

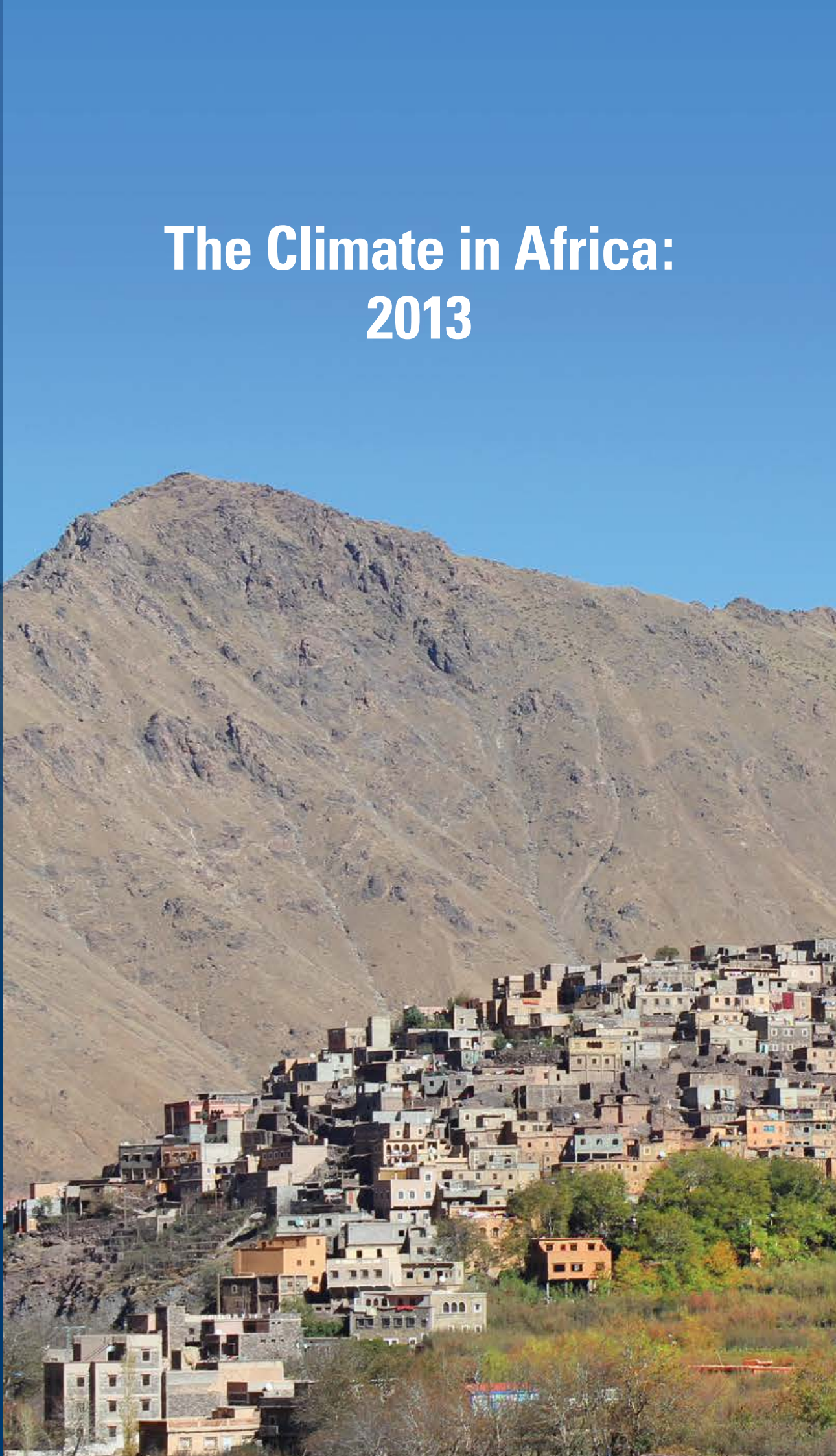
The Climate in Africa: 2013



**World
Meteorological
Organization**

Weather · Climate · Water

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Chairperson, Publications Board
World Meteorological Organization (WMO)
7 bis, avenue de la Paix
P.O. Box 2300
CH-1211 Geneva 2, Switzerland

Tel.: +41 (0) 22 730 84 03
Fax: +41 (0) 22 730 80 40
E-mail: Publications@wmo.int

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Foreword

In Africa in 2013, the critical weather and climate trends of the last decades continued: it was one of the warmest years on the continent since at least 1950, with temperatures above average in most regions. Precipitation at the continental scale was near average. But several extreme events hit the region. The floods that hit Mozambique in January were among the 10 most severe in the world that year, based on the number of deaths. In contrast, the rains in Namibia and neighboring countries fell well below normal, leading to a severe drought.

These are some of the findings addressed 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 every subregion 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 (along with a 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 subregions.

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 Regional Climate Outlook Forums established through WMO for Southern Africa, Central Africa, West Africa, Northern Africa, and the Greater Horn of Africa.

'The Climate in Africa: 2013' is based on datasets and information contributed by WMO Members and partners. That information has been assessed in regional and subregional contexts. Comparisons were made with climatological averages and records whenever possible and appropriate. The report's temperature assessment is based on the combination of the Global Historical Climatology Network and the Climate Anomaly Monitoring System (GHCN CAMS) datasets by the US National Oceanic and Atmospheric Administration, providing a high resolution 0.5° latitude x 0.5° longitude analysis of global land air surface temperatures from 1948 to near present. Precipitation assessments are based on the analysis done by the Global Precipitation Climatology Centre. Other data sets 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.

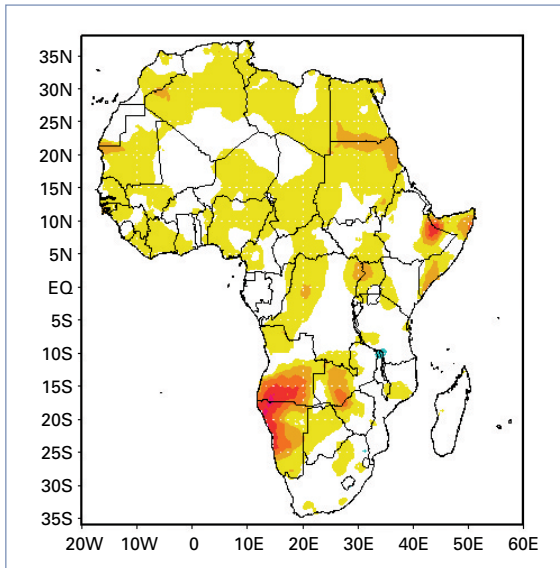
We welcome your feedback on this report and insights into how you have made use of it in your work.



(M. Jarraud)
Secretary-General

Climate assessment: key continental features

Figure 1. Temperature anomaly over Africa in 2013 with respect to 1961–1990; gridded data based on station observations. (Source: CAMS GHCN by NOAA-ESRL)



surface air temperature, a global anomaly of 0.85°C was recorded.

