CLIMATE RISK COUNTRY PROFILE

MOZAMBIQUE

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This profile is part of a series of Climate Risk Country Profiles developed by Climate Change Group of the World Bank Group (WBG). The country profiles aim to present a high-level assessment of the climate risks faced by countries, including rapid-onset events and slow-onset changes in climate conditions, many of which are already underway, as well as summarize relevant information on policy and planning efforts at the country level.

The country profile series are designed to be a reference source for development practitioners to better integrate detailed climate data, physical climate risks and need for resilience in development planning and policy making.

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Unless otherwise noted, data is sourced from the WBG's Climate Change Knowledge Portal (CCKP), the WBG's designated platform for climate data. Climate, climate change and climate-related data and information on CCKP represents the latest available data and analysis based on the latest Intergovernmental Panel on Climate Change (IPCC) reports and datasets. The team is grateful for all comments and suggestions received from climate and development specialists, as well as climate research scientists and institutions for their advice and guidance on the use of climate related datasets.

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FOREWORD

Development progress has stalled in many countries amid low growth, increased fragility and conflict, pandemic-related setbacks, and the impacts of climate change. Droughts, extreme heat, flooding and storms push millions into poverty annually, causing unemployment and risking unplanned internal and cross-border migration. Every year, an estimated 26 million people fall behind due to extreme weather events and natural disasters. These shocks have the potential to push a total of 130 million into poverty by 2030.

The World Bank Group (WBG) is supporting countries to meet these challenges. As part of our vision to end poverty on a livable planet, we are investing in development projects that improve quality of life while creating local jobs, strengthening education, and promoting economic stability. We are also helping people and communities adapt and prepare for the unpredictable and life-changing weather patterns they are experiencing, ensuring that limited development resources are used wisely and that the investments made today will be sustainable over time.

Having access to data that is accurate and easily understandable is of course critical to making informed decisions. This is where the report you are about to read comes in.

Climate Risk Country Profiles offer country-level overviews of physical climate risks across multiple spatiotemporal scales. Each profile feeds into the economy-wide Country Climate and Development Reports and draws its insights from the Climate Change Knowledge Portal, the WBG's 'one-stop-shop' for foundational climate data.

Guided by World Bank Group data and analytics, developing countries can conduct initial assessments of climate risks and opportunities that will inform upstream diagnostics, policy dialogue, and strategic planning. It is my sincere hope that this country profile will be used to inform adaptation and resilience efforts that create opportunities for people and communities around the world.

Valerie Hickey, PhD
Global Director
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KEY MESSAGES

Mozambique has a tropical climate, with a distinct hot, rainy season and a cooler, dry season. The climate is characterized by significant variability, including frequent extreme weather events such as droughts, floods, and tropical cyclones. Droughts pose a serious threat to rain-fed agriculture.

Temperatures in Mozambique have already risen, with the most significant increases occurring during the dry season. From 2000 to 2050, temperatures are projected to continue increasing by 0.31°C per decade under the SSP3-7.0 scenario. This results in more extremely hot days and nights, and more humid and hot days toward the end of the century, which could have serious consequences for health, agriculture, energy demand, and related sectors.

Over the historical period, most regions have experienced a slight decline in precipitation, averaging around a 1% decrease, but this change is not significant. Looking ahead, Mozambique is projected to experience a slight reduction in total precipitation, though the change is not consistent across CMIP6 models. The median precipitation anomaly for the period 2040–2059 compared to 1995–2014 is projected to be –23 mm, reflecting a 2.6% decrease compared to the historical period. Consequently, the maximum yearly number of consecutive dry days is expected to increase, though only slightly by one additional drought day per year per decade from 2000 to 2050.

Extreme precipitation events, such as those with return periods of 100 years, are projected to occur 1.77 times more frequently by mid-century (2035–2064) under the SSP3-7.0 scenario compared to historical data from 1985–2014. This means that a once-in-a-century event would occur approximately every 58 years by 2050.

Long-term sea-level rise presents a significant threat to populated coastal areas, especially when combined with cyclones storm surge. Warming oceans are expected to severely impact marine biodiversity and artisanal fisheries. Additionally, Mozambique's vulnerability to recurrent bacterial diseases will likely be exacerbated, leading to heightened public health risks.

Addressing water sanitation issues, as well as preparing for droughts, extreme temperatures, heavy precipitation events, and sea level rise will be critical to mitigating these growing challenges.

COUNTRY OVERVIEW

Mozambique, located in southeastern Africa, is a coastal country bordered by six nations: Tanzania to the north, Malawi and Zambia to the northwest, Zimbabwe to the west, and South Africa and eSwatini to the southwest. With a coastline stretching over 2,500 kilometers, the country faces Madagascar to the east. Mozambique's geography is characterized by coastal lowlands along the Indian Ocean, uplands in the central-west, and high plateaus in the northwest (**Fig. 1a**). To the west, the landscape transitions into mountains and escarpments, especially in the northern provinces of Tete and Niassa. The southern region of the country is generally lower in elevation, featuring semi-arid lowlands.

Mozambique is endowed with an abundance of natural resources, including vast arable land, freshwater, and an increasing wealth of offshore natural gas and mineral deposits. The nation's three major deep-water seaports—Maputo, Beira, and Nacala—further bolster its position as a hub for trade and economic activity.

To this date, agriculture remains a central pillar of the economy. The country's population, which exceeds 33 million as of 2023 (**Fig. 1b**), is predominantly rural, with around 61% of the population living in rural areas and 69% of the workforce engaged in agriculture[1]. The fertile soils in the northern and central regions of the country enable significant agricultural output. These areas benefit from a tropical climate that supports the cultivation of crops like cassava, sugarcane, corn, peanut, rice, sorghum, millet, or wheat. The main cash crops are tobacco, cotton, sesame, sugar, and tea[2]. The Zambezi River, one of Africa's largest, plays a crucial role in Mozambique's agricultural and industrial sectors. It provides ample water for irrigation, allowing for year-round farming in the central and northern regions. Additionally, the river is key to the country's hydroelectric power generation. The southern provinces of Mozambique, primarily composed of lowland areas with a more arid climate compared to the rest of the country, face challenges related to water scarcity and more limited agricultural potential. The country is working to diversify its agricultural base and increase its resilience to climate-related challenges.

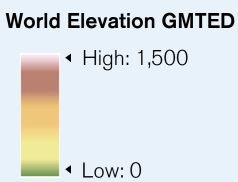
Mozambique's climate is characterized by significant variability, with frequent extreme weather events such as droughts, floods, and tropical cyclones. Droughts are a recurring disaster, occurring approximately every three to four years. These events pose a severe challenge to development, especially as most of the population relies on rain-fed agriculture for their livelihoods. The country's vulnerability to such extreme weather is exacerbated by its location at the end of several transnational river basins, making it prone to flooding, particularly in its delta regions. Flooding, especially when compounded by storm surges from cyclones, can devastate both agricultural land and critical infrastructure.

Mozambique is prioritizing disaster prevention and enhancing its early warning systems[3]. In response to climate change, adaptation efforts are being implemented across critical sectors, including agriculture, energy, environment, water security, and coastal protection, with a focus on preventing erosion and flooding and safeguarding fisheries and food security.

1 World Bank Development Indicators (2023).
2 Wikipedia https://en.wikipedia.org/wiki/Agriculture_in_Mozambique and USDA Foreign Agricultural Service US. Department of Agriculture https://ipad.fas.usda.gov/countrysummary/default.aspx?id=MZ
3 Updated First Nationally Determined Contribution (2021) https://unfccc.int/sites/default/files/NDC/2022-06/NDC_EN_Final.pdf. First Biennial Update Report (2022) https://unfccc.int/documents/624696

FIGURE 1A. Topography of Mozambique (in meters)[4] and Subnational Boundaries (World Bank cartography). Topography Plays a Crucial Role in Shaping Wind Patterns, Climate, and the Impacts of Sea Level Rise.

