MONITORING FOR ENVIRONMENT AND SECURITY IN AFRICA

From Earth Observation to Policy Making – Advancing Sustainable Development in Africa

CONTINENTAL ENVIRONMENTAL BULLETIN

April 2016

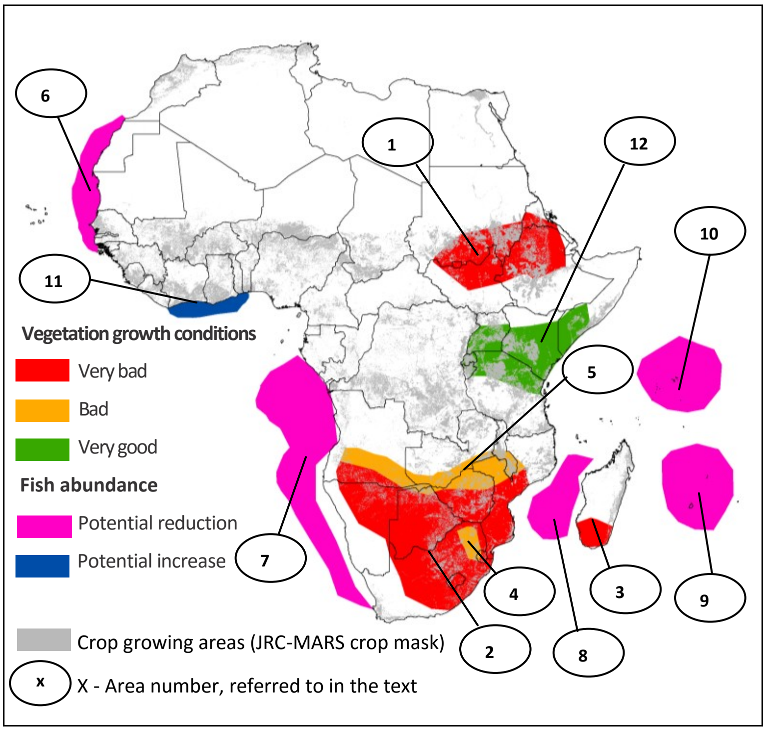


Figure 1: Map of highlights

HIGHLIGHTS

From September 2015 to March 2016

El Niño related drought conditions since the start of the season have led to poor crop and rangeland production in southern Africa and the northern part of eastern Africa.

Delays in the onset of the rainy season, with repeated failures in the start of the season, negatively affected crop growth, and pastures available livestock.

Conditions of normal to very good vegetation growth, due to enhanced El Niño rains in eastern Africa.

Intensification of upwelling has created optimal conditions to promote fish growth in the Guinea Current Large Marine Ecosystem.

Warmer than usual sea surface temperature could possibly reduce fish production in the Canary and Benguela Large Marine Ecosystems.

Warmer than usual sea surface temperature surrounding the Indian Ocean islands shows a decrease in primary production between the eastern coast of Africa and the South Western Indian Ocean islands. Possible reduction in fish production in the region.

Content

CLIMATE OVERVIEW AND OUTLOOK

Between October 2015 and February 2016, strong El Niño conditions have caused a significant deficit in precipitation across many areas of southern Africa; and also the flood events over eastern Africa.

PRECIPITATION ASSESSMENT

Significant deficit and poor distribution of seasonal precipitation since September 2015 have negatively affected many countries in southern Africa. By contrast, most of eastern Africa recorded near to above average precipitation with flood events during September to December 2015.

Below average to well below average precipitation has been observed over north-eastern Libya, some parts of southern Africa and southern Kenya during January to March 2016. Near to above average precipitation has been observed over areas covering parts of Namibia, Angola, Botswana, Zambia; Tanzania and Mozambique, northern DRC and northern Madagascar (figure 2).

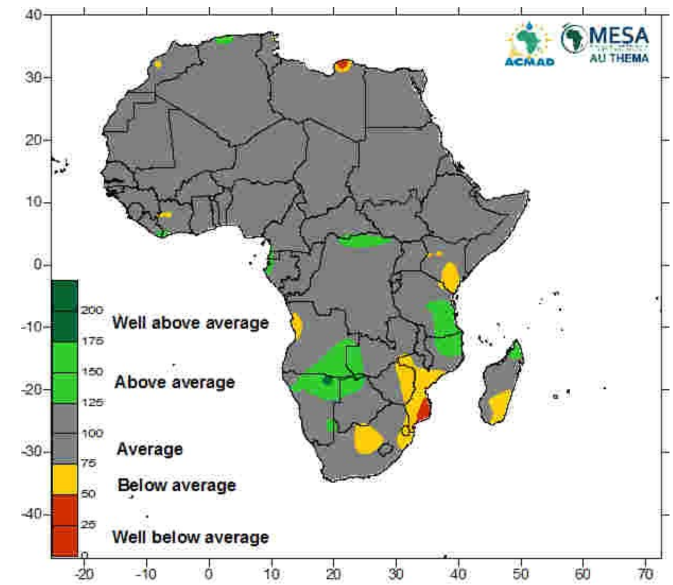


Figure 2: Precipitation as % of long term Average (1981-2010) for January to March 2016

TEMPERATURE ASSESSMENT (near surface)

During 2015 temperature anomalies of more than +2°C were recorded over northern Namibia, most of Angola and parts of South Africa. From January to March 2016, this was also recorded in south-eastern Sudan, northern Ethiopia, northern Zimbabwe and eastern South Africa.

RECENT SEA SURFACE TEMPERATURE CONDITIONS AND OUTLOOK

Pacific Ocean: From September 2015 to February 2016 strong El Niño conditions were observed in the ENSO region, followed by moderate El Niño conditions during March 2016. Most model outputs and expert assessments predict that this condition will approach near to below average during the coming months.

Atlantic Ocean: The mid latitude and south Atlantic regions were characterised by neutral to warm conditions during the past few months. These could lead to near to above average precipitation with early onset, over the northern Gulf of Guinea countries and the southern Sahel region during the coming months.

The Tropical North Atlantic sea surface temperatures (SST) have been above average during the past few months. Most model outputs and expert assessments predict near to above average conditions during the coming months.

Indian Ocean: A positive SST anomaly has dominated most of the tropical Indian Ocean since April 2015. Most models and expert assessments support a persistence of this pattern during the coming months.

Given these SST anomalies, temperature patterns and trends, knowledge and understanding of seasonal climate variability in Africa, and available long range forecast products from Global Producing Centers for Long Range Forecasts; the following outlooks on precipitation are provided for April-May-June 2016 (figures 3 and 4).

PRECIPITATION OUTLOOK

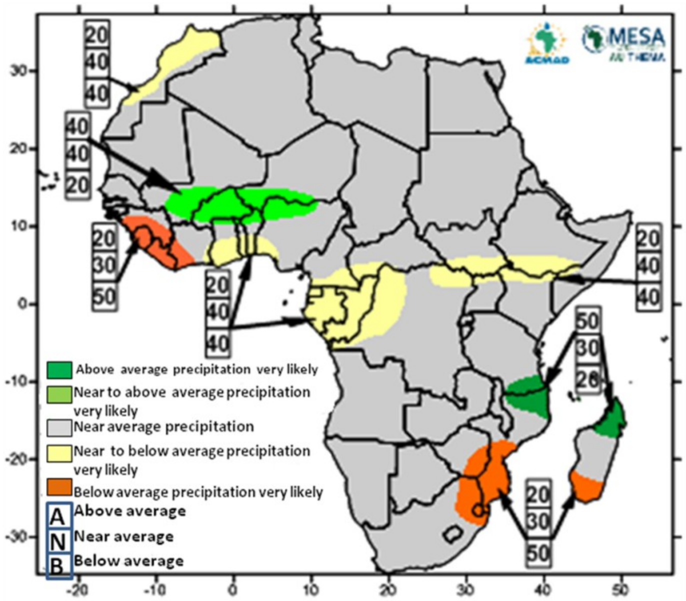
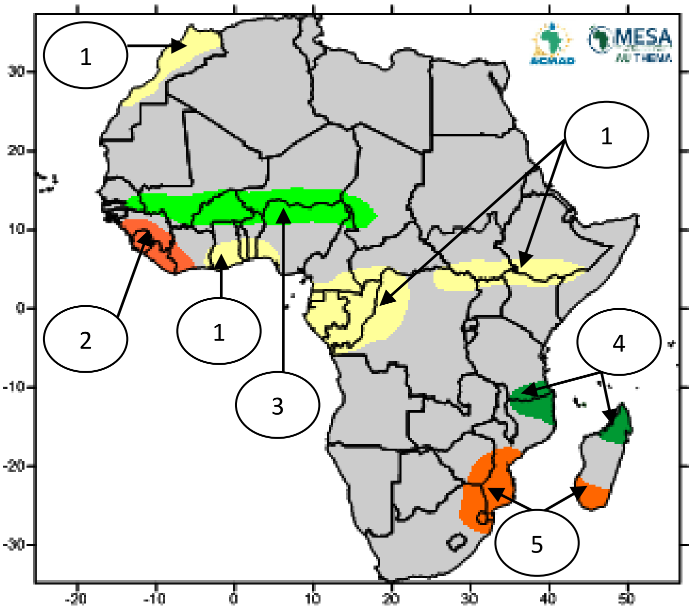


Figure 3: Seasonal Precipitation forecast for April-May-June 2016 (issued on March 31, 2016)



1: Near to below average precipitation very likely.

