G20 CLIMATE RISK ATLAS

Impacts, policy, economics

cmcc

SOUTH AFRICA

With the scientific contribution of Enel Foundation

How to read the Atlas: graphs, colours and scenarios.

The maps used in this Atlas are taken from **The World Bank Official Boundaries** - ***https://datacatalog.worldbank.org/search/dataset/0038272*** (accessed on May 28, 2021). For the section Energy, the maps are based on Panoply Data Viewer ***https://www.giss.nasa.gov/tools/panoply/credits.html***

Each sector of this Atlas contains data and information on various climate scenarios.

When reported in graphs, the **colour black** indicates data and information referring to the current state, the past or the baseline.

When the authors refer to **RCP (Representative Concentration Pathways)**, the 3 colours used across the factsheet refer to 3 scenarios, which are 3 different development options with different levels of greenhouse gas emissions, **respectively low emissions (green), medium emissions (orange), and high emissions (red)**. The same colour code is used when RCPs are associated with Shared Socioeconomic Pathways (SSP).

In some cases, the authors refer to global warming scenarios. In these cases, the 3 colours used refer to a temperature rise of **1.5°C (green), 2°C (dark green), and 4°C (red)**.

When the authors refer exclusively to **Shared Socioeconomic Pathways - SSPs** (Population affected by river floods in the section: "Water"), data related to **SSP3** - that encompasses, among other things, slow economic growth, material-intensive consumption, and persisting or worsening inequalities – **are reported in a lighter shade**; **SSP5** – which refers to social and economic development that is coupled with an energy-intensive lifestyle and the abundant exploitation of fossil fuel resources – is shown using a **middle shade of the colour**, whereas data related to **the present** conditions **are represented in a dark shade**.

Further details on scenarios, methodologies, and the full list of references are available at: **www.g20climaterisks.org**

Concept and graphic design by element6.eu

SOUTH AFRICA
CLIMATE

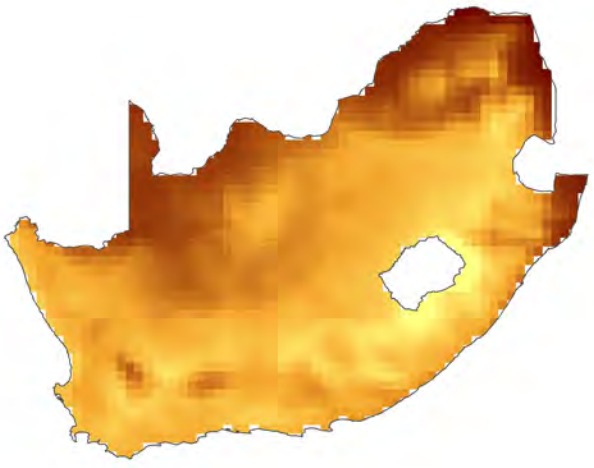
OVERVIEW

The climate in South Africa is more variable than other countries in sub-Saharan Africa due to its subtropical location and the presence of oceans on three sides of the country. In general, it is a warm temperate climate with some differences between west and east coasts, which are related to cold and warm coastal currents and in part influenced by the El Niño–Southern Oscillation. A singularity is the Western Cape which features a Mediterranean climate.

TEMPERATURE

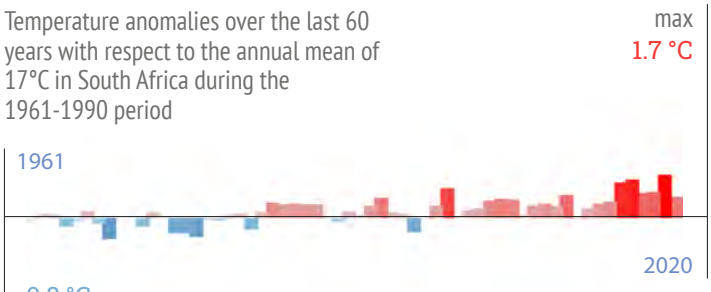
South Africa experiences average annual temperatures of 17°C. The southern and eastern areas are the regions with the lowest temperatures due to their altitude. The warmest areas are the coastal ones and inland areas of the northern Cape.

MEAN TEMPERATURE



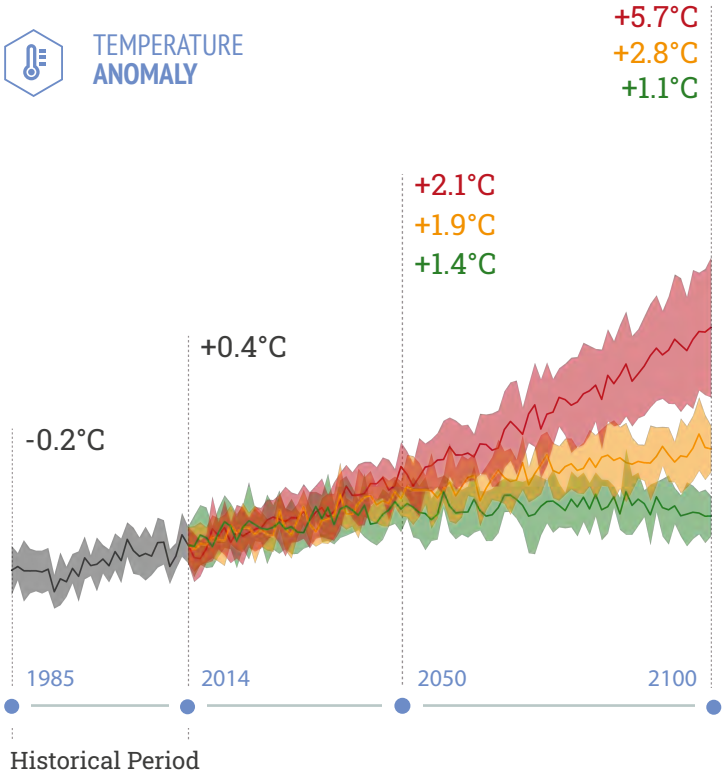
TEMPERATURE TREND

Temperature anomalies over the last 60 years with respect to the annual mean of 17°C in South Africa during the 1961-1990 period



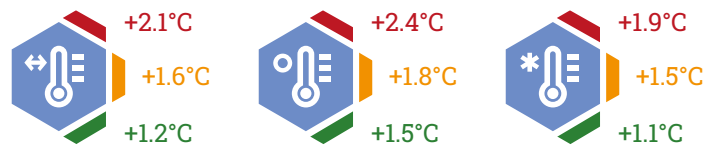
TEMPERATURE PROJECTIONS

Under a low emissions scenario projected temperature variations will remain contained under 1.5°C, both by 2050 and 2100.
Under a high emissions scenario, with no reduction in GHG emissions, much greater temperature anomalies are expected by both 2050 and 2100.



EXPECTED VARIATION FOR TEMPERATURE AT 2050

The indicators show variations in selected temperature characteristics for a thirty-year period centred on 2050 (2036-2065) with respect to the reference period 1985-2014.



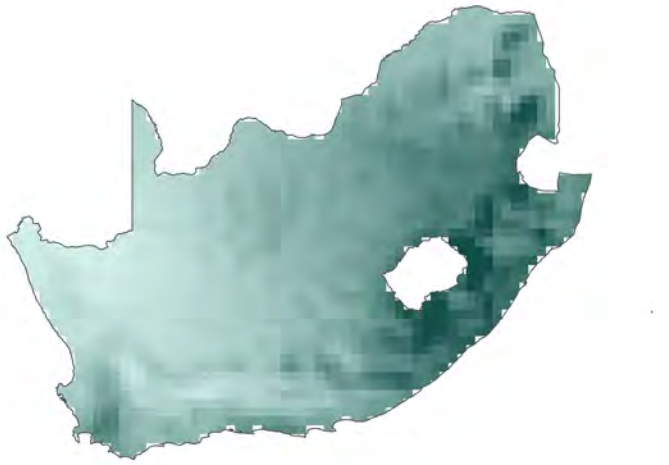
PRECIPITATION

The precipitation regime in South Africa exhibits changes depending on time of the year and location. Generally speaking, South Africa is a relatively dry country: the Western Cape gets most of its rainfall in winter, whereas the rest of the country is generally a summer-rainfall region.
Rainfall concentrations vary across seasons and, at an annual timescale, it is highly irregular in most parts of the country. Changes in South Africa's rainfall seasons could affect farming and water resources. In terms of geographical distribution, there is more precipitation in the coastal areas of the Indian Ocean compared to other parts of the country.

MEAN PRECIPITATION

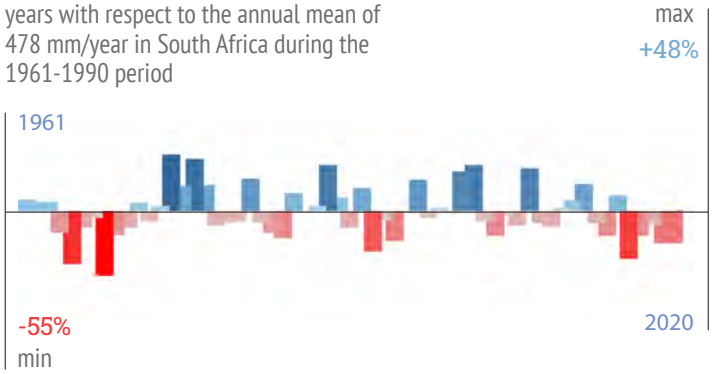
61 — 2,273

mm/year / Over 1991-2020



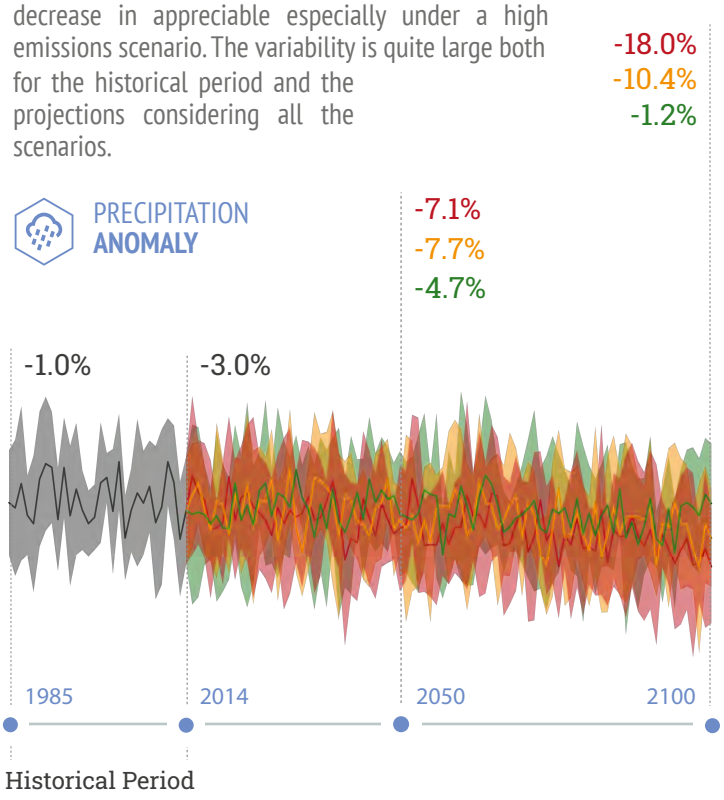
PRECIPITATION TREND

Precipiation anomalies over the last 60 years with respect to the annual mean of 478 mm/year in South Africa during the 1961-1990 period



PRECIPITATION PROJECTIONS

Precipitation trend shows a slight decrease in precipitation during the last part of 21st century: such a decrease in appreciable especially under a high emissions scenario. The variability is quite large both for the historical period and the projections considering all the scenarios.