FIGURE 1B. Estimated Population Density (population per square km), 2020[5]



[4] Global Multi-resolution Terrain Elevation Data GMTED2010 https://pubs.usgs.gov/of/2011/1073/

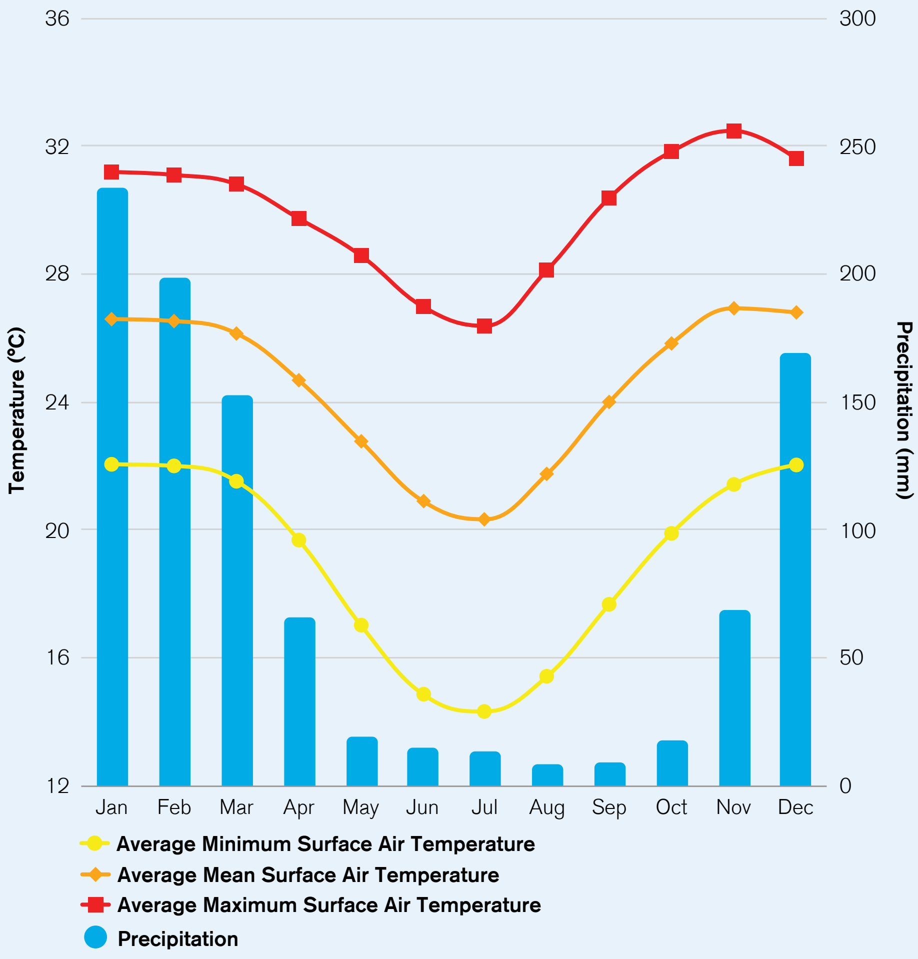
[5] Mozambique: Estimated population density (2020) https://reliefweb.int/map/mozambique/mozambique-estimated-population-density-2020-2-may-2023

CLIMATE OVERVIEW

Data overview: Historically, observed data is derived from the Climatic Research Unit, University of East Anglia (CRU), CRU TS version 4.08 gridded dataset (data available 1901–2023) - stations data -, and from the ERA5 reanalysis collection from ECMWF (1950–2023).

Mozambique's tropical climate is shaped by several climatic and geographical factors, including its proximity to the Indian Ocean, its varying elevation, and its position relative to the Intertropical Convergence Zone (ITCZ). Mozambique experiences a humid tropical climate with hot, rainy summers from November to April, influenced by the monsoon winds from the Indian Ocean, and dry colder winters from May to October (**Fig. 2**).

FIGURE 2. Monthly Historical Climatology of Average Temperature (minimum, average, and maximum) and Total Precipitation (1991–2023) for Mozambique (CRU dataset)



The northern areas receive the highest annual rainfall, supporting lush vegetation and abundant agriculture, and have a more pronounced dry season. The southern provinces are more arid and prone to droughts, which can have significant impacts on agriculture and water availability. Mozambique is also affected by tropical cyclones, particularly during the rainy season, which can bring heavy rains and cause flooding, especially in the coastal and low-lying areas.

The El Niño-Southern Oscillation (ENSO) significantly impacts Mozambique's climate, bringing extreme weather events. During El Niño, the country experiences droughts, especially in the southern and central regions, leading to crop failures, water shortages, and food insecurity. In contrast, La Niña causes increased rainfall, which can lead to flooding, particularly in low-lying areas and river basins. The wetter conditions during La Niña in turn increase the prevalence of malaria[6].

Mozambique's average annual precipitation is 970 mm (CRU data), with a peak of 233 mm in January (**Fig. 2**). Temperatures range from a high of 28°C (with a minimum of 24°C and a maximum of 32°C) during the summer to a low of around 21°C (with a minimum of 15°C and a maximum of 26°C).

Annual rainfall varies widely across the country, decreasing as you move south. Zambézia displays the highest annual precipitation at 1209 mm, followed by Niassa (1127 mm), while in the southern provinces, annual precipitation is 731 mm in Inhambane, 723 mm in Maputo, and only 539 mm in Gaza.

The highest average yearly temperatures in Mozambique are found in the northern coastal regions, gradually decreasing toward the south and the mountainous areas. For example, Cabo Delgado in the north has an average temperature of 25.5°C (ranging from a minimum of 20.5°C to a maximum of 30.5°C), while Maputo in the south has an average of 23.7°C (ranging from 17.7°C to 29.7°C). The highest summer temperatures in Mozambique are recorded in the interior region of Tete, where the maximum temperature during the hottest month reaches 33.9°C. The southern Gaza also experiences high temperatures, with maximums reaching 33.4°C.

See **Tables A1 and A2** for historical temperature and precipitation values across regions.

TEMPERATURE AND PRECIPITATION HISTORICAL AND PROJECTED TRENDS

Data overview: Historical observed data is derived from the ERA5 reanalysis collection from ECMWF (1950–2023). Modeled climate data is derived from CMIP6, the Coupled Model Intercomparison Project, Phase 6. This risk profile focuses primarily on SSP3-7.0[7], which projects a doubling of CO2 emissions by

[6] Harp, R. D., Colborn, J. M., Candrinho, B., Colborn, K. L., Zhang, L., & Karnauskas, K. B. (2021). Interannual climate variability and malaria in Mozambique. *GeoHealth*, 5, e2020GH000322. https://doi.org/10.1029/2020GH000322

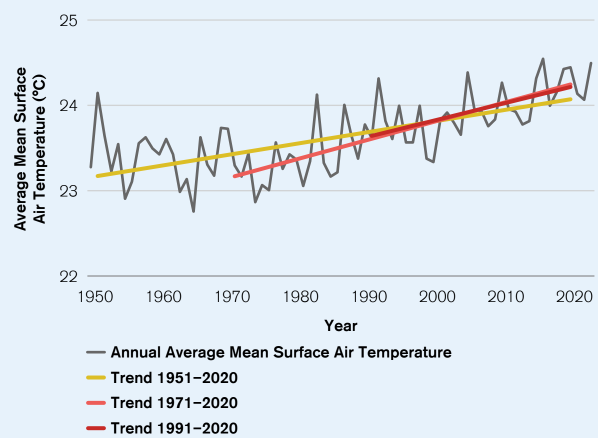
[7] Climate scientists may prioritize SSP4.5 and SSP8.5 to cover a range of potential futures, but SSP8.5 is frequently avoided in policy discussions due to its extreme nature. SSP3-7.0 is understood as a balanced compromise—sufficiently pessimistic yet in line with current policies. Note that patterns of change are generally consistent across scenarios, differing only in timing and impact intensity. For example, impacts projected under SSP3-7.0 by 2070 (2.8°C warming) are projected to occur by 2060 under SSP5-8.5, given the same level of warming. This approach allows scenarios to be translated by focusing on the warming signal rather than specific timelines. Please see the attached tables, which illustrate the relationship between warming levels and future periods for different scenarios. For more information see: IPCC AR6 https://data.ceda.ac.uk/badc/ar6_wg1/data/spm/spm_08/v20210809/panel_a

2100, a global temperature change of approximately 2.1°C by mid-century (2040–2059) and 2.7°C (likely 2.1°C to 3.5°C) by the end of the century (2080–2099), with respect to pre-industrial conditions (1850–1900).

Historical Temperature Changes

Over the past few decades, mean surface air temperatures have increased significantly, with a trend of 0.14°C per decade from 1951 to 2020, 0.22°C per decade from 1971 to 2020, and 0.20°C per decade from 1991 to 2020 (ERA5, **Fig. 3**). From 1971 to 2020, the trend shows a higher increase in daytime temperatures (Tmax) at 0.22°C per decade, compared to nighttime temperatures (Tmin), which have risen by 0.15°C per decade over the same period (**Table A1**).

FIGURE 3. Mozambique's Annual Mean Surface Air Temperature Time Series and Decadal Trends for Different Periods between 1951 and 2020 as Indicated, ERA5 Data



The districts Gaza and Tete experienced the largest 50-year temperature trend at 0.25°C per decade from 1971 to 2020. Tete and Zambézia experienced the largest trend in maximum temperature, at 0.27°C and 0.26°C per decade respectively. The highest increase in minimum temperature was experienced in Niassa (at 0.21°C per decade) from 1971 to 2020.

Seasonally, the largest temperature increase has occurred during the dry season, at a 0.25°C per decade in winter (June–August) and 0.28°C per decade in spring (Sept–Nov) (December to May) from 1971 to 2020, compared to 0.2°C per decade in summer (Dec–Feb) and 0.17°C per decade in fall (March–May).

Projected Temperature Changes

Mozambique's temperatures are projected to increase further into the future for all the scenarios (**Fig. 4**). Under SSP3-7.0, the mean air surface temperature nationwide increases from 24.28°C during the historical reference period of 1995–2014 to 25.75°C (10th percentile 25.14°C, 90th percentile 26.46°C) for the period 2040–2059. The minimum temperature nationwide increases from 19.44°C during the historical reference period to 20.92°C (20.36°C, 21.53°C) for 2040–2059. Maximum temperature increases from 29.13°C to 30.58°C (29.80°C, 31.49°C) for 2040–2059.

