ENSO: Humanitarian Implications and Scenarios

The El Niño Aftermath and Perspectives for 2016-2017

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El Niño-La Niña: Summary Highlights for 2016-2017

Red=Negative; Orange=Watch; Green=Positive

Region	Current Timing	Context	Outlook
EAST AFRICA (Ethiopia, Sudan, Eritrea, Djibouti, Somaliland)	First half of 2016 main season	Severe and widespread drought throughout 2015. Ethiopia and producing regions of Sudan hit particularly hard. Early season of 2016 (March-May) favourable over most of Ethiopia (except SW), Eritrea, Somaliland	Some dryness in June-July in S Ethiopia, Uganda, NW Kenya. Current season developing appropriately in Sudan. Favourable forecasts for July to October rainfall across the region.
EAST AFRICA (Kenya, Somalia)	First half of long dry season prior to Short Rains / Deyr (Oct-Dec 2016)	Oct-Dec 2015: No large scale flooding, extended season and good rainfall in Uganda, W Kenya. Poor in Southern Somalia. March-May 2016: Dry in Somalia and coastal Kenya	Drier than average conditions expected for Short Rains / Deyr season If a La Niña materializes, possible poor season also in March-May 2017.
SOUTHERN AFRICA	Dry Season prior to re-start of rains from October 2016	Extreme 2 year long drought widespread across the region (2014-2016). Large regional scale crop losses for two years in a row Regional scale drought related emergency with high level of assistance required until May 2017	Seasonal forecasts point to favourable rainfall patterns though February 2017, leading to perspectives of a good agricultural season in 2016-2017. A La Niña event will enhance favourable perspectives further. Enhanced flood risk as downside.
CENTRAL AMERICA	Primera Season (April-August)	Severe 2 year long drought in the region (2014-2016). Regional scale crop losses for two years in a row	Drier than average conditions across many of the areas hit by drought in previous seasons Seasonal rainfall forecasts for second half of 2016 not very consistent, probably no better than on average rainfall to be xpected.
ASIA and PACIFIC	Mid way through main rainfall season	Severe 2 year long drought in SE Asia and Philippines (2014-2016). PNG severely affected by drought and frosts SE Asia and Philippines very dry until May 2016, improving since then. Current fairly wet conditions across India and China and most of the region.	Forecasts indicate wetter than average season across most of Asia. Good crop production perspectives for Indian subcontinent, moderated by enhanced flood risk. However, SE Asia and Philippines, to remain on average at best.
SOUTH AMERICA	Dry Season	Rainfall deficits in the northern half of the continent, and excessive rainfall and flooding in southern regions during 2015-2016	Broadly favourable rainfall patterns expected for first stages of the next season (Oct-Jan), in particular western Amazon, Pacific regions
WEST AFRICA	First half of the season	Little or no impact from extended El Niño across the Sahel in 2015 Very persistent drier than average conditions along Gulf of Guinea	Drier than average conditions extending from Senegal across the Guineas and along the Gulf of Guinea. Good conditions from Mali eastwards to Chad. Forecasts indicate to on or above average rainfall for Sahel, but the Senegal region may face poor prospects.

El Niño 2015-2016 At A Glance:

A Long Lived and Intense Event

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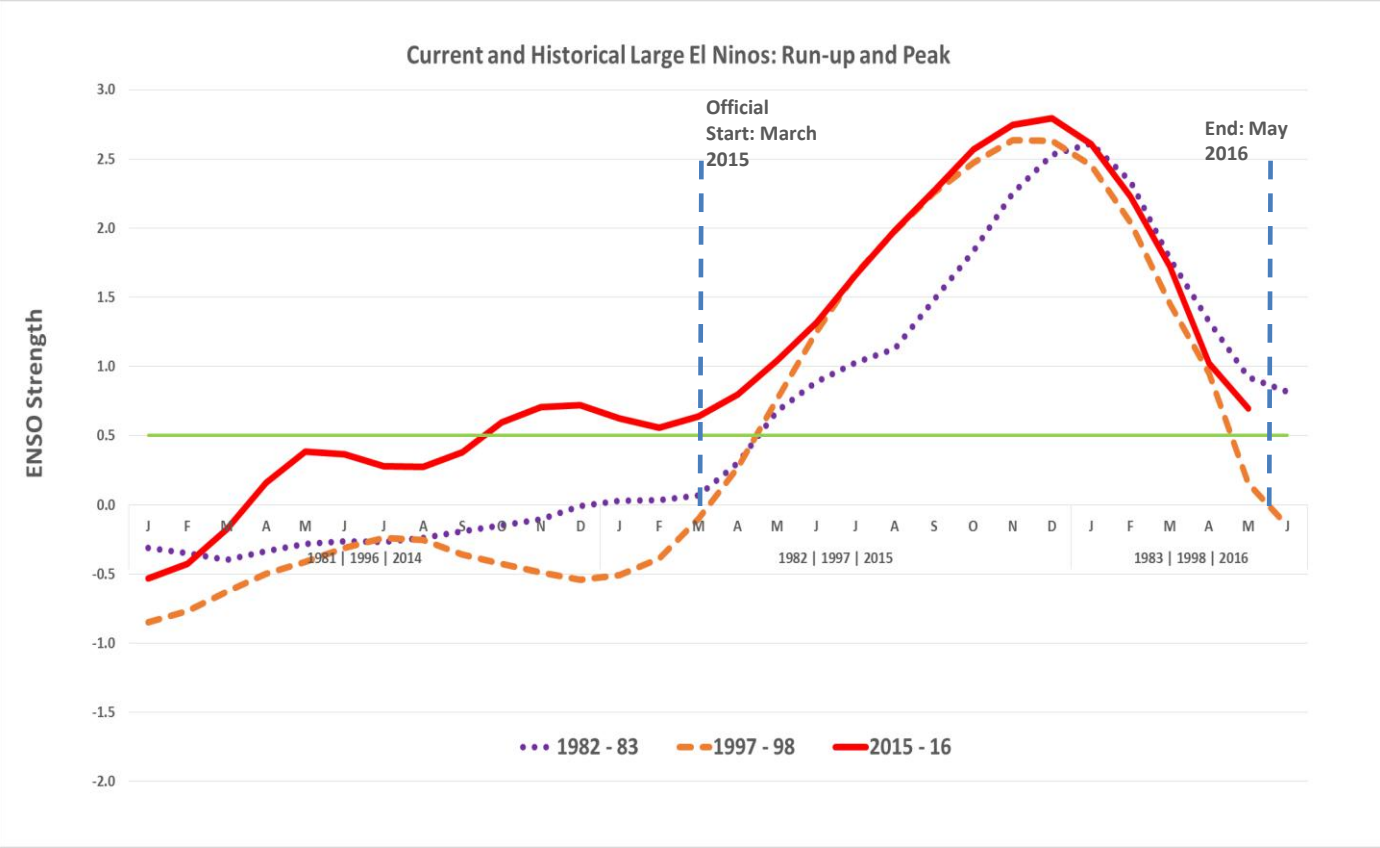
The El Niño 2015-16 in the Context of Past El Niños

The 2015/16 El Niño Event

An El Niño event was officially declared in March 2015, gaining in intensity until it reached its peak in December 2015. The event came to an end in May 2016, becoming one the strongest on record, together with the El Niños of 1982-83 and 1997-98.



Variation of the Sea Surface Temperature (SST) anomalies in the Pacific Niño3.4 area (classic ENSO strength indicator) for the three largest El Niño events on record: 1982-83, 1997-98 and 2015-16.
The plot displays a period of two and a half years covering the year before the event, and the year and a half enclosing the event duration (start-peak-end) – this emphasises the way the El Niños evolved from run-up to peak.

The Special Nature of the 2015-16 El Niño

Some particular features of this El Niño deserve special consideration. We can highlight these features by comparing the evolution of the three strongest El Niños on record from the year preceding their onset until the year of their ending.

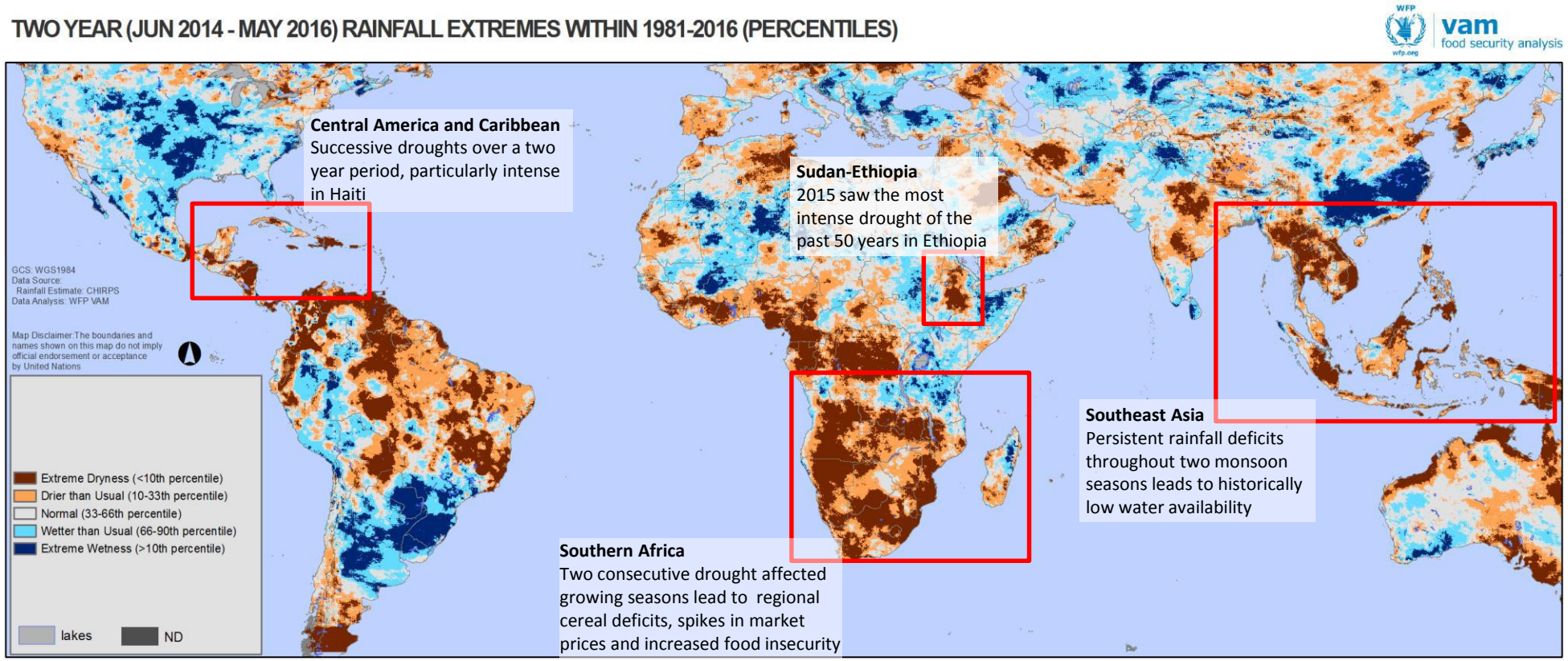
We can see that the El Niño 2015-16:

- **was preceded by El Niño-like effects** – borderline El Niño conditions were in place since mid-2014 but never fulfilled the required criteria. Nevertheless, significant El Niño like impacts were felt across the Globe
- **was one of the strongest** in the available record
- **was one of the longest lived** El Niños on record

This combination of precursor El Niño-like impacts in the run-up to the main event, its high intensity and its long duration resulted in an **extended** period of **extreme dryness** at a near **global scale** which had serious implications for the food security of large numbers of people around the globe.

The El Niño 2015-16: Global Multi-Year Impacts

El Niño 2015-2016 at a Glance



El Niño Impacts: Global and Extreme

The combination of intensity and longevity of this El Niño, led to severe impacts that extended over multiple growing seasons and across the globe.

These impacts are mapped by analysing the two year rainfall from June 2014 to May 2016, a period which includes the quasi El Niño conditions from mid 2014 and the full blown El Niño from March 2015 to May 2016.

This two year rainfall amount was analysed in terms of how extreme it stands within the historical record (1981-2016).

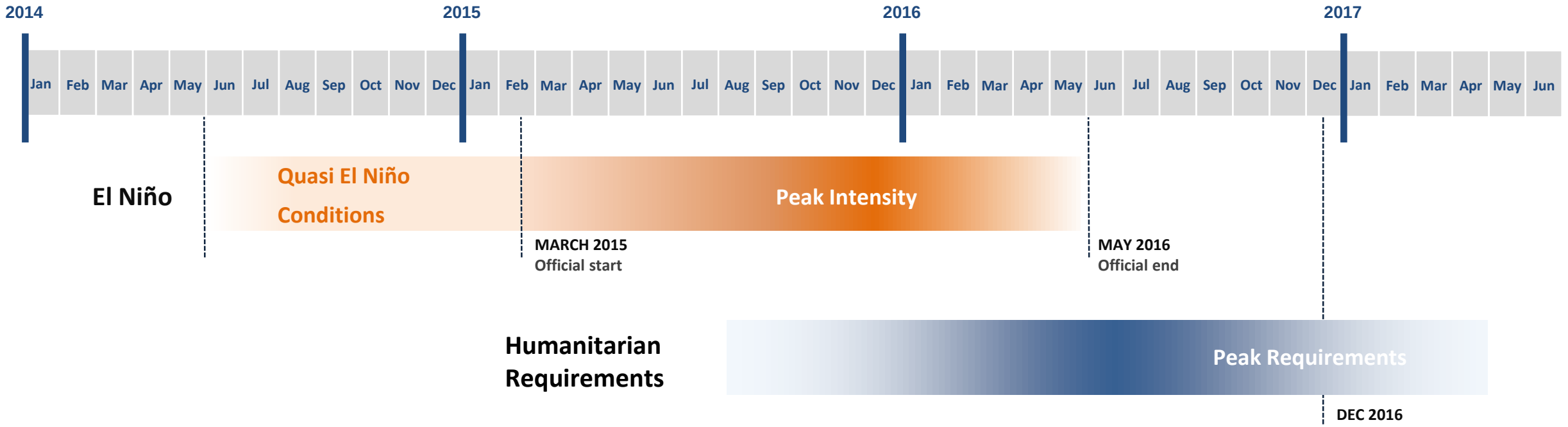
Extreme was defined as amounts falling in the driest or wettest 10% of the record – corresponding to amounts that were the 3rd driest (wettest) or worse.

