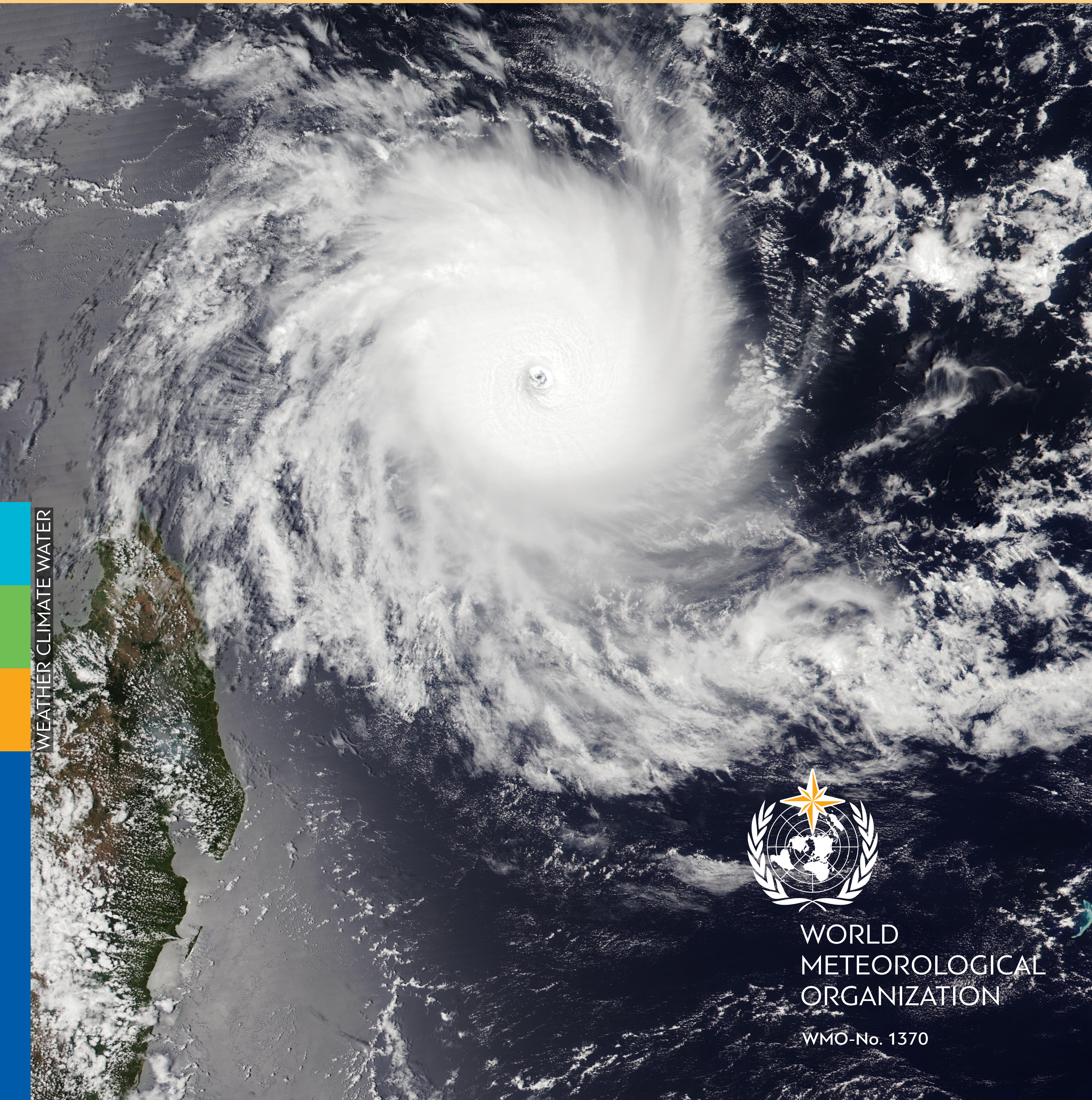
State of the Climate in Africa

2024



WEATHER CLIMATE WATER

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Cover: Tropical Cyclone *Chido* on 12 December 2024
Credit: VIIRS image from the National Oceanic and Atmospheric Administration (NOAA) NOAA-21 Satellite

Contents

We need your feedback

This year, the WMO team has launched a process to gather feedback on the *State of the Climate* reports and areas for improvement. Once you have finished reading the publication, we ask that you kindly give us your feedback by responding to this short survey. Your input is highly appreciated.

Key messages

The average temperature across Africa in 2024 was approximately 0.86 °C above the 1991–2020 average, making 2024 the warmest or second warmest year on record (1900–present), depending on the dataset used. The past decade has been the warmest on record.

Sea-surface temperatures across the region reached record highs, with particularly rapid warming in the Atlantic Ocean and the Mediterranean Sea.

Sea levels are rising at rates near or above the global average, except in the southern Mediterranean Sea, where the increases are significantly lower.

Exceptionally heavy rainfall and devastating floods affected multiple locations across Africa, causing widespread fatalities, displacement and infrastructure damage. In West and Central Africa, torrential rains impacted millions of people, with Nigeria, Niger, Chad, Cameroon and the Central African Republic among the hardest hit countries.

The 2023 positive El Niño phase and the 2023 positive Indian Ocean Dipole phase, both of which extended into early 2024, played significant roles in the extreme weather patterns observed in 2024.

Prolonged drought in Southern Africa led to widespread crop failures, food insecurity and significant humanitarian and environmental challenges. Critically low water levels in Lake Kariba, the world's largest man-made lake, caused severe electricity shortages in Zambia and Zimbabwe, drastically reducing hydroelectric power generation, triggering prolonged blackouts and economic disruptions.

Artificial Intelligence, numerical weather prediction models and mobile communication tools are enhancing the accuracy and accessibility of weather services in Africa, but scaling up digital transformation requires greater investment in infrastructure, stronger data-sharing frameworks and more inclusive service delivery.

The State of the Climate in Africa report reflects the urgent and escalating realities of climate change across the continent. It also reveals a stark pattern of extreme weather events, with some countries grappling with unprecedented flooding caused by excessive rainfall and others enduring persistent droughts and water scarcity.

WMO and its partners are committed to working with WMO Members to build resilience and strengthen adaptation efforts in Africa to protect lives and economies through initiatives such as Early Warnings for All. It is my hope that this report will provide inspiration and guidance for collective action to address increasingly complex challenges and cascading impacts.

(Prof. Celeste Saulo)
Secretary-General

Her Excellency, Josefa Leonel Correia Sacko (former Commissioner for Agriculture, Rural Development, Blue Economy and Sustainable Environment of the African Union Commission) has been committed to the annual production of the State of Climate Reports to support Member States in the implementation of weather- and climate-related strategic frameworks in Africa.

Global climate context

The global annual mean near-surface temperature in 2024 was 1.55 °C [1.42 °C to 1.68 °C] above the 1850–1900 pre-industrial average and 1.19 °C [1.15 °C to 1.24 °C] above the 1961–1990 baseline. The global mean temperature in 2024 was the highest on record for the period 1850–2024 according to all six datasets that WMO uses to monitor global mean temperature,[1] beating the previous record of 1.45 °C [1.32 °C to 1.57 °C] set in 2023. Each of the years from 2015 to 2024 was one of the 10 warmest years on record.

Atmospheric concentrations of the three major greenhouse gases reached new record observed highs in 2023, the latest year for which consolidated global figures are available, with levels of carbon dioxide (CO_2) at 420.0 ± 0.1 parts per million (ppm), methane (CH_4) at 1 934 ± 2 parts per billion (ppb) and nitrous oxide (N_2O) at 336.9 ± 0.1 ppb – respectively 151%, 265% and 125% of pre-industrial (before 1750) levels (Figure 1). Real-time data from specific locations, including Mauna Loa[2] (Hawaii, United States of America) and Kennaook/Cape Grim[3] (Tasmania, Australia) indicate that levels of CO_2, CH_4 and N_2O continued to increase in 2024.

The rate of ocean warming over the past two decades (2005–2024) was more than twice that observed over the period 1960–2005, and the ocean heat content in 2024 was the highest on record. Ocean warming and accelerated loss of ice mass from the ice sheets contributed to the rise of the global mean sea level by 4.7 mm per year between 2015 and 2024, reaching a new record observed high in 2024. The ocean is a sink for CO_2. Over the past decade, it absorbed about one quarter of the annual emissions of anthropogenic CO_2 into the atmosphere.[4] CO_2 reacts with seawater and alters its carbonate chemistry, resulting in a decrease in pH, a process known as "ocean acidification".

