The Climate in Africa

2013

World Meteorological Organization
Weather • Climate • Water

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Foreword

The year 2013 was Africa's second warmest since at least 1950. Most of the continent saw normal to above normal annual temperatures. Precipitation levels were more variable. Mozambique's January floods were among the world's 10 most severe for 2013, as measured by the number of deaths, while precipitation levels in northern Mali were well above average. But the rains in Namibia and neighboring countries were well below average, leading to the worst drought anywhere in the world in 2013.

These are just some of the findings featured in The Climate in Africa: 2013, WMO's first peer-reviewed statement on regional climate conditions. Modeled on the global statements issued by WMO every year since 1993, The Climate in Africa was produced by an African Task Team composed of well-regarded scientists and experts representing very sub-region of the continent. The work was conducted in consultation with the African Centre of Meteorological Applications for Development (ACMAD).

WMO issues its authoritative annual climate statements (and its decadal statement for 2001-2010) to provide data and information that make it possible to place current climate conditions in a historical context. Recognizing that Africa is particularly vulnerable to climate variability and climate change, WMO has issued this supplementary statement to provide greater detail about each of Africa's sub-regions.

This regional statement provides further evidence that weather and climate services are vital for protecting life and property in Africa. The need to inform decisions about disaster risk, agriculture, water resources, public health and other climate-sensitive sectors is the driving force behind the WMO-led and Norway-funded Global Framework for Climate Services (GFCS) Adaptation Programme in Africa. A partnership among national governments and seven international agencies and research institutes, the Programme is increasing the resilience of people who are most vulnerable to the impacts of weather and climate. The Programme is further supported by the Climate Outlook Forums established through WMO for Southern Africa, Central Africa, West Africa, and the Greater Horn of Africa.

The Climate in Africa: 2013 is based on datasets and information that have been contributed by WMO Members and partners and assessed in their regional and subregional context. Comparisons were made with climatological averages and records whenever possible and appropriate. The report's temperature and precipitation assessment is based on the Climate Anomaly Monitoring System (CAMS) managed by the US National Oceanic and Atmospheric Administration (NOAA). Other datasets have also been used for additional analysis. National Meteorological and Hydrological Services of the WMO Regional Association I (Africa) were the main providers of the underlying observations and climate information.

We welcome your feedback on this report and insights into how you have made use it in your work.

Michel Jarraud

Secretary-General

Climate assessment: Key continental features

Temperature

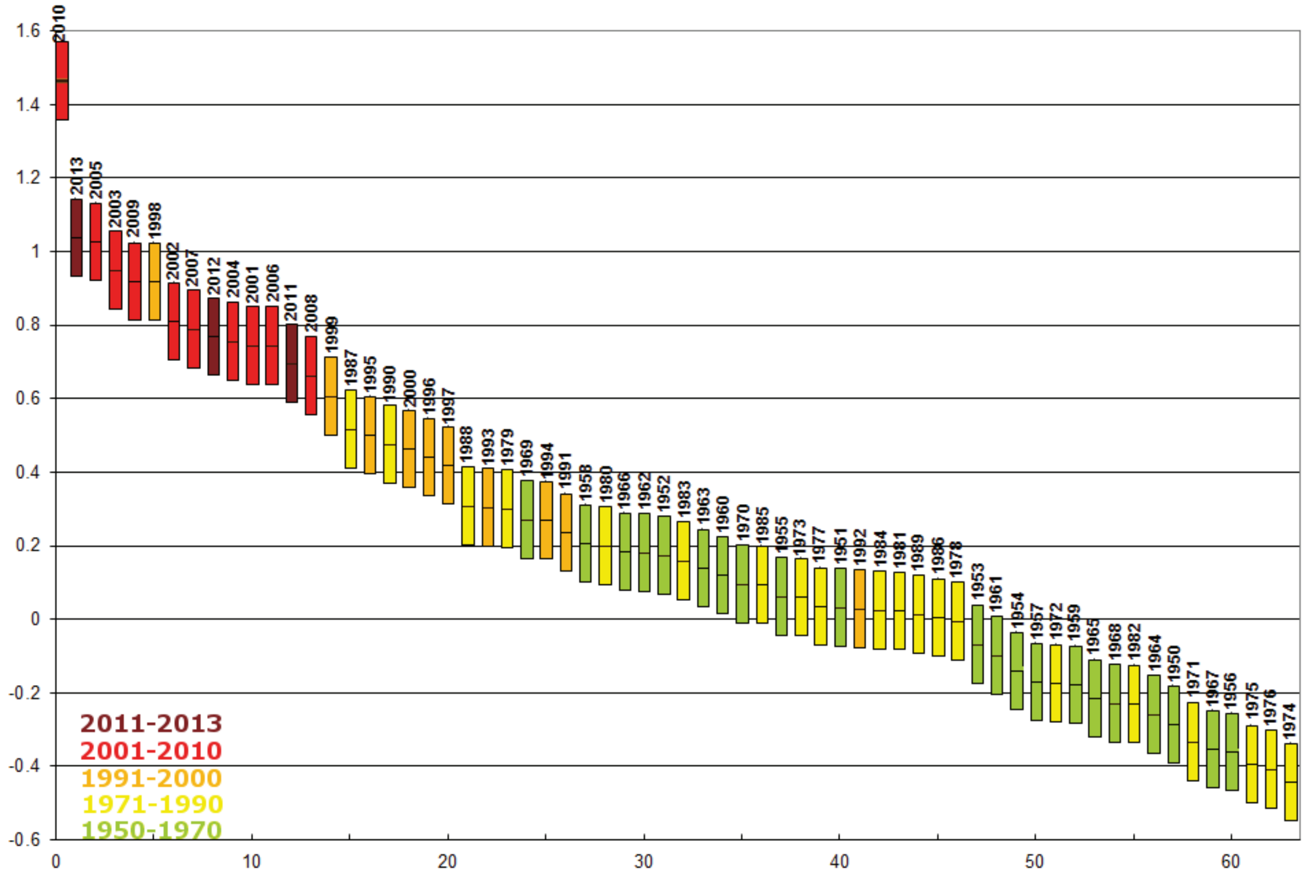

Figure 1: Ranked temperature anomalies (°C) for Africa for 1950-2013 relative to 1961-1990; gridded data based on station observations. (Data source: NOAA/NCEP/CPC/CAMS). The spread of the bars shows the 95% confidence interval.

The year 2013 in Africa ranks as second warmest year (see Figure 1) recorded since 1950 with an anomaly of +1.04°C above the 1961-1990 average. The El Niño year 2010 was the warmest year for the continent followed by 2013, which was slightly warmer than 2005 based on the 1961-1990 average. Since 1950, the temperature trend for Africa shows an average increase of 0.02°C per year (solid

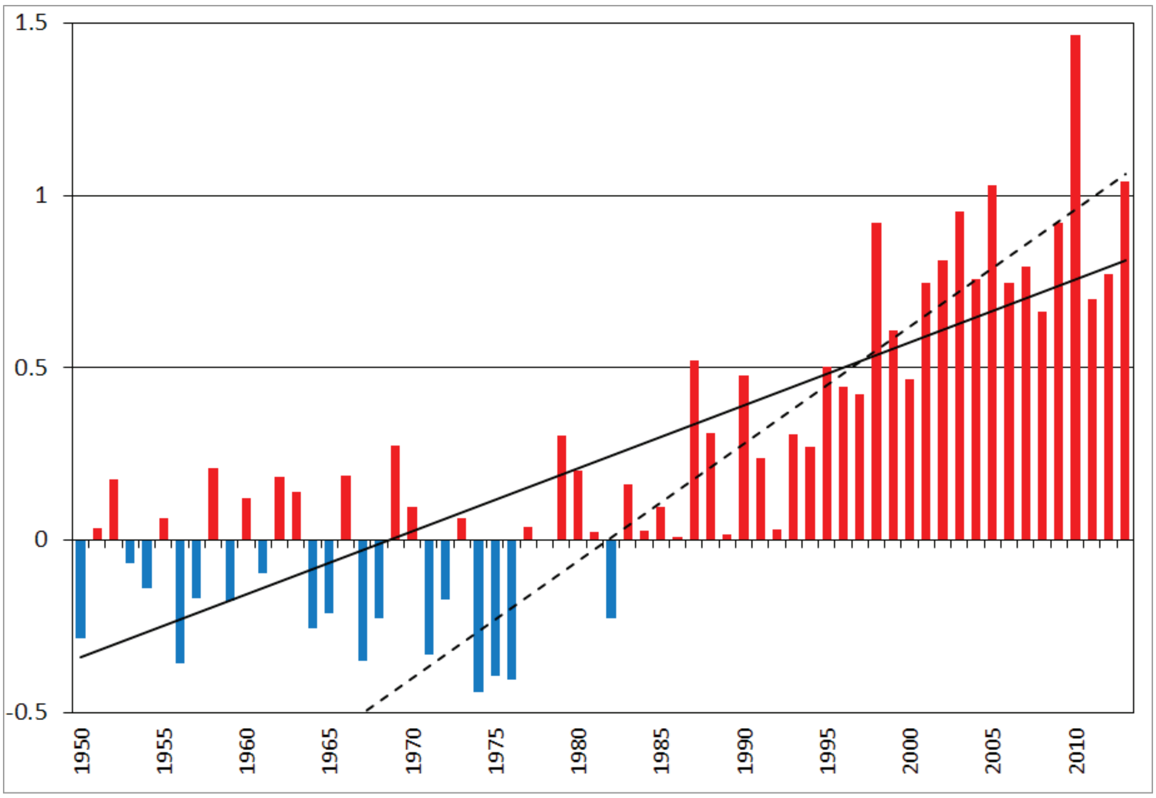

Figure 2: Temperature anomalies (°C) for Africa relative to 1961-1990 (bars), trend for 1950-2013 (black solid line) and trend for for 1990-2013 (black dashed line); gridded data based on station observations. (Data source: NOAA/NCEP/CPC/CAMS)

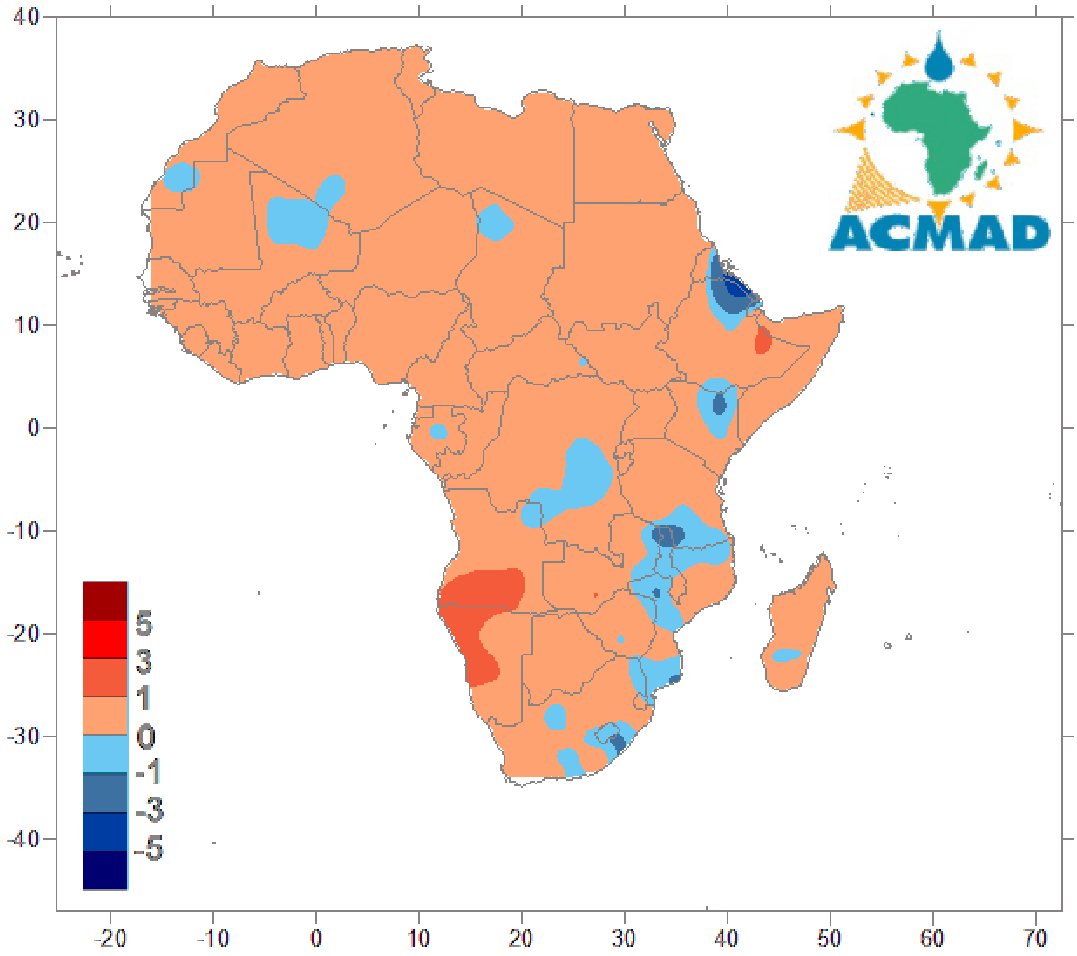

Figure 3: Annual temperature anomalies (°C) for Africa for 2013 relative to 1961-1990 base period; gridded data based on station observations. (Data source: NOAA/NCEP/CPC/CAMS)

line, Figure 2). However, since 1990 the trend strengthened to 0.03°C per year (dashed line, Figure 2).

