CLIMATE RISK COUNTRY PROFILE

SEYCHELLES

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ACKNOWLEDGEMENTS

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.

This effort is managed and led by MacKenzie Dove (Technical Lead, CCKP, WBG) and Pascal Saura (Task Team Lead, CCKP, WBG).

This profile was written by Anna Cabré Albós (Climate Change Consultant, CCKP, WBG).

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
Climate Change Group
World Bank Group

KEY MESSAGES

The main climate change risks for Seychelles are sea level rise, storm surge, coastal flooding, increased temperatures and extreme weather events, and the potential decline of marine ecosystems.

Historical trends in temperature: Over the past few decades, mean surface air temperatures have increased significantly, with a notably faster rise observed in the last three decades compared to earlier periods. The warming trend from 1971 to 2020 shows an increase of 0.14°C per decade, which rises to 0.18°C per decade from 1991 to 2020. The most substantial warming has occurred during the hot season, particularly from December to May. As a result, there has been an increase in the number of days with extreme maximum temperatures, more summer days, and a higher frequency of days with a high level of humid heat.

Projected trends in temperature: Seychelles' temperatures are projected to increase further into the future for all the scenarios at a rate of 0.24°C per decade (for SSP3-7.0, from 2000 to 2050). By the end of the century (2080–2099), most of March and April are expected to experience a heat index (measuring heat and humidity in the shade) greater than 37°C (SSP3-7.0). Under high emissions scenarios, tropical nights (Tmin > 26°C) are predicted to occur year-round by the end of the century. Historically, only three months per year experienced tropical nights. During the period 2040–2059, the number of hot days (Tmax > 30°C) is expected to average 8 days per year (just over a week) under the SSP3-7.0 scenario. By the end of the century (2080–2099), this number is projected to rise to 119 days per year, nearly 4 months.

Historical trends in precipitation: Precipitation has been increasing fast and significantly since the 1970s in the region, at a rate of 62 more mm per decade from 1970 to 2020. The increase in annual precipitation is due to higher intensity storms. However, the number of consecutive wet days has been decreasing steadily, 2.02 days/decade from 1951 to 2020, which indicates an increase in erratic weather behavior.

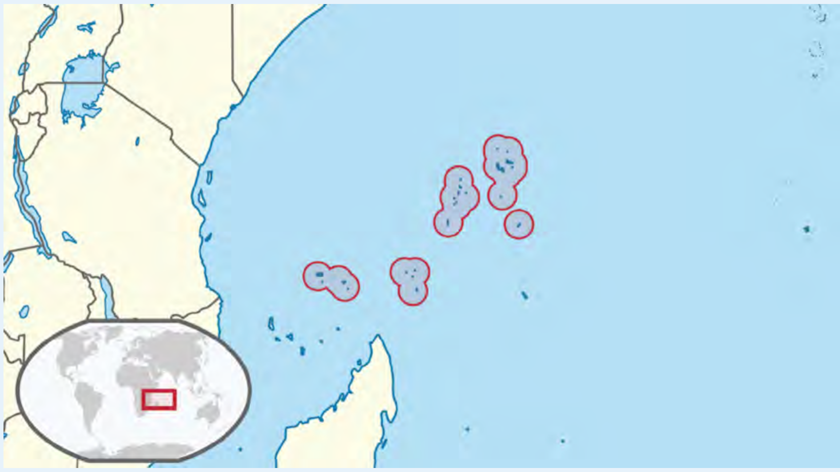
Projected trends in precipitation: In the Seychelles, climate change is expected to cause a long-term increase in the average annual precipitation levels (below 3% change by mid-century compared to the historical period), mostly driven by changes from January to March (rainy season), but interannual variability and inter-model dispersion remains very high, so the annual trends are not robust. In the Seychelles, extreme precipitation events with return periods of 25, 50, and 100 years are projected to occur more than twice as often by the end of the 21st century (2070–2099) under the SSP3-7.0 scenario, compared to historical values from 1985–2014.

Finally, the marine ecosystems and coastal communities will be impacted by rising temperatures affecting coral reefs and fisheries, along with rising sea levels, which, combined with more extreme precipitation events, will result in higher sea level surges and an increased risk of coastal inundation.

COUNTRY OVERVIEW

Seychelles is an island nation situated in the Somali Sea region of the Indian Ocean, slightly north and northeast of Madagascar. Seychelles lies between approximately 4°S and 10°S and 46°E and 54°E (**Fig. 1**).