The projected temperature increase from 2000 to 2050 is 0.31°C per decade under SSP3-7.0, higher than the historical trend observed over the past 50 years (0.22°C per decade, ERA5). Moreover, this rate accelerates to 0.47°C per decade from 2050 to 2100 under the same scenario. The median temperature anomaly from 1995–2014 to 2040–2059 under SSP3-7.0 is projected to be 1.44°C, with similar increases seen for minimum

FIGURE 4A. Projected Average Mean Surface Air Temperature for Different Climate Change Scenarios as Labeled, Along with the 10th–90th Percentile Dispersion Across Models

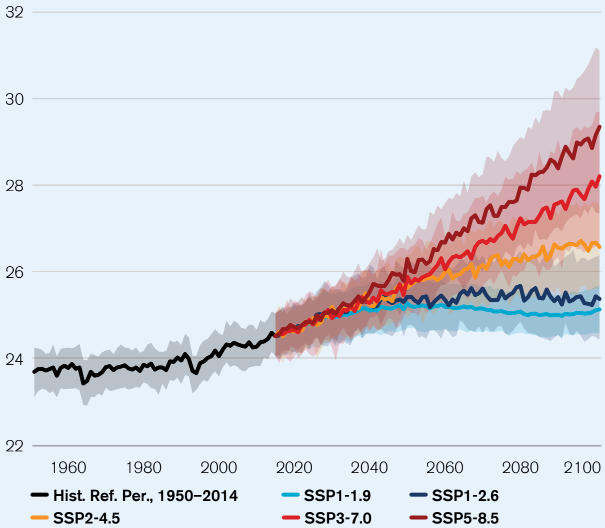
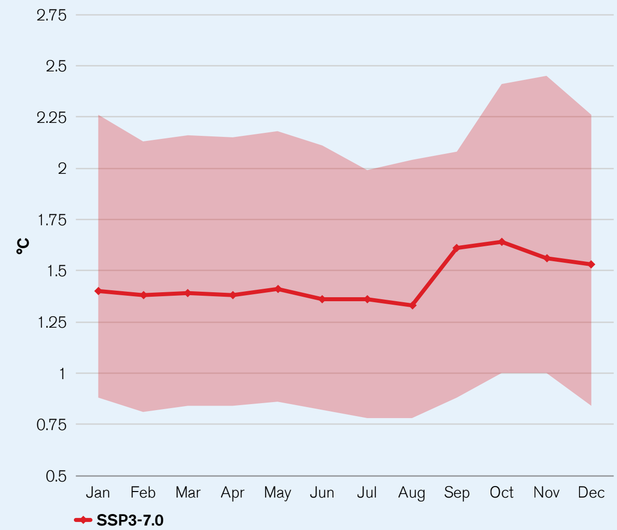


FIGURE 4B. The Projected Monthly Anomaly of the Average Mean Surface Air Temperature for 2040–2059 (relative to the reference period 1995–2014) Under SSP3-7.0, Along with the 10th–90th Percentile Dispersion Across Models

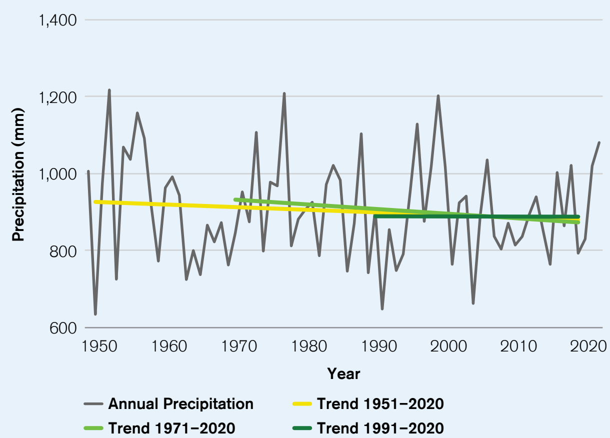


and maximum temperatures, and slightly larger during spring. The highest trend projected from 2000 to 2050 is in Manica (0.33°C per decade) followed by the southern districts of Gaza, Maputo, and Cidade de Maputo at 0.32°C per decade (**Table A3**).

Historical Precipitation Changes

Historical annual precipitation averages 888 mm per year from 1990 to 2020 (ERA5, **Fig. 5**)[8], with values ranging from 630 to 1,200 mm, showing significant interannual variability. No long-term significant trends are detected in Mozambique during the historical period. Most regions have

FIGURE 5. Mozambique's Annual Precipitation Time Series and Decadal Trends for Different Periods between 1951 and 2020 as Indicated, ERA5 Data



[8] Note that the ERA5 total precipitation is slightly lower than the reported by CRU, 970 mm.

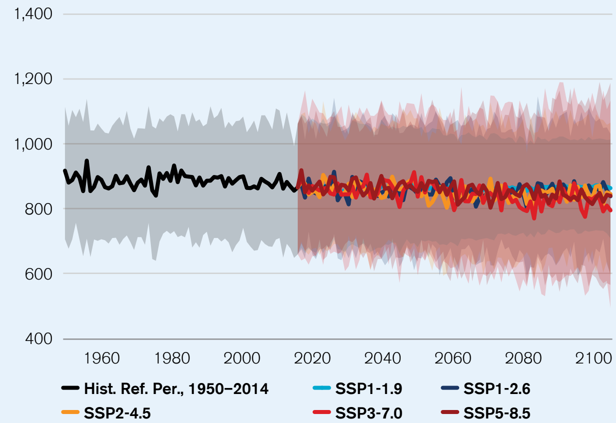
observed a decrease in precipitation, especially northern provinces, southern provinces, and on the coast, but these changes are not significant and represent only a 1% decrease on average (**Table A2**).

Projected Precipitation Changes

Mozambique is in a region where light decreases in total precipitation are projected, although the change is not robust across CMIP6 models (**Fig. 6**). Under SSP3-7.0, Mozambique's average annual precipitation is predicted to change nationwide from 880 mm (781 mm, 10th percentile, 977 mm, 90th percentile) during the historical period (1995–2014, historical scenario) to 861 mm (702 mm, 1045 mm) for 2040–2059.

The median precipitation anomaly projected for 2040–2059 compared to 1995–2014 is –23 mm, reflecting a 2.6% decrease with respect to the historical period. The percentage decrease is highest in Sofala, with a 4.4% decrease by 2040–2059, followed by Zambézia (3.8% decrease), Manica (3.5% decrease), and Inhambane (3.4% decrease) (**Table A5**).

FIGURE 6. Projected Annual Precipitation for Different Climate Change Scenarios as Labeled, Along with the 10th–90th Percentile Dispersion Across Models



IMPACTS OF A CHANGING CLIMATE

Hot Days

Hot days pose significant risks to both human and animal health, increasing the likelihood of heat-related illnesses, while also heightening the threat of wildfires, damaging crops, straining water supplies, increasing irrigation needs, and driving up energy demand, all of which can disrupt infrastructure, ecosystems, food security, and livelihoods.

Future projections indicate a significant increase in the number of hot days (Tmax > 30°C), driven by rising temperatures (**Table A3**). During the historical period (1995–2014), Mozambique experienced an average of 143 (129, p10, 157, p90) hot days per year (almost 5 months). Under the SSP3-7.0 scenario, this number is expected to rise to 205 (171 to 243) days per year (almost 7 months) by 2040–2059, and by the end of the century (2080–2099), it could reach 272 (221 to 312) days per year (9 months), with only the colder season escaping from high temperatures. The anomaly is highest during April and September (beginning and end of the dry season) and lowest during July (coldest mid-dry season). Cabo Delgado will experience the highest increase in the yearly number of hot days, with 21 more days per decade from 2000 to 2050.

Future projections also indicate a significant increase in the number of extremely hot days (Tmax > 35°C). During the historical period (1995–2014), Mozambique experienced an average of 17 (12, p10, 21, p90) extremely hot days per year. Under the SSP3-7.0 scenario, this number is expected to rise to 39 (23 to 60) days per year by 2040–2059, and by the end of the century (2080–2099), it could reach 84 (44 to 137) days per year. (almost 3 months) The increase is highest during November. The rate of increase in the yearly number of extremely hot days will be highest during the second half of the century. From 2050 to 2100, the projected trend is 12 more days per decade, the highest in Sofala with 15 more days per decade.

Next, we examine the percentage of the population at high health risk due to extremely hot days. For the calculation of population exposure, high-risk areas are locations where the 50-year return level[9] of the annual number of days with maximum temperatures exceeding 35°C is greater than 30[10] (**Table A6**). As a result of rising extreme temperatures, the proportion of Mozambique's population exposed to high heat is projected to increase throughout the 21st century. Exposure is expected to rise from 30% during the historical period (1975–2024, centered on 2000) to 54% by 2035 (2010–2059), and could reach 87% by the century's end (2050–2099, centered on 2075).