Dry extremes are represented in dark brown while wet extremes are represented in dark blue. Less extreme drier and wetter than average regions are also depicted in lighter shades.

The map makes clear the truly global extent of extreme conditions during the two year period from mid 2014-mid 2016. In particular, areas of extreme dryness over multiple growing seasons affected some of the most vulnerable and food insecure populations across the globe.

The cumulative impacts of this global, multi year drought will now filter through until early 2017 at least.

Timing of El Niño 2015-2016 Impacts and Humanitarian Requirements



El Niño Ends but Humanitarian Requirements Increase

These multiple-season impacts of the El Niño of 2015-2016 and its precursor conditions had very important consequences upon humanitarian requirements and levels of assistance.

The first impacts upon the growing seasons of 2014-2015 resulted in increased food insecurity of poor rural communities and enhanced their vulnerability to further shocks.

The more severe impacts upon the growing seasons of 2015-2016 resulting from the main El Niño event, hit already weakened populations, resulting in enhanced negative effects upon household food security and nutrition.

However, these effects on food security and nutrition of the El Niño impacts on crop production and pasture resources are delayed in time:

Harvests (even if very meagre) and national stocks will supply households and markets for a period of time – major increases in food insecurity therefore tend to happen at a later date, when cereal availability is low and market prices increase.

Because of these delays, the levels of required humanitarian assistance are expected to keep rising and to reach a peak around late 2016 – early 2017.

One of the hardest hit regions is Southern Africa, where the harvests have just ended – given the regional scale and high magnitude of crop losses, this region will contribute substantial numbers of food insecure people to the large numbers that have already resulted from the droughts in Ethiopia, Latin America and Caribbean, SE Asia and Pacific region.

Is a La Niña on the Cards?

Hopes of Recovery Tempered by Risks

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Current Evidence and Scenarios for a La Niña Event

Is a La Niña Event On The Cards?

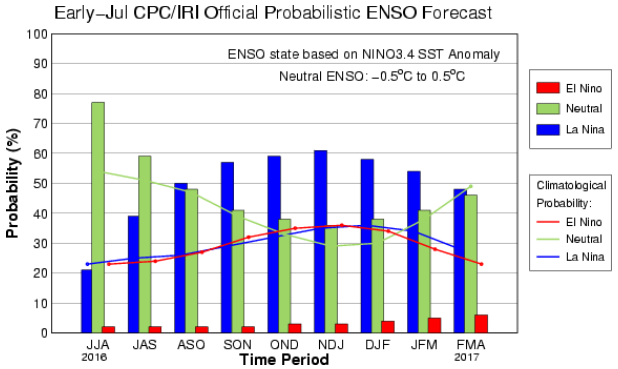
Current Forecasts

The El Niño event of 2015-2016 is now over.

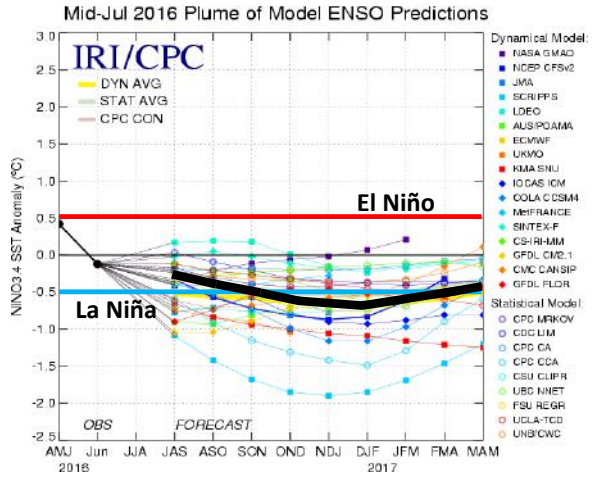
Neutral conditions are holding now for a short while, with the likelihood of a La Niña event increasing (blue bars, left plot), to about 60% in late 2016.

Forecasts of ENSO evolution (plot below right) predict that La Niña conditions are possible from mid Summer – early Autumn according to the majority of model results.

Unlike the 1997/1998 episode, this year's La Niña episode is expected to remain weak in its intensity – see black line (consensus forecast) just about going under the La Niña threshold.



Probability of a La Niña developing (blue bars) vs neutral conditions (green) and El Niño (red).

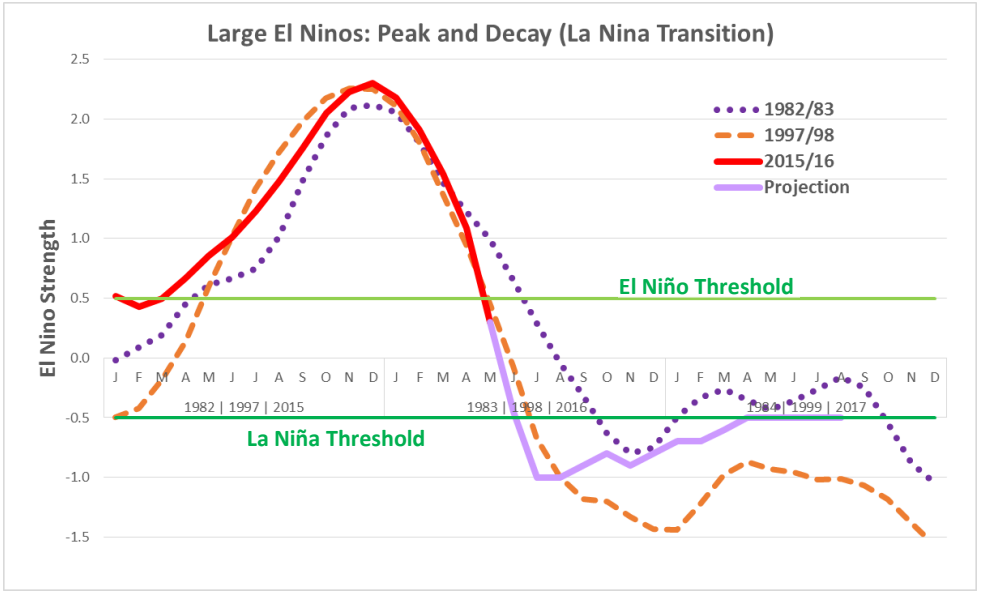


Forecasts of El Niño / La Niña indicator.
Neutral conditions between red and blue lines.
Black line is consensus forecast

How Does This Compare to Previous Large El Niños?

Post El Niño situations can be very diverse as shown by the evolution of the three strongest El Niños on record – shown in the plot below (two years enclosing the event's duration and the third year following year).

The latest El Niño decayed fast much like the 1997-98 event; however while this progressed into a strong and long lived La Niña event, the current event is forecast (purple line) to evolve into a short-lived, weak La Niña episode. The El Niño of 1982-82 decayed more slowly and only entered a proper La Niña event more than a year later compared to 1997-98.



Variation of the SST anomalies in the Pacific Niño3.4 area (classic ENSO strength indicator) for the three largest El Niño events on record: 1982-83, 1997-98 and 2015-16.
The plot displays a period of three years covering the two years enclosing the event duration (start-peak-end) plus the year that follows – this shows the El Niño decay phase and the post-El Niño period.

What Else Will Influence Global Weather?

What else might play a role?

The El Niño and La Niña events translate the influence of the inter-tropical Pacific Ocean sea surface temperature (SST) patterns on the global weather.

Although these are of major importance, they are not the only determinant of the performance of growing seasons around the world. SST patterns in other oceans also play an important, if maybe less well researched and not always recognised, role. The following sea surface patterns are of particular relevance:

- **Tropical Atlantic Ocean** patterns influence rainfall in the western Sahel and along the Gulf of Guinea.
- **Indian Ocean** patterns influence rainfall both in the Indian subcontinent and in Eastern and Southern Africa. These influences are being increasingly recognized and are now translated into numerical indicators such as the **Indian Ocean Dipole** (IOD) and the **Subtropical Indian Ocean Dipole** (SIOD). These indicators are calculated as differences in average sea surface temperatures between two locations

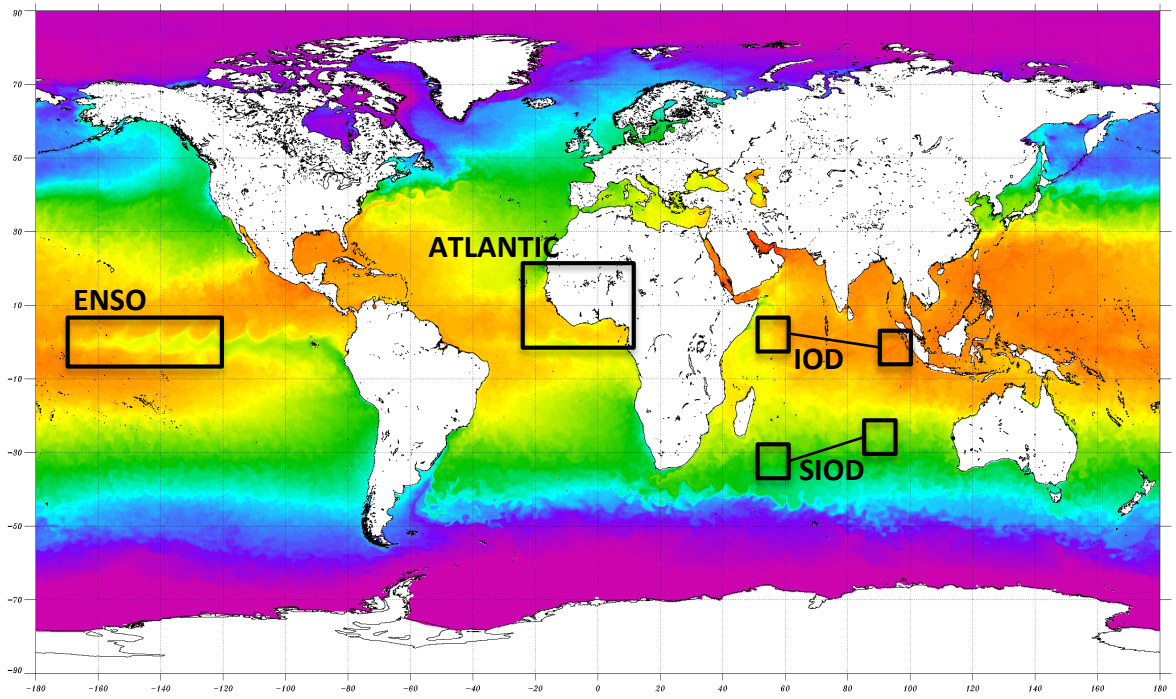
Atlantic and Indian Ocean SST patterns can enhance, minimize or alter ENSO influences and may explain some of the historical variability seen in ENSO impacts.

In the Atlantic, typically, warmer (cooler) waters off West Africa and cooler (warmer) waters in the Gulf of Guinea lead to wetter (drier) conditions in the Sahel and drier (wetter) conditions along the Gulf of Guinea.

Indian Ocean SST patterns can influence rainfall patterns in Southern Africa, Eastern Africa as well as Indonesia and Australia. Positive SIOD values are broadly associated with increased rainfall in southern Africa while positive IOD values are associated with enhanced rainfall in Eastern Africa.

However, Indian Ocean SST patterns are very variable and difficult to forecast far in advance. Their influence on the late 2016 rainfall seasons in southern and eastern Africa can only be evaluated later in the year.

More details are provided in the region-specific slides.



Map of sea surface temperature showing the location of ocean areas either used to derive monitoring indicators (ENSO, IOD, SIOD) or otherwise of significant influence on the weather of areas of humanitarian intervention (ATLANTIC). Sea surface temperature patterns in the Atlantic or those represented by the Indian Ocean indicators can enhance, minimise or alter ENSO influences.

