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# Summary of climate variability and extremes and their main impacts on agricultural production in 2018

2019

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The European Commission's  
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**Contents**

1 The general state of climate in 2018 .....6

2 Climate anomalies and extremes impact on agriculture in 2018 based on ASAP assessments .....8

3 Impact on crop seasons started in late 2018 and crop conditions in January 2019 ....17

4 Seasonal climate forecasts and potential impact on agriculture in 2019 .....19

References .....20

## **Foreword**

Climate variability and extremes have been identified by the 2018 Global Report on Food Crises (FSIN 2018) and by the 2018 report on State of Food Security and Nutrition in the World (FAO, IFAD, UNICEF, WFP and WHO, 2018) as one of the main factors triggering food crises and responsible for a renewed increase in global hunger. In particular, the second part of the 2018 State of Food Security and Nutrition in the World (SOFI) report provided a detailed analysis on how climate factors impact the different dimensions of food security. The preparation of this report has also evidenced the difficulties in retrieving reliable and comprehensive global data on climate extremes occurrence and on their impact on agricultural production as well as on other dimensions. In order to increase the availability and timeliness of such information to the drafting teams of the above mentioned reports, the Food and Nutrition Security Knowledge Centre of the JRC aims at providing annual overviews of the main climate extremes affecting agricultural production in countries with high risk of food insecurity. Consulted sources include mainly: the WMO State of the Climate report, the JRC's ASAP (Anomaly hotspots of Agricultural Production) early warning system, the GEOGLAM Crop Monitor for Early Warning and seasonal forecasts from the Climate Change group of JRC's Food Security Unit. This is the first annual overview and can be seen as a test for future reports. More information for the 2019 issue is planned specifically for floods and storms impact. Also the 2019 annual overview will be made available earlier (draft in mid December, final version by mid January) in order to be available in time to the drafting teams of the Global Report on Food Crises and of the SOFI report.

## **Abstract**

This yearly summary reviews the main climate extremes described by the WMO state of the climate preliminary report for 2018 that had an impact on agricultural production according to JRC's agricultural early warning system ASAP (Anomaly hotspots of Agricultural Production). Such a summary can be used as a starting point for more detailed analysis of agricultural production problems and their impact on food security as it is done by several multi-agency reports such as the Global Report on Food Crises and the Food Security and Nutrition State in the World. In 2018 major droughts affected crop and rangeland productivity in Northern and Central Europe as well as in Australia. Southern Africa experienced early season dry spells reducing maize crop production, while East, West and Central Africa experienced localized flooding during an otherwise favourable agricultural season. In Asia, Afghanistan was the main affected country with food production seriously limited by drought, while exceptional Monsoon rains and Typhoons were a problem in the Philippines, Myanmar and Laos. The final part of the report includes an overview of climate extremes affecting crop seasons ongoing in early 2019 as well as a short summary of seasonal forecasts for the first 3 months of 2019.

# 1 The general state of climate in 2018<sup>1</sup>

As of November 2018, the year 2018 was the fourth warmest year on record, with the last four years being the warmest four. Year 2018 started with weak La Niña up to March. From October, weak signs of a return to El Niño could be observed.

## El Niño / La Niña

Warmer/cooler than usual Sea Surface Temperatures (SSTs) within the world's major oceans are considered to be key drivers of regional climate variability from year to year across the globe. Arguably, the most important driver of climate variability is the El Niño-Southern Oscillation (ENSO), which is comprised of anomalous (i.e. warmer or cooler) SSTs in the equatorial Pacific Ocean. Periods where the central/eastern Pacific Ocean are dominated by warmer than usual SSTs are referred to as El Niño conditions, while periods when these SSTs are cooler than the average are known as La Niña. Where SSTs are warmer than usual cloud forming convection is more active than usual, driving rising moist air. Conversely, dry air descends where SSTs are cooler than usual. These changes in atmospheric circulation influence both the tropics and mid-latitudes, affecting both precipitation and temperature in these regions. ENSO is the dominant mode of climate variability globally, influencing weather and climate fluctuations in southern and eastern Africa, central and south America, south and southeast Asia. It has the greatest impact on equatorial east Africa and subtropical southern Africa during austral summer.

