# IGAD CLIMATE PREDICTION AND APPLICATIONS CENTRE

## CLIMATE WATCH FOR THE PERIOD JUNE -DECEMBER 2015

## "EL NIÑO EVOLUTION OVER EASTERN EQUATORIAL OCEAN REGION AND POTENTIAL IMPACTS OVER THE GREATER HORN OF FRICA"

## (REF: ICPAC/CW/No.31 AUGUST 2015)

## Contents



## SUMMARY


IGAD Climate Prediction and Applications Centre (ICPAC) Mission is to foster climate information, prediction, timely early warning and applications for disaster risk reduction and sustainable development in the Greater Horn of Africa (GHA). ICPAC also supports capacity building, climate monitoring, prediction and early warning to IGAD member states for coping with current climate extremes as well as adapting to future climate changes reduction in support of disaster management for sustainable development efforts. The support includes Disaster management programme and activities related to the IGAD Drought Disaster Resilience and Sustainability Initiative (IDDRSI) Strategy. IDDRIS strategy which is being implemented in the GHA region follows the Summit of the Heads of States and Government of the East African Community (EAC) and the Inter-Governmental Authority on Development (IGAD) that was

held in Nairobi, Kenya in September 2011, to address regional challenges triggered by the impacts of the severe regional scale drought of 2009-2011. The Summit called for the needs for effective early actions from climate early warning systems. Useful details of IDDRSI are freely available at http://resilience.igad.int/.

ICPAC produces regular regional 10 day, monthly and seasonal climate early warning updates. ICPAC also releases a special early warning **Climate Watch** bulletin to provide updates on the evolving global and/ or regional climate phenomenon that may have profound impacts on region. Climate watch is therefore intended to be a proactive climate impacts advisory. Climate extremes such as floods and droughts often have far reaching socio-economic impacts in the region. Among the ocean-atmosphere phenomenon that is often cause greatest disruption of the normal climatic conditions worldwide is the El Niño-Southern Oscillation (ENSO) events. Impacts of Strong ENSO have been associated with worldwide occurrences of floods, droughts, cold/warm temperatures, large scale winds and oceans currents anomalies in some regions. El-Niño updates from the global climate centres including WMO August 2015 El-Niño report suggest that El-Niño conditions over tropical Pacific are likely to continue in the coming few months. While precise estimates of peak strength are not possible, models and expert opinion favor waters in the east-central tropical Pacific to warm to near or greater than +2.0°C above average, potentially placing this El Niño event among the four strongest events since 1950; (http://www. wmo.int/ pages/ members/members_en.html; http://www.wmo.int/pages/prog/wcp/wcasp/RCCs.html). Previous strong El Niños with highest temperatures recorded generally during October - December months were observed in 1957,1965,1972,1982 and 1997. There are few cases when El-Niño conditions persisted the whole year when an onset started during late part of the previous year as were witnessed in **1953, 1958, 1969, 1977, 1987, and 1991.**

This current climate watch gives an update of the evolving El-Niño phenomenon, as well as the potential regional climate impacts during the period extending from September 2015 to February 2016. Also included in the discussion are the potential modification of ENSO regional impacts by the complex interactions with other global and regional systems such as Indian Ocean Dipole (IOD), Atlantic Oscillatory systems, topographical systems; the large inland water bodies, among others. The major regional climate anomalies that were observed over GHA during the months of May to July2015 are also included in the climate watch.

## 1. WHAT ARE EL NIÑO, LA NIÑA AND EL NIÑO – SOUTHERN OSCILLATION (ENSO) EVENTS?

The term El Niño (Spanish word for *"the Christ-child"*), refers to the periodic building up of a large pool of unusually warm waters in the eastern and central equatorial Pacific Ocean. La Niña on the other hand is used to describe the periodic building up of unusually *cold waters* in the same ocean basin (**Figure 1**). Thus, La Niña and El Niño are mutual exclusive phenomena that periodically occur in the equatorial Pacific Ocean region. In general, most of El Niño events are immediately followed by La Niña events that have often resulted into floods following droughts or vice versa in many parts of the world.