FIGURE 1. Map Indicating the Location of the Seychelles Archipelago[1]



The Seychelles consists of two primary island groups: the Mahé group, which comprises over 40 central granitic islands (to the northeast), and a second group of more than 70 coralline islands. Although the total land area is just 452 km², the islands are dispersed across a vast exclusive economic zone covering 1,336,559 km².

The Mahé islands are characterized by rugged, mountainous terrain, lush tropical vegetation, with narrow coastal strips and central hill ranges. The highest point in Seychelles, Morne Seychellois, stands at 905 meters and is part of the capital island Mahé (**Fig. 2**). In contrast, the outer coralline islands are flat, rising just above sea level, and only very few are inhabited[2].

Almost 90% of the Seychelles' population resides on the island of Mahé, with a significant portion living in the capital, Victoria, along the eastern coast (**Fig. 3**).

The other two relevant islands of the archipelago, in terms of population and area, are Praslin and La Digue. The country's birth, death, and population growth rates are all lower than the global average. Life expectancy for both men and women surpasses the global average by a considerable margin.

Tourism plays a crucial role in the economic stability and growth of the Seychelles. Agriculture contributes only a small portion to the GDP and employs a similarly modest share of the workforce. The fishing industry, primarily focused on tuna, plays a more significant role.

1 Wikipedia https://en.wikipedia.org/wiki/Geography_of_Seychelles
2 Britannica https://www.britannica.com/place/Seychelles/History

FIGURE 2. Topography of Mahé (the main island of Seychelles)[3]. The Island's Topography Plays a Crucial Role in Shaping Wind Patterns, Climate, and the Impacts of Sea Level Rise. Rainfall is Generally More Pronounced on the Side of the Mountains Facing the Wind.

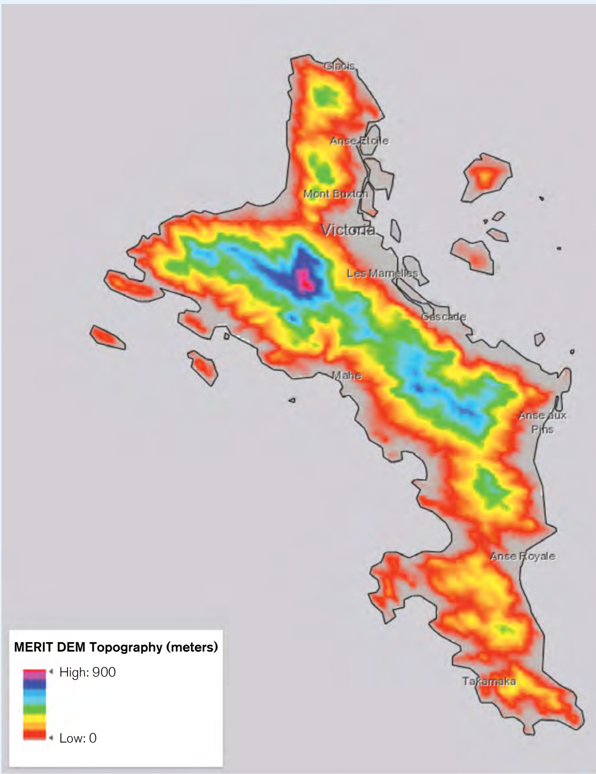
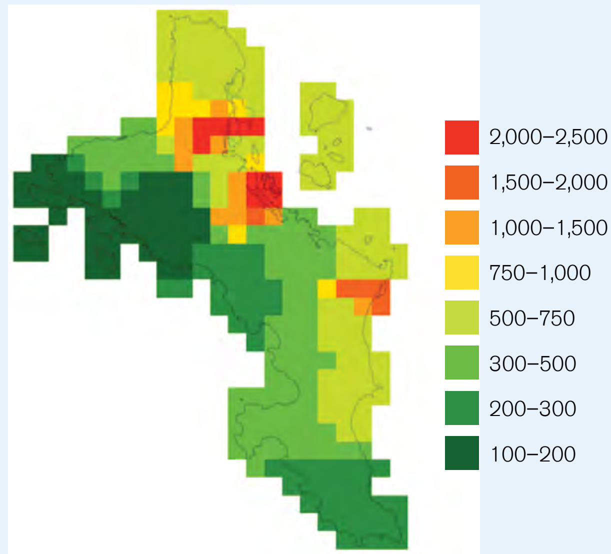


FIGURE 3. Population Density (per square km) in the Island of Mahé, 2020[4]. Most of the Population Lives on the Eastern Side of the Island



The main climate change risks for Seychelles are sea level rise, storm surge, coastal flooding, increased temperatures and extreme weather events, and decline of marine ecosystems. EM-DAT[5] shows water-related disasters as the more relevant natural hazards, including flood, riverine flood, and tropical cyclones. Think Hazard[6] shows coastal flood and cyclone as the riskiest natural hazards, followed by landslide, tsunami, and extreme heat, most of which are expected to worsen due to climate change.