East Africa:

Intense El Niño Impacts, Contrasting Outlooks

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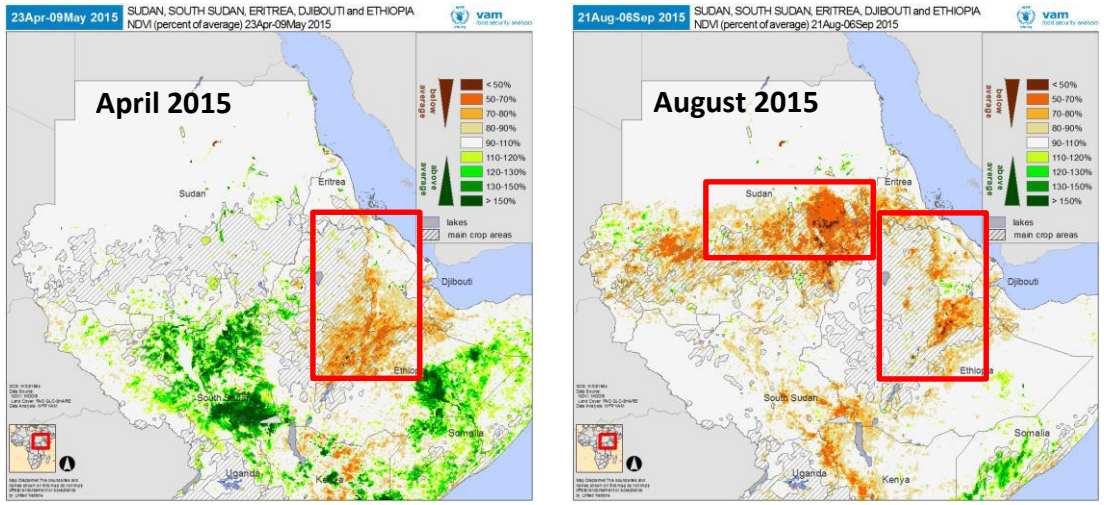
East Africa: Intense Impacts, Contrasting Outlooks

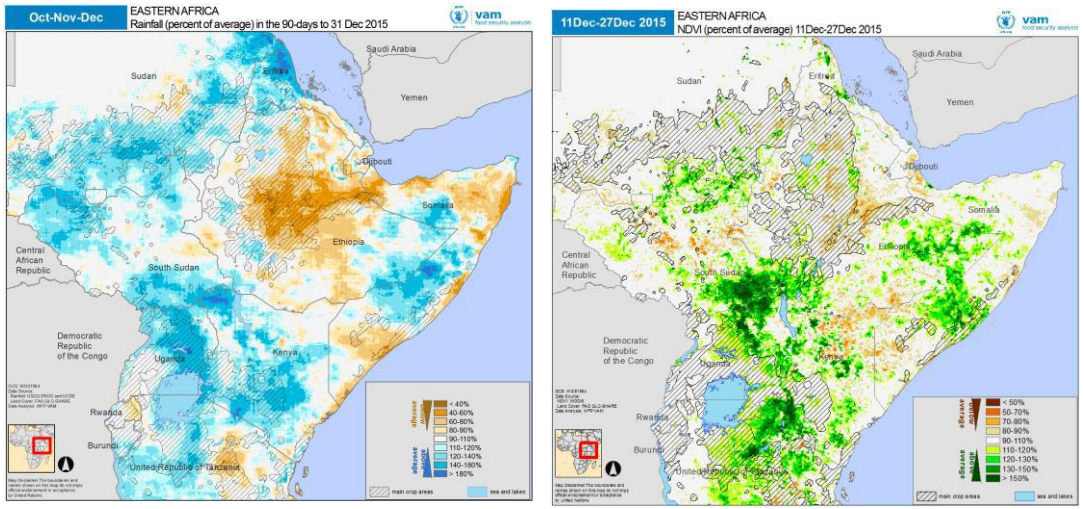
El Niño Impacts on the 2015 Seasons

March-October 2015



NDVI in late April 2015 (centre) and late August 2015 (right) as a percentage of the average. These are times of the peak vegetation development for the Belg and Meher seasons, respectively. Greens for wetter than average, orange shades for below average conditions. Red boxes highlight areas of greatest impact.

October-December 2015



October to December 2016 rainfall as a percentage of the average (left). Blues for wetter than average, orange and browns for below average conditions. NDVI in December 2015 (right) as a percentage of the average. Greens for wetter than average, orange shades for below average conditions.

Major Drought Events in Ethiopia and Surrounding Regions

Intense drought affected the 2015 rainfall seasons in Ethiopia, Sudan, Eritrea, Djibouti and Somaliland. Ethiopia was the country most severely affected, having endured two severe drought events in the same calendar year:

- From March to May affecting pastoral semi-arid regions (specially Afar), areas where the first (Belg) of two growing seasons takes place as well as neighbouring areas of Somaliland, Djibouti and Eritrea
- From July to September, affecting the same regions plus more northern and central areas with a single main growing season.

The second drought affected a wider geographical area that also included most of Sudan's major agricultural and pastoral areas. Although from October there was a recovery in rainfall, with the rains lasting longer than usual, this came too late to provide significant relief.

No Flooding and Localized Dryness for Kenya and Somalia

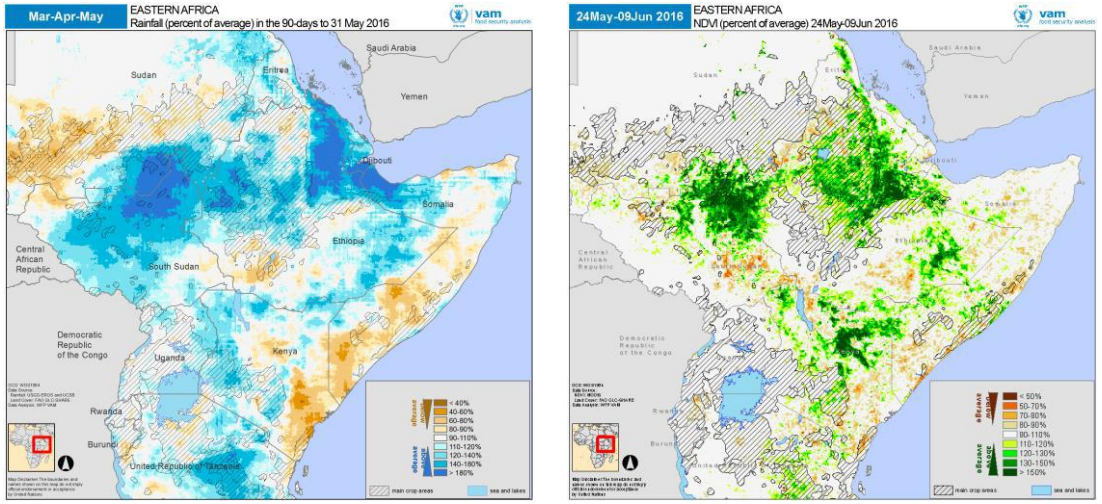
In Somalia and Kenya, fears of large scale flooding during the Short Rains (Oct-Dec) as in the 1997-98 intense El Niño did not materialize. Flooding was limited to early season episodes in central Somalia and localised flooding and flash floods in central and western Kenya, where seasonal rainfall was more consistently above average.

The El Niño also led to a longer than usual season in South Sudan and neighbouring areas of Uganda and NW Kenya leading to exceptional vegetation cover levels. Tanzania also benefitted from above average rainfall.

In contrast, NE and coastal Kenya as well as southern and coastal Somalia experienced irregular and below average rainfall, with moderately negative impacts on crop production and pasture resources. Dryness remained in in central Ethiopia and northern Somalia (Puntland) during these very late stages of the local season.

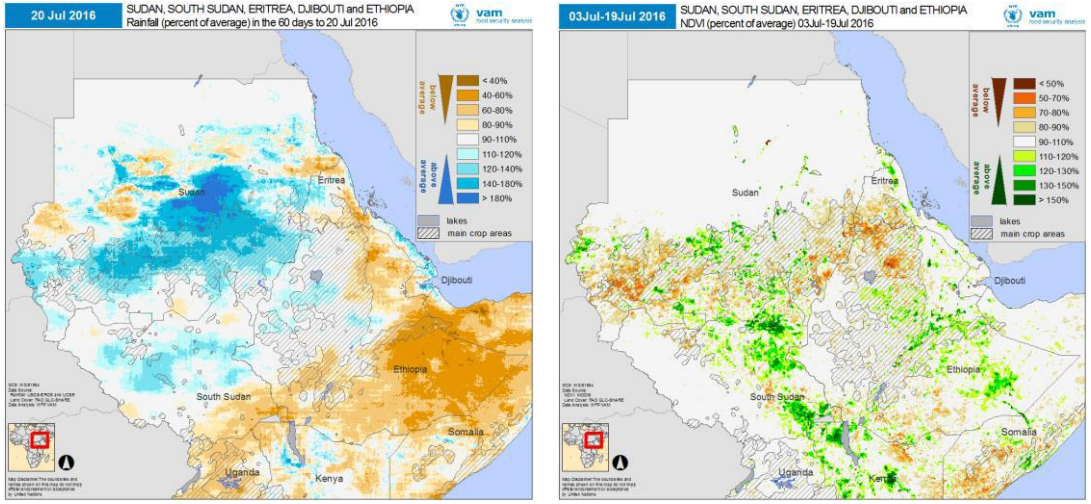
Developments During 2016

March-May 2016



March to May 2016 rainfall as a percentage of the average (left). Blues for wetter than average, orange and browns for below average conditions. NDVI in late May (right) as a percentage of the average. Greens for wetter than average, orange shades for below average conditions.

June 2016 onwards



Late May to late July 2016 rainfall as a percentage of the average (left). Blues for wetter than average, orange and browns for below average conditions. NDVI in mid July (right) as a percentage of the average. Greens for wetter than average, orange shades for below average conditions.

March-May 2016: Ethiopia Recovers, Poor Season in Somalia and Kenya

After drought persisted until March across the Afar, Somaliland and many areas of Ethiopia, steady, very heavy rainfall (more than twice the usual amounts) lasted until late May. Similar conditions benefitted South Sudan and SE Ethiopia. SW Ethiopia, however had an unfavourable season as early season dryness persisted. Vegetation cover in pastoral areas reached record levels, allowing a degree of recovery to pastoralist livelihoods devastated by last year's droughts. Agricultural areas also benefitted from the above average rainfall.

In contrast with most of the region, the coastal areas of Kenya and most of south and central Somalia endured significantly drier than average conditions during the Long Rains season of March to May/June 2015. This also affected SW areas of Ethiopia.

In Somalia, these conditions affected agriculturally productive regions, leading to perspectives of below average crop production.

No further improvements are expected: June was fairly dry and the long dry season has now started and will extend to October 2016. Therefore conditions prior to a possible La Niña influenced next season are already unfavourable.

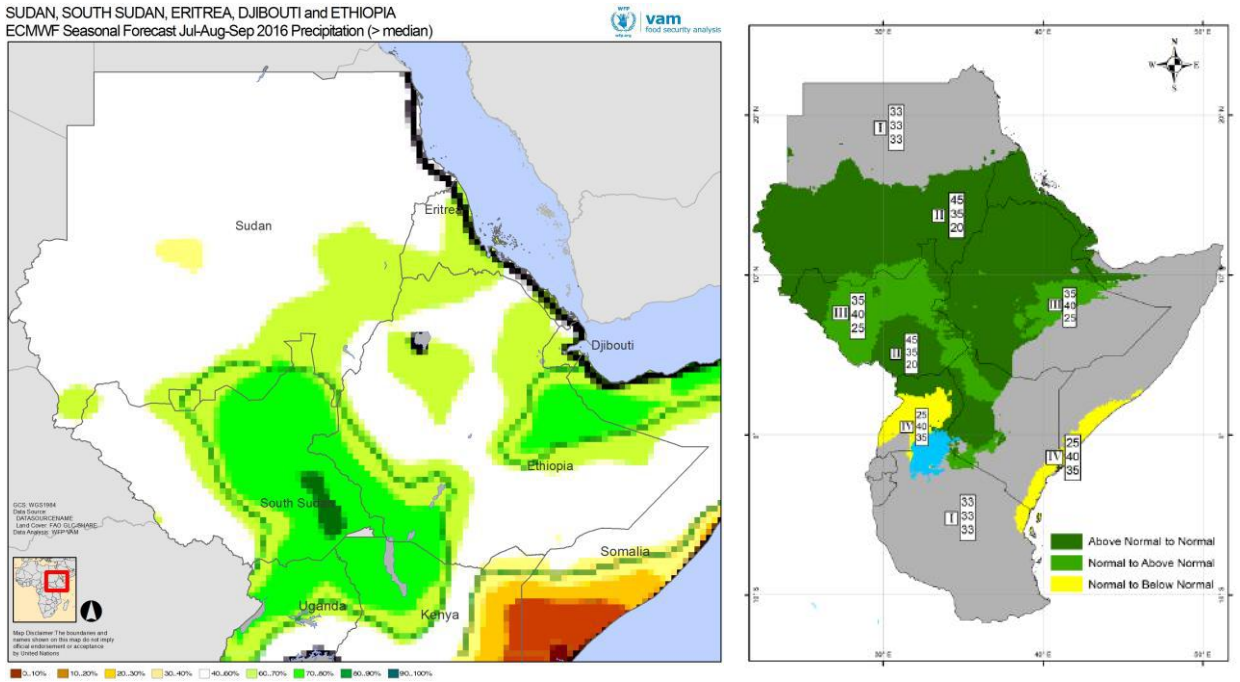
Variable Performance Across the Region

The main season in the Ethiopia and Sudan region is now unfolding and will last until late 2016. Performance in June-July 2016 has been quite variable – across Sudan, wetter than average conditions reflect recent widespread heavy rains, after an patchy and drier start.