At global scale, the assessment of the annual temperature indicates that the year 2013 ties with 2007 as the sixth warmest year since global records began in 1850, with a global land and ocean surface temperature that was 0.50°C above the 1961–1990 average (source: WMO statement on the status of the global climate in 2013).

In 2013, some areas in Africa recorded annual temperature anomalies (see Figure 3) close to 3°C, in particular: Southern Angola, northwestern Namibia and eastern Ethiopia. Anomalies close or below -3°C were observed over northern Ethiopia, southern Eritrea, in northeastern Kenya, southern Tanzania, northern Malawi and in western South Africa.

Elsewhere, temperatures were dominated by positive anomalies, except few areas with near zero or slightly negative values.

Precipitation

For the second consecutive year, global precipitation during 2013 tied with the 1961–1990 average of 1033 mm, according to the WMO annual statement on the status of the global climate in 2013. With focus on Africa, the continent had an overall near average annual rainfall in most parts, except in northern Mali where well above average precipitation (175% of the annual precipitation or more) was recorded (see Figure 4). Well below average precipitation (50% of the annual precipitation or less) was observed in northern Somalia and northwestern Namibia. The latter was hit by a severe drought with a total precipitation rate at or below 50 percent of annual average over parts of the country.

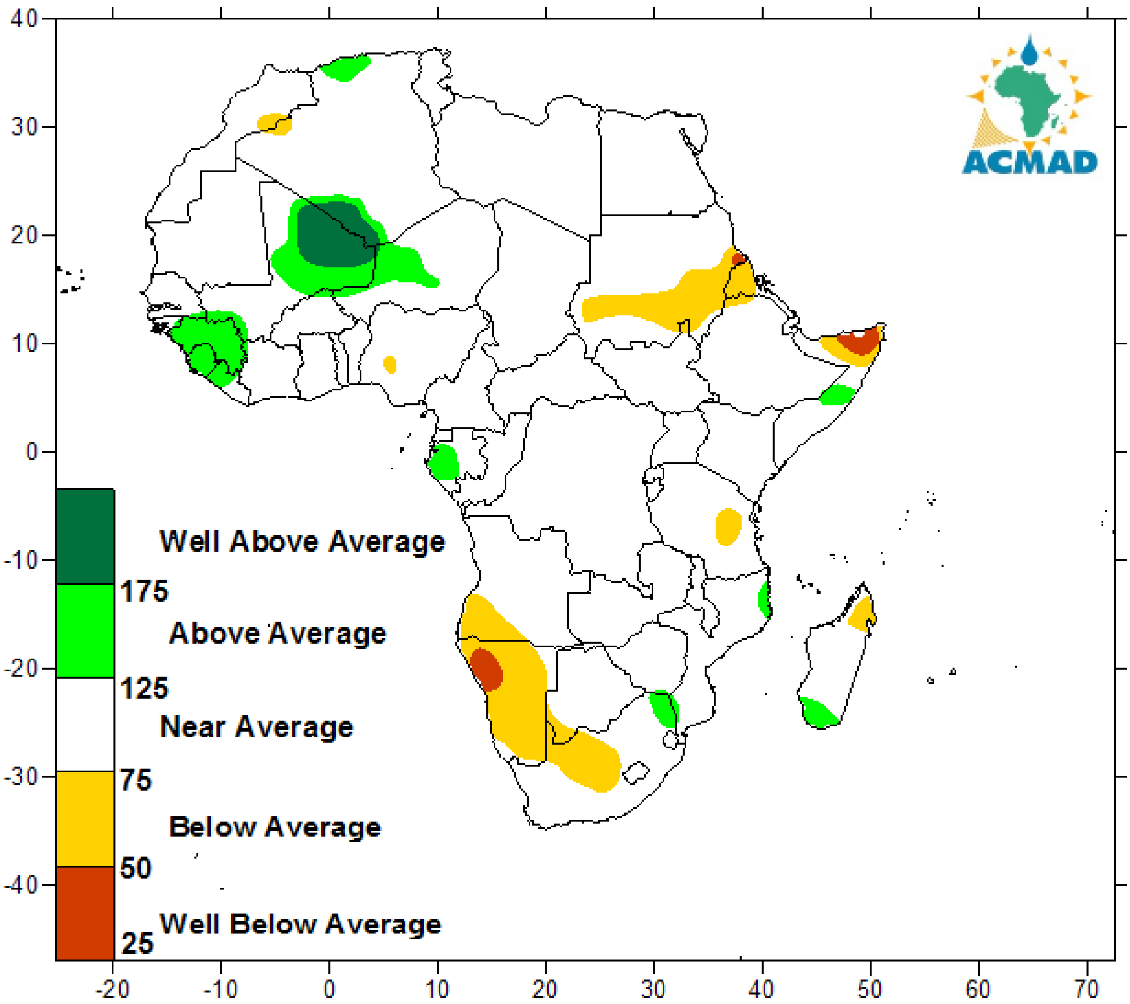

Figure 4: African annual precipitation in percentage of average for 2013; gridded data based on precipitation estimates from rain gauge and satellite data analysis with respect to 1981-2010. (Data source: NOAA/ NCEP/CPC/ CAMS-OPI).

Sea Surface Temperature: A possible influence on the African climate in 2013

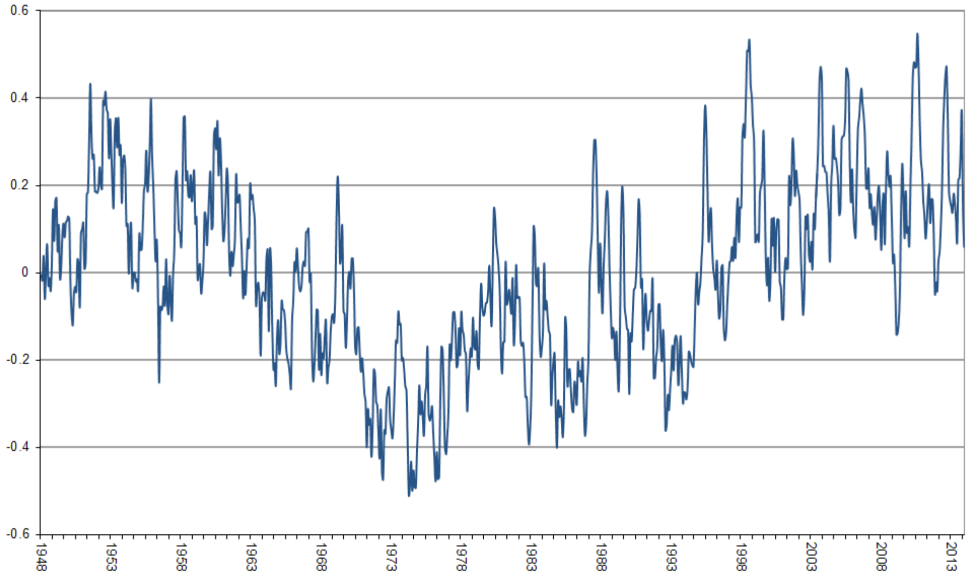

Figure 5: Atlantic Multidecadal Oscillation Index 1948-2013 (Data source: NOAA/ESRL)

The only prominent sea surface temperature (SST) anomaly which seems to be linked to the extreme events and flooding (see Williams et al., 2010) reported in West Africa in 2013 is the prominence of the Atlantic Multidecadal Oscillation (AMO, see Figure 5) featuring a warm tropical north Atlantic from January to October. In July, the Atlantic equatorial cold tongue intensified further (see Figure 6, right) contributing to the enhancement of the West African Monsoon (WAM). Torrential rains fell along the Sahel band in August while below average rainfall prevailed over the Gulf of Guinea region. This is a classic picture of the WAM decadal signal also linked to the AMO.

Elsewhere, SST anomalies were weak. ENSO neutral conditions prevailed throughout the year. The Indian Ocean Dipole (IOD) mode was slightly negative throughout the year and may have contributed to below average rainfall in eastern Africa, especially in Tanzania. However, SST anomalies were overall quite weak across the Indian Ocean basin. Strong SST gradients between subtropical and tropical southwestern Indian Ocean may have contributed to some of the observed seasonal rainfall anomalies over eastern and parts of southern Africa (SST analysis based on NOAA, 1981-2010 climatology, see Figure 6, left and 10).

As an additional note, in equatorial East Africa and southern Africa, there was a strong subseasonal variability. Intraseasonal variability including the Madden–Julian Oscillation (MJO) and Kelvin Waves, and internal atmospheric variability might have had some influence in triggering some of the observed extremes.

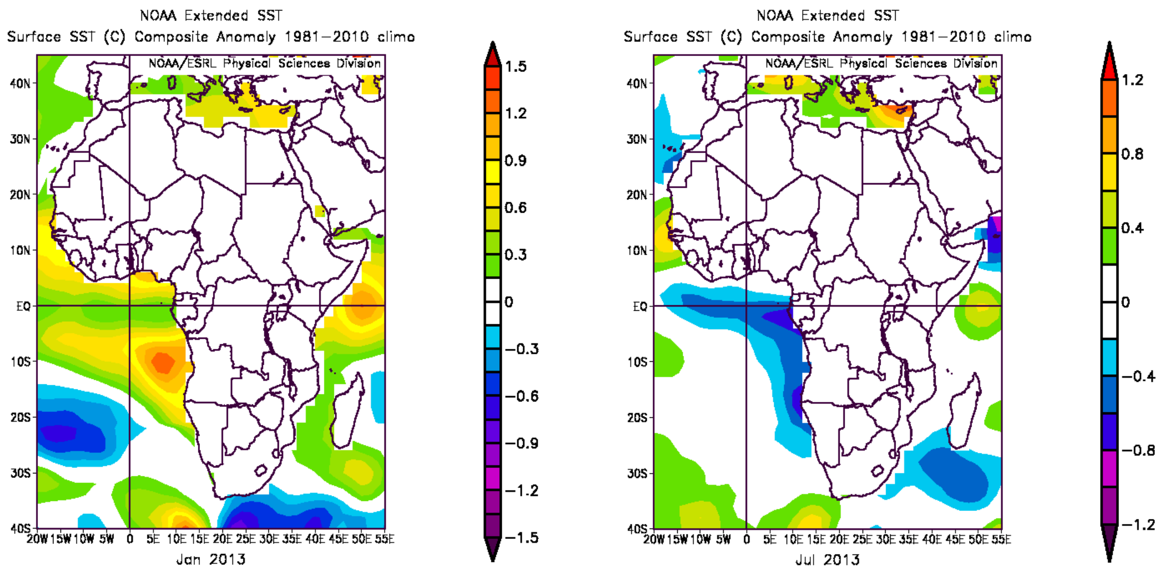

Figure 6: Sea surface temperature anomalies for January (left) and July (right) 2013 (Source: NOAA/CPC).