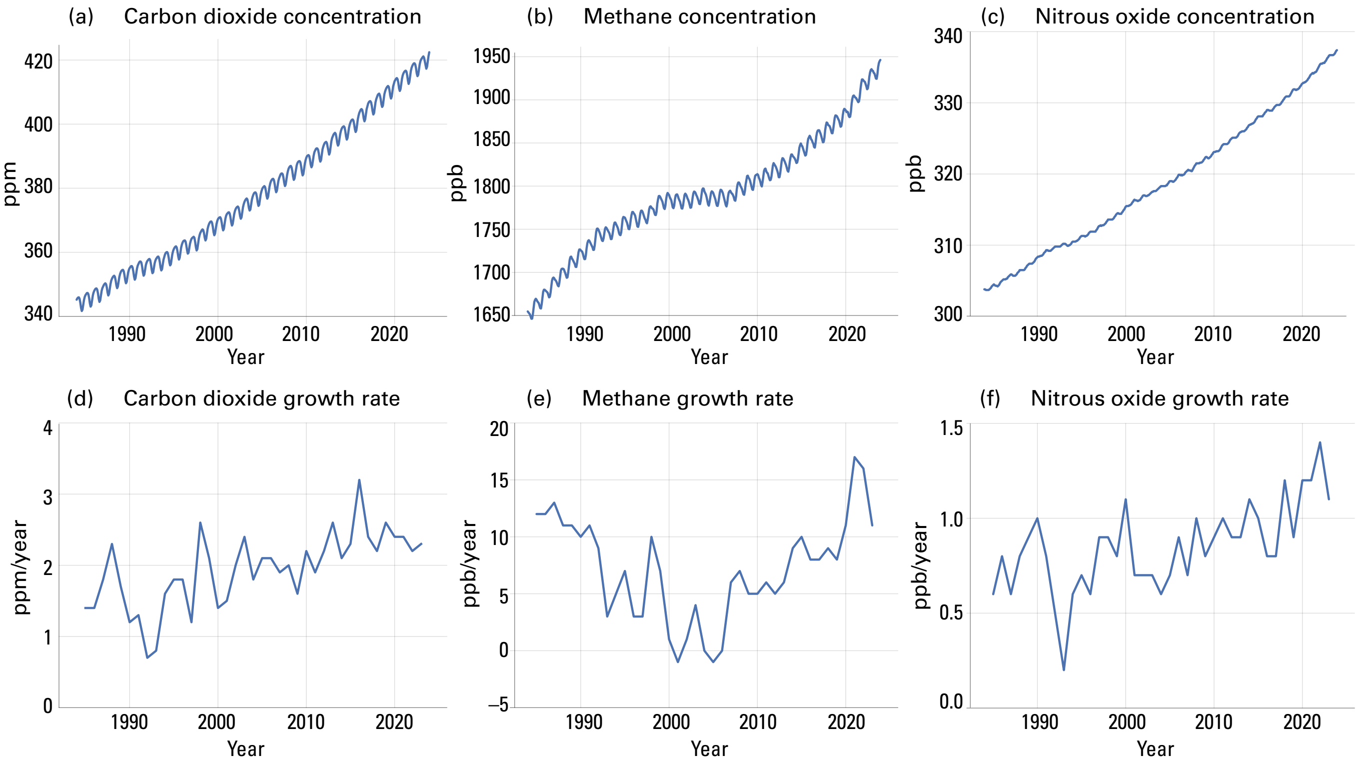


Figure 1: Top row: Monthly globally averaged mole fraction (measure of atmospheric concentration), from 1984 to 2023, of (a) CO_2 in parts per million, (b) CH_4 in parts per billion and (c) N_2O in parts per billion. Bottom row: Growth rates representing increases in successive annual means of mole fractions for (d) CO_2 in parts per million per year, (e) CH_4 in parts per billion per year and (f) N_2O in parts per billion per year.

Regional climate

The following sections analyse key climate indicators in Africa. Some of the indicators are described in terms of anomalies, or departures from a reference period. Where possible, the most recent WMO climatological standard normal, 1991–2020, is used as a reference period for consistent reporting. Exceptions to the use of this reference period are explicitly noted.

TEMPERATURE

Variations in surface temperature have a large impact on natural systems and human beings.

LONG-TERM TEMPERATURE ANOMALIES IN AFRICA

The near-surface air temperature averaged across WMO Regional Association I (RA I) (Africa) in 2024 was the warmest or second warmest on record (1900–present). The mean value for 2024 across the six datasets shown in Figure 2 was 0.86 °C above the 1991–2020 average (0.60 °C–1.05 °C, depending on the dataset used). Relative to a 1961–1990 baseline, the mean anomaly was 1.53 °C (1.35 °C–1.63 °C, depending on the dataset used).

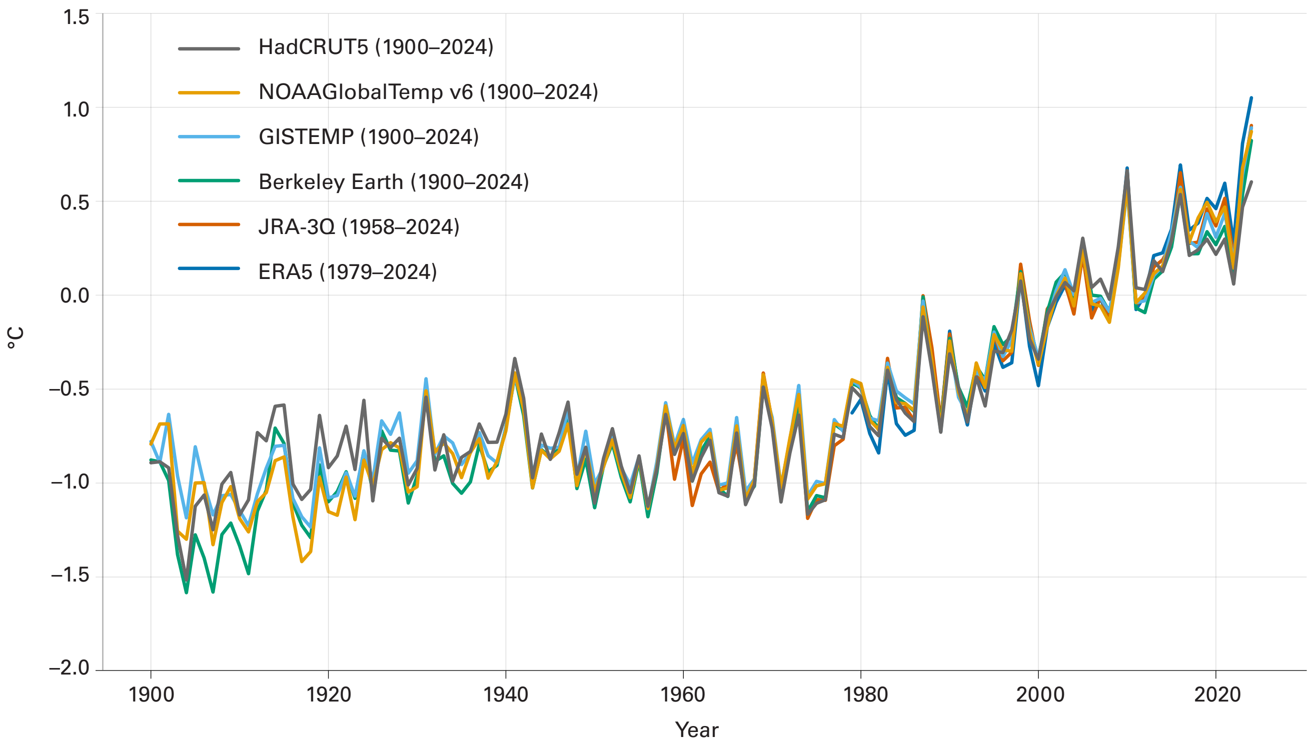
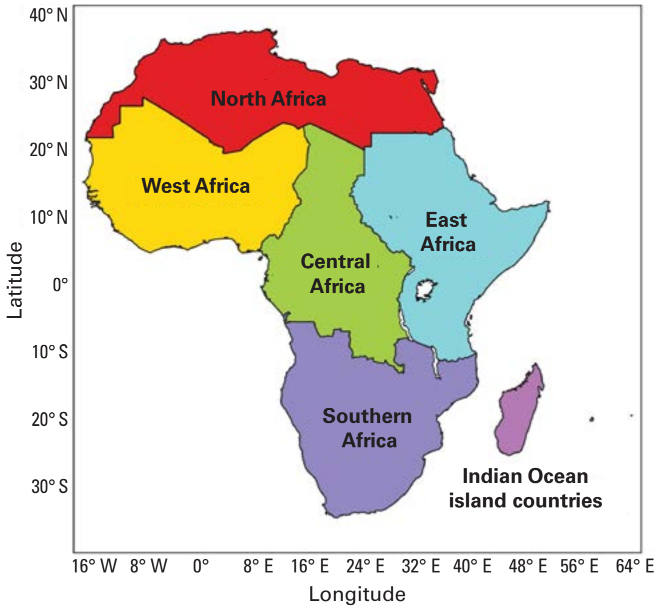