Elsewhere, drier than average conditions in the past two months are widespread across the region: in Uganda, parts of South Sudan and southern Ethiopia this is affecting early stages of the growing season, although there is plenty of time for a recovery in conditions. In Afar, SE Ethiopia and central-southern Somalia this period is mostly out of season.

Current vegetation patterns are complex: they reflect lingering effects of the extreme conditions of the past year (Sudan and northern Ethiopia), the abundant rains of March-May (South Sudan, Afar) and the patchy and irregular performance of the June-July rains. Below average vegetation in Sudan and Ethiopia should recover in response to recent rainfall.

Perspectives for mid-2016 (Sudan-Ethiopia): Favourable Outlook



ECMWF rainfall forecast for July-September 2016 (left), GHACOF climate outlook (right).
Green shades = wetter than average conditions. Yellow and brown shades drier than average conditions.

Ethiopia-Sudan, July-October 2016

The forecasts for the main rainfall season of July-October indicate on or above average rainfall across Sudan, Ethiopia and Eritrea. Favourable conditions may extend to South Sudan and neighbouring areas of Uganda, NW Kenya and SW Ethiopia.

This implies a continuation of the recovery in ground moisture conditions that started in April 2016 and opens favourable perspectives for improved crop production and pasture resources across the region, particularly in the regions more severely affected by drought in 2015.

Note however, that meaningful recovery from the large livestock losses endured in 2015 will take a significant time and requires a succession of good seasons. A good main season (Meher) harvest is a must to improve cereal availability as it typically makes up 90% of Ethiopia's annual cereal production. Therefore, any substantial reduction in humanitarian requirements will not take place until after the Meher harvests in late 2016.

La Niña impacts on Belg season performance are variable – may favour some NW areas with earlier starts of the season but lead to below average rainfall in most other Belg areas. Impacts maybe fairly moderate as the event at this stage is expected to be weak and short lived.

2016: Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2017: Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Wetter than average

Mar-May 2016
Evidence: Actual Data
Ethiopia (Belg)
Eritrea
Somaliland

Wetter than average

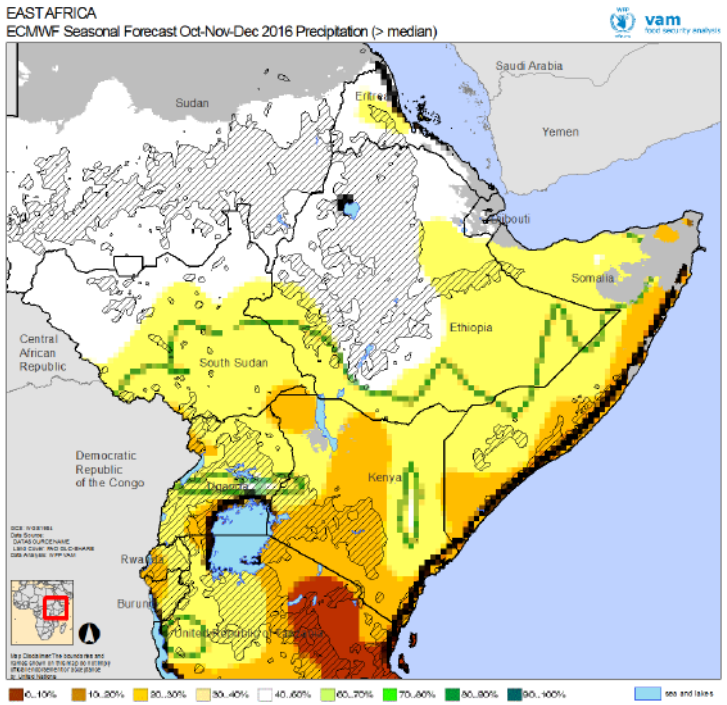
Jul-Oct 2016:
Evidence: Forecast
Ethiopia (Meher, Second)
Eritrea
Sudan (Main)

Mixed / Poor?

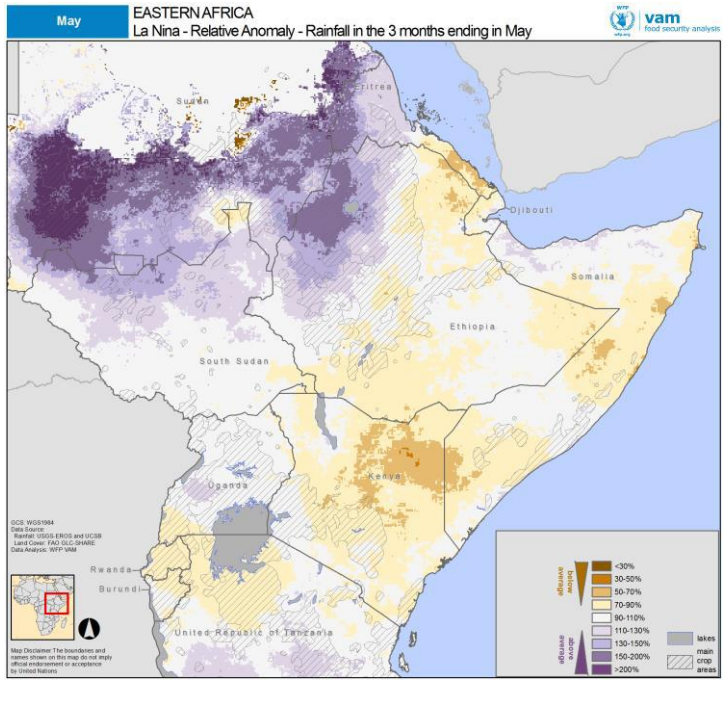
Mar-May 2016
Evidence: Historical Analysis
Ethiopia (Belg)
Eritrea
Somaliland

East Africa: Intense Impacts, Contrasting Outlooks

Perspectives for 2016-2017: Worries for Somalia and Kenya



October-December 2016: Forecast



March-May: Historical La Niña

Left: ECMWF rainfall forecast for October-December 2016. Green shades, wetter than average, brown shades drier than average.
Right: Average March-May rainfall for La Niña seasons 1981-2013 compared to same average for Neutral seasons.
Yellows and browns = La Niña drier than neutral seasons, purples = La Niña wetter than neutral seasons

Somalia-Kenya, late 2016-early 2017

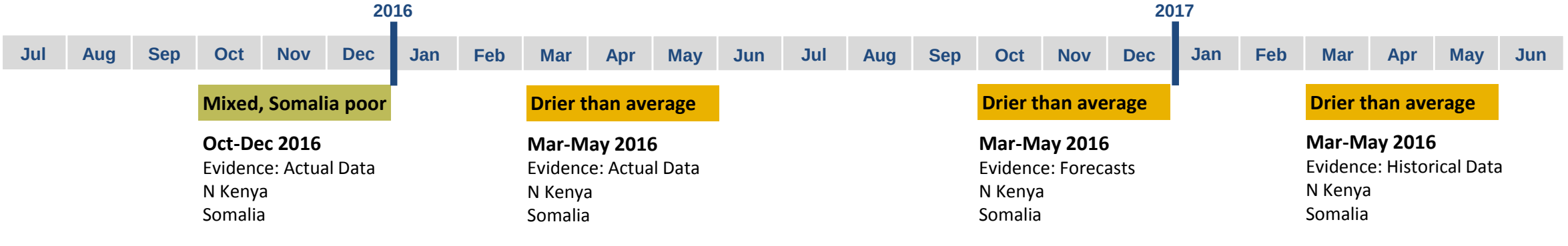
Forecasts for the next Short Rains season (October-November 2016) indicate widespread below average rainfall (map left) across the region, in agreement with a typical La Niña situation.

For the Long Rains of March-May 2017, a comparison of the average March-May rainfall between La Niña and neutral seasons based on historical data for 1981-2013 (map right) shows that La Niña seasons are associated with drier than average seasons across much of the region.

This configures unfavourable developments for Somalia and eastern Kenya until mid 2017:

- Households are more vulnerable to drought impacts as a result of the poor performance of the Long Rains season of 2016 that has recently ended.
- According to forecasts, this will be followed by a drier than average Short Rains season in late 2016
- In the worst case scenario, under La Niña conditions, another poor Long Rains season in March-May 2017 may follow.

Note that the 2010-2011 catastrophic drought in these regions, also associated with a la Niña event, remains a major historical outlier and an outcome of that magnitude is therefore unlikely.



Southern Africa:

The Aftermath of a Two Year Drought

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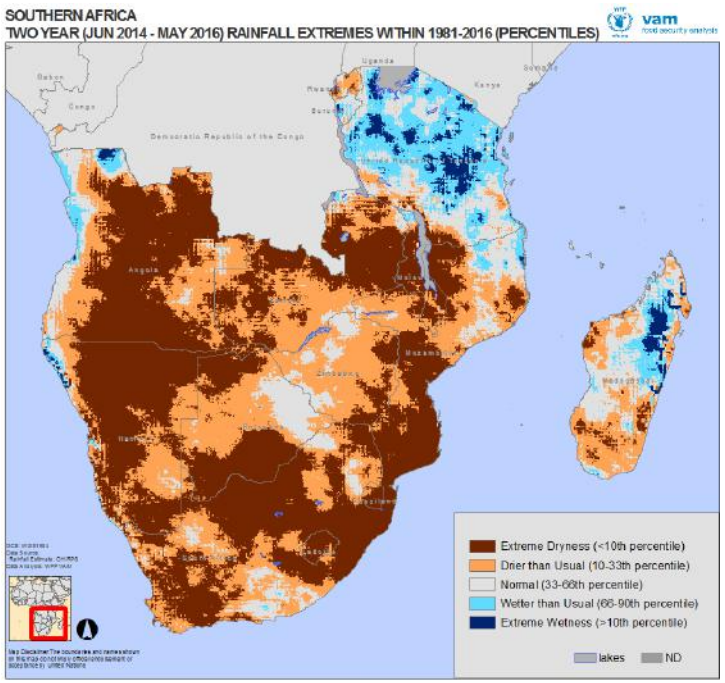
Extent and Impact of a Two Year Regional Drought

Southern Africa: Aftermath of a Two Year Drought



Two Year Rainfall from June 2014 to May 2016 expressed in terms of how extreme it was within the historical record (1981-present).

Extreme dryness or wetness was defined as amounts falling in the driest or wettest 10% of the record – corresponding to the 3rd driest (wettest) or worse. The map also shows less extreme drier and wetter than average regions.

MAIZE PRODUCTION ('000 MT)

Country	Pre-Drought Average	2015 %Change	2016 %Change
Angola	1205	34%	86%
Botswana	18	-18%	-78%
Lesotho	77	-4%	-67%
Malawi	3661	**-21%**	**-42%**
Mozambique	1602	17%	12%
Namibia	63	-39%	-40%
South Africa	12495	**-16%**	**-38%**
Swaziland	89	6%	-63%
Zambia	2910	-10%	-6%
Zimbabwe	1173	**-37%**	**-56%**
TOTAL	23293	-12%	-26%

Southern Africa regional maize production in two seasons of drought:

2014-15 and 2015-16 maize production is compared to the average of the 5 harvests that preceded the two drought affected seasons.

Major concerns highlighted: Sharp production drops in large producers (SA) and countries with large food insecure populations (Malawi and Zimbabwe).

Data: SADC / FAO-Stat

Two Year Drought causes a wide range of cross-sectoral impacts

Southern Africa has been affected by drought in two consecutive growing seasons. The previous growing season of October 2014 to April 2015 was characterized by extensive rainfall deficits during key stages of the staple maize crop development (planting and flowering/grain filling). Significant, though localized, flooding in Malawi and northern Mozambique further compounded the problems.

The growing season of 2015-2016 that has just ended was one of the driest on record, being particularly intense in its earlier stages – this led to major impacts on crop production as it led to extensive decreases in planted area. Where planting was successful, yields were affected by much drier than average conditions that lasted until late February 2016. An improvement in rainfall from March onwards did little to alleviate the problems affecting crop production, though it improved water reservoir and hydro power production perspectives in the Zambezi.

Maize Production Hit Hard for the Second Year Running

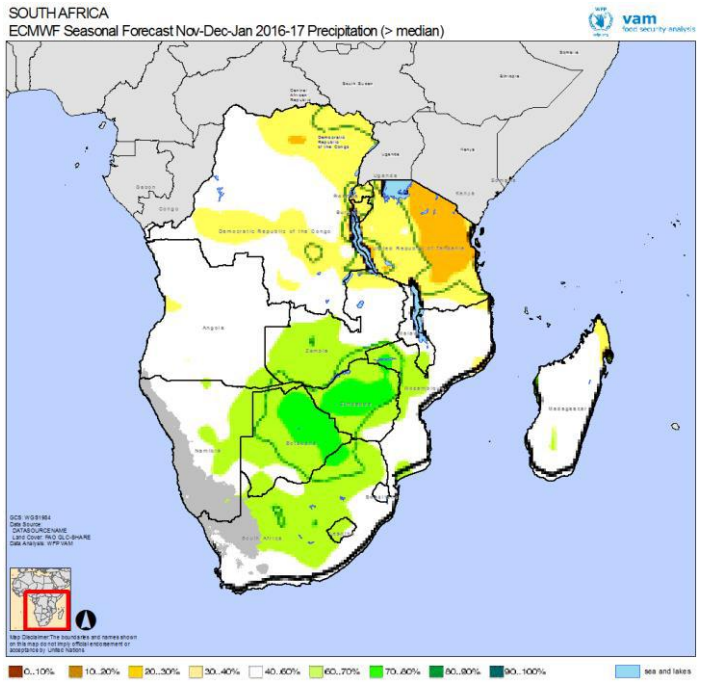
Two consecutive droughts had a major impact on regional crop production. The table above shows maize production for the harvests of 2015 and 2016 as variations from a pre-drought baseline (average of the 5 harvests 2010 to 2014): the region as a whole suffered two major consecutive drops in production, of 12 percent and 26 percent relative to this pre-drought baseline.

