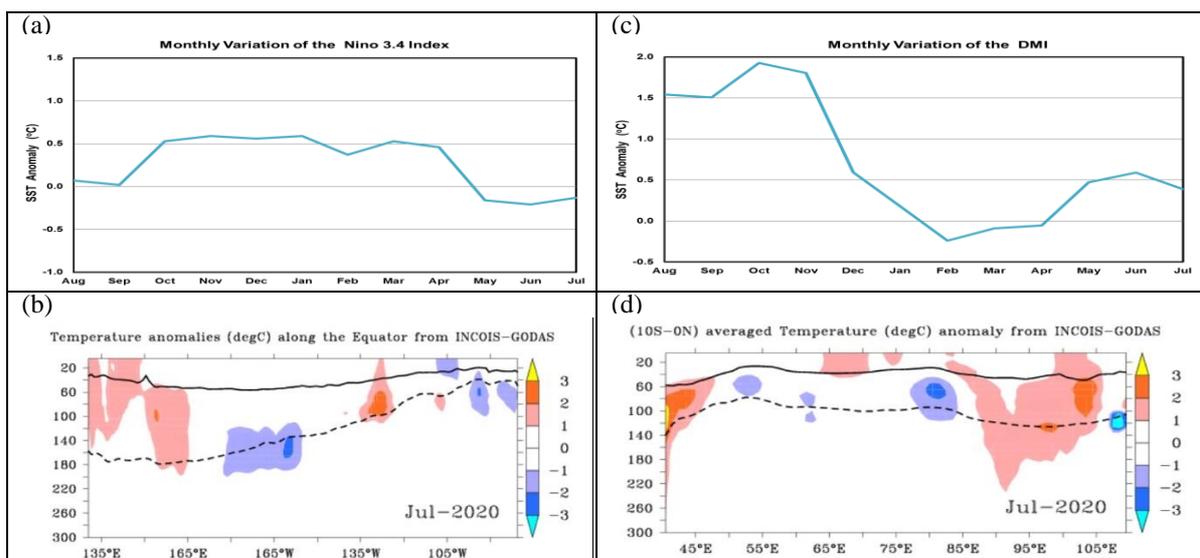


Fig.2: (a) Monthly variation of Niño 3.4 SST index anomaly for the last 12 months and **(b)** equatorial-longitude section of ocean temperature anomalies in the equatorial (5°S-5°N) Pacific Ocean for the month of July, 2020. **(c)** Same as (a) but for Dipole Mode Index (DMI). **(d)** Same as (b) but 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 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 2020 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) indicates that below normal SSTs are likely over some parts of eastern equatorial Pacific Ocean from ASO to NDJ season. Normal to warmer than normal SSTs are likely over parts of north and over north west Pacific Ocean Pacific during most of the forecasted seasons. Currently, ENSO-neutral conditions are prevailing over the equatorial Pacific Ocean. The latest MMCFS forecast indicates ENSO neutral conditions are most likely to continue during the entire forecast period (Fig.4a).

In the Indian Ocean, normal SSTs are likely over Bay of Bengal and Arabian Sea during most of the forecasted seasons (Fig.3). Slightly warmer than normal SSTs are likely over eastern part near Indonesian region as compared to western parts of Indian Ocean from ASO to OND seasons. At present, neutral IOD conditions are observed over Indian Ocean and the latest MMCFS forecast indicates neutral IOD conditions to turn into negative IOD conditions and are likely to continue till OND season (Fig.4b).