When large pools of warm/cold waters are observed in any parts of the global oceans, the atmosphere and the neighbouring oceans respond to cooling and warming in various ways **(Figure 1)**. The atmosphere, for example, may respond to strong El Niño and La Niña events by shifting the east-west air circulation cells commonly referred to as the Southern Oscillation (SO). The close linkages between La Niña / El Niño events and the atmospheric circulation response (SO) have made many scientists to often refer to the two systems simply as El Niño / Southern Oscillation (ENSO). In such cases, El Niño and La Niña phenomena are simply referred to as the *warm* and *cold ENSO* phases respectively. The *warm* and *cold ENSO phases* (El Niño / La Niña events) are known to trigger worldwide anomalies in ocean currents and atmospheric air circulation that consequently have various impacts on rainfall and temperature in specific areas around the world.

It has been observed that during *El Niño and La Niña* events, world-wide weather and climate extremes such as droughts, floods, cold/hot spells, tropical cyclones, etc are common, even in some regions that are very far away from the Pacific Ocean basin. Such weather and climate extremes are often associated with far reaching socio-economic impacts including loss of life and property; outbreak of diseases, mass migration of people and animals; lack of water, energy, food and other basic needs of human kind.

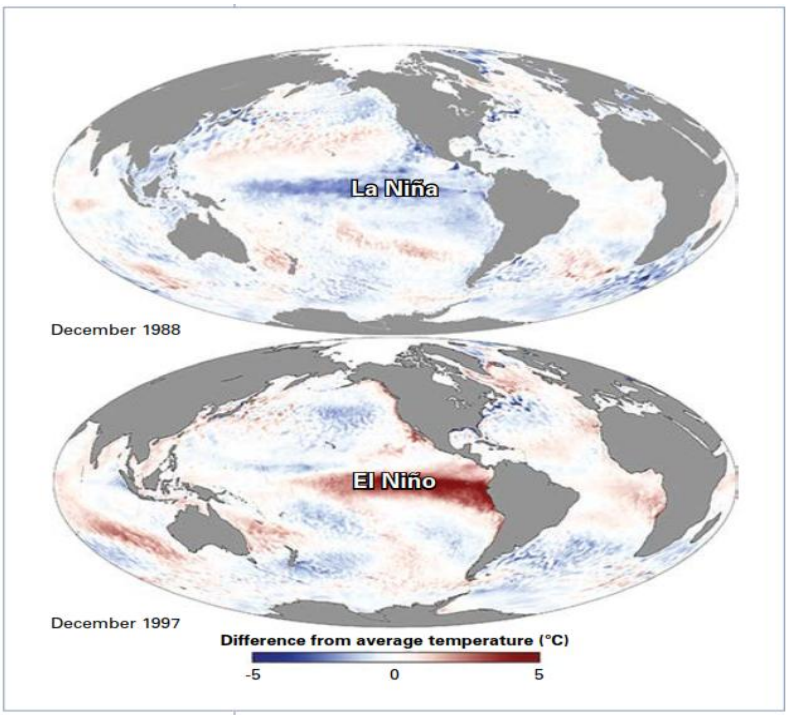



Figure 1: Typical Sea Surface Temperature anomalies over the eastern and central equatorial Pacific Ocean during (a) cold and (b) warm ENSO events (source: WMO Technical Paper No. 1145, 2014 /NOAA Climate.gov)

## 2. TYPICAL IMPACTS OF EL-NIÑO AND LA NIÑA OVER THE GREATER HORN OF AFRICA (GHA)

The northern and southern sector of GHA receives peak rainfall during the northern hemisphere summer and winter months of June-August and December – February respectively. The equatorial areas of the GHA have two main rainfall peaks centered about March-May and October-December months. However influence of topography and nearness to large water bodies ensures that some parts of the equatorial sector receive rainfall all year round.

### 2.1 El-Niño Impacts in the Northern Sector of GHA

Warm episodes (El-Niño events) are often, but not always, associated with suppressed (below normal) rainfall over most parts of the northern sector of the GHA region during the peak rainfall season of July to September. On the other hand, cold events (La Niña) tend to enhance (above normal) rainfall amounts over most parts of the sector during the same period.