The central regions of Zambézia, Tete, and Sofala have historically faced dangerous heat levels, with exposure rates of 54%, 54%, and 60% respectively. By 2035, projected population exposure in these areas will increase to 71%, 59%, and 83%. In the southern provinces of Gaza and Maputo, exposure will rise from 43% and 14% in 2000 to 82% and 72% by 2035. By the end of the 21st century (2075), all regions are expected to experience over 90% heat exposure, except for Niassa, Cabo Delgado, Tete, and Inhambane, which will have exposure rates around 70%. By 2075, Tete and Sofala will face even higher temperatures (Tmax > 40°C), with exposure rates reaching 42% and 45%, respectively. For the calculation of population exposure to Tmax > 40°C, high-risk areas are locations where the 50-year return level of the annual number of days with maximum temperatures > 40°C is greater than 20.

Hot Nights

Hot nights pose risks to sleep quality, human health, and agricultural crops, as the lack of cooling during the night can exacerbate heat stress on plants, hindering growth and reducing yields, while also increasing the risk of heat-related illnesses, higher energy consumption, and greater strain on power grids.

The number of hot (tropical) nights (Tmin > 23°C) is projected to rise significantly (**Table A4**). Historically (1995–2014), Mozambique experienced an average of 52 (40, 63) tropical nights per year, reaching their peak in

[9] A 50-year return level refers to an event that is expected to occur, on average, once every 50 years.

[10] Population dataset: Gridded Population of the World, Version 4: GPWv4; Revision 11, Dec 2018. For each pixel (at approximately 25 km resolution), the return level for a given return period is calculated by fitting a Generalized Extreme Value (GEV) distribution to the time series. A pixel is classified as "too risky" (1) if the return level exceeds the specified threshold, and "not too risky" (0) otherwise. The reported population exposure represents the percentage of the total population in each region that is exposed to risk (1).

summer (Dec–Feb). Between 2000 and 2050, the projection shows an increase of 13 additional tropical nights per decade, reaching 114 (86 to 142) tropical nights annually (almost four months) by 2040–2059 with the highest changes during summer and expanding into spring and fall. The trend will continue, leading to 185 (141 to 227) tropical nights annually (above six months) by the end of the century (2080–2099).

Tropical nights exceeding a higher threshold (Tmin > 26°C) are rarer but are also projected to increase. From only 2.2 (0.8, 4.3) nights during the historical period, this is expected to rise to 14.5 (6.2, 28.0) nights by mid-century and 59 (24, 113) nights by the end of the century (2 months). The increase is projected to be 13 more yearly tropical nights per decade between 2050 and 2100. The increase is highest during the summer months.

Cidade de Maputo currently experiences 88 days per year with minimum temperatures (Tmin) above 23°C, followed by Sofala (75 days) and Gaza (71 days). By mid-century, Cabo Delgado is projected to see the most tropical nights, increasing to 147 nights from a historical 49, with an additional 21 nights per decade from 2000 to 2050. By the end of the century (2080–2099), Cidade de Maputo, Sofala, Gaza, and Tete will experience the highest number of tropical nights, with Tmin above 26°C, reaching 87, 83, 79, and 75 days, respectively.

At the national level, population exposure to dangerous levels of tropical nights (Tmin > 26°C) is projected to rise from 7% during the historical period (centered at 2000) to 25% by 2035 and 75% by 2075 (**Table A6**). For the calculation of population exposure, high-risk areas are locations where the 50-year return level of the annual number of days with night temperatures > 26°C is greater than 30. Historically, only Tete and Sofala were exposed to hot night temperatures, at 20% and 18% respectively. By 2035, 89% of population in Cidade de Maputo are exposed, 44% in Tete, 43% in Sofala, and 41% in Gaza. By the end of the 21st century (2075), the southern Sofala, Inhambane, Gaza, Maputo and Cidade de Maputo are more than 98% exposed, while the northern and more mountanious regions reach 78% exposure in Zambézia, 73% in Nampula, 64% in Cabo Delgado, and between 40 and 50% in Tete. This dramatic increase in exposure will significantly heighten risks to both health and agriculture.

Humid Heat

The Heat Index is a measure of perceived temperature that combines both air temperature and humidity in the shade[11]. When both are high, the Heat Index rises, significantly increasing the risk to human health. In such conditions, the body's ability to cool itself through sweating is impaired, which can lead to heat-related illnesses or even fatalities. The number of days with a Heat Index of 35°C or higher is expected to become increasingly significant by the end of the 21st century, especially during the summer months. While the period from 2040–2059 is projected to experience only 15 (5 to 29) days with a Heat Index above 35°C, the trend will accelerate from 2051 to 2100, with an increase of 13.5 additional days per decade. By 2081–2100, the total number of such days could reach 69 per year (30 to 120)—more than two months of extreme humid heat that was only occasionally felt during the historical period (**Table A4**).

[11] Heat Index as defined by US-National Weather Service - Steadman R.G., 1979: The assessment of sultriness, Part I: A temperature-humidity index based on human physiology and clothing science. J. Appl. Meteorol., 18, 861–873, doi: http://dx.doi.org/10.1175/1520-0450

This risk is particularly severe in Sofala, where the number of days with a Heat Index above 35°C is projected to rise significantly by the end of the 21st century under the SSP3-7.0 scenario at a rate of 20 more yearly humid and hot days per decade. By 2080–2099, this region is expected to experience 111 days (about 3.7 months) per year. In comparison, during the mid-century period (2040–2059), the number of such days is projected to reach 31 per year, while historically (1995–2014), the regions experienced no extreme heat index.

Next, we examine the percentage of the population at high health risk due to increased humid heat. High-risk areas are locations where the 50-year return level of the annual number of days with heat index exceeding 35°C is greater than 20 —a threshold considered particularly dangerous for health (**Table A6**). Historically (2000), 2.3% of the population was exposed to a high heat index. By 2035, this exposure is projected to rise to 50%, and by 2075, it is expected to reach 85%. By 2035, exposure will be particularly high in Sofala, Gaza, and Cidade de Maputo, above 96%, followed by Maputo (72%) and Zambézia (58%). By 2075, the southern regions are 100% exposed (Sofala, Inhambane, Gaza, Maputo and Cidade de Maputo), followed by central and northern Nampula (96%), Cabo Delgado (95%), Zambézia (87%), and Manica (78%). Only Tete and Niassa, interior mountainous regions, are projected to experience less than half exposure (at 46% and 35% respectively) by the end of the 21st century.

Drought

Drought conditions can severely disrupt the growth cycle of crops, leading to crop collapse and reduced yields, especially in places with poor irrigation systems. This not only affects agricultural productivity but also the livelihoods of small farmers, particularly those who rely on their crops for access to nutritious food.

The annual maximum number of consecutive dry days (<1 mm daily), or CDD, reflects the duration and severity of the dry season. Changes in CDD can signal either an extension or reduction of the dry season, as well as shifts in weather erraticity. Historically, the number of consecutive dry days has ranged between 50 and 100 days per year, with an average of 68 days annually from 1990 to 2020 (according to ERA5 data). Over the past 50 years (1971–2020), the duration of the dry season has significantly increased at a rate of 2.25 more days per decade, but note the high interannual variability and the declining trend, not significant, when looking at 70 years data (**Fig. 7a**). Notably, between 1971 and 2020, a widespread drying trend has been observed in most regions, but is only significant in Tete, at 3.63 more annual consecutive dry days per decade, from 96 CDD historically (**Table A2**).

In accordance, the maximum number of consecutive wet days (>1 mm daily), which has historically varied between 15 and 35 days per year, with an average of 20 days annually from 1990 to 2020, has followed an opposite trend (**Fig. 7b**). There has been a significant reduction of 0.81 fewer days of continuous wet spells at the national level, with a significant decline of 1.82, 1.66, and 1.14 days per decade in the northern regions of Niassa, Cabo Delgado, and Nampula (**Table A2**).

In the future, according to CMIP6, CDD is projected to increase only slightly from 71 (62, 80) CDD during the historical period (1995–2014) to 77 (60, 92) by 2040–2059 and 85 (62, 105) by 2080–2099, at a linear rate of 1 more CDD per decade from 2000 to 2050 (**Table A5**). The maximum number of consecutive wet days, which historically averaged 30 days according to CMIP6 simulations (note this is higher than actual historical reanalysis data by ERA5), is projected to remain around the same in the future.