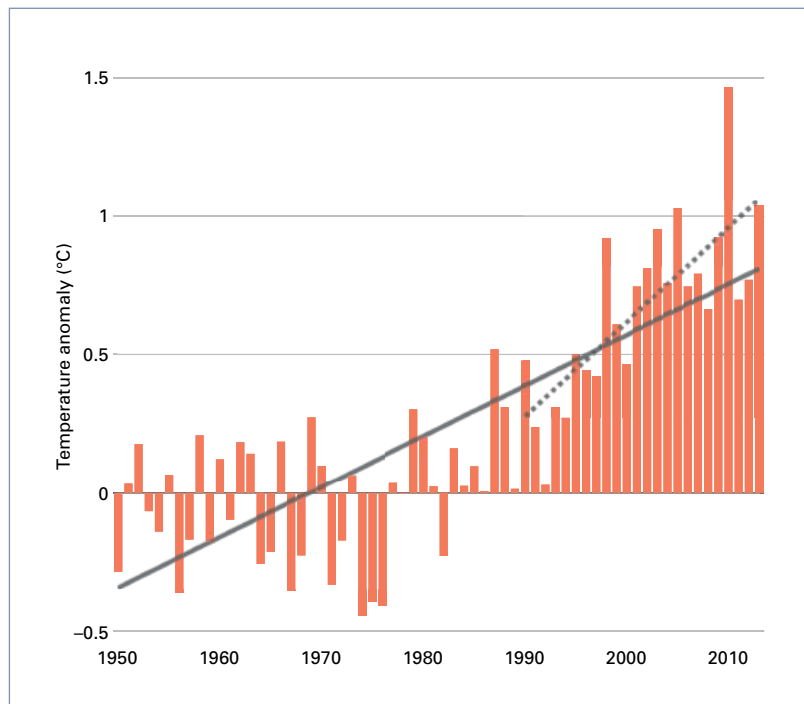
Because the data with respect to in-situ surface air temperature across Africa is sparse, a one-year regional assessment for Africa could not be based on any of the three standard global surface air temperature data sets from NOAA-NCDC, NASA-GISS or HadCRUT4. Instead, the combination of the Global Historical Climatology Network and the Climate Anomaly Monitoring System (CAMS GHCN) by NOAA's Earth System Research Laboratory was used to estimate surface air temperature patterns. This is a high resolution (0.5°x0.5°) data set of observed and interpolated global land surface temperatures and precipitation from 1948 to near present (Fan et. al 2008).

TEMPERATURE

At the global scale, the assessment of the annual mean surface air temperature indicated that 2013 tied with 2007 as the sixth warmest year since global records began in 1850, with a global land and ocean surface air temperature 0.50°C above the 1961–1990 average (source: WMO Statement on Status of the Global Climate 2013). For land-only

Within the uncertainties and respecting the cautions listed for that data set (see also box: Data gaps in Africa), Figure 1 indicates a pattern of positive surface air temperature anomalies over substantial areas of Africa in 2013, with Angola and Namibia reporting the largest positive anomalies. With the same caution, a tentative assessment of surface air temperature over land in Africa indicates that 2013 ranks among the five warmest years. Figure 2

Figure 2. Temperature anomaly over Africa from 1950 to 2013 with respect to 1961–1990; gridded data based on station observations. (Source: CAMS by NOAA-ESRL)



shows a time series of the annual surface air temperature anomalies over land in Africa since 1950. This series exhibits similar long-term positive anomalies observed globally since the mid-1970's, with an acceleration of warming since the 1990's. The years 1998, 2005 and 2010 were the warmest years in Africa (up to 2013), fitting well with the temperature ranking globally (WMO Annual Statement on the Status of Global Climate in 2013).

PRECIPITATION

Average annual global precipitation during 2013 was the same as the 1961–1990 global average of 1033 mm, according to the WMO Statement on the Status of the Global Climate 2013.

Because adequate long-term precipitation time series were unavailable at the time this report was being written, it was not possible to assess the annual average total precipitation over the continent and its global index in a historical

context. Nevertheless, the analysis of precipitation anomalies over the continent was possible based on the precipitation analysis provided by the Global Precipitation Climatology Centre (GPCC), in Offenbach, Germany. Based on this analysis, near average total annual rainfall dominated most of the continent, particularly north of the Equator. But significant rainfall deficits affected southern parts of West Africa and a large portion of central Africa and parts of Southern Africa. Madagascar suffered from drought conditions in the northern part of the country, while a tropical cyclone brought above average precipitation to the southern tip.

Significant precipitation deficits over Namibia and Angola caused extreme drought conditions. In contrast, the eastern part of southern Africa was affected early in the year by above average rainfall, leading to severe flooding, particularly in Mozambique, Botswana and Malawi. More detailed analysis is provided in the sub-regional section.

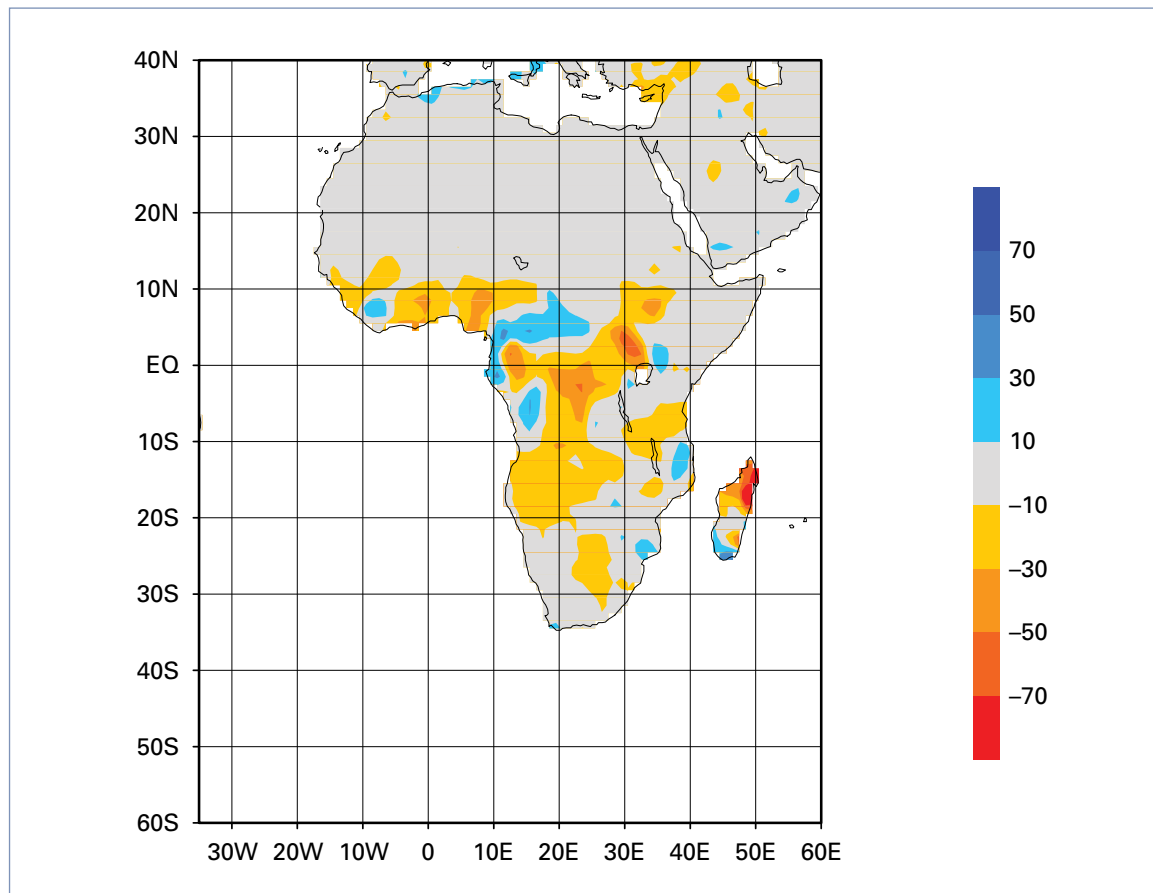


Figure 3. African annual precipitation in deviation from normals (mm/month) for 2013 with respect to 1951–2000 (Source: GPCC)

Data Gaps in Africa

Climate observations are derived from numerous meteorological and related observational networks and systems that underpin applications such as weather and climate monitoring and forecasting, air pollution modeling and environmental impact assessments. The WMO Integrated Global Observing System (WIGOS), together with the WMO Information System (WIS), serves as the basis for all Members and WMO Programmes to provide and have access to accurate, reliable and timely weather, climate, water and related environmental observations and products.