Figure 2. Annual regional mean temperature anomalies for WMO RA 1 (Africa) (°C, difference from the 1991–2020 average) from 1900–2024. Data are from the following six datasets: Berkeley Earth, ERA5, GISTEMP, HadCRUT5, JRA-3Q, NOAAGlobalTemp v6.

TEMPERATURE IN THE AFRICAN SUBREGIONS

Temperature trends and anomalies are also analysed by subregion, considering overall geographic and climatic patterns, for North Africa, West Africa, Central Africa, East Africa, Southern Africa and the Indian Ocean island countries (Figure 3).



In 2024, Africa experienced continued warming trends consistent with the global increase in average temperatures, as shown in Figure 2. Temperatures across the continent remained above the long-term averages, with significant anomalies recorded in North Africa and northern Southern Africa (Figure 4 (left)).

Figure 3. The six African subregions referred to in this report: North Africa (red), West Africa (yellow), Central Africa (green), East Africa (light blue), Southern Africa (dark blue) and the Indian Ocean island countries (purple)

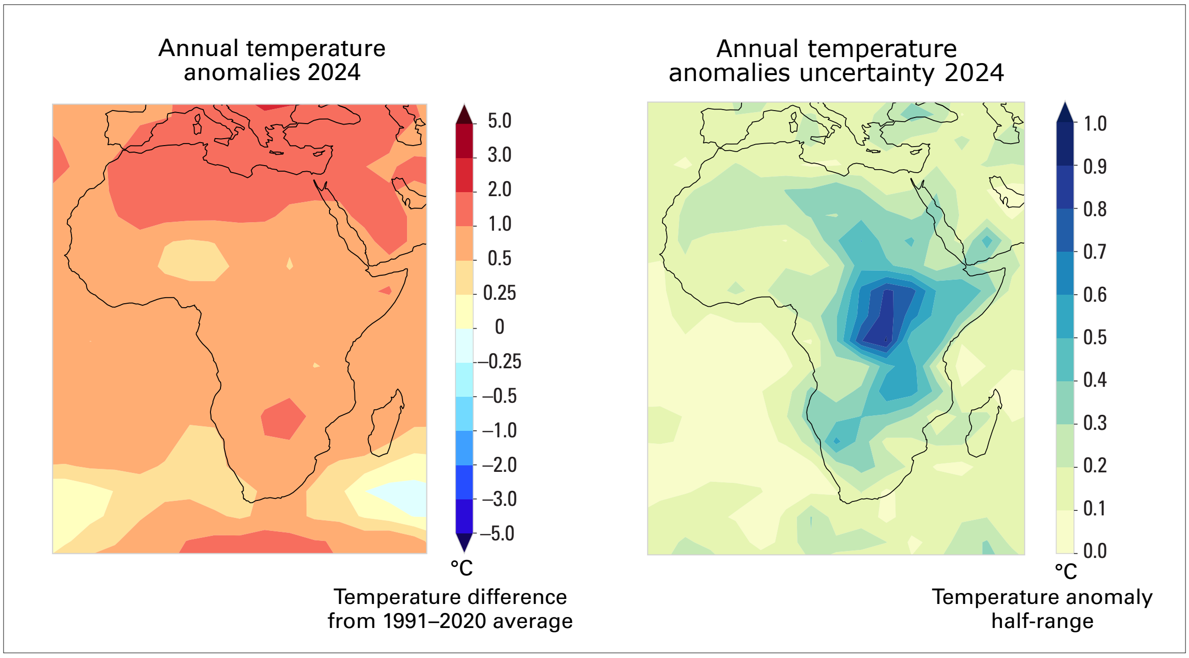


Figure 4. Left: Annual temperature anomalies 2024: Annual near-surface temperature anomaly (in °C, relative to the 1991–2020 average) for 2024. Data shown are the median of the following six datasets: Berkeley Earth, ERA5, GISTEMP, HadCRUT5, JRA-3Q and NOAAGlobalTemp v6. Right: Annual temperature anomalies uncertainty 2024: Annual near-surface temperature uncertainty (in °C) for 2024. Data shown are the half-range of the following six datasets: Berkeley Earth, ERA5, GISTEMP, HadCRUT5, JRA-3Q and NOAAGlobalTemp v6.

The area-averaged temperature trend for the period 1991–2024 (Table 1 and Figure 5) indicates significant increases for each of the six African subregions. These temperature anomalies have amplified challenges such as water scarcity, food insecurity and ecosystem stress, highlighting the urgent need for adaptive strategies and robust climate action on the continent.

Table 1. Near-surface air temperature anomalies in °C for 2024 relative to the 1991–2020 and 1961–1990 reference periods. Anomalies for the whole African continent and for each of the African subregions have been calculated using six different datasets, including observational datasets (HadCRUT5, NOAAGlobalTemp, GISTEMP and Berkeley Earth) and reanalyses (JRA-3Q and ERA5). The range of anomalies among these datasets is given in brackets.

Subregion	*2024 anomalies relative to 1961–1990*	*2024 anomalies relative to 1991–2020*
North Africa	2.14 °C [1.99 °C–2.26 °C]	1.28 °C [1.04 °C–1.47 °C]
West Africa	1.40 °C [1.28 °C–1.48 °C]	0.72 °C [0.62 °C–0.82 °C]
Central Africa	1.37 °C [1.09 °C–1.54 °C]	0.81 °C [0.49 °C–1.22 °C]
East Africa	1.37 °C [1.01 °C–1.57 °C]	0.68 °C [0.22 °C–0.89 °C]
Southern Africa	1.43 °C [1.27 °C–1.59 °C]	0.84 °C [0.65 °C–1.01 °C]
Indian Ocean island countries	1.21 °C [1.06 °C–1.48 °C]	0.66 °C [0.46 °C–0.79 °C]
Africa	**1.53 °C [1.35 °C–1.63 °C]**	**0.86 °C [0.60 °C–1.05 °C]**