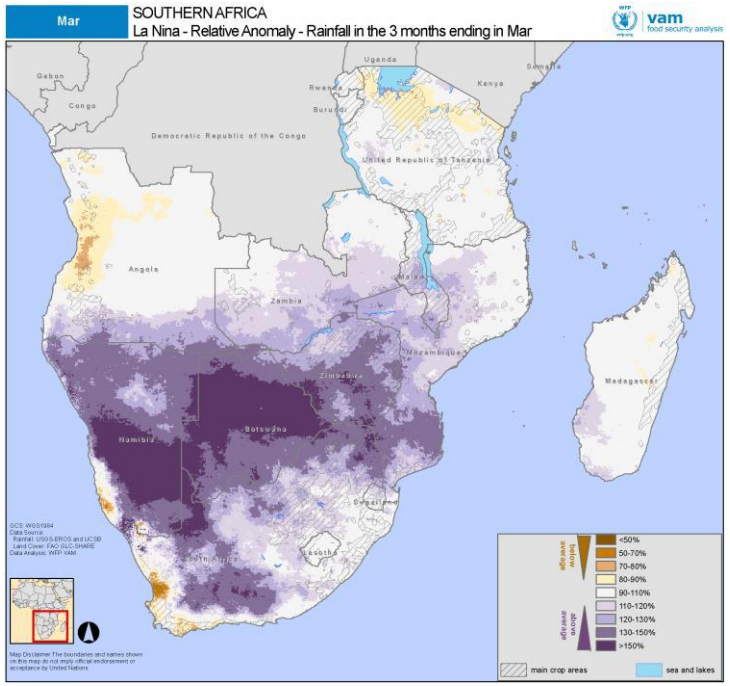
Of particular relevance are the sharp falls in maize production of the major regional producer – South Africa, with consecutive drops of 16 and 38 percent – and in the two countries with highest numbers of food insecure people, Zimbabwe (consecutive drops of 37 and 56 percent) and Malawi (consecutive drops of 21 and 42 percent). Also notable are production near wipe outs in Lesotho, Swaziland and Botswana.

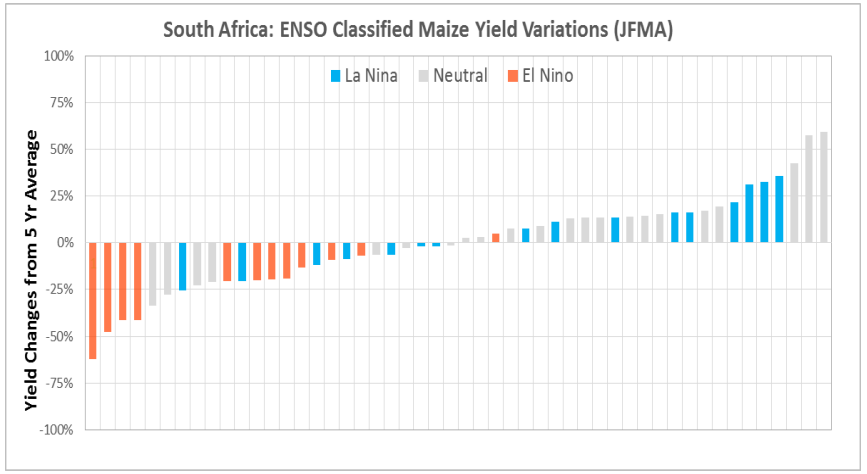
Only Mozambique, Angola and Zambia (to a lesser degree) escape this tendency as their more northern producing areas make them less sensitive to El Niño impacts.

Optimistic Perspectives for the Next 2016-17 Growing Season

Southern Africa: Aftermath of a Two Year Drought







South Africa: ranked national maize yield variations from the 5 year average, coded according to ENSO phase. Larger positive increases (right side) are preferentially associated with La Niña (blue bars).

Data: FAOSTAT, CPC. Analysis: WFP-VAM

Left: ECMWF rainfall forecast for November-January 2016. Green shades: wetter than average conditions. Brown shades: drier than average conditions.
Right: Average January-March rainfall for La Niña seasons 1981-2013 compared to Neutral seasons. Browns: La Niña drier than neutral seasons; Purples: La Niña wetter than neutral seasons

Forecasts and Long Term Data Underscore Optimistic Perspectives

Southern Africa's next growing season will develop from October 2016 to April 2017 with harvests in May 2017. Current seasonal forecasts for Nov 2016-Jan 2017 point to broadly above average rainfall, in particular over the areas that suffered the most intense drought in the previous season. This period covers the first stage of the season (planting and early crop development) – favourable rainfall will encourage increases in planted area; if later rainfall remains favourable, this will be followed by increased yields.

As seasonal forecasts do not yet cover the core period of next season (Jan-Mar 2017), historical data may provide an indication of what might be expected: comparing the average January-March rainfall between La Niña and neutral seasons within the period 1981-2013 (map right above) shows that La Niña seasons are associated with wetter than average conditions across most of the region.

Based on these seasonal forecasts and on historical data assuming a La Niña event materializes, crop production and pasture condition perspectives are quite favourable. In effect, historical agricultural statistics (from FAO-Stat) for the major regional producer (South Africa) and the most food insecure country (Zimbabwe) shows that maize productivity in most La Niña seasons tends to be above a 5 year average (plot above right).

Therefore, significant improvement in crop production relative to those of the past two seasons can be expected for the next regional harvest, provided farmers in the region can capitalize on these favourable perspectives by having access to suitable levels of inputs.

Central America and Caribbean:

In the Grip of Long Term Dryness

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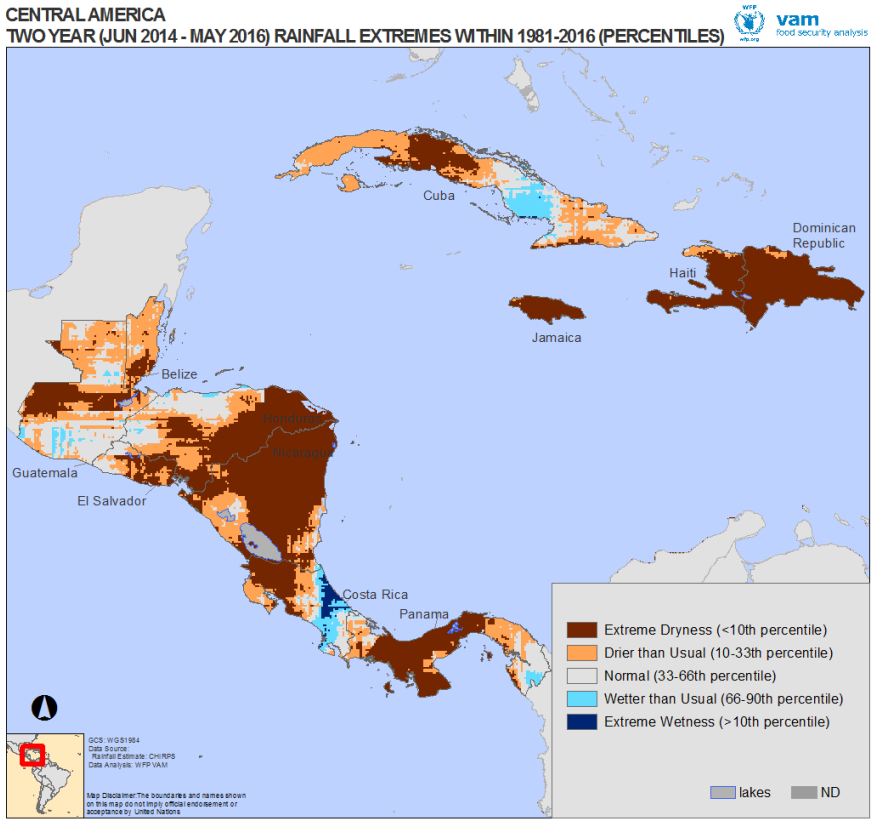
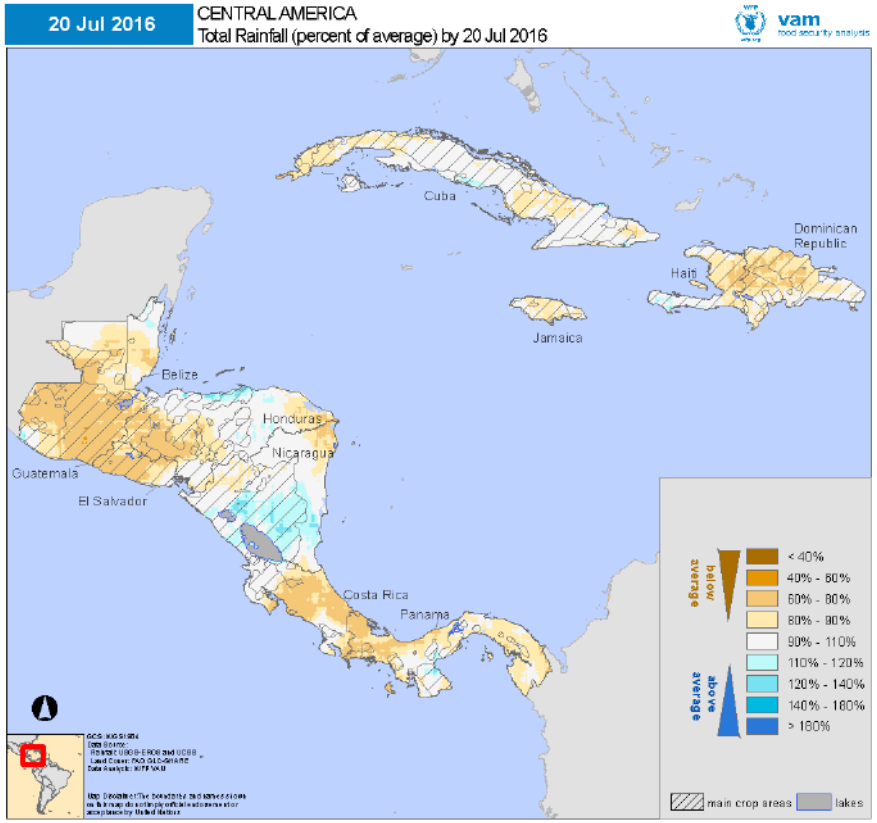
Central America: In The Grip of Long Term Dryness

El Niño 2015 Outcomes and Current Status





Left: Two Year Rainfall from June 2014 to May 2016 expressed in terms of how extreme it was within the historical record (1981-present).

Extreme dryness or wetness was defined as amounts falling in the driest or wettest 10% of the record – corresponding to the 3rd driest (wettest) or worse. The map also shows less extreme drier and wetter than average regions.

Right: February to mid July 2016 rainfall as a percentage of the average (left). Blues for wetter than average, orange and browns for below average conditions.

Long Term Dryness Followed by a Poor Start of the 2016 Season

The Central America and Caribbean region has been affected by extremely dry conditions during the two years from June 2014 to May 2016. This period covers most of the Primera (April to August) and Postrera (August to November) seasons of 2014 and 2015, as well as the initial conditions of the current Primera season of 2016.

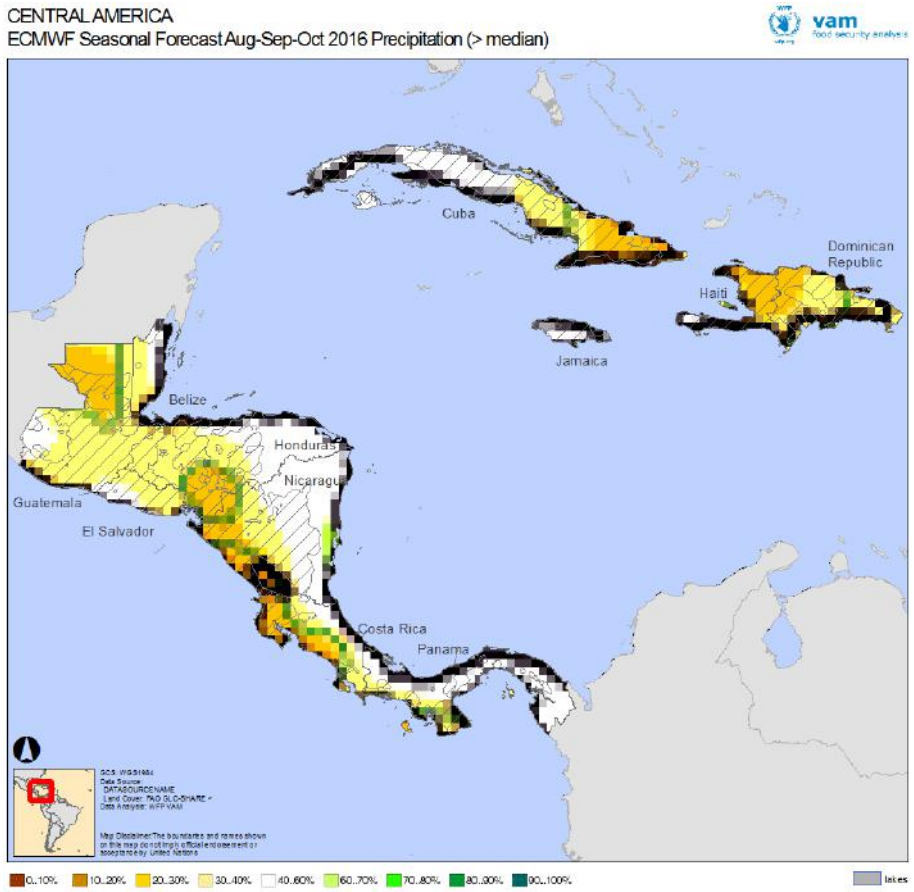
The map above left shows the extent of areas where the 2014-2016 period was one of the driest on record. The areas most affected by this long term extended dryness were Hispaniola (Haiti and Dominican Republic) as well as Nicaragua, Honduras, El Salvador and Guatemala, in particular areas with poorer, more vulnerable populations.