2: Below average precipitation very likely during the season. Normal to late onset of precipitation season.

3: Near to above average precipitation very likely. Normal to early onset of precipitation season.

4: Above average precipitation very likely with heavy precipitation.

5: Below average precipitation very likely during the season. Normal to early cessation of precipitation season.

Figure 4: Significant weather and climate events expected from April to July 2016 for Africa (issued on 31 March 2016).

WATER RESOURCES

This section deals for the first time with parts of the hydrological balance from Earth Observation data (source: European Centre for Medium-Range Weather Forecasts, ECMWF). The objective is to produce the simplified depth of runoff per river sub-basin, based on the analysis of precipitation and evapotranspiration (RUNOFF=RAIN-ETP). The water sub basin boundaries are from the HYDROSHEDS data.

WATER RESOURCES IN CONGO, LAKE CHAD AND ZAMBEZI BASINS

During this period from September 2015 to March 2016, there has been a deficit in the depth of runoff in the Lake Chad Basin, the northern part of the Congo Basin and a large part of the Zambezi Basin. In these areas the values are less than -250 mm. In the north-western part of the Zambezi Basin, the central and southern parts of the Congo Basin, the depth of runoff is between +50 and +300 mm (Figure 5).

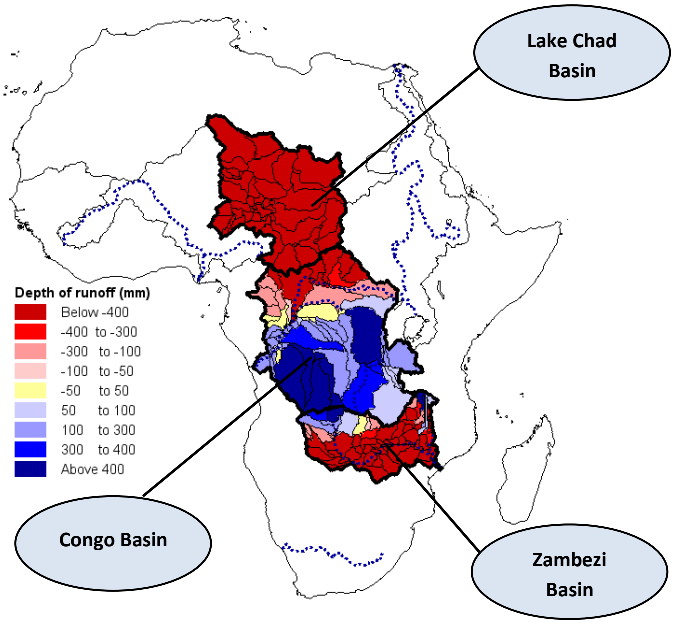


Figure 5: Congo, Lake Chad and Zambezi basins – Cumulative depth of runoff from September 2015 to March 2016

<u>CONGO BASIN: In the northern part, the dry season was drier than the average.</u>

The cumulative rainfall for the period was greater than 1000 mm over the greater part of the Congo Basin, with exceptional high values of more than 1500 mm in the Kasai sub-basins which may have led to flooding. By contrast the northern part of the Basin recorded precipitation of the order of 100 mm less than the average, leading to a drop over the season in water levels of the Oubangui and Sangha rivers which affected navigation (figure 6).

In the central and southern part of the Congo Basin the depth of runoff was positive, between +50 and +300 mm, whereas the northern part was in deficit with values between -150 and -50 mm.

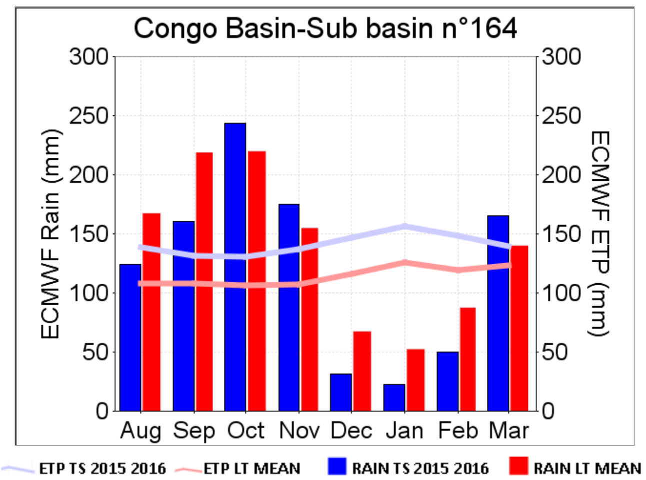


Figure 6 : ECMWF Rainfall and ETP over the Congo Basin – Sub basin n°164

<u>LAKE CHAD BASIN: Seasonal deficit in the depth of runoff</u>

The situation in Lake Chad Basin was a seasonal deficit in the depth of runoff due to the lack of precipitation in this period (figure 7).

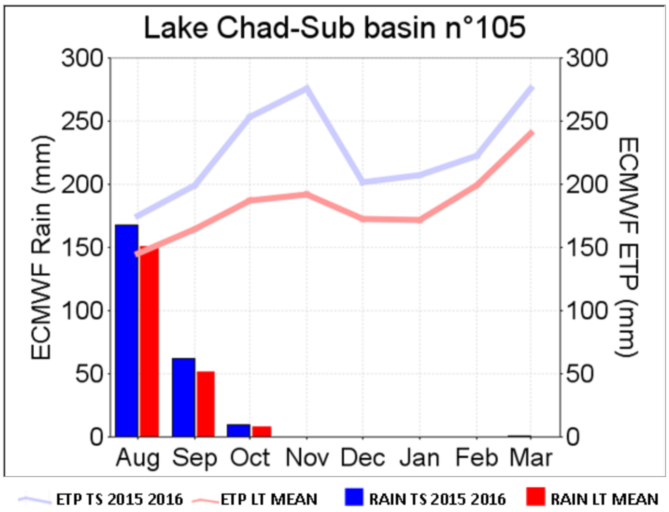


Figure 7 : ECMWF Rainfall and ETP over the Lake Chad Basin – Sub basin n°105

<u>ZAMBEZI BASIN – Continuing deficit improving in March</u>

In the Zambezi basin, monthly precipitation in large areas of the basin was from 250 to 1000 mm, well below the average, leading to a water deficit from September to February. Note that the rainfall started to increase in March (figure 8).

Evapotranspiration was high throughout the period leading to a deficit in the depth of runoff.

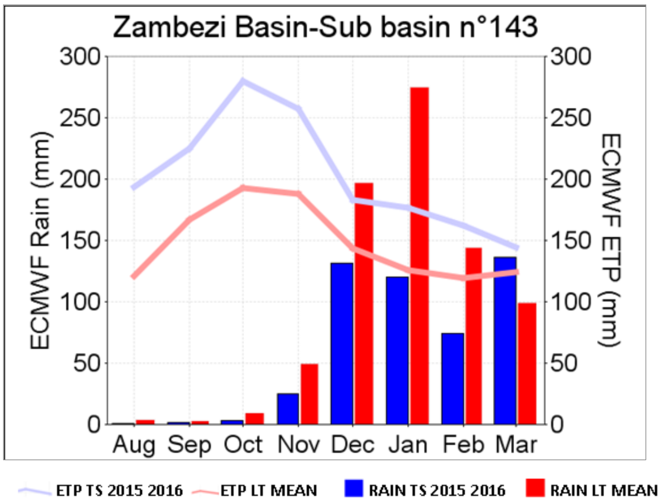


Figure 8: ECMWF Rainfall and ETP over the Zambezi Basin – Sub basin n°143

PROTECTED AREAS

CONTINENTAL OVERVIEW: El Niño impacted protected areas over the continent.

The maps below (figure 9 and 10) show vegetation and anomalies in rainfall estimates for protected areas in Africa. El Niño rains from September impacted differently the protected areas in different regions of Africa. Southern Africa and northern part of east Africa indicates below average conditions while the equatorial part, central and much of west Africa present normal to above normal conditions.