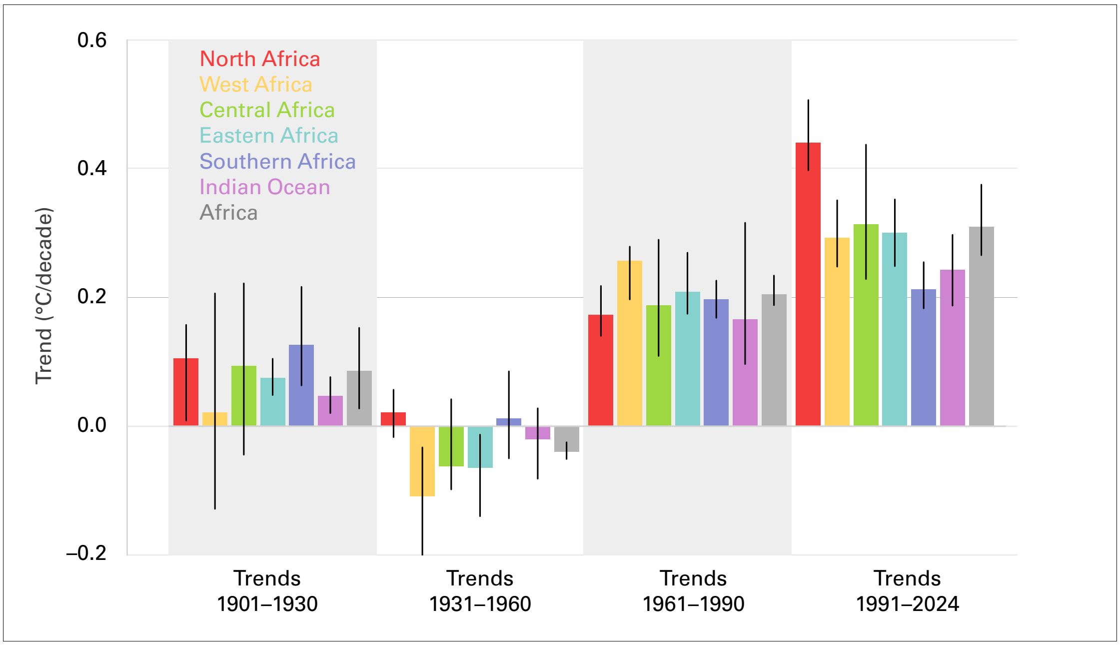


Figure 5. Trends in the area-averaged temperature in °C/decade for the six African subregions: North Africa (red), West Africa (yellow), Central Africa (green), East Africa (light blue), Southern Africa (dark blue), the Indian Ocean island countries (purple) and the whole of Africa (grey) over four sub-periods: 1901–1930, 1931–1960, 1961–1990 and 1991–2024. The trends were calculated using different datasets, including observational datasets (HadCRUT5, NOAAGlobalTemp, GISTEMP and Berkeley Earth) and reanalyses (JRA-3Q and ERA5). The black vertical lines indicate the range of the six estimates.

PRECIPITATION

Precipitation provides water for drinking, domestic uses, agriculture, industry and hydropower. Precipitation variations also drive droughts and floods.

In 2024, many regions in Africa received lower-than-normal precipitation amounts, while other regions had normal or higher-than-normal precipitation totals (Figure 6). Drier-than-normal conditions were observed in particular in the northern parts of Southern Africa (where drier-than-average conditions have persisted for the last five years) and the South-west Indian Ocean islands, including Madagascar. Furthermore, the Somali Peninsula, western Central Africa and some areas in the north-western Sahel region received below-normal rainfall. Unusually dry conditions were also observed along the north-western coast of Africa. The drought in north-western Africa has lasted for about six years. A precipitation excess was observed in parts of the Sahel region, many parts of Central and East Africa, north-eastern Madagascar, the Seychelles, parts of the Comoros and parts of Angola.

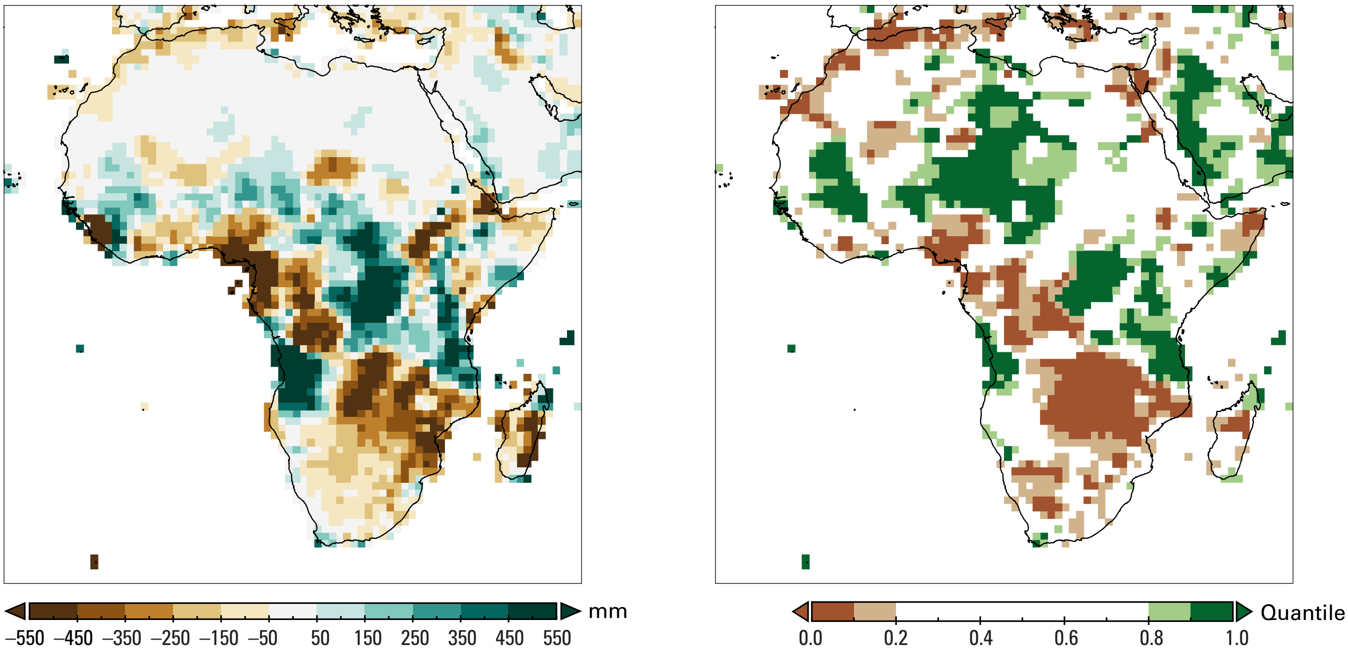


Figure 6. (Left) Precipitation anomalies in mm for 2024: Blue areas indicate above-average precipitation, and brown areas indicate below-average precipitation. The reference period is 1991–2020. (Right) Twelve-month precipitation quantile for 2024 (comparison of the annual total to the 1991–2010 period). Green areas indicate unusually high precipitation totals (light green indicates the highest 20%, and dark green indicates the highest 10% of the observed totals). Brown areas indicate abnormally low precipitation totals (light brown indicates the lowest 20%, and dark brown indicates the lowest 10% of the observed totals).

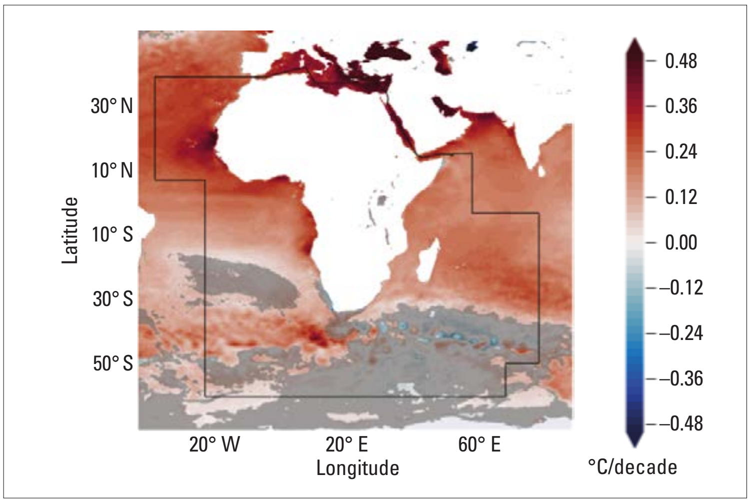
Source: Global Precipitation Climatology Centre (GPCC)

OCEANS

SEA-SURFACE TEMPERATURE

Variations in sea-surface temperature (SST) alter the transfer of energy, momentum and gases between the ocean and the atmosphere.

Particularly large increases in SST have been observed in the Atlantic Ocean and Mediterranean Sea areas of the region (Figure 7, top). The area-averaged time series of the region (Figure 7, bottom) indicates that average SST warming is occurring at a rate which is comparable to the global mean. Values of SST in the year 2024 were the highest in the observed record, exceeding the previous record set in 2023.