FIGURE 7A. Mozambique's Historical Annual Maximum Number of Consecutive Dry Days, Along with Decadal Trends for Various Periods between 1951 and 2020, based on ERA5 Data

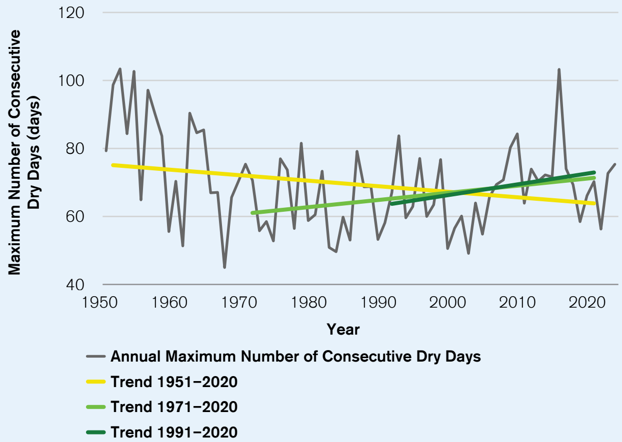
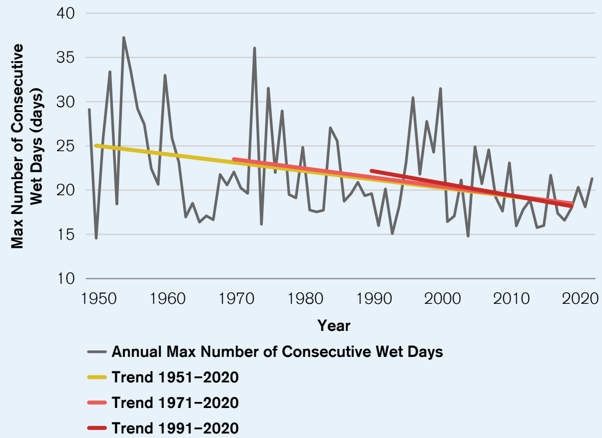


FIGURE 7B. Mozambique's Historical Annual Maximum Number of Consecutive Wet Days, Along with Decadal Trends for Various Periods between 1951 and 2020, based on ERA5 Data



Extreme Precipitation

Intense precipitation events are expected to become more frequent, with their return periods decreasing. In a warmer world, the potential of air to carry moisture goes up, and thus the potential for heavier precipitation goes up. Intense precipitation events, characterized by the largest single-day event during the historical period, will likely recur more frequently (e.g. the return period will decrease, **Table 1**), which can negatively affect the flooding risk, and be dangerous for infrastructure, human safety, or agriculture. In Mozambique, recurrent flooding, flash floods and landslides will become more frequent due to intense rain. Extreme precipitation events with return periods of 100 years are projected to occur 1.77 times more frequently by mid-century (2035–2064) under the SSP3-7.0 scenario, compared to historical data from 1985–2014. This means that what was historically a 100-year event will occur approximately every 58 years by 2050. In Mozambique, a historical 100-year precipitation event corresponds to 161 mm of rain falling in a single day—an amount that, historically, has been observed during the whole December (164 mm).

Similarly, 50-year return events are projected to increase 1.65 times, 25-year events 1.54 times, and 10-year events 1.4 times by mid-century. However, there is significant uncertainty in these projections (**Table 1**). By the end of the 21st century, 100-year rare events are projected to occur 2.8 times more frequently, happening every 37 years instead of every 100 years. Similarly, 20-year, 25-year, and 50-year events are expected to occur at least twice as often—2.01, 2.11, and 2.44 times more frequently, respectively. This means rare precipitation events will become normal on a yearly basis.

As a result, 23% of the population in Manica and 17% of population in Sofala will be exposed to dangerous levels of extreme rainfall by 2075, from 5% and 0% during the historical period (2000) (**Table A7**). Risk areas are defined as locations where the 50-year return level of the annual number of days with precipitation > 50 mm exceeds 5.

TABLE 1. Future (2035–2064) and (2070–2099) Return Period (years) for Extreme Precipitation Events that Correspond to the Return Levels for the Largest Single-Day Event During the Historical Period (1985–2014) for SSP3-7.0. Change in Future Exceedance Probability Expressed as Change Factor for Extreme Precipitation Events that Correspond to the Return Levels for the Largest Single-Day Event During the Historical Period (1985–2014) for Future (2035–2064) and (2070–2099) SSP3-7.0.

Time Period	Historical Return Period (1985–2014, center 2000)					
1985–2014 center 2000	5-yr	10-yr	20-yr	25-yr	50-yr	100-yr
	Return Level (mm) - Median (10th, 90th)					
198–2014 center 2000	77.44 (52.20–115.33)	94.29 (61.74–147.87)	112.53 (71.27–189.35)	119.02 (74.52–205.58)	139.72 (84.62–264.15)	160.92 (94.60–342.18)
	Future Return Period (years) - Median (10th, 90th)					
2035–2064 center 2050	3.86 (2.65–5.52)	7.20 (4.40–11.24)	13.44 (7.28–23.25)	16.43 (8.54–29.56)	30.80 (13.85–63.06)	57.63 (22.41–136.33)
2070–2099 center 2085	3.37 (2.20–5.06)	5.86 (3.46–9.85)	10.15 (5.27–19.25)	12.12 (5.99–24.03)	21.07 (8.84–48.59)	36.84 (12.93–98.73)
	Change in Future Annual Exceedance Probability (change factor) - Median (10th, 90th)					
2035–2064 center 2050	1.30 (0.87–1.80)	1.40 (0.84–2.11)	1.50 (0.82–2.50)	1.54 (0.81–2.65)	1.65 (0.78–3.21)	1.77 (0.75–3.94)
2070–2099 center 2085	1.50 (0.95–2.16)	1.74 (0.96–2.73)	2.01 (0.96–3.56)	2.11 (0.96–3.92)	2.44 (0.97–5.33)	2.80 (0.97–7.39)

Fractional change above 1 indicates increased probability and decreased return period. For example, a fractional change of 1.77 indicates a 77% increase in the probability of suffering 100-year extreme precipitation events in the future, or 1.77 more likely.

The rest of the areas are not subject to this risk. However, when defining risk areas as locations where the 25-year return level of the annual largest 5-day precipitation exceeds 130 mm, historical data shows that almost all regions are already at nearly 100% exposure, except for Niassa (69%), Cabo Delgado (55%), and Tete (69%). By the end of the 21st century, by 2075, these regions are projected to surpass 90% exposure, aligning with the other regions.

Sea Surface Temperatures

The IPCC East Southern Africa region, where Mozambique's coasts are located, have historically experienced an average sea surface temperature of 26.2°C (ranging from 25.1°C to 26.5°C) between 1995 and 2014 (CMIP6 models[12]). With climate change, the region is already experiencing more frequent marine heatwaves. Under the SSP3-7.0 scenario, sea surface temperatures are projected to increase by 0.5°C (0.4°C at the 10th percentile to 0.7°C at the 90th percentile) in the near term (2021–2040), 1.0°C (0.8°C to 1.3°C) by mid-century (2041–2060), and 2.3°C (1.7°C to 3.0°C) by the end of the century (2081–2100), relative to recent historical averages (1995–2014), which are already higher than sea temperatures during pre-industrial conditions. This temperature increase is expected to be similar throughout the year.

[12] IPCC AR6 WGI Interactive Atlas https://interactive-atlas.ipcc.ch/.

Due to the inertia of the oceans, these temperature increases are unlikely to reverse anytime soon. A rise of more than 1°C is expected to have catastrophic consequences for fisheries, biodiversity, and coral reefs, which are especially vulnerable to even small increases in sea temperature.

Sea Level Rise

According to altimetry (satellite) data, sea level rose 11 centimeters total from 1993 to present along Mozambique's coastline[13]. Under the SSP3-7.0 scenario, sea level is expected to rise 18 centimeters from 2020 to 2050, with a likely range from 13 to 25 centimeters, and 69 centimeters from 2020 to 2100, with a likely range from 51 to 94 centimeters (**Fig. 8**). This means that sea level rise is projected to increase by 0.24 meters by 2050 and 0.75 meters by 2100 under the SSP3-7.0 scenario, relative to 1995–2014.

FIGURE 8. Projected Total Sea Level Change Under Different SSP Scenarios Relative to the Historical Baseline (1995–2014). The Shaded Ranges Show Uncertainties at 17th–83rd Percentile Ranges. Data from NASA[14].

Over the next two decades, sea level rise is expected to occur at a similar rate regardless of emissions, scenarios, or warming levels. However, beyond this period, high-emission scenarios project significantly greater increases in sea level. Despite uncertainties, it is certain that sea levels will continue to rise across all scenarios for centuries, underscoring the need for long-term planning. Sea level rise could reach 0.3 m above historical conditions starting

[13] NASA https://earth.gov/sealevel/sea-level-explorer/

[14] What are low confidence scenarios? https://earth.gov/sealevel/about-sea-level-change/future-sea-level/the-basics/#otp_what_are_low_confidence_projections_vs._medium_con

around 2050 or earlier in all scenarios, and 0.5 m during the second half of the 21st century with respect to the 1995–2014 baseline[15]. "Under the SSP3-7.0 scenario, there is a 92% chance of exceeding half meter of global sea level rise 9% chance of exceeding 1 meter of global sea level rise by 2100"[16].

Between 1980 and 1990 (10-year period), there were 891 days exceeding the minor high-water level in Mozambique, accounting for 24% of the total 3650 days. This number increased to 1112 days (30% of the time) between 2005 and 2015. The minor high-water level is defined as 40 cm above the average high tide (mean higher high-water, MHHW) and serves as an indicator of potential flooding impacts. As sea levels rise, flooding will start to occur more often and with worsening severity.

Extreme sea level surge events are projected to become significantly more frequent across much of the tropics. In Mozambique, a sea level event with a 100-year return period, currently reaching around 2 to 3 meters, is expected to occur as often as once every 5 years in the northern coast and once every 50 years in most coastal Mozambique by 2050 under the RCP4.5 scenario, with approximately 2.0°C of warming[17]. On the other hand, Tebaldi et al. (2021)[18] project that 100-year sea level events might become annual occurrences with just 1.5°C of global.

