South African Weather Service

Annual State of the Climate of South Africa 2024

South African Weather Service
Private Bag X097
Pretoria
0001

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South African Weather Service

Executive Summary

Global Perspective from the WMO State of the Global Climate 2024

- Greenhouse gases: Concentrations of the three main greenhouse gases – carbon dioxide, methane and nitrous oxide – reached record-high observed levels in 2023, the latest year for which consolidated global values are available (1984-2023). Real-time data from specific locations show that levels of the three greenhouse gases continued to increase in 2024 (see section on greenhouse gases for a local perspective).
- The annually averaged global mean near-surface temperature in 2024 was 1.55 ± 0.13 °C above the 1850-1900 average used to represent pre-industrial conditions. 2024 was the warmest year in the 175-year observational record, clearly surpassing the previous warmest year, 2023 at 1.45 ± 0.12 °C above the 1850–1900 average.
- In 2024, ocean heat content reached its highest level in the 65-year observational record, exceeding the previous record high set in 2023.
- In 2024, global mean sea level reached a record high in the satellite record (from 1993 to present).
- Acidification of the ocean surface has continued over the past 39 years as shown by the steady decrease of global average ocean surface pH.
- The past three years (2022-2024) represent the most negative three-year mass balance on record, and 7 of the 10 most negative mass balance years since 1950 have occurred since 2016.
- The minimum daily extent of Arctic sea-ice in 2024 was the 7th lowest in the observed record from 1979.
- Extreme weather events in 2024 led to the highest number of new displacements recorded per year since 2008 along with new, onward and protracted displacement of significant numbers of people across the globe.

Please see State of the Global Climate 2024 (https://wmo.int/publication-series/state-of-global-climate-2024) for the complete publication.

South Africa

Surface Temperature

In line with the global temperatures, South Africa experienced a new record warm year. Very hot conditions were experienced mainly in the central and northern interior. In the south, however, temperatures were closer to normal. The annual mean temperature anomaly for 2024, based on the data of 26 climate stations, was on average about 0.9 ºC above the average of the reference period (1991-2020), making it approximately the hottest year on record since 1951.

Precipitation

The most significant feature of the rainfall during 2024 was the near-normal rainfall amounts received over most of South Africa. The major exception is the north-western to central interior which received well below-normal rainfall, with some places experiencing extremely dry conditions.

Noteworthy climate and weather events

In South Africa, the year started off with relatively wetter conditions in the central and eastern parts of South Africa, but very dry in the west. Several significant adverse weather events in the east caused incidents of flooding, with displacement of many people and extensive damage to infrastructure. The rainfall distribution was reflected in the surface temperatures with normal to below-normal temperatures in the central and eastern parts and 2-3°C above normal in the west. February and March were mostly dry, with maximum temperatures over the central parts 3-4°C above normal. However, on 13 March heavy rain affected parts of Zululand region in KwaZulu-Natal on the 13th with reports of flooded and damaged low-lying bridges and roads as well as fatal accidents, after tropical storm Filipo made landfall in Mozambique. In April the rainfall situation changed considerably, with the central and southern parts receiving more than double the usual amounts for the month. These conditions were also accompanied by flooding, loss of life and damage to infrastructure, e.g. a storm in Margate on the East Coast on the 14th left five people dead when 250 mm of rain was recorded in 24 hours. May experienced dry condition in the western and central interior. Almost the whole country was abnormally hot, with maximum temperatures 3-4°C above normal. In June the south and central parts received in general more than 200% of normal rainfall. Seven people died and two were missing after heavy rains that resulted in high water levels and severe flooding in parts of Gqeberha and Kariega in the Eastern Cape on the 1st. Six people were killed. More than 1100 residents were evacuated to places of safety. In July the region of heavy rainfall shifted to the west. Infrastructure damage to homes, roads, power supply and schools were reported in neighbourhoods of the Western Cape on the 11th with residential roofs blown off in Wynberg, 217 schools reporting damage to infrastructure and at least 10000 households hit by power cuts. About 100 roads were closed on the 11th due to safety concerns. In contrast, the northern parts of the country experienced extremely hot conditions for winter, continuing to a somewhat lesser degree into August. From November to December large parts of the eastern half of South Africa was characterised with significantly above-normal temperatures. Many weather stations recorded their maximum temperatures for these months, with several heat warnings and heat waves issued.

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Most significant severe weather events per province

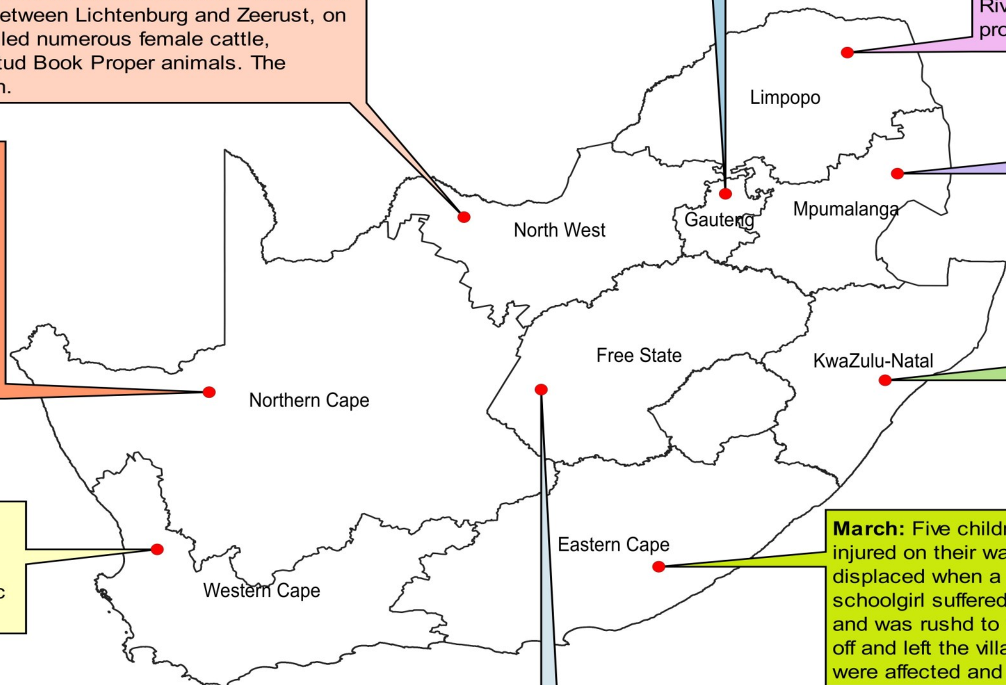
November: At least 24 people were injured and 620 homes destroyed when a tornado hit parts of Randfontein and Toekomsrus, west of Johannesburg on the 27th. The entire portion of Umphakathi Mall was cordoned and closed off, where the 24 injured people were rushed to different clinics after being hit by a collapsed ceiling, affecting a number of shops. Close to 400 homes were affected in Greenfield while 220 were destroyed in Toekomsrus, leaving people without shelter. Several cars were also destroyed.

November: A devastating lightning struck 53 female Bonsmara cattle in a 407-hectare farm, Eye of Malemani, between Lichtenburg and Zeerust, on the 9th after a severe thunderstorm killed numerous female cattle, including calves and four high-value Stud Book Proper animals. The estimated damage exceeds R1 million.

November: Two pupils drowned in the Ngwaritsi River in Ga Masemola after heavy rains hit the province on the 17th resulting in high dam levels.

July: Heavy rains led to flooding in Hantam, Kamiesberg, and Middelpos, on the 9th. Some residents around Hantam suffered severe damage to their properties and were relocated to temporary accommodation at Lenie Skippers Community Hall. Strong winds also caused damage to telecommunications infrastructure, affecting network coverage.

October: Three units of the Olifants Rest Camp in the Kruger National Park caught a spreading veld fire on the 14th. Guests lost their belongings and were relocated to other rest camps. The park was experiencing very hot and windy conditions.



January: Two farmworkers were struck and killed by lightning while working in Bergville on the 3rd, and 50 other workers on the same farm were injured.

June: The Drakenstein Municipality was worst hit by gale-force winds on the weekend of the 1st, leaving 30 houses with collapsed roofs and traffic lights not operating.

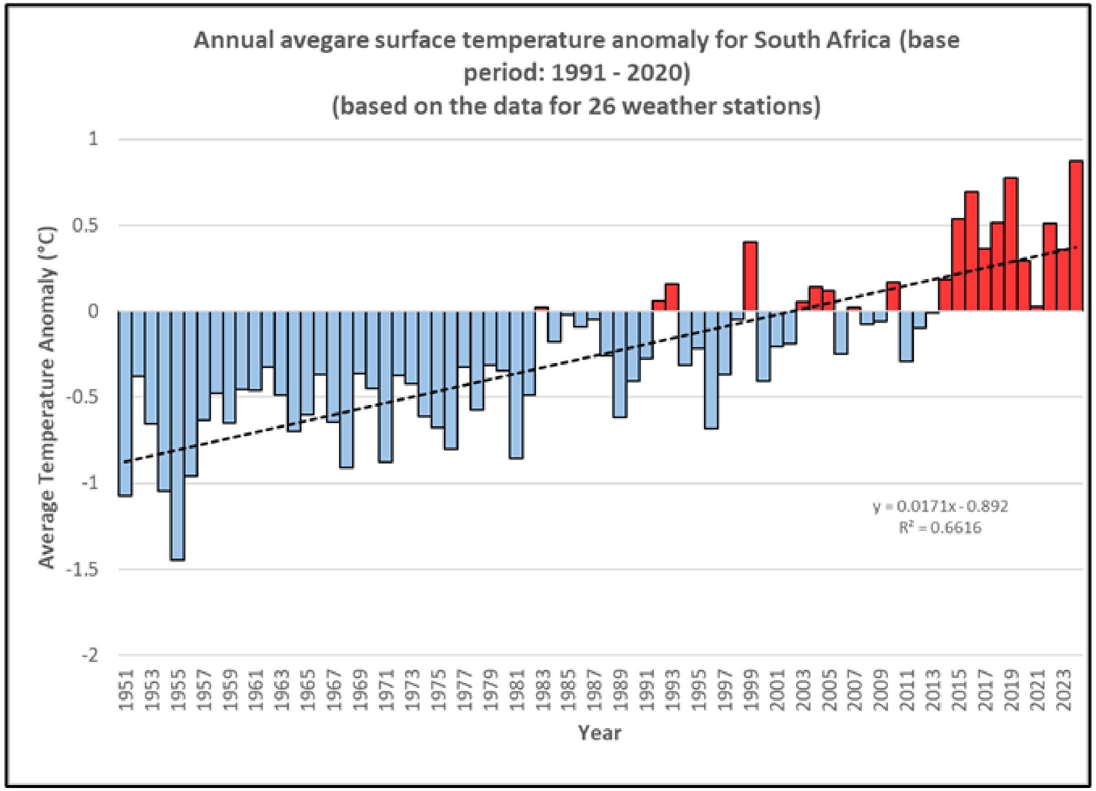
March: Five children from Thembeni village in Qonce were injured on their way from school by flying zinc sheets that were displaced when a violent storm hit the Thembeni on the 4th. One schoolgirl suffered a severe cut after being hit by the roof sheet and was rushd to the hospital. The strong winds ripped rooftops off and left the village without power for 2 days. About 13 houses were affected and left roofless.