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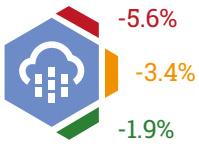
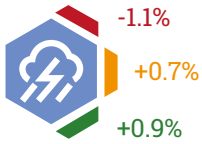
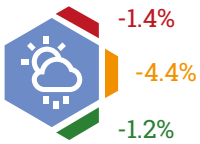


Annual total precipitation



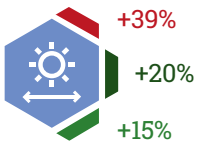
Precipitation of wettest month



Precipitation of warmest quarter

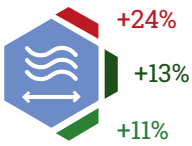
VARIATION OF SPECIFIC CLIMATE INDICATORS

Climate indicators variation showing impacts of climate change on sectors such as agriculture, health and water. Analysis considers 3 threshold average temperature increase: **+1.5°C**, **+2°C**, **+4°C**.



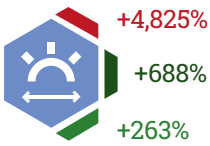
Agricultural drought proportion of time

% of time



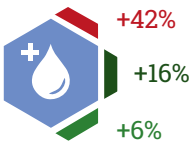
Hydrological drought proportion of time

% of time



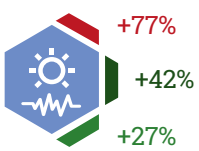
Heatwave duration

% of time



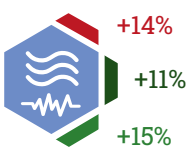
Runoff increase

% of area



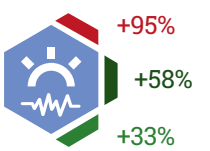
Agricultural drought frequency

% of change



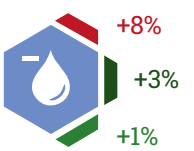
Hydrological drought frequency

% of change



Heatwave frequency

% of change



Runoff decrease

% of area

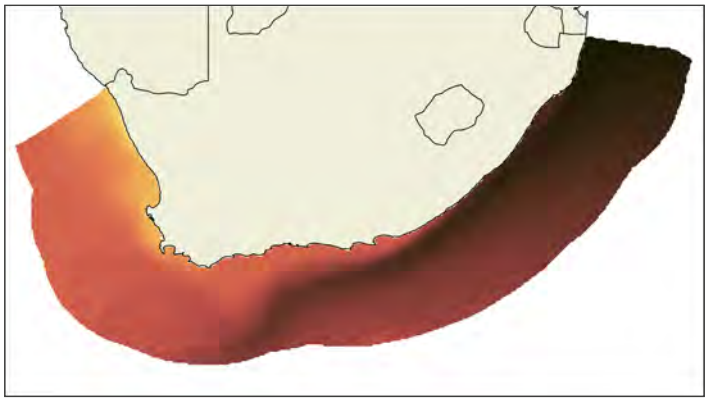
SOUTH AFRICA OCEAN

OCEAN IN SOUTH AFRICA

South Africa's marine exclusive economic zone (EEZ) varies from colder Atlantic waters to temperate conditions on the Indian Ocean and hosts different coastal ecosystems, such as coral reefs, seagrass meadows and kelp beds. The country's coastal systems are naturally diveded into two areas: the Atlantic and Indian marine regions.

CURRENT CLIMATE CONDITIONS

Mean sea surface temperature reflects the different climate regimes, from the relatively cold waters of the Atlantic region to the warmer ones of the Indian coasts.

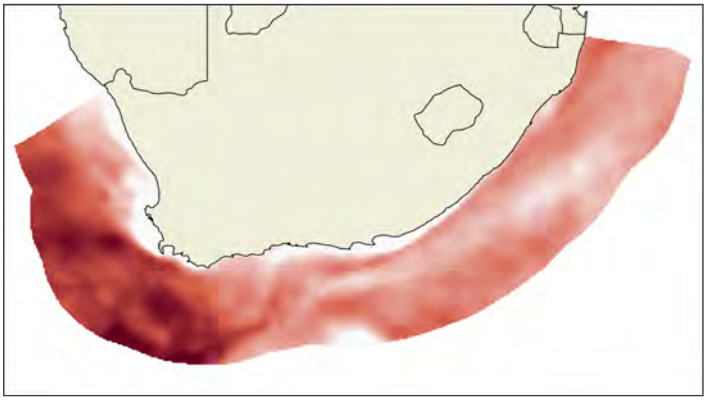


10 — 25 **MEAN**

SEA SURFACE TEMPERATURE

Celsius degrees / Over 1991-2020

0 — 0.25 **TREND**

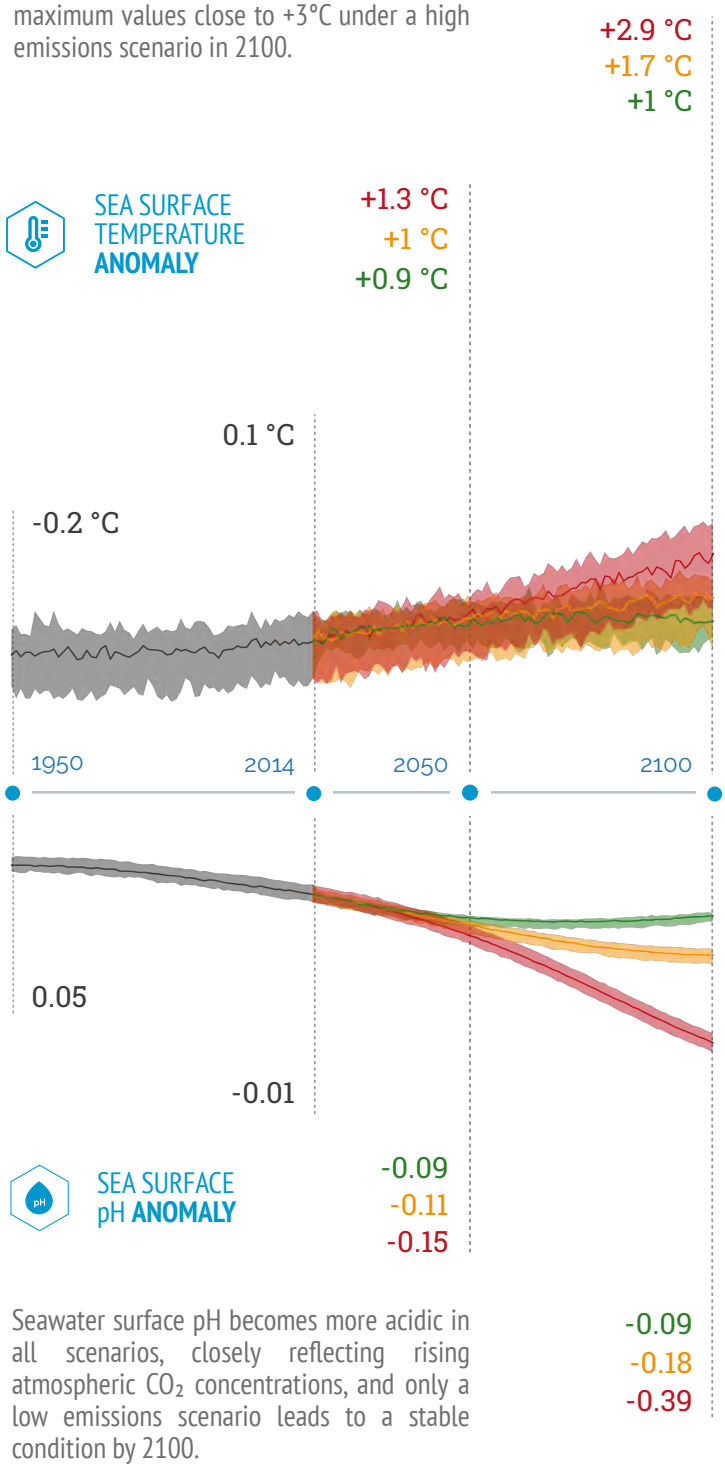


Surface temperature trends indicate a general warming of 0.1°C per decade in all marine areas, with increased gains in the south-western areas.

FUTURE PROJECTIONS

Projected annual changes within the marine EEZ for the two most significant marine indicators of climate change: sea surface water temperatures and pH.

Seawater temperature changes are in line with the definitions of each scenario, with maximum values close to +3°C under a high emissions scenario in 2100.



Seawater surface pH becomes more acidic in all scenarios, closely reflecting rising atmospheric CO_2 concentrations, and only a low emissions scenario leads to a stable condition by 2100.

ECOSYSTEM INDICATORS AT 2050

Regional changes in key marine ecosystem indicators under projected future scenarios by mid-century (2036-2065) with respect to present climate conditions (1985-2014).

Atlantic

Indian

Temperature regulates the metabolism of marine organisms determining which habitats remain suitable. Excessive warming will likely push ecosystems beyond tolerance thresholds.

Atlantic		Indian	
18.89°C	+1.24 °C +1.04 °C +0.83 °C	22.56°C	+1.47 °C +1.13 °C +1.08 °C

pH represents the acid/base status of marine waters, where a decreasing pH reflects the acidification of the ocean due to increased absorption of atmospheric CO_2.

Atlantic		Indian	
8.11	-0.15 -0.12 -0.09	8.11	-0.15 -0.11 -0.09

Oxygen is fundamental to sustain marine life and its reduction can have a large impact on coastal ecosystem services including fisheries and aquaculture.

Atlantic		Indian	
235.24 mmol/m³	-1.52 % -1.12 % -1.23 %	221.04 mmol/m³	-2.54 % -1.89 % -1.74 %

Chlorophyll is an indicator of the biomass available at the base of the marine food web supporting all ecosystem productivity.

Atlantic		Indian	
0.69 mg/m³	-2.75 % -0.14 % -1.3 %	0.37 mg/m³	-11.41 % -12.23 % -10.6 %

FISH CATCH POTENTIAL

Fish catch potential is an estimate of the maximum fish catch achievable given the marine resources available over a sustained period. It is linked to the concept of maximum sustainable yield, meaning the maximum amount of fish that can be extracted from a system without causing a collapse in fish populations.

It is a characteristic of the natural system, which is substantially different from realized catch, and a direct result of the fishery policy in place.

Fish catch percentage change

2050

-11.2%

-6.0%

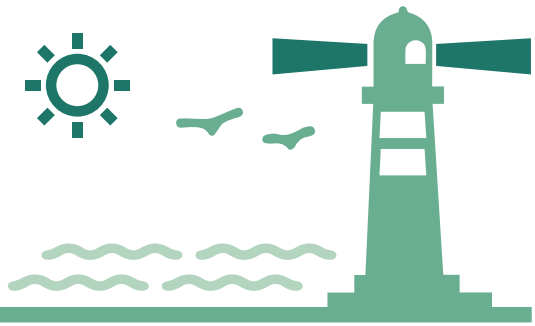
ANALYSIS DETAILS

All datasets were analysed using only data from within the marine EEZ and therefore excluding overseas territories, detached islands and any disputed or joint territories with other nations. In the assessment of current climate conditions, seawater surface tempererature data was obtained using satellite observations distributed in the framework of ESA Climate Change Initiative.

Future projections of marine indicators are represented by the combined analysis of results from 15 different Earth System models participating in the Coupled Model Intercomparison Project Phase 6 (CMIP6). These models include new and better representations of physical and biogeochemical processes, compared to previous IPCC assessment reports.

Fish catch potential data was obtained using the FAO's technical report and refers to the best and worst case climate scenarios from the Fifth IPCC Assessment Report. These mean estimates are subject to substantial uncertainties as discussed in the original work.