Extreme weather, including record temperatures and heatwaves, drought and disastrous precipitation, marked the first half of summer in the northern hemisphere. This has had widespread impacts on human health, agriculture, ecosystems and infrastructure and led to devastating wildfires (<https://public.wmo.int/en/media/news/july-sees-extreme-weather-high-impacts>).

Temperature was well above average and precipitation well below for large areas in central and northern Europe. Central Europe was affected by unprecedented spring and summer climate anomalies with exceptionally warm and dry conditions. Above normal wildfire activity was registered in northern Europe.

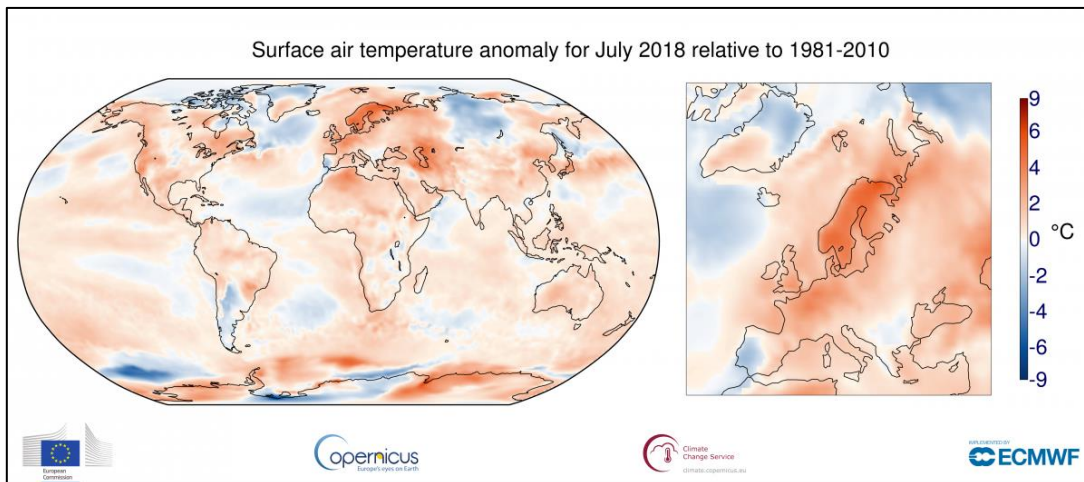


Fig. 1. Surface air temperature anomaly for July 2018 relative to the July average for the period 1981-2010, showing major positive anomalies for Europe, Central Asia and Northern Africa. Source: ERA-Interim. (Credit: Copernicus Climate Change Service / ECMWF)

Eastern Australia and Java also experienced significant drought during 2018 and in particular in the second half of the year. Severe drought affected Uruguay, and both

<sup>1</sup> Section 1 includes a selection of findings from WMO (2018)

northern and central Argentina, in late 2017 and early 2018. Exceptionally high temperatures occurred in many parts of the Middle East and North Africa in late June and in early July.

It was an intense tropical cyclone season with serious impacts and flooding, in the Philippines, Japan, Vietnam, Laos and DPRK. There were two significant hurricane landfalls on the United States mainland in 2018, each associated with severe damages. Cyclones also affected Yemen, Oman, India, Djibouti, Northern Somalia and Madagascar.

In August, a major flood affected the state of Kerala (India) as a result of exceptionally heavy monsoon rains. Destructive flooding was experienced by Japan in late June – early July. Exceptional rains from March to April in East Africa alleviated the previous drought conditions but also caused flooding in Kenya, Somalia, Ethiopia and Tanzania.

## 2 Climate anomalies and extremes impact on agriculture in 2018 based on ASAP assessments<sup>2</sup>

The largest impact of unfavourable climate conditions on crops and rangelands at the global scale in 2018 is due to the spring-to-summer drought that hit central and northern Europe and the prolonged drought affecting winter crops in Australia. Exceptionally hot and dry spring-to-summer conditions in Europe led to heavy agricultural losses in many countries (MARS, 2019). North America and Southern Europe on the contrary experienced favourable agro-climatic conditions leading to high corn production and partially compensating for the drought impact in Northern Europe.