Climate observations must meet high standards defined by a number of important criteria. First, climate observations need to account for the full range of elements that describe the climate system. Second,

an observation at a particular time needs a reference climate against which it can be evaluated, that is, a reference climatological period must be selected. In this regard, observations from stations that exist only for a short period (from days to a few years), or that relocate frequently, will generally have less value than observations from stations whose operations have been maintained to established standards over many years. Third, a climate observation should be associated – either directly or indirectly – with a consistent set of data (metadata) describing the conditions in which climate observations were collected, which will provide users with information on how the observations can be interpreted and used.

In order to assess the state of the climate in any region, regular distributed and long-term observations are needed within that region. Unfortunately, WMO Regional Baseline Climatological Network (RBCN) stations and GCOS Global Surface Network (GSN) stations across the African continent often lack resources to report on monthly or on annual (see Figure 4) time scales. As several African nations implement national observing networks, and as those national networks begin to contribute data reliably to, for example, the RBCN (Figure 5), there is a potential for much needed improvements in regional and large-scale climate information for Africa.

Figure 4. Global Surface Network, number of months reported per station (June 2013 to May 2014, red=12, blue=6-11, green=1-5, gray=0)
(Source: NOAA/NCDC)

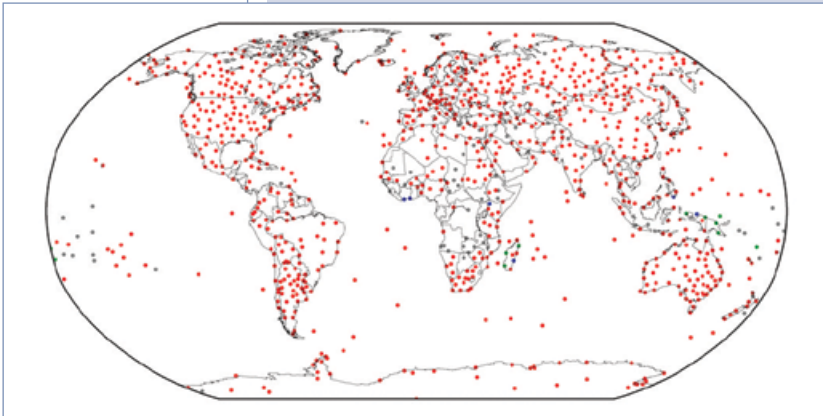
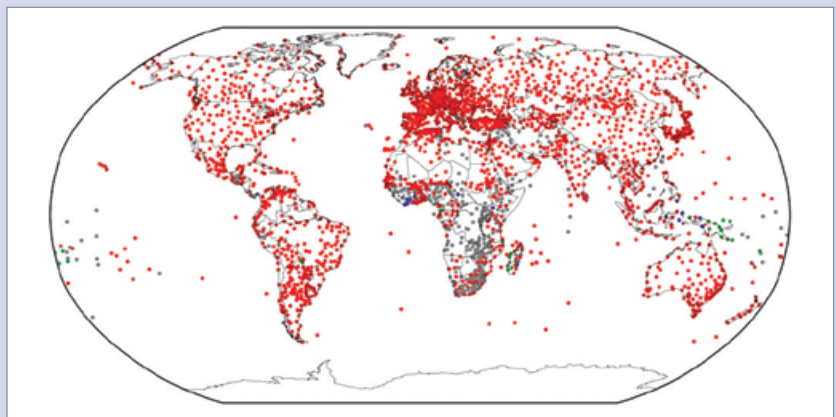


Figure 5. Regional Baseline Climatological Network, number of months reported per station (June 2013 to May 2014, red=12, blue=6-11, green=1-5, gray=0)
(Source: NOAA/NCDC)



Climate assessment: subregional features

Six subregions were considered in assessing climate features on subregional scale: Southern Africa, central Africa, western Africa, eastern Africa, northern Africa and south-west Indian Ocean island countries. A survey was sent to all African countries and the feedback was used to summarize key features in each subregion.

SOUTHERN AFRICA

The *southern African* subregion is characterized by tropical and subtropical climate, which is influenced by the long coastline 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).

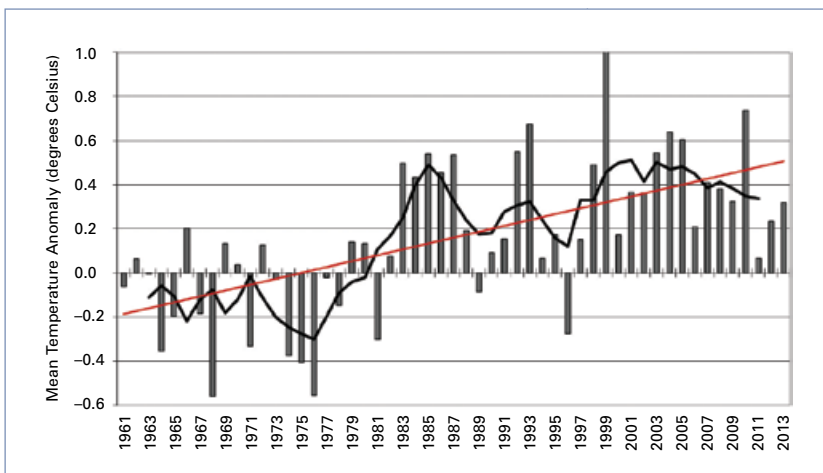
TEMPERATURE

In the southern African subregion, warmer than average temperatures were recorded, in particular in the western parts (see Figure 1). The highest temperature deviations were observed in parts of Namibia, Angola and Zambia, leading to a severe drought in Namibia and Angola.

The South African Weather Service reported an annual mean temperature anomaly for 2013 from the preliminary data of 21 climate stations of 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 (see Figure 6).

PRECIPITATION

In 2013, normal to slightly below normal precipitation was recorded in most parts of the subregion (see Figure 3) with Namibia being the most affected. In January, Mozambique (see Figure 7) recorded well above average precipitation (up to 70 mm above monthly average rainfall), causing floods in several places (see section: Extreme weather and climate events p. 16). In fact, the below average precipitation in January in Namibia, Angola, Botswana and South Africa continued in the following months.



Combined with above normal temperatures, this led to a severe drought, particularly in Namibia and Angola.

In South Africa, the rainfall conditions contrasted from west to east and north to south. Dry conditions persisted for most of the year over the north-western province and the southern Free State provinces. January and February were characterized by below normal rainfall over the western interior, while wetter conditions were observed in the south and east. In March, good rain fell over the western interior, but the rainfall was again below normal over this region from April onwards, spreading over the north-west and Limpopo provinces in May. The dry conditions persisted over north-western 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.