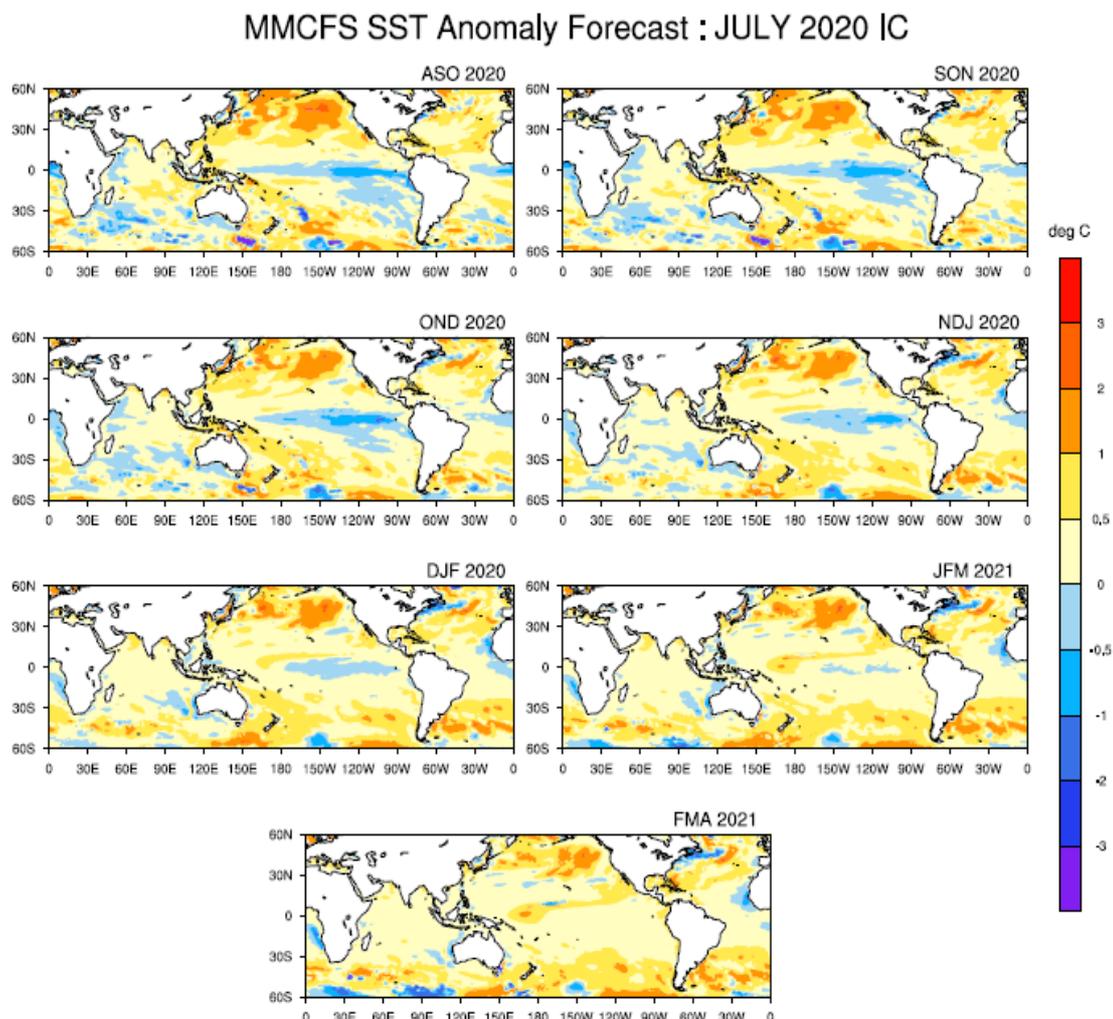


Fig.3: Forecasted Seasonal mean SST anomalies for 3 monthly seasons, (a) August to October (ASO), (b) September to November (SON), (c) October to December (OND), (d) November to January (NDJ), (e) December to February (DJF), (f) January to March (JFM) and (h) February to April (FMA) (Model bias correction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