In Africa, 2018 was generally a good year for main season cereals production in East, West and Northern Africa, whereas the main cereals production season in Southern Africa had poor outcomes due to early season dry spells. Major floods hit parts of East Africa in April/May (Kenya, Somalia) and Sudan and Nigeria in August and September, respectively<sup>3</sup>. In the late part of 2018 (since October) the short rainy season in Somalia, Kenya and Southern Ethiopia was again affected by rainfall deficits of up to 50% of climatology, leading to low crop and rangelands productivity in areas that have already experience short season drought in 2017. During the same period, the initial part of the main cereals season in Southern Africa is affected by rainfall deficit and high temperatures.

In Asia, Afghanistan was the country most affected by drought for both winter and summer crops in 2018. The country suffered major production drops leading to internal displacement of population in some areas. Winter crop production was affected mainly in the northern and western provinces (Hirat, Badghis, Faryab, Jawzjan, Balkh), whereas irrigated summer crop area and production was affected mainly in Jawzjan and Faryab. Rangeland areas in many parts of the country produced extremely low biomass leading to livestock losses.

Dry conditions in Argentina resulted in agricultural losses. In central America, despite mixed crop conditions in Haiti and losses for small scale farmers in El Salvador, Honduras and Nicaragua, the 2018 crop production was generally good.

Typhoon Manghkut/Ompong, which crossed the Philippines in mid-September, was associated with losses in crops and fisheries that put the population's food security at risk. According to the Department of Agriculture of the Philippines, over 550 000 hectares of agricultural land were affected, and agricultural losses could reach at least US\$ 265 million. Disruption to agricultural production was expected to affect the country's food supply for the following months, while the loss of livelihood for farmers and fisher folk during the September-October harvest could worsen food insecurity and malnutrition. Parts of Myanmar also experienced typhoon impact.

Finally, in the Middle East, Yemen, which is experiencing the largest food security crises due to a persisting conflict, also experienced a summer to autumn drought affecting rain-fed cereals. Syria and parts of Iraq had strong drops of winter cereal production due to a severe winter-spring drought while in south/central Iran and south Iraq summer crop areas and production were reduced due to lack of irrigation water.

Figure 2 provides a summary map showing the number of times a country has been classified as agricultural production hotspot countries by the ASAP early warning system in

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<sup>2</sup> This section largely builds on data and analysts' assessments provided by the JRC ASAP system (Anomaly hot Spots of Agricultural Production), an early warning decision support system for food security analysis (Rembold et al., 2019). In this system, automatic warnings about climate and biomass indicators anomalies are issued every ten days, while a detailed assessment of agricultural production hotspot countries is performed by JRC analysts at the end of each month.

<sup>3</sup> More information on the extent and impact of these floods is available in the ASAP special focus section:  
[https://mars.jrc.ec.europa.eu/asap/files/Floods\\_2018\\_May.pdf](https://mars.jrc.ec.europa.eu/asap/files/Floods_2018_May.pdf)  
[https://mars.jrc.ec.europa.eu/asap/files/special\\_alert\\_2018\\_08.pdf](https://mars.jrc.ec.europa.eu/asap/files/special_alert_2018_08.pdf)  
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2018. Table 1 shows in detail which months of the year were affected and the severity of problem (ASAP analysts distinguish two hotspot levels, i.e. hotspot and major hotspot). Table 2 provides per country a short summary of the main climate anomalies and their impacts on agricultural production.