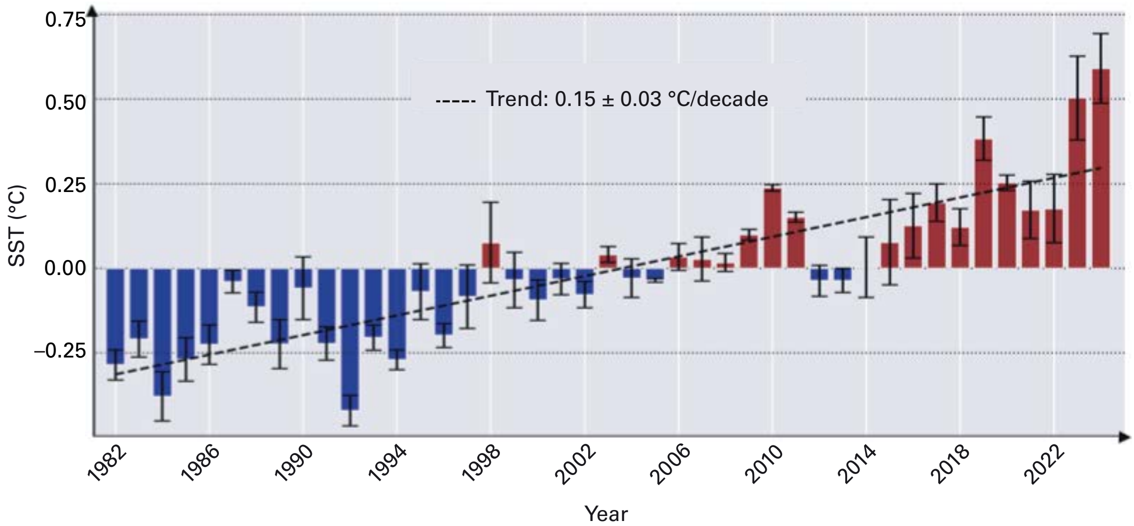


Figure 7. Top: Map of regional SST trends over the period 1982–2024 using the Copernicus Marine Service Operational Sea Surface Temperature and Ice Analysis (OSTIA) product. Grey areas indicate where less agreement could be obtained from an ensemble of three international SST products (Copernicus Marine OSTIA, Copernicus Marine ESA-CCI, NOAA OISST). WMO Region I Africa is outlined in black. Bottom: SST anomalies averaged over WMO Region I Africa from 1982–2024. The dashed line indicates the linear trend over the period. The Copernicus Marine OSTIA product was used to generate this graph, and the ensemble of this product with the other products (ESA-CCI up to 2022; NOAA OISST up to 2024) was used to provide the annual mean ensemble spread (two standard deviations, black lines).

SEA LEVEL

Sea level rises in response to ocean warming (via thermal expansion) and the melting of glaciers, ice caps and ice sheets, thereby affecting the lives and livelihoods of coastal communities and low-lying island nations. The rates of sea-level rise from 1993 to 2024 have been computed from altimetry-based regional sea-level trends for seven different regions around Africa (the boxed areas in the map in Figure 8). Table 2 shows the mean sea-level trends for each region, as well as the coastal trends (from the coast to 50 km offshore) averaged in each region. The average sea-level rise from 1993 to 2024 was near or above the global mean in every region except the southern Mediterranean Sea (Region 7), where the sea-level rise was significantly lower than the global mean.

Table 2. Sea-level rise in mm/year for the seven coastal regions of Africa and the global ocean

Region number	*Ocean/sea*	*Average sea-level trend (mm/year)*	*Sea-level trend averaged over 0–50 km from the coast (mm/year)*
1	Red Sea	3.55 ± 0.3	3.85 ± 0.35
2	Western Indian Ocean	3.85 ± 0.3	4.10 ± 0.35
3	South-west Indian Ocean	3.45 ± 0.3	3.79 ± 0.35
4	South-east Atlantic Ocean	3.31 ± 0.3	3.34 ± 0.35
5	Tropical Atlantic Ocean	3.50 ± 0.3	3.67 ± 0.35
6	North-east Atlantic Ocean	3.40 ± 0.3	3.42 ± 0.35
7	Southern Mediterranean Sea	2.50 ± 0.3	2.80 ± 0.30
	Global	**3.4 ± 0.3**	

Source: The data are based on the Copernicus Climate Change Service (C3S) gridded sea level product (https://cds.climate.copernicus.eu/datasets/satellite-sea-level-global?tab=overview; resolution 0.25°).

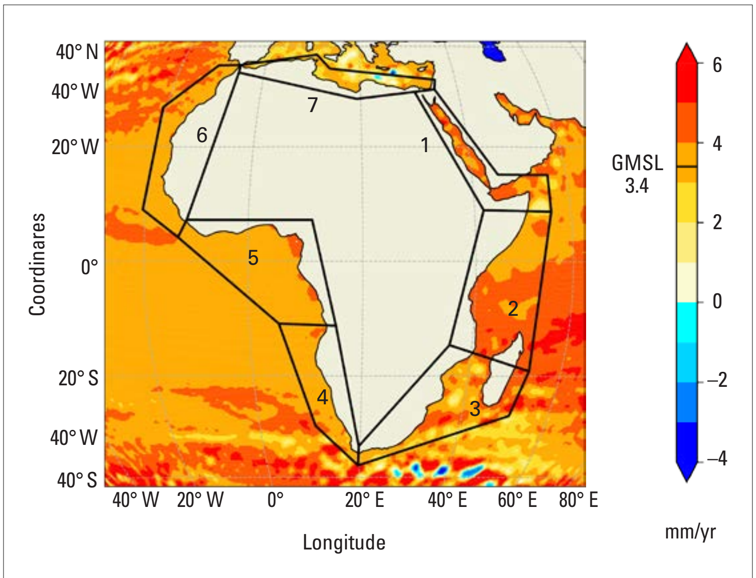


Figure 8. Spatial sea-level trends in the seven coastal regions of Africa covering the period from January 1993 to November 2024: Red Sea (1), Western Indian Ocean (2), South-west Indian Ocean (3), South-east Atlantic Ocean (4), Tropical Atlantic Ocean (5), North-east Atlantic Ocean (6) and Southern Mediterranean Sea (7).

Source: The data are based on the Copernicus Climate Change Service (C3S) gridded sea level product (https://cds.climate.copernicus.eu/datasets/satellite-sea-level-global?tab=overview; resolution 0.25°).

Extreme events

In 2024, Africa experienced a series of extreme weather events that had significant impacts across the continent. The 2023 positive El Niño phase and the 2023 positive Indian Ocean Dipole phase, both of which extended into early 2024, played major roles in the extreme weather patterns observed in 2024. These climatic phenomena contributed to the severe flooding in East Africa and the drought conditions in Southern Africa.

Southern Africa

Southern Africa experienced damaging drought conditions, particularly in Zambia, Malawi and Zimbabwe. Zambia and Malawi declared national disasters after experiencing their worst drought in at least two decades. This drought devastated agriculture and led to significant food insecurity. In March, Tropical Storm *Filipo* struck Inhambane province in Mozambique, resulting in fatalities and displacement. In May, Tropical Cyclone *Hidaya* brought heavy rainfall and strong winds over parts of southern Tanzania. This event occurred just after deadly rainfall in April affected Tanzania and Kenya. In June, severe storms produced heavy rainfall and strong winds along South Africa's eastern coast, particularly affecting the Eastern Cape and KwaZulu-Natal provinces. These storms caused flooding, tornadoes and significant damage to infrastructure, resulting in multiple fatalities and displacing thousands.

East Africa

Exceptionally heavy long rains from March to May led to severe flooding in Kenya, Tanzania, Burundi and other parts of East Africa. Hundreds of people lost their lives, and more than 700 000 were affected across the region. In July, heavy rainfall in the mountainous Gofa zone of south-western Ethiopia triggered devastating landslides, leaving over 15 000 people in immediate need of evacuation due to the risk of further landslides. The International Federation of Red Cross and Red Crescent Societies (IFRC) reported that the landslide in Gezei Gofa Woreda left 236 confirmed dead, making it the deadliest in Ethiopia's history.[5] The floods in Kenya during the March to May season caused widespread displacement and damage to infrastructure, exacerbating the vulnerability of affected communities. Rainfall during the October to December season was below average, consisting of very few wet days in November. However, even though maps may indicate that the average rainfall in East Africa from October to December was close to normal, it was too little to sustain food crops and livelihoods in many areas. This raised food concerns from late 2024 to early 2025. During mid-March, and in particular, from 16 to 18 March, an unprecedented heatwave swept across South Sudan, with temperatures reaching 45 °C, forcing schools to close and disrupting education.[6] Somalia experienced similar extreme heat with associated climate impacts, leading to food shortages and affecting families' livelihoods and access to education for children.