September: One person died when thousands of people were stuck in heavy snow on the N3 highway between the Free State and KwaZulu-Natal for three days between the 20th and 22nd. Icy conditions, wet weather, and poor visibility were reported along other sections of the route, causing dangerous driving conditions between Free State and KwaZulu-Natal, as well as the southern parts of Mpumalanga and Gauteng. Traffic was stopped at the Harrismith South Interchange in the Free State and Tugela Plaza in KwaZulu-Natal.

National Climate Overview

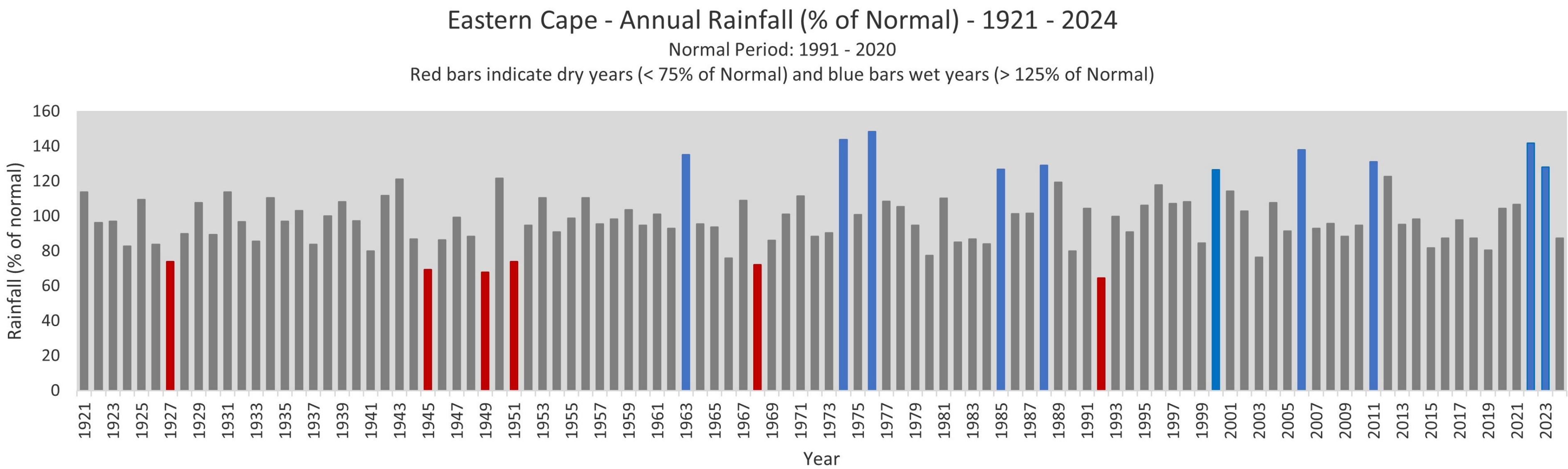
Average Surface Temperature

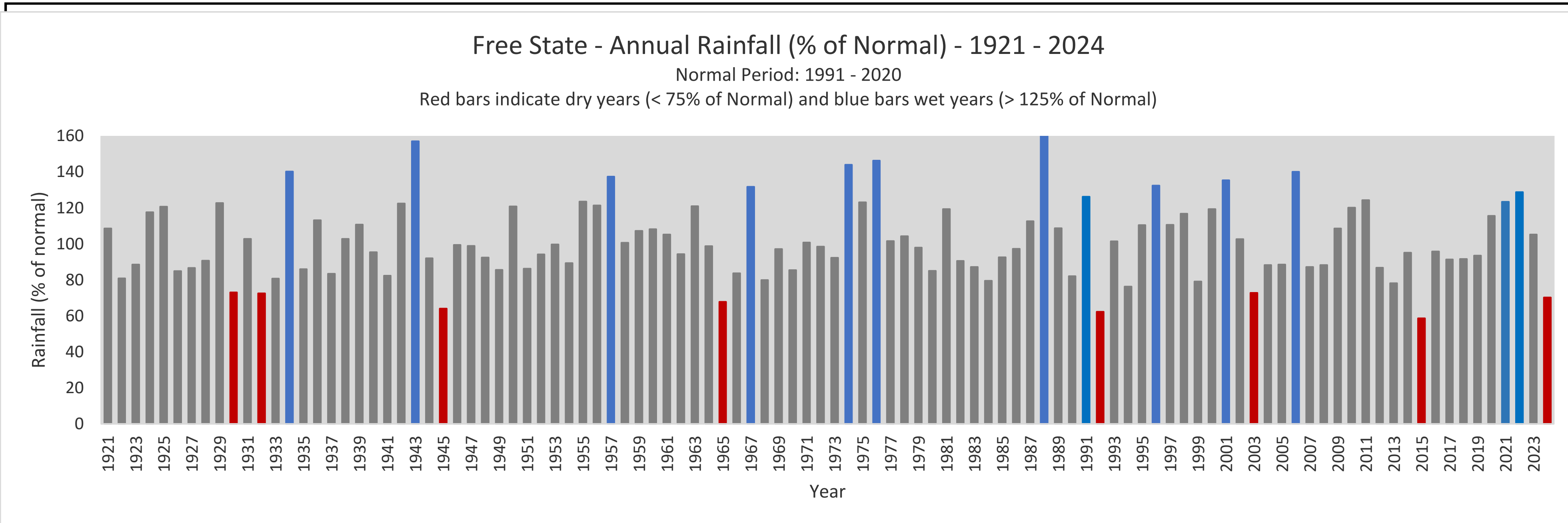
The annual mean temperature anomaly for 2024, based on the data of 26 climate stations, was on average about 0.9 ºC above the average of the reference period (1991-2020), making it approximately the hottest year on record since 1951. A warming trend of approximately 0.17 ºC per decade is indicated for the country, over the period 1951-2024, statistically significant at the 5% level.