## 2.2 El-Niño Impacts in the Equatorial Sector of GHA

Over the equatorial sector, enhanced rainfall is common during October to December of the onset year for El Niño events over most areas. The enhanced rainfall during October to December tends to extend into the following year, making the wet the usually dry months of January and February. On the other hand, rainfall tends to be suppressed during the June to September period in the western parts of the sector.

During a cold event, the rainfall in March to May and October to December tends to be suppressed over most parts of the sector while rainfall is enhanced in June to September in the western areas.

## 2.3 El-Niño Impacts in the Southern Sector of GHA

Warm/Cold events as well as below/above average rainfall amounts are often observed over most parts of the southern sector of the GHA duringEl-Niño / La Niña events.

It should however be noted that not all El-Niño or La Niña events give the same impacts in the GHA. In other words, no two events are exactly similar as to the nature of their occurrence and the impacts on local climate patterns. In addition, the overall influence on the rainfall patterns is dictated by a number of other factors such as the time of onset, month of peak intensity, seasonal persistence and withdrawal phases as well as strength of the event and the characteristics of the surrounding ocean basins. These ocean basins are the moisture sources for rainfall generation. Indian Ocean Dipole (IOD) is one of the key regional systems over Indian Ocean that has significant impacts on climate over GHA.

# 3. INDIAN OCEAN DIPOLE (IOD)

The Indian Ocean Dipole (IOD) is a coupled ocean and atmosphere phenomenon in the equatorial Indian Ocean that affects the climate over the surrounding Indian Ocean basin including GHA (Saji *et al*., 1999). A positive IOD period is characterized by cooler than normal water in the tropical eastern Indian Ocean and warmer than normal water in the tropical western Indian Ocean. Owiti *et al*. (2008) observed that ENSO linkages seemed to be stronger when the

large positive IOD indices coincided with El Niño events. In general, above/ below normal rainfall conditions spread over the region during the positive/negative IOD events.

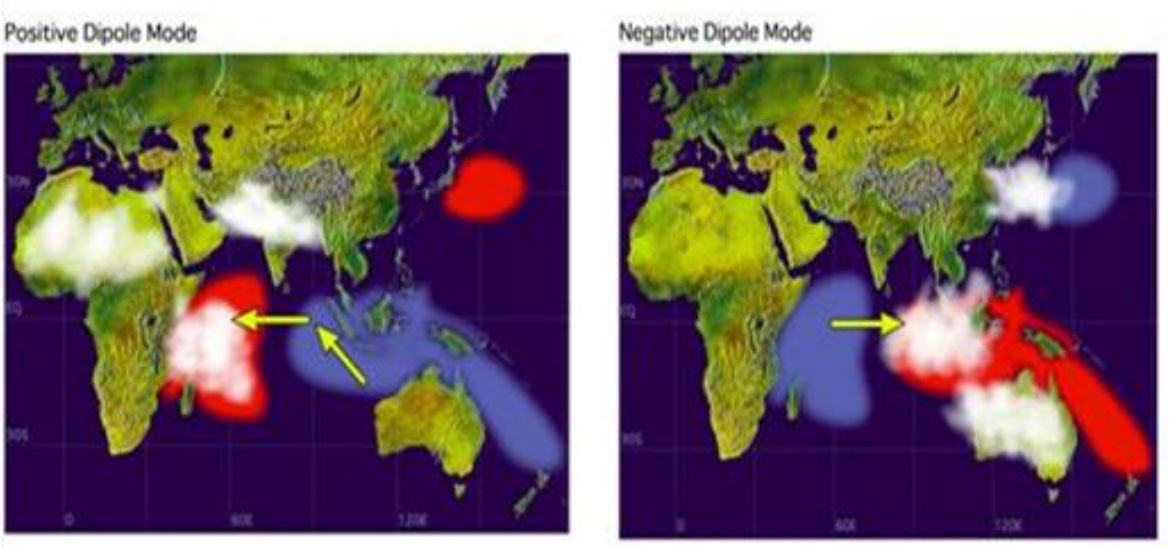
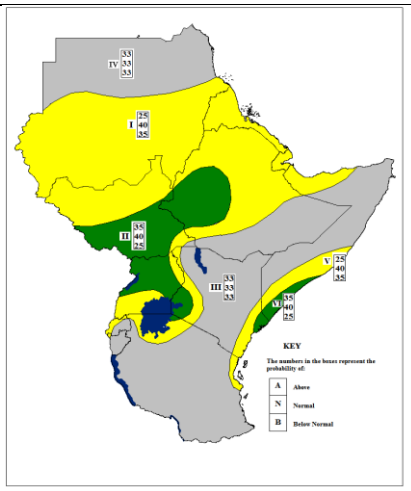
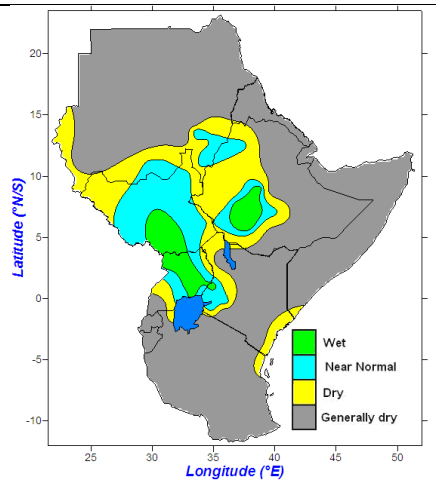