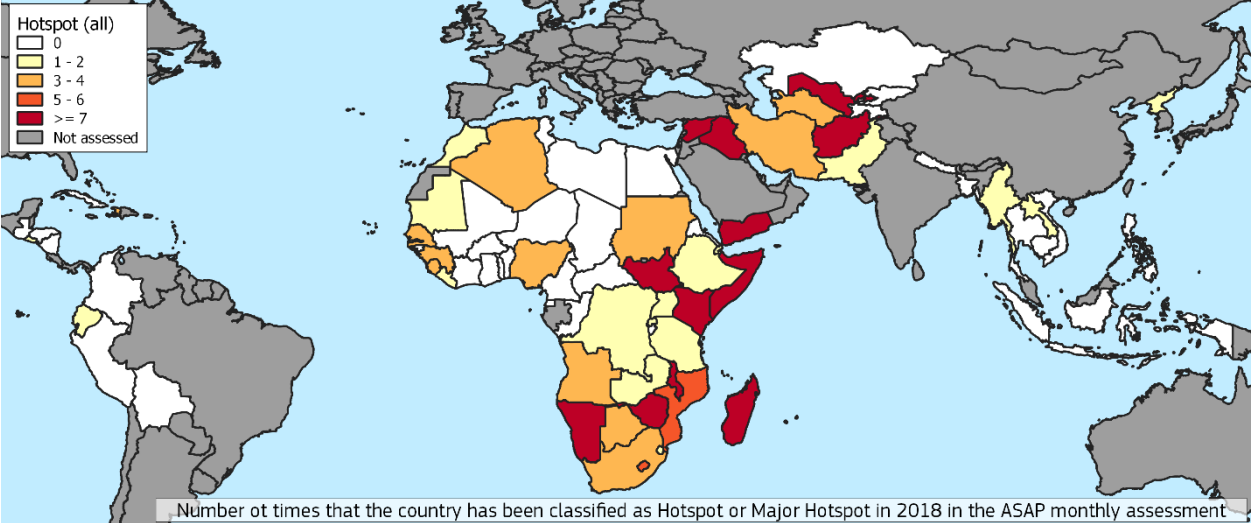


Fig. 2. Overview of ASAP hotspot countries in 2018. The colour coding refers to the number of times a given country has been classified as hotspot or major hotspot in the monthly assessment (maximum number of times is thus 12). Out of these, South Sudan, Somalia, Nigeria, Yemen, Afghanistan and Syria have been major hotspots for 1 month or longer in 2018.

Table 1. ASAP hotspot warnings by month for countries that have been classified as hotspots for at least 1 month in 2018.