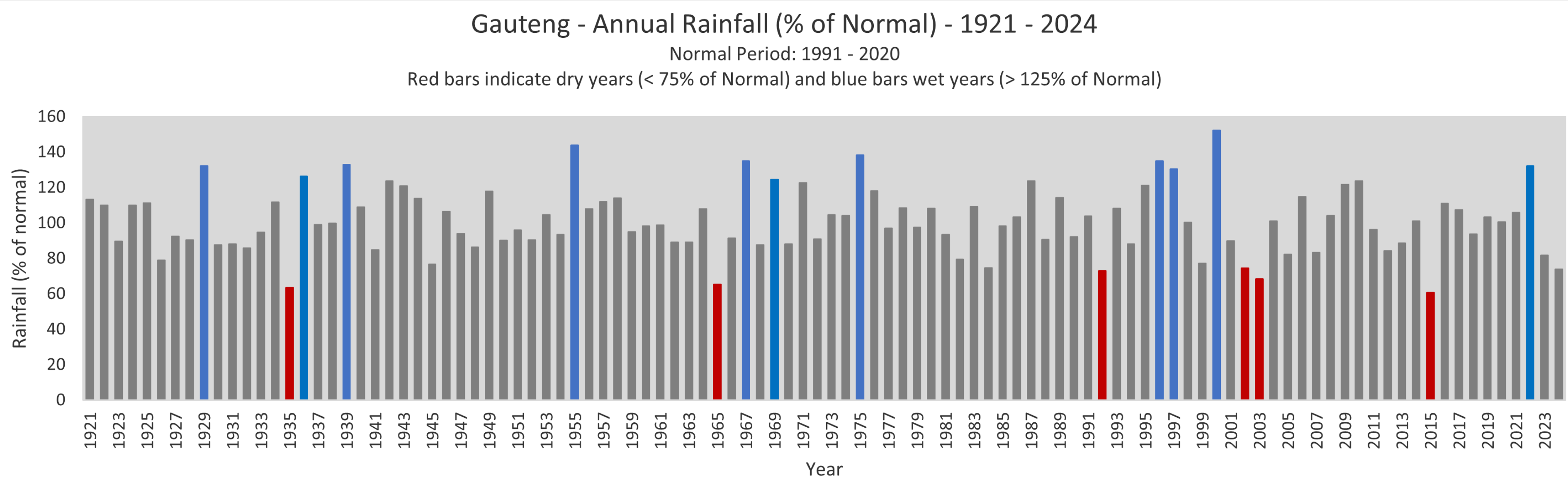


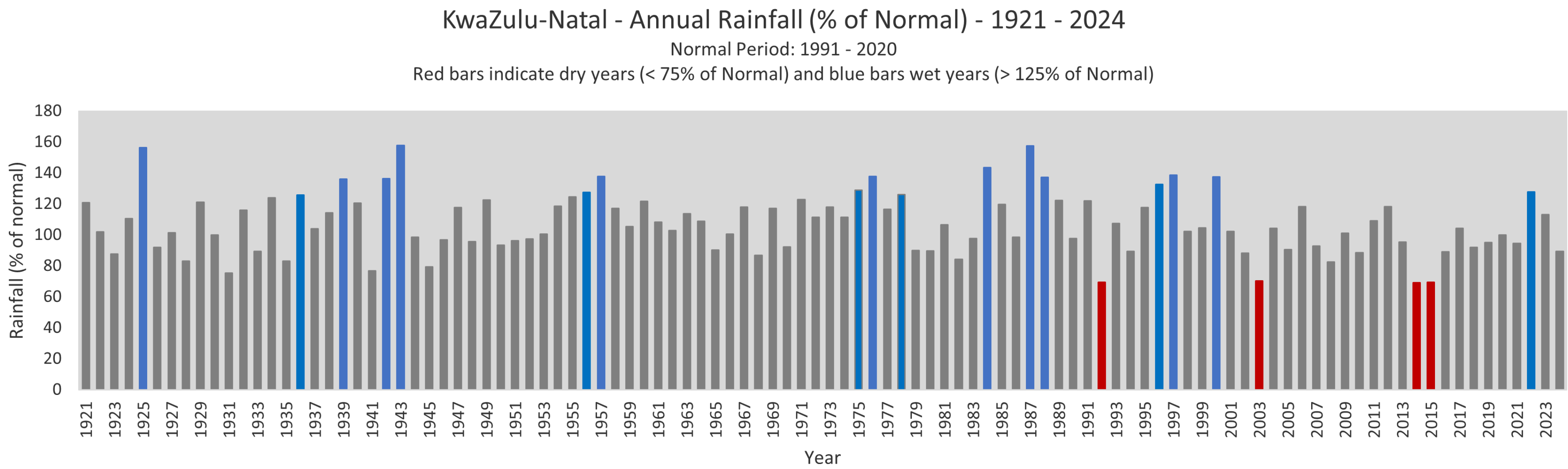
Provincial Rainfall

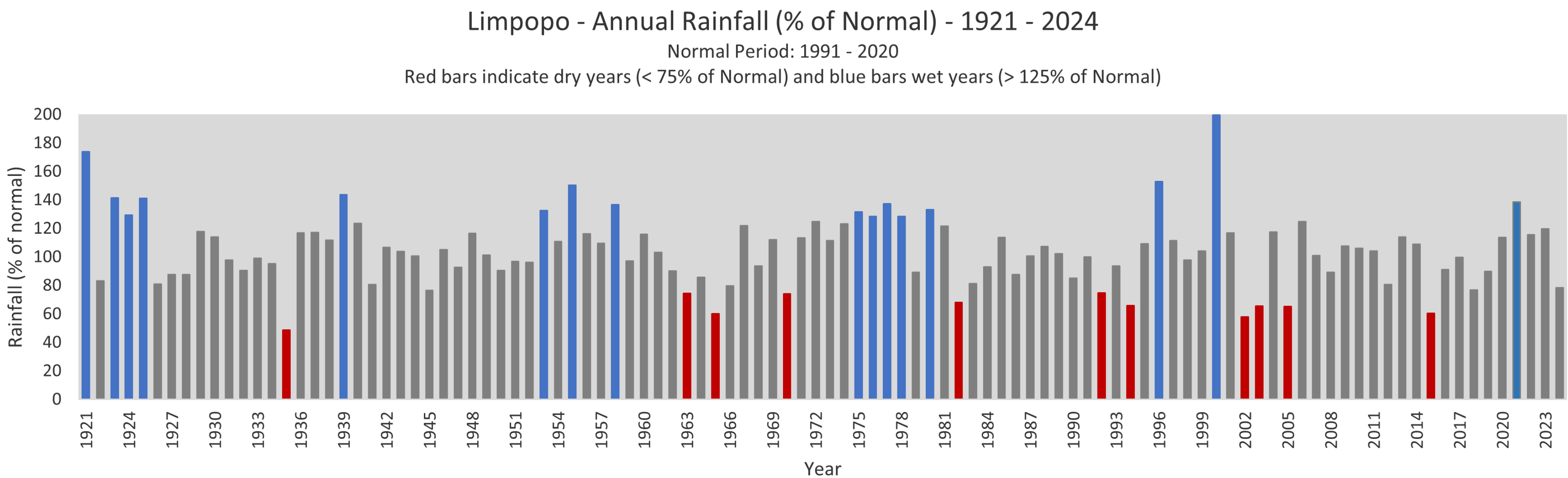
The provincial rainfall statistics are based on the average rainfall of the SAWS-developed homogeneous rainfall districts, that mostly falls within a particular province. This approach ensures a more even weighting of rainfall stations in the spatial rainfall estimations. South Africa received near-normal rainfall across most provinces, but dry in the Northern Cape and Free State.

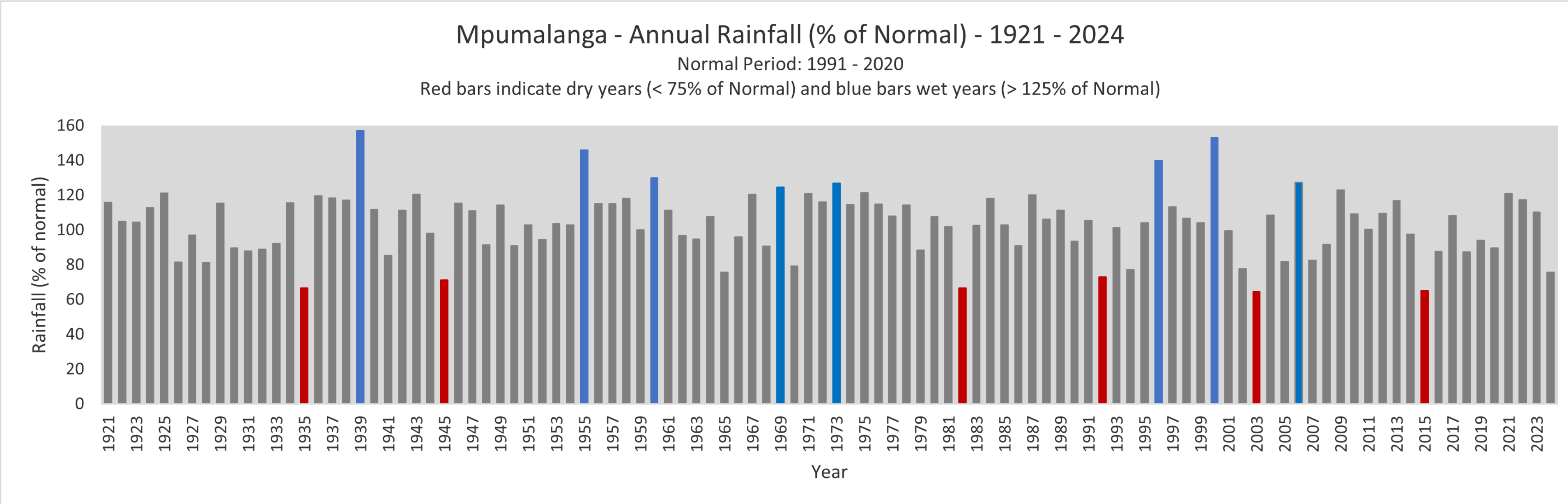



Free State - Annual Rainfall (% of Normal) - 1921 - 2024
Normal Period: 1991 - 2020
Red bars indicate dry years (< 75% of Normal) and blue bars wet years (> 125% of Normal)
Rainfall (% of normal)
Year

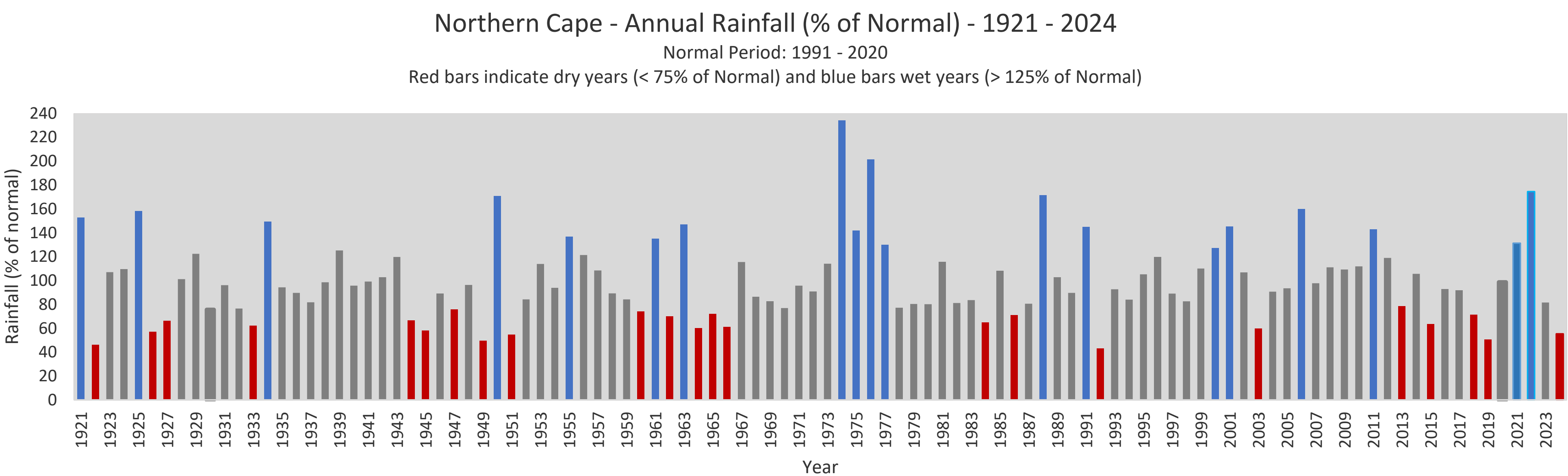

Gauteng - Annual Rainfall (% of Normal) - 1921 - 2024
Normal Period: 1991 - 2020
Red bars indicate dry years (< 75% of Normal) and blue bars wet years (> 125% of Normal)
Rainfall (% of normal)
Year


KwaZulu-Natal - Annual Rainfall (% of Normal) - 1921 - 2024
Normal Period: 1991 - 2020
Red bars indicate dry years (< 75% of Normal) and blue bars wet years (> 125% of Normal)
Rainfall (% of normal)
Year

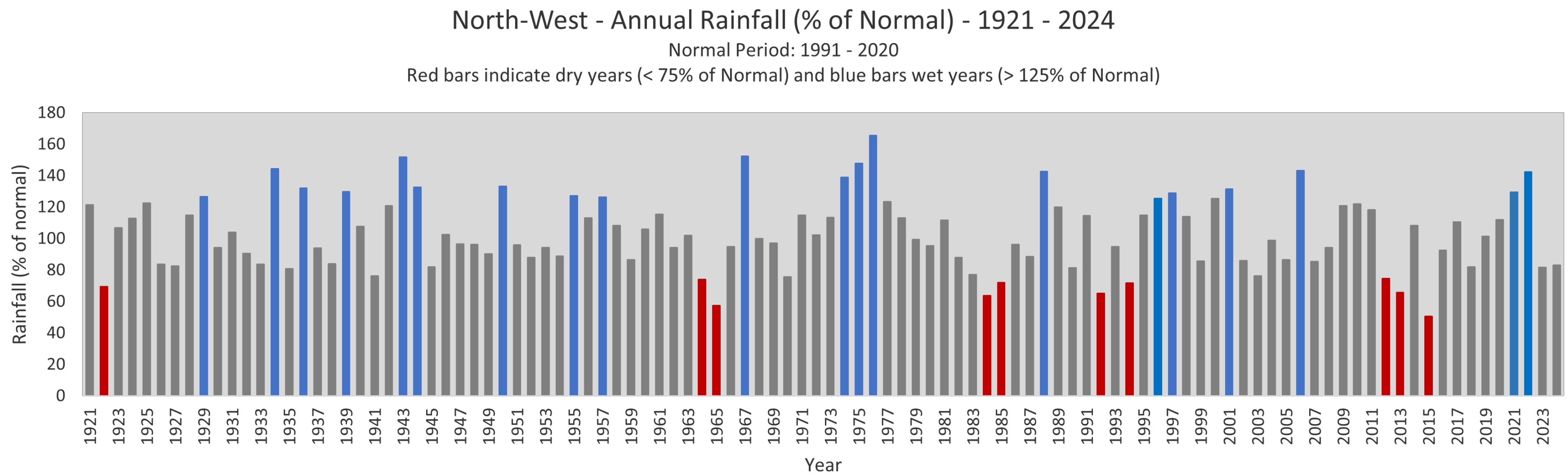

Limpopo - Annual Rainfall (% of Normal) - 1921 - 2024
Normal Period: 1991 - 2020
Red bars indicate dry years (< 75% of Normal) and blue bars wet years (> 125% of Normal)
Rainfall (% of normal)
Year