Central Africa

Several Central African countries, including Cameroon, Chad and the Central African Republic, experienced severe flooding due to heavy rainfall, causing widespread devastation and displacement across the region. Chad was particularly hard hit, with 1.9 million affected people by September.[7] In December 2024, heavy rainfall and strong winds affected the western regions of the Democratic Republic of the Congo, particularly Kongo Central province. This severe event led to significant damage and displacement within the province.

West Africa

Torrential rains across the region led to devastating floods that affected over four million people, severely impacting a number of countries in West Africa. In Nigeria, floods in Maiduguri, the capital of Borno State, resulted in at least 230 deaths and displaced approximately

600 000 people. Niger and Chad also experienced significant flooding, leading to widespread displacement and loss of life. During March–April, an unprecedented heatwave swept across the Sahel, with temperatures reaching record highs. The impacts of this heatwave illustrate the increasing vulnerability of the Sahel region to rising temperatures. Extreme weather events have a direct impact on children and can lead to significant educational disruptions. A United Nations Children's Fund (UNICEF) report[8] indicated that at least 242 million children worldwide missed school due to such events in 2024, with a substantial number from sub-Saharan Africa.

North Africa

North Africa experienced several notable extreme weather and climate events. Unprecedented heavy rainfall in September 2024 led to severe flooding in various parts of Morocco. In Tata province, 18 fatalities were reported, and villages in the Anti-Atlas mountains suffered significant damage, including the destruction of infrastructure such as roads, wells and electrical networks. Rainfall amounts in some areas exceeded annual averages within a short period. In September/October, the Sahara region witnessed its first significant floods in half a century (see Figure 6). In Tagounite, Morocco, about 170 mm of rain fell within 24 hours, leading to the filling of Lake Iriqui, which had been dry for 50 years. Extreme heat events occurred in several North African countries, including Egypt and Algeria, and have become a common phenomenon in the region. In July, a heat dome[9] phenomenon caused record-breaking temperatures across North Africa.

South-west Indian Ocean region

The South-west Indian Ocean region experienced significant extreme weather events in 2024, notably Tropical Cyclones *Belal* (January), *Gamane* (March) and *Chido* (December), as well as a number of severe tropical storms accompanied by heavy rainfall and flooding. In 2024, 13 tropical systems reached at least tropical-storm status in this region. Nine of these were classified as tropical cyclones (TCs), including four classified as intense TCs. Nine of the 13 systems also had direct impacts on inhabited lands, including in Tanzania, a country which is usually only indirectly affected by these systems. For the first time in the satellite era, two tropical cyclones, *Hidaya* and *Ialy*, developed in May. They moved over the far north-western part of the basin near Tanzania and Kenya, over a region rarely frequented by mature tropical systems. Tropical Cyclone *Ialy* became the northernmost tropical cyclone observed since the beginning of the satellite era.

Tropical Cyclone *Belal* made landfall in La Réunion and also impacted Mauritius, leading to loss of life, flooding and infrastructure damage on both islands. Tropical Cyclone *Gamane* rapidly developed near Madagascar and made landfall over the north-eastern part of the country, near the city of Vohemar, only 36 hours after becoming a tropical storm. The loss of life and damages attributed to *Gamane* were mainly due to heavy rainfall. Tropical Cyclone *Chido* was associated with heavy rainfall and violent winds and had devastating effects as it made landfall on Mayotte, France (as the most powerful storm to impact the island in 90 years), then Cabo Delgado province in Mozambique and subsequently Malawi. Tens of thousands of people were affected; many were left homeless and without access to drinkable water.

These events underscore the increasing vulnerability of African nations to climate-induced disasters and highlight the urgent need for adaptive strategies and resilience-building measures across the continent.

SPATIAL PATTERNS OF EXTREME PRECIPITATION AND DROUGHT

There was unprecedented rainfall across large parts of the Sahel region in 2024 (Figure 9(a)). In August, some areas of the Sahara Desert received more than five times their annual average rainfall within that month alone. This extraordinary precipitation led to floods that damaged infrastructure and filled typically dry lakebeds. The floods were catastrophic in a number of countries, including Sudan, Nigeria, Niger, Chad and Cameroon, resulting in fatalities and displacing millions.

The drought severity anomalies depicted in Figure 9(b) show that the areas most severely affected by drought were in Southern Africa and parts of Central Africa, where widespread crop failures threatened food security for millions of people and posed severe humanitarian and environmental challenges. Droughts led to critically low water levels in Lake Kariba, the world's largest man-made lake, resulting in significant electricity shortages in Zambia and Zimbabwe. Hydroelectric power generation was drastically reduced, causing prolonged power outages and economic disruptions.

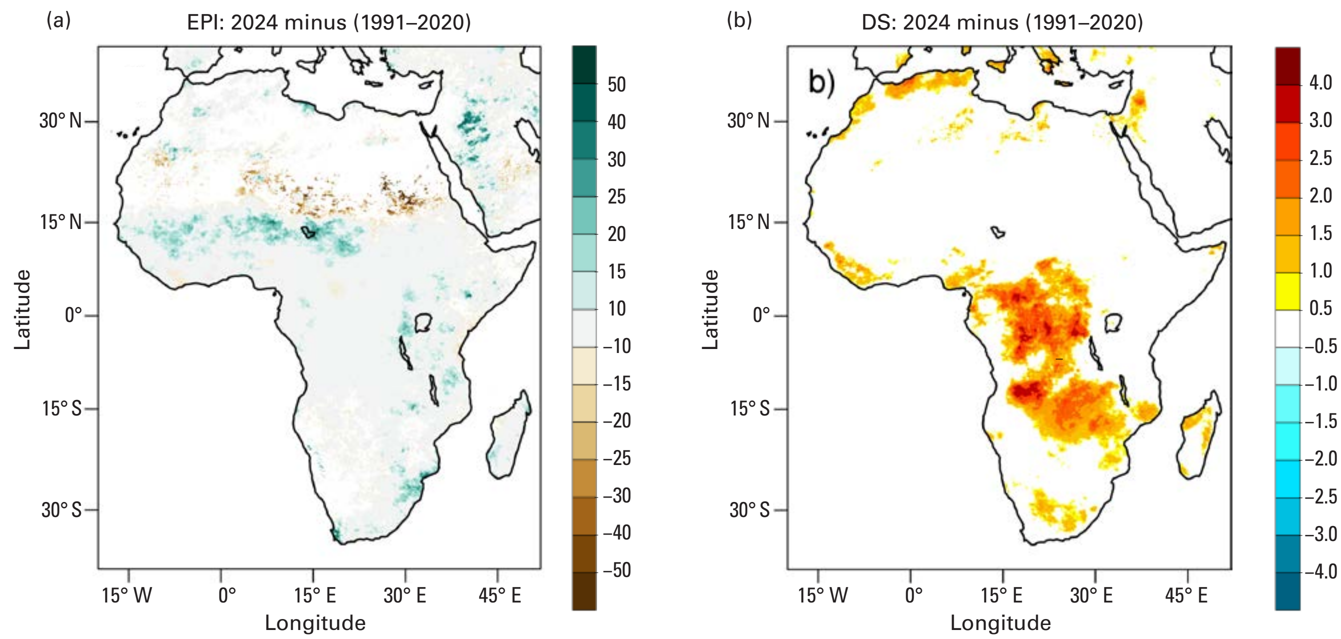


Figure 9. Spatial distribution of (a) anomalies of extreme precipitation intensity (EPI) for 2024 with respect to the reference period 1991–2020 based on the total precipitation from very wet days (R95PTOT) index applied to the Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) dataset and (b) anomalies of drought severity (DS) for 2024 with respect to the reference period 1991–2020 based on the 12-month Standardized Precipitation Index (SPI12) applied to CHIRPS.[a] Drought severity is calculated as the absolute value of the sum of all SPI12 values lower than –1 for December.

[a] https://opendata.dwd.de/climate_environment/GPCC/html/fulldata-monthly_v2020_doi_download.html

MARINE HEATWAVES

Marine heatwaves (MHWs) are prolonged periods of extreme heat that affect the ocean and have a range of consequences for marine life and dependent communities.