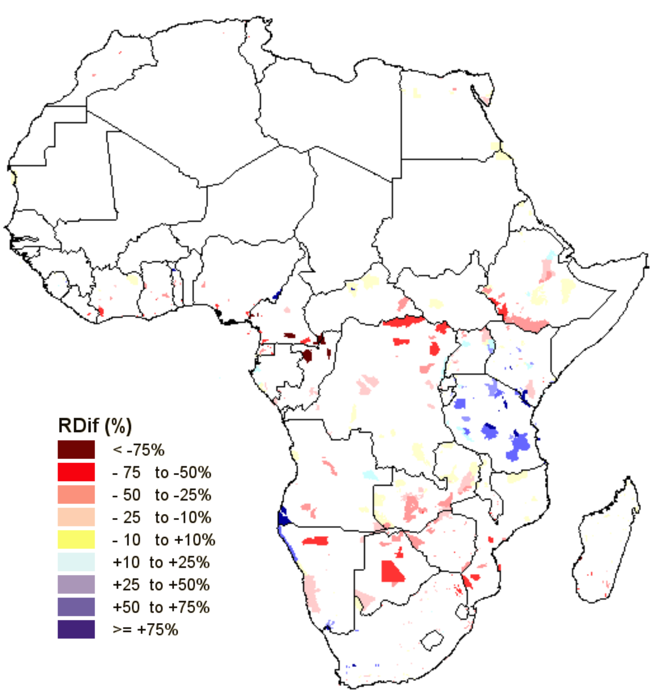


Figure 9: Rainfall anomaly on protected areas (monthly RFE anomaly) – January 2016

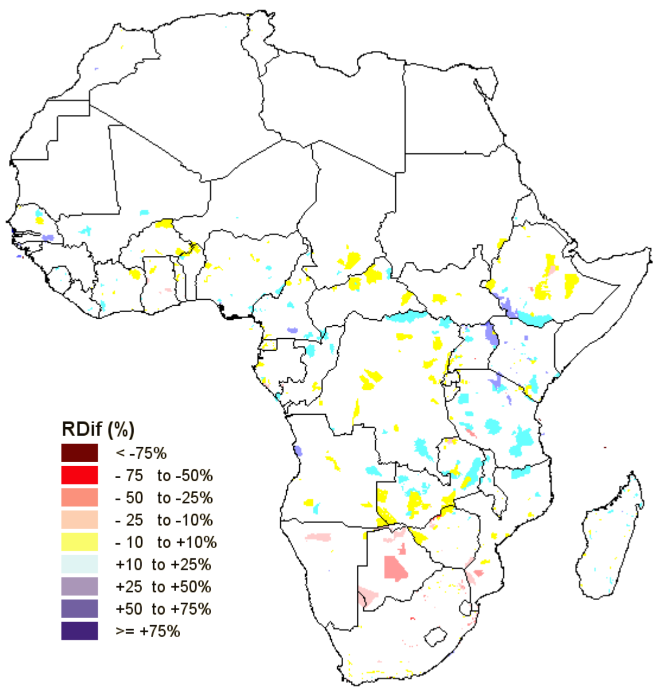


Figure 10: Vegetation anomaly on protected areas - ten days NDVI anomaly - January 2016

EASTERN AFRICA:

- **The reporting period (September to March) corresponds to the El Niño period.**
- **The impacts of El Niño indicate wetter conditions for most of the countries of the region, except for the northern part where the impacts are reversed.**

Most of the protected areas received above average rains, which had a positive impact on vegetation development and consequently there was good forage production for wildlife in the protected areas (figure 11).

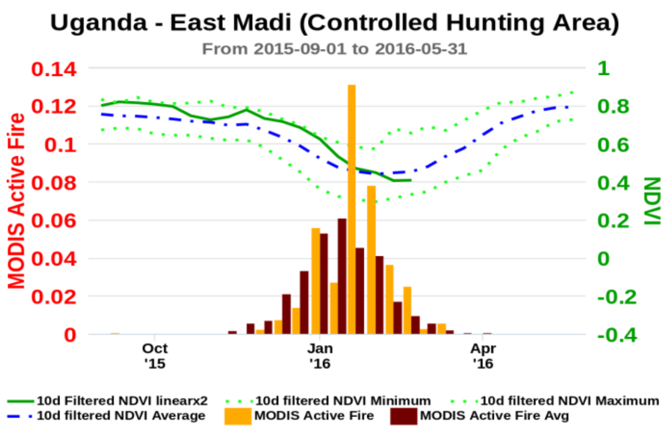


Figure 11: Fire and Vegetation over Protected Areas – East Madi, Uganda

In the northern part (northern and central Ethiopia, Eritrea, Sudan), the two consecutive seasons of below average rainfall had a negative impact on vegetation development (figure 12). This situation resulted in lower forage conditions for wildlife and livestock in the area. The current seasonal forecast for the March to May season for this area indicates near average to below average rainfall which might further deteriorate the prevailing situation.

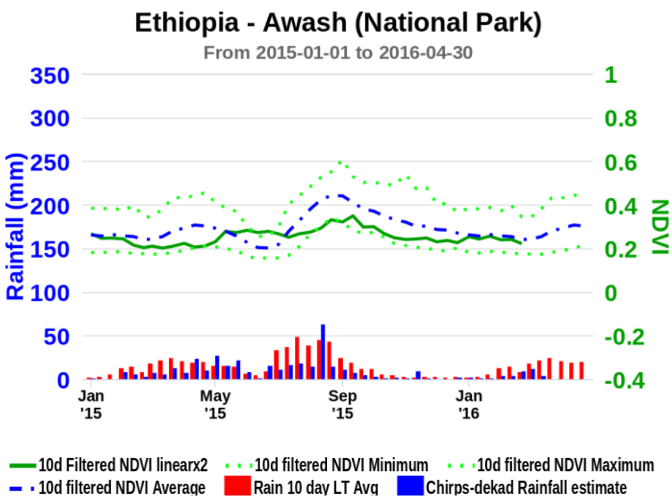


Figure 12 : Vegetation rainfall in Awash National Park, Ethiopia

PROTECTED AREAS

SOUTHERN AFRICA: The impact of El Niño led to drier conditions.

In southern Africa, most of the area suffered from the below average rainfall recorded for the season (from October to March) and the subsequent effect on vegetation development. Most of the affected areas (Botswana, South Africa, Namibia, Mozambique, Zimbabwe) (figure 1, area 2) received well below average rainfall for over 2 months and this heavily affected the development of vegetation.

In some instances, this was below the historical minimum for the last 15 years (figure 13 et 14).

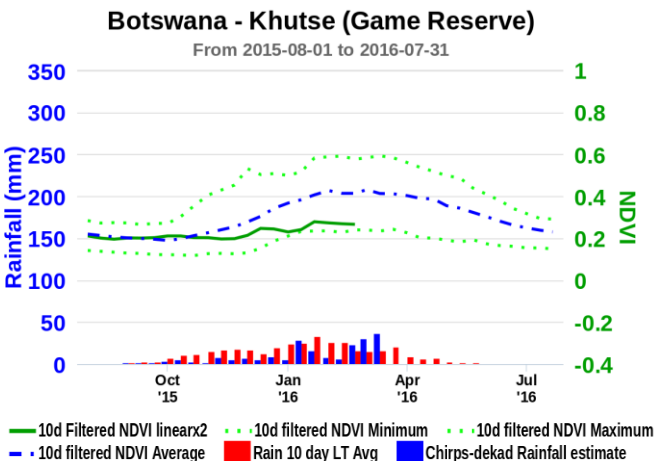


Figure 13 : NDVI and Rainfall time series in Khutse (Game Reserve), Botswana

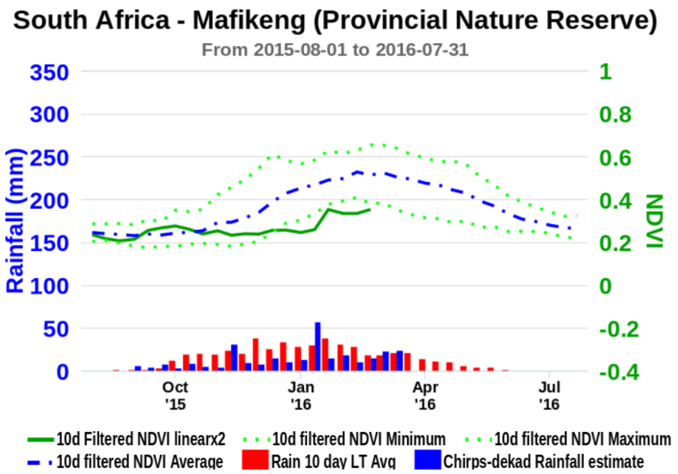


Figure 14: NDVI and Rainfall time series in Mafikeng, South Africa

The graphs (figure 13 et 14) and the matrix (figure 15) representative of the situation of the protected areas in southern Africa shows clearly the prevailing drier conditions in most of the PAs in area 1 on figure 1. It can be noticed that the vegetation conditions were below average (1999-2014) throughout the season (figure 15).