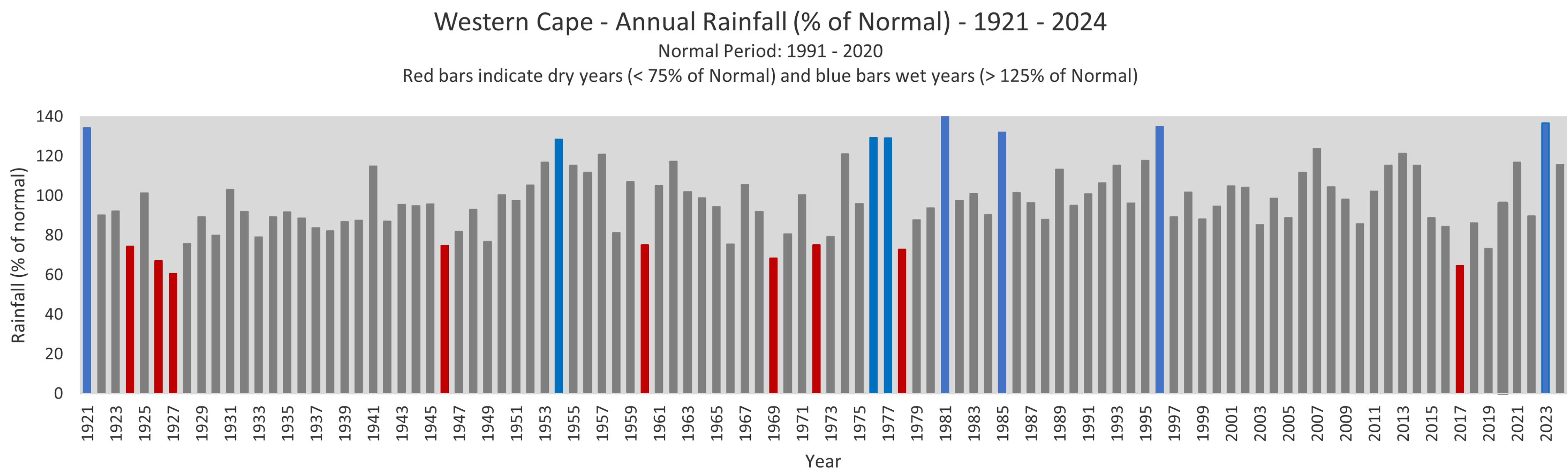


Mpumalanga - Annual Rainfall (% of Normal) - 1921 - 2024
Normal Period: 1991 - 2020
Red bars indicate dry years (< 75% of Normal) and blue bars wet years (> 125% of Normal)
Rainfall (% of normal)
Year



Northern Cape - Annual Rainfall (% of Normal) - 1921 - 2024
Normal Period: 1991 - 2020
Red bars indicate dry years (< 75% of Normal) and blue bars wet years (> 125% of Normal)
Rainfall (% of normal)
Year


North-West - Annual Rainfall (% of Normal) - 1921 - 2024
Normal Period: 1991 - 2020
Red bars indicate dry years (< 75% of Normal) and blue bars wet years (> 125% of Normal)
Rainfall (% of normal)
Year

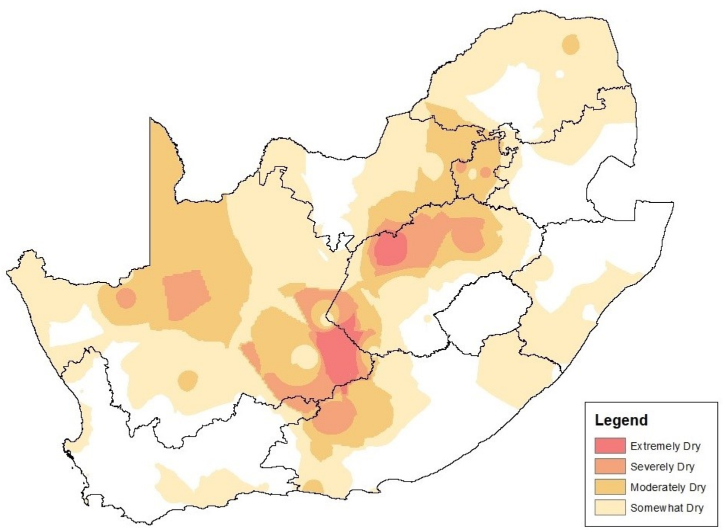

Western Cape - Annual Rainfall (% of Normal) - 1921 - 2024
Normal Period: 1991 - 2020
Red bars indicate dry years (< 75% of Normal) and blue bars wet years (> 125% of Normal)
Rainfall (% of normal)
Year

Indications of drought

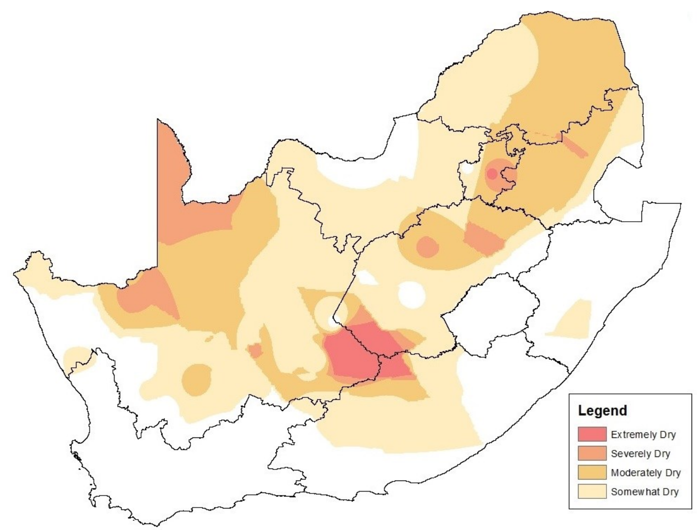
A meteorological drought is defined on the basis of the degree of dryness in comparison to “normal” or average amounts of rainfall for a particular area or place and the duration of the dry period.

The Standardized Precipitation Index (SPI) is an index based on the probability of rainfall for any time scale and can assist in assessing the severity of drought. Long-term drought usually occur when moisture supply is abnormally below average for periods of up to two years, where-after widespread desiccation occurs. A 12-month and 24-month SPI is a comparison of the precipitation for 12 and 24 consecutive months with the same 12 and 24 consecutive months during all the previous years of available data respectively. SPIs of these longer timescales are useful in identifying areas of long-term drought, as they are linked to streamflow, reservoir levels and even groundwater levels. The most noteworthy in the 24-month SPI map below are the moderately dry to extremely dry conditions in the Northern Cape, around the southern Free State and isolated parts in the north-eastern interior.

12-month SPI for January 2024 to December 2024



24-month SPI for January 2023 to December 2024



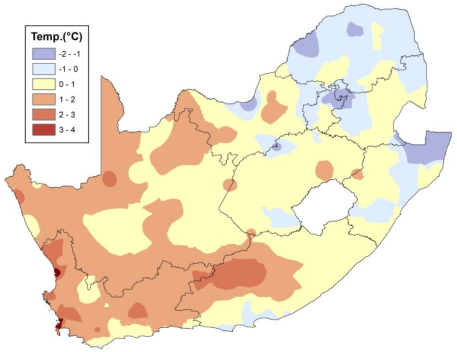
Monthly maps

Following are monthly maps for

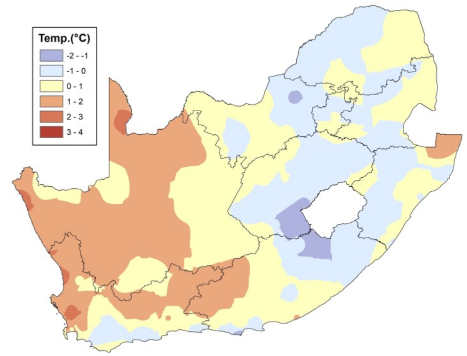
- Maximum temperature deviations from the 1991-2020 normal
- Minimum temperature deviations from the 1991-2020 normal
- Standardized Precipitation Index (SPI), indicating dry areas