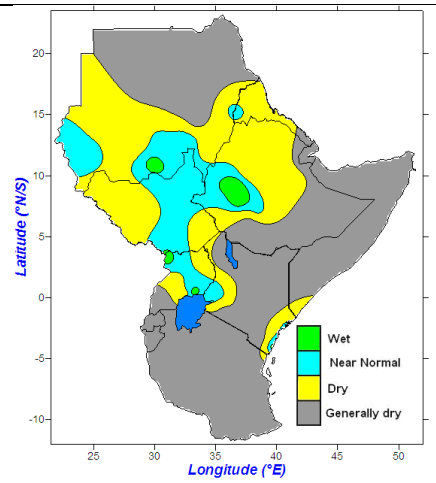

Figure 2: Typical positive and negative modes of the Indian Ocean Dipole (source: http://www.jamstec.go.jp/frcgc/research/d1/iod/IOD1.html )

## 4. REGIONAL CLIMATE PATTERNS JUNE- JULY 2015

Over the northern sector, observed rainfall during June and July has been notable below the average, especially over the arid and semi-arid parts. Drought conditions are also evident over most eastern parts of the equatorial sector (Figure 3b and 3c). These had been anticipated in the regional climate outlook for June to August 2015 season that was released at GHACOF 40 that was held in Djibouti from 25 to 26 May 2015 (Figure 3a). Depressed rainfall can further be witnessed from monthly rainfall received from individual locations (Figure 4: a, b, c). Some of these northern and western areas received more rainfall during the month of August. During El Niño years many parts of the northern sector are expected to receive depressed season rainfall when regional climate circulations are favorable.




| a: Regional rainfall climate outlook for June to August 2015 | b: June 2015 rainfall anomaly | c: July rainfall anomaly |
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Figure 3: Regional rainfall performance during June to July 2015