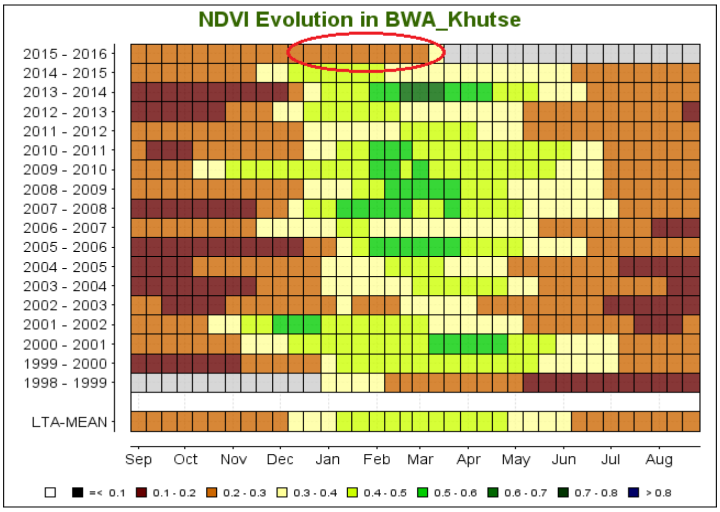


Figure 15: Evolution of the Vegetation Index compared to previous years, for Khutse Protected Area in Botswana

This situation reduced the availability of forage for wildlife within the protected areas in the region. The seasonal forecast for the coming season, April to June, indicates normal to below normal rainfall for the southern half of the region, and normal to above normal rainfall over the northern part. Consequently, vegetation (forage and pasture) might not recover during the dry season over the southern part of the region.

The impact as a result of this situation for protected areas and surroundings can include deaths of wildlife and livestock, human-wildlife conflicts competing for scarce resources, poaching activities, and illegal collection of resources within the protected areas.

WESTERN AFRICA:

- **Good rains during the season allowed good development of vegetation, and thus good availability of forage.**
- **Above average number of fires were observed during the fire season (October to April) as a result of high fuel availability due to good vegetation development.**

In west Africa, this reporting period corresponds with the end of the rain season. After a late start to the rains, the season was generally good and the rains well distributed. Good development of vegetation was observed and led to good forage availability for wildlife and livestock.

The good vegetation development observed during the season produced a high amount of fuel and led to an increased number of fire events in the area (figure 16) since the start of the fire period.

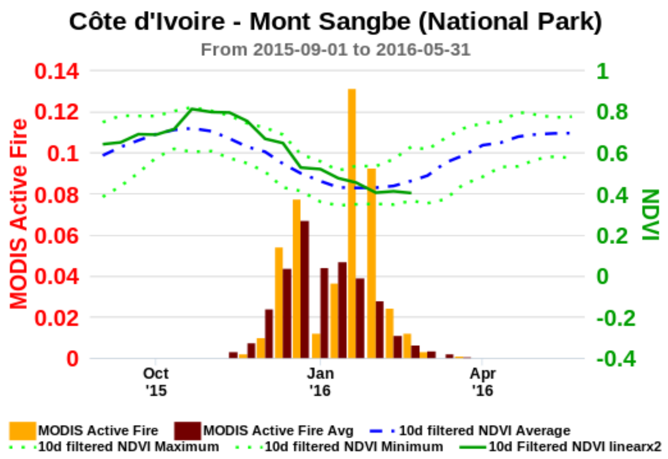


Figure 16: Fire and Vegetation over Protected Areas-Mont Sangbe, Cote d'Ivoire

AGRICULTURE – CROPS AND RANGELAND

The reporting period of this bulletin is from September 2015 to March 2016. This period coincides with the growing season for southern and eastern Africa.

SOUTHERN AFRICA (figure 1, areas 2, 3, 4 and 5): The 2015-16 season was characterised by El Niño which has resulted in a severe drought across the southern half of the region. Good vegetation conditions are observed over the northern half of the SADC region.

The 2015-16 season was characterised by El Niño which resulted in a severe drought across southern parts of the region; mostly over Botswana, Lesotho, Swaziland, Namibia, southern parts of Angola, Mozambique, Madagascar, Malawi, South Africa, Zimbabwe and Zambia. The onset of rains was delayed, shortening the growing season over these areas. In areas where rains began on time, subsequent periods of prolonged dryness and high temperature led to stunted growth (figure 1, areas 2, 3, 4 and 5).

As early as February most crops over the southern half of the region had reached permanent wilting point. In Zimbabwe, Botswana, South Africa, southern Mozambique, Swaziland and Lesotho; thousands of livestock deaths were also recorded during this period. Consequently, drought has been declared in these countries. The current drought situation has been compounded by the fact that the previous 2014-15 season was also affected by drought over most parts of the region. Over southern parts of Botswana the vegetation was below the long term minimum ever observed since the start of the season (figure 17).

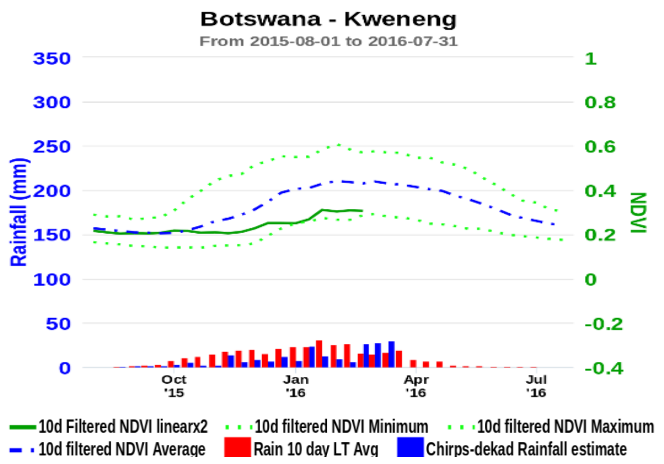


Figure 17: NDVI and Rainfall time series for Kweneng district- Botswana

Over this area the erratic rainfall and below normal rainfall for five consecutive months negatively impacted on vegetation growth.

Whilst the southern parts of the region are characterised by drought conditions, the northern half of the region (greater parts of Tanzania & DRC, northern Mozambique, Malawi & Zambia) have received above normal rainfall since the start of season, raising prospects for good harvests over these areas especially in Tanzania where vegetation is almost approaching the long-term maximum (figure 18).

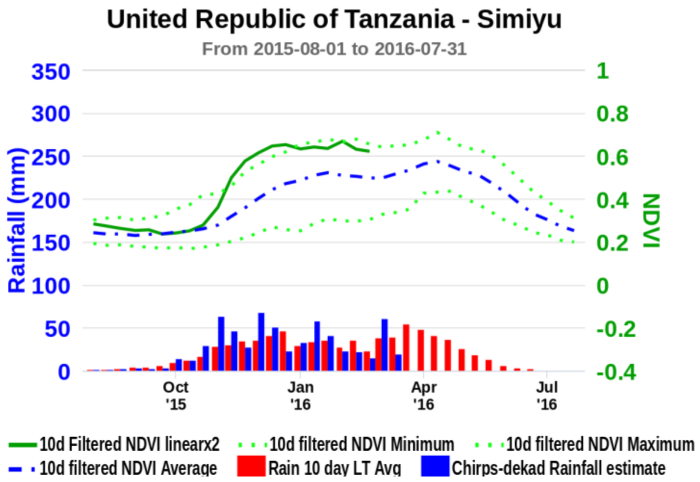


Figure 18: NDVI and Rainfall time series in Simiyu, Tanzania

The rainfall received between mid February and March especially on the southern half of the region was too late to save crops which have wilted. However, It helped recovery of rangeland as well as replenishment of watering points for livestock.

The seasonal forecast for April to June indicates normal to below normal rainfall for the southern half of the region, and normal to above normal rainfall over the northern part. Consequently the recovery of pasture might not be sustained into the dry season over drought affected areas.

WESTERN AFRICA:

- **2015 crop and pasture production higher than that of 2014.**
- **Important damage and loss of lives due to bush fires in some Guinea Gulf countries.**
- **Early to average onset of the 2016 long rainy season in Guinea Gulf countries.**
- **Below average cumulative rainfall and long dry spells forecasted for the 2016 long rainy season in Guinea Gulf countries.**

After an almost general late onset, the rainfall situation improved significantly from the end of July 2015. Some areas of the Sahel and the west of the region even experienced an exceptional extension of the rainy season till late October or early November (figure 19). Agricultural production has generally been higher than that of 2014 and the average of the past five years, except in Burkina Faso, Guinea Bissau and Chad, where small decreases (<10%) compared to the five-year average were recorded for cereal crops. The rangeland situation, after being very critical until July due to the late start of the rainy season, improved thereafter with forage growth due to regular rainfall.

However, some areas of low vegetation development, which are prone to forage deficit, were still existing in late October in the Louga and Matam regions in Senegal, the Guidimaka region in Mauritania, the southern regions of Tillaberi, Maradi and Zinder in Niger and Chari-Baguirmi in Chad (figure 20).