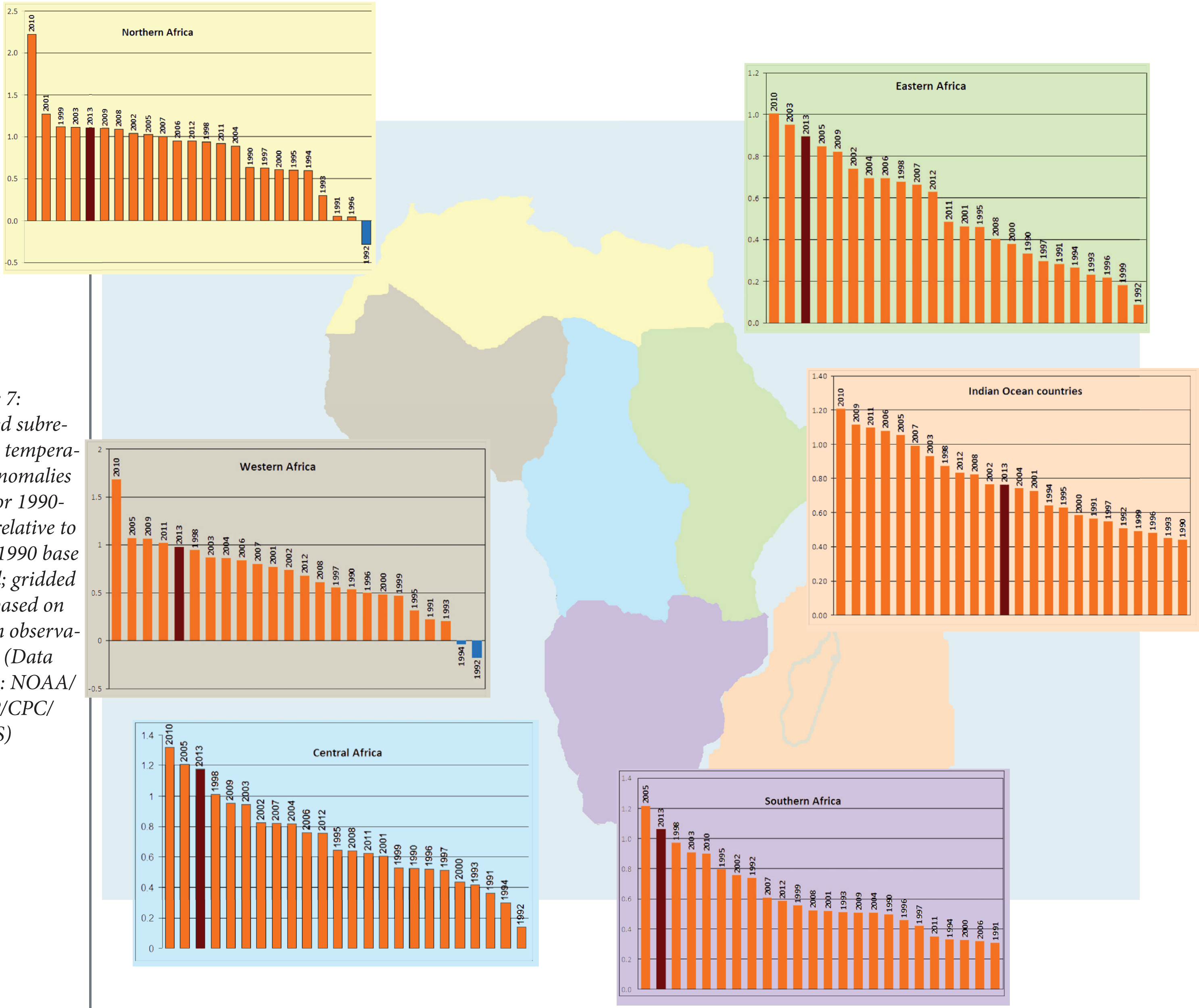

Figure 7: Ranked subregional temperature anomalies (°C) for 1990-2013 relative to 1961-1990 base period; gridded data based on station observations. (Data source: NOAA/NCEP/CPC/CAMS)

Climate Assessment: Subregional features

For this assessment the continent of Africa was divided into six subregions: Southern Africa, central Africa, western Africa, eastern Africa, northern Africa and Indian Ocean island countries.
Figure 7 shows the temperature rankings for all subregions. Except for the Indian Ocean island countries, 2013 ranked among the five warmest years in all subregions. When it comes to the warmest year recorded since at least 1950, 2010 ranks first on a continental level and in all subregions except in southern Africa, where 2005 was the warmest.

Southern Africa

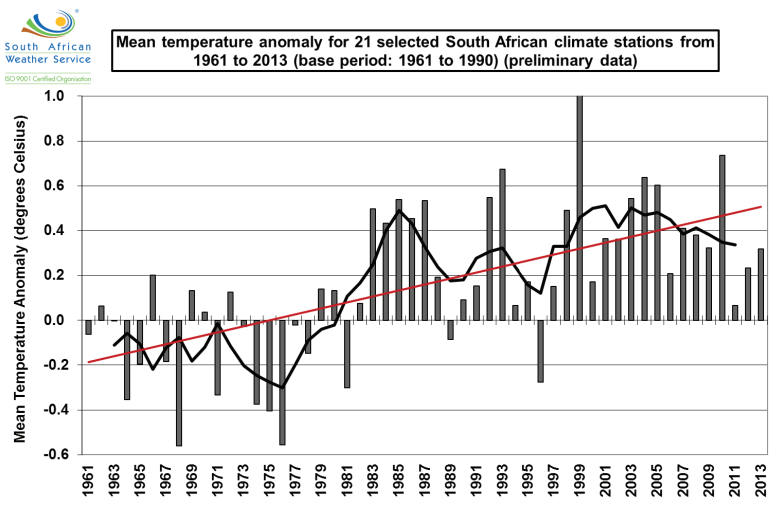

Figure 8: Temperature anomaly in South Africa in 2013 with respect to 1961-1990 (Source: SAWS)

The *southern African* subregion is characterized by tropical and subtropical climate which is influenced by the long coast line, from the Indian to the Atlantic Ocean. The most influential climate factors are ocean currents, the ITCZ and quasi-stationary high pressure systems (St. Helena High in the South Atlantic and Mascarene High in the Indian Ocean). The subregion is mainly characterized by a wet and hot season from October to March (summer) and a cool and dry season from April to September (winter).

Temperature

In the subregion, 2013 ranked as the second warmest year behind 2005 with an anomaly of 1.1°C above the 1961-1990 average. The annual temperature anomaly with respect to 1961-1990 (see Figure 3 and 9) shows the highest temperature deviations in parts of Namibia, Angola and Zambia. Namibia was gripped by one of the worst droughts ever recorded. Anomalies in these regions were as high as 3°C above normal throughout the year.

CLIMATE OF THE SOUTHERN HEMISPHERE IN 2013

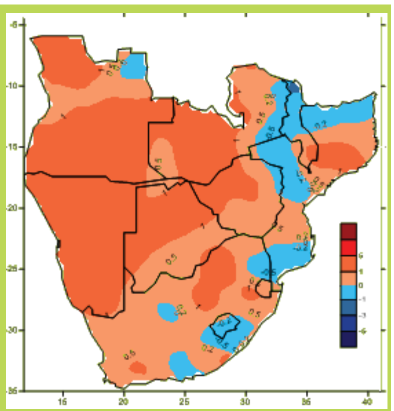

Figure 9: Temperature anomaly over Southern Africa in 2013 with respect to 1961-1990; gridded data based on station observations. (Data source: NOAA/NCEP/CPC/CAMS)

The southern hemisphere recorded its third warmest year behind 2005 and 2009 with regard to land only surface temperatures.

In South America, a warm October–December period contributed to Argentina's second warmest year since records began in 1961, at 0.57°C above average, behind only the record warmth set just last year in 2012. Many regions of the country had their warmest December on record, due largely to the most significant heat wave in Argentina since February 1987. December 2013 was the warmest of any month for the captial city of Buenos Aires since records began in 1906. Argentina's five warmest years on record have all occurred in the past eight years (since 2006).

In the South-west Pacific, Australia also observed its warmest year since national records began in 1910, at 1.20°C above average and 0.17°C higher than the previous record warmest such period in 2005. January 2013 was the hottest month ever in the country. Monthly maximum temperature anomalies reached +5°C in north west New South Wales. On January 7th, a new national area-averaged daily maximum temperature of 40.30°C was set. The extreme warmth combined with a warmer-than-average December and February to give the country its hottest summer (December–February) on record. Warmer-than-average temperatures continued through the year as Australia observed its third warmest winter (June–August) on record followed by its record warmest spring (September–November). Temperatures for September were 2.75°C above average, the highest monthly temperature departure from average ever recorded in Australia. The country recorded its all-time warmest 12-month period during September 2012–August 2013, only to see the record broken the following two consecutive months, making November 2012–October 2013 the current warmest 12-month period on record.

The anomalous warmth was also present during austral winter in New Zealand, which experienced its fourth warmest July and record warmest August. These warm months contributed to the country's warmest winter on record. New Zealand recorded its third warmest year since its national records began in 1909.

In southern Africa, most parts recorded above to well above normal temperatures in 2013. Angola, Namibia, Botswana, Zambia and Zimbabwe observed the highest anomalies (see Figure 9). The annual mean temperature anomalies for 2013 for South Africa from the preliminary data of 21 climate stations were on average about 0.3°C above the reference period (1961-90). A warming trend of 0.13°C per decade is indicated by the data of these particular climate stations. By February, maximum temperatures in the central and north-western interior were 3-4°C above the 1971-2000 normal. Even in Cape Town, hikers had to be air-lifted off Table Mountain due to dehydration caused by the extremely hot conditions.

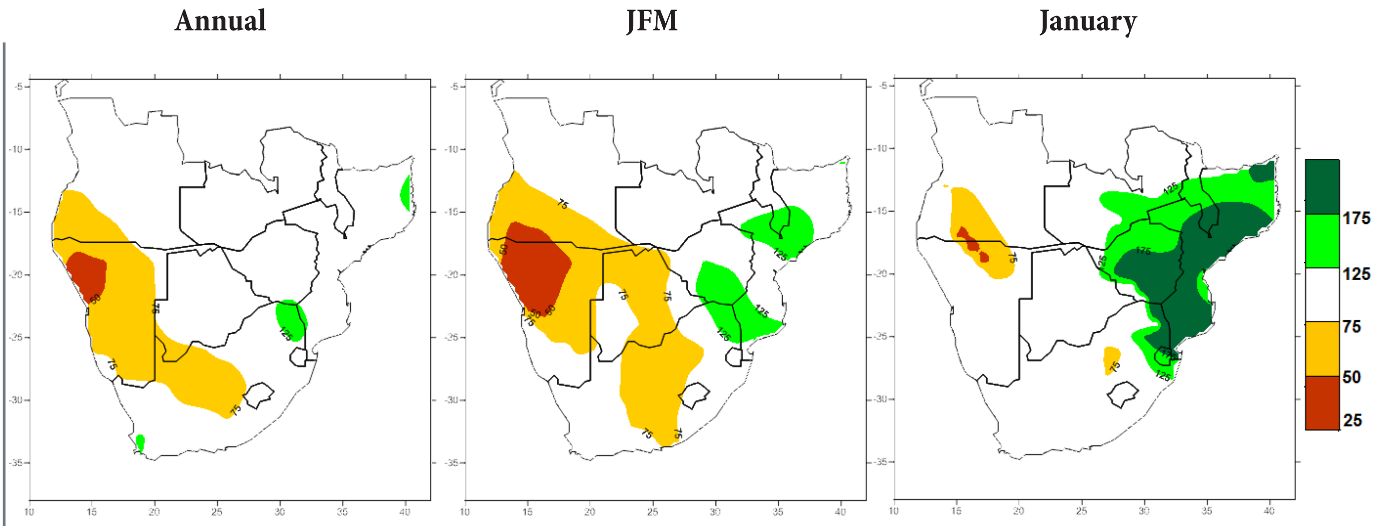

Figure 10: Southern African precipitation in percent of average for 2013 (left), JFM (middle) and January (right) focusing on the 1981-2010 base period; gridded data based on precipitation estimates from rain gauge and satellite data (Data source: NOAA/NCEP/CPC/CAMS-OPI).