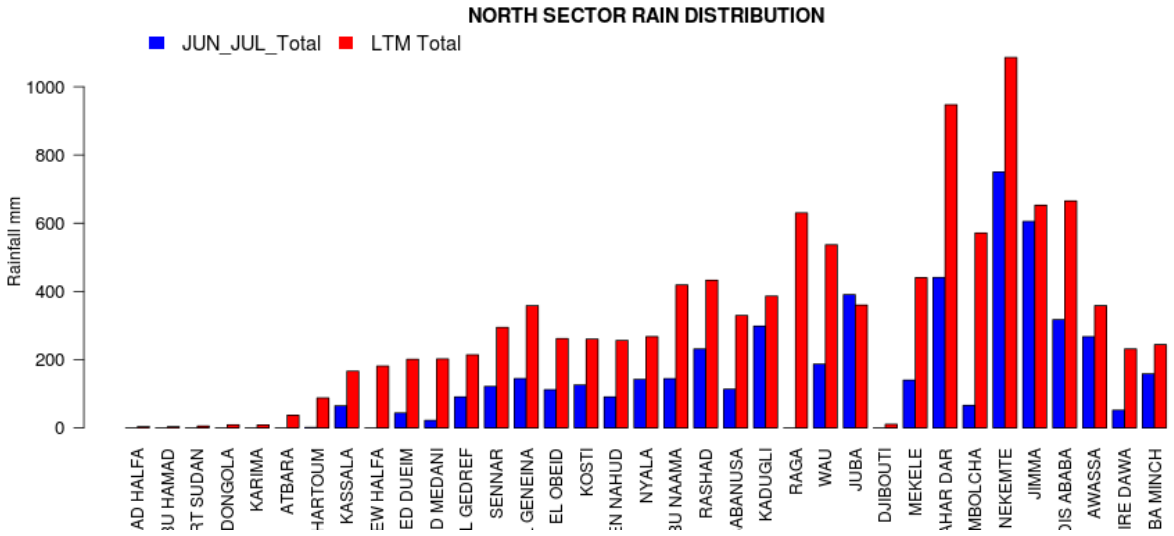


Figure 4a: Rainfall distribution in the Northern Sector stations (June-July 2015)

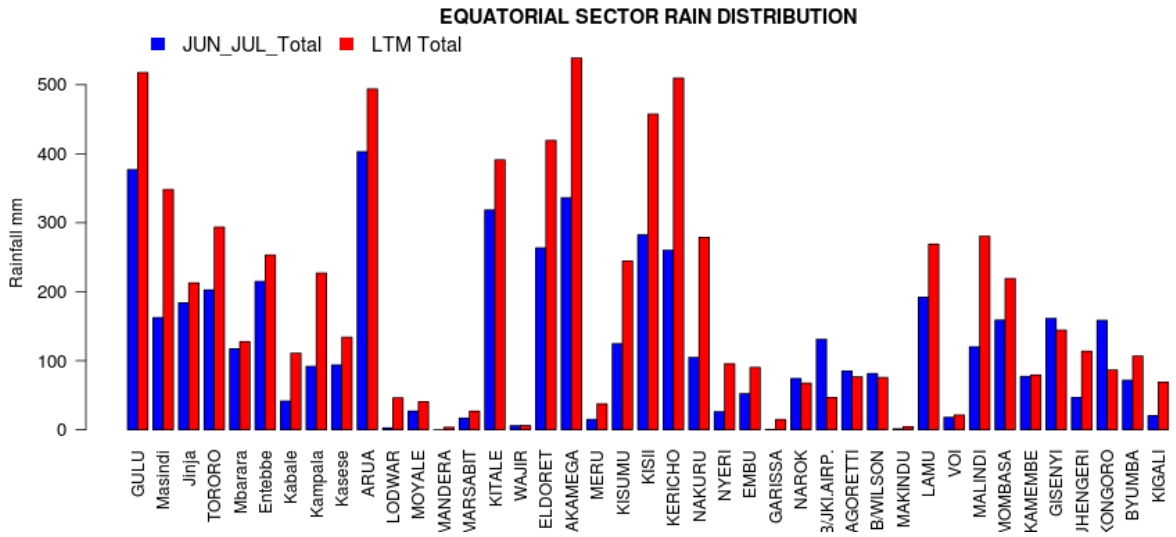


Figure 4b: Rainfall distribution over the Equatorial Sector stations (June-July 2015)