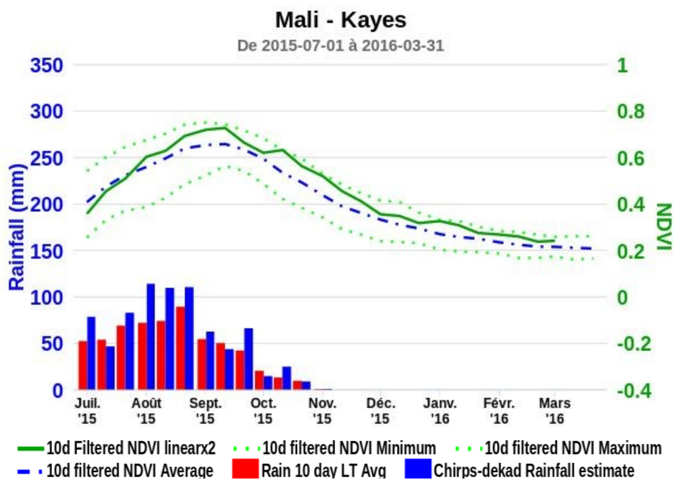


Figure 19 : NDVI and Rainfall time series in Kayes, Mali

WESTERN AFRICA: ***Continued***

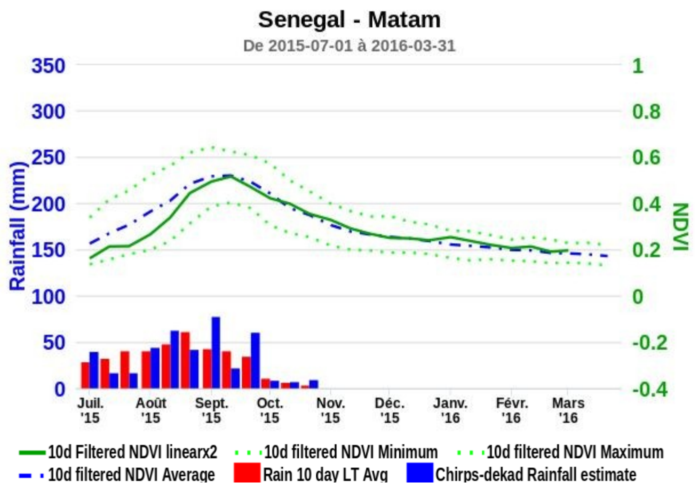


Figure 20 : NDVI and Rainfall time series in Matam, Senegal

The movements of transhumant herds were normal with good access to fodder resources and water sources, except in northern Mali and the Lake Chad Basin because of insecurity. In coastal countries, particularly in Togo and Liberia, an increase in bushfire occurrence was observed since the beginning of the fire period (November), with massive destruction of forests and loss of human lives.

The 2016 long rainy season in Guinea Gulf countries had an early to normal onset thanks to the rains that fell during the second decade of March. However, the forecasts made at the PRESA GG-03 meeting in mid-March 2016 in Lome, Togo, indicate the likelihood of having long dry spells after crop installation and below average cumulative rainfall amounts throughout the Guinea Gulf region. Rainfall deficits observed here and there during the first decade of April may support this prediction. This can be explained by the prevalence of an El Niño condition and also the current cooling of waters in the Gulf of Guinea. This situation requires close monitoring in the coming weeks and months.

EASTERN AFRICA (figure 1, areas 1 and 2):

- **Good vegetation development has been observed over the equatorial sector of eastern Africa due to El Niño rains.**
- **Two consecutive seasons of below average rainfall seasons have led to bad crop production in the northern sector of eastern Africa (Ethiopia, Eritrea, Sudan and South Sudan). The current rainy season is forecasted to receive near average to below average rainfall, further worsening the prevailing situation.**
- **Flooding is observed as a result of El Niño rains over the equatorial sector of eastern Africa.**

In eastern Africa, the period corresponds to the end of the rain season in the northern sector, and both the September to December 2015 season and the start of the rain season from March to May 2016 for the equatorial sector.

In the equatorial sector of eastern Africa, the September to December season was characterised by the El Niño rains which were above average for the whole season and led to good vegetation development. Good crop production is expected in area 12 (figure 21).

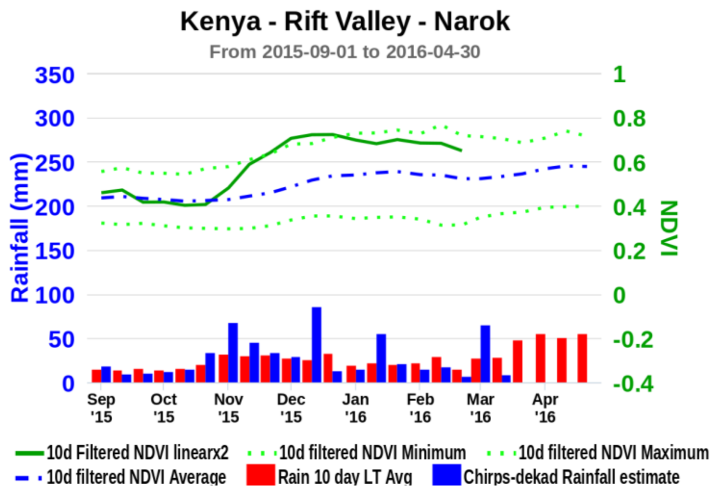


Figure 21 : NDVI and Rainfall time series in Rift Valley – Narok, Kenya

In the northern sector of IGAD (especially Ethiopia, Eritrea, Djibouti, Sudan, South Sudan), the season is coming to the end in this reporting period. The previous below average rain season combined with the failed El Niño rains for September to December (figure 22), led to poor development of vegetation. Poor crop production is expected which will negatively impact millions of people in that region.

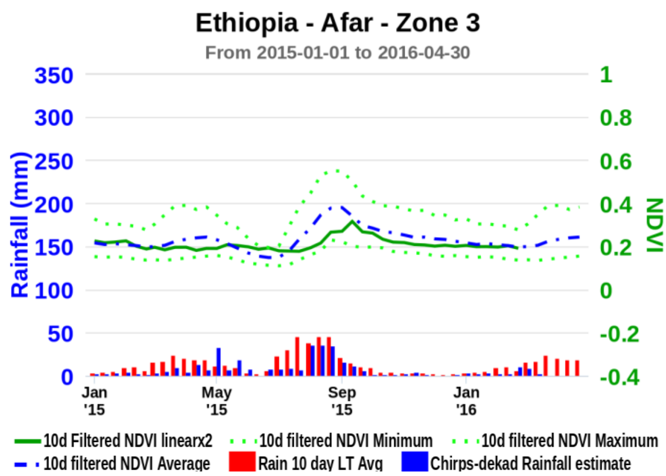


Figure 22 : NDVI and Rainfall time series in

__For the coming season__ in the equatorial sector (March to May) the season is predicted to receive near average to above average rainfall, and near average to below average over the northern sector of eastern Africa. The equatorial sector is predicted to have good rains, so good development of vegetation is expected which would lead to good crop production. In the northern sector, the combined effect of the failed rains due to El Niño and the current seasonal forecast will further exacerbate the already bad situation prevailing in the region. Close monitoring of this is highly recommended.

CONTINENTAL OVERVIEW: Increased primary production in some parts of the western coast of Africa, and higher than normal sea surface temperatures in the South Western Indian Ocean

Generally, the period from August 2015 to February 2016 was warmer than the average from 2002 to 2014, for most parts of the eastern Atlantic and the South West Indian Ocean (figures 23 and 24) which may be the effect of the current El Niño. There was a corresponding increase in Chlorophyll-a (Chl-a) concentration in some coastal and continental shelves in the western and eastern coasts of Africa, except around the coast of Madagascar.