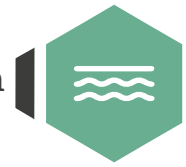
SOUTH AFRICA COASTS



OVERVIEW

With 3,751 kilometres of shoreline, the South African coast is very diverse. To the west beaches, cliffs and arid landscapes face the Atlantic Ocean, whereas to the east temperate and grassy environments look out over the Indian Ocean.The largest coastal settlements on are Cape Town and Durban, each with more than 3 million inhabitants, and Port Elizabeth, with around 1 million. The coastal economy has been evolving in recent years, with more economic activity and an increasing population.

Shoreline Length



Sandy Coast Retreat at 2050

CLIMATE CHANGE HAZARDS

Coastal hazards such as erosion, storm tide inundation and permanent flooding, can have strong adverse impacts on coastal regions, with loss of sandy shores, damage to settlements, infrastructure and ecosystems. Climate change can exacerbate these impacts due to rising sea levels and increasing impacts of waves and storms. Climate change impacts on the coastal zone of South Africa are mainly driven by rising sea levels and possible changes in storm intensity and direction, affecting both the east and west coasts. Some parts of South Africa are also sensitive to the risk of sea level rise and land loss, with the main urban centres on the coast already being actively managed with coastal protection structures. In general, the beaches of South Africa are likely to be impacted by coastal erosion and recession.

SEA LEVEL RISE

Relative sea level rise has been observed over the past century around the coast of South Africa, with a yearly average increase of approximately 1.71 millimetres per year since the 1990s. The latest IPCC projections indicate that, by 2050, global sea levels may rise between 0.18 metres, under a low emissions scenario, and 0.23 metres, under a high emissions scenario.

Observed and projected sea level rise at 2050

EXTREME SEA LEVEL

On average, one in 100 extreme sea level events are expected to rise from 2.29 metres at present day to 2.54 metres by 2050 under a medium emissions scenario.

Current and projected extreme sea level at 2050

OBSERVED STORMS

The wave climate of South Africa is influenced by different types of storms developing both in the South Atlantic and the Indian Ocean. Waves significantly affecting the coastal zone and its infrastructure are generated mainly in the southern Atlantic, or by low pressure systems along the southern to eastern coast and, occasionally, by tropical cyclones moving down the Mozambique channel. The wave climate around the South African coast shows clear seasonality and varies in intensity and directionality.

FUTURE STORMS

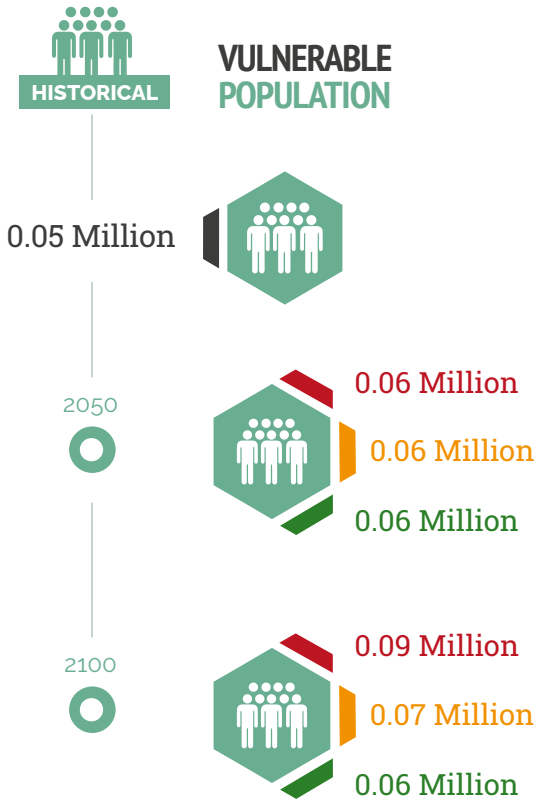
Although averages appear to remain constant, there seems to be some variation in individual storm intensities. For example, considering the peaks of individual storms during the more extreme winter period (June to August), an increasing trend of about 0.5 metres over 14 years has been observed. The trend could be indicative of a significant increase in storminess over the coming decades. What is clear is that rising sea levels will also increase the frequency of extreme sea level events.

VULNERABILITY AND RISK

In South Africa the most important drivers of risk to coastal infrastructure from erosion and flooding are waves, tides and future sea level rise.

With most of the coastal population concentrated in a relatively limited number of coastal cities, such as Cape Town and Durban, the population exposure is relatively low given the nature of the shoreline that combine sandy beaches and rocky shores.

Beaches are likely to recede and nearby infrastructure to be damaged in some locations, however, widespread land loss is not expected. Recent estimates show that, under a medium emissions scenario, the total population exposed to the annual coastal flood level is expected to increase from 50,000 to 60,000 people by 2050.



INFLUENCE OF SEA LEVEL RISE ON EXTREME SEA LEVEL

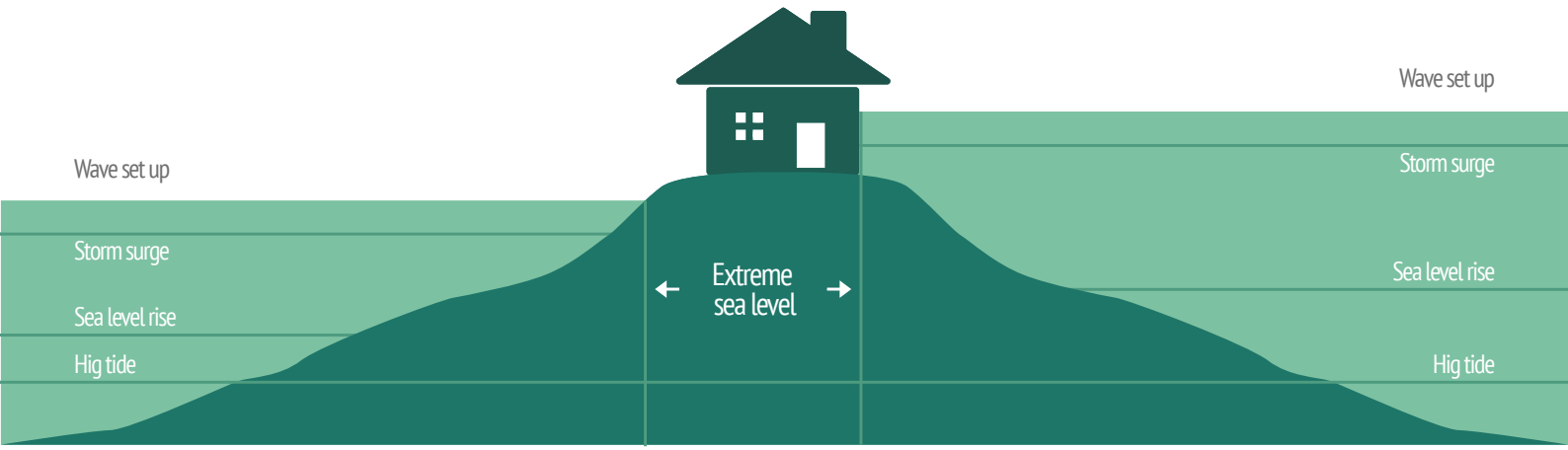
Present and future sea level rise are a consequence of carbon induced global warming causing melting ice and ocean expansion due to heat accumulation.

The extreme sea levels reported here are based on the 100-year storm surge + wave set up + sea level rise + high tide indicators. The first two parameters (storm surge + wave set up) are based on the 100-year value for the event; sea level rise is its projected value at 2050; and high tide is the absolute value of the highest tide calculated for a given locality, which won't be influenced by climate change.

+ Wave set up refers to the accumulation of water near the shore due to the presence of breaking waves.

+ Storm surge is an occasional increase in sea level driven by shoreward wind-driven water circulation and atmospheric pressure.

+ High tide is usually the highest tide reached in a given location based on tide records.



Present sea levels have risen globally by approximately 20 centimetres over the past century.

Future sea level rise is a projection based on different global warming scenarios, at approximately 100 centimetres by the end of 2100, with consequent inundation during extreme sea level events.

SOUTH AFRICA
WATER

OVERVIEW

South Africa's water resources are, in global terms, scarce and extremely limited. The average rainfall of 450 millimetres per year is well below the world average of 860 millimetres; evaporation is comparatively high; no truly large or navigable rivers exist; and the combined runoff of 49 billion cubic metres per year is less than half of that of the Zambezi River, the closest large river to South Africa.

In addition, South Africa has scarce groundwater resources and the natural availability of water across the country is highly uneven with more than 60% of the river flow arising from only 20% of the land.

Four of South Africa's main rivers are shared with other countries, which together drain about 60% of the country's land area and contribute about 40% of its total river flow.

Renewable internal freshwater resources
45 billion m^3

Renewable internal freshwater resources per capita
786 m^3

With an average precipitation of about 460 millimetres per year, South Africa is a very arid country, especially when compared to the world average precipitation of 860 millimetres per year. Sparse precipitation is aggravated by exceptionally high potential evapotranspiration, that ranges from about 1,800 millimetres per year in the east of the country to more than 3,000 millimetres per year in the north-western part of the country. For the majority of the country, rainfall occurs predominantly as brief afternoon thunderstorms in the summer months. The Western Cape is the exception, which has a typically Mediterranean climate, with frontal rainfall that is concentrated in winter.

CLIMATE CHANGE HAZARDS

Climate change can affect water resources through increasing temperatures, higher rates of evapotranspiration and altered rainfall patterns. This leads to changes in the water cycle, including decrease of snow and ice coverage, alterations of surface runoff and groundwater storage, as well as drought and flood occurrence. Based on rising population, economic growth projections, and current efficiency levels, demand for water by people, industry and agriculture is expected to rise by 17.7 billion cubic metres by 2030, while water supply is projected to amount to 15 billion cubic metres, representing a 17% gap between water supply and demand. Climate extremes are also expected to change in South Africa.

KEY POINT RUNOFF

South Africa's water requirements are mostly provided through surface runoff, captured in rivers and dams. Irrigation accounts for about 62% of the country's water use, while delivering a substantially lower economic yield per unit water than through the other sectors. Lately, the use of groundwater has increased dramatically, primarily due to extraction for irrigation. Nationally, irrigation accounts for over 64% of groundwater use.

At a country scale, an average increase in surface runoff by approximately 5% and 9% is expected respectively under low and high emissions scenarios for the 2045-2055 period compared to 2015-2025. If temperatures rise by 1.5°C, 2°C or 4°C, 1%, 3.2% or 8% of the area of the country will likely experience an increase in runoff, while 6%, 15.5% or 42% of the surface of the country will likely experience a decrease in runoff, respectively.

2050

Changes in annual runoff
% of change

+9.0%
+5.0%

2050

Runoff increase
% of area

+8.0%
+1.0%

KEY POINT DROUGHTS

South Africa is subject to the occurrence and impacts of droughts, in particular in its western and northern provinces. Frequent droughts in the past have occurred, with detailed records of droughts since the 1950s and very damaging droughts in the 1980s, 1990s and 2010s. Droughts in South Africa are mainly driven by climatic forces and by the influence of climate oscillations such as the El Niño, which is associated with extreme drought conditions.

The latest extreme drought is the 2018-2020 drought caused by the latest El Niño event. Droughts are expected to increase in the future, driven by increasing water use and changing global climatic patterns. More frequent and stronger El Niño events are also possible.

2050 Severe drought likelihood increase
% of change

+38.9%

+21.2%

2050 Hydrological drought frequency
% of change

+14.0%

+10.0%

KEY POINT GROUNDWATER

The total renewable groundwater in South Africa is estimated at 10,343 million cubic metres per year (or 7,500 million cubic metres per year under drought conditions), while the current use is between 2,000 and 4,000 million cubic metres per year. In South Africa, groundwater is widely used for rural water supply, particularly in the east of the country, and also for irrigation, particularly in the west.