[3] The map was created using ArcGIS Online with elevation from the MERIT DEM dataset https://hydro.iis.u-tokyo.ac.jp/~yamadai/MERIT_DEM/

[4] Population dataset: Gridded Population of the World, Version 4: GPWv4; Revision 11, 30 sec resolution (1 km).

[5] The International Disaster Database https://www.emdat.be/

[6] Think Hazard https://thinkhazard.org/en/report/220-seychelles

Seychelles updated Nationally Determined Contribution[7] highlights key climate adaptation strategies aimed at protecting its Blue Economy and Blue Carbon ecosystems. These measures focus on preserving fisheries, biodiversity, and tourism, while enhancing coastal resilience against storms, flooding, and sea level rise.

CLIMATE OVERVIEW

Data overview: Historically, observed data is derived from the Climatic Research Unit, University of East Anglia (CRU), CRU TS version 4.07 gridded dataset (data available 1901–2022). The CRU dataset relies on stations data.

The climate of the Seychelles archipelago is heavily shaped by the surrounding ocean, particularly through variations in monsoonal winds, ocean currents, and sea surface temperature patterns, resulting in a tropical maritime climate, with consistently warm temperatures and high humidity throughout the year. Daytime temperatures generally reach the high 20s (°C) or low 30s, while nighttime temperatures fall to the low-to-mid 20s (°C) (**Fig. 4**). Since most of the islands lie outside the cyclone belt, strong winds are infrequent.

In the coolest month, July, temperatures range from a low average of 23.27°C to a high of 27.95°C. The southeast trade winds, blowing steadily from May to November, create the most pleasant conditions during this time. The warmer period, from December to April, brings increased humidity, with winds flowing predominantly from the northwest, with April being the hottest month, where temperatures range from 25.23°C at night to 31.31°C during the day. In mountainous islands, near sea-level, the maximum temperature is a few degrees °C higher than at higher altitude.

Precipitation peaks in January at 277 millimeters (mm) and is the minimum in July (the cold season), at 58 mm, making the total annual precipitation for the full archipelago 1,654 mm. Rainfall varies significantly across the Seychelles islands due to their wide geographical spread and distinct climate influences, as well as the impact of the diverse topography. The mountainous island of Mahé, for instance, receives an annual rainfall of 2,286 mm, while lower-lying islands like Aldabra, located over a thousand kilometers to the west, see considerably less rainfall (less than half), with only 984 mm annually. On mountainous islands, rainfall is typically higher in the hilly interiors compared to sea-level areas, reflecting the influence of elevation on precipitation patterns.

The Seychelles is influenced by several key modes of natural climate variability, which impact its weather patterns, rainfall, temperatures (**Fig. 5**), and even cyclone activity. El Niño-Southern Oscillation (ENSO) typically brings hotter than usual climate, which can result in coral bleaching due to ocean warming and a higher probability of experiencing cyclones. The opposite is true during La Niña. Other modes of variability are the Indian Ocean Dipole (IOD) or the Indian Ocean Basin Mode (IOBM). Short-term variability is influenced by monsoon and cyclone systems and the Inter-Tropical Convergence Zone (ITCZ). The ITCZ moves north and south with the seasons, and when it is positioned closer to the Seychelles (typically in the austral summer, between November and April), it brings heavy rainfall.

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[7] NDC, 2021 https://unfccc.int/sites/default/files/NDC/2022-06/Seychelles%20-%20NDC_Jul30th%202021%20_Final.pdf

FIGURE 4. Monthly Historical Climatology of Average Temperature (minimum, average, and maximum) and Total Precipitation (1991–2022) for the Entire Seychelles Archipelago (CRU dataset)

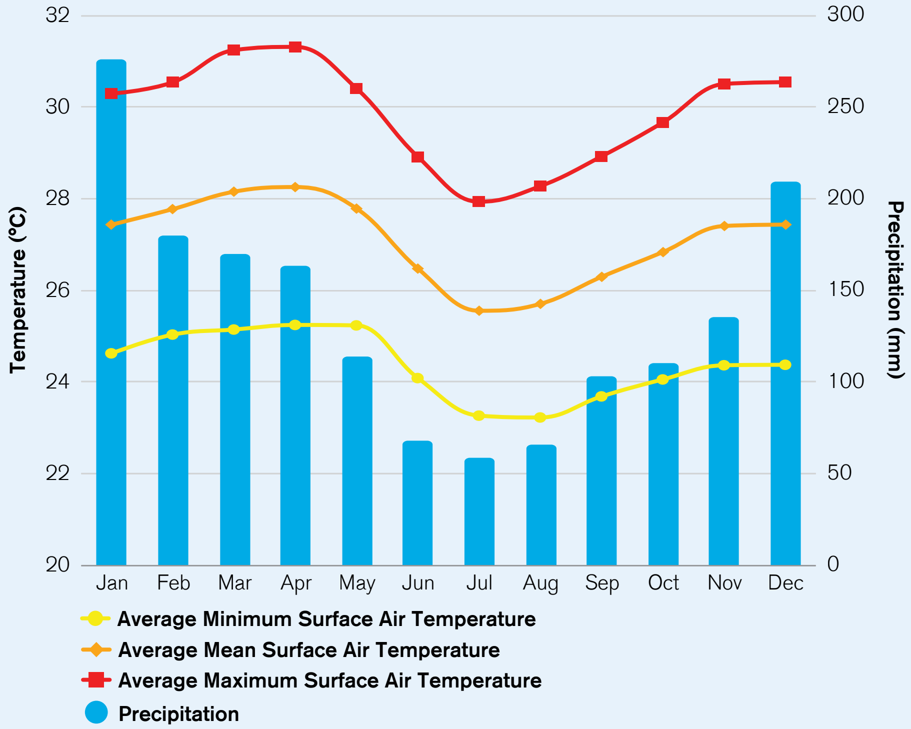


FIGURE 5A. Observed Annual Average Mean Surface Air Temperature of Seychelles for 1901–2022, CRU Dataset

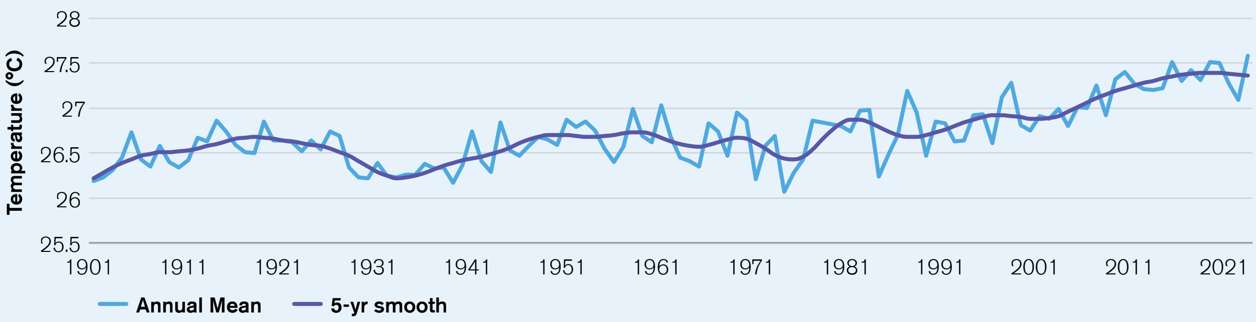
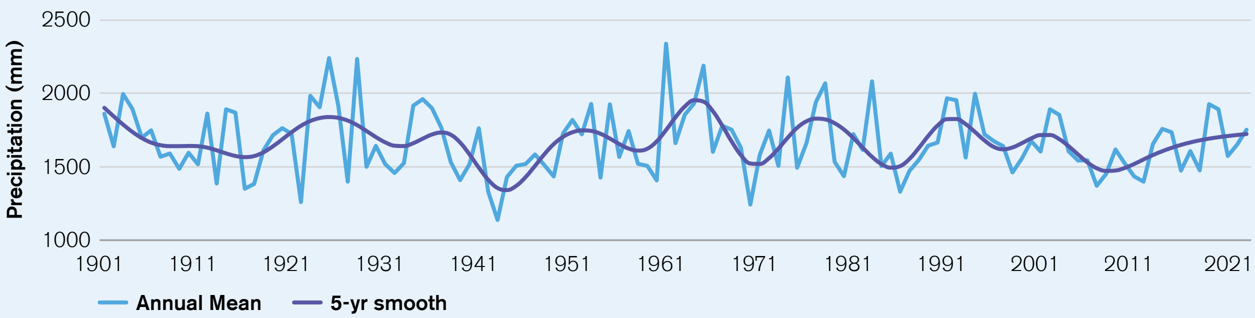


FIGURE 5B. Observed Total Annual Precipitation of Seychelles for 1901–2022, CRU Dataset



TEMPERATURE AND PRECIPITATION HISTORICAL AND PROJECTED TRENDS

Data overview: Historical observed data is derived from the ERA5 reanalysis collection from ECMWF (1950–2020). Modeled future climate data is derived from CMIP6, the Coupled Model Intercomparison Project, Phase 6. This risk profile focuses primarily on SSP3-7.0[8], which projects a doubling of CO_2 emissions by 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 air surface temperatures have risen significantly, with a notably faster increase observed in the last three decades compared to earlier periods. The temperature trends are as follows: from 1951 to 2020, the trend is 0.11°C per decade; from 1971 to 2020, it increases to 0.14°C per decade; and from 1991 to 2020, the trend further rises to 0.18°C per decade (ERA5 dataset). The largest temperature increase has occurred during the hot season, particularly from December to May, with a trend of 0.15°C per decade from 1971 to 2020, while the other two seasons, from June to November, have experienced a lower trend of 0.11°C per decade. The minimum and maximum average temperatures are growing at similar rates.

Projected Temperature Changes

Seychelles' temperatures are projected to increase further into the future for all the scenarios. Under SSP3-7.0, the mean temperature nationwide increases from 26.22°C during the historical reference period of 1995–2014 to 26.75°C (26.54°C, 10th percentile, 27.16°C, 90th percentile) for the period 2020–2039, and to 27.32°C (27.05°C, 27.91°C) for the period 2040–2059.

The minimum temperature nationwide increases from 25.58°C during the historical reference period to 26.13°C (25.9°C, 26.53°C) for the 2020–2039 period, and 26.68°C (26.41°C, 27.28°C) for 2040–2059. Maximum temperature increases from 26.84°C to 27.39°C (27.17°C, 27.78°C) for the 2020–2039 period, and 27.28°C (27.67°C, 28.54°C) for 2040–2059.

The projected temperature trend from 2000 to 2050 is 0.24°C per decade (for SSP3-7.0), which is a higher rate than that observed historically, 0.18°C per decade from 1991 to 2020, (ERA5 dataset). Warming is projected to continue at a a higher rate after 2050 under the SSP3-7.0 scenario, 0.35°C per decade from 2050 to 2100. Projected warming under SSP2-4.5 and SSP1-2.6 is lower, and under SSP5-8.5, higher (**Fig. 6a**).

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[8] 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

FIGURE 6A. Projected Average Mean Surface Air Temperature for Different Climate Change Scenarios as Labeled

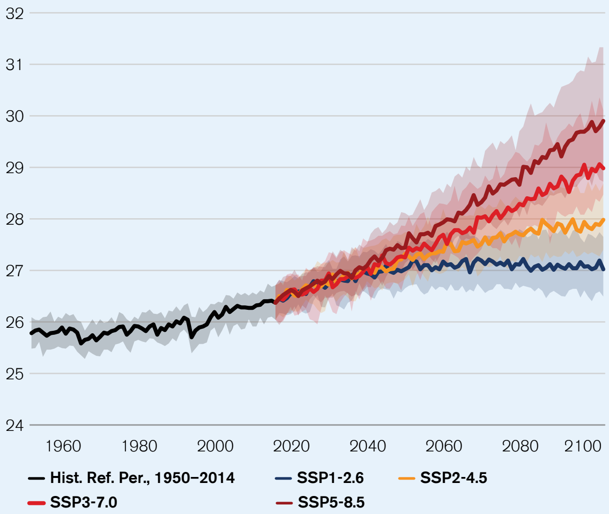
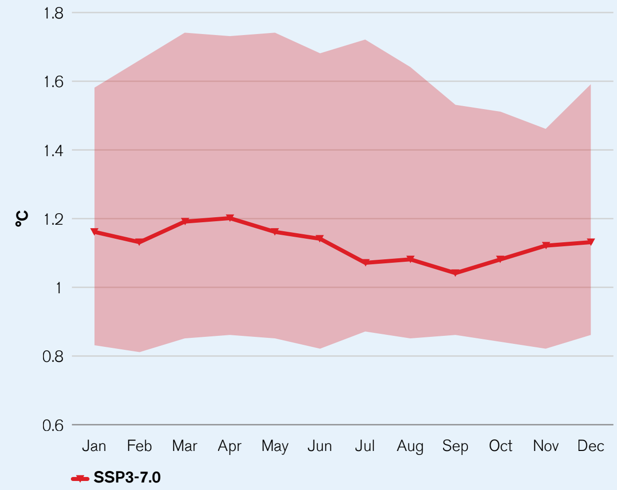


FIGURE 6B. The Projected Monthly Anomaly of the Average Mean Surface Air Temperature for 2040–2059 (relative to the reference period 1995–2014) Under SSP3-7.0, Along with the 10th–90th Percentile Dispersion Across Models



The temperature increase for 2040–2059 (relative to the reference period 1995–2014) under SSP3-7.0 is slightly higher during the March–May period (the hotter, rainy season) compared to July–September (the cooler, dry season), as observed historically, although there is considerable uncertainty across models (**Fig. 6b**).

Historical Precipitation Changes

The long-term historical trend in precipitation is not significant (1951–2020), but precipitation has been increasing fast and significantly since the 1970s in the region (**Fig. 7**). The precipitation trends for the periods 1971–2020 and 1991–2020 show increases of 61.71 mm per decade and 133.22 mm per decade, respectively. These trends correspond to approximately 5% and 10% increases per decade relative to the historical reference period of 1995–2014.

The recent increase in annual precipitation, primarily driven by more intense storms, is observed throughout the central Indian Ocean (**Fig. 8** shows the trend in

FIGURE 7. Historical Precipitation (1950–2022) and Linear Trends for Different Periods as Labelled, ERA5 Dataset

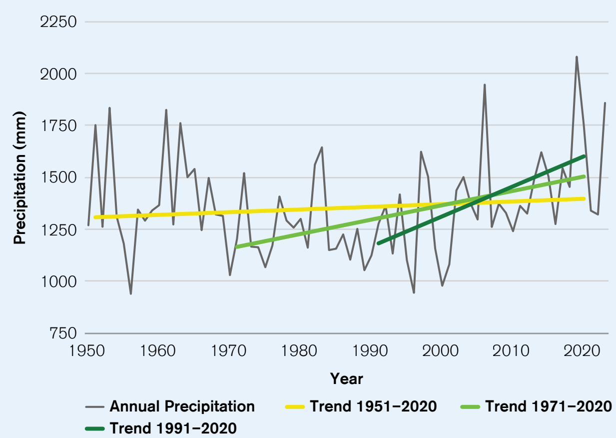
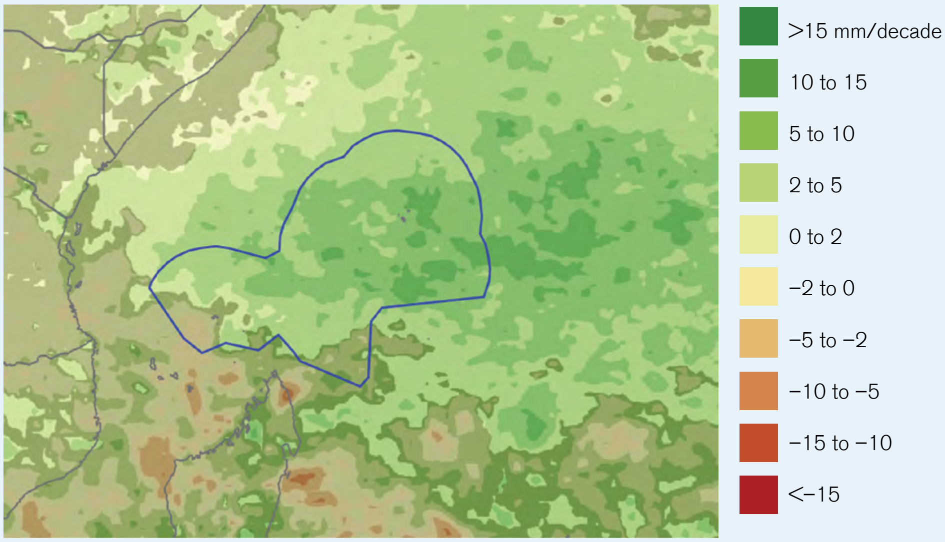


FIGURE 8. Precipitation Trend from 1971 to 2020 for the Yearly Largest 1-Day Precipitation Amount[9]. The Areas with Clear Shading Indicate a Significant Trend, with