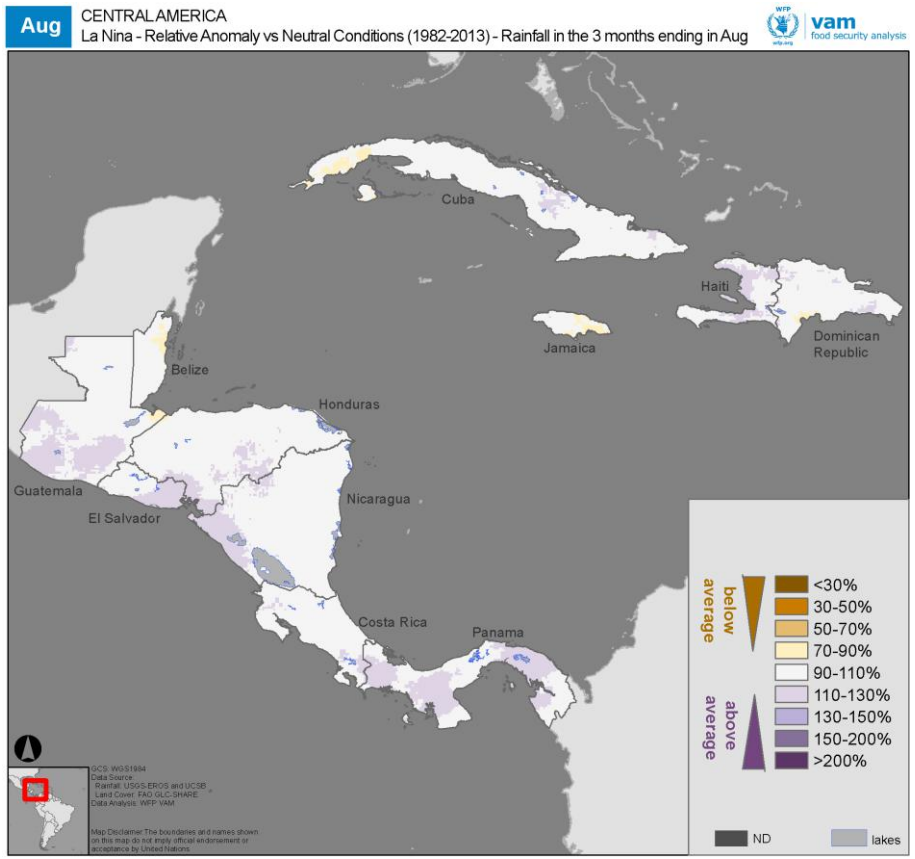
Impacts have been more pronounced during the Primera season when the bulk of the region's maize crop is produced. This has resulted in general drops in maize production (and beans to a lesser degree) with significant additional impacts on water resources for agriculture and livestock.

The first growing season of 2016 (Primera) has so far been unfavourable across most of the region, in particular in Guatemala, Salvador and Honduras. Unfavourable perspectives will hold for the Primera season unless the situation is quickly reversed.

This will add further problems to the vulnerable poor rural populations already hit by a succession of droughts in past seasons.

Perspectives Until Late 2016





Left: ECMWF rainfall forecast for August-October 2016. Green shades = wetter than average conditions. Brown shades drier than average conditions.

Right: Average June-August rainfall for La Niña seasons 1981-2013 compared to Neutral seasons. Browns – La Niña drier than neutral seasons; Purples – La Niña wetter than neutral seasons

Uncertain Perspectives for the Remainder of 2016

Current seasonal forecasts for rainfall in the Postrera season of 2016 present mixed outcomes, from moderately drier than average conditions (ECMWF, map left) to above average rainfall from CPC/NOAA.

If the more pessimistic forecasts are realized, the region may not see significant improvements in the availability of cereal and level of hydrological resources (rivers levels, reservoirs, long term soil moisture reserves). Given the poor start so far, this maybe the more likely outcome for 2016.

Should a La Niña materialize it will have little impact on the current season rainfall patterns and may not last long enough to influence next year's Primera season rainfall.

In any case, historical data (1981-2013) shows at best a weak tendency for wetter than average Primera seasons during La Niña seasons (map right above) and no well defined expectation can be outlined.

South America:

A typical El Niño season

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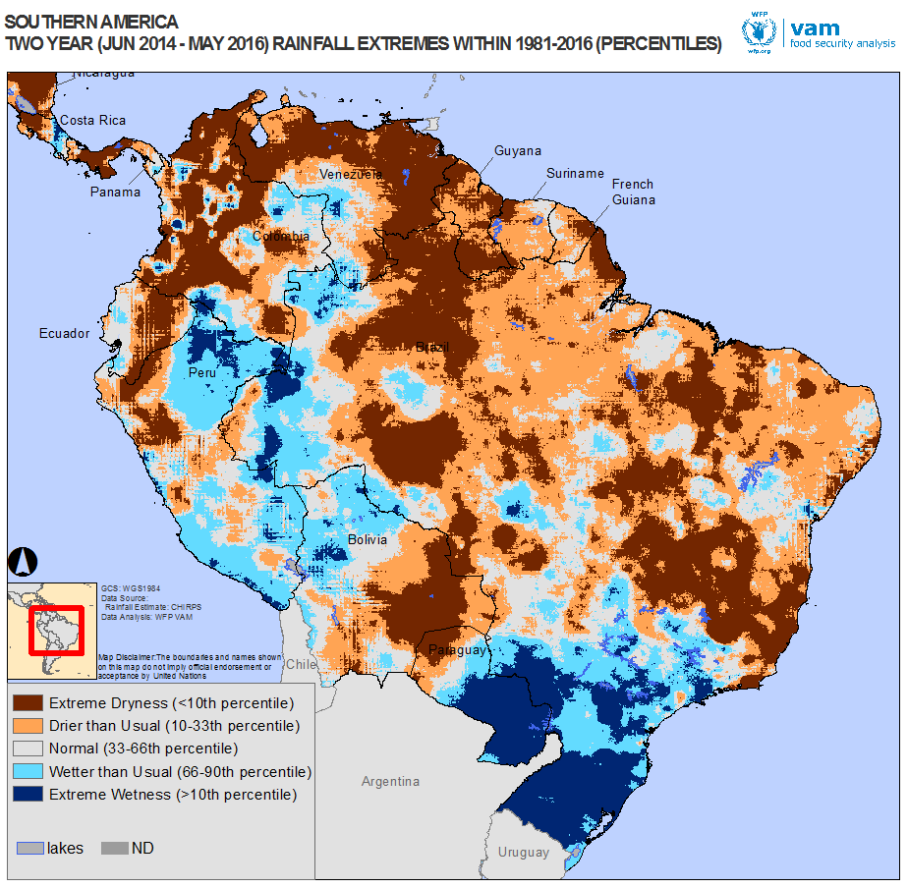
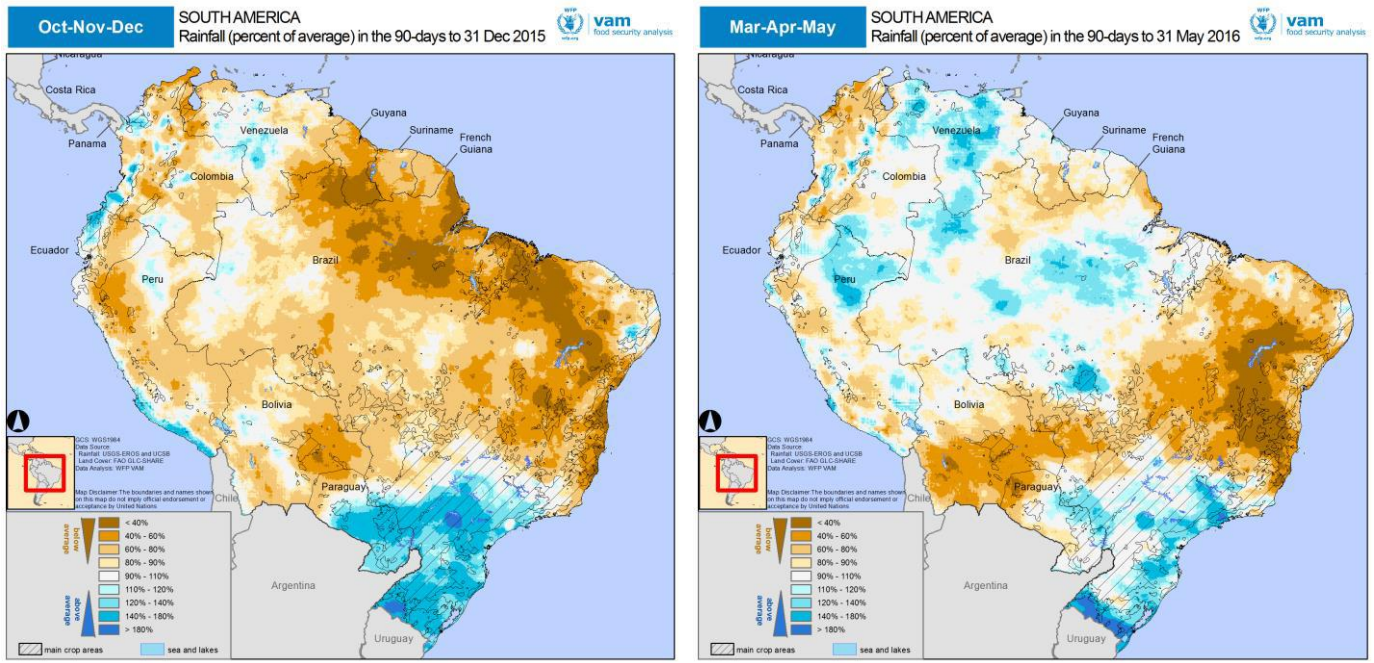
El Niño Impacts and Current Status

South America: A typical El Niño season





Left: Two Year Rainfall from June 2014 to May 2016 expressed in terms of how extreme it was within the historical record (1981-present). Extreme dryness or wetness was defined as amounts falling in the driest or wettest 10% of the record – corresponding to the 3rd driest (wettest) or worse. The map also shows less extreme drier and wetter than average regions.

Right: October-December 2015 and March to May 2016 rainfall as a percentage of the average. Blues for wetter than average, orange and browns for below average conditions.

Typical El Niño Impacts Spread over two Seasons

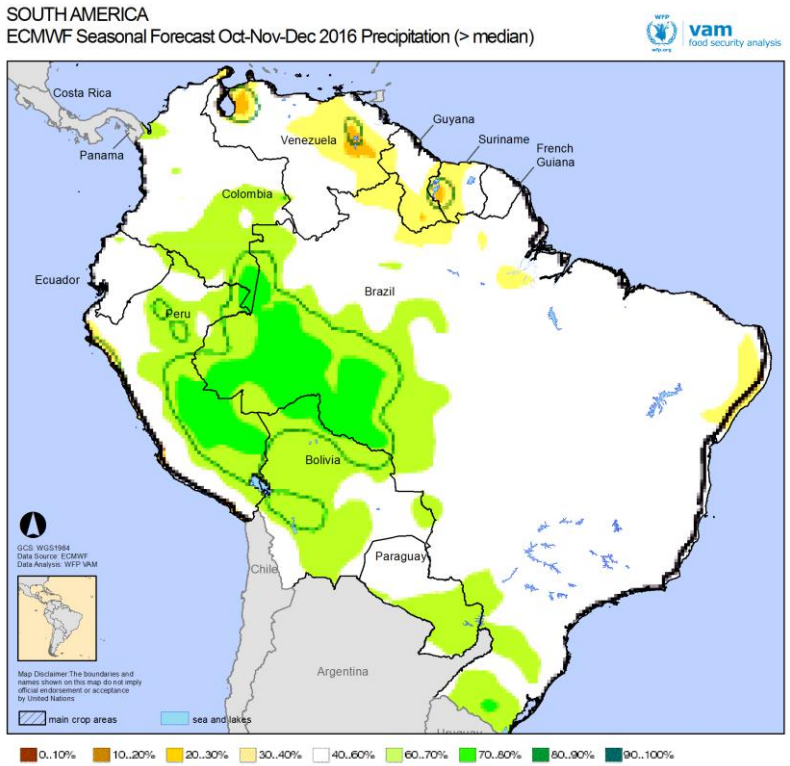
South America has not been immune to El Niño influences and as other regions, the two years from June 2014 to May 2016 have been characterized by rainfall extremes. Extremely drier than average conditions can be seen (map left) extending from Equador, Colombia, Venezuela and through western Brazil into eastern Bolivia. As typical of El Niño season, most of the northern half of Brazil had a drier than average season.