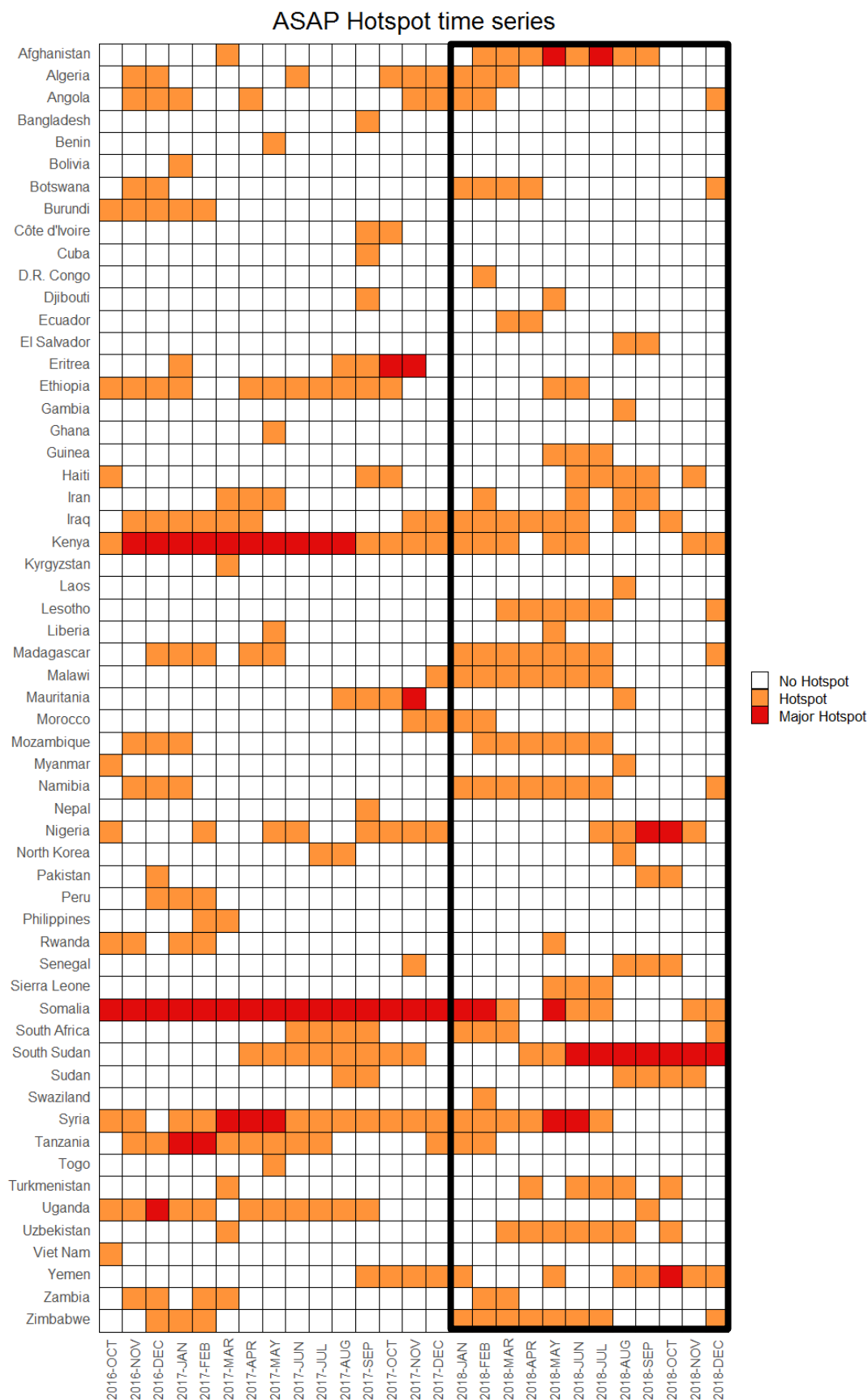


Table 2. Short description of agricultural hotspot warnings at country level with main impact of climate anomalies on crops and rangelands, and other factors with negative impact on food security (where known). NB: information about production, floods and storms data comes from several sources, full information for each country can be found at <https://mars.jrc.ec.europa.eu/asap/>.

Country	Month of 2018	Type of Climate anomaly	Impact on crop/rangelands	Other factors with possible negative impacts on food security
<b>Afghanistan</b>	8	Winter-spring drought	Strong drop of rainfed cereals production in the north and west, reduced summer crops production due to reduced irrigation	250,000+ people displaced as a result of drought
<b>Algeria</b>	3	Delay in start of the 2017/2018 season	Late season rainfall allowed for complete crop recovery and exceptional yields	
<b>Angola</b>	3	Delayed start of the season of the 2017/2018 season and of the 2018/2019 season	No major impact on 2017/2018 productivity but low rangeland production in Namibe and Cunene. 2018/2019 season still in an early stage to be assessed.	
<b>Botswana</b>	5	Dry-spell in January and irregular early season rainfall	Decreased national crop production and low rangeland productivity until March	
<b>Djibouti</b>	1	Cyclone Sagar in May		
<b>DPRK</b>	1	High temperature (2-3 °C above average) from 21/7 to 20/8	Possible reduced pollination of cereals maize and rice	
<b>DRC</b>	1	Irregular rainfall distribution in Kivu and Katanga provinces	No information on impact on crop production	Insecurity and political unrest possibly affecting food production
<b>Ecuador</b>	2	Rainfall deficits throughout the season in coastal regions	Below average crop production	

<b>El Salvador</b>	2	Dry spells from end of June through the beginning of August and heavy rains in early October	2018 aggregated cereal production is expected to be below average due to crop losses for subsistence farmers in the <i>primera</i> agricultural season and localized floods in the <i>postrera</i> season	
<b>Ethiopia</b>	2	Irregular rainfall during <i>Belg</i> season and localized dry condition in main season	Below average <i>Belg</i> production as well as local crop failure in Afar, Tigray and Somali regions	
<b>Gambia</b>	1	Irregular rainfall in July/August		
<b>Guinea</b>	3	Delayed start of the season followed by recovery thanks to good rainfall	No major impact on crop production	
<b>Haiti</b>	5	Irregular rainfall distribution since mid-June, notably in the south and northwest	Drought affected agriculture in 2018 leading to below average production	
<b>Iran</b>	4	Winter spring drought in the centre south	Reduced cereal production in the centre south (Esfahan, Fars) largely offset by good production in the north and west	Chronic and dramatic irrigation water shortage; ban of crops (rice, watermelon) in the south
<b>Iraq</b>	8	Winter spring drought	Winter cereals production drop in the north (Ninewa, Dahuk); summer crops (rice and maize) production drop in the south	Conflict; strong irrigation water shortage in Najaf and Qadissiya (government ban for rice and maize)
<b>Kenya</b>	7	Excessive rainfall in April lead to floods in Eastern Kenya. Irregular rainfall distribution during short rains	Generally good production year. Localized flood damage and low production in marginal areas (parts of eastern Kenya and southern inlands)	Flood damages to infrastructure