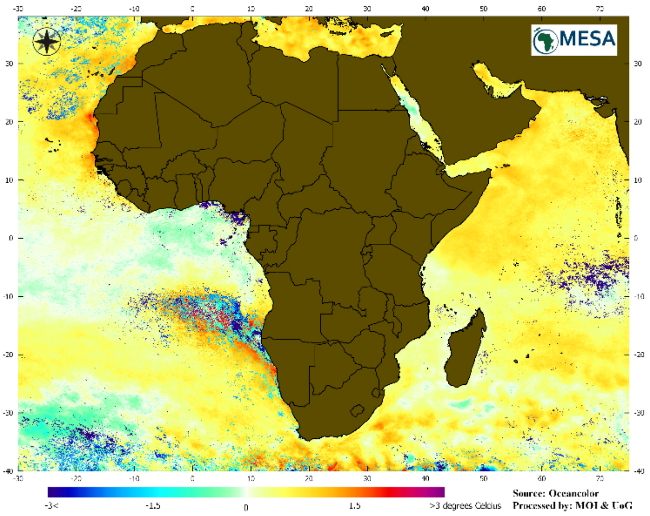


Figure 23: Sea Surface Temperature anomaly from Aug 2015 to Feb 2016

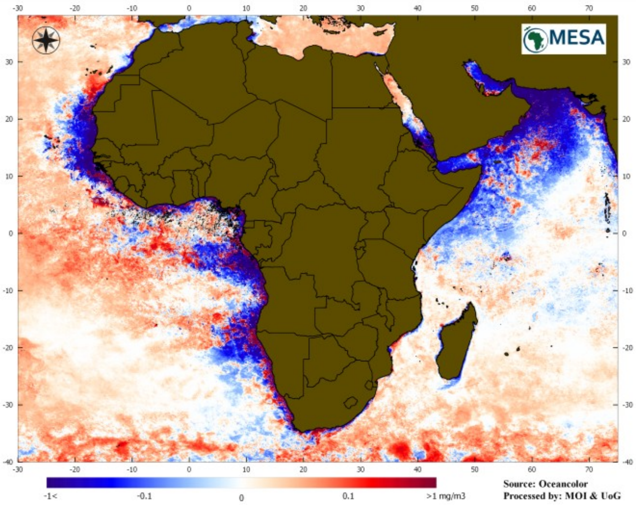


Figure 24: Chlorophyll Concentration anomaly from Aug 2015 to Feb 2016

EASTERN ATLANTIC: Intense upwelling associated with increased primary production

Canary Current Large Marine Ecosystem (figure1, area 6)

Warmer sea surface temperatures were observed off the northern coast of Africa. The warm sea surface temperatures (SST) observed in the fishing areas north of Liberia to Mauritania for the period from August 2015 to February 2016 were consistent with low Chl-a concentrations observed in the same region. This suggests that phytoplankton, which is the vital food source for herbivorous pelagic fish, were in low abundance in terms of supporting fish growth. The upwelling zone of the Canary Current is a major fishing zone for industrial fishing fleets that target high value commercial species including cephalopods and tuna. Like the industrial fisheries, the artisanal fisheries are also expected to have low fish catch.

It is anticipated that SST will decrease in the coming few months with no potential increase in Chl-a concentration, suggesting that phytoplankton biomass may decrease in the Canary Current (figure 25, a). By contrast, there was positive Chl-a concentration anomalies of the coast of Guinea which is indicative of high phytoplankton biomass, an essential condition for fish to aggregate.

Guinea Current Large Marine Ecosystem (figure 1, area 11)

Surface temperature in the Gulf of Guinea and equatorial waters were relatively colder than the average surface temperature. Phytoplankton abundance was higher than usual (positive Chl-a anomalies) in most part of the Guinea Current and equatorial regions which can be linked to high nutrient availability resulting from upwelling, as indicated by negative SST anomalies during August and September 2015 (figure 25, b). During the upwelling months, SST was lower than usual which is indicative of upward flow of nutrient-rich bottom water to nourish phytoplankton growth at the ocean surface. This might have improved the chances of finding fish for the commercial fishermen from Ghana who carry out fishing on the high seas. Negative Chl-a anomalies, i.e. less Chl-a than normal, on the continental shelves in the Gulf of Guinea may affect activities of the artisanal and semi-industrial fishermen, as fish abundance is anticipated to be low. At the southern limit of the Guinea Current (near the Benguela) negative Chl-a anomalies could be attributed to the warming of the upper ocean (positive SST anomalies), which is expected to increase stratification and reduce nutrient concentration, which in turn will reduce phytoplankton growth.

Benguela Current Large Marine Ecosystem (figure 1, area 7)

In the Benguela, SST was generally warmer than usual except at the northern limit which was colder. Primary production was relatively higher in coastal regions from Namibia to the western coast of South Africa. This observation could suggest fishing in the coastal regions, which are largely undertaken by the artisanal fishery, might have been positively affected. Patches of increased Chl-a concentration in the oceanic region may have positively affected fish aggregation. In the coming few months, it is anticipated that SST will steadily increase, which will reduce phytoplankton growth.

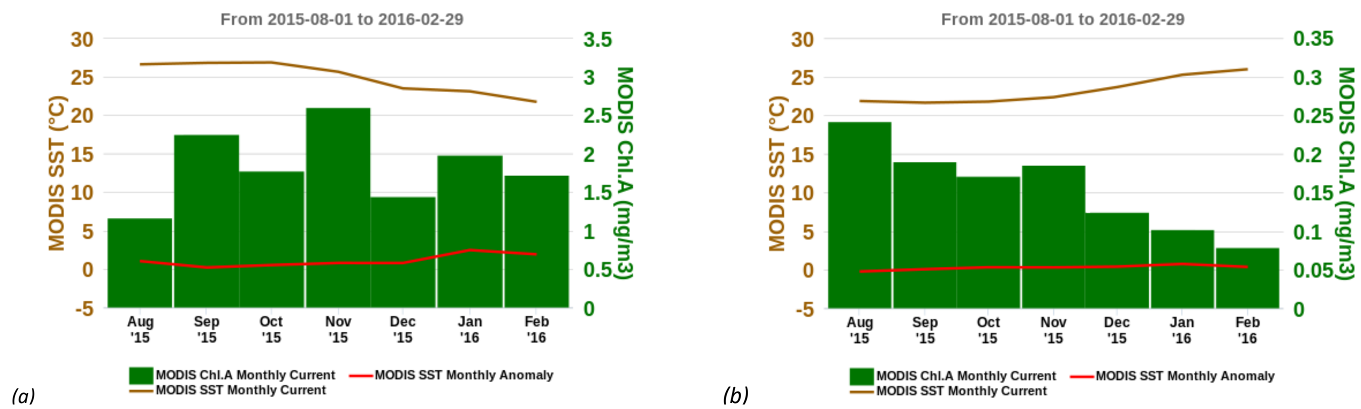


Figure 25: Time series of SST from Aug 2015 to Feb 2016 for (a) Mauritanian part of the North Atlantic Ocean and (b) Guinea Current part of the Eastern Atlantic

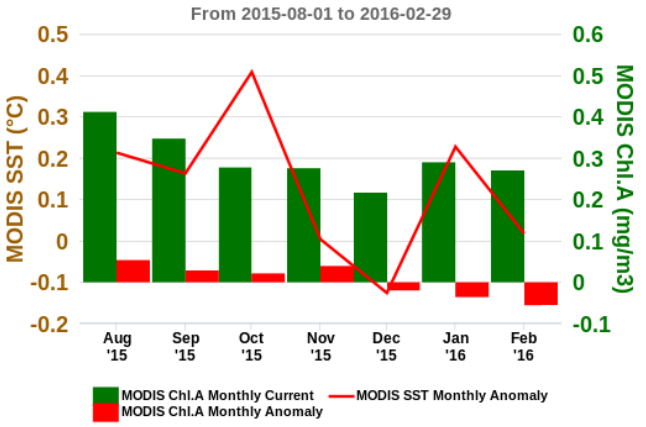
SOUTH WESTERN INDIAN OCEAN: Sea surface temperature higher than usual.

The Mozambique Channel (figure 1, area 8)

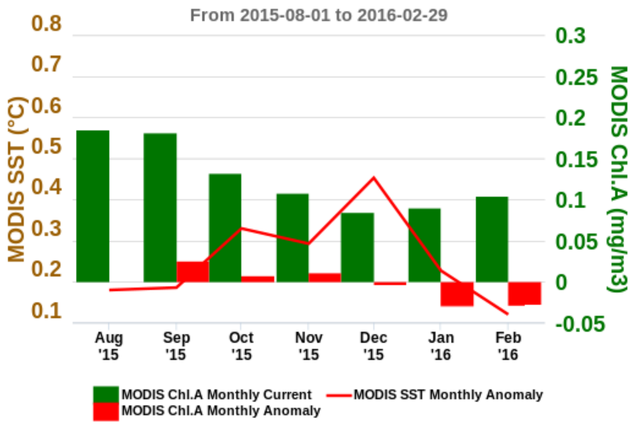
The Mozambique Channel

In the Mozambique Channel, warmer water was recorded which could have been due to the impacts of El Niño in the Pacific. This warm effect was connected with the South Equatorial Current, and a warm stretch of water on the continental shelf. The warm effect was observed along the Channel and mixed with southern cold water, that are represented by negative SST anomaly patches. In contrast to normal conditions, chlorophyll concentration is lower than usual around the coast of Madagascar, but the conditions are above normal in the Channel.

The times series analysis performed in a region west of Madagascar indicates warmer temperatures, with values 0.4^{0}C above normal, except for November and December which are below normal (figure 26, a). Chlorophyll concentration is lower from December to February, this correlates with a rise in temperature, which is expected. The eastern part of Madagascar was relatively warmer with a maximum of 0.5^{0}C above normal, and chlorophyll values the same as the western part of the country (figure 26, b). It is anticipated that the fishery sector will have a reduction in catch during this period.