Current estimated groundwater use is between 2,000 and 4,000 million cubic metres per year. Groundwater in South Africa is often overexploited and droughts are causing the depletion of renewable reservoirs. At the country level, a -8.2%, -9.2% and -11% decrease of the annual groundwater recharge for the period 2045-2055 compared to the timeframe 2015-2025 is expected respectively under under low, medium and high emissions scenarios.

2050 Groundwater Recharge
% of change

-11.0%

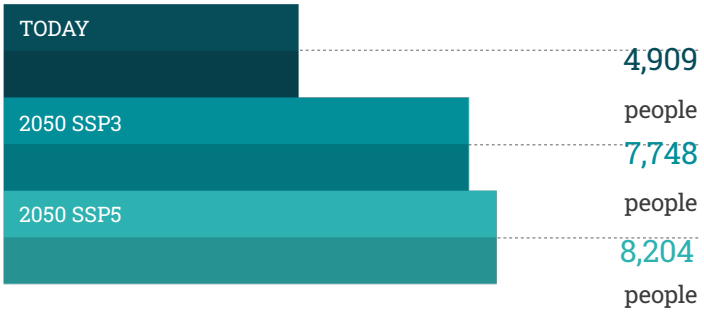
-9.2%

KEY POINT FLOODS

Floods are the most frequently recorded disaster in southern Africa. South Africa is no exception and experienced 77 major floods between 1980 and 2010, costing the lives of at least 1,068 people. Many severe floods have occurred since 2010 with losses of life, livelihoods and extensive damage to built infrastructure. Major floods have affected large urban areas such as Johannesburg, Durban and Cape Town.

The highest variability in storm flows can be seen in the western interior, whereas the lowest variability is found in parts of the Eastern Cape, KwaZulu-Natal and the Free State. Changing rain patterns may affect the frequency and intensity of floods and the population exposed to river floods is expected to increase from about 5,000 in the present day to about 7,700 under SSP3 and 8,200 under SSP5 by 2050, with a potential higher impact of river flood events.

POPULATION AFFECTED BY RIVER FLOODS

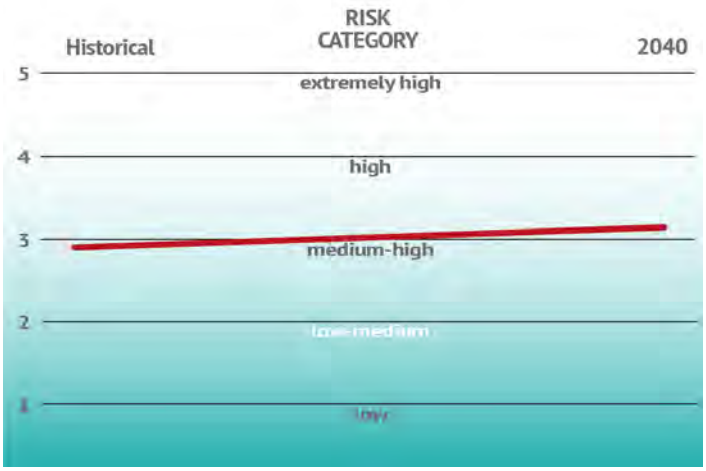


RISK INDICATORS

The water stress index summarises current and future water related vulnerabilities and risks at the global level. Scores are based on the ratio of total water withdrawals, including agriculture, industrial and human consumption, to available renewable surface and groundwater supplies.

WATER STRESS

South Africa's water stress level is considered medium-high for the recent past (1960-2014 average), and it is expected to increase in the near future (2030-2050) based on climate change projections.



SOUTH AFRICA AGRICULTURE

OVERVIEW

South Africa has a market-oriented agricultural economy that is highly diversified with production of major grains, oilseeds, deciduous and subtropical fruits, sugarcane, citrus, wine and most vegetables. The agriculture to GDP ratio has been decreasing steadily as other sectors have emerged over the years. However, the total value of the sector increased six-fold from 1970 to 2018.

South Africa features a range of agro-ecological zones, including Fynbos, Savanna, Grassland, Nama Karoo, Succulent Karoo, Forest, and Albany Thicket. Each has unique rainfall patterns, and diversified rainfed agricultural conditions. Such diversity allows for the production of different agricultural commodities. Agriculture share was estimated at 60% of total water withdrawal in 2018, with groundwater extensively used in rural and arid areas.

19.3 Mt Sugarcane

12.5 Mt Maize

2.9 Mt Citrus

2.5 Mt Potato

1.9 Mt Grapes

1.9 Mt Wheat

Added Value of Agriculture, Forestry and Fishing

4,971 USD Million

6,875 USD Million

Share of Agriculture Value added in Total GDP

2000 — 2.5 %

2018 — 2.1 %

Agricultural land

2000 — 14,197 Thousand HA

2018 — 12,413 Thousand HA

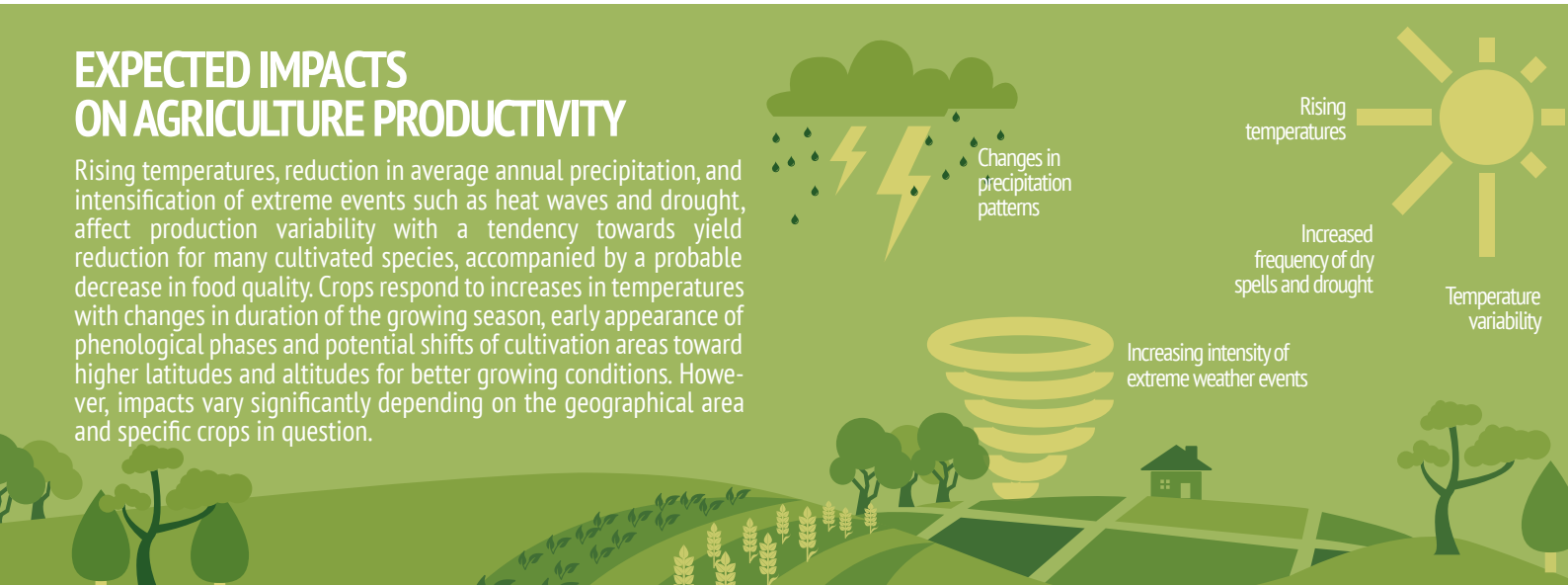
Area Equipped for Irrigation

2000 — 1,498 Thousand HA

2018 — 1,670 Thousand HA

EXPECTED IMPACTS ON AGRICULTURE PRODUCTIVITY

Rising temperatures, reduction in average annual precipitation, and intensification of extreme events such as heat waves and drought, affect production variability with a tendency towards yield reduction for many cultivated species, accompanied by a probable decrease in food quality. Crops respond to increases in temperatures with changes in duration of the growing season, early appearance of phenological phases and potential shifts of cultivation areas toward higher latitudes and altitudes for better growing conditions. However, impacts vary significantly depending on the geographical area and specific crops in question.

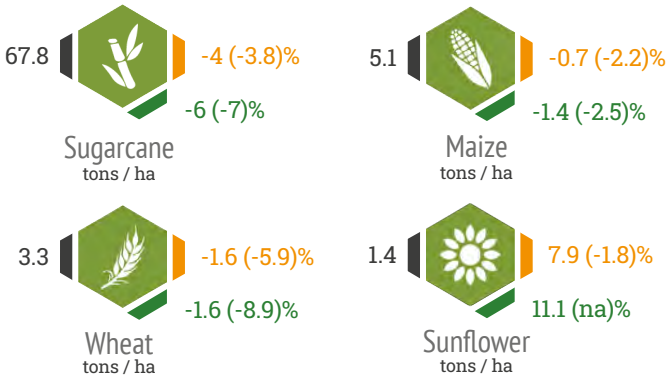


CROP PRODUCTIVITY

Crop productivity refers to the harvested yield of a crop per unit of land area. It is strongly influenced by climate and other environmental and management factors.

Climate change is expected to have an impact on the productivity of several major crops, although this may in part be offset by the fertilizing effect of higher CO_2.

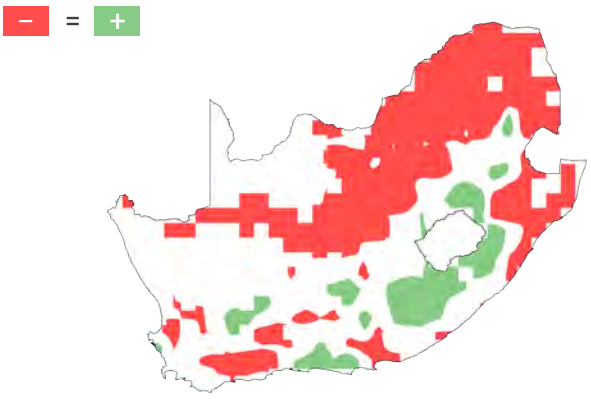
Impacts are estimated using a range of model projections based on low to high emission scenarios and reported as percentage changes between the 30-year average around the historical period and the 30-year average around 2050.



2050

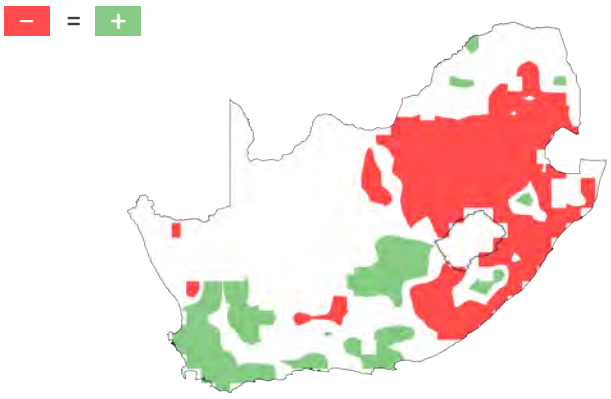
Productivity change with (without) the CO_2 fertilization effect. Estimates assume sufficient water and nutrient supplies, and do not include impacts of pests, diseases, or extreme events.

CHANGE IN MAIZE



Key staples such as maize and wheat may suffer a decline in productivity due to extreme heat exposure, with largest yield productivity losses identified in the northern provinces. The impact of climate change will vary among different wheat cultivars. An average marginal decline in wheat productivity at country level, as well as projected yield increases in the Western Cape provinces, are expected. Although sugarcane biomass growth is expected to increase, the sucrose level may decrease due to higher rates of respiration and structural growth.