<b>Lao</b>	1	Excessive rainfall in July and August due to tropical storms (Son-Tinh and Bebinca)	Floods and damage to recently planted rice fields; delay in rice transplanting	Flood damage to housing and infrastructure (dam collapse in Attapeu province) and displaced people
<b>Lesotho</b>	6	Erratic rainfall distribution and dry spells, snow and frost	Below average cereal production (-35% of the 5-year average)	Pest infestation
<b>Liberia</b>	1	Slight initial delay of the season	No major impact on crop production	
<b>Madagascar</b>	8	The Southern part of the country experienced major drought conditions during the first half of the year	In the south west and especially Atsimo Adrefana and Androy regions, poor rainfall during the whole crop season, resulted in crop failure. Rangelands in Atsimo Adrefana and Androy regions have also experienced significant moisture stress.	
<b>Malawi</b>	7	Uneven temporal rainfall distribution and prolonged dry spells in southern parts	Overall production 9% below average	Fall armyworm
<b>Mauretania</b>	1	Rainfall deficit in August	Low rangeland productivity in the western part of the country	
<b>Morocco</b>	2	Delay in start of the 2017/2018 season	Late season rainfall allowed for complete crop recovery	
<b>Mozambique</b>	6	Early season dryness and high temperatures in south and central provinces	Crop failure in Gaza, Inhambane, Sofala and Tete provinces. Above average crop production in the north.	
<b>Myanmar</b>	1	Heavy monsoon rain in July-August	Damage to recently planted main season rice and delay in rice planting in the south	Flood damage to infrastructure and

				housing, 120,000 displaced people
<b>Namibia</b>	8	Prolonged January/February dry spell and irregular rainfall distribution throughout the season	Drought affected rangeland productivity and livestock status. Early rangelands depletion. Delayed start of 2018/2019 season	
<b>Nigeria</b>	5	Excessive rainfall in August and September leading to major floods along the Niger and Benue river	Above average crop production in rainfed areas but losses and damage to irrigation infrastructure in riverine areas	Flood damage to housing, roads and irrigation infrastructure. Conflict in the north/east and insecurity across the country contribute to reduce crop and livestock production
<b>Pakistan</b>	2	Poor monsoon rainfall (July - October)	Reduced summer crops and rangeland production in the south (Sindh, Balochistan)	Reduced irrigation (low level of dams)
<b>Rwanda</b>	1	Excessive rainfall in April-May	Floods damaging rice and sugar production	Flood damage to housing
<b>Senegal</b>	3	Rainfall deficit in August/September in the North	No major impact on crop production but decreased rangeland productivity	
<b>Sierra Leone</b>	3	Rainfall deficit in main season affecting Northern half of country	No information about impact on crop production	
<b>Somalia</b>	8	Major drought in 2017/2018 <i>Deyr</i> season followed by rainfall deficit >40% during <i>Gu</i> season.	Significantly reduced national cereals production (37% below average in Southern Somalia and 87% below average in the North/West)	Floods in riverine areas in April caused by torrential rainfall in upper parts of Shabelle and Juba river basins
<b>South Africa</b>	4	Delayed onset of rainy season. Prolonged drought in Cape area	Close to average crop production thanks to abundant rainfall in second part of the season	Low water availability in Cape area

<b>South Sudan</b>	9	Drought conditions in the second half of the season especially in the South East	Decreased crop production and early decline of rangeland availability	Prolonged conflict and displacements have a strong negative impact on food production and livelihoods
<b>Sudan</b>	4	Abundant rainfall in July/August in main cereal producing areas and parts of Darfur	Generally positive agro-climatic conditions but flooding in riverine areas	High fuel and farming input prices contributed to decreased sown areas and yields
<b>Swaziland</b>	1	Irregular rainfall in December 2017 to January 2018	Good crop conditions recovery thanks to good rainfall in February/March	
<b>Syria</b>	7	Winter to spring drought	Strong winter cereals production drop in the north (failed sowings in Hassakeh)	Conflict, reduced irrigation with respect to pre-conflict level
<b>Tanzania</b>	2	Delayed start of the second season in north/west	Season still ongoing	
<b>Turkmenistan</b>	5	Winter to spring drought	Winter wheat and rangeland production drop in the south-east	Reduced summer crops and cotton production as a result of reduced irrigation
<b>Uganda</b>	1	Delayed start of the season in southern Uganda and drought in Karamoja	Low crop and rangeland productivity in Karamoja	
<b>Uzbekistan</b>	7	Winter to spring drought	Reduced winter cereals and rangeland production in the south-east	
<b>Yemen</b>	7	August-September dry spell in the west	Reduced cereals (sorghum and millet) production in the west (Al Hudaydah)	The conflict is the first cause of food insecurity (mainly due to harbour