January 2024

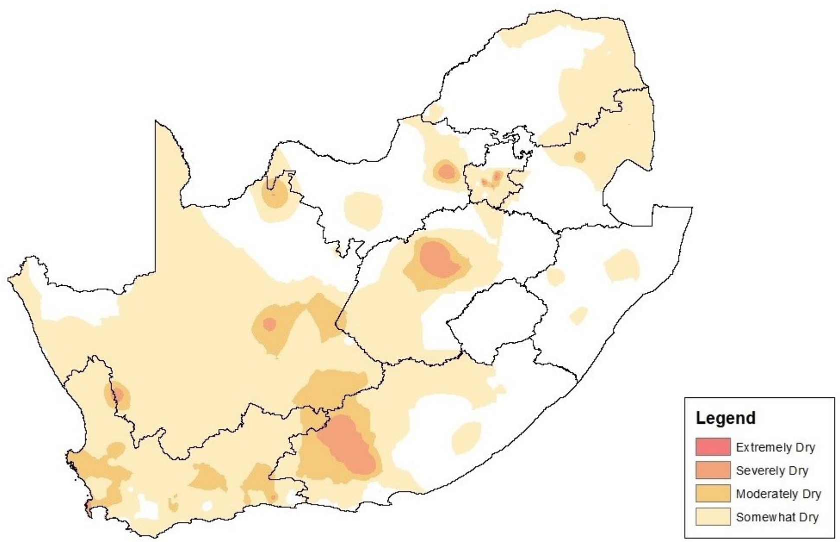
Maximum temperature deviations



Minimum temperature deviations

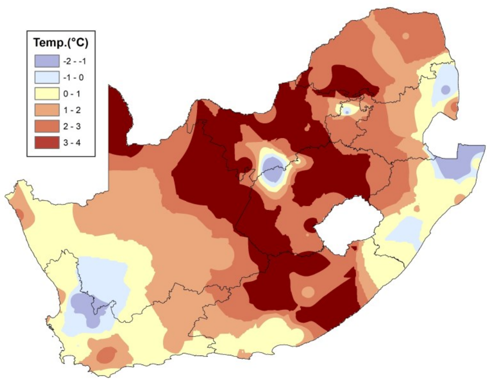


SPI

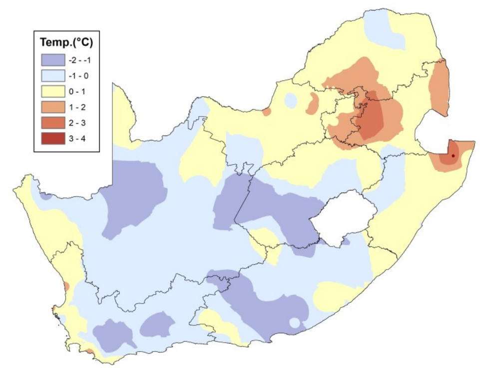


February 2024

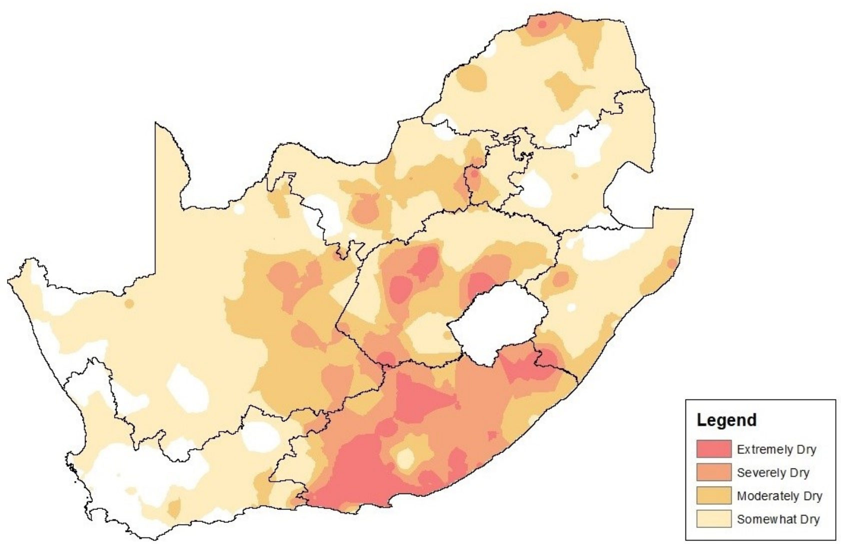
Maximum temperature deviations



Minimum temperature deviations

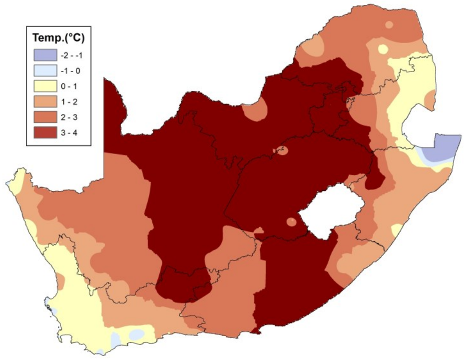


SPI

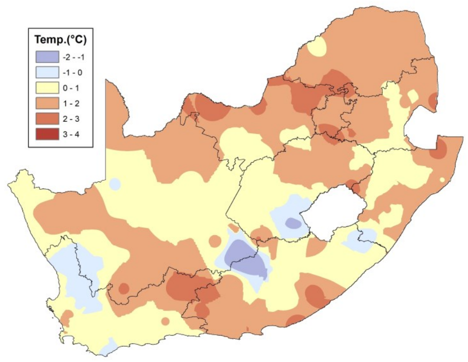


March 2024

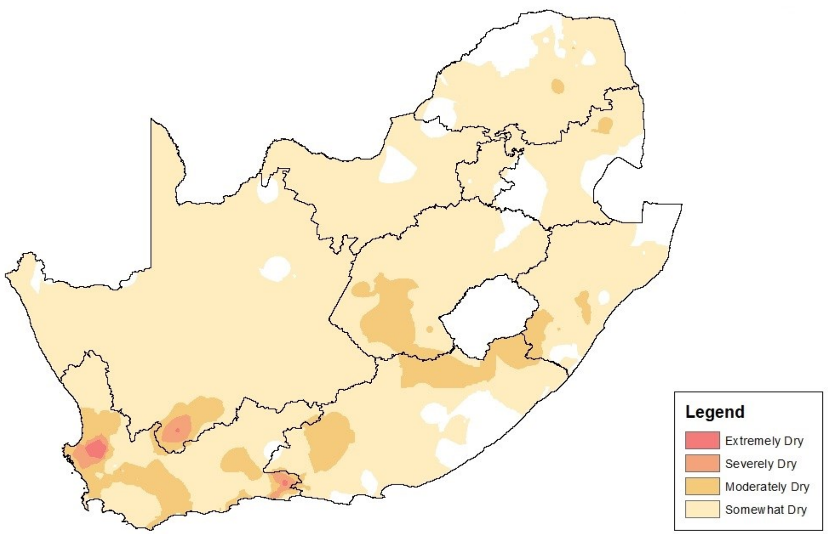
Maximum temperature deviations



Minimum temperature deviations

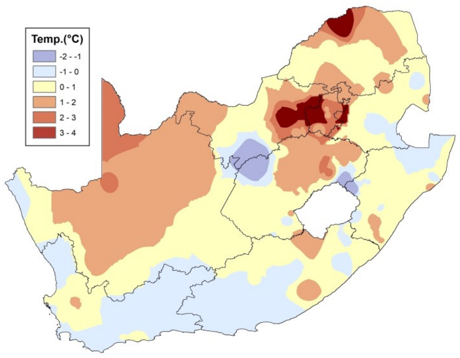


SPI

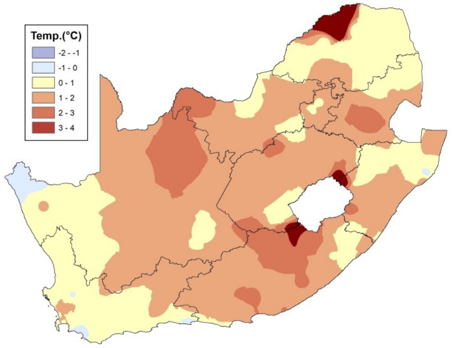


April 2024

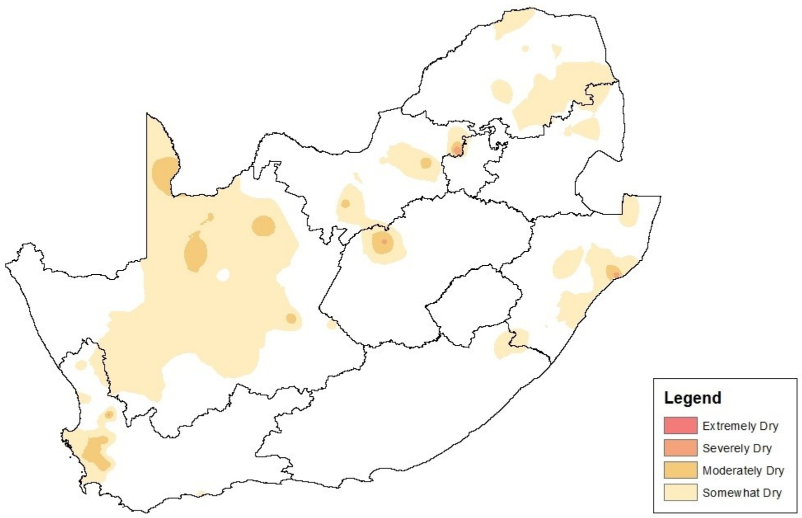
Maximum temperature deviations



Minimum temperature deviations

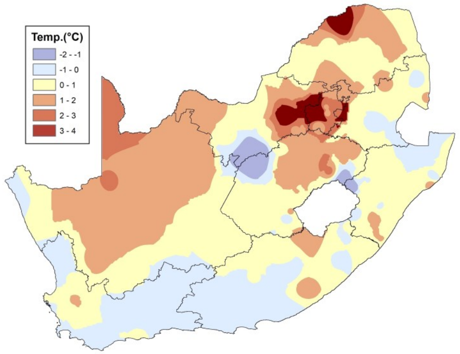


SPI

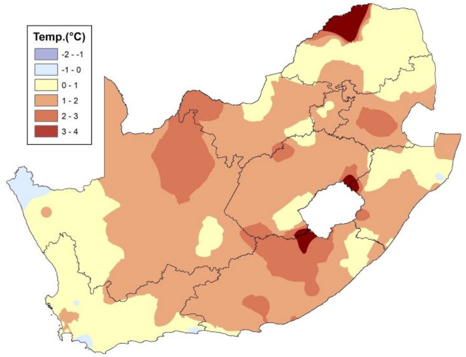


May 2024

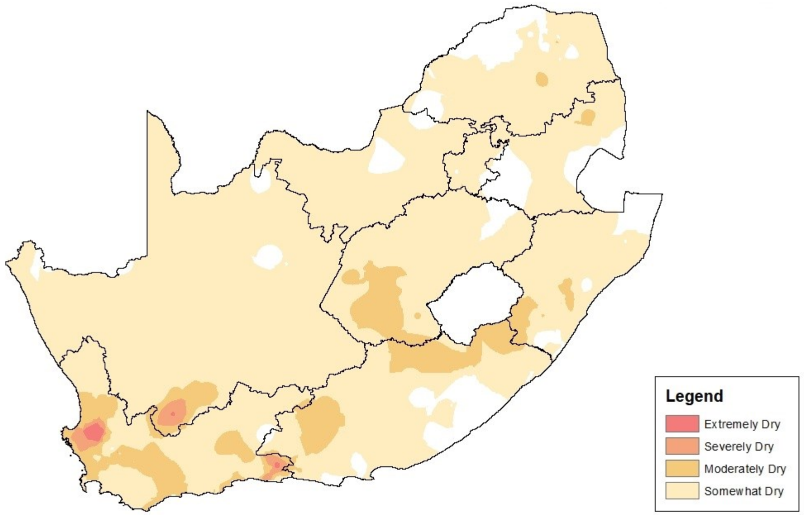
Maximum temperature deviations



Minimum temperature deviations

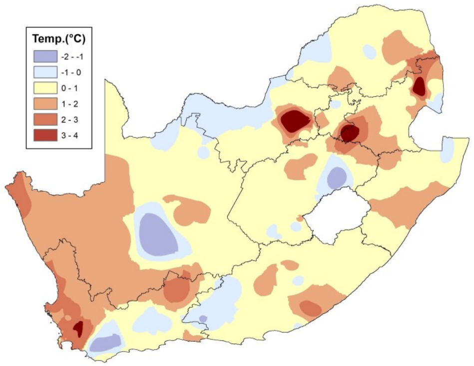


SPI

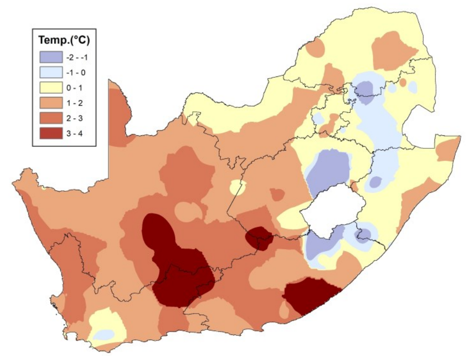


June 2024

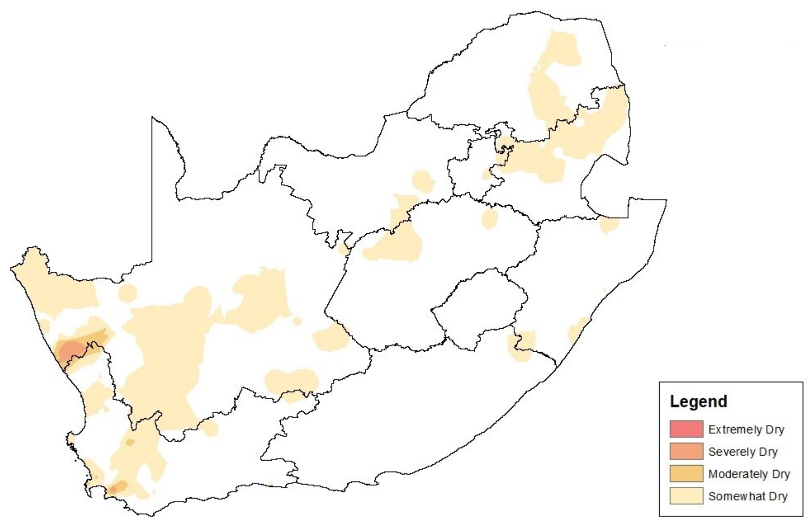
Maximum temperature deviations