Cyclones

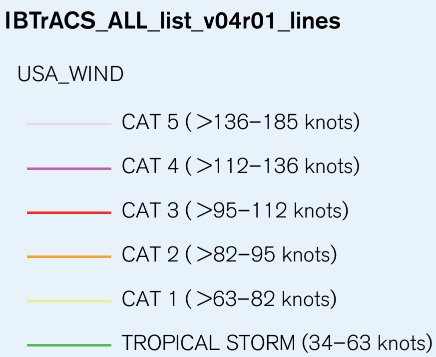
Mozambique lies in the primary cyclone zone (**Fig. 9**). These storms can cause coastal damage, infrastructure destruction, biodiversity loss, and the displacement of communities. Additionally, flooding and landslides may become more frequent due to storms and coastal storm surge.

Data overview: The occurrence of tropical cyclones in any specific location remains a rare event, making historical records too limited to reliably estimate recurrence intervals for these storms. This historical uncertainty can be partially addressed using models that simulate large ensembles of tropical cyclones. One such tool is the Columbia HAZard Model (CHAZ[19]), which generates an extensive synthetic catalog of potential cyclone tracks by simulating tropical cyclones across the oceans and their impacts upon landfall. This approach provides a more comprehensive perspective compared to observational data alone. The findings presented here rely exclusively on the CHAZ model, utilizing the column relative humidity (CRH) configuration to represent moisture. These simulations are informed by 12 different Global Circulation Models from the CMIP6 ensemble and project tropical cyclone activity during the historical period (1951–2014) and into the future under the SSP2-4.5 scenario, focusing on the period 2035–2064 (centered around 2050). We apply a footprint to the CHAZ tracks to

15 NASA Sea Level Projection tool at 20°S, 35°E https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool?lat=-20&lon=%2035&data_layer=scenario
16 NASA https://earth.gov/sealevel
17 Vousdoukas, M.I., Mentaschi, L., Voukouvalas, E. et al. Global probabilistic projections of extreme sea levels show intensification of coastal flood hazard. Nat Commun 9, 2360 (2018). https://doi.org/10.1038/s41467-018-04692-w
18 Tebaldi, C., Ranasinghe, R., Vousdoukas, M. et al. Extreme sea levels at different global warming levels. Nat. Clim. Chang. 11, 746–751 (2021). https://doi.org/10.1038/s41558-021-01127-1
19 Lee, C.-Y., Tippett, M. K., Sobel, A. H., & Camargo, S. J. (2018). An environmentally forced tropical cyclone hazard model. *Journal of Advances in Modeling Earth Systems*, 10, 223–241. https://doi.org/10.1002/2017MS001186

capture the full extent of the cyclones. This is especially important for small islands to ensure that the cyclone's impact is not underestimated. The footprint is based on modeled horizontal wind profiles and latitude, using a dual-exponential decay function derived from 380 observed storms, as detailed by Willoughby et al. (2006)[20].

FIGURE 9. Observed Historical Cyclones from IBTrACS[21]. All Recorded Cyclones have been Classified According to the Saffir-Simpson Scale Using the Variable "USA_wind", which Records Sustained Maximum Winds Every 3 Hours (see label in knots). The IBTrACS Historical Data Covers Cyclones Recorded from 1840 to 2023, with the Caveat that Records Prior to 1980 may be Incomplete.



[20] Willoughby, H. E., R. W. R. Darling, and M. E. Rahn, 2006: Parametric Representation of the Primary Hurricane Vortex. Part II: A New Family of Sectionally Continuous Profiles. *Mon. Wea. Rev.*, 134, 1102–1120, https://doi.org/10.1175/MWR3106.1.

[21] International Best Track Archive for Climate Stewardship (IBTrACS) https://www.ncei.noaa.gov/products/international-best-track-archive

Tropical Cyclones are classified using the Saffir-Simpson Hurricane Scale, which is based on maximum sustained wind speeds (see **Fig. 9**). Historically, the frequency of tropical cyclones (maximum wind speeds above 34 knots) in the entire Mozambican Exclusive Economic Zone EEZ is 2.70 cyclones per year, corresponding to a return period of 0.37 years. Of these, 1.02 cyclones per year make landfall, equivalent to a return period of about 0.98 years. More than half of the tropical cyclones that intersect with the EEZ are tropical storms (59.4%), 19.2% are Category 1 cyclones, and only 1.42% reach Category 5 intensity. At landfall, the proportion of lower-intensity cyclones increases, with tropical storms accounting for 65.65%, while the proportion of high-intensity cyclones, such as Category 5, decreases to 0.47% (**Fig. 10 and Table 2**).

FIGURE 10. Simulated Percentage of Cyclone Types for Global Oceans, Indian Ocean, East Mozambican Exclusive Economic Zone, Mozambique (landfalls), CHAZ, Historical Simulation (1951–2014)

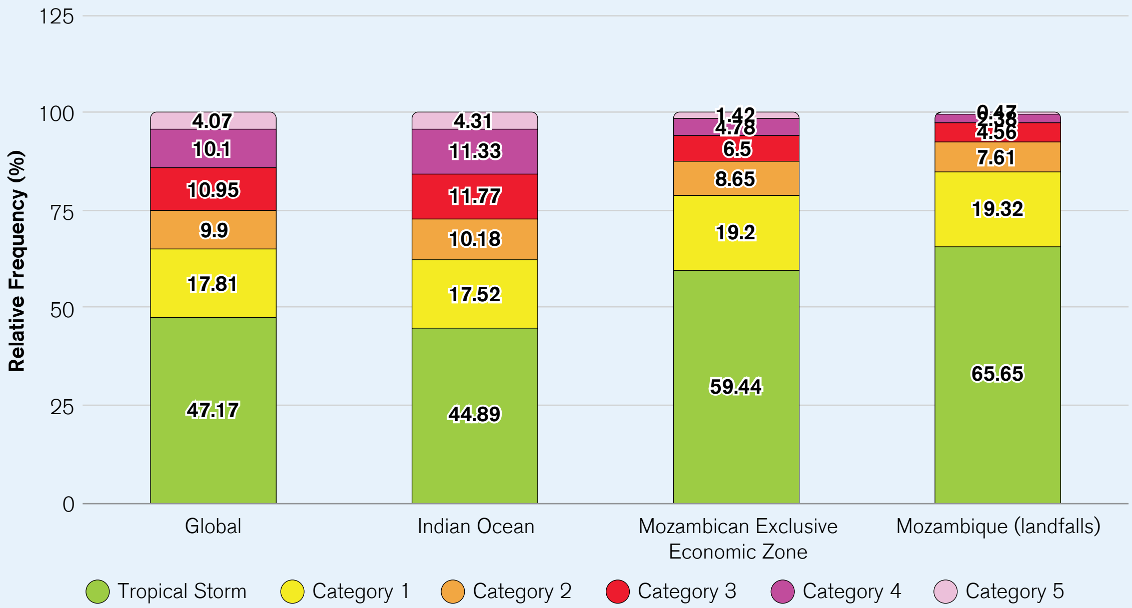


TABLE 2. Median Value (with 10th and 90th percentiles) of Counts of Cyclones per Year for Historical (1951–2014) Period for Global Oceans, Indian Ocean, Mozambican EEZ, and Mozambique (landfalls). Values are Rounded to One Thousandths.

	Global	Indian Ocean	Mozambican EEZ	Mozambique (landfalls)
Category 5	4.140 (3.370, 4.500)	1.170 (0.960, 1.380)	0.038 (0.012, 0.044)	0.005 (0.002, 0.005)
Category 4	10.270 (9.180, 10.750)	3.070 (2.350, 3.250)	0.129 (0.054, 0.141)	0.024 (0.011, 0.027)
Category 3	11.130 (10.080, 11.470)	3.200 (2.540, 3.250)	0.175 (0.095, 0.186)	0.047 (0.025, 0.049)
Category 2	10.060 (9.380, 10.220)	2.770 (2.370, 2.860)	0.234 (0.151, 0.246)	0.078 (0.048, 0.079)
Category 1	18.100 (17.450, 18.270)	4.760 (4.430, 5.030)	0.519 (0.399, 0.581)	0.197 (0.154, 0.204)
Tropical Storm	47.950 (44.960, 48.530)	12.190 (10.910, 12.700)	1.605 (1.508, 1.768)	0.669 (0.633, 0.692)
Total	101.650 (94.420, 103.740)	27.150 (23.570, 28.480)	2.701 (2.220, 2.966)	1.020 (0.874, 1.055)

In this region, the CHAZ model does not project any significant changes in the frequency of tropical cyclones in the future.

Natural Hazards

Climate change is now recognized to have a significant impact on disaster management efforts and poses a significant threat to the efforts to meet the growing needs of the most vulnerable populations. According to EM-DAT[22], 117 events were recorded from 1983 to 2023, with bacterial diseases emerging as the most common natural hazard (22% of events), followed by tropical cyclones, riverine flood, flood (in general), drought, storm, landslide, and coastal flood all these related to water disasters (**Table 3**). Bacterial diseases in Mozambique are primarily water-borne, exacerbated by existing issues with water sanitation. The growing unpredictability of climate change is expected to hinder efforts to address these diseases. Additionally, rising temperatures will alter the timing and distribution of vector-borne diseases, further complicating public health efforts.