CHANGE IN WHEAT

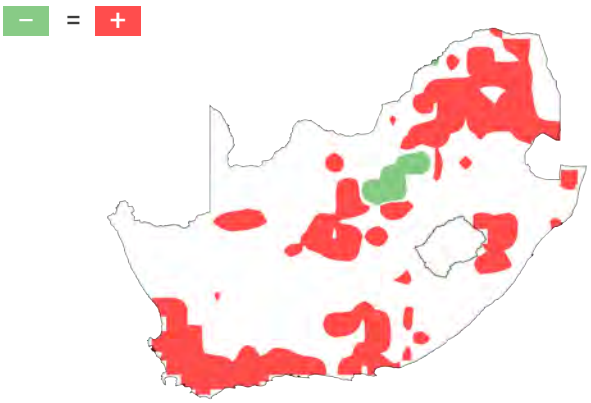


Sunflower seed cultivation may largely benefit from climate change, with general and consistent increases in productivity. Under moderate warming, irrigated vineyards will maintain and increase productivity. For more significant warming, from 2 to 3°C small reductions of 2 to 5% are expected. Larger losses in productivity (10-15%) are expected for non-irrigated vineyards. Fruit Production (apples, pears) in the Western Cape will suffer from lack of winter chilling following warming.

ADAPTATION IN AGRICULTURE AND WATER RESOURCES

One of the major issues affecting future South African agriculture will be linked to more recurrent and pronounced droughts and worsening water security. South Africa has endured ongoing droughts since 2014, most notably in the Western Cape. Over 338 million USD have been lost in the Western Cape agricultural economy due to drought. Irrigation demand in South Africa is highly likely to rise in the future due to increasing temperature and plant evapotranspiration. This increase is likely to result in added pressure on existing water resources, which may in turn lead to less certain water supply for crops and smaller yields from irrigated agriculture.

CHANGE IN WATER DEMAND



2050

Agriculture
Water Demand
% of change

A substantial increase in water demand (20-25%) is expected to maintain agricultural production, which will require adaptation, agronomic practices and crop varieties enhancing water-use efficiency to limit stress on water resources.

SOUTH AFRICA FORESTS

FORESTS IN SOUTH AFRICA

Although highly fragmented, South African forest resources are diverse, rich in biodiversity and widespread, particularly in the central-eastern coastal areas. Their shape is strictly related to the passage of fire.

Afro temperate, coastal, Misbelt, scarp and sand forests are the main types of ecosystems with small strips of mangroves in the estuaries of the east coast which are now critically endangered.

FORESTED AREA AND CARBON STORAGE

South Africa is not a highly forested country. Approximately 15% of the land surface is covered in forests,and the trend has been steadily decreasing in recent decades. Approximately 0,9 gigatonnes of carbon are stored in wooded lands (soil included), with an important portion stored in mangrove ecosystems. South African forests are a net carbon sink.

1990

18 Mln ha
Million hectares
Forested area

50 Tons/ha
Tons of Carbon per hectare
Carbon stock

2020

17 Mln ha
Million hectares
Forested area

50 Tons/ha
Tons of Carbon per hectare
Carbon stock

2050

Productivity anomaly
Tons of Carbon per hectare per year

+0.36

+0.28

FOREST PRODUCTIVITY

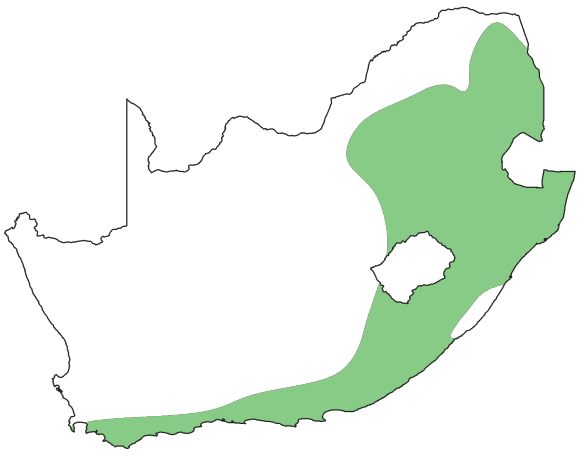
Forest productivity or Net Primary Production is the net carbon captured by plants. It is the difference between the carbon gained by Gross Primary Production - net photosynthesis measured at the ecosystem scale - and carbon released by plants' respiration. It is expressed per unit land area.

Increase particularly in the south and south-east

+ Fertilizing effect of increasing atmospheric CO_2 and nitrogen deposition promote productivity

No areas with an expected decrease in forest primary production

+ Increasing dry season reduces productivity



KEY SPECIES UNDER CLIMATE CHANGE

ENDANGERED

INDIGENOUS

Regenerative capacity of indigenous forest resources are negatively affected by climate extremes

LESS SENSITIVITY

PINUS

Pinus species show less sensitivity to rising temperatures

REDUCTION

REFORESTATION

climate change will probably reduce areas suitable for plantation forests significantly

VULNERABILITY

MANGROVES

Rapid sea level rise will threaten coastal mangrove forests significantly

FIRES IN SOUTH AFRICA

Fire is a structural ecological process that provides several types of ecosystem services and impacts on socio-ecological systems, including human health, carbon budgets, and climate change. Changes in global fire activity are influenced by multiple factors such as land-cover change, policies, and climatic conditions. Fire also releases large quantities of greenhouse gases into the atmosphere, contributing to a vicious cycle.

During the last two decades, the total forest area affected by fire amounts to approximately 0.42 million hectares.

BURNING
0.42 MILLION HECTARES OF FOREST

EMITTING
9.78 TERAGRAMMES OF CARBON PER YEAR

SAVANNA FIRE EMISSIONS CONTRIBUTED TO 84% OF TOTAL FIRE RELATED CARBON EMISSIONS

COSTING
7.8 MILLION USD IN ANNUAL SUPPRESSION COSTS

WHERE DO FIRES OCCUR?

Wilfires mostly affect mountain grasslands and fynbos.

Historically, forest fires are concentrated in the mountainous regions of KwaZulu-Natal and Mpumalanga in the north-east, as well as across the Western Cape.

FUTURE BURNED AREA

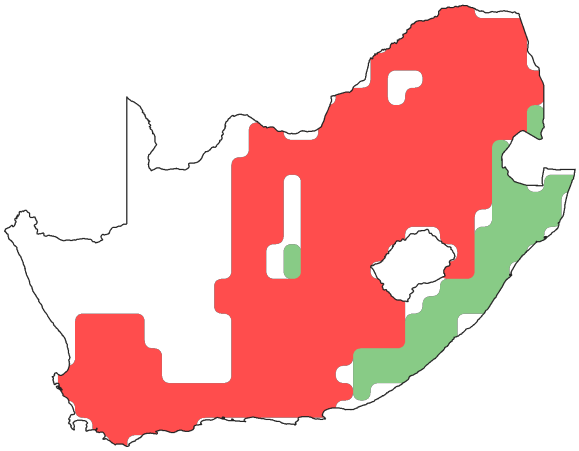
Under a low emissions scenario, models project a generalized increase in burned area from Western Cape to the north-eastern regions, encompassing Mediterranean forests, desert shrublands, montane grasslands and subtropical forests. Under a medium emissions scenario, the spatial pattern is expected to be similar. In the future, burned areas might decrease across south-eastern areas.

Burned Area
km² per year

2050

+750

+1,328



Decrease in burned areas for a low emissions scenario

Increase in burned areas for a low emissions scenario
+ Prolonged fire season length and increased fire exposure in terms of weather conditions considered conducive to fires

CASE STUDY: INVASIVE SPECIES

Invasive alien species not only threaten native vegetation but also affect flammability and fire behaviour.

In 2017, exacerbated by an unprecedented drought, wildfires burned 15,000 hectares in Western Cape destroying more than 800 buildings and killing 7 people. Over half of the biomass consumed belonged to invasive species increasing wildfire severity and difficulty of firefighting.

Large fires might also affect natural touristic attractions impacting on ecosystem services. For instance, in 2018 large fires burned more than 86,000 hectares along the Garden Route in the southern part of the country.

FUTURE FIRE EMISSIONS

Fire emissions follow a similar spatial pattern to burned areas under both low and medium emissions scenarios.

Fire Carbon emission
Teragrams of Carbon per year

2050

+5.2

+7.1

SOUTH AFRICA URBAN

OVERVIEW

In South Africa, 67.4% of the population lives in urban areas. This rate is expected to rise both in relative and absolute terms: whereas the urban population currently 39.5 million, it is expected to increase to 58 million, with an urbanization rate of 79.8%, by 2050.

Increases in population are expected, particularly in big agglomerations with more than 5 million inhabitants and in small centres with a population of less than 300,000 people.

While the urban population is increasing, cities need to tackle important challenges related to poverty and inequality as 25% of urban dwellers live in inadequate urban environments lacking basic services.

Built up areas cover only 0.89% of South Africa (10,873.57 square kilometers).

2020 — 39,550,889

Population in Urban Areas

2050 — 58,056,843

Graphs refer to data provided by United Nations, Department of Economic and Social Affairs, Population Division (2018). World Urbanization

2020 — 67.4%

Urbanization Rate

2050 — 79.8%

OVERVIEW OF KEY CLIMATE IMPACTS IN URBAN AREAS

Climate change impacts are enhancing urban challenges in South Africa. The main climate stressors are increasing heat and water related stress.

HEATWAVES AND HEAT STRESS

Mean temperatures in South Africa are rising and the country is experiencing a significant number of heatwaves. Heatwave impacts in South African cities are actually scarcely monitored due to lack of data.

In Cape Town, a three years drought brought the city's urban water supply down to critical levels of water scarcity in 2018. It was revealed that, already under present day conditions, 28% of South African towns have inadequate water resources and are in need of urgent attention for ensuring equal access to safe drinking water.

With regards to the future climate and the expected rise in both duration and intensity of heatwaves, heatwaves are recognized as an additional challenge for future urban policies. The city of Durban, for instance, expects an increase in mean temperatures by **1.5°C** to **2.5°C** by 2065, as well as an increasing number of heatwaves.

2050 — Cooling Degree Days (% of change): +89.0%, +35.0%, +22.0%

2050 — Heatwave frequency (% of change): +95.1%, +57.8%, +33.1%

2050 — Heatwave duration (% of time): +4,825%, +688%, +263%

UNEQUAL EXPOSURE AND COMPOUNDED IMPACTS

Rising temperatures in urban areas cause health impacts, most of which are felt among those living in poorer neighbourhoods and informal settlements, with limited access to electricity - and thus to air conditioning - and poor housing quality.

For Cape Town, most informal settlements were found to be part of the city's hot spots for urban heat island effects, due to lack of vegetation. Furthermore, the urban heat island effect enhances the impacts of air pollution. The entire urban population of South Africa is constantly exposed to air pollution levels which exceed threshold values recommended by the WHO.

2017

Population exposed to air pollution

100.0%

COASTAL FLOODING

Nearly 20% of the South African coastline has some form of development at less than 100 metres from the shoreline, resulting in a high amount of settlements and infrastructure at risk of storm surges. Due to rising sea levels, such impacts are beginning to affect coastal areas and tourism related infrastructure.

2050

Projected sea level rise

0.23 m

0.18 m

2100

0.77 m

0.38 m

CHANGING PRECIPITATION PATTERNS

Intensity of precipitation events increased, whereas the number of rain days has decreased significantly over the last 50 years. In Cape Town, many of the poorer neighbourhoods found in low-lying areas with high groundwater levels are regularly flooded.

The areas have no stormwater infrastructures and lack systems for waste water disposal. More wealthy neighbourhoods are located on higher ground and are therefore rarely affected by floods. Despite increasing trends in annual precipitation, changing rainfall patterns will bring more intense precipitation events, which increase the risk of flash floods and landslides.