Minimum temperature deviations

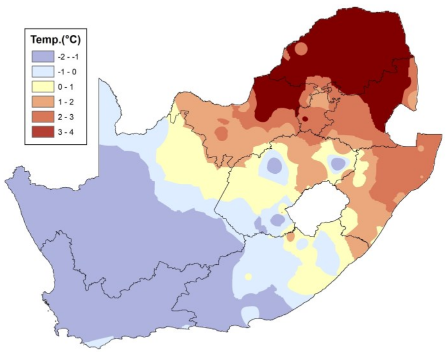


SPI

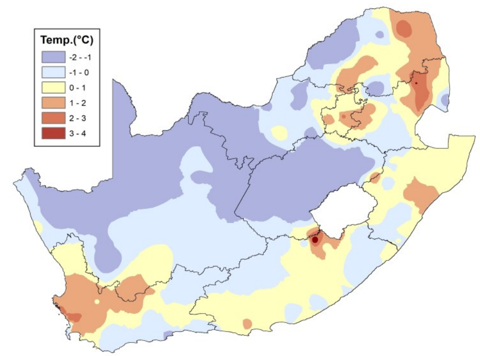


July 2024

Maximum temperature deviations



Minimum temperature deviations



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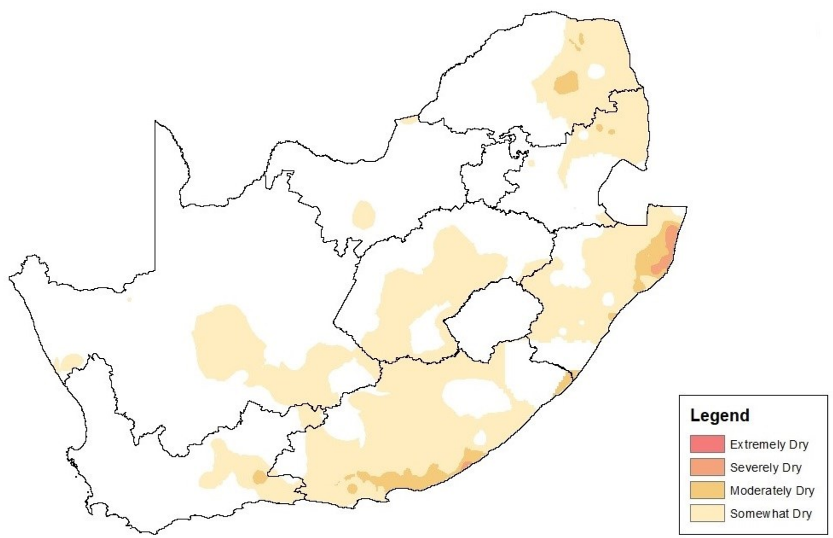
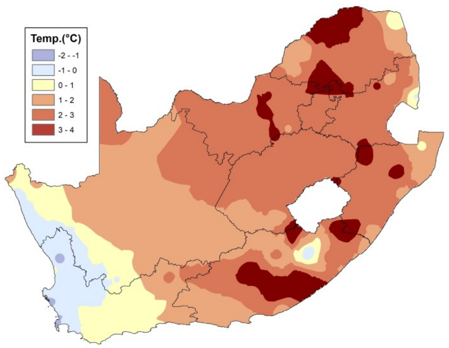
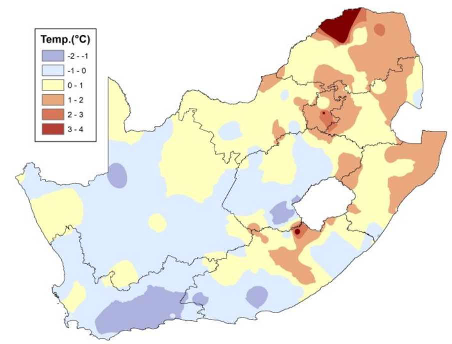


August 2024

Maximum temperature deviations



Minimum temperature deviations



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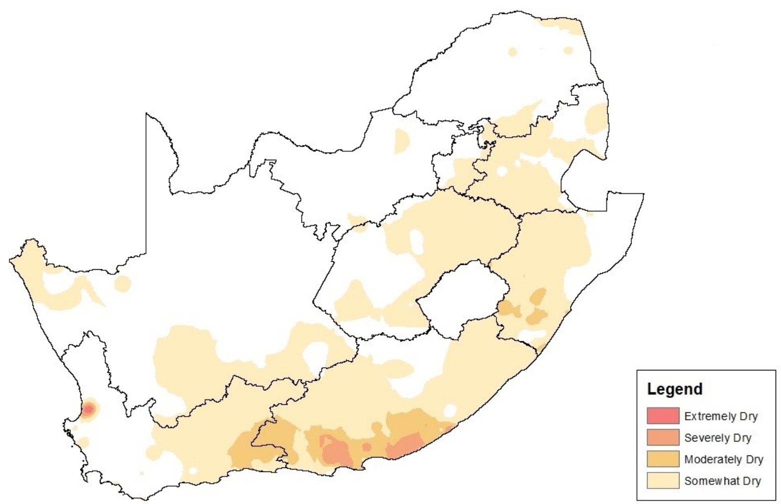
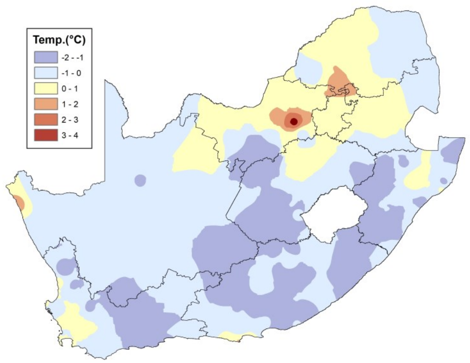
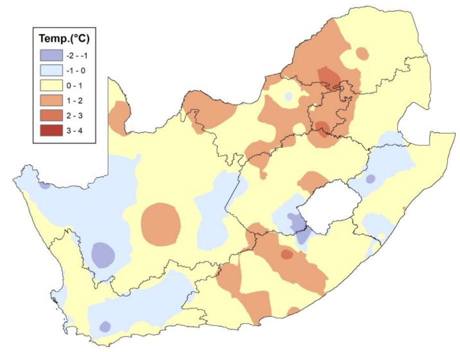


September 2024

Maximum temperature deviations



Minimum temperature deviations



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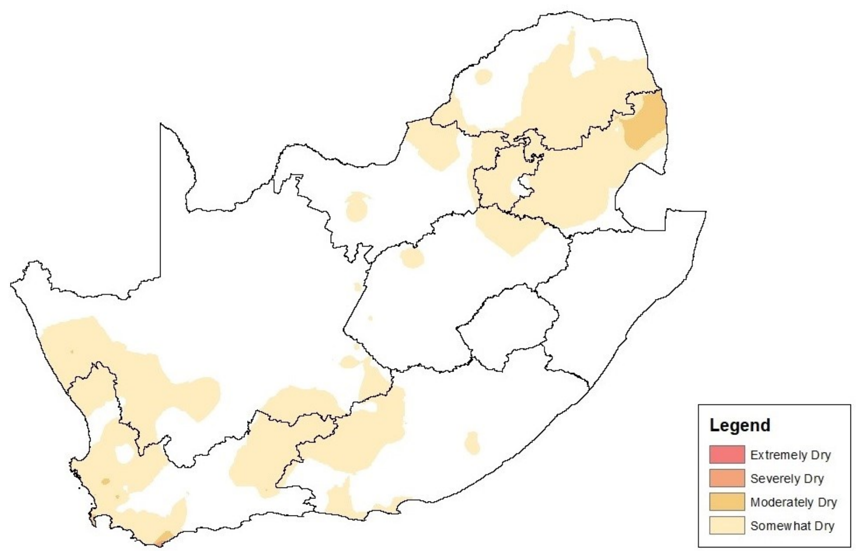
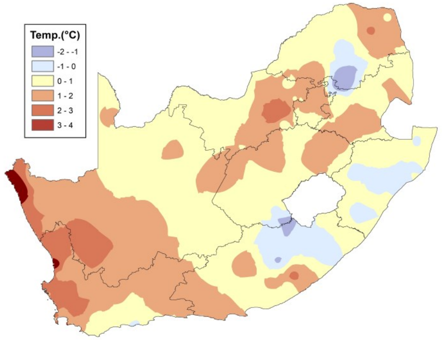
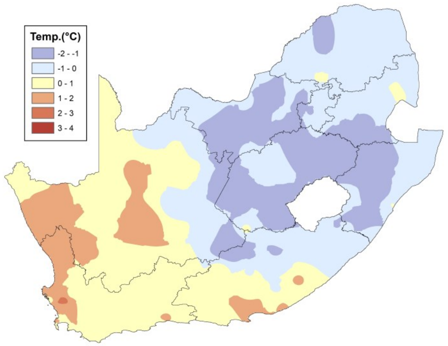


October 2024

Maximum temperature deviations



Minimum temperature deviations



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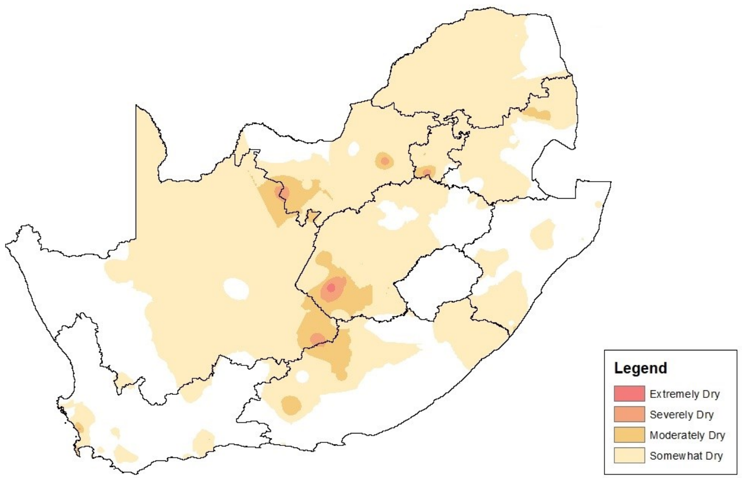
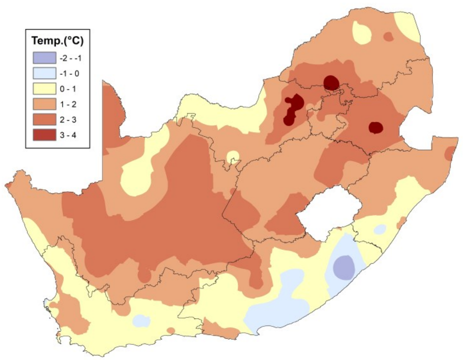
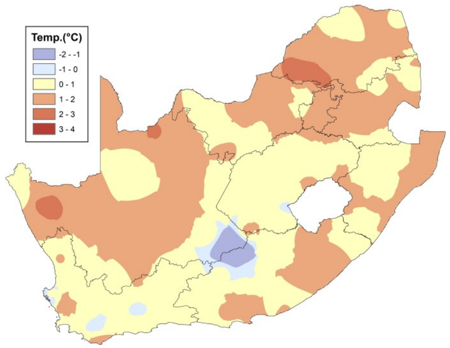