Figure 6. Temperature anomaly (in °C) for South Africa for 1961 to 2013 with respect to 1961–1990. Red line shows a trend line fitted over whole time series. (Source: SAWS)

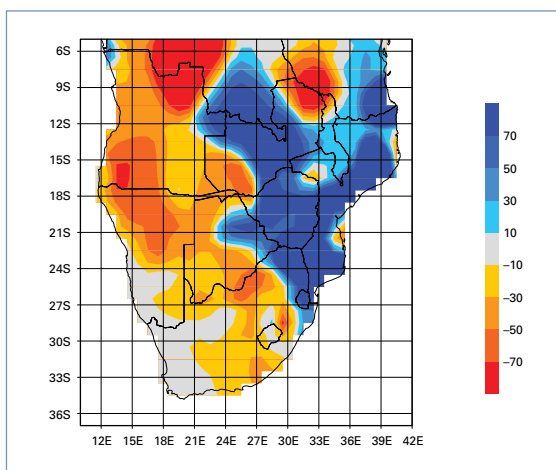


Figure 7. Southern African precipitation in deviation from normals (mm/month) for January 2013 with respect to 1951–2000 (Source: GPCP)

Extreme temperatures in the southern hemisphere in 2013

The southern hemisphere recorded its third warmest year (after 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 the year before, 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 capital 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 in 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, and Zambia observed the highest anomalies. By February, maximum temperatures in the central and north-western interior of South Africa were 3–4°C above the 1971–2000 normal. Even in Cape Town, hikers had to be airlifted off Table Mountain because of dehydration caused by the extremely hot conditions. (Sources: SAWS, Tokyo Climate Centre and NOAA-NCDC)

SOUTH-WEST INDIAN OCEAN ISLAND COUNTRIES

The *south-west Indian Ocean island countries* consist of many islands grouped into five countries, including Comoros, Madagascar,

Mauritius, Mayotte Island (France), 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 south-eastern trade winds.

TEMPERATURE

Island	National temperature anomaly (with respect to)	Precipitation: Percentage of normal (with respect to)
Madagascar	+0.4°C (1971–2000)	98% (1981–2010)
La Réunion	+0.45°C (1981–2010)	83% (1971–2000)
Mauritius	+0.45°C (1971–2000)	102% (1971–2000)
Comoros	+0.5°C (1971–2000)	near average

All of the countries in this subregion experienced warmer than average conditions in 2013 according to the National Meteorological Services (see table above). 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.

The National Meteorological Service of Madagascar recorded the third warmest year on record since 1971, with 2006 and 2010 being the warmest and 2013 being slightly warmer than 2012. The highest positive anomaly of about +0.8°C was observed in the eastern station of Sainte-Marie, in the north-western 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 temperatures were above normal along the central western coast, and below normal along the north-eastern coast. The highest positive anomaly was recorded at Morondava (+1.1°C) and the highest negative anomaly was recorded at Sambava (-0.8°C).

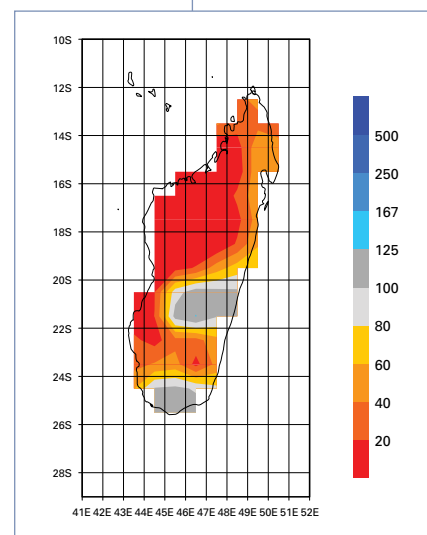
In La Réunion, 2013 was the sixth warmest year on record since 1971 as observed by Météo

France. Minimum temperatures were generally cooler than average for May to August, and maximum temperatures were above average for July to December.

PRECIPITATION

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 north-eastern part and above normal at the southern tip (see Figure 3). The January to March 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 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 8) winter season was generally drier than normal across the whole region. A severe drought affected the north-western part of Madagascar, La Réunion Island and Comoros, with amounts averaging about 50% and below compared to the 1951–2000 average.

Figure 8. Percentage of normal precipitation over the Indian Ocean region for JJA 2013 with respect to 1951–2000 (Source: GPCC)



Special Focus: 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, was particularly affected by La Niña. However, the study suggested that the 2011 long rainy season (March- June) deficit was more probable when taking into account anthropogenic climate change factor

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

CENTRAL AFRICA

Central Africa is one of the wettest parts of the continent and is 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 subregion.

TEMPERATURE

Much of central Africa experienced normal to above-normal temperatures during the year, with an anomalous warmth across southern Angola. National Meteorological Services reported an anomaly of about +0.6 °C above the 1961–1990 reference period in Cameroon and an annual mean temperature of 25.9°C, which is about 0.9°C above the 1961–1990 average for Brazzaville, Congo.

PRECIPITATION

The MAM season in central Africa was characterized by well-below average precipitation in Zambia and Uganda. During the JAS wet season, well-below average precipitation was recorded over Gabon. From October to November, well-above average rainfall was observed over western Gabon.

EASTERN AFRICA

The subregion of *eastern Africa* covers the 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 lakes 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 one 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 experience a drier-than-normal period between November and March.

TEMPERATURE

Eastern Africa recorded near average temperatures during 2013 in most parts of the subregion. Nevertheless, Kenya registered several breaking records in some locations during the year. In fact, several daily maximum temperature records were broken in January, February and August, in many places, including Wajir, Mombasa, Mandera, and Dagoretti Corner (Nairobi). The average January temperature at Wajir was the highest recorded in the past half century.

PRECIPITATION

Precipitation data in the region remain limited. Heavy rainfall leading to floods was reported in mid-April in Ethiopia and in Kenya between March and May, and in South Sudan and Sudan in August, among others.

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.

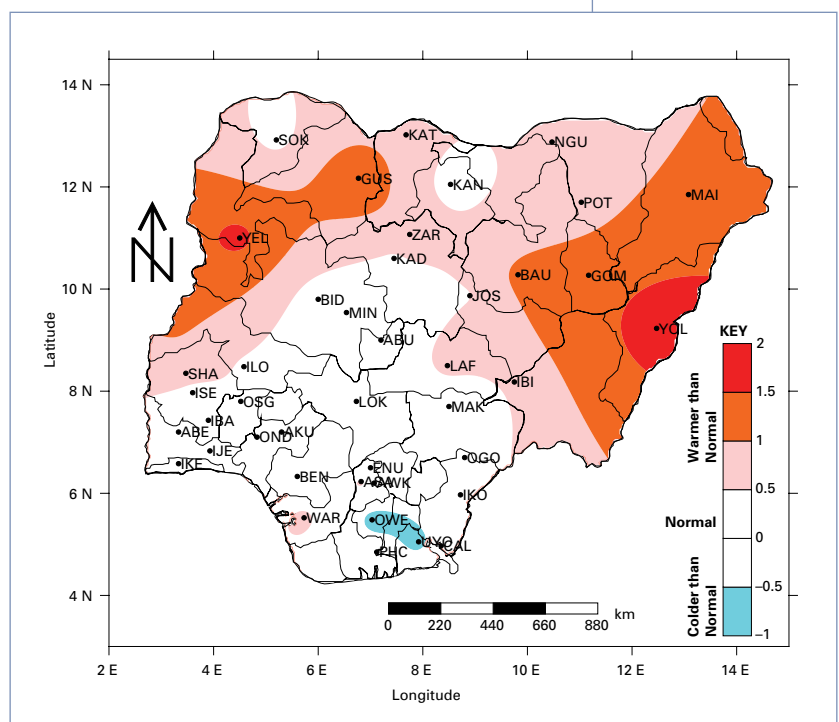
TEMPERATURE

The year 2013 was characterized by mean temperatures close to or slightly above the average in most of the countries.

In Côte d'Ivoire, as reported by the National Meteorological Service, 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 therefore 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 (see Figure 9). The hot season 2013 (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.

Figure 9. Temperature anomaly for Nigeria in 2013 with respect to 1981–2010
(Source: Nigerian Meteorological Agency)



This period can therefore be regarded as the cold season in Nigeria with December as the coldest month. Colder than normal minimum temperature anomalies (-0.5 to -2.0°C) were recorded in places around the south-east 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.

Other country reports were received from the Gambia and Guinea. In the Gambia, the national mean 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 below-average precipitation in the coastal areas of western Africa (see Figure 3). Well-above average precipitation was recorded during some seasons, in particular from July to August in northern Mali (see Figure 10).