2050

Runoff increase

% of area

+8%

+3%

+1%

SURFACE SEALING AND FLOODS

Heavy precipitation in cities is problematic due to the high level of sealed surfaces. Soil sealing increases run off and reduces the amount of water absorbed by soil. Where there are large amounts of impervious ground cover, short duration extreme rainfall events can lead to increased flooding, even resulting in flash floods.

INFORMAL SETTLEMENTS

Due to high rates of urban growth and a high percentage of households living in slum areas, the exposure of the South African urban population to future floods is critically high. Low income households are particularly affected as these are frequently situated in low lying areas and lack efficient drainage systems.

These urbanization patterns, created during the apartheid period, could lead to the creation of high risk areas and poverty traps where high rates of losses and damages go hand in hand with limited ability to cope and adapt due to marginalization, high poverty, and culturally-imposed gender roles.

2010

% of urban population

Population living in slums

25.6%

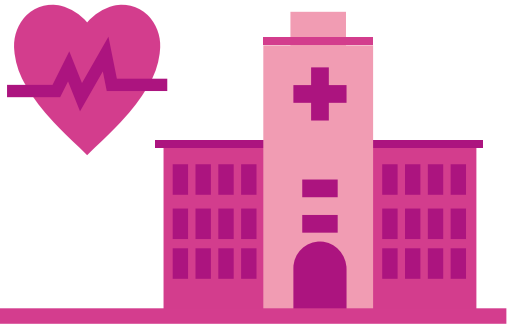
2018

% of total population

Urban population living in areas where elevation is below 5 meters

0.1%

SOUTH AFRICA
HEALTH



OVERVIEW

South Africa already has a high burden of disease linked to environmental stressors, and climate change will exacerbate many of these social and environmental issues. Health risks that climate change may aggravate over the next few decades include: heat stress; vector-borne diseases (such as malaria, dengue fever and yellow fever); extreme weather events; air pollution; and communicable diseases.

HEAT RELATED MORTALITY

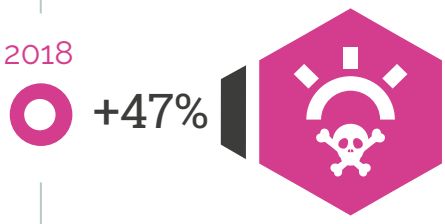
Warming and increased frequency and duration of heatwaves has already affected the wellbeing of the South African population.

Under a high emissions scenario, heat-related deaths in the elderly (65+ years) are projected to increase to about 116 deaths per 100,000 by 2050, compared to the baseline estimate of about 2 deaths per 100,000 annually between 1961 and 1990.

Under a low emissions scenario, heat-related deaths in the elderly will increase to 20 deaths per 100,000 in 2050. In 2018, there was a 74% increase in heat-related deaths in South Africa compared to the 2000 to 2004 baseline. 43.8% of heat-related mortality in South Africa, from 1991 to 2015, can be attributed to human-induced climate change.

Heat-related mortality

% change with respect to 2000-2004



IMPACTS ON LABOUR

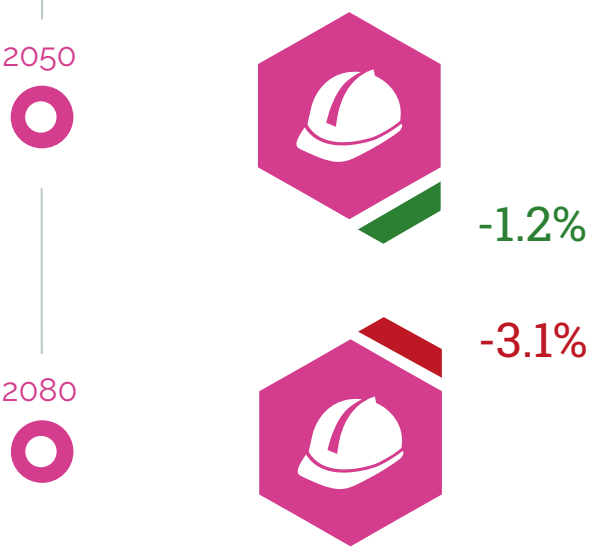
Labour is directly affected by changes in environmental conditions. Warming affects both the number of hours worked (labour supply) and on the productivity of workers during their working hours (labour productivity). Both labour supply and productivity are projected to decrease under future climate change in most parts of the world, and particularly in tropical regions.

Parts of sub-Saharan Africa, south Asia, and southeast Asia are at highest risk under future warming scenarios. Future climate change will reduce global total labour in the low-exposure sectors by 18 percentage points and by24.8 percentage points in the high-exposure sectors under a 3.0°C warming scenario

In South Africa, there was 39.9% loss in potential hours of labour in the agriculture and construction sectors in 2019, compared to the 1990s baseline. Total labour in South Africa is expected to decline by 1.2% under a low emissions scenario, and by 3.1% under a medium emissions scenario.

Impact on total labour

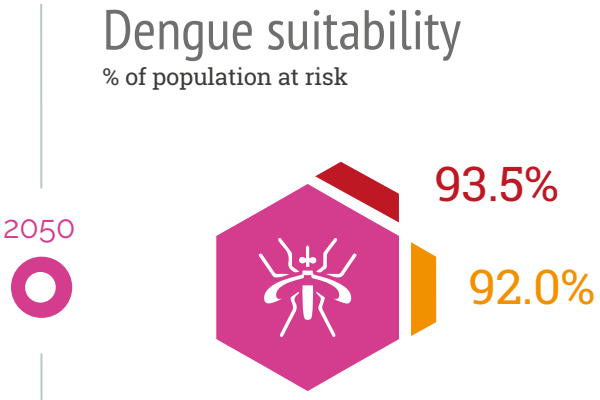
% change with respect to 1986-2005 baseline



CLIMATE CHANGE AND DENGUE

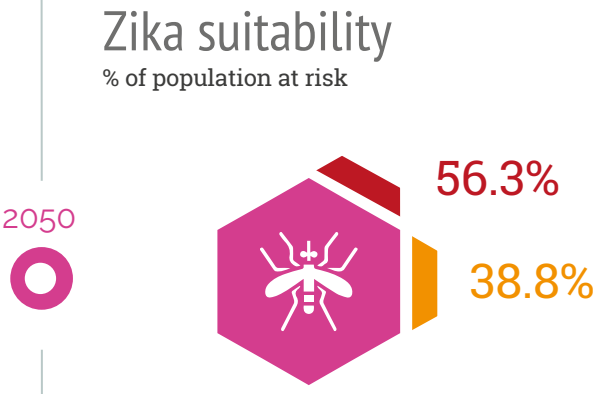
Dengue has spread throughout the tropical world over the past 60 years and now affects over half the world's population. Globally, vectorial capacity for both dengue vectors (A. aegypti and A. albopictus) has been rising steadily since the 1980s, with nine of the ten highest years occurring since 2000.

Climatic stressors are one important driver of the current distribution and incidence of dengue. Climate change is likely to expand the geographical distribution and suitability of several vector-borne human infectious diseases including dengue. The risk of dengue transmission is increased by warming climates, as the growth and development of mosquitoes are significantly influenced by temperature, precipitation, and humidity.



CLIMATE CHANGE AND ZIKA

Zika virus has spread to at least 49 countries and territories since 2013. Climate change impacts on transmission suitability risk have increased over the years and future warming over 1.3 billion additional people could face suitable transmission temperatures for Zika by 2050.



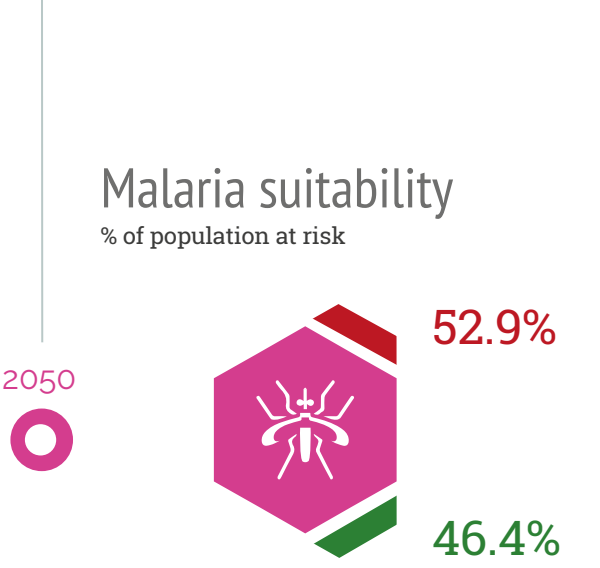
DENGUE AND ZIKA: POPULATION AT RISK

As high temperatures and high levels of moisture are favourable conditions for the distribution of dengue vectors, these diseases are likely to increase in the future due to climate change.

Under a medium emissions scenario, 92% of the population will be at risk of transmission-suitable mean temperature for dengue by 2050, whereas 93.5% will be at risk under a high emissions scenario. In the case of Zika, 38.8% of the population will be at risk by 2050 under medium emissions, whereas 56.3% will be at risk under high emissions.

CLIMATE CHANGE AND MALARIA

As mosquitoes thrive in a warm moist environments, there is enormous concern that projected global warming coupled with ecological factors may make malaria parasites spread over more provinces in South Africa. 46.4% of the South African population will be at risk of malaria under a low emissions scenario in 2050, whereas 52.9% will be at risk under a high emissions scenario.



POLLUTION AND PREMATURE MORTALITY

Air pollutants, including particulate matter (PM), sulphur dioxide, ozone, carbon monoxide, benzene, lead and nitrogen dioxide, are a concern for public health, and their concentration in ambient air is regulated in South Africa. In addition, climate change will influence the concentration of criteria pollutants by affecting weather patterns. Ambient air pollution is estimated to have been responsible for 4% of deaths in South Africa in 2015.

SOUTH AFRICA ENERGY

ENERGY SYSTEM IN A NUTSHELL

South Africa has one of the highest energy intensities of GDP in the world and relies heavily on domestic coal. Renewables hold a negligible share; the government is pushing to increase diversification of the electricity mix, but currently there is no clear indication about what sources are to be supported.

Due to income inequality, electricity use is skewed towards higher income households, with over half of it accruing to the richest 20% of the population.

0.19
ktoe/US$
Energy intensity

1.1%
AC Share in electricity consumption

ENERGY SUPPLY

South Africa's energy mix is strongly dominated by coal for industrial use and electricity generation (73% of total primary energy supply in 2018) followed by (imported) oil for transport (15%), which also uses a significant volume of biofuels (6% of total primary energy supply). Natural gas (3%), nuclear (2%) and other renewables (1%) hold very modest to negligible shares. Hydropower is virtually non-existent (0.1%). The country imports oil, oil products and natural gas, but is otherwise more than self-sufficient.

CLIMATE CHANGE TODAY

INCREASING TEMPERATURES

In South Africa, mean annual temperatures have increased at least 1.5 times the observed global average increase of 0.65°C during the last 50 years, resulting in increasing cooling needs.

EXTREME EVENTS

A lower water availability and increased exposure to extreme events has been observed. The severe floods of April 2019 severely damaged the electricity grid in the affected areas.

ENERGY DEMAND

In South Africa, energy is used mainly by the industrial sector (41% of final demand in 2018, including non-energy uses accounting for 6.7% of total demand), transport (27%) and residential (19%), followed by commercial use (8.5%) and agriculture and fishing (3.2%). Air conditioning's contribution to residential electricity demand is minimal (1.1% in 2017, 6% of the households) due to the temperate climate, and to the limited affordability of electricity for most of the population.

FUTURE ENERGY DEMAND

South Africa has a dry/temperate climate; hence cooling needs prevails. This is projected to result in an increase in electricity demand of 421 PJ (or 117 million KWh) by 2050 under a medium emissions scenario. Air conditioning units are expected to increase exponentially from 12 million units in 2016 to 236 million units in 2050.