				blockade as country imports over 80% of its food) and inflation
<b>Zambia</b>	2	Dry spell and high temperatures in January	Low crop production in Southern Zambia but above average in central and north	
<b>Zimbabwe</b>	8	Rainfall deficits in December and January especially in southern provinces	Above average national production but low crop production in southern part	



### 3 Impact on crop seasons started in late 2018 and crop conditions in January 2019

By mid January 2019, the main crop season has started in North Africa, central Asia and Southern Africa<sup>4</sup>.

In North Africa, after a good start of the winter crop season in October/November, December was marked by above average temperatures and decreased rainfall in the coastal areas of Morocco and Algeria. Average or above average rainfall will be needed in January/February to ensure good seasonal outcomes.

In Afghanistan, which experienced a major drought in 2018, below average December 2018 rainfall along the northern and western border of the country (Kunduz, Balkh, Jawzjan, Faryab, Badghis, Hirat received from 25 to 50% of the average 30-45 mm) puts at risk the 2018/2019 winter crops, although it is still too early to assess any impact on cereals or rangelands.

In Southern Africa's 2018-2019 main season, a timely onset was followed by a major rainfall deficit in November/December affecting parts of Angola, most of Botswana, Namibia, Lesotho, Zimbabwe and parts of Mozambique, Zambia and South Africa. In January 2019, rainfall improved in the Eastern part of the region, but there is still a significant rainfall deficit coinciding with exceptionally high temperatures and suggesting an increased risk of low 2019 cereal production.

*Table 3. Countries experiencing climate anomalies during an ongoing crop season in late 2018 / early 2019 according to ASAP.*

<b>Country</b>	<b>Agriculture info for the period late 2018/early 2019</b>
<b>Afghanistan</b>	Rainfall deficit in the northern part in December, possible drought impact on winter cereals
<b>Angola</b>	Delayed start of 2018/2019 season and early season rainfall deficit
<b>Ethiopia</b>	Drought in South/Eastern (same region experienced drought in 2017)
<b>Iraq</b>	Favourable start of the winter season
<b>Kenya</b>	Dry conditions in early 2019 in Garissa, Wajir, and Isiolo, possibly affecting rangelands
<b>Lesotho</b>	Poor and irregular rainfall distribution since October 2018
<b>Madagascar (southern and southeastern)</b>	Early season drought in south and west following major drought in 2018
<b>Malawi</b>	Overall good start of the season
<b>Mozambique</b>	Rainfall deficit affecting 2019 season in the south
<b>Somalia</b>	30-40% below average production for <i>Deyr</i> season ending in January 2019
<b>South Sudan</b>	High temperatures in Dec. 2018 leading to early rangelands depletion
<b>Syria</b>	Favorable start of the season
<b>Tanzania</b>	Below average crop conditions in North/West in January 2019
<b>Uganda</b>	Early rangelands depletion in Karamoja due to poor 2018 rainfall
<b>Zambia</b>	Mixed crop conditions in South in January 2019

<sup>4</sup> NB: due to the purpose of this report (as explained in the foreword) this report focuses mainly on countries with high risk of food insecurity.

<b>Zimbabwe</b>	Erratic early season rainfall in southern regions
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## 4 Seasonal climate forecasts and potential impact on agriculture in 2019

Multi-Model Ensemble seasonal forecast for the next three months (February-March-April) shows warmer-than-usual conditions likely to occur in central and southern Africa, Australia, the Mediterranean region, south-east Asia, South America (except for its southern part) and the Pacific side of North America (Fig. 3).