(a)



(b)

Figure 26: Time series of SST from Aug 2015 to Feb 2016 for (a) the Madagascar part of the Mozambique Channel and (b) Madagascar part of the Indian Ocean

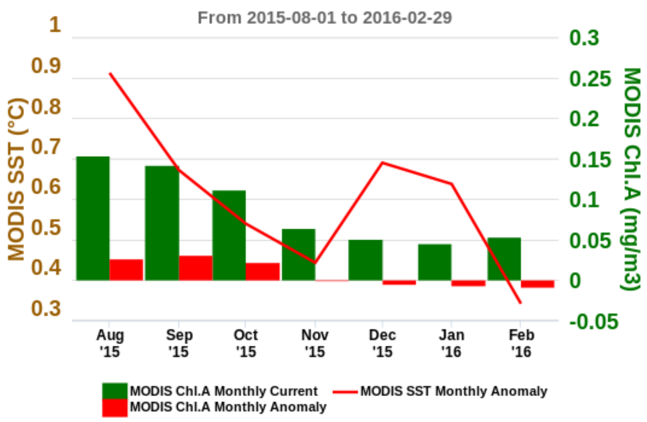
Mauritius and Seyshelles EEZ

Mauritius EEZ (figure 1, area 9)

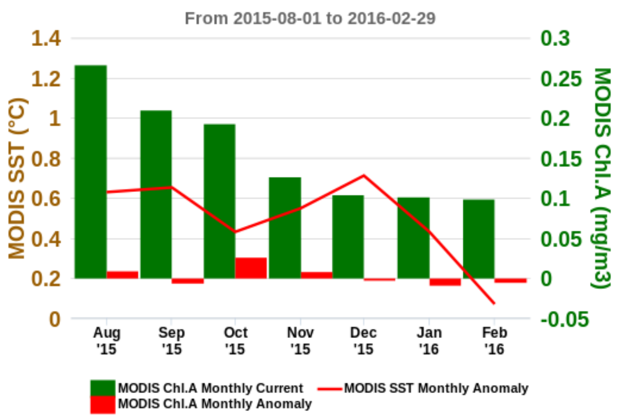
The region surrounding Mauritius were considerably warmer than usual (> 0.5^{0}C) during the summer season compared to the seasonal average (figure 27, a). As expected for the Economic Exclusion Zone (EEZ) of Mauritius, the chlorophyll concentration was higher up to October and reduced below normal from December, as a consequence of the rise in sea temperature. A sudden rise in sea temperature can also be noted from November to January which reflects the warm temperature on land during this period. The chlorophyll concentration values which were below the average, represent a low level of primary production from November to February. Low concentrations of Chl-a, which directly results in low plankton production, implies a possible decrease in fish.

Seychelles EEZ (area 10)

The Seychelles region is generally productive with high chlorophyll concentration. For the period of analysis the level was about normal, but the sea temperature was above normal with the maximum in December, reflecting the general state in the Indian Ocean (figure 27, b). The eastern region of Seychelles indicates an upwelling with low surface temperature, which should have been reflected in high values of chlorophyll, but was not the case. This means that fishing areas in this region were likely to have reduced phytoplankton biomass, implying less fish catch.



(a)



(b)

Figure 27: Time series of SST from Aug 2015 to Feb 2016 for (a) Mauritian part of the Indian Ocean and (b) Seychelles part of the Indian Ocean

ELECTRONIC MONITORING OF FISHING VESSELS

Periodic information on fishing activities from electronic monitoring systems is widely used to support fisheries management. MESA through its fisheries management services is providing indicators of fishing effort derived from satellite Automatic Identification Systems (AIS), to support monitoring efforts of coastal countries in Africa.

Analyses of fishing vessel traffic collected from AIS in the eastern tropical Atlantic from January to March 2016, show the major fishing areas for industrial fishing fleets in the eastern tropical Atlantic (figure 28). These areas were the continental shelf regions from northern Mauritania to Sierra Leone, the Gulf of Guinea, and the oceanic waters south of Cape Verde between latitudes 5°N - 16°N and west of longitude 20°W. Another fishing area covered the continental shelves of Congo, DR Congo, Angola and Namibia.

A total of 349 fishing vessels flagged to 39 countries operated within the major fishing areas within the three month period. It was observed that a large number of fishing vessels operated from Sierra Leone to Mauritania, with the least number within the shelves off Congo to Namibia (counts of fishing vessels per area (degree square): Sierra Leone to Mauritania [42%]; Gulf of Guinea [32%]; South of Cape Verde [17%]; and Congo to Namibia [9%]. This suggests there was higher fishing pressure within the Canary Current LME, and least fishing pressure in the Benguela LME.

Fishing activities within the shelves off Sierra Leone to Mauritania were dominated by vessels from China and Spain. The two countries contributed close to 65% of the estimated fishing pressure with 155 vessels operating in the region (figure 29, a). Vessels flagged to Ghana, China and Spain actively operated in the Gulf of Guinea and contributed close to 70% of the fishing effort. A total of 92 vessels were estimated to have fished in the region (figure 29, b). The fishing areas south of Cape Verde and from Congo to Namibia had a relatively lower number of fishing vessel operating in the regions. Vessels flagged to Spain, Japan and China were observed to be actively fishing in the two areas.

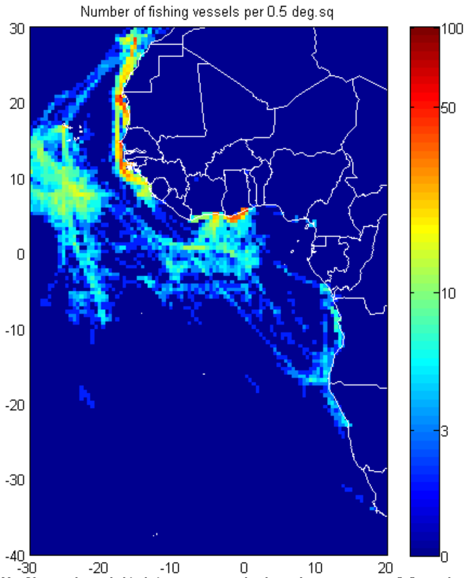
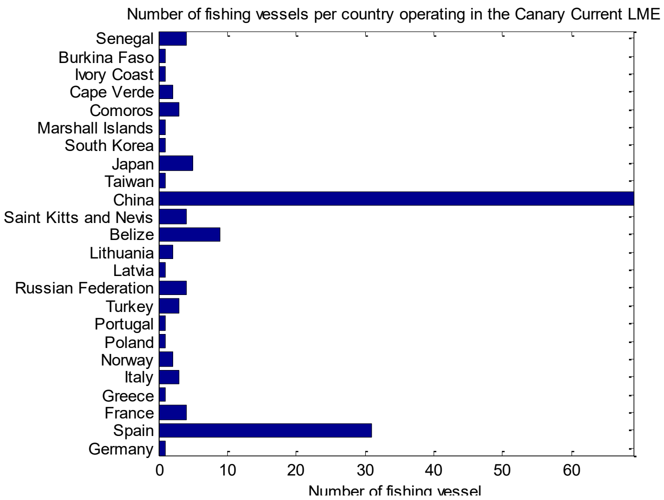


Figure 28. Counts of fishing vessels for January – March, 2016

(a)



(b)

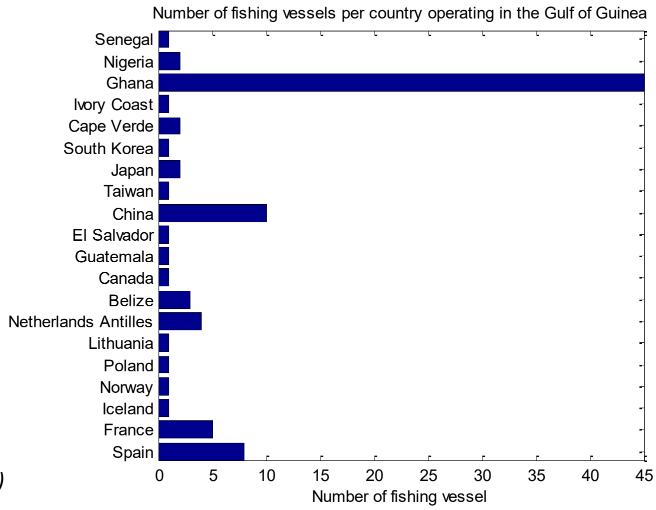


Figure 29 (a-b). Counts of fishing vessels per county

EXPLANATION OF THE GRAPH LEGENDS

10d Filtered NDVI linear x2	10 day NDVI filtered by smoothing (2 linear passes)
Anomaly	Difference from a long term mean
Chirps—dekad rainfall estimate	CHIRPS is a source of rainfall estimation, see http://chg.geog.ucsb.edu/data/chirps/
dekad	10 day period
ETP TS / LT MEAN	EvapoTranspiration Time Series / Long Term Mean
LTA	Long Term Average – mean value over the reference period; for NDVI – 1999-2014, for RFE – 2000-2014
LTA-MEAN / LT AVG	Long Term Average – Mean
LTA-MIN / LTA-MAX	Long Term Average – Minimum / Long Term Average - Maximum
NDVI	The Normalized Difference Vegetation Index (NDVI) is an indicator of greenness.
RAIN TS / LT MEAN	Rainfall Time Series, using CHIRPS / Long Term Mean, using CHIRPS
RFE	RainFall Estimate, using CHIRPS
SST	Sea Surface Temperature

A SPATIO-TEMPORAL ANALYSIS OF THE CONTINENTAL ENVIRONMENT USING CLUSTER ANALYSIS

Medium and low resolution satellites produce a lot of data due to the high frequency revisiting period at continental level. Statistical methods like cluster classification can be applied to NDVI time series, to get an overview of the patterns of vegetation evolution within the period of interest. It can then be used to reduce the field of analysis by excluding desert areas and focusing on areas where agricultural monitoring is relevant.