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 Guinea region, as reported by Agrhymet. 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 south-west. 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. (Source: Nigerian Meteorological Agency)

Other country reports were received from Senegal, Guinea and the Gambia. 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).

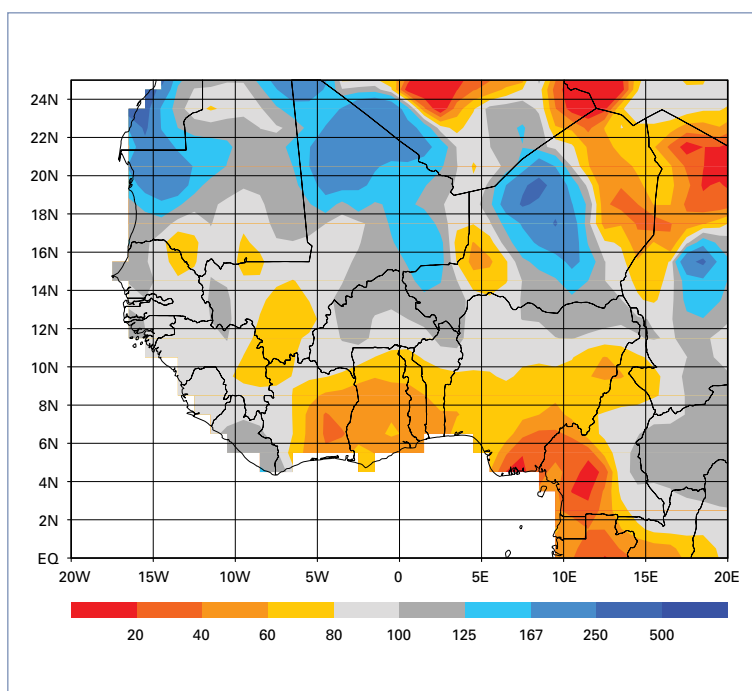


Figure 10. Percentage of normal precipitation over western Africa in JJA 2013 (Source: GPCC)

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

There are two important tasks 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 design 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 CCI/WCRP/JCOMM Expert Team on Climate Change Detection and Indices (ET-CCDI) and the CCI Task Team on Climate Data Rescue (CCI/TT-DARE).

To help accelerate Data Rescue, the ETCCDI and CCI/TT-DARE approach is being implemented based on a series of workshops to set up DARE initiatives addressing the rescue and digitization of climate data in the context of climate change assessment and adaptation. So far this approach has led to a good progress in DARE, for example, the European Climate Assessment and Datasets (ECA&D) in Europe, the Mediterranean Data

Rescue initiative (MEDARE) in the greater Mediterranean Region, and the Southeast Asia Climate Assessment and Datasets (SACA&D) in South-East Asia. All these initiatives constitute the subregional layers of a more global initiative of climate assessment and climate data sets (ICA&D) being supported technically by Koninklijk Nederlands Meteorologisch Instituut (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 for NMHSs at subregional levels to work together to identify best mechanisms and practices to accelerate Data Rescue and to develop useful climate information for decision-making 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 the African Centre for Meteorological Applications for Development (ACMAD) under WMO auspices and CCI 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

During 2013, above-normal temperatures prevailed over most of northern Africa, exceeding

by at least 1°C the 1961–1990 normal temperatures, except over the northern parts of the subregion (in Morocco and Algeria).

According to the National Meteorological Services in the region, Morocco had its 11th warmest year in 2013. Tunisia recorded the ninth warmest year. 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 the 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 $+4^{\circ}\text{C}$ 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 21.6°C and $+0.7^{\circ}\text{C}$ above the 1971–2000 average.

PRECIPITATION

According to the reports of the National Meteorological Services in the region, precipitation was near average for most of northern Africa in 2013 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).

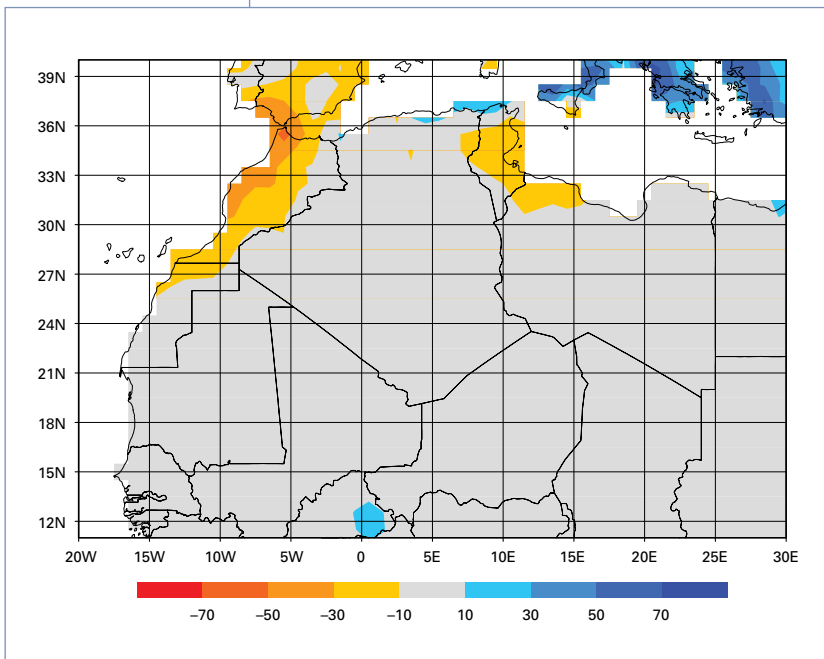


Figure 11. Northern Africa precipitation in deviation from normals for DJF 2013 (mm/month) for 2013 with respect to 1951–2000 (Source: GPCC)

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 that “the glaciers have retreated from their former extent of

11.40 km² in 1912 to 1.76 km² 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”.

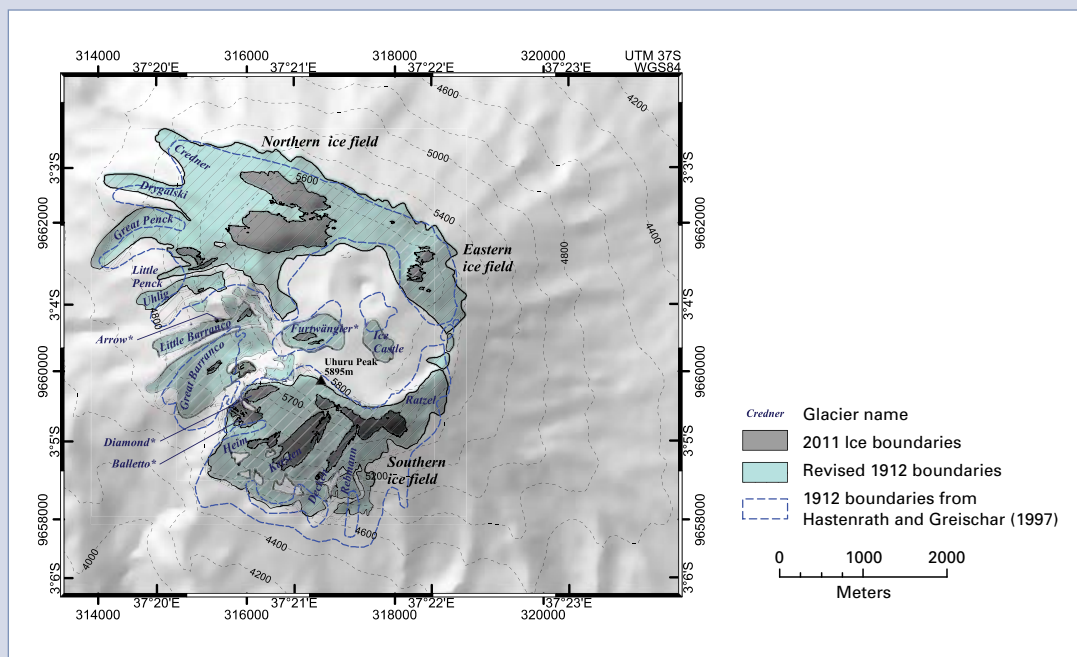


Figure 12. Glacier extent on Kilimanjaro in 1912 and 2011 (N. Cullen et al., 2013, top) and picture from Kilimanjaro in July 2012 (bottom).