Net change in energy demand due to changes in DD/CDD

Billion KWh

2050

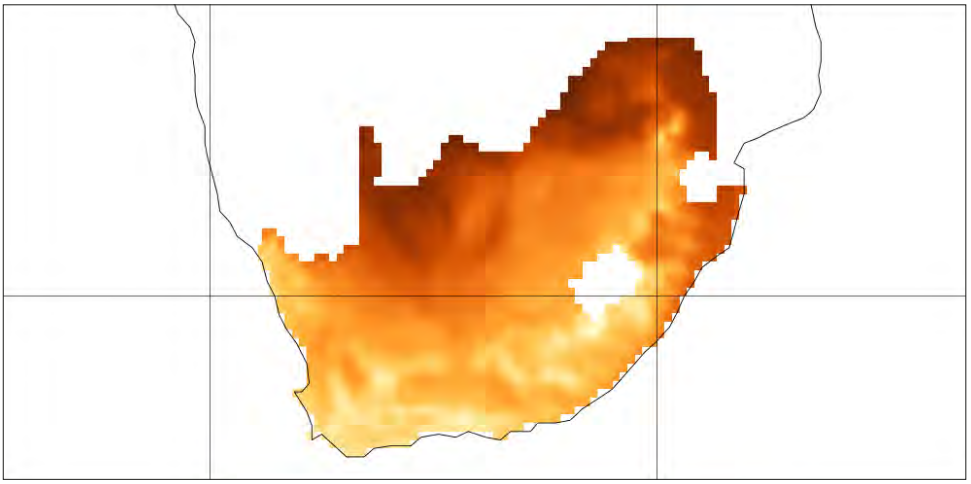
+ 116.98

COOLING NEEDS

Strongest increases in cooling needs along the northern border. Moderate ones around the elevations where heating degree days are expected to drop the most.

COOLING DEGREE DAYS

0 — 632

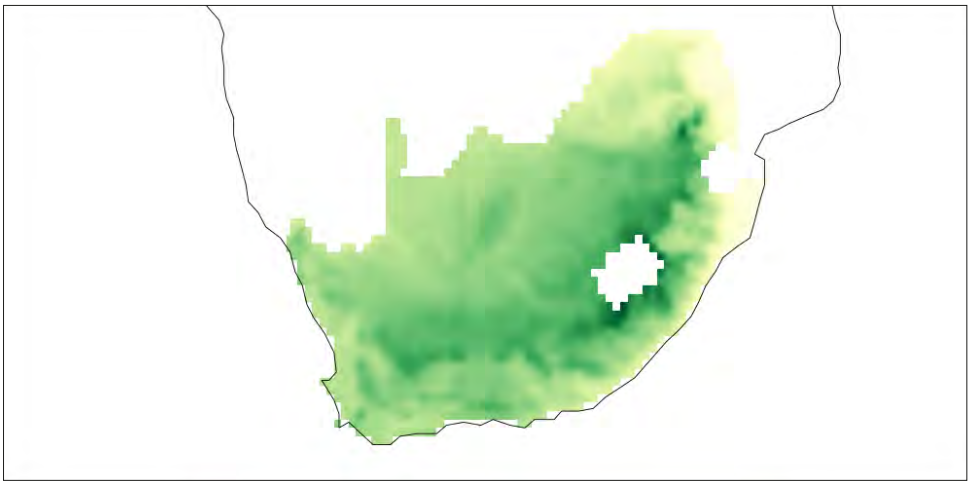


HEATING NEEDS

Moderate decreases in heating needs are expected all over the country; larger drops are expected in the southernmost elevations on the plateau above Cape Town, Sutherland, and the areas around Lesotho.

HEATING DEGREE DAYS

-547 — 0



FUTURE ENERGY SUPPLY

The future configuration of the South African energy mix is likely to be determined by the evolution of energy policies and hence is outside the scope of this report.

There appear to be no long-term plans for decarbonization, and the push for diversifying away from coal has not yet taken a definite direction; the high relevance of the vulnerabilities of the coal extraction industry and of coal-fueled thermal plants is, however, posed to decrease in the coming decades.

Change in Hydropower generation

% of change

2050

-5.02%

-4.29%

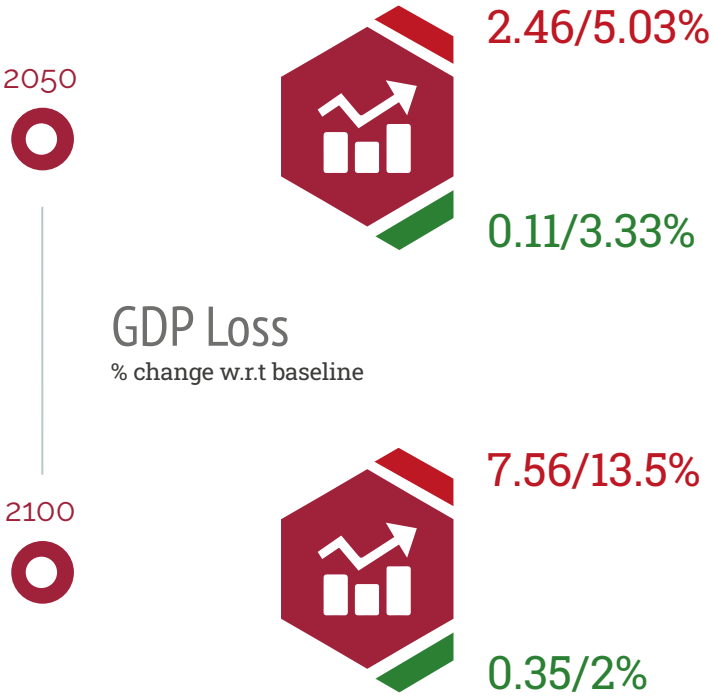
EXPECTED IMPACTS OF CLIMATE CHANGE

There are no quantitative projections of the impacts of climate change on South Africa's energy sector (bar a modest drop in hydropower). Qualitatively, the main concerns are for the impact of increased frequency of extreme events on the energy system, and for the impact of droughts on the thermal efficiency of coal power plants.

SOUTH AFRICA ECONOMY

OVERVIEW

South Africa is ranked lowest among the G20 countries in terms of GDP. South Africa was badly hit by the COVID 19 pandemic, recording a decline in real GDP of 7% in 2020. However, the country is recovering with a growth rate of 3.1% in 2021.



IMPACTS ON GDP

Climate change will have an effect on the growth rate and overall economic performance of the country. By mid century, costs could reach between 8 and 12 billion EUR (or 3% to 5% of GDP) under low and high emissions scenarios, respectively.

By the end of the century South Africa could stand to lose up to 13.5% of GDP, or 33 billion EUR under a high emissions scenario.

SECTORAL ECONOMIC IMPACTS

IMPACTS ON INDUSTRY AND INFRASTRUCTURE

The South African coastline covers more than 3,000 kilometers and links together the east and west coasts of Africa. Infrastructure and economic activities on the coast are exposed to sea-level rise and storm surges.

Road infrastructure alone, assuming that no adaptation measures are taken, could total expected annual damages of 190 million EUR by mid century, rising to 323 million EUR by the end of the century.

IMPACTS ON AGRICULTURE

Climate change induced changes in temperature and precipitation are expected to reduce annual agricultural output.

By mid century, South Africa could lose between 5.7% and 7.1% of the agricultural sector's contribution to value added under medium and high emissions scenarios, respectively. This translates into an economic loss of between 94 million and 122 million EUR.

Predicted declines in agricultural productivity, the resulting increases in domestic prices and negative effects on trade are expected to have serious implications for household incomes that, by mid century, could be reduced by almost 5 billion EUR. All this is also expected to affect GDP growth. Impacts on agriculture alone can determine a drop in GDP by 6% by 2080 relative to a no climate change scenario.

Some slightly positive effects from moderate climate change cannot be excluded in the livestock sector. Under a low emissions scenario by mid century, gains to the ranglands livestock production of between 10.9 to 19.6 million EUR may be experienced due to increase in the productivity of some vegetation types.

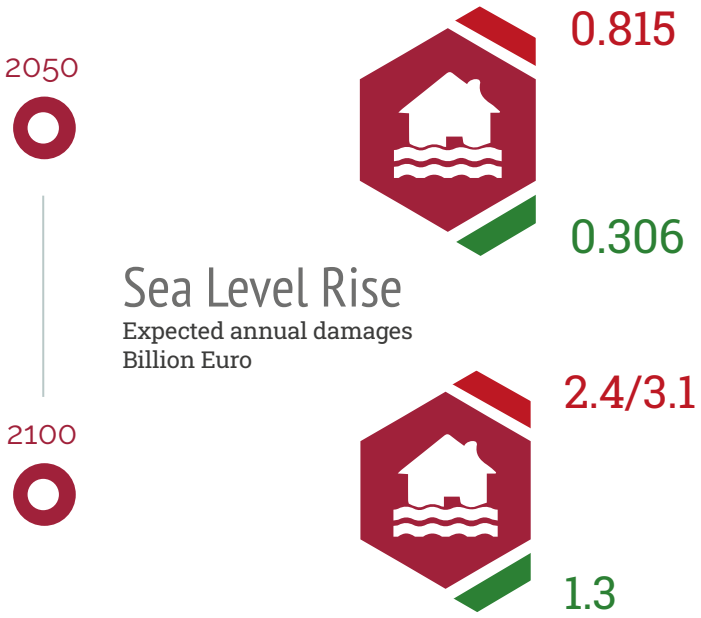
IMPACTS ON FORESTRY AND FISHERY

As a result of declines in the amount of suitable land available for forestry, by mid century also under a low emissions scenario forestry output could be reduced by as much as 43%, for a loss of 41 million EUR.

SEA LEVEL RISE DAMAGES

Under current levels of coastal protection, by mid century, sea-level rise and coastal flooding can cost the country 306 to 815 million EUR in terms of expected damages to assets under low and high emissions scenarios, respectively.

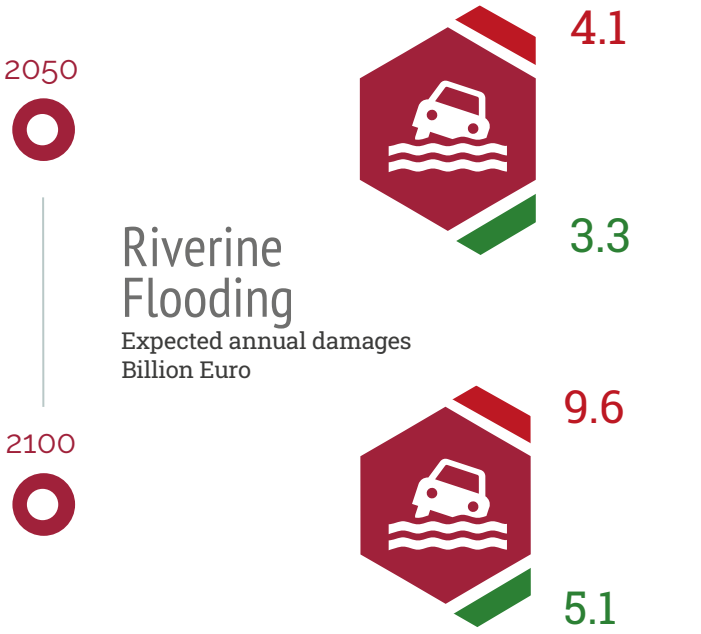
By the end of the century, expected losses may increase to 1.3 billion EUR under a low emissions scenario and 2.4 to 3.3 billion EUR under a high emissions scenario.



RIVER FLOODING DAMAGES

River flooding can also provoke non-marginal damages, in fact, potentially more severe than those from sea-level rise.