According to NOAA's seasonal forecasts<sup>5</sup>, El Niño is expected to form and continue through the Northern Hemisphere spring 2019 (~65% chance). North American Multi-Model Ensemble (NMME) forecasts through the northern hemisphere spring and summer 2019 favor below-average rainfall over portions of Southern Africa, the Maritime Continent region, portions of Central America and the Caribbean, and northern South America.

### Probabilistic Multi-Model Ensemble Forecast

/GPC\_seoul/GPC\_washington/GPC\_tokyo/GPC\_exeter/GPC\_moscow/GPC\_beijing  
/GPC\_melbourne/GPC\_cpctec/GPC\_montreal/GPC\_ecmwf/GPC\_offenbach

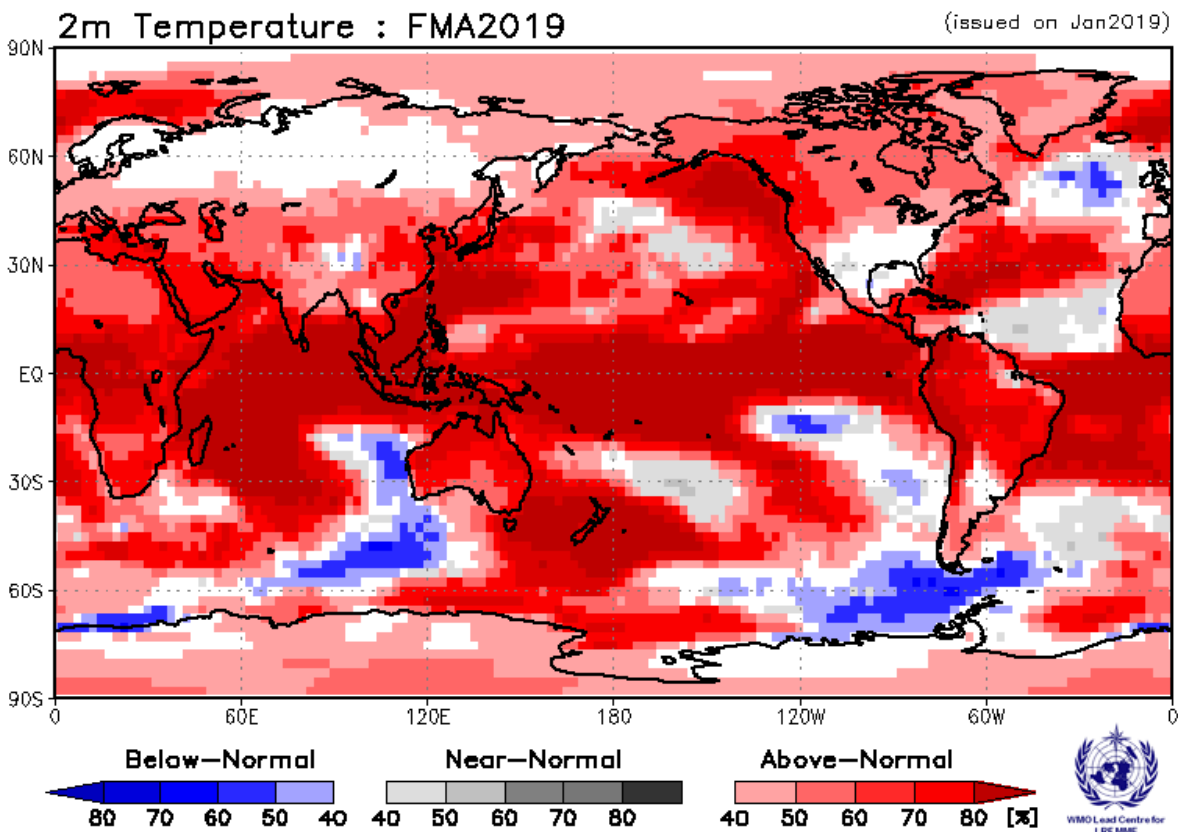


Fig. 3. Multi model ensemble forecast for 2m air temperature (source: WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble)

<sup>5</sup> [http://www.cpc.ncep.noaa.gov/products/international/africa/cons\\_fcsts/Global\\_Forecasts\\_Discussion.pptx](http://www.cpc.ncep.noaa.gov/products/international/africa/cons_fcsts/Global_Forecasts_Discussion.pptx)

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