Precipitation

In 2013, normal to below normal precipitation was recorded with Namibia being the most affected. In January, Mozambique (see Figure 10, right) and neighbouring countries recorded well above average precipitation causing floods in several places. January to March rainfall in southern Africa (see Figure 10, right) shows precipitation below to well below normal over Namibia, Angola, Botswana and South Africa leading to one of the worst droughts ever recorded in Namibia.

In South Africa, the most significant feature of the rainfall during 2013 was the dry conditions that persisted for most of the year over the northwestern province and the southern Free State provinces. January and February were characterized by below-normal rainfall over the western interior with wetter conditions in the south and east. While good rains fell over the western interior in March, the rainfall was again below-normal over this region from April, spreading eastwards over the northwest and Limpopo provinces in May. These dry conditions persisted over northwestern and the southern Free State until November, with relief only in December. In the meantime, above-normal rainfall was experienced over the south-west of the country.

Indian Ocean Island Countries

The *Indian Ocean island countries* consist of many islands grouped into five countries, including Comoros, Madagascar, Mauritius, the Mayotte Island (France), the La Réunion Island (France) and Seychelles. The region has a warm and wet season from November to April and a cooler and dry season from May to October and is mainly influenced by the southeastern trade winds.

Temperature

With an annual temperature anomaly of +0.76°C above the 1961-1990 average, 2013 ranked in the subregion as 12th warmest year with 2010, 2009 and 2011 being the warmest on record (see Figure 7). All of the countries in this region experienced warmer than average conditions in 2013. The month of November was the warmest November since 1971 across all islands. In La Réunion, it was the warmest November on record since 45 years. In Seychelles, a positive monthly anomaly as high as +3°C was observed, and in Madagascar and Comoros, positive anomalies up to +2°C were recorded.

In Madagascar, 2013 was the third warmest year on record since 1971, with 2006 and 2010 being the warmest and 2013 being slightly warmer than 2012. The overall mean temperature was 23.5°C which is +0.5°C above normal. The highest positive anomaly of about +0.8°C was observed in the eastern station of Sainte-Marie, in the northwestern station of Antsohihy, and in the central highland station of Fianarantsoa. During the January to March summer months, the mean seasonal temperatures were above normal in the northern areas of the island with the highest positive anomalies observed in Sainte-Marie (+1.3°C) and Antsohihy (+1.0°C). During the austral June to August winter months, the mean seasonal temperature were above normal along the central western coast, and below normal along the northeastern coast. The highest positive anomaly was recorded at Morondava (+1.1°C) and the highest negative anomaly was recorded at Sambava (-0.8°C).

In La Réunion, 2013 was the sixth warmest year on record since 1971, with an annual mean tem-

perature anomaly of +0.45°C above the 1981-2010 average. Minimum temperatures were generally cooler than average for May to August, and maximum temperatures were above average for July to December.
Mauritius recorded an annual mean temperature of 23.6°C for 2013 which is about +0.45°C above the 1971-2000 average. In Comoros, the annual mean temperature was 26.6°C for 2013 which is +0.5°C above the 1971-2000 average. Mayotte Island recorded an above normal temperature anomaly of about +0.5°C.

Precipitation

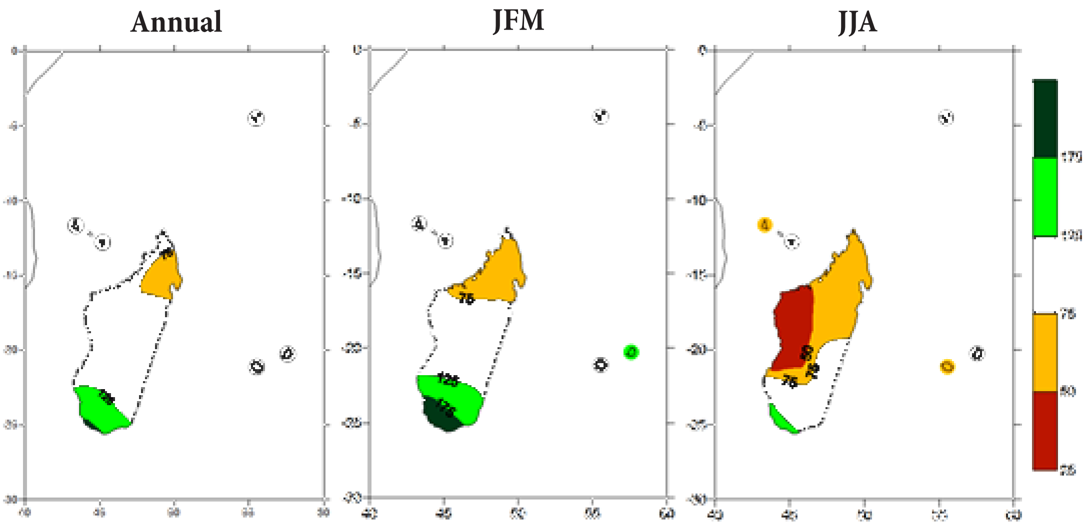

Figure 11: Percentage of normal precipitation over the Indian Ocean region for 2013 (left), for JFM (middle), for JJA (right) with respect to 1981-2010; gridded data based on precipitation estimates from rain gauge and satellite data (Data source: NOAA/NCEP/CPC/CAMS-OPI)

Near normal precipitation was observed in most parts of the region during 2013. However, in Madagascar the mean annual rainfall was below normal in the northeastern part and above normal at the southern tip (Figure 11, left). Comoros and Mauritius, both recorded near normal precipitation with an annual total of 1419 mm and 2049 mm, respectively.
The January to March (JFM, see Figure 11, middle) total seasonal rainfall was below normal in the northern part of Madagascar and well above normal in the southern tip of the island, mainly due to Tropical Cyclone Haruna, which hit the southern part in February. Mauritius recorded above normal precipitation during JFM. For the La Réunion Island, January was the wettest month during the year, mainly due to the tropical cyclones Dumile and Felleng.
The climatologically dry June to August (JJA, see Figure 11, right) winter season was generally drier than normal across the whole region. A severe drought affected the northwestern part of Madagascar, La Réunion Island and Comoros, with amounts averaging about 50% and below compared to the 1981-2010 average.

Central Africa

Central Africa is one of the wettest parts of the continent and influenced by the position of the Intertropical Convergence Zone (ITCZ). Three peak rainfall periods are considered for the region: MAM (March-April-May), JAS (July-August-September) and OND (October-November-December). The length of the rainy season varies from the coastal area (more than 8 months) to the dry desert area in the northern part of the subegion.

Temperature

2013 ranked as the third warmest year behind 2010 and 2005 in the region (see Figure 7). The observed anomaly of +1.18°C above the 1961-1990 average was slightly below the 2005 anomaly. Much of central Africa experienced above average temperatures during the year, with a significant anomalous warmth across southern Angola.
In Cameroon, the national anomaly was about +0.6 °C. Brazzaville, Congo recorded an annual mean temperature of 25.9°C which is about 0.9°C above the 1961-1990 average.

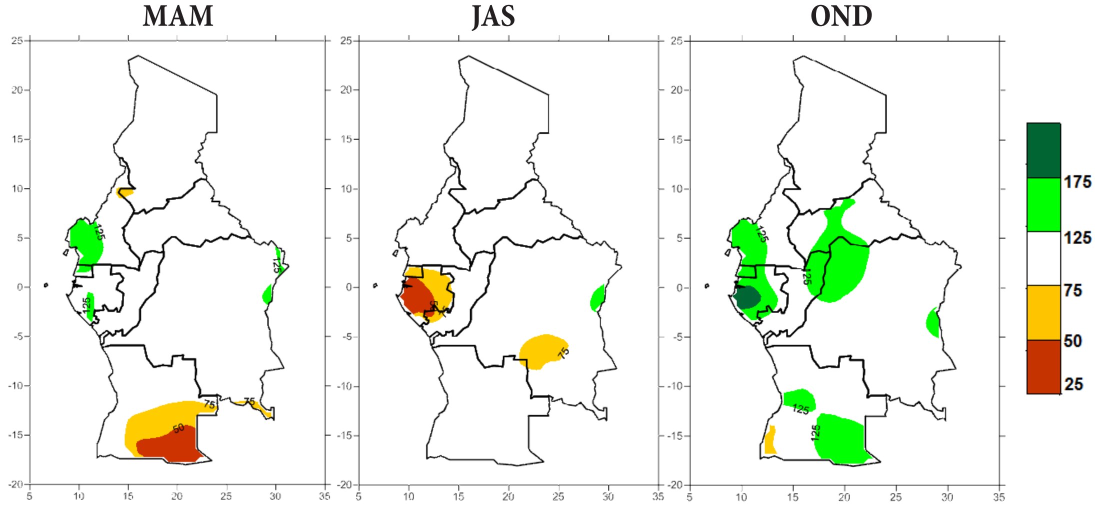

Figure 12: Central African precipitation in percent of average for MAM (left), JAS (middle) and OND (right) based on 1981-2010 average; gridded data based on precipitation estimates from rain gauge and satellite data (Data source: NOAA/NCEP/CPC/CAMS-OPI).

Precipitation

The MAM season in central Africa was characterized by well below average precipitation in southwestern Angola. During the JAS wet season well below precipitation was recorded over western Gabon. From October to November well above average rainfall was observed over western Gabon (see Figure 12).

Eastern Africa

The subregion of *eastern Africa* covers the coastal countries from Eritrea in the north to Tanzania in the south. The subregion has a broad diversity of terrain and climate. The two highest mountains in Africa, Mt. Kilimanjaro and Mt. Kenya, lie in East Africa as well as one of the largest freshwater lake on the planet, Lake Victoria. The climate is typically equatorial with high temperatures year round and little seasonal variation, especially closer to the equator. Rainfall in the region is highest in the mountains and lowest in the north. It increases southwards. Northern Somalia is one of the driest regions with an average annual rainfall of 130 mm due to the rain shadow effect caused by the mountain ranges in the east. The coast and the mountains in the south of the region typically receive more than 1200 mm a year. There are two short rainy seasons: one around April/May/June (AMJ), and the other in October/November/December (OND). Rainfall is strongly influenced by the Inter-tropical Convergence Zone (ITCZ) that streams low pressure around the equator. Rainfall in the region is also affected by El Niño, and in years when this phenomenon prevails, eastern Africa receives more rainfall especially during the first rainy season of the year. In contrast, if La Niña is prevailing, the southern parts of the subregion normally experiences a drier-than-normal period between November and March.