By mid century total asset losses could reach 3.3 to 4.1 billion EUR and in the second half of the century 5.1 to 9.6 billion EUR under low and the high emissions scenarios, respectively.



IMPACTS ON ENERGY

As with all other economic sectors, energy supply and energy networks in South Africa will undergo more intense stress from extreme weather events. Economic impacts of shifts in household and firm energy demand (see chapter on energy) are difficult to predict and will mostly lead to redistribution effects.

In the case of South Africa, the magnitude of the increase in demand for cooling is expected to exceed by far the one of the (tiny) decrease in heating demand, hence a significant increase in energy bills is expected.

IMPACTS ON TOURISM

The tourism sector has grown considerably in South Africa over recent decades, and is now a key component of GDP: roughly 11%, or 27.5 billion EUR. The sector is highly reliant on nature-based activities and hence is extremely sensitive to any changes in the climate and any losses to habitats and biodiversity. The country's unique natural resources are the primary attraction for tourists visiting South Africa, where 36% of international visitors were attracted by the wildlife, and 33% by scenic beauty.

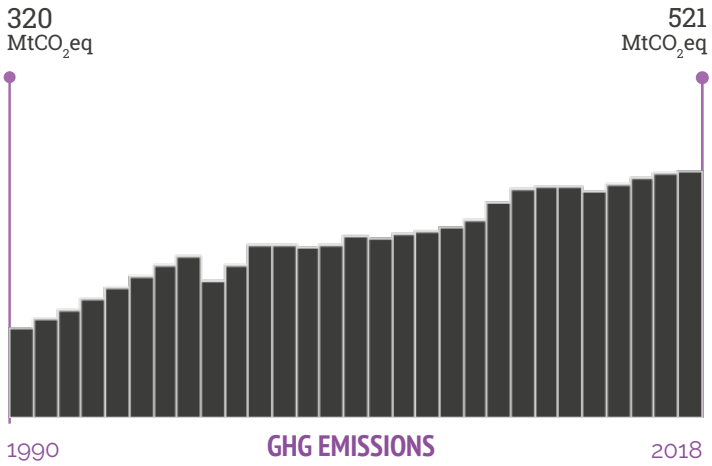
Increasing risk of malaria is expected to reduce the numbers of visitors in South Africa, as they will opt for areas free of the disease. No exact projections have been estimated for the losses to the sector under different climate change scenarios, but clearly the magnitude of losses would be large. Given that 36% of visitors were motivated by wildlife, South Africa stands to lose 3.6% of GDP, or €9 billion if this resource was completely eradicated by climate change. The exact contribution of biodiversity to the sector is difficult to calculate, but it is suggested that biodiversity losses could cost the tourism sector at least 0.23 billion EUR per year.

Additionally, rising temperatures and changing rainfall patterns could alter the length of the tourist season, with knock-on effects for related industries such as transport, restaurants, crafts and other tourist dependent business services such as tour guides.

SOUTH AFRICA POLICY

OVERVIEW

South Africa is the 15th largest emitter among G20 countries, and the 9th in terms emissions per capita. Emissions have increased significantly in recent decades.



INTERNATIONAL COMMITMENTS

South Africa ratified the Paris Agreement and submitted its NDC in 2016, with the target of reaching peak carbon emissions by 2030.

CLIMATE POLICY COMMITMENTS CHRONOLOGY

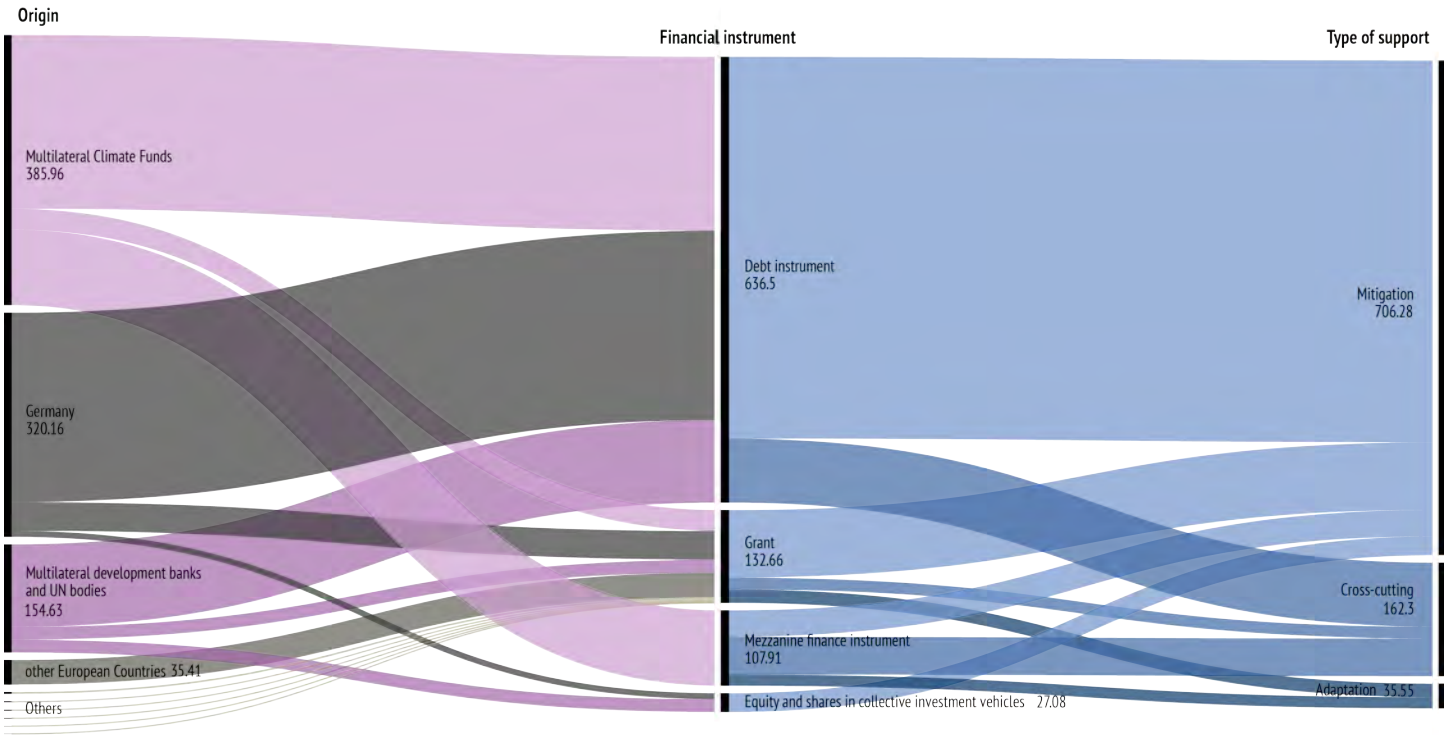
2002 — **Kyoto Protocol - 1st period**
No target

2016 — **Paris Agreement - 1st NDC**
Peak GHG emission by 2030

2021 — **Paris Agreement - NDC update**
Annual emissions in a range of 398-510 $MtCO_2eq$. in 2025 and of 350-420 $MtCO_2eq$. in 2030

INTERNATIONAL CLIMATE FINANCE ASSISTANCE

In 2017-2018 South Africa received 900 million USD in climate-related development finance, according to the OECD DAC's data. More than half comes from multilateral channels, whereas Germany is the main bilateral donor. The majority comes in the form of debt and equity instruments.

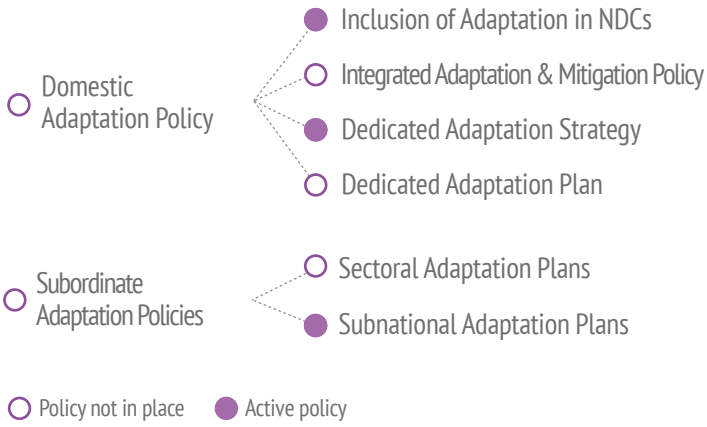


SUSTAINABLE RECOVERY POLICY

South Africa allocated 44.14 billion USD to total public spending in 2020. Out of this amount, the Global Recovery Observatory reported 2.45 billion USD in recovery spending. Only a small fraction, amounting to 100 million USD, is labelled as sustainable spending, mainly dedicated to green infrastructure and nature conservation.

DOMESTIC ADAPTATION POLICY

South Africa included adaptation in its NDC. The country adopted a dedicated National Adaptation Strategy, while the planning is delegated to sub-national administrations. No sectoral plans are foreseen in this legal framework.



ADAPTATION POLICY HIGHLIGHTS

TRANSNATIONAL INITIATIVES

Africa Adaptation Initiative

The AAI aims to enhance action on adaptation, with the aim of addressing the adaptation financing gap, and implementing measures to address disaster risk reduction and resilience needs in Africa.

NATIONAL INITIATIVES

The Adaptation Network

The Adaptation Network is a platform for sharing experiences, practical approaches and frameworks relating to climate change adaptation. Membership includes representatives from civil society, government, parastatals, academia and business

Reducing Disaster Risks from Wildfire Hazards Associated with Climate Change in South Africa

The project aims at reducing the country's environmental, social and economic vulnerability to the increased incidence of wildfires, through a biome-scale change in the fire management approach (from reactive fire-fighting to proactive fire management)

SUBNATIONAL INITIATIVES

City of Cape Town Climate Change Strategy

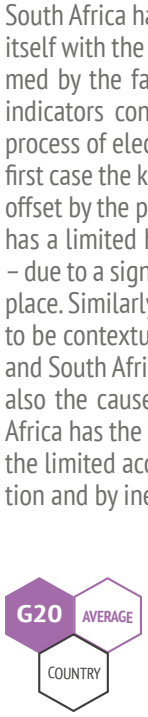
The draft strategy contains 35 goals. For adaptation, they focus on rising temperatures, water scarcity, flood risk and storm damage, coastal erosion, sea level rise, and fire risk.

Building resilience in the greater uMngeni catchment

The project aims to increase resilience of vulnerable communities in the uMgungundlovu District of KwaZulu-Natal, through interventions such as early warning systems, climate-smart agriculture and climate proofing settlements.

ENERGY TRANSITION

South Africa has yet to strengthen its efforts to transform its energy sector, and align itself with the trajectories of the most virtuous G20 countries. This analysis is confirmed by the fact that South Africa ranks below the group's average in all the five indicators considered in the analysis. Reliance on fossil fuels and a still partial process of electrification are two of the main problems affecting South Africa. In the first case the key role of coal in the energy and electricity mixes is not yet sufficiently offset by the penetration of renewables, although it must be noted that South Africa has a limited hydroelectric capacity compared to other G20 members, even though – due to a significant solar and wind potential - interesting efforts are already taking place. Similarly, when it comes to Electrification, the performance of the country has to be contextualized in the African continent, where electrification is extremely low and South Africa represents a positive regional exception. The massive use of coal is also the cause of negative results in terms of Emissions, a sector in which South Africa has the lowest ranking, while poor Efficiency performances are determined by the limited access to modern forms of energy for parts of the South African population and by inefficient energy transportation networks.



Only actively pursuing an energy transition based on decarbonization and electrification – from policy and regulation, to health and education – will enable countries to benefit the most from future opportunities and fight climate change whilst ensuring an equitable distribution of wealth.

The Energy Transition indicators were developed by Enel Foundation in cooperation with SACE, and provide a retrospective analysis based on historical data.