As the Earth has warmed over the past few decades, the frequency, duration and intensity of MHWs have increased, particularly in the strong and extreme marine heatwave categories.[10, 11, 12] MHWs influence regional climate and often have substantial impacts on the marine environment. They are known to interact with and intensify tropical cyclones, making them more destructive and therefore a serious threat to many socioeconomic activities in Africa.[13, 14]

Almost the entire ocean area around the African continent was affected by MHWs of strong, severe or extreme intensity during 2024 (Figure 10, left); this was particularly the case in the tropical Atlantic, where the heatwaves are the most intense. From January to April 2024, nearly 30 000 000 km^2 of the region's ocean was affected by MHWs, with the affected area decreasing by about half in the latter six months of the year (Figure 10, right, upper panel). The total area affected by MHWs around the African continent in 2024 was the largest since the start of the record in 1993, exceeding the previous record set in 2023 (Figure 10, bottom, lower panel).

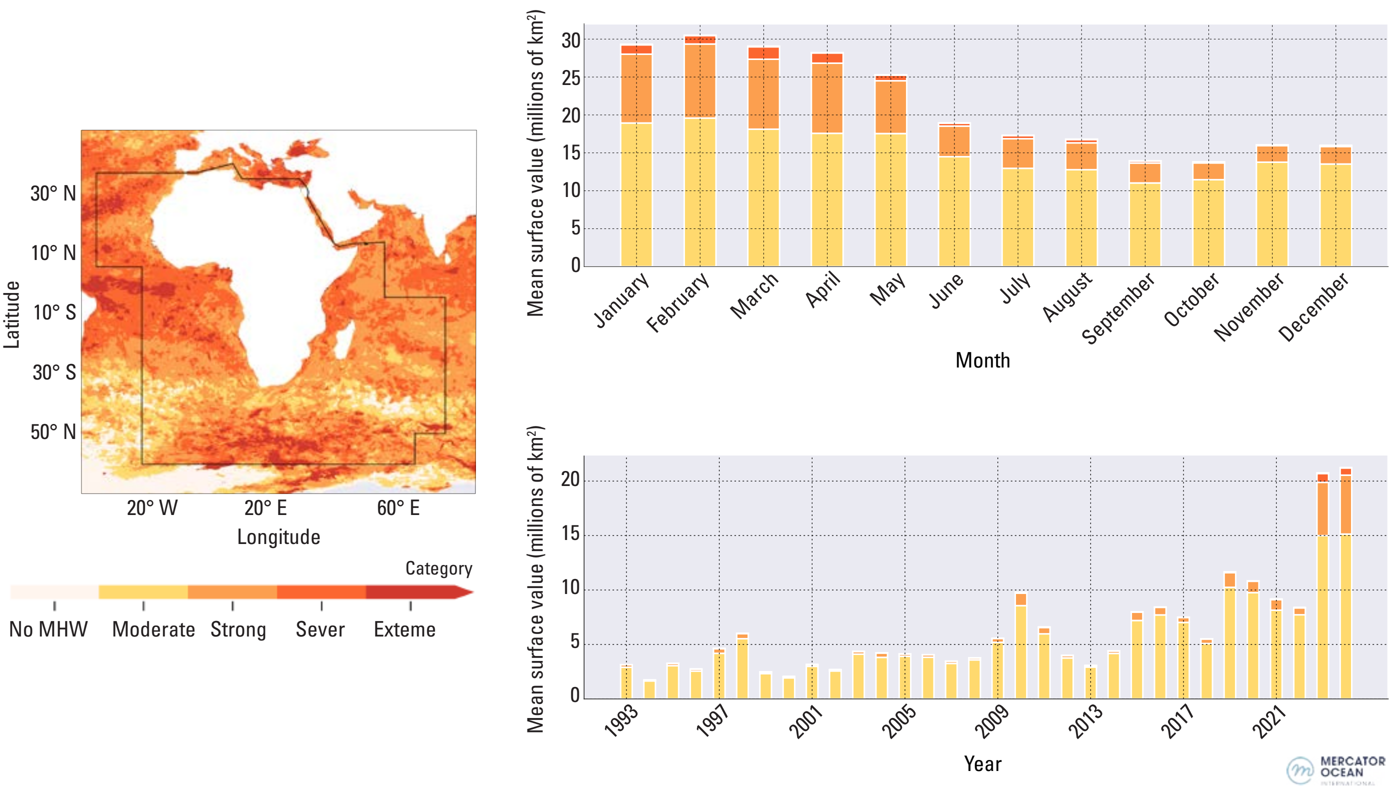


Figure 10. Left: Map of MHWs by category for 2024 for WMO Region I Africa (black line) from Copernicus Marine Service. Right: Monthly mean surface area covered by MHWs during 2024 (upper panel), and annual mean surface area covered by MHWs over the entire record (lower panel). The categories are indicated by the colours in the bar at the bottom of the left panel.

Major climate drivers

There are many modes of natural variability in the climate system, often referred to as climate patterns or climate modes, which affect weather and climate at timescales ranging from days to months, or even decades. The El Niño–Southern Oscillation (ENSO) phases (El Niño and La Niña) and the SST anomaly patterns in the tropical Atlantic Ocean and the Indian Ocean usually constitute the main drivers of rainfall variability in Africa. El Niño conditions continued from 2023 until the second quarter of 2024, after which neutral-to-weak La Niña conditions prevailed until the end of the year (Figure 11(a)). The Tropical North Atlantic (TNA) index was in a positive phase throughout 2024, indicating positive SST anomalies in the eastern parts of the tropical North Atlantic Ocean (Figure 11(b)). The Tropical South Atlantic (TSA) index was also in a positive phase for the first half of 2024, indicating positive SST anomalies in the eastern parts of the tropical South Atlantic Ocean. It then moved into a less positive phase, indicating weaker positive SSTs for the rest of the year (Figure 11(c)). An unstable weak positive phase characterized the South-western Indian Ocean Index (SWIO) at the beginning of 2024. This later developed into a moderate positive phase, though one that was weak at times (September–October) (Figure 11(d)). The Indian Ocean Dipole Mode Index (DMI) began with a positive phase, increasing the likelihood of above-average rainfall in East Africa. It then alternated between negative and positive phases between June and September. In the last quarter of the year, it entered a negative phase (Figure 11(e)). These contrasting variations of the regional indices characterized the climate impacts, especially the drought in Southern Africa, leading to states of emergency in Zambia and Malawi.

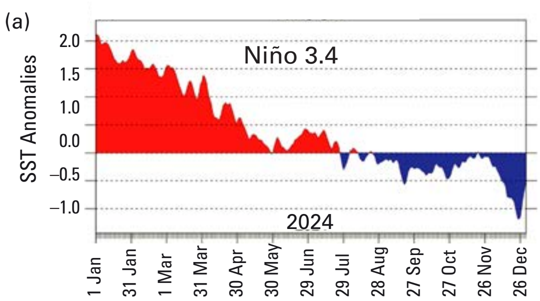
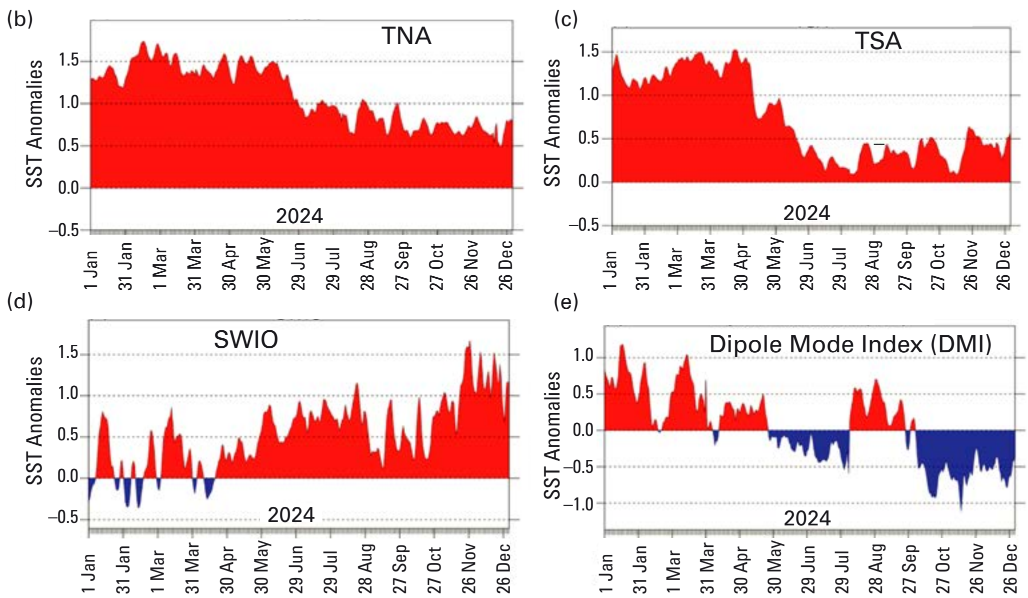


Figure 11. Time series of climate indices for 2023 and 2024: (a) Niño 3.4 index [SST anomalies averaged over 5°S–5°N; 170°W–120°W]; (b) TNA index [SST anomalies averaged over 5.5°N–23.5°N; 15°W–57.5°W]; (c) TSA index [SST anomalies averaged over 0–20°S; 10°E–30°W]; (d) SWIO index [SST anomalies averaged over 32°S–25°S; 31°E– 45°E]; (e) Indian Ocean DMI – the difference between the SST anomalies over the tropical western Indian Ocean [10°S–10°N; 50°E–70°E] and the tropical eastern Indian Ocean [10°S– 0; 90°E–110°E]. Anomalies are deviations from the 1991–2020 mean.