Temperature

2013 was the third warmest year in the subregion behind 2010 and 2003 (see Figure 7) with an anomaly of 0.9°C above the 1961-1990 normal temperature. Well above average temperatures were recorded in Somalia and eastern Ethiopia, in northern Sudan and in Uganda. Below average tem-

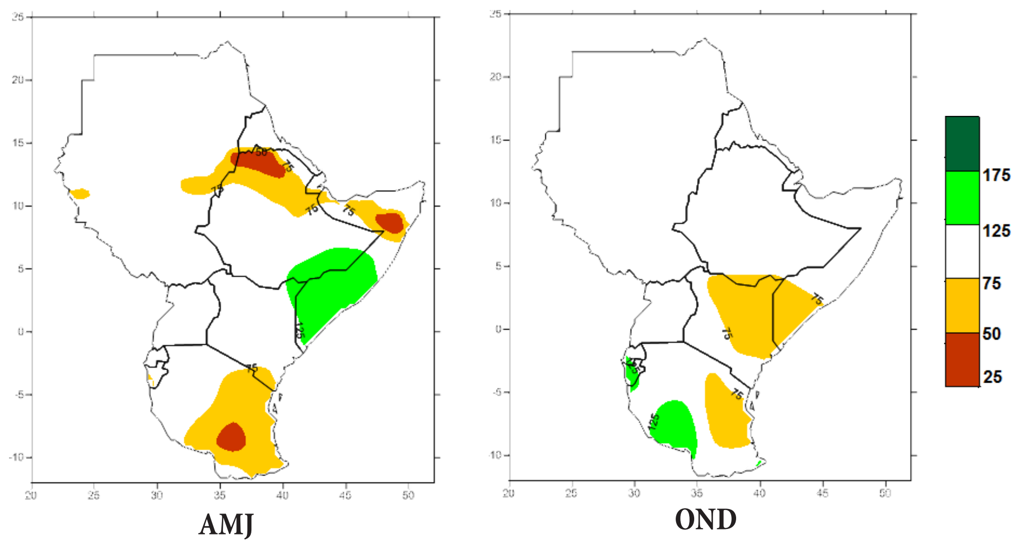

Figure 13: Percentage of normal precipitation over eastern Africa for AMJ (left) and OND (right)with respect to 1981-2010; gridded data based on precipitation estimates from rain gauge and satellite data (Data source: NOAA/NCEP/CPC/CAMS-OPI).

peratures were observed at the border of Ethiopia and Eritrea.

Precipitation

From April to June northern Ethiopia, northern Somalia and western Tanzania recorded below to well below precipitation. Conversely, southern Somalia and parts of southern Ethiopia observed above average precipitation (see Figure 13).

From October to December below normal precipitation was observed in parts of Kenya, Somalia, Ethiopia, Tanzania. Above average precipitation was recorded in Burundi and southern Tanzania.

Featured Article: Can the 2011 East African drought be attributed to human-induced climate change?

In early 2011, the Greater Horn of Africa was impacted by a severe drought which consisted of the failure of two successive rainy seasons.

A study performed by Lott et al. (2013) assessed the short rainy (October-December) and long rainy season (March-June) in Eastern Africa in 2010 and 2011, respectively. Therefore the technique of event attribution has been applied using the observed sea surface temperatures (SSTs), and sea ice conditions with a state-of-the-art climate model.

The two rainy seasons were simulated hundreds of times to produce possible distributions of precipitation. Simulations of the climate without human influences include only natural forcings and an estimate of the change in the SST and the sea ice due to anthropogenic forcings subtracted from the observations.

The results of this study show that the observed rainfall deficit for the 2010 short rainy season (October to December) was well within the probability distribution and, as widely reported, particularly affected by La Nina. The 2011 long rainy season (March to June) instead, shows some evidence that the failure was more probable following anthropogenic climate change.

Further work is needed to understand the mechanisms involved and to address the uncertainties of this study more deeply.

Western Africa

The *western Africa* subregion is influenced by the Inter-Tropical Divergence (ITD). Northwards sub-Saharan and desert conditions are prevailing. The rainy season in coastal areas in West Africa is generally observed from the end of April to July with a second and shorter rainy season in September and October. Further inland towards the desert, only one rainy season from July to September is observed.

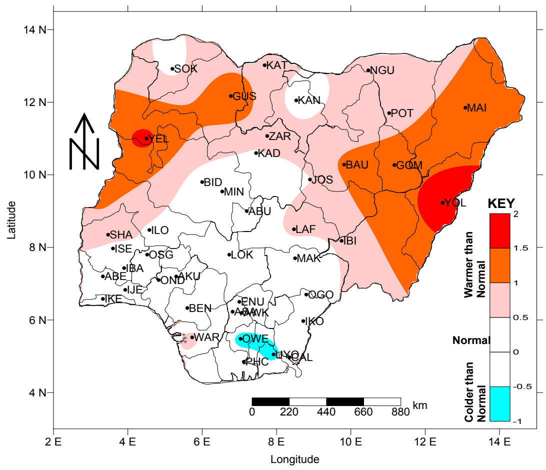

Figure 14: Temperature anomaly for Nigeria in 2013 with respect to 1981-2010 (Source: Nigerian Meteorological Agency)

Temperature

The year 2013 was the fifth warmest since 1950 for the subregion with an anomaly of +0.97°C and characterized by mean temperatures above the average in most of the countries except for northern Mali.

In Côte d'Ivoire an annual mean temperature anomaly of +0.8°C with respect to the 1961-1990 average was recorded for 2013.

In Nigeria, mean temperature anomalies in 2013 were on average -0.2°C below the 1981-2010 average of 33.5 °C and therewith lower than in 2009 and 2010, but close to the 2012 anomaly. Many places experienced normal to above normal temperatures based on the reference period 1981-2010. The hot season 2013 (i.e. February-March in the south and March-April in the north) recorded warmer-than-normal conditions in the north, varying from +0.5 to +2.2°C above the 1981-2010 average. Most of the central and southern cities were predominantly normal to colder-than-normal with Iseyin being coldest with an anomaly of -2.2°C (with respect to 1981-2010). The long-term monthly minimum temperature averages for the country shows that the lowest values are usually recorded in January and December. This period can therefore be regarded as the cold season in Nigeria with

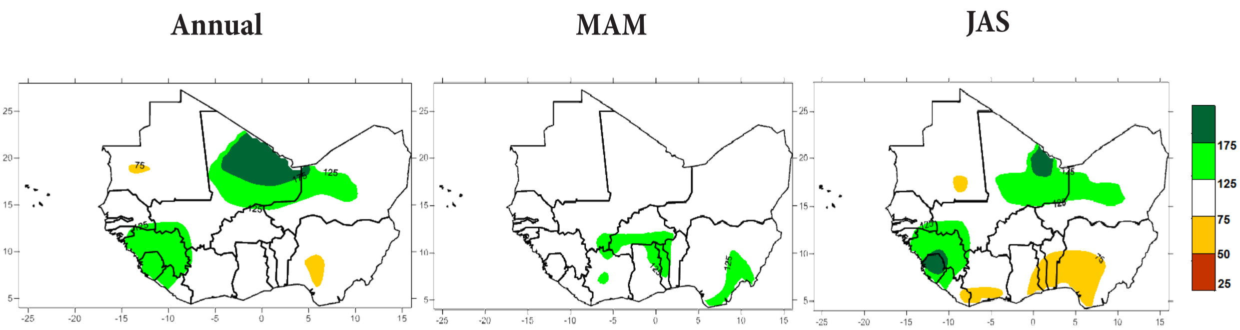

Figure 15: Annual percentage of normal precipitation over western Africa in 2013 (left), MAM seasonal precipitation anomaly (middle), JAS seasonal precipitation anomaly (right) with respect to 1981-2010; gridded data based on precipitation estimates from rain gauge and satellite data (Data source: NOAA/NCEP/CPC/CAMS-OPI).

December as coldest month. Colder than normal minimum temperature anomalies (-0.5 to -2.0°C) were recorded in places around the southeast and Delta region during December, with Owerri recording the highest negative value (-1.7°C). Most areas in the north and middle belt recorded minimum temperature departures above normal (+1.0 to +3.8°C) with the highest anomaly of +3.8°C over Yola and Lafia. Kano recorded the highest negative anomaly (-3.8°C) during the cold season.

In the Gambia, the national average temperature was 27.9°C with an anomaly of +0.1°C above the 1981-2010 average.

In Guinea, the annual mean temperature for 2013 was 25.4°C with an anomaly of +0.56°C compared to the 1981-2010 period.

Precipitation

The year 2013 was characterized by above average precipitation in Guinea, Sierra Leone, Liberia, southern and northern Mali, and western Niger. Well above precipitation was recorded during July to September in northern Mali and Sierra Leone (see Figure 15).

In Côte d'Ivoire, precipitation during the last 3 years 2011, 2012 and 2013 was near the average with 13% below the 1961-1990 average in 2013. In November rainfall exceeded the normal by 41% (reference period 1971-2000). The crop season 2013 was characterized by a late onset of rains from May to mid-July in the Sahel and Gulf of Guinean region (Agrhymet, November 2013). The onset of rains in 2013 was very late, compared to the period 1981-2010, in particular at the coast according to the evaluation done by the National Meteorological Service.

In Nigeria, wetter-than-normal conditions were experienced in Bauchi, Kaduna, Katsina and Nguru in the north and Ogoja, Ikom, Uyo, Calabar, Benin and Ikeja in the south causing floods in some areas. Drier-than-normal conditions were experienced in and around Shaki, Iseyin, Abeokuta, Oshogbo, Yelwa, Gusau, Bida, Minna, Abuja, Ibi and Yola.

The Little Dry Season (LDS in JAS), which describes the reduced rainfall between the two peak periods, was most pronounced in the southwest. The signal of the LDS was first felt in the last week of July over Abeokuta, Ikeja, Oshogbo and Ibadan. It lasted for three to four weeks over the area. A normal growing season was recorded, which led to a good farming year across the country. Dry spell episodes were reported in most parts of the northern states shortly after onset of the rains, resulting in the replanting of crops in these areas.

In Senegal, normal to above normal annual precipitation was recorded. In Guinea, the observed precipitation of 2178 mm was slightly above the 1981-2010 average of 2133 mm. In the Gambia, total precipitation was 973 mm and 37% above the long term mean of 709mm (with respect to 1981-2010).

Featured article: Western Africa Climate Assessment & Dataset (WACA&D)

There are two important issues for the WMO Data Rescue (DARE) program which are locating and inventorying old climate records with useful Metadata and coordinating a collective approach for undertaking the subsequent steps in recovering and digitizing the records. WMO efforts are targeting a collective DARE undertaking at regional and subregional levels to develop sustained effective initiatives, using regional infrastructure and new technologies. WMO Regional Climate Centres helped very much in designing regional and subregional Data Rescue initiatives. Framing Data Rescue projects and activities in the context of the need for long term high quality climate data sets for climate services and for climate change assessment and adaptation was recommended by the Joint CCl/WCRP/JCOMM Expert Team on Climate Change Detection and Indices (ET-CCDI) and the CCl Task Team on Climate Data Rescue (CCl/TT-DARE).

Figure 16: Countries involved in WACA-DARE (Source: Google)

To help accelerate Data Rescue, the ETCCDI and CCl/TT-DARE approach is being implemented based on a series of workshops to set up DARE initiatives coupling with Climate Assessment and Climate Adaptation. So far this approach has led to a good progress in DARE, i.e ECA&D, in Europe, MEDARE in the greater Mediterranean Region, SACA&D in South East Asia. All these initiatives constitute the sub-regional layers of a more global initiative of climate assessment and climate data sets (ICA&D) being supported technically by KNMI.

The International Workshop on Rescue and Digitization of Climate Records for countries in West Africa, was one of this series of workshops. The purpose was to bring NMHSs at sub-regional levels together to work collectively and to identify best mechanisms and practices to accelerate Data Rescue and to develop useful climate information for decision makings and climate assessment.

The participants agreed to create a West Africa Climate Assessment and Data rescue initiative (WACA-DARE) and developed a road map with detailed specifications for short, medium and long term activities. The initiative will be coordinated by ACMAD under WMO auspices and CCl guidance. WACA-DARE constitutes henceforth the West African component of the WMO sponsored International Climate Assessment and Data (ICA&D) sets.

Northern Africa

Northern Africa is characterized by a Mediterranean climate at the coast and a large desert area in the south where temperatures are the hottest.

Temperature

In the subregion, 2013 ranked as fifth warmest year since 1950 (see Figure 7), close to 2003 and behind 1999, 2001 and 2010 with the latter being the warmest on record.

During 2013, above average temperatures prevailed over northern Africa exceeding by 1°C the 1961-1990 normals except over the northern parts of the subregion (in Morocco and Algeria).