Extreme weather and climate events in 2013

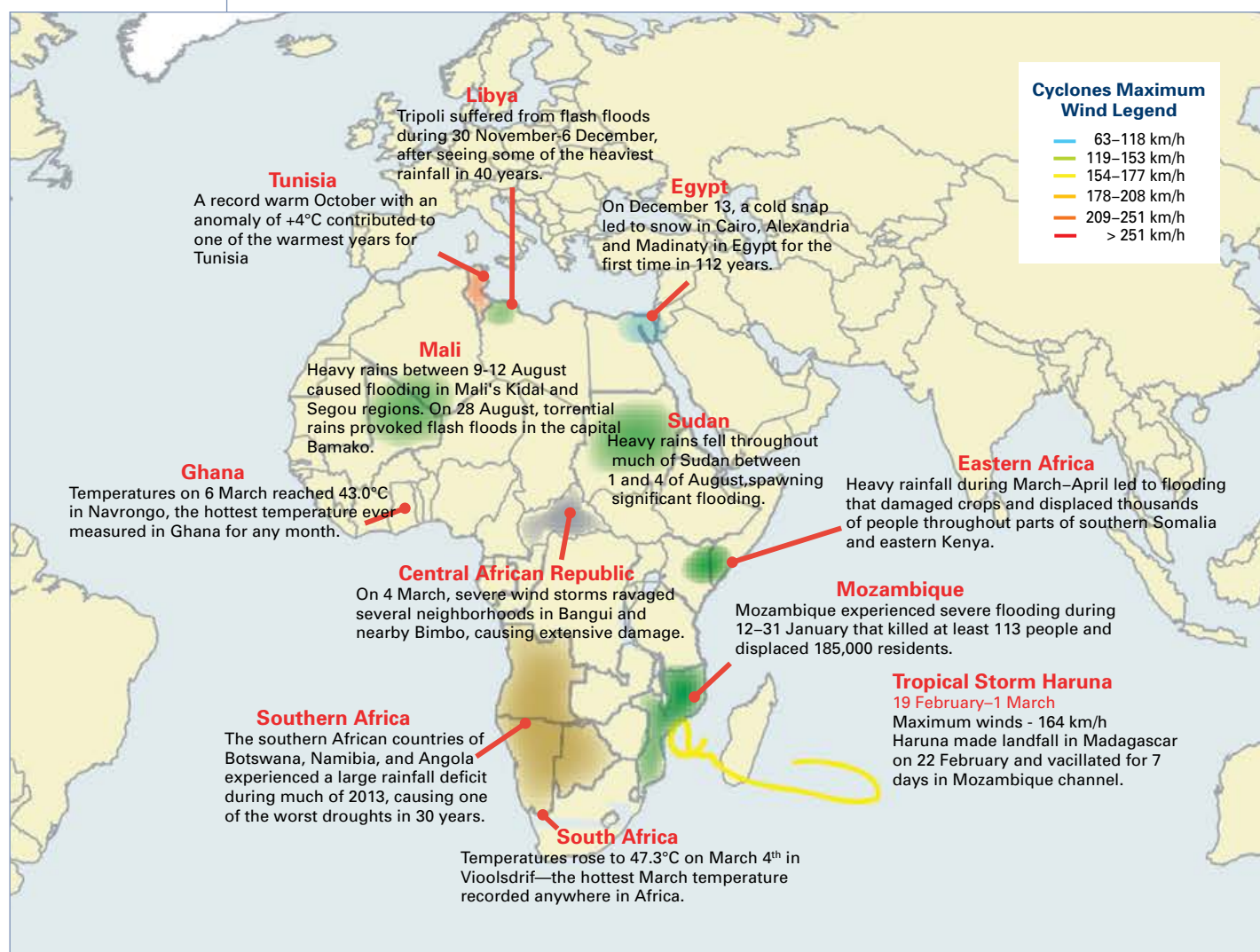
According to the Annual Disaster Statistical Review 2013 published by the Centre for Research on the Epidemiology of Disasters (CRED), hydrological disasters represented 77.3% of occurrence of all natural disasters in Africa, followed by meteorological (13.6%) and climatological disasters (9.1%).

The number of victims (4.92 million) was below the annual average number of disaster victims (affected and killed) during 2003–2012 (30.1 million), mainly due to the low number of victims of climatological disasters. Hydrological disasters affected more than 1.5 million people. The floods in South Sudan, Sudan, Mozambique, Niger and Senegal accounted for 71 % of hydrological disasters victims. With more than 140 000 affected and

killed victims, the cyclone 3A in Somalia was the meteorological disaster with the most severe human impact.

The estimation of natural disaster damages in Africa remains extremely challenging as impact data is often poorly reported or lacking. In 2013, reported damages from natural disasters amounted to only one fifth of the annual average of the 2003–2012 period. The damages reported include: Six main flooding events were recorded in 2013, including in Niger with US\$ 64 million induced damages, Kenya (US\$ 36 million), Mozambique (US\$ 30 million), Sudan (US\$ 7 million), Uganda (US\$ 3.1 million) and Ethiopia (US\$ 2.2 million); one drought in Namibia (US\$ 64 million); the Tropical Cyclone *Haruna* in Madagascar

Figure 13. Selected extreme weather and climate events for Africa in 2013
(Source: NOAA-NCDC)



(US\$ 25 million) and one tropical depression in Seychelles (US\$ 9.3 million).

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 (4 210 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. A total of 16 370 people were affected. Malawi faced acute food shortage, which exacerbated the situation for 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 185 000 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 2 500 families (11 000 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 floodwaters. About 1 800 people were affected. (IFRC, 17 Apr 2013)

South-West Indian Ocean islands countries		
Comoros	Rainfall with a peak of 392 mm in the region of Bambao-Hambou on 30 July .	There were 1 063 people displaced.
Madagascar	Heavy precipitation affected the central and south-western part around 15 February .	Eight people died, and 2 146 were displaced or left homeless.
Mauritius	A 1h rainfall above 100 mm was recorded in a few places around Port Louis on 30 March .	There were eleven fatalities, along with 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.
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 required. On 27 September, a second rupture in the dam started flooding the area and nearly 9 000 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 33 000 people were affected, and 337 families had their houses damaged or destroyed. Almost all wells and latrines in these areas were damaged by floodwaters. (IFRC, 18 Sep 2013)
Congo	Exceptional 24h precipitation of 38,6 mm was recorded on 3 March and 8 November .	Mudslides and landslide engulfed dwelling houses and killed 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.	Eight people were confirmed dead, and over 25 000 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)

Eastern Africa		
Ethiopia	Heavy rains in several areas caused flooding starting in mid-April .	More than 9 000 households were affected in the Somali region and more than 1 300 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	Damage to infrastructure and inaccessible roads were reported.
	Heavy rains induced floods in the southern Narok and northern Kajiado provinces and also 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 2 000 people were displaced. (Kenya Daily Nation, 9 Aug 2013)
	<i>By the end of the season, more than 140 000 people were displaced and 96 deaths were recorded in Kenya. Almost 14 000 acres of arable farmland were destroyed. A large number of latrines collapsed and contaminated water sources. (IFRC, 14 Nov 2013)</i>	
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.	As many as 7 000 households in 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 150 000 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.	There was 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. The Government estimated that 114 000 households were affected with at least 110 people injured and 76 people killed. A total of 50 000 houses were completely destroyed, displacing a large part of the affected population. (IFRC, 10 Oct 2013)