Source: https://psl.noaa.gov/data/gridded/data.noaa.oisst.v2.highres.html



Climate-related impacts and risks

The year 2024 was either the warmest or the second-warmest year on record for Africa, depending on the dataset used, and the impacts of extreme weather and climate events were notable across the continent. In Southern Africa, rainfall was significantly below average from the beginning of the year, which led to widespread drought conditions that adversely affected agriculture and water resources. The Horn of Africa also faced drought conditions in some areas, although severe flooding occurred in Kenya and Tanzania. Extreme heat events were especially intense in North Africa.

CLIMATE-RELATED IMPACTS ON AGRICULTURE AND FOOD SECURITY

North Africa experienced its third consecutive below-average cereal harvest in 2024 due to widespread rainfall shortages and extremely high temperatures. As a result, subregional cereal production for the year was estimated to be about 7% below the five-year average (2019–2023). In Morocco, for example, six consecutive years of drought have had a significant impact on agricultural production, which was estimated to be 42% lower in 2024 than the five-year average.[15]

Cereal outputs in most West African countries were forecast to be at above-average levels in 2024. However, rainfall deficits between July and September were expected to reduce yields in northern Côte d'Ivoire, Benin, Ghana and Togo, likely resulting in localized production shortfalls.[16] Flooding affected over 4 million people in West Africa, with devastating impacts in Mali, where floods in July and August resulted in the destruction of about 500 000 ha of cropland. In northern Mali, acute food insecurity reached catastrophic levels for segments of the population due to violence and severe restrictions to food access.[17]

Conversely, in East African countries, the lingering impact of the prolonged and severe drought due to La Niña between late 2020 and early 2023 was still evident in the first quarter of 2024 in Kenya, Uganda, Somalia, Djibouti and Ethiopia. The rains during the March to May period boosted crop yields, although total maize yields remained 5% to 10% below the five-year average.[18] In Kenya, floods led to more than 30 000 livestock deaths and destroyed 170 000 ha of cropland.[19] The extremely high prices of maize (the staple food), which had prevailed in Kenya since 2022, started to decline during 2024 as local maize supplies increased. However, this relief is likely to be short-lived due to scarcity following the poor October–December 2024 rainfall, which was insufficient to sustain rain-fed agriculture. In Sudan, cereal production was forecast to decline by 35% in 2024, driven by the prolonged conflict that severely disrupted agricultural operations and further aggravated food insecurity across the country, where 21.1 million people were at the "crisis" food insecurity level, 6.4 million people were at the "emergency" food insecurity level and 0.1 million people were at the "famine" food insecurity level.[20]

In Southern Africa, El Niño-driven drought sharply reduced the 2024 cereal harvest in most of the region. The aggregate cereal yields were 16% below the five-year average. The most affected countries were Zambia and Zimbabwe (43% and 50% below the five-year average, respectively).[21] Malawi and Mozambique were less affected by drought, though production declines of 17% and 12%, respectively, were forecast for 2024. Significantly below-average harvests were also anticipated in South Africa, Botswana, Eswatini, Lesotho and Namibia. In Madagascar, cyclones caused localized floods, resulting in crop loss and infrastructure damage. However, the overall agricultural production prospects at the national level were generally favourable in 2024.

An overview of the state of climate services in Africa can be accessed here:
https://wmo.int/publication-series/state-of-climate-africa-2024.

Climate policy and strategic perspectives

FINANCIAL RESOURCE CHALLENGES CONTINUE TO HAMPER PROGRESS IN CLIMATE ADAPTATION IN AFRICA

The costs associated with climate change in African countries can reach up to 5% of their gross domestic product (GDP), significantly hindering their development efforts and their ability to alleviate poverty across the continent.[22] Despite an increase in international adaptation finance to developing countries from 22 billion US dollars (US$) in 2021 to US$28 billion in 2022, the funding remains far below the estimated annual need of US$187 billion to US$ 359 billion.[23] Although over 40 African countries have finalized or are in the process of developing their National Adaptation Plans (NAPs), the quality and effectiveness of the implementation of these plans vary greatly among countries.[24] As climate change impacts intensify, raising awareness of effective adaptation strategies, strengthening policy frameworks and advancing innovative technological solutions will be crucial in building societal, economic and ecological resilience in Africa.

DIGITAL TRANSFORMATION TO ENHANCE DATA COLLECTION AND SERVICE DELIVERY IN AFRICA

In light of the growing impacts of climate change and weather and climate extremes, digital transformation is critical to enhancing the scope and precision of weather data and to improving lead times in service delivery. NMHSs can significantly improve their ability to monitor and predict highly localized weather hazards by making use of the latest advances in numerical weather prediction (NWP) models and artificial intelligence (AI). Mobile applications, cell broadcast, SMS alerts, community radio systems and other communication platforms can further help NMHSs reach last-mile communities with improved forecasts in a timely manner.

There is an increasing awareness of the benefits of using digital platforms in many countries in Africa to improve weather forecasting and early warnings. For example, the Nigeria Meteorological Agency has embraced digital platforms to disseminate vital agricultural advisories and climate information. Similarly, the Kenya Meteorological Department provides weather forecasts to farmers and fishers through mobile applications and SMS messages. The South African Weather Service has also integrated AI-based forecasting tools and modern radar systems for effective and timely weather predictions. While these efforts represent important steps towards the digital transformation of weather and climate services, much more is needed to integrate these digital technologies into operational systems throughout the continent, including:

- Increased investment in digital infrastructure and capacity-building: Adequate funding needs to be provided to deploy digital technologies and support related capacity-building in order to collect hydrometeorological data in real time, especially over remote areas.

- Stronger data stewardship and sharing frameworks: National and regional weather, water, and climate services frameworks need to enhance coordination among NMHSs, the private sector and local communities to address cross-border climate data sharing. Digital transformation using advanced data collection and on-cloud platforms can enable cross-border collaboration, access to real-time climate data for better precision in forecasts, and appropriate responses to eventual disasters.

- Improved equitable access and inclusive service: Digital transformation at NMHSs and sector application agencies can greatly enhance their e-service delivery to vulnerable groups by providing equal access to critical climate information. In this regard, the use of mobile apps, SMS alerts, community radio systems and other digital communication platforms can be helpful in delivering climate information and early warnings to last mile communities.

Digital transformation has been identified as a regional priority for Africa in the coming years. In a complementary effort in 2024, 18 NMHSs across the continent upgraded their websites and digital communication systems to enhance the reach and impact of their services, products and warnings. These new websites feature functionalities that improve warning communications, product and data interactivity, user engagement and overall public service delivery. In addition, support from WMO is aiding these NMHSs in their efforts to leverage social media platforms. These channels are crucial for effectively reaching populations and intermediary organizations in Africa. Some of the countries already supported include Togo, Benin, Mali, Burkina Faso, Malawi, Sudan, South Sudan, Niger, Seychelles, Burundi and Chad.

Datasets and methods

A description of the data and methods used for this report can be accessed here:

https://wmo.int/publication-series/state-of-climate-africa-2024.

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Endnotes

1. Data are from the following datasets: Berkeley Earth, ERA5, GISTEMP v4, HadCRUT.5.0.2.0, JRA-3Q and NOAAGlobalTemp v6.

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