TABLE 3. EM-DAT Natural Disaster Subtype Counts and Percentages, Categorized by Type: Purple for Diseases and Infestations, Blue for Water-Related Disasters, Orange for Droughts, Red for Wildfires, and Black for Other Events. A Total of 117 Events were Recorded from 1983 to 2023.

Disaster Subtype	Count	Percent
Bacterial disease	26	22.2
Tropical cyclone	23	19.7
Riverine flood	20	17.1
Flood (General)	15	12.8
Drought	15	12.8
Storm (General)	5	4.3
Landslide (wet)	2	1.7
Coastal flood	2	1.7
Infestation (General)	1	0.9
Infectious disease (General)	1	0.9
Parasitic disease	1	0.9
Ground movement	1	0.9
Wildfire (General)	1	0.9
Viral disease	1	0.9
Flash flood	1	0.9
Lightning/Thunderstorms	1	0.9

Think Hazard[23] identifies river floods, urban floods, coastal floods, cyclones, extreme heat, and wildfires as the highest natural risks, most of which are closely linked to the climate crisis, followed by earthquakes, tsunamis, and water scarcity as medium risks.

[22] The International Disaster Database https://www.emdat.be/
[23] Think Hazard, GFDRR, https://thinkhazard.org/en/report/170-mozambique

Blue Economy Impacts

Mozambique's key marine ecosystems include its extensive coral reefs, mangrove forests, seagrass beds, and coastal wetlands. These ecosystems are vital for biodiversity, supporting a wide range of marine life, including fish, shellfish, and marine mammals. Together, these marine ecosystems contribute to the country's economy, particularly through artisanal fisheries, tourism, and coastal protection, while also playing a critical role in maintaining environmental balance and biodiversity. However, models predict a decline in marine biodiversity and fish biomass along the East African coast because of climate change.

By the period 2090–2099 and under the high-emissions scenario RCP8.5 (+4.4°C), marine animal biomass along Mozambique's coast is expected to decline around 15% to 40% (Tittensor et al., 2021[24]), relative to levels observed during 1990–1999.

The historical maximum sustainable yield from 2012 to 2021 is 106 metric tons for Mozambique's Exclusive Economic Zone. By 2100, under the RCP8.5 scenario (with a projected warming of +4.5°C), the maximum sustainable yield is expected to decrease slightly by almost 6% compared to historical levels (Free et al., 2020[25]).

Trisos et al. (2020)[26] project that as climate change advances, the risks to biodiversity will intensify, potentially leading to a catastrophic loss of global biodiversity. Using temperature and precipitation projections from 1850 to 2100, they assess the exposure of over 30,000 marine and terrestrial species to hazardous climate conditions. The study predicts that climate change will abruptly disrupt ecological assemblages, as most species within any given assemblage will simultaneously face conditions beyond their niche limits.

[24] Tittensor, D.P., Novaglio, C., Harrison, C.S. et al. Next-generation ensemble projections reveal higher climate risks for marine ecosystems. Nat. Clim. Chang. 11, 973–981 (2021). https://doi.org/10.1038/s41558-021-01173-9

[25] Free CM, Mangin T, Molinos JG, Ojea E, Burden M, Costello C, et al. (2020) Realistic fisheries management reforms could mitigate the impacts of climate change in most countries. PLoS ONE 15(3): e0224347. https://doi.org/10.1371/journal.pone.0224347

[26] Trisos, C.H., Merow, C. & Pigot, A.L. The projected timing of abrupt ecological disruption from climate change. *Nature* 580, 496–501 (2020). https://doi.org/10.1038/s41586-020-2189-9

ANNEX – TABLES: HISTORICAL AND PROJECTED CHANGES ACROSS REGIONS

Historical Climate Across Regions

Table A1 and A2 show the variations in historical temperature and precipitation across Mozambique's districts.

TABLE A1. Historical a) Air Surface Temperature Averages (1991–2020), CRU, and b) Trends per Decade (1971–2020), ERA5, for Average, Minimum and Maximum Temperatures (in deg C), All Columns Colored According to Intensity. The Regions are Organized from North to South. Significant trends are shown in bold.

	Historical Air Surface Temperature Averages (1991–2020) (degrees C), CRU				Trend per Decade (1971–2020) (degrees C/decade), ERA5		
Regions	**Temp**	**Min Temp (night temp)**	**Max Temp (day temp)**	**Max Temp During Hottest Month**	**Temp**	**Min Temp (night temp)**	**Max Temp (day temp)**
Mozambique	24.4	19.0	29.9	32.5	**0.22**	**0.15**	**0.22**
Niassa (interior)	23.6	18.2	29.1	32.2	**0.23**	**0.21**	**0.21**
Cabo Delgado	25.5	20.5	30.5	32.7	**0.19**	**0.17**	**0.14**
Nampula	25.1	20.1	30.1	32.7	**0.22**	**0.18**	**0.2**
Zambézia	24.7	19.4	30.1	33.0	**0.24**	**0.15**	**0.26**
Tete (interior)	24.4	18.5	30.3	33.9	**0.25**	**0.14**	**0.27**
Manica (interior)	23.7	18.0	29.5	32.3	**0.21**	**0.12**	**0.21**
Sofala	25.1	20.0	30.2	32.6	**0.18**	**0.1**	**0.19**
Inhambane	24.2	19.2	29.2	31.7	**0.22**	**0.15**	**0.21**
Gaza	24.1	17.7	30.5	33.4	**0.25**	**0.19**	**0.22**
Maputo	23.7	17.7	29.7	32.4	**0.18**	**0.14**	**0.14**
Cidade de Maputo	23.8	18.7	29.0	31.6	**0.12**	**0.11**	**0.09**

TABLE A2. Historical Precipitation, Maximum Number of Consecutive Dry Days per Year, and Maximum Number of Consecutive Wet Days per Year (1991–2020) (in mm), and Linear Trends per decade from 1971 to 2020, All Columns Colored According to Intensity, and trends bolded when significant. The Decadal Trend in Historical Precipitation is Negligible (around 3% maximum) and Not Significant (not shown). CRU and ERA5 Datasets as Indicated.

Regions	Historical Precipitation (1991–2020) (mm), CRU		Maximum Number of Consecutive Dry Days per Year - CDD - ERA5		Maximum Number of Consecutive Wet Days per Year - CWD - ERA5	
	Summer Max Pr	Total Yearly Pr (mm)	Historical	Trend (1971–2020)	Historical	Trend (1971–2020)
Mozambique	233	970	68	**2.25**	20	**−0.81**
Niassa (interior)	279	1127	105	3.67	29	**−1.82**
Cabo Delgado	241	1025	83	1.16	24	**−1.66**
Nampula	288	1103	62	1.24	23	**−1.14**
Zambézia	287	1209	32	0.27	21	–0.56
Tete (interior)	240	867	96	**3.63**	24	–0.48
Manica (interior)	250	989	55	0.91	16	0.23
Sofala	245	1027	40	0.91	16	–0.13
Inhambane	154	731	56	2.43	11	–0.22
Gaza	107	539	62	2.04	9	–0.29
Maputo	128	723	44	0.15	8	–0.11
Cidade de Maputo	147	791	33	1.11	9	–0.03

Projected Climate Across Regions

Tables A3 to A5 shows the variations in CMIP6 historical and projected temperature and precipitation related variables across Mozambique's districts.

TABLE A3. CMIP6 Simulated Historical Averages (1994–2015), Mid-Century SSP3-7.0 Projections (2040–2059), End-of-Century Projections (2080–2099), and Decadal Trends (2000–2050 or 2050–2100 depending on variable) for a) Average Surface Air Temperature, b) Number of Hot Days per Year with Tmax > 30°C, and c) Number of Hot Days per Year with Tmax > 35°C

	Average Surface Air Temperature (degrees C)				Number of Hot Days per Year with Tmax > 30°C (days)				Number of Hot Days per Year with Tmax > 35°C (days)			
Regions	**1994–2015**	**2040–2059**	**Trend 2000–2050**	**Trend 2050–2100**	**1994–2015**	**2040–2059**	**2080–2099**	**Trend 2000–2050**	**1994–2015**	**2040–2059**	**2080–2099**	**Trend 2050–2100**
Mozambique	24.28	25.75	0.31	0.47	143.18	205.16	271.78	13.38	16.75	39.01	84.31	11.98
Niassa	23.63	25.12	0.31	0.47	93.66	161.76	249.86	14.44	4.58	18.28	52.69	9.53
Cabo Delgado	25.24	26.63	0.29	0.41	162.88	257.99	333.27	21.17	3.84	18.05	58.51	11.46
Nampula	24.8	26.18	0.29	0.43	147.99	222.25	295.67	16.43	4.82	19.84	63.52	11.75
Zambézia	24.4	25.82	0.29	0.47	148.49	204.08	264.8	11.78	20.06	42.59	89.73	12.08
Tete	24.04	25.62	0.31	0.51	141.22	194.61	259.1	11.17	28.71	56.25	102.66	12.1
Manica	23.25	24.85	0.33	0.52	130.7	187.32	248.25	11.83	18.95	44.7	93.5	12.91
Sofala	24.8	26.31	0.3	0.48	169.18	228.02	283.88	12.48	22.43	51.11	107.19	14.83
Inhambane	24.27	25.63	0.3	0.44	151.49	203.56	261.23	11.38	13.9	37.28	83.48	12.31
Gaza	24.59	26.07	0.32	0.47	180.21	225.12	275.94	10.04	38.52	74.05	128.51	13.33
Maputo	23.72	25.15	0.32	0.45	134.7	184	239.43	11.22	17.02	39.6	81.41	11.1
Cidade de Maputo	23.49	24.89	0.32	0.41	61.2	107.6	168.42	10.61	1.58	8.05	28.93	6.2