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 3 000 houses were destroyed and 13 000 hectares of farmland were affected. More than 10 000 people were displaced and more than 30 000 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 6 712 people were affected. (OCHA, 27 Aug 2013)
Côte d'Ivoire	From 17 to 25 November , a total of 184.5 mm of rain was recorded, with a peak of 72.5mm on 19 November in Abidjan. The total precipitation in November for Abidjan was 294 mm, the highest value for November rain in the last 53 years. (1961–2013)	Flood in Abidjan on 25 November caused serious disruption of traffic
Gambia (the)	On 15 August , the Nema-kunku area was affected by flash floods	One person's life 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 population 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.	The flooding caused destruction of property and farmlands in Agona East district in the Central region, affecting at least 1 000 people. (IFRC, 18 Apr 2013)
Guinea	On 14 November , the Tougué area experienced heavy rainfall with strong wind.	Rain destroyed 7 000 hectares of rice field, with an estimated value of US\$ 2 million.
	On 8 September , Saraboido (Koundara) experienced heavy rainfall with strong wind.	Five 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 11 300 people were affected. (OCHA, 26 Aug 2013)
	On 28 August , torrential rains provoked flash floods in the capital Bamako.	There were 37 fatalities and at least 20 000 displaced people. (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 4 225 people, displaced 2 305, killed 8, and damaged over 500 homes. (OCHA, 27 Sep 2013)

Niger	<p>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.</p>	<p>Thirty-two deaths were recorded and more than 135 000 people were affected. Houses collapsed. Approximately 12 000 hectares of crops were flooded. (IFRC, 6 Sep 2013, OCHA, 17 Sep 2013)</p>
	<p>Starting in October, floods along the Komadougou river affected the Diffa Region.</p>	<p>There were 5 400 people affected. (OCHA, 15 Nov 2013).</p>
Nigeria	<p>Heavy rains prompted flash floods in the state of Kano on 9 August.</p>	<p>More than a thousand homes were destroyed.</p>
	<p>A 25h widespread rainfall on 22/23 September across the south-west hit the cities Benin, Ibadan, Ondo and Oshogbo.</p>	<p>Many roads and houses were submerged. The continuous rainfall killed people, damaged properties and wreaked havoc.</p>
	<p><i>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 35 000 people and 2 217 farms were affected by floods during 2013. (OCHA 2013 Rainy Season Overview, 11 September 2013)</i></p>	
Senegal	<p>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.</p>	<p>Agriculture lands were submerged with water in Fatick and Kedougou.</p>
Togo	<p>Rainfall of 173.3 mm on 15 August at Dapaong, which is the highest precipitation recorded since the establishment of the station in 1957.</p>	<p>Fields were devastated, roads were broken, and bridges were damaged.</p>

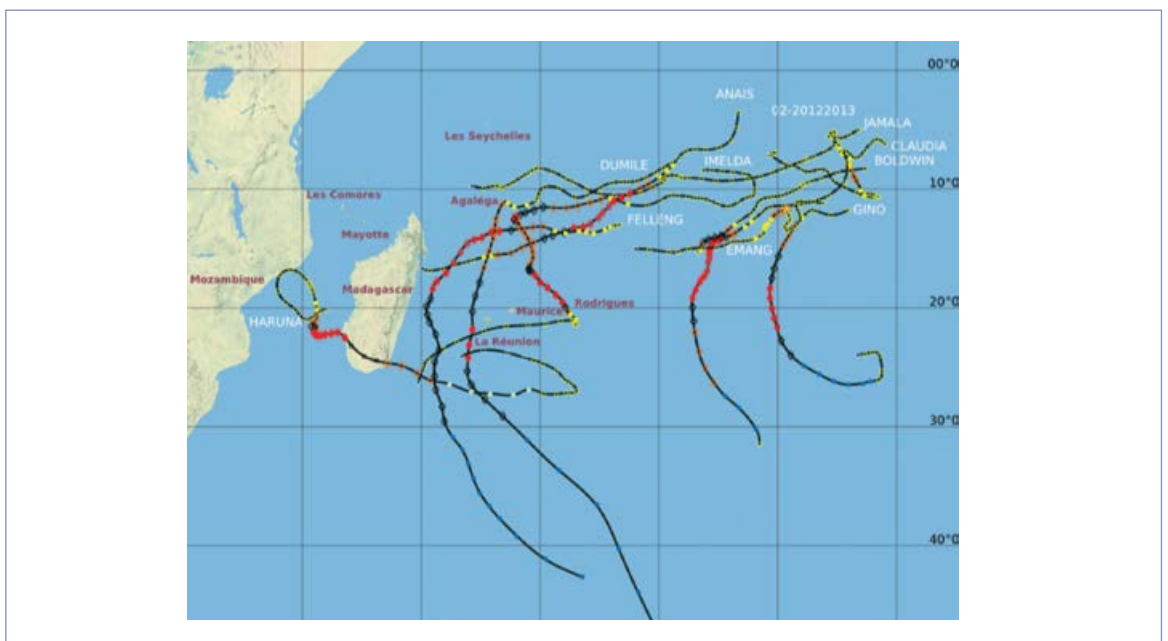
Northern Africa		
Algeria	Flash floods were recorded on 9 October	There were at least 7 fatalities.
Canary Islands	Heavy precipitation on 11 December . 109 mm in Tenerife-Sud and 103.8 mm in Tenerife-airport of Los Rodeos in 24h.	These were the station records at both stations for December.
Libya	Tripoli suffered flash floods during 7 days from 30 November , after seeing some of the heaviest rainfall in 40 years.	Sixteen people were killed, electricity and telecommunications were disrupted, and more than 400 houses were damaged.
Morocco	Heavy precipitation during a 3h period on 17 September in Marrakesh.	Two people were 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 was recorded in Sfax, Tunisia, on 22 December.	

TROPICAL CYCLONES AND WIND STORMS

In 2013, the south-western Indian Ocean tropical cyclone activity was near average, both in terms of the number of named storms and also in terms of number of storm days. Ten named tropical storms during the year were recorded,

which is close to the 1981–2010 and the 2001–2010 average of 9 storms (WMO Statement on the Status of the Global Climate). Seven storms reached the tropical cyclone intensity and 4 storms had direct influences on inhabited lands. The most severe storms in terms of impact are listed in the table.