Figure 30 below shows on the right the 7 cluster classes over Africa, and on the left the corresponding average NDVI profiles, using the same colour schemes.

It depicts mainly: the desert area (cluster 7), the area of perennial vegetation (cluster 1 mainly in Central Africa), the season centred on September (clusters 3 & 5 mainly over the Soudan-Sahelian zone with different levels of vegetation activity), the season centred on December (cluster 2) and February (cluster 4), the area with low NDVI from November (cluster 6 over southern and eastern Africa), the algorithm is assigning each pixel to the most similar cluster according to statistical proximity factors. Each cluster is characterised by a specific profile depicting the evolution of the NDVI during the period. It shows the vegetation growth pattern over space and time, giving an overview of the vegetation growth.

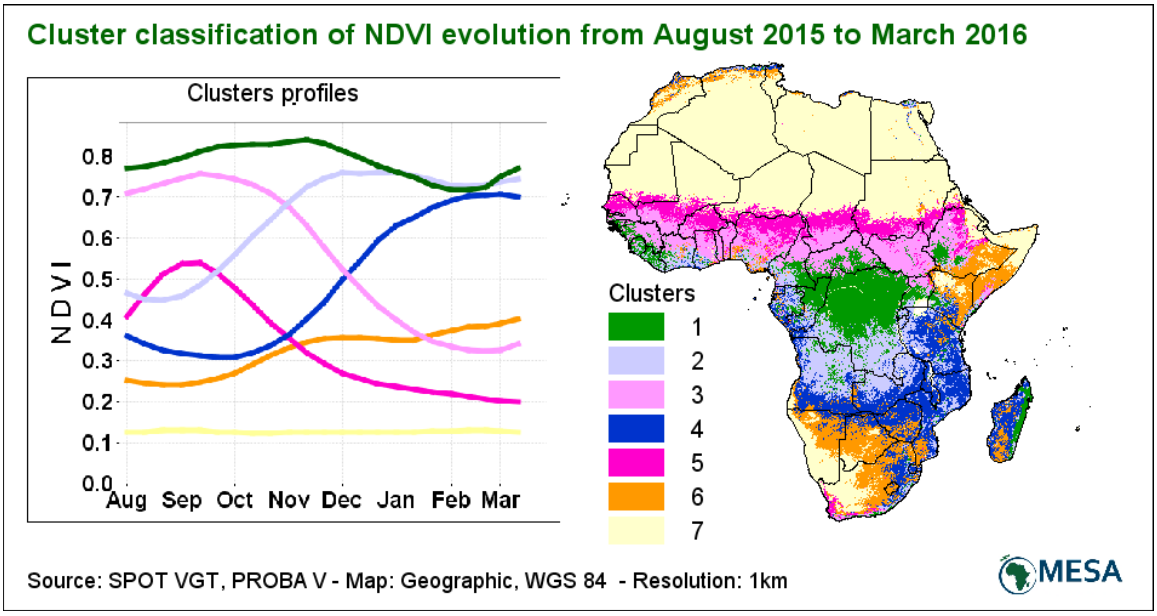


Figure 30: Cluster classification of the 10 day NDVI from August 2015 to March 2016

The same method can be applied to the NDVI anomalies to identify problem areas, when they started, how long they last and how important is the anomaly in vegetation growth compared to the average.

Figure 31 below shows in dark red, cluster 5, the area affected by significant anomalies up to -30% (Relative difference= [Current NDVI – Average NDVI]/Average NDVI). The reduction started in October and continued to worsen up to December 2015, then it slightly improved, but was still below the seasonal NDVI value.

Due to its duration (several months), intensity (up to -30%) and the periods of the agricultural season when it occurred; this anomaly is a significant signal of an important drought that hit several countries. Detailed analysis can then focus on such area to better define the type and impact of such drought.

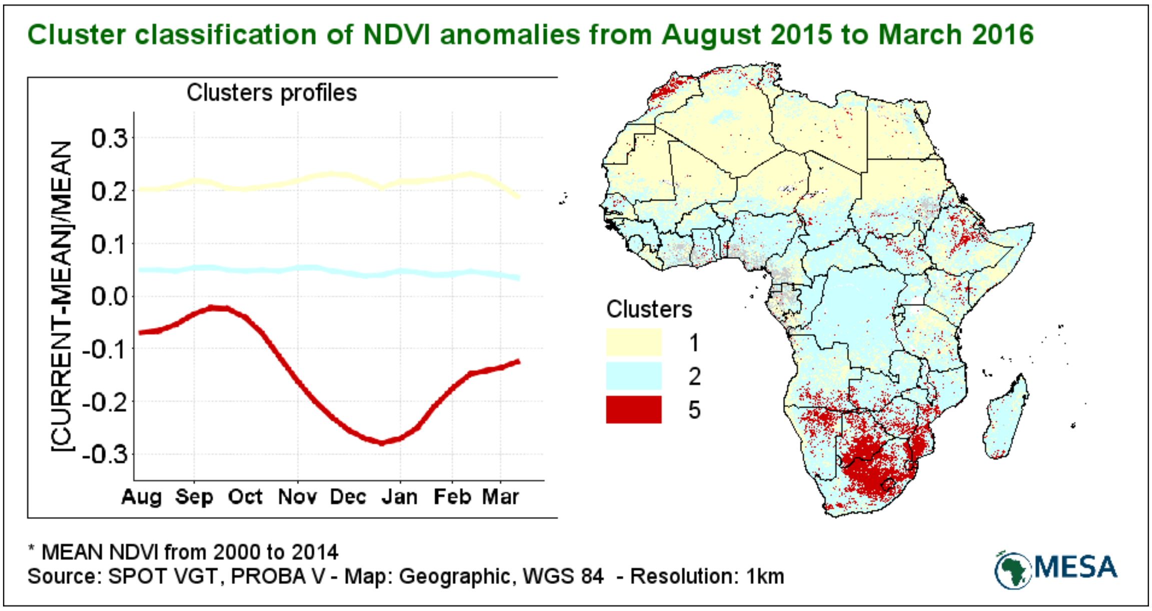


Figure 31: Cluster classification of the 10 day NDVI anomaly from August 2015 to March 2016

THE MESA PROGRAMME

MESA uses space-based and in-situ data to enable an improved management of the environment and food security at continental, regional and national levels in Africa. MESA consolidates and widens the operational environmental services developed in the AMESD (African Monitoring of the Environment for Sustainable Development) programme, and is a contribution to the GMES-Africa initiative of the EU-Africa Joint Strategy.

The purpose of the MESA programme is to increase the capacity in information management, decision making and planning of African continental, regional and national institutions mandated for environment, climate and food security. This will be achieved by enhancing access to reliable, timely and accurate land, marine and climate data and information for Africa. MESA is exploiting Earth Observation (EO) data and technologies to promote socio-economic progress towards achieving the Millennium Development Goals.

USING EARTH OBSERVATION FOR ENVIRONMENTAL ANALYSIS

This bulletin is based on the analysis of environmental indicators derived from satellite imagery, allowing cost effective monitoring of the environmental situation at the continental level. These indicators include NDVI and other vegetation indicators (http://land.copernicus.eu/global); RFE Rainfall products (http://earlywarning.usgs.gov/fews); active fire products (https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms) and chlorophyll-a and SST products (http://oceancolor.gsfc.nasa.gov). These Earth Observation indicators are complemented by seasonal climate forecasts and other sources of information. The bulletin is produced twice a year.

The EUMETCast system provided by EUMETSAT routinely distributes Earth Observation data by satellite broadcasting, thus addressing the issue of data reception in areas with poor internet connectivity. The retrieving of Earth Observation data from the EUMETCast receiving station, and the computation of the environmental indicators is automatically performed by the Environmental Station, or eStation, software developed by the Joint Research Centre of the European Commission. The eStation is comprehensive remote sensing software distributed to all sub-Saharan African countries on the AMESD and MESA Stations, in the framework of the AMESD and MESA programmes.

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