TABLE A4. CMIP6 Simulated Historical Averages (1994–2015), Mid-Century SSP3-7.0 Projections (2040–2059), End-of-Century Projections (2080–2099), and Decadal Trends (2000–2050 or 2050–2100 depending on variable) for a) Number of Hot Nights per Year with Tmin > 23°C, b) Number of Hot Nights per Year with Tmin > 26°C, and c) Number of Hot Humid Days per Year with Heat Index > 35°C

Regions	Number of Tropical Nights per Year with Tmin > 23°C (days)				Number of Tropical Nights per Year with Tmin > 26°C (days)				Number of Days with Heat Index > 35°C (days)		
	1994–2015	2040–2059	2080–2099	Trend 2000–2050	1994–2015	2040–2059	2080–2099	Trend 2050–2100	2040–2059	2080–2099	Trend 2050–2100
Mozambique	52.14	113.98	185.25	13.15	2.16	14.5	59.21	13.05	14.81	69.23	13.48
Niassa	24.42	76.47	169.75	10.62	0.94	6.52	34.94	9.42	1.34	24.06	5.52
Cabo Delgado	48.83	147.4	227.53	21.04	1.36	9.54	50.78	14.52	7.5	79.25	17.65
Nampula	58.65	138.08	211.67	17.19	0.99	10.91	59.56	16.19	11.63	84.25	17.18
Zambézia	58.23	121.98	192.42	13.65	2.01	14.76	64.59	14.85	23.58	89.6	16.15
Tete	58.69	114.32	177.67	11.31	5.06	25.08	75.16	12.82	12.88	57.43	11.48
Manica	30.45	76.41	144.46	9.33	1.07	8.57	41.43	9.26	10.39	51.44	10.35
Sofala	75.08	140.12	203.27	14.26	2.4	19.61	83.06	17.01	30.83	110.56	19.96
Inhambane	59.32	111.26	171.74	11.75	2.02	14.23	56.68	11.24	16.63	75.61	14.69
Gaza	71.2	122.73	180.47	11.23	3.59	23.72	78.82	14.39	26.31	82.7	14.29
Maputo	47.4	95.41	153.31	10.32	1.43	12.23	49.59	10.14	16.58	60.97	11.37
Cidade de Maputo	88.28	141.22	202.29	11.55	7.42	33.21	87.3	14.5	15.31	58.56	11.85

TABLE A5. CMIP6 Simulated Historical Averages (1994–2015), Mid-Century SSP3-7.0 Projections (2040–2059), End-of-Century Projections (2080–2099) (for CDD), and Decadal Trends (2000–2050) or Anomalies (with respect to historical period) for a) Yearly Averaged Precipitation, b) Maximum Number of Consecutive Dry Days per year - CDD, c) Maximum Number of Consecutive Wet Days per Year - CWD. We Do Not Show Projected Changes for CWD as These are Minimal.

	Yearly Average Precipitation (mm)				Maximum Number of Consecutive Dry Days per Year - CDD				Maximum Number of Consecutive Wet Days per Year - CWD
Regions	1994–2015	2040–2059	PR Anomaly 2040–2059	% Anomaly Change to 2040–2059	1994–2015	2040–2059	2080–2099	Trend 2000–2050	1994–2015
Mozambique	880	861	–23	–2.6	71	77	85	1.02	30
Niassa	1083	1066	–18	–1.7	108	116	126	1.06	50
Cabo Delgado	930	912	–14	–1.5	94	101	110	0.54	41
Nampula	998	984	–28	–2.8	71	79	88	1.04	38
Zambézia	1044	1025	–39	–3.8	36	40	46	0.81	32
Tete	911	886	–21	–2.3	98	105	117	1.37	34
Manica	818	792	–28	–3.5	60	64	69	0.77	20
Sofala	832	805	–35	–4.4	42	45	49	0.79	20
Inhambane	588	571	–19	–3.4	51	57	62	1.37	12
Gaza	521	513	–8	–1.5	57	63	69	1.4	11
Maputo	652	641	–7	–1.0	40	44	47	0.94	11
Cidade de Maputo	764	749	–8	–1.0	31	33	35	0.51	12

Population Exposure Across Regions

Tables A6 and A7 shows the variations in CMIP6 historical and projected population exposure to temperature and precipitation related variables across Mozambique's districts[27].

TABLE A6. For Each Admin1 District, Percent of the Population at High Health Risk for Three Periods: Retrospective (1975–2024, centered on 2000), Future (2010–2059, centered on 2035), and Distant Future (2050–2099, centered on 2075), Under SSP3-7.0. High-Risk Areas are Defined as Locations where the 50-Year Return Level Indicates, that, on Average Once Every 50 Years, a Year Occurs with a) More Than 30 Days with Tmax > 35°C, b) More Than 20 Days with Tmax > 40°C (not showing retrospective nor future periods as data is everywhere zero then), c) More than 30 Nights Characterized by Night Temperatures Surpassing 26°C, d) More than 20 Days Characterized by Heat Index Surpassing 35°C.

	Number of Days with Tmax > 35degC - hd35			Number of Days with Tmax > 40degC - hd40	Number of Days with Tmin > 26degC - tr26			Number of Days with Heat Index > 35degC - hi35		
Regions	**hd35 - 2000**	**hd35 - 2035**	**hd35 - 2075**	**hd40 - 2075**	**tr26 - 2000**	**tr26 - 2035**	**tr26 - 2075**	**hi35 - 2000**	**hi35 - 2035**	**hi35 - 2075**
Mozambique	30.11	53.69	87.3	18.52	7.19	25.46	74.81	2.31	49.58	84.62
Niassa	3.88	30.35	70.81	0	0.71	2.9	40.2	0	1.18	35.4
Cabo Delgado	3.15	14.22	72.22	0	2.18	10.37	64.37	0	17.55	94.56
Nampula	13.5	38.48	91.57	0	4.85	14.52	73.05	0	40.83	96.1
Zambézia	54.19	70.77	96.46	32.65	11.7	25.27	79.94	4.9	58.34	86.57
Tete	54.38	58.51	69.17	41.72	20.13	43.71	48.45	6.6	39.68	45.93
Manica	29.56	54.2	93.68	22.95	2.06	6.17	44.17	0.95	21.31	77.56
Sofala	60.46	82.74	98.78	44.74	17.77	43.11	98.06	8.93	96.2	100
Inhambane	9.44	28.95	67.76	2.85	5.63	38.07	100	0	38.48	100
Gaza	42.77	82.55	97.3	27.96	0.27	40.85	100	0	97.18	100
Maputo	14.13	72.4	99.82	7.28	0.25	27.77	99.41	0	71.16	100
Cidade de Maputo	0	11.44	96.94	0	3.8	88.56	100	0	97.77	100

[27] Population dataset: Gridded Population of the World, Version 4: GPWv4; Revision 11, Dec 2018. For each pixel (at approximately 25 km resolution), the return level for a given return period is calculated by fitting a Generalized Extreme Value (GEV) distribution to the time series. A pixel is classified as "too risky" (1) if the return level exceeds the specified threshold, and "not too risky" (0) otherwise. The reported population exposure represents the percentage of the total population in each region that is exposed to risk (1).

TABLE A7. For Each Admin1 District, Percent of the Population at High Health Risk for Three Periods: Retrospective (1975–2024, centered on 2000), Future (2010–2059, centered on 2035), and Distant Future (2050–2099, centered on 2075), Under SSP3-7.0. High-Risk Areas are Defined as Locations where the 50-Year Return Level of a) Consecutive Days of Drought (CDD) Exceeds 90 Days in a Year (3 months), b) the Annual Number of Days with Precipitation > 50 mm Exceeds 5 Days

	Maximum Number of Consecutive Dry Days per Year - CDD			Number of Days with Precipitation > 50 mm - r50		
Regions	**CDD - 2000**	**CDD - 2035**	**CDD - 2075**	**r50 - 2000**	**r50 - 2035**	**r50 - 2075**
Mozambique	42.85	48.82	58.08	0.36	0.89	3.11
Niassa	99.45	99.47	100	0	0.04	0.03
Cabo Delgado	90.49	91.38	94.47	0	0	0
Nampula	66.45	76.45	95.96	0	1.57	1.59
Zambézia	5.87	7.87	24.4	0	0	0
Tete	91.76	94.06	94	0	0	0
Manica	28.08	28.11	34.21	4.85	7.69	23.21
Sofala	25.2	29.33	38.08	0.04	0.39	16.86
Inhambane	21.57	32.1	37.8	0	0.01	0.04
Gaza	28.12	30.88	48.05	0	0	0
Maputo	5.11	22.72	11.81	0	0.09	0.12
Cidade de Maputo	0	0	0	0	2.23	2.18

CLIMATE RISK COUNTRY PROFILE

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