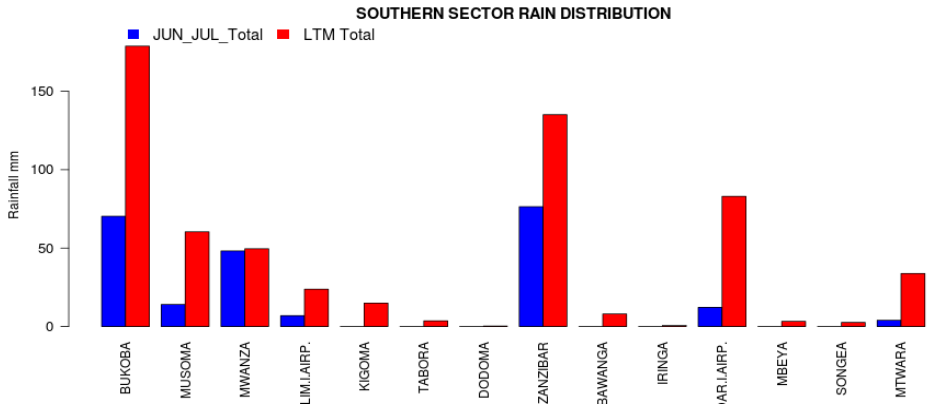


Figure 4c: Rainfall distribution in the Southern Sector stations (June-July 2015)

## 5. CURRENT AND PROJECTED STATE OF EL NIÑO AND THE GLOBAL AS WELL AS REGIONAL CLIMATE SYSTEMS

The figure 5 shows the most recent patterns of global ocean sea surface temperatures up to mid August 2015. It indicates a clear evidence of a weak El Niño condition over eastern equatorial Pacific ocean region, which have been persisting since late 2014, and is expected to continue into northern hemisphere spring months of 2016.

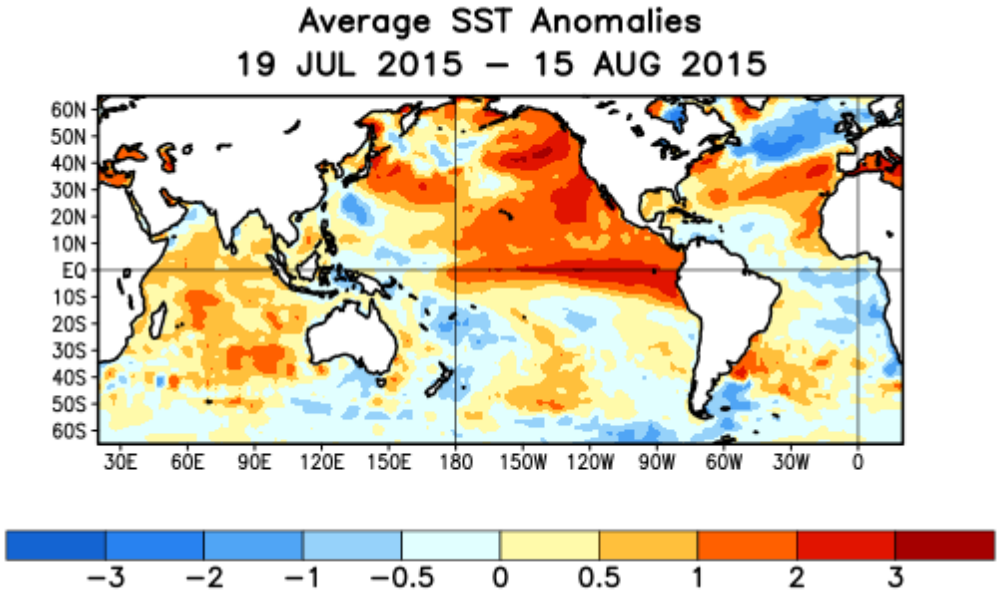


Figure 5: Tropical Ocean Sea Surface Temperature Anomaly Patterns to mid-August 2015 (Courtesy of NOAA)

## 5.2 Predicted ENSO Nino3.4 and Indian Ocean Dipole (IOD) February 2016

Most models from global climate prediction centres suggest a likelihood of the El Niño conditions to persist throughout the rest of the year and into northern hemisphere spring months of 2016 (Figure 6). Positive IOD phase is also projected to persist during the remaining part of the year (Figure 7).