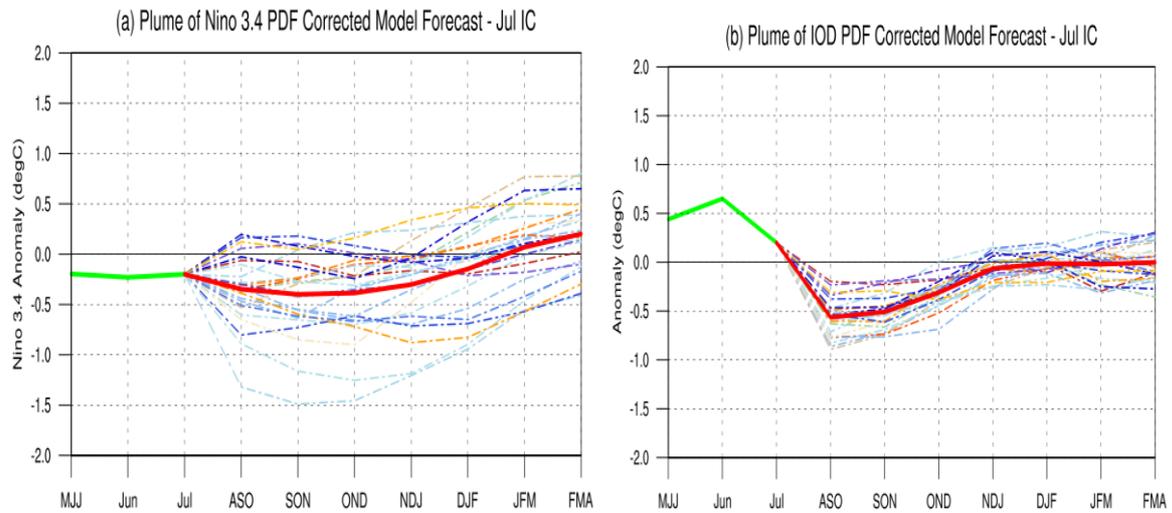


Fig.4: Plume of (a) Niño 3.4 SST anomalies, (b) Indian Ocean Dipole Mode Index forecasted by high resolution CFSv2. The forecasts were PDF corrected for bias and variance. The solid green line is the observed SST anomaly (ERSSTv5, NOAA) and solid red line is the ensemble SST anomaly forecast mean of 25 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

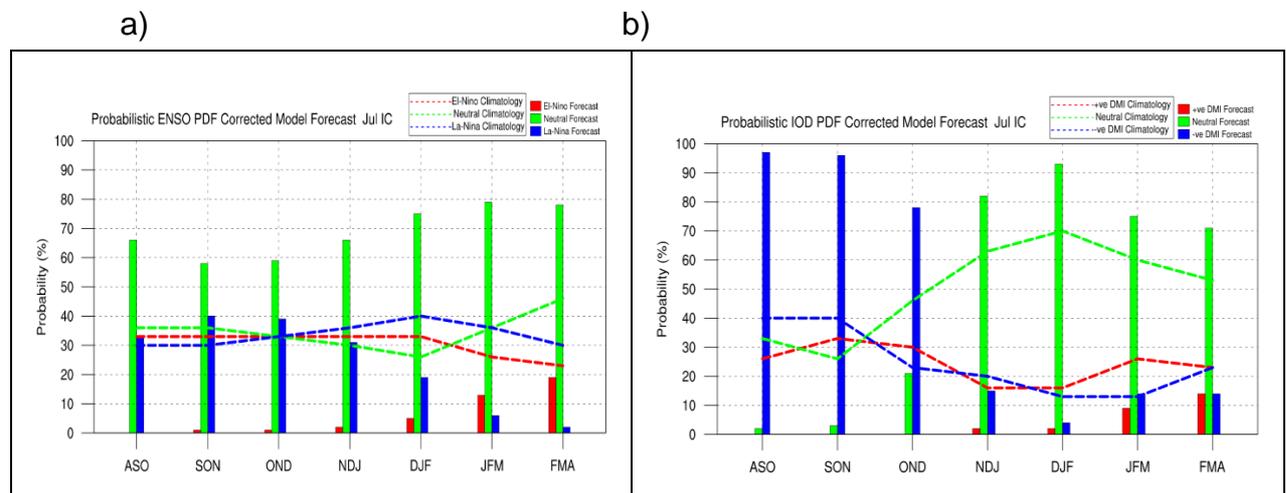


Fig.5: Probability forecast along with climatological probabilities of (a) Niño 3.4 and (b) Indian Ocean Dipole Mode Index from high resolution MMCFS. Data source for Climatology probabilities: NOAA Extended Reconstructed SST V5. Criteria used for Probabilistic ENSO Forecast: ≤ -0.5 La Niña, >0.5 to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

The probability forecast for IOD (Fig.5b) indicates enhanced probability for negative IOD conditions from ASO to OND seasons. NDJ season onwards enhanced probability for neutral IOD conditions is predicted.