Morocco had its 11th warmest year in 2013 with an anomaly of 1.4°C above the 1961-1990 average. Tunisia recorded the ninth warmest year with an anomaly as high as in Morocco. Autumn and particularly spring were warmer than normal with anomalies exceeding the 1961-1990 averages by more than 2°C over Libya and Tunisia.

At monthly timescale, March was warmer than normal over most parts of the region and October was very hot over Tunisia and most parts of Algeria with anomalies exceeding +4°C in many locations, while Egypt experienced below normal temperatures. Spring temperature anomalies of 2.2°C above normal and October temperature anomalies of 4°C above average contributed to one of the ten warmest years in Tunisia since 1950. In February below average temperatures over Tunisia, Algeria and the north of Morocco were recorded and led to cold waves in several locations.

The Canary Island mean temperature in 2013 was 21.6ºC and +0.7ºC above the 1971-2000 average.

Precipitation

In 2013, precipitation was near average for most of northern Africa except over the most northern parts of Tunisia and Algeria where above normal precipitation was recorded. After a dry winter, in particular in Morocco, well above normal conditions prevailed in northern Algeria and north western Morocco in spring. March was wet over Morocco, saving the agriculture season, which recorded below average precipitation during February. During autumn, a precipitation deficit prevailed over most parts of the region except parts of eastern Algeria and northern Tunisia. September was wet over northern parts of Algeria and Tunisia causing flash floods due to heavy rainfall.

The Canary Island total precipitation in 2013 was 245.5 mm, slightly above the mean total precipitation for the 1971-2000 reference period (239.5 mm).

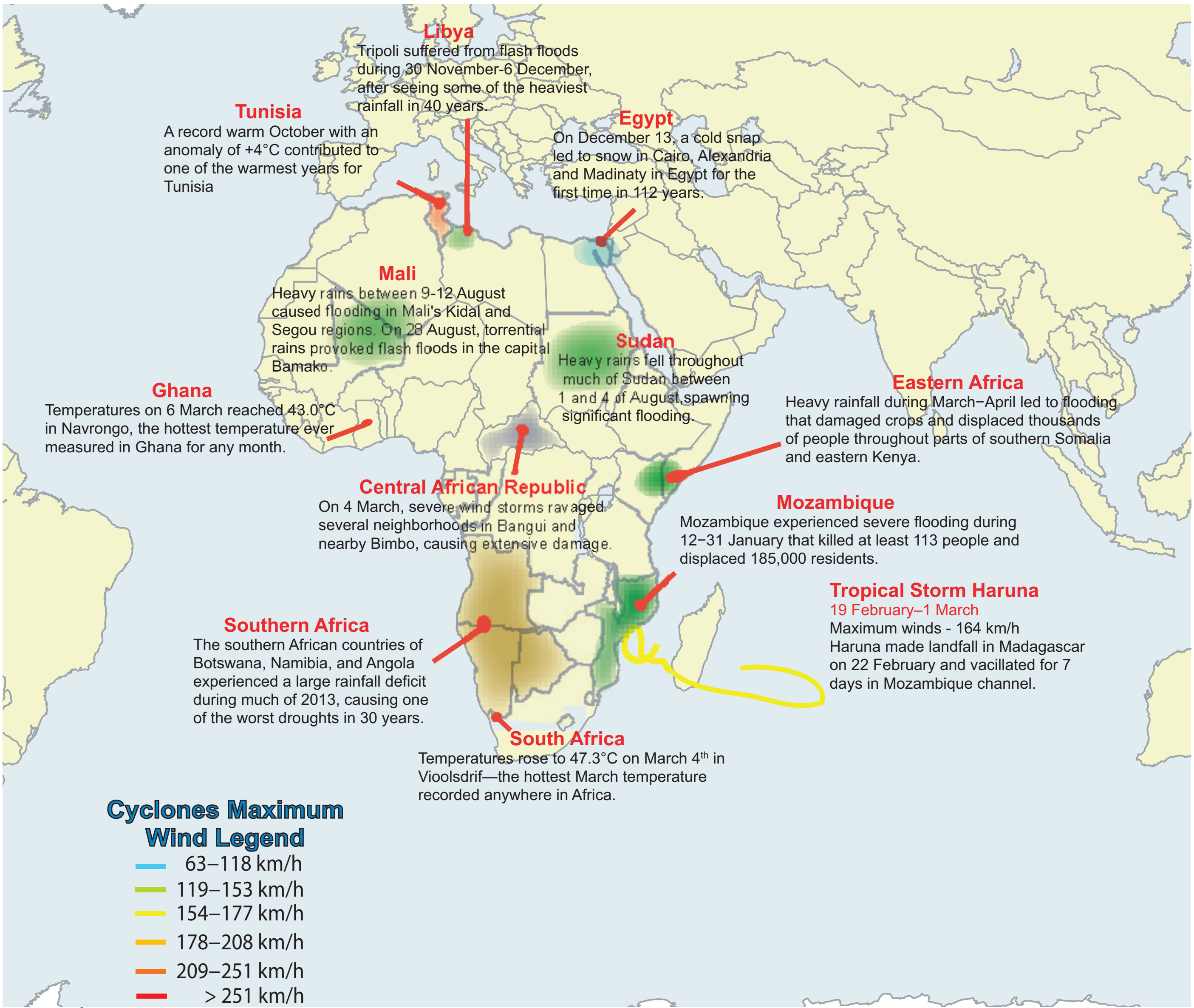

Figure 17: Selected extreme weather and climate events for Africa in 2013 (Source: NOAA-NCDC)

Extreme Weather and Climate events in 2013

Floods and heavy precipitation

Heavy precipitation and floods were recorded in January, in particular in Mozambique which ranks among the ten most severe flooding events globally in 2013 with regard to the number of people killed (source EM-DAT/CRED).

In July and August, floods were reported in Niger, Nigeria, Mali and Sudan with a total of more than 140 deaths. Heavy precipitation and a prolonged precipitation season was reported in coastal parts of Central Africa from Cameroon to the Democratic Republic of Congo.

The table on the next pages shows a summary of the floods reported during 2013. If the source is not indicated, the information was retrieved from National Meteorological Service reports. Impacts, if reported, can be found in the right column.

Southern Africa		
Botswana	Between ***16-23 January***, heavy rains caused extensive flooding in the Central Province of Botswana.	At least 842 families (4210 persons) were affected. The torrential rains destroyed homes, roads, flooded dams, fields and destroyed livestock and livelihoods. (IFRC, 20 Feb 2013)
Malawi	Malawi recorded heavy rains from ***mid-December 2012 to mid-January 2013***, resulting in flooding in several districts, with Mangochi district in the southern part being the most affected.	Houses collapsed and roads were rendered impassable, livestock and crops were washed away. 16370 individuals were affected. Malawi faced acute food shortage, which exacerbated the situation of the flood-affected communities. (IFRC, 30 Nov 2013)

Mozambique	On ***12 January***, the Mozambique authorities declared an orange alert due to heavy rains. On ***22 January***, an institutional red alert was declared.	At least 113 people were killed and over 185000 people were temporarily displaced. (UN Resident Coordinator, 20 Feb 2013)
Namibia	Heavy rains and rising river levels in the Zambezi River catchment since ***early January 2013*** caused flooding in the Caprivi region.	Community houses, infrastructure and crop fields were flooded. Up to 2500 families (11000 people) were evacuated. (IFRC, 16 Mar 2013)
Zambia	Heavy rain caused flooding in Zambia ***from 17 January to 13 February***, with Mumbwa district in the central province being the most affected.	Agricultural fields, infrastructure and property were damaged and destroyed. Drinking water was contaminated by flood waters. About 1800 people were affected. (IFRC, 17 Apr 2013)
Eastern Africa		
Ethiopia	Heavy rains in several areas caused flooding starting in ***mid-April.***	More than 9000 households were affected in the Somali region and more than 1300 households in the Oromia region and SNNPR. The floods caused displacement, damage to infrastructures and loss of livelihoods, including houses, water schemes, livestock, farmlands and food stocks. (OCHA, 22 Apr 2013)
Kenya	Isolated torrential rainfall as part of the long rainy season caused flooding in several parts between the ***middle of March and May***. The worst affected areas included the Marsabit and Isiolo provinces, where heavy rains triggered floods	Damages to infrastructure, and inaccessible roads were reported.
	Heavy rains induced floods in the southern Narok and northern Kajiado provinces, and caused flooding along the Tana River at the ***beginning of April.***	Displacement of thousands of people during the first week of April was caused. (FEWS, 10 Apr 2013)
	A flood occurred ***in August*** in the Marigat District after the waters of Lake Baringo rose.	More than 2000 people were displaced (Kenya Daily Nation, 9 Aug 2013).
	By the end of the season, more than 140000 people were displaced and 96 deaths were recorded in Kenya. Almost 14000 acres of arable farmland were destroyed. A large number of latrines collapsed and contaminated water sources. (IFRC, 14 Nov 2013).	
Somalia	Seasonal rains started at the ***end of September*** and contributed to flooding in the Middle Shabelle region, where flooding had already started ***in mid-August*** due to rains in the Ethiopian highlands. Heavy downpours ***in October and early November*** exacerbated the flooding in Jowhar district and parts of neighboring Balcad district.	7000 households distributed along 28 villages were affected as reported by FSNAU (OCHA, 17 Nov 2013).
South Sudan	Heavy rains started at the ***beginning of August***.	Damage to houses, crops and basic infrastructure in several of South Sudan's northern states was caused. More than 150000 people were in need of assistance. (OCHA, 16 Oct 2013)

Sudan	Heavy rains fell throughout much of Sudan between ***1 and 4 August***, spawning significant flooding.	Extensive damage and loss of life in fifteen states, with Khartoum, Gezira, Blue Nile, River Nile, White Nile and Northern state being the most affected, were caused. The Government estimated that 114000 households were affected with at least 110 people injured and 76 people killed. A total of 50000 houses have been completely destroyed, displacing a large part of the affected population. (IFRC, 10 Oct 2013)
Indian Ocean islands countries		
Comoros	Rainfall with a peak of 392 mm in the region of Bambao-Hambou on ***30 July.***	1063 people displaced
Madagascar	Heavy precipitation affected the central and south-western part around ***15 February.***	8 people died, 2146 were displaced or homeless
Mauritius	An 1h rainfall above 100 mm was recorded in a few places around Port Louis on ***30 March***	11 fatalities, flooded roads and underground parking areas
La Réunion Island	Rainfall above 150 mm in a short time was recorded at Fond du Sac on ***13 February.***	Houses and schools were flooded
Western Africa		
Benin	Heavy rains during the ***third quarter of 2013*** led to the River Niger overflowing its banks, which caused flooding in the Malanville and Karimama districts.	More than 3000 houses were destroyed and 13000 hectares of farmland were affected. More than 10000 people were displaced and more than 30000 people were affected.
Burkina Faso	Starting ***in August***, severe floods were reported. Est, Boucle de Mouhoun, Sahel and Hauts-Bassins were most affected.	At least 751 homes and 6712 people were affected. (OCHA, 27 Aug 2013)
Côte d'Ivoire	184.5 mm of precipitation from ***17 to 25 November*** with a peak of 72.5mm on 19 November in Abidjan. The total precipitation in November for Abidjan was 294 mm, the highest value of November rain in the last 53 years (1961-2013)	Flood in Abidjan on 25 November: serious disruption of traffic
Gambia (the)	On ***15 August*** Nemakunku area was affected by flash floods	A life of a person was lost and thousands were affected.
Ghana	Severe rainstorms in Ghana's Northern and Volta regions started in the ***first week of March 2013*** and continued for two weeks.	The ensuing floods resulted in the displacement of populations and loss of property. The Government declared the affected areas a disaster zone.
	On ***8 April***, severe rainstorms caused further flooding. While the rainy season begins in March, heavy rains usually start in May.	Destruction of property and farmlands in Agona East district in the Central region, affecting at least 1000 people (IFRC, 18 Apr 2013)
Guinea	On ***14 November***, the Tougué area experienced heavy rainfall with strong wind	7000 hectars of rice field were destroyed with estimated value of two millions US$
	On ***8 September***, Saraboido (Koundara) experienced heavy rainfall with strong wind.	5 people died