November 2024

Maximum temperature deviations



Minimum temperature deviations



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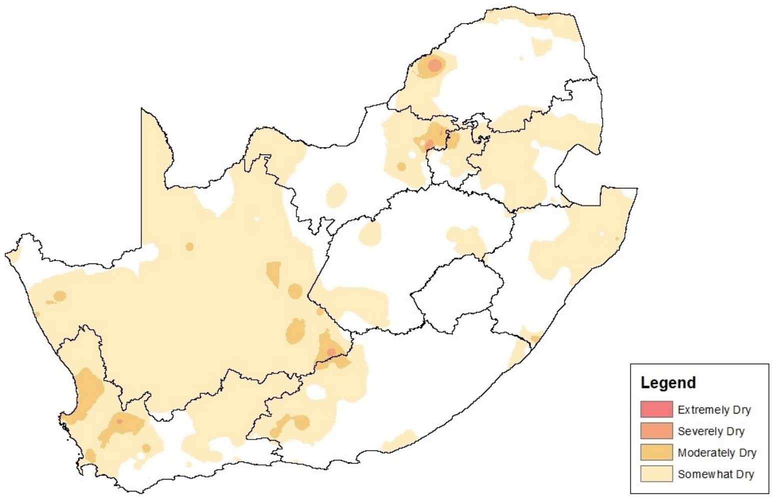
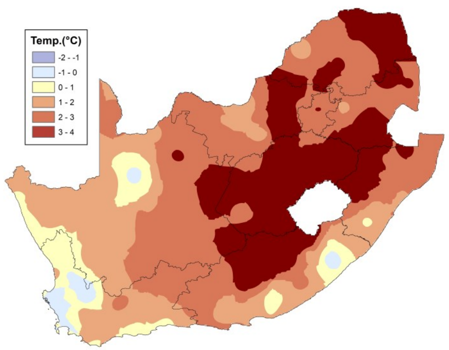
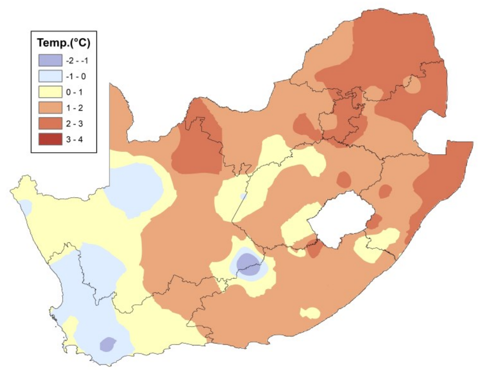


December 2024

Maximum temperature deviations



Minimum temperature deviations



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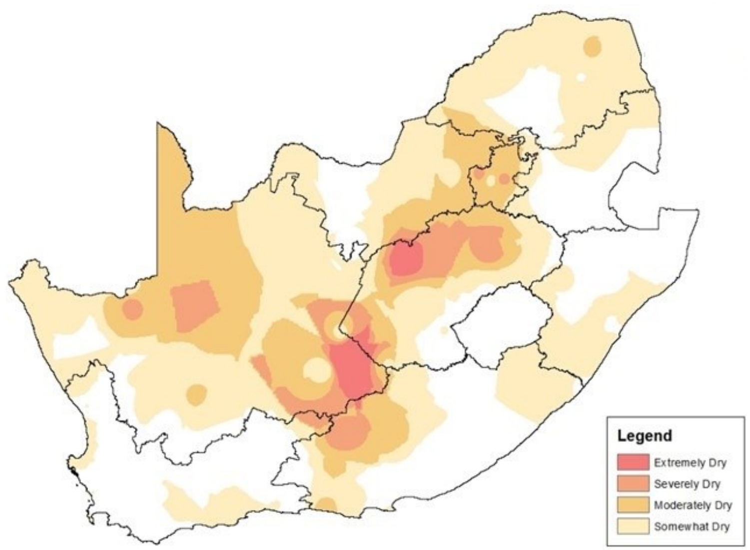
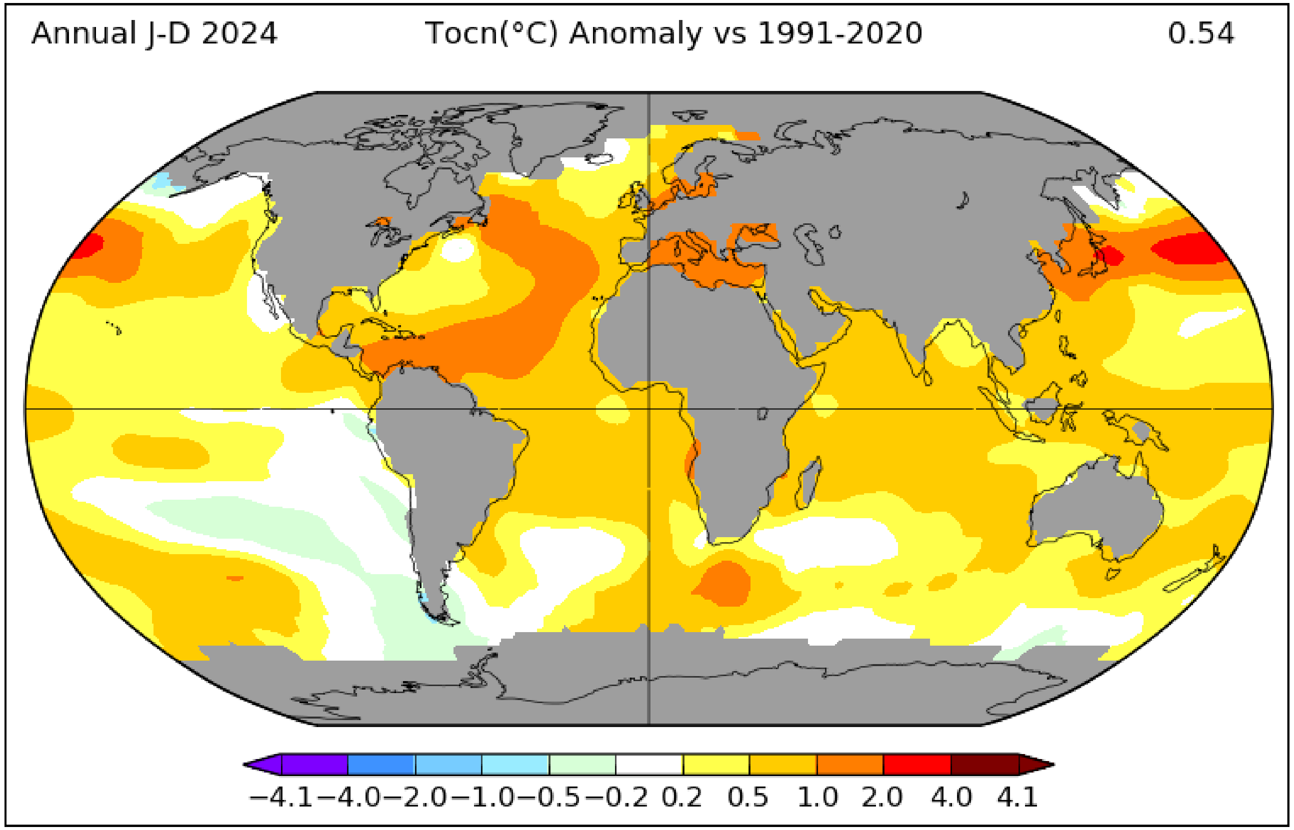


Sea-Surface Temperature Anomalies

Sea-surface temperature anomalies around the coast of South Africa for 2024 shows values slightly above the 1991—2020 normal ((0 to 0.5°C). This is somewhat lower than the global anomaly of about 0.5°C.

Source: Data.GISS: GISS Surface Temperature Analysis (GISTEMP v4) (https://data.giss.nasa.gov/gistemp/maps): Accessed 24-04-2025
GISTEMP Team, 2025: GISS Surface Temperature Analysis (GISTEMP), version 4. NASA Goddard Institute for Space Studies. Dataset accessed 20YY-MM-DD at https://data.giss.nasa.gov/gistemp/.
Lenssen, N., G.A. Schmidt, M. Hendrickson, P. Jacobs, M. Menne, and R. Ruedy, 2024: A GISTEMPv4 observational uncertainty ensemble. J. Geophys. Res. Atmos., 129, no. 17, e2023JD040179, doi:10.1029/2023JD040179.



Greenhouse Gases

South Africa, in particular SAWS, maintains a long-term GHG measurement facility at Cape Point.

Cape Point data reflects the global averages, which show that atmospheric concentrations of all the major long-lived greenhouse gases continue to increase, consequently driving climate change processes.

The rate of CO_2 accumulation in the atmosphere has increased unabatedly since atmospheric measurements began. Global average annual mean CO_2 concentration reached 420.0 ppm in 2023.

Similarly, during the past 2 years, the quantities of both atmospheric methane and nitrous oxide have increased unsurpassed levels.

Background

Greenhouse gases (GHGs) play a critical role in regulating Earth's climate by trapping heat in the atmosphere, a natural process known as the greenhouse effect. Key gases like carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and water vapor allow sunlight to enter the atmosphere, warming the Earth's surface. As the planet emits heat in the form of infrared radiation, these gases absorb and re-radiate the energy, preventing it from escaping into space. This process is essential for maintaining a habitable climate, as it keeps global temperatures above freezing. However, human activities such as burning fossil fuels, deforestation, and industrial processes-particularly since the 1860's—have significantly increased GHG concentrations, thereby intensifying the greenhouse effect. This enhanced warming contributes to rising global temperatures, melting ice caps, sea-level rise, and extreme weather events, collectively known as climate change.

Monitoring GHG levels is vital for understanding their impact on climate systems and guiding mitigation strategies. Atmospheric GHG concentrations are measured through ground-based stations, satellite observations, and air sampling techniques, providing real-time data for climate modelling and policymaking. These measurements help identify trends, track emissions sources, and assess the effectiveness of international agreements like the Paris Agreement. Without accurate monitoring, it would be impossible to gauge the extent of anthropogenic impacts or design science-based solutions to reduce emissions. Furthermore, tracking GHGs provides critical insights into natural carbon sinks, such as forests

Carbon dioxide (CO_2)

The Cape Point Global Atmosphere Watch (GAW) station in South Africa, located on the Cape Peninsula, plays a critical role in monitoring atmospheric carbon dioxide (CO_2) and other relevant greenhouse gas levels in the Southern Hemisphere. As one of the few major monitoring sites in the Southern Hemisphere, and the most comprehensive in all of Africa, the station provides valuable data on CO_2 concentrations, helping to track trends over time and contributing to refining global climate models predictions.

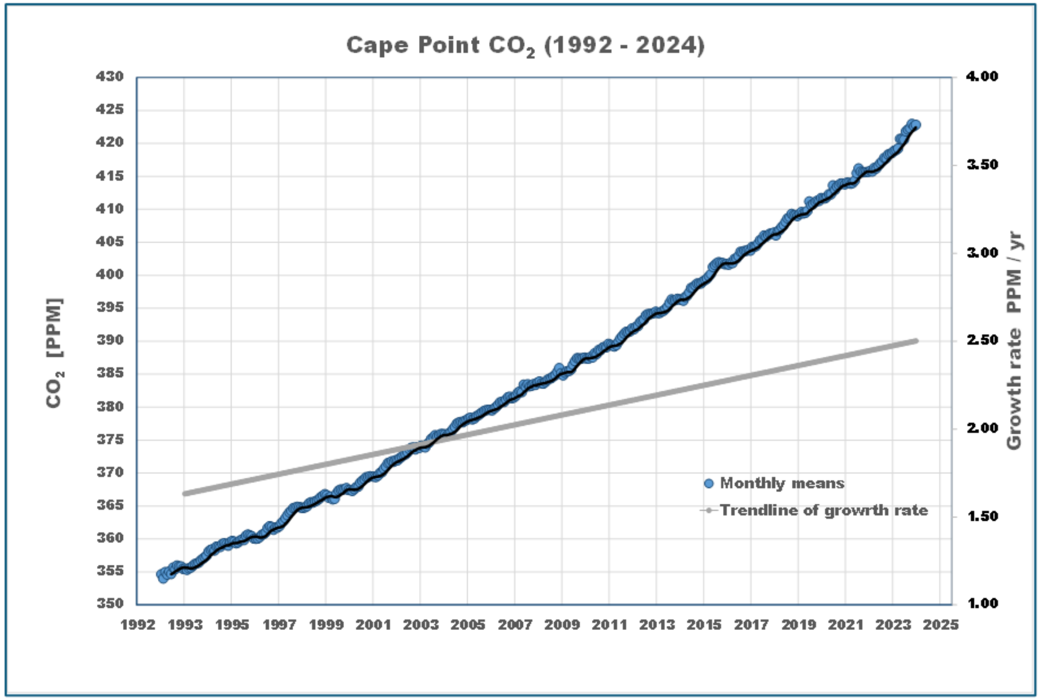
Current data from Cape Point shows a steady increase in CO_2 concentrations, in line with global trends. The station has recorded consistently rising CO_2 levels, with average concentrations having surpassed the 420 parts per million (ppm) mark in recent years. This is significant as it mirrors the rising CO_2 levels seen at other major stations, such as Mauna Loa in Hawaii, as well as Cape Grim in Tasmania, Australia. The data collected at Cape Point not only reflects the global impact of human activities, such as fossil fuel combustion and deforestation, but also natural processes such as biomass burning - both of which contribute to the observed rise in greenhouse gases. These CO_2 measurements are essential for understanding the pace and impact of climate change, especially in a region like Southern Africa, which is highly vulnerable to climate variability and extreme weather events, influenced by increasing levels of atmospheric CO_2.