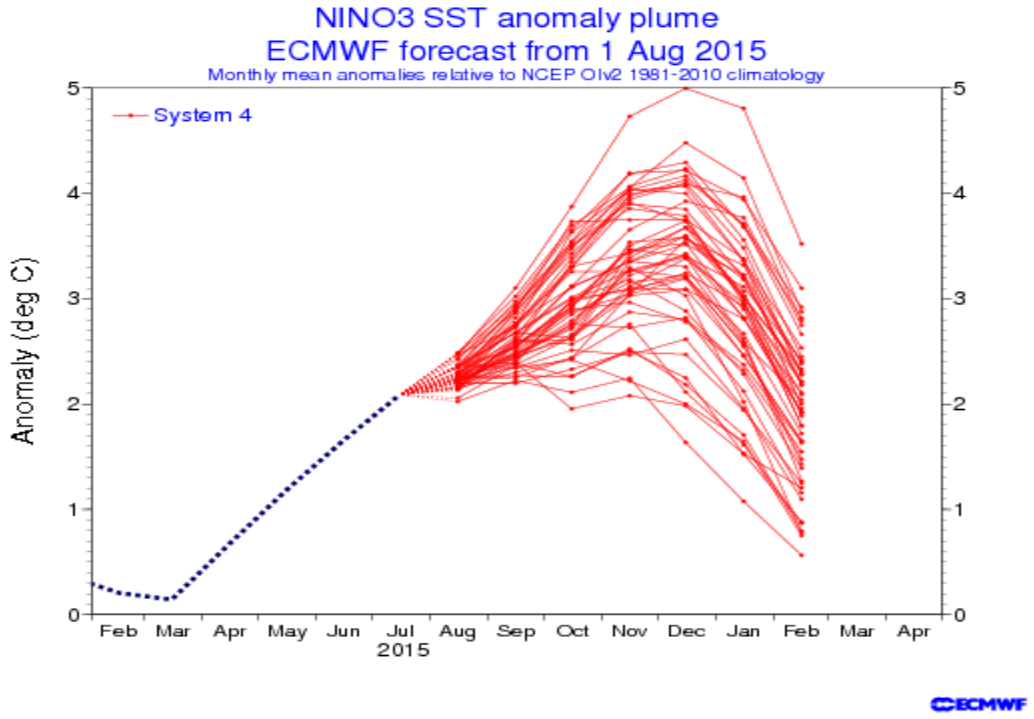


Figure 6: Predicted ENSO Nino3 sea surface temperature conditions during September2015- February2016. (Courtesy of ECWMF)