Mali	Heavy rains between ***9-12 August*** caused flooding in Mali's Kidal and Segou regions.	Houses, latrines and fields were destroyed and around 11300 people were affected. (OCHA, 26 Aug 2013)
	On ***28 August,*** torrential rains provoked flash floods in the capital Bamako.	37 fatalities and at least 20000 displaced people were recorded. (OCHA, 11 Sep 2013)
Mauritania	Since ***early August 2013***, heavy rains affected several regions with anomalies as high as 35 per cent above normal, The most affected regions were Tagant, Trarza, Inchiri and Nouakchott.	Households, infrastructure and livelihoods were affected. The floods affected 4225 people, displaced 2305, killed 8, and damaged over 500 homes (OCHA, 27 Sep 2013).
Niger	***On 13 August***, torrential rainfall resulted in heavy flooding all over Niger. The central Maradi region was the most affected. Other affected regions were Maradi, Tillabery, Dosso, Tahoua, Niamey and Zinder.	32 deaths were recorded and more than 135000 people were affected. Houses collapsed. Approximately 12000 hectares of crops were flooded. (IFRC, 6 Sep 2013, OCHA, 17 Sep 2013)
	Starting ***in October***, floods along the Komadougou river affected the Diffa Region.	5400 people were affected (OCHA, 15 Nov 2013).
Nigeria	Heavy rains prompted flash floods in the state of Kano ***on 9 August.***	More than a thousand homes were destroyed.
	A 25h widespread rainfall on ***22/23 September*** across the southwest hit the cities Benin, Ibadan, Ondo and Oshogbo.	Many roads and houses were submerged. The continuous rainfall killed people, damaged properties and wreaked havoc.
	2013 was a season with less negative impact due to floods in Nigeria. In the affected states, damage to infrastructure and loss of lives was marginal and not as high as during 2012. OCHA reported that 35000 people and 2217 farmlands were affected by floods during 2013 (OCHA 2013 Rainy Season Overview, 11th September 2013).	
Senegal	Senegal experienced exceptionally high rainfall in ***late August***, reaching as much as 230 mm in some areas. Dakar, Fatick and Kaolack were the worst affected regions by the ensuing flash floods.	Agriculture lands were submerged with water in Fatick and Kedougou.
Togo	Rainfall of 173.3 mm on ***15 August*** at Dapaong, highest precipitation amount recorded since the establishment of the station in 1957.	Field devastated, road broken, bridge damaged
Northern Africa		
Algeria	Flash floods were recorded on ***9 October***	At least 7 fatalities.
Canary Islands	Heavy precipitation on ***11 December***: 109 mm in Tenerife-Sud and 103.8 mm in Tenerife-airport of Los Rodeos in 24h.	Station record at both stations for December
Libya	Tripoli suffered flash floods during 7 days from ***30 November***, after seeing some of the heaviest rainfall in 40 years.	16 people were killed, electricity and telecommunication was disrupted and more than 400 houses were damaged.
Morocco	Heavy precipitation during 3-h period on ***17 September*** in Marrakesh.	Two people killed, 10 homes collapsed, and many districts were impassable.
Tunisia & Algeria	On ***19 September***, floods hit eastern Tunisia and eastern Algeria. A new 24h monthly record of 143 mm has been registered in Sfax, Tunisia, on 22 December.	

Central Africa		
Cameroon	In the night of ***17/18 September***, heavy rain caused the rupture of the dam along the Logone River at the town of Dougui, Kai Kai District in the Far North Region of Cameroon.	Initial evacuations of people to the banks of the dam were caused. On 27 September, a second rupture in the dam started flooding the area and nearly 9000 people were displaced. (IFRC, 1 Oct 2013).
Central African Republic	On ***3-4 September***, heavy rains lasted for hours and caused flooding in several areas of the 3rd district of Bangui.	Almost 33000 people were affected. 337 families had their houses damaged or destroyed. Almost all wells and latrines in these areas were damaged by flood waters. (IFRC, 18 Sep 2013)
Congo	Exceptional 24h precipitation of 38,6 mm was recorded on ***3 March and 8 November***	Mudslides, landslide engulfing the dwelling houses and killing several people in certain neighborhoods of Brazzaville
Uganda	Heavy rains at the ***beginning of May*** caused the banks of the Nyamwamba river to burst, which resulted in flooding in western Uganda's Kasese district.	8 people were confirmed dead, and over 25000 were affected. The flooding caused widespread destruction of houses, crops and facilities such as bridges, roads and power lines. Major infrastructures such as a hospital and sewage treatment unit were damaged. (IFRC, 17 May 2013)

Focus on the Kilimanjaro Glacier

A group of researchers from the University of Otago, New Zealand published in 2013 a paper (Cullen et al., 2013), in which they presented their study of the glacier on the Kibo peak of Kilimanjaro. Their research encompasses surveys made in 1912 and available satellite imagery up to 2011. The spatial extent of the glacier in 1912 and 2011 is shown below.

The article states "the glaciers have retreated from their former extent of 11.40 km^2 in 1912 to 1.76 km^2 in 2011, which represents a total loss of about 85 % of the ice cover over the last 100 yr." Using linear extrapolation of three cumulated glacier areas, they made rough estimates of decades when ice will disappear from the western, southern, and central slopes of the Kibo peak of Kilimanjaro. The authors conclude that if present-day climatological conditions are maintained, "it is highly unlikely that any body of ice will be present on Kilimanjaro after 2060".

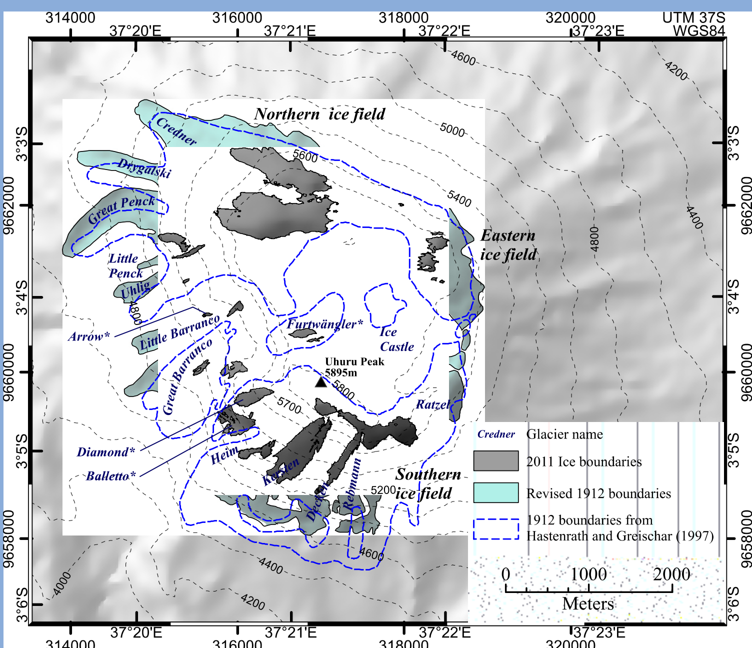

Figure 18: Glacier extent on Kilimanjaro in 1912 and 2011 (N. Cullen et al., 2013) and picture from Kilimanjaro in July 2012.

3.2 Tropical Cyclones and wind storms

In 2013, the southwestern Indian Ocean tropical cyclone activity was near average, both in terms of number of named storms and also in terms of number of storm days. 9 named tropical storms during the year were recorded including 7 storms occurring between January and May, and 2 in December. 7 storms have reached the tropical cyclone intensity and 4 storms had direct influences on inhabited lands.

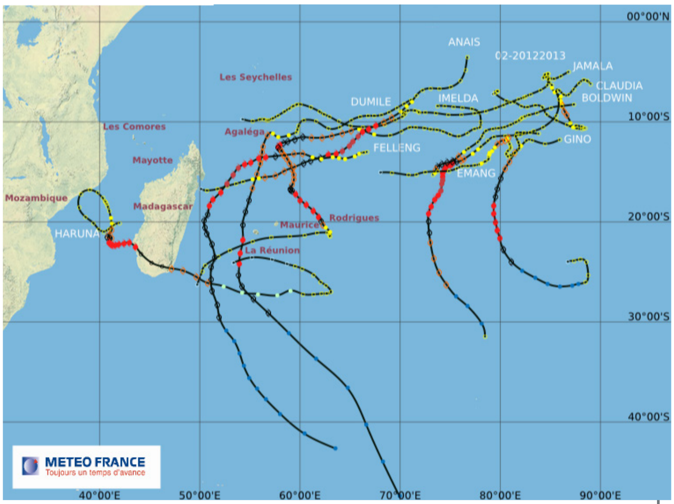

Figure 19: Tropical cyclones in the southwestern Indian Ocean during the 2012/2013 season (Source: MeteoFrance)

Tropical Cyclone Dumile in La Réunion and Mauritius	TC Dumile cruised about 100 km from the western coast of La Réunion. It brought 1187 mm/48h at Commerson. A maximum wind gust of 189 km/h was recorded at Maido (located in the highlands).	It caused few damages, essentially to agriculture but it ended the 2012 drought.
	In Mauritius the highest gust recorded was 97 km/h; the maximum 24h rainfall was 104 mm	A few trees were uprooted, minor damages to houses was observed
Tropical cyclone Felleng in Seychelles and Madagascar	On 27/28 January, the eastern coast of the Seychelles island Mahe was devastated by tropical depression Feleng and the island La Digue was severely affected.	1000 families were affected by floods and landslides. 246 families were registered as displaced after their houses were either destroyed or damaged. (IFRC, 23 May 2013)
	TC Felleng longed southward near the east coast of Madagascar between 30 January and 2 February and brought torrential rain.	Five people died and 964 were displaced. (Resident Coordinator, 1 Feb 2013)
Tropical cyclone Haruna in Madagascar and Mozambique	Maximum sustained winds of 164 km/h were recorded. The powerful tropical category 2 cyclone made landfall in the south-west near Cape Saint-Vincent on 22 February, damping more than 160 mm in 24 hours. Earlier, Haruna vacillated for seven days in the Mozambique Channel, bringing above-normal rainfall to the western coast of Madagascar. More than 230% of normal rainfall was recorded between 10-20 February over the districts of Morombe and Taolagnaro.	The cyclone caused 26 deaths and affected over 40000 people. (UNCT, 7 Mar 2013)
Tropical Cyclone in Somalia	The State of Puntland in north-eastern Somalia was hit by a tropical cyclone on 10 November which caused subsequent flash floods.	Massive destruction resulted in the death of 162 people, displacement of tens of hundreds of nomads, decimation of approximately 1 million livestock and destruction of over 1000 houses according to Government statistics, was caused.
Severe wind storm in the Central African Republic	On 4 March, a severe wind storm ravaged several neighborhoods in Bangui and nearby Bimbo, causing extensive damage. The town of Bouar in the western part of the country experienced heavy rains accompanied by strong winds.	1006 houses were destroyed and 308 were damaged. 8710 people were either homeless or have lost their belongings in the storm. Up to 869 wells have been polluted by debris and 914 latrines were destroyed. (IFRC, 21 Mar 2013)
Severe wind storm in Guinea	A severe wind storm hit the coastal area around Boffa on 18 August. A maximum wind speed of 32 m/s was recorded	5 persons were killed