In contrast, southernmost Brazil, Paraguay, Uruguay and areas of northern Argentine, registered very wet conditions, resulting in flood events.

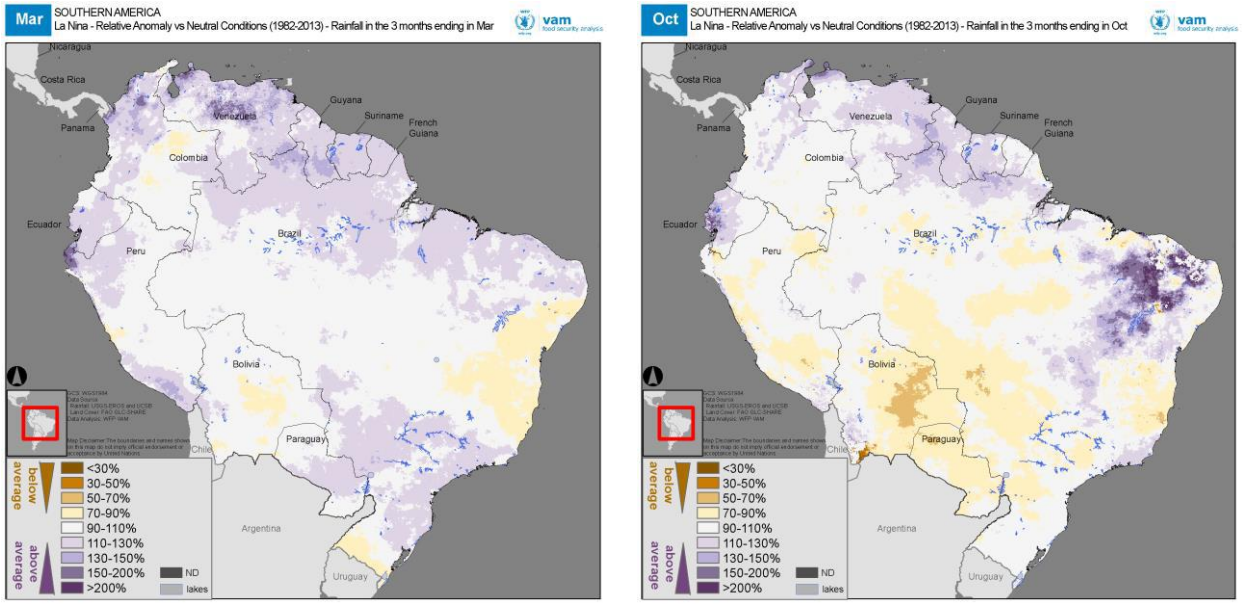
The growing season that has recently ended was characterized by severely below average rainfall in more northern areas of the continent, from the Guyanas to central coastal Brazil. Dry conditions also affected Bolivia and NW Peru. On the other hand, extreme wet conditions occurred during this period affecting southernmost Brazil, Paraguay and Uruguay.

Later phases of the season saw a maintenance of drier than average conditions in Bolivia and in western states of Brazil (Bahia, Pernambuco, Piaui).

Expectations for 2016-17: Forecasts and Historical Patterns



ECMWF rainfall forecast for October-December 2016. Green shades mean wetter than average conditions. Brown shades mean drier than average conditions.



Average January-March (left) and August-October rainfall (right) for La Niña seasons 1981-2013 compared to Neutral seasons. Browns – La Niña drier than neutral seasons; Purples – La Niña wetter than neutral seasons

A Weak Tendency for Better Rains in 2016-2017

Current seasonal rainfall forecasts for October-December 2016 (map above left) indicate favour above average rainfall, likely more concentrated on Peru, Ecuador, Bolivia and the western Amazon basin. Most forecasts point in the same broad direction, though with differences in the areas affected.

Beyond early 2017, assuming a La Niña event materializes, past behavior of La Niña influenced seasons can provide some clues as to possible developments.

Maps above right show a comparison between average rainfall for La Niña seasons and average rainfall for neutral seasons, for January-March and for August to October.

Assuming a La Niña is in place in late 2016, the expectations based on historical patterns are for moderately above average rainfall during early 2017 (January-March) across most of the continent. The perspectives are less optimistic for Bolivia and western Brazil.

Assuming the La Niña influences remain in place until later in the year (August to October), moderately wetter than average conditions should be maintained in the northern parts of the continent. Elsewhere, moderately drier than average conditions (e.g. Bolivia) are of reduced significance as this is outside the main growing season.

Asia and the Pacific:

Variable post-El Niño scenarios

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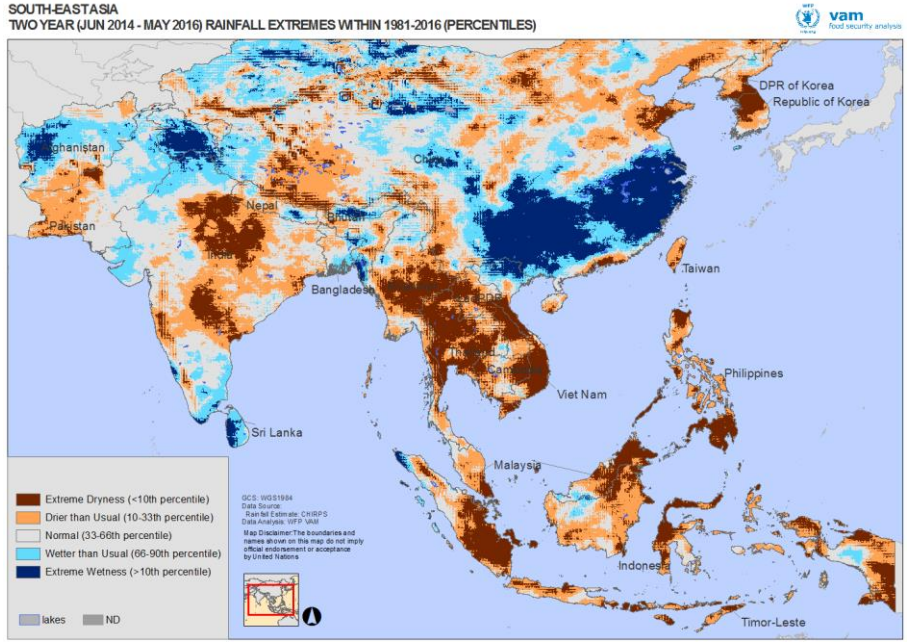
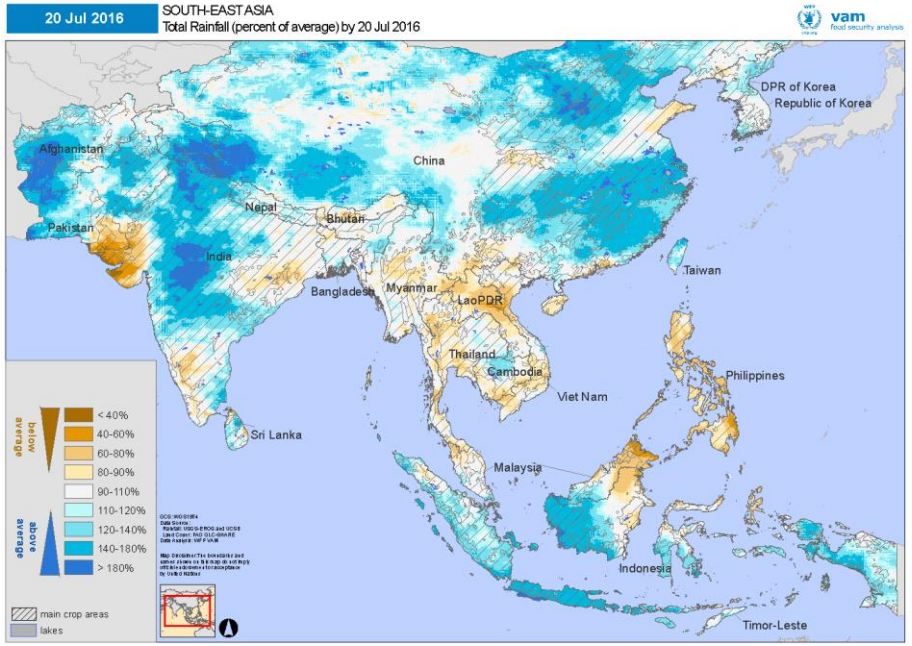
El Niño Outcomes and Current Status

East Asia: Variable post-El Niño scenarios



Two Year Rainfall from June 2014 to May 2016 expressed in terms of how extreme it was within the historical record (1981-present).

Extreme dryness or wetness is defined as amounts falling in the driest or wettest 10% of the record – corresponding to the 3rd driest (wettest) or worse. The map also shows less extreme drier and wetter than average regions.



Cumulative rainfall February to mid July2016, as a percentage of the 20-year average. Hashed pattern indicates main agricultural areas. Brown shades indicate below-average rainfall; blue shades indicate above-average seasonal rainfall.

2014-2016: Two Years of Rainfall Extremes

Across many areas of Asia, the two year rainfall from June 2014 to May 2016 reached historical extremes, particularly on the dry end of the scale. This period covers two Asian monsoons and two main seasons of the Indonesian region. SE Asia is the area most affected by this extended dryness – in areas of central and south Vietnam, central Laos and eastern Cambodia, conditions over this two year time span have been the driest on record (since 1981).

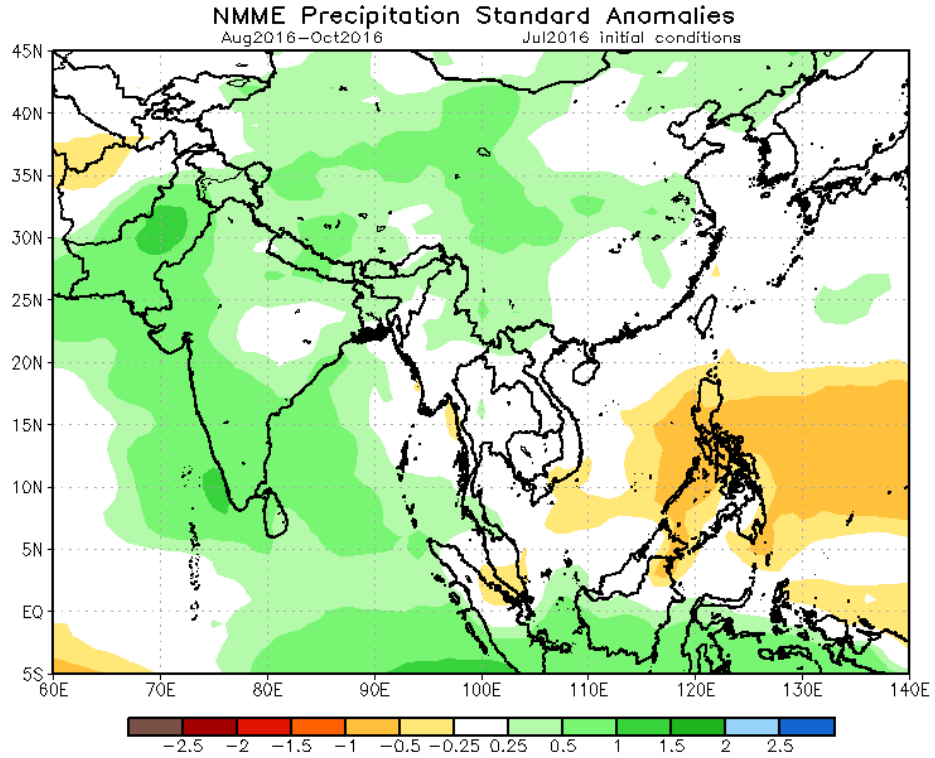
Similarly dry conditions predominated in Indonesia and southern Philippines plus the border regions between the two Koreas. Severe drought also affected Papua New Guinea and many Pacific Islands. In contrast, SE China endured extremely wet conditions.