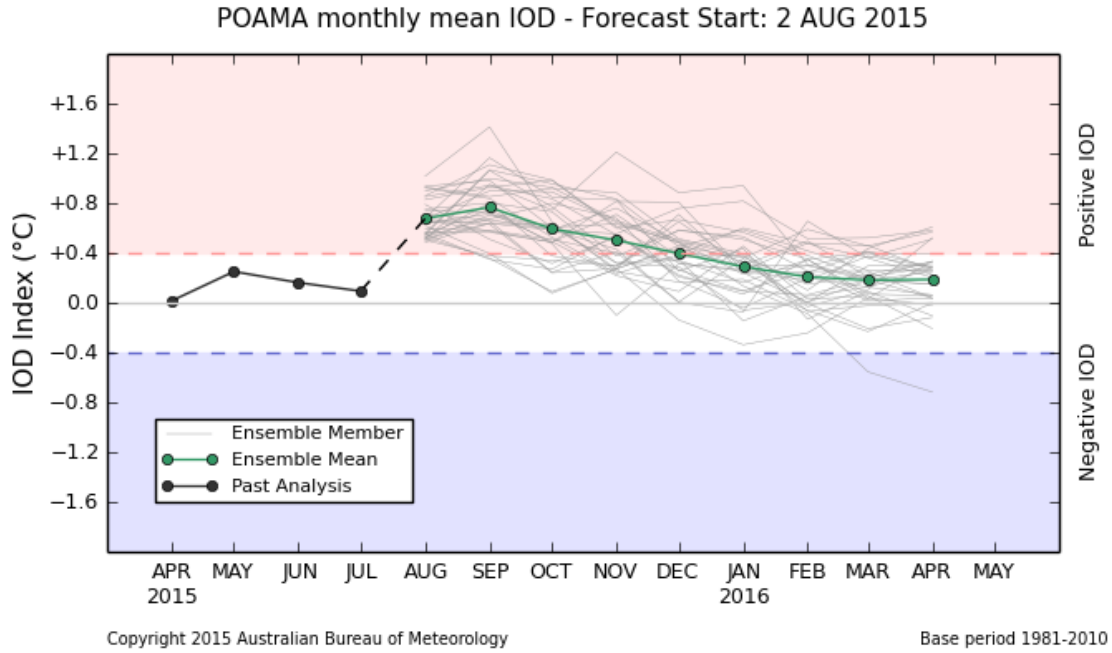


Figure 7: Predicted Indian Ocean Dipole (IOD) index during September 2015- February 2016 Source: http://www.bom.gov.au/climate/enso/index.shtml#tabs=Indian-Ocean)

Both the are crucial indicators of likely occurrences of climate extremes over GHA regional. The implications of the observed and projected IOD and ENSO conditions on the regional rainfall during September – December 2015 will be discussed at GHACOF41 that will be held in Dar es Salaam between 24-25 August 2015. Regional status and update will be provided monthly by ICPAC and Member States National Meteorological and Hydrological Services (NMHSs).

## 6. CONCLUSION

September – December is a major rainfall season for the equatorial sector of GHA while December – February is the peak rainfall season further south of the equator, while most of the tropical and northern parts are normally dry. El-Niño updates from the global climate centres including WMO August 2015 El-Niño report suggest that El-Niño conditions over tropical Pacific are likely to continue in the coming few months. While precise estimates of peak strength are not possible, models and expert opinion favor waters in the east-central tropical Pacific to warm to near or greater than +2.0°C above average, potentially placing this El Niño event among the four strongest events since 1950; (http://www. wmo.int/ pages/ members/members_en.html;http: //www.wmo.int/pages /prog/wcp /wcasp/ RCCs.html). Previous strong EL Niños with highest temperatures recorded generally during October - December months were observed in 1957, 1965, 1972, 1982 and 1997. There are few cases when El-Niño conditions persisted the whole year when an onset started during late part of the previous year as were witnessed in 1953, 1958, 1969, 1977, 1987, 1991 and 2004.

If the traditional patterns of El-Niño, IOD and other associated regional climate systems prevail then enhanced (above normal) rainfall conditions would be dominant over most parts of the equatorial sector of the GHA region during the peak rainfall season of October to December 2015 as well as the usually driest months of January- February 2016. Suppressed (below normal) rainfall conditions would be dominant over most parts of the regions further south of the equator during January- February 2016. The regional rainfall expectation for September – December 2015 will be released atGHACOF41 that is to be held in Dar Es Salaam between 24-25 August 2015.

El Niño conditions are sometimes followed by La Niña conditions, with reverse regional climate anomaly conditions to those observed during El Niño. Thus climate anomalies over many parts

of the world including the GHA influenced by El-Nino conditions often reverse when La Niña conditions sets in immediately after an El Niño even. Thus various anomalous climate extremes will dominate over the region for the next several months if El Niño event will persist or reverse to La Niña conditions. Regular forecast updates will be provided by the National Meteorological Services (NMSs), the IGAD Climate Prediction and Applications Centre (ICPAC), WMO and the major Global Climate Centres. The users are therefore strongly advised to keep in contact with their National Meteorological Services for interpretation, local details, updates and guidance on this climate brief.

**7. References**


OwitiZ., L. Ogallo, and J. Mutemi, 2008: Linkages between the Indian Ocean Dipole and East African Seasonal Rainfall Anomalies. J. Kenya Meteorol. Soc., 2(1), 3 –17 (2008)

Saji N.H., Goswami B.N., Vinayachandran P.N., and T. Yamagata, 1999: A dipole mode in the tropical Indian Ocean, Nature, 401, 360-363.

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