DROUGHTS, HEAT WAVES AND FIRES

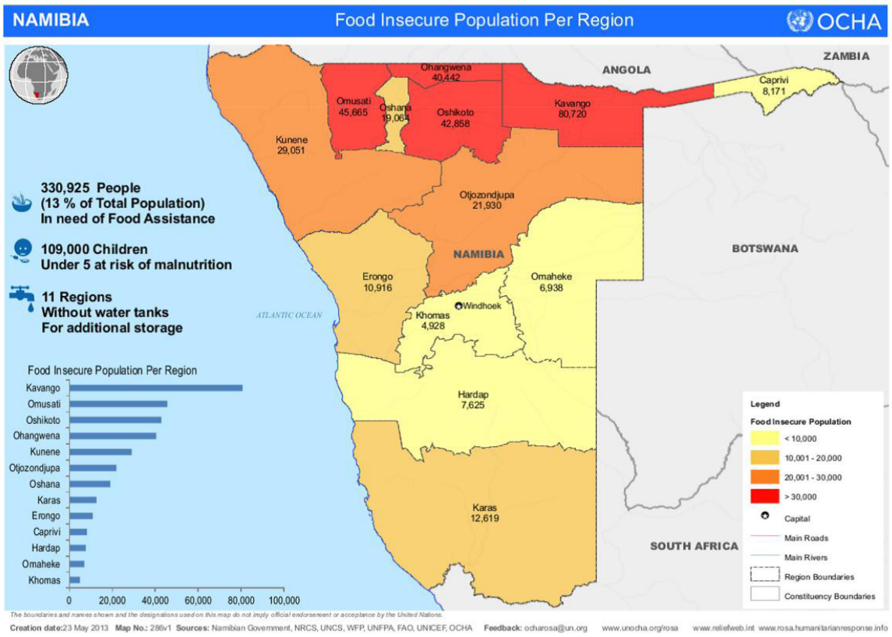

Figure 20: Food insecured population per region (Source: OCHA)

Droughts	
In **Namibia**, a prolonged dry season resulted in widespread crop failure across the country and the most severe drought recorded globally in 2013 (Source: EM-DAT/CRED). Severe drought conditions lasted from January to August.	The Government estimated that the 2013 harvest would produce 42 per cent less than the 2012 harvest. Around 4000 livestock died. The situation was particularly severe in the north, and along the Caprivi strip. An estimated 780000 people – approximately one third of Namibia's entire population – were classified as food insecure. Of these, 330 000 people were in need of urgent support, according to the Government.
The drought in Namibia (see above) also affected southern **Angola**	Reports from the government, the UN and the few aid agencies on the ground suggested that approximately 1.5 million people in five provinces were food insecure. An assessment carried out by the international NGO Caritas in early June in Namibe Province found 250000 people in need of support, following the failure of 70 per cent of crops as a result of a lack of rain.
Historic drought conditions impacted La Réunion during May–September. This is the dry season for the island; however, it was the driest of at least the past 50 years, with 50 per cent of average precipitation for the period.	Underground and superficial water resources reached historical low levels leading to water restrictions.
Extreme high temperature and heat waves	
The temperature in Navrongo, **Ghana** reached 43.0°C on 6 March	It was the warmest temperature ever measured in Ghana for any month
Two heat waves hit southern **Morocco** in August with a daily maximum temperature anomaly of 10.4°C above normal.	Fires burned 960 hectares of Argan trees.

Extremely high temperatures in the range of 40°C and above were recorded in northern **Nigeria** from the third week of February to the first week of June. Sokoto, Maiduguri, Yelwa and Gusau recorded the highest daily temperatures in excess of 43°C.	
The temperature in Vioolsdrif, **South Africa** soared to 47.3°C on 4 March. This was the hottest March temperature ever measured anywhere in Africa.	
Fires	
On 6 January, a fire outbreak in the village of Alloya in **Benin** was observed. Dusty hot winds from the Sahara Desert worsened the situation. (IFRC, 19 Jan 2013)	Hundreds of houses were destroyed and almost 3000 people were displaced
The risk of fire increased as a result of the dry Harmattan wind that blew across **Sierra Leone** in January 2013. Several villages in the northern and southern provinces were affected by fire disasters between 2-28 January,	279 houses were destroyed and 450 families (2257 individuals) were made homeless. (IFRC, 19 Feb 2013)
Bush fires were recorded in **Côte d'Ivoire** during the dry season (November 2012 to February 2013) in the north of the country.	

Other Extreme Events

Dust haze	
Two spells of thick dust haze engulfed **Nigeria** in February. The first one (1–9 February) had widespread effect over most part of the country, reaching as far as Ogoja, Obudu, Enugu, Port Harcourt and Abeokuta and a visibility between 300–1000 m. The other one occurred from 16–18 February with a visibility between 400–800 m especially over Potiskum and Maiduguri axis. Major dust spells occurred in December. From 13–23 December, dust affected the north-eastern part of the country and areas in the southwest with visibility ranging between 300–1500 m. The last spell of the year occurred from 30–31 December affecting only the northeastern axis with visibility between 1000–1500 m.	The outbreak of dust haze, which reduced horizontal visibility to 300 - 900 m affected most parts of the country. Coastal cities also experienced visibility reduction to 200 - 900 m due to early morning fog. These weather conditions disrupted flight operations at various airports, as flights were delayed, rescheduled or canceled.
Extreme cold temperature and cold waves	
On December 13, a cold snap led to snow and hail in St. Catherine and other parts of **Egypt**.	
A minimum temperature of 5.7°C was observed at Eldoret Meteorological Station in the North Rift, **Kenya** on 16 July.	The lowest minimum temperature recorded in July at the station over the past decade.
In June 2013, minimum temperatures were about 1-2 °C below the 1971-2000 average over most of the western half of **South Africa**. However, it should be noted that in some places over the eastern parts the minimum temperatures were 3-4°C above-average.	

Focus on Greenhouse Gas observations in Africa

Long-lived greenhouse gases have the strongest and the most certain warming effect on the climate. According to the recent IPCC report dramatic emission reductions are needed to keep the increase of global average temperature by 2100 below 2°C.

CO_2 is the most important long-lived greenhouse gas related to human activities. Though, CO_2 emission from fossil fuels are projected to increase substantially with the development in Africa. Tropical forest may serve as source and a sink of CO_2, depending on climate conditions. Substantial CO_2 emissions are associated with the deforestation process.

Methane, the second most important long-lived greenhouse gas, is emitted from tropical wetlands and provides substantial contribution to the global methane budget. Tropical wetlands are very sensitive to climate, so their emissions can substantially change the climate in the future. Analysis of the observational data shows that recent renewed growth of the globally averaged methane is largely driven by emissions in the tropics and subtropics.

Emission calculations using observations and inverse modeling are important as an independent check of the self reported emissions on a national basis. Ground based observations are essential for performing such emission verifications. The use of the satellite information, assimilated in the inverse model, did not bring substantial improvement of the emissions estimates and left the uncertainty at the level of 50% for Africa.

Currently, 12 active stations are registered in WMO Region RA I in the GAW Station Information System (GAWSIS). Only five are situated on the African continent and only three, namely Assekrem, Algeria, Cape Point, South Africa and Gobabeb, Namibia submitted data to the World Data Center for Greenhouse Gases (WDCGG) in 2012.

General tendencies at the mentioned three stations correspond to the tendencies in global averages, namely increase in CO_2 and CH_4 mole fractions. CH_4 and CO_2 mole fractions at the Southern Hemispheric stations are lower than global averages, while those at the Northern Hemispheric stations are higher than the global averages (for methane) confirming the known inter-hemispheric gradient.

As convincing statistics to assess the distribution and variability of greenhouse gas concentration in Africa for 2012 are not available, it is important that greenhouse gas measurements are put in place and are maintained over the years. Countries are encouraged to utilize the existing experience in the region (e.g. South Africa, Algeria and Kenya).

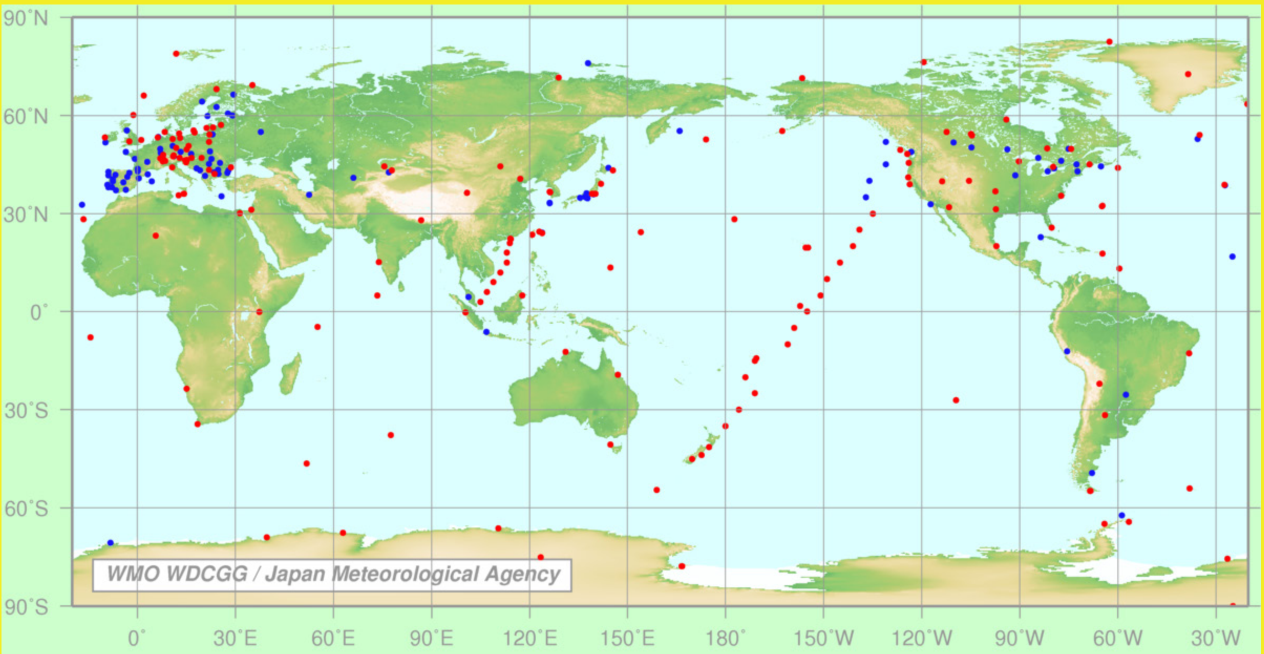

Figure 21: Distribution of the fixed stations that contribute data to the WDCGG. The red dot denotes that the data from the station has been updated in the last 365 days. (Source: WDCGG)

Acryonyms

ACMAD	African Centre of Meteorological Application for Development
Agrhymet	Regional Centre for Agrometeorology, Hydrology, Meteorology
CPC	Climate Prediction Center
DJF	December-January-February
DRC	Democratic Republic of the Congo
EM-DAT/CRED	Emergency Events Database of the Centre for Research on the Epidemiology of Disasters
ESRL	Earth Science Research Laboratory
FEWS	Famine Early Warning Systems Network
FSNAU	Food Security and Nutrition Analysis Unit - Somalia
GAW	Global Atmosphere Watch
IFRC	International Federation of Red Cross
ITCZ	Inter-tropical convergence zone
ITD	Inter-tropical divergence
JAS	July-August-September
JFM	January-February-March
JJA	June-July-August
KNMI	Royal Netherlands Meteorological Institute
MAM	March-April-May
NOAA	National Oceanic and Atmospheric Administration
NGO	Non-governmental Organization
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
OND	October-November-December
SAWS	South African Weather Service
SNNPR	Southern Nations, Nationalities, and Peoples' Region Ethiopia
UN	United Nations
UNCT	United Nations Country Team
WDCGG	World Data Centre for Greenhouse Gases
WMO	World Meteorological Organization

Data set used:

The Climate Anomaly Monitoring System (CAMS) by NOAA NCEP CPC is a high resolution (0.5x0.5) analyzed global land surface temperatures and precipitation from 1948 to near present. (see http://iridl.ldeo.columbia.edu/SOURCES/.NOAA/.NCEP/.CPC/.CAMS/)

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Acknowledgements

This publication was issued in collaboration with WMO Members of RA I, the Tast Team on the African Climate and several international climate and meteorological institutions. The scientific content was developed and reviewed by a numer of international experts:

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Belachew Kebede Bayih	National Meteorological Services Agency, Ethiopia
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