Drier than average first half of 2016 in SE Asia

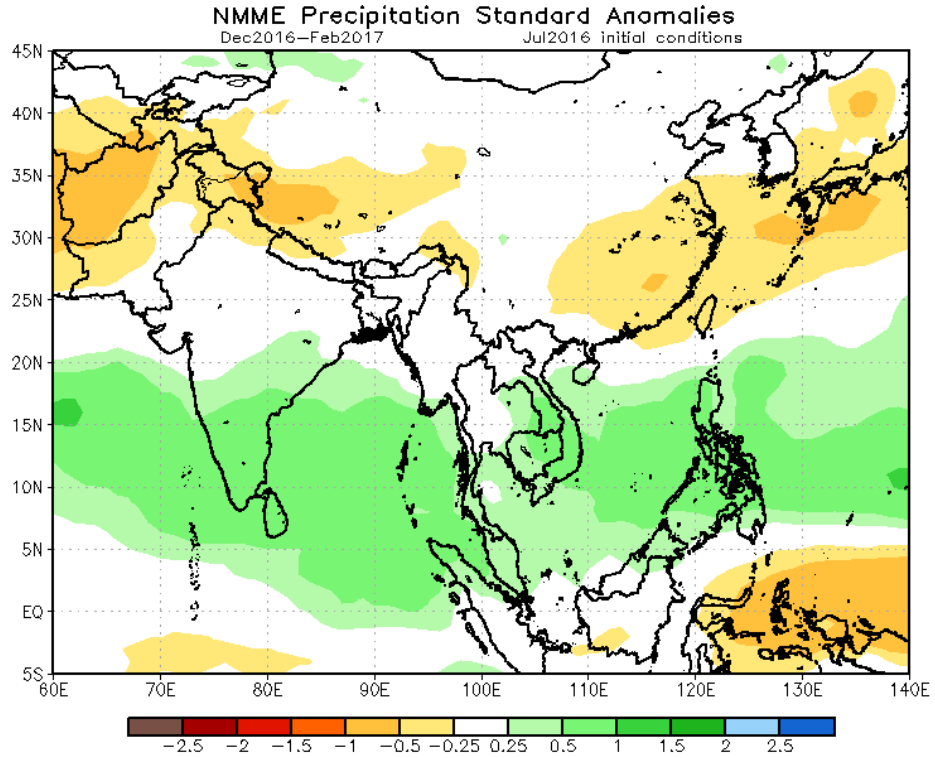
Markedly drier than average conditions have dominated across SE Asia, Philippines and parts of Borneo until May 2016. Conditions have improved since, though rainfall patterns are still irregular and overall seasonal rainfall is still below average

In contrast, wetter than average conditions have predominated across the rest of the continent, with the exception of southern India. Improvements have been noticed in PNG and the Pacific region.

Outlook for the main 2016 season and 2016-2017



NOAA/CPC rainfall forecast for August-October 2016. Green shades, wetter than average conditions. Yellow-red shades, drier than average conditions



NOAA/CPC rainfall forecast for October-December 2016. Green shades, wetter than average conditions. Yellow-red shades, drier than average conditions.

Forecasts for the Main Season

Rainfall forecasts for the August-October period (bulk of the monsoon rainfall) indicate wetter than average conditions over most of India, SW China and in most of Indonesia (though here this period is not the main rainfall season).

For SE Asia (Myanmar to Vietnam and Philippines) the forecasts indicate on or below average rainfall for this main period of the growing season.

Hence, there may not be a substantial relief from the conditions that have prevailed since early 2015, in particular considering the strong rainfall deficits that had already accumulated until mid 2016.

Forecasts for 2016-17

Rainfall forecasts for December-February 2016 (early-mid season in the Indonesian region) indicate on average conditions over Java and Borneo. Elsewhere in Indonesia, tendencies are less well defined, with some forecasts pointing to drier conditions over the southeastern areas of Indonesia and PNG and others to above average rainfall.

Elsewhere in Asia, most of India and parts of SE Asia (Cambodia-southern Vietnam), forecasts of above average rainfall may indicate a longer lasting monsoon.

These conditions extend to the Philippines where the secondary cropping season may enjoy favourable conditions, helping a recovery from the pronouncedly dry conditions of the past two years.

West Africa:

Largely Untouched by El Niño

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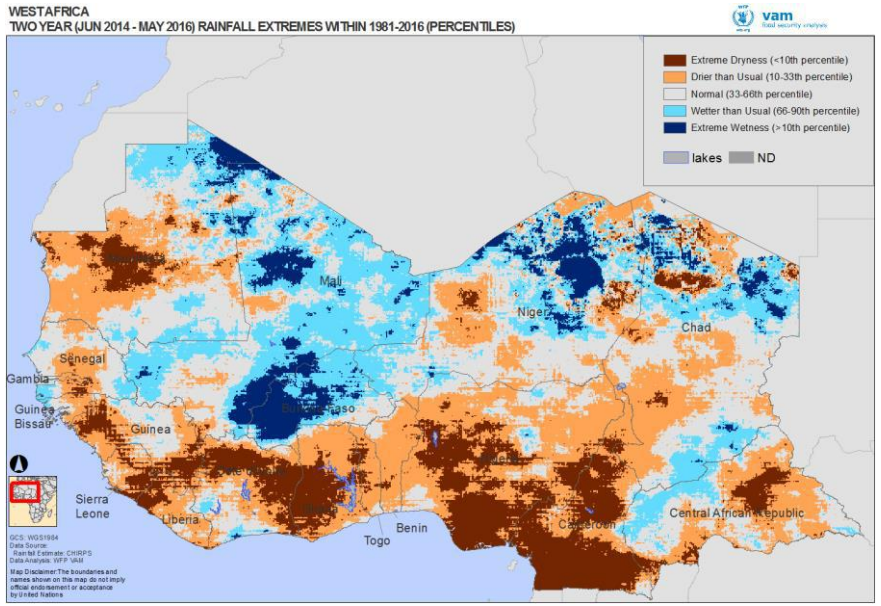
West Africa: Largely Untouched by El Niño



Two Year Rainfall from June 2014 to May 2016 expressed in terms of how extreme it was within the historical record (1981-present).

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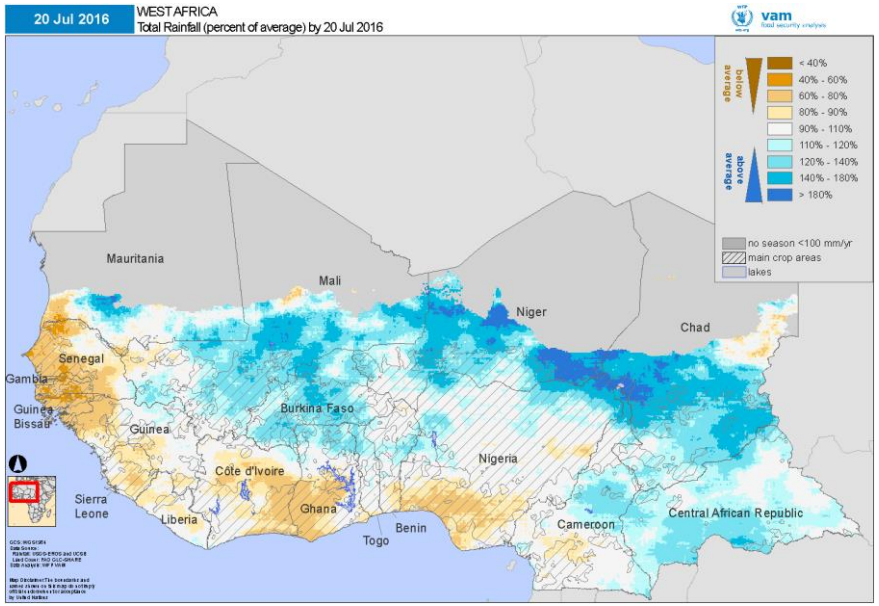


Cumulative rainfall February to mid July 2016, as a percentage of the 20-year average. Hashed pattern indicates main agricultural areas. Brown shades indicate below-average rainfall; blue shades indicate above-average seasonal rainfall.

Sahel Left Untouched by El Niño

Unlike many other regions of the globe, West Africa endured little impact from the El Niño event and the drier period that preceded it. During 2014-2016, the Sahelian region in particular, enjoyed two regular seasons with at most fairly localized drier than average areas and a much wetter than average period in Burkina Faso – Mali.

The Gulf of Guinea countries in contrast endured a much drier than average 2014-2016, along a region from northern Cote d'Ivoire, western Ghana, southern Nigeria and Cameroun, with impacts on crop production and water resources.

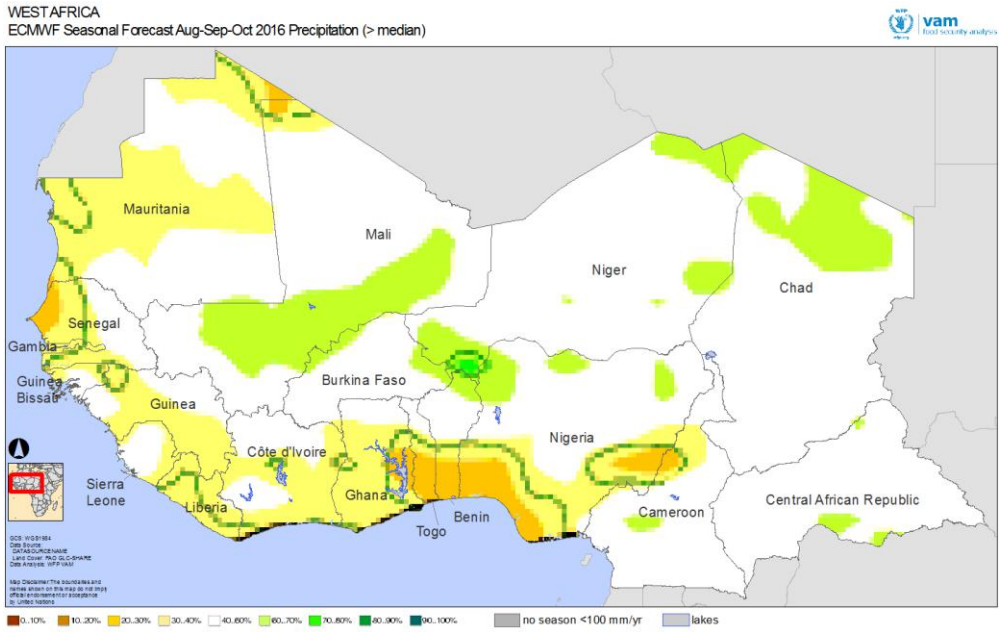
These two patterns are related: El Niño is not the single influence on West Africa weather and in this case, sea surface temperature patterns in the Atlantic changed in a way that enhanced rainfall in the Sahel and suppressed rainfall along the Gulf of Guinea.

2016 Season with Variable Performance

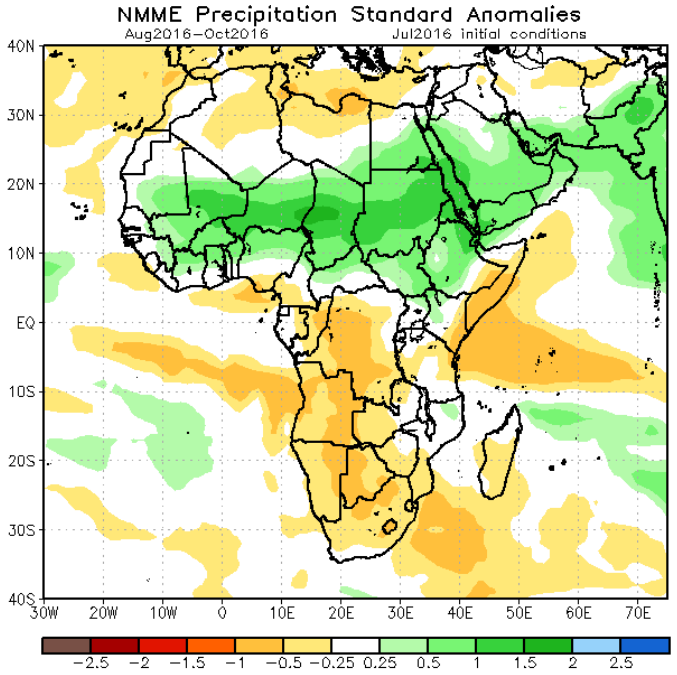
The 2016 season is starting its core period and so far shows variable performance across West Africa. Western regions – Sierra Leone, Guineas and Senegal in particular, as well as the Gulf of Guinea (Ghana-Cote d'Ivoire) have endured drier than average conditions from the start of the season. In the Gulf of Guinea this implies a continuation of the drier than average conditions that have persisted for the past two seasons.

In contrast, regions extending from central Mali across to Chad have been enjoying regular and abundant rainfall. In particular the marginal sahelian areas of Niger, the Lake Chad region and most of Chad have been extremely wet during June and July, with corresponding good perspectives for the agricultural season and pastoral resources.

Outlook for the 2016 season



ECMWF rainfall forecast for August-October 2016. Green shades mean wetter than average conditions. Orange and yellow shades mean drier than average conditions.



NOAA/CPC rainfall forecast for August-October 2016. Green shades, wetter than average conditions. Yellow-red shades, drier than average conditions

Variable Outlooks for the Remainder of the 2016 Season

Current seasonal forecasts offer variable outlooks for the rest of the season – this has also been the case for other regions, and no clear guidance can be offered at this stage.

Forecasts from the ECMWF provide an outlook that resembles the current seasonal rainfall pattern, with a continuation of drier than average conditions in the western areas of the region and along the Gulf of Guinea. In more central and eastern areas the tendency is for average conditions until the end of the season.

Other forecasts offer contrasting perspectives, with CPC/NOAA predicting above average rainfall across most of the region and the UK Metoffice predicting below average rainfall for all regions west of Chad.

The La Niña event, even if it materializes is not expected to influence the region this season, since its onset will happen during the last stages of the Sahelian season at the earliest. La Niña influences upon Sahelian rainfall are also poorly defined, with a only a fairly moderate tendency for wetter than average conditions. Atlantic sea surface temperatures will remain a greater influence.

Data Sources:

Rainfall: CHIRPS, Climate Hazards Group, UCSB

Vegetation: MODIS NDVI, EOSDIS-NASA

Land Cover: FAO GLC-Share

Seasonal Forecasts: ECMWF, Regional COFs, CPC, UKMetOffice

Processing:

VAM software components, ArcGIS

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