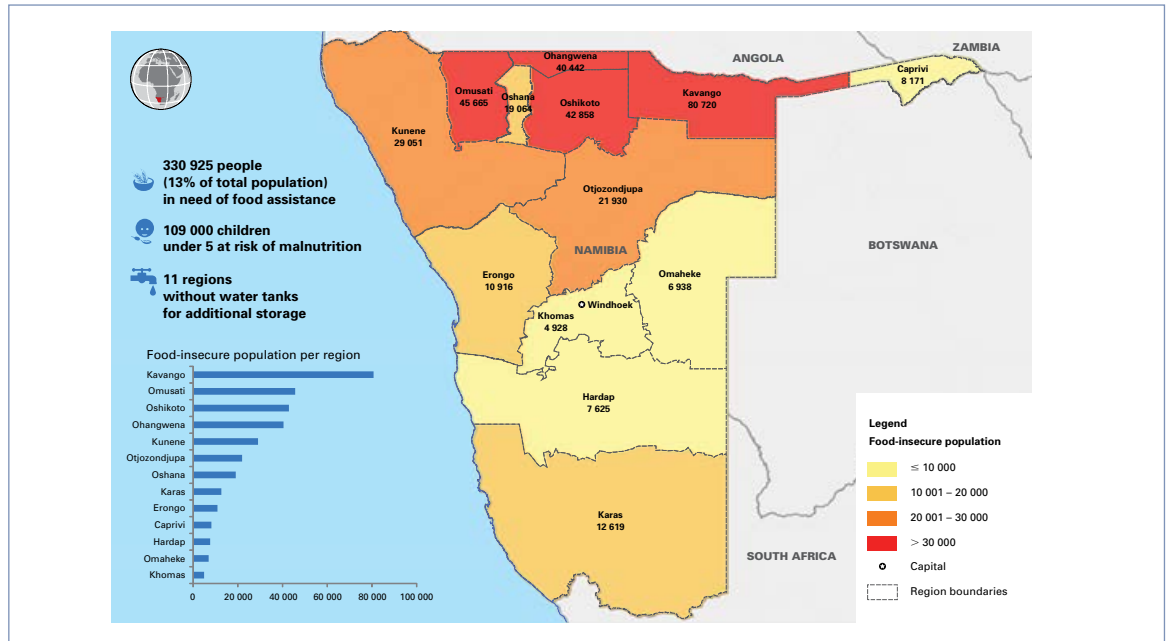
Figure 14. Tropical cyclones in the southwestern Indian Ocean during the 2012/2013 season (Source: MétéoFrance)



Tropical Cyclone <i>Dumile</i> in La Réunion and Mauritius	TC <i>Dumile</i> cruised about 100 km from the western coast of La Réunion. It brought 1 187 mm total rainfall in 48 hours at Commerson. A maximum wind gust of 189 km/h was recorded at Maïdo (located in the highlands).	It caused little damage, primarily damage 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 damage to houses was observed
Tropical Cyclone <i>Felleng</i> in Seychelles and Madagascar	On 27/28 January, the eastern coast of the Seychelles island Mahe was devastated by tropical depression <i>Felleng</i> and the island La Digue was severely affected.	One thousand families were affected by floods and landslides. There were 246 families displaced after their houses were either destroyed or damaged. (IFRC, 23 May 2013)
	TC <i>Felleng</i> moved 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 <i>Haruna</i> 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, dumping more than 160 mm of rain in 24 hours. Earlier, the strength of <i>Haruna</i> 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 40 000 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 deaths of 162 people, displacement of tens of hundreds of nomads, decimation of approximately 1 million livestock and destruction of over 1 000 houses, according to Government statistics..
Severe wind storm in the Central African Republic	On 4 March, a severe windstorm 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.	The windstorm destroyed 1 006 houses and damaged 308. The storm affected 8 710 people, either leaving them homeless or destroying their belongings. Up to 869 wells were polluted by debris and 914 latrines were destroyed. (IFRC, 21 Mar 2013)
Severe wind storm in Guinea	A severe windstorm hit the coastal area around Boffa on 18 August. A maximum wind speed of 32 m/s was recorded	Five persons were killed

DROUGHTS, HEAT WAVES AND FIRES

Figure 15. Food insecure population per region in Namibia in May 2013
(Source: OCHA)



Droughts

In Namibia, a prolonged dry season resulted in severe drought and widespread crop failure across the country. (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. About 4 000 livestock died. The situation was particularly severe in the north, and along the Caprivi strip. An estimated 780 000 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 250 000 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 affected La Réunion during May–September. This is the dry season for the island, but this was the driest year of at least the past 50 years, with 50 per cent of average precipitation for the period.

Underground and surface water resources reached historic 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 3 000 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.	Fire destroyed 279 houses and 450 families (2 257 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 parts of the country, reaching as far as Ogoja, Obudu, Enugu, Port Harcourt and Abeokuta, reducing visibility to 300–1000 m. The second one occurred from 16–18 February with a visibility between 400–800 m, affecting especially the 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 south-west with visibility ranging between 300–1500 m. The last spell of the year occurred from 30–31 December, affecting only the north-eastern 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.

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.

This was the lowest minimum temperature recorded in July at the station over the past decade.

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.

CO₂ is the most important long-lived greenhouse gas related to human activities. In Africa, CO₂ emissions from fossil fuels are projected to increase substantially with economic development. Tropical forests may serve as a source and a sink of CO₂, depending on climate conditions. Substantial CO₂ emissions are associated with the deforestation process.

Methane, the second most important long-lived greenhouse gas, is emitted from tropical wetlands and provides a 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 these three stations correspond to the tendencies in global averages, namely an increase in CO₂ and CH₄ mole fractions. CH₄ and CO₂ 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 (for example, of South Africa, Algeria and Kenya).

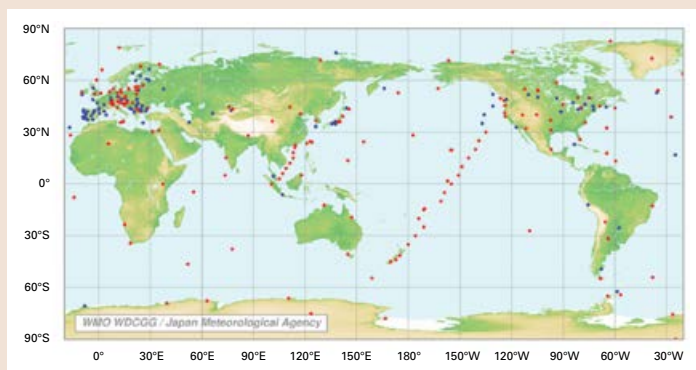


Figure 16. Distribution of the fixed stations that contribute data to the WDCGG. The red dot denotes that the data from the station has been updated in the last 365 days. (Source: WDCGG)

Acronyms

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
GPCC	Global Precipitation Climatology Centre
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:

Temperature: The combination of the Global Historical Climatology Network and the Climate Anomaly Monitoring System (CAMS GHCN) by NOAA NCEP CPC is a high resolution (0.5°x0.5°) analyzed global land surface temperatures and precipitation from 1948 to near present. (see <http://www.esrl.noaa.gov/psd/data/gridded/data.ghcncams.html>)

Precipitation: <http://gpcc.dwd.de>

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Members of the Task Team on the African Climate

Belachew Kebede Bayih	National Meteorological Services Agency, Ethiopia
Maimuna U. Borno	Nigerian Meteorological Agency, Nigeria
Andre Kamga	ACMAD, Niger
Coulibaly Kolotioloma	Direction de la Météorologie Nationale, Côte d'Ivoire
Isaias Gabriel António Raiva	Instituto Nacional de Meteorologia, Mozambique
Zo Andrianina Patrick Rakotomavo	Direction Générale de la Météorologie, Madagascar
Rachid Sebbari	Direction de la Météorologie Nationale, Morocco
Simplicite Tchinda Tazo	Direction de la Météorologie Nationale, Cameroon

Other experts

Tommaso Abrate	WMO
Jessica Blunden	NOAA, USA
David Carlson	WMO
Peer Hechler	WMO
Anna Pirani	The Abdus Salam International Centre for Theoretical Physics, Italy
Vladimir Ryabinin	WMO
Daniel Sighomnou	WMO
Oksana Tarasova	WMO
Wassila Mamadou Thiaw	CPC, USA
Blair Trewin	BoM, Australia

WMO Secretariat coordination

Omar Baddour
Karolin Eichler

For more information, please contact:

World Meteorological Organization

7 bis, avenue de la Paix – P.O. Box 2300 – CH 1211 Geneva 2 – Switzerland

Communications and Public Affairs Office

Tel.: +41 (0) 22 730 83 14/15 – Fax: +41 (0) 22 730 80 27

E-mail: cpa@wmo.int

www.wmo.int