Cape Point Global Atmosphere Watch Station

The Cape Point Global Atmosphere Watch (GAW) Station, located at the southern tip of Africa, is one of the Southern Hemisphere's key greenhouse gas monitoring stations in the World Meteorological Organization's GAW network. It has been collecting valuable GHG data for 45 years.

Atmospheric concentrations of CO_2 measured at Cape Point remain in a continuous upward cycle with annual trends and growth rates accelerating since measurements started in 1992. This is also consistent with other Southern Hemisphere stations as well as the global trend. The annual average CO_2 at Cape Point reached 420.0 ppm in 2023.

Greenhouse gas concentrations in the Southern Hemisphere are typically lower than the global averages, since the bulk of the emissions originate in the Northern Hemisphere. It takes approximately 1 year for Northern Hemisphere air, with higher greenhouse gas concentrations, to mix into the Southern Hemisphere and appear in the Cape Point observations.



Blue circles represent Cape Point monthly mean CO_2 in clean air, measured from 1993 to end 2023. The monthly means are computed from hourly data and represent thousands of individual measurements. To obtain clean air measurements, the data was selected to include only periods when airmasses have travelled long distances across the Southern Ocean and is consequently free from any local sources of pollution. The grey line is a trend of the calculated annual growth rate at Cape Point, and closely follows the global observed CO_2 trend.

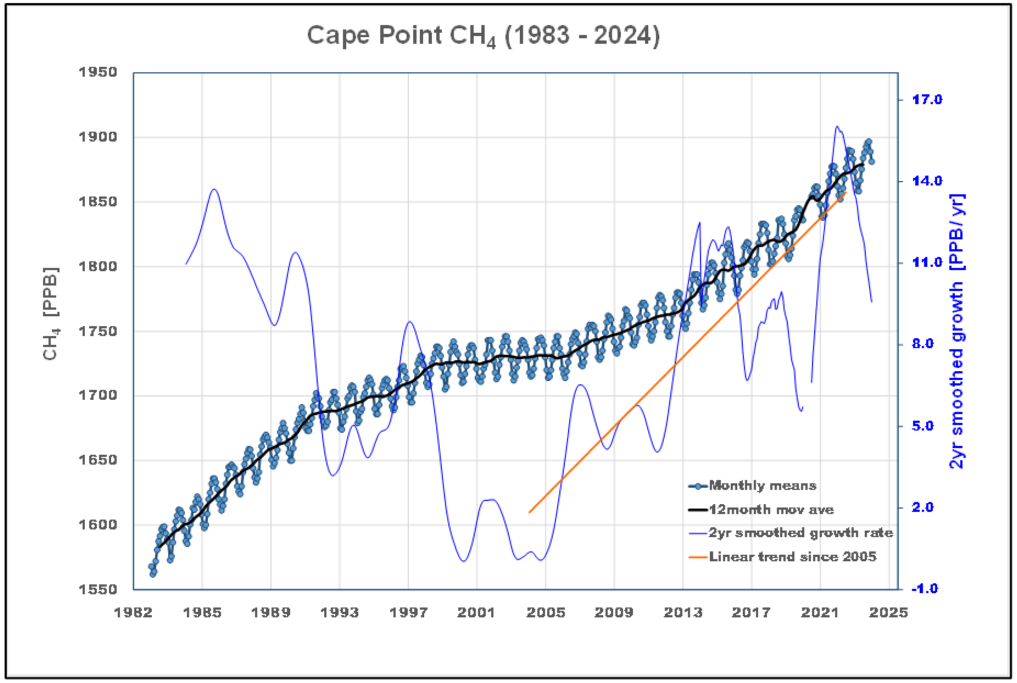
The global annual mean CO_2 concentration in 2023 was 420.0±0.1 parts per million (ppm) — signifying a 151% increase from the concentration of 277 ppm recorded in pre-industrial times. The rising CO_2 levels recorded at Cape Point align with the broader trends in the Southern Hemisphere, and they serve as a stark reminder of the cumulative global impact of greenhouse gas emissions. Although South Africa has committed to reducing its emissions and expanding renewable energy sources, the challenges remain considerable, given the country's current energy infrastructure and economic constraints. Cape Point's continuous CO_2 measurements are thus critical not only for tracking atmospheric changes but also for informing South African policy on emissions and climate adaptation.

Methane (CH_4)

The most significant of the non-CO2 greenhouse gases are methane and nitrous oxide. In 2023, the global annual mean concentration of methane was 1,934±2 parts per billion (ppb), whilst Cape Point recorded 1872 ppb, somewhat lower than the global mean. This amounts to a 265% rise above the 1750 benchmark level of 729 ppb. Methane (CH_4) is the second most important greenhouse gas in terms of radiative forcing and is emitted from a wide range of sources, both natural and anthropogenic. South Africa's methane levels, monitored at sites like the Cape Point Global Atmospheric Watch (GAW) station, have been influenced by trends seen globally and across the Southern Hemisphere. Methane concentrations have shown a concerning increase, consistent with the global upward trend of greenhouse gas emissions. The Southern Hemisphere, generally having lower methane emissions than the Northern Hemisphere, is now experiencing accelerated growth in methane levels, in part due to regional emissions from agriculture, waste, and energy extraction activities, especially in fossil fuel production areas like Africa and Australia.

Globally, methane emissions are estimated to have reached around 120 million tons in 2023, much of which comes from energy production, agriculture, and waste. This has been exacerbated by large methane emission events detected by satellites, which rose by over 50% from 2022 to 2023. Microbial decomposition of organic matter in wetlands is the largest single source of methane emissions known to us.
South Africa's methane levels and trends reflect the broader Southern Hemisphere challenges, and as such, emissions need to be managed more effectively to prevent further contributions to global warming, which methane can accelerate significantly.
In Africa, methane reduction strategies are still developing, but the continent plays a critical role due to its natural gas reserves and growing industries, which need improved regulation and methane monitoring practices to achieve meaningful reductions.

Human activities are responsible for emissions from fossil fuel extraction and use (including natural gas), farming of livestock, rice cultivation and waste from landfills and agriculture. Together, these sources account for about 65% of global methane emissions. Methane has a global warming potential 81 times stronger than CO_2 when measured over a 20-year timeframe.
However, since 2020, atmospheric methane concentration has increased rapidly, by more than 10 ppb per year, with rises of 13 and 11 ppb in 2022 and 2023 respectively.

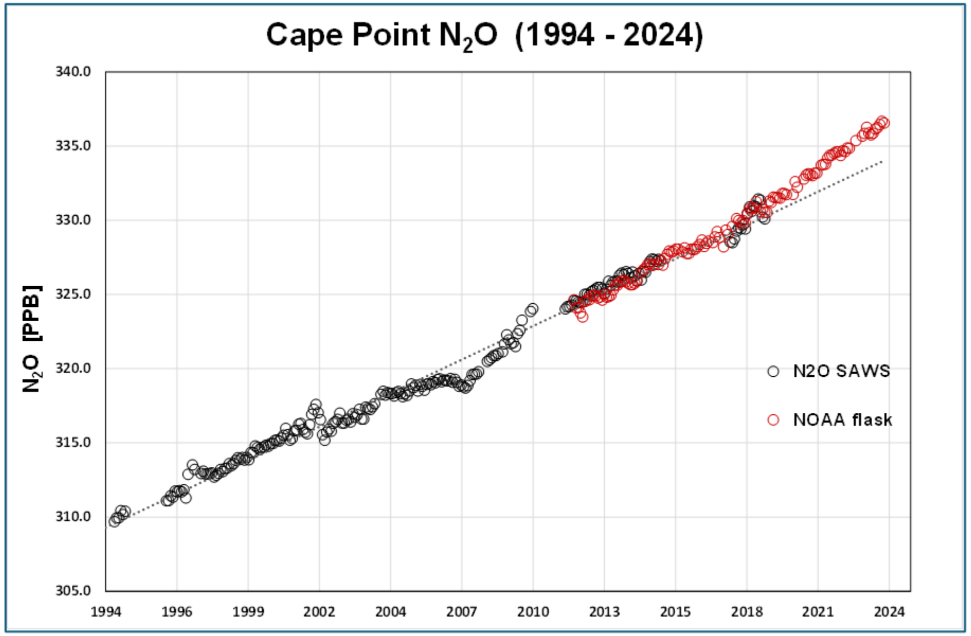


Blue circles represent Cape Point monthly mean CH4 in clean air, measured since 1983. The blue line represents a 2yr smoothed growth rate, highlighting complicated processes that resulted in much variation from year to year. A linear trend line (red) was fitted through the 2005 – 2023 growth rate, to show the steep increase during the past 2 decades which closely tracks the global observed CH4 trend.

Nitrous oxide (N_2O)

The third-most significant non-CO_2 greenhouse gas is nitrous oxide, occurring in the natural atmosphere in part per billion (ppb) levels. Nitrous oxide (N_2O) has a global warming potential of 273 times that of CO_2 when calculated for a 20-year lifespan.

N_2O is emitted into the atmosphere from both natural sources (oceans, soils, biomass burning) and anthropogenic sources (fertilizer use, and various industrial processes) in an approximately 60% to 40% ratio. The globally averaged N_2O concentration in 2023 reached 336.9±0.1 ppb, showing an increase of 1.1 ppb with respect to the previous year. The current 2023 levels have increased by 125% from the pre-industrial level (270.1 ppb). The annual increase from 2022 to 2023 was slightly higher (1.3 ppb) than the increase from 2021 to 2022 (1.1 ppb) and slightly higher than the mean growth rate over the past 10 years (1.1 ppb yr-1). This can be seen in the figure below where the red circles show a deviation from the dotted long-term linear trend line.



Black circles represent Cape Point monthly mean N_2O in clean air, measured since 1994. The dotted line shows a near linear increase (trend) since measurements started. Red circles show data collected from the NOAA collaborative flask sampling program at Cape Point. The data was selected to only include periods when airmasses have travelled long distances across the Southern Ocean and is consequently free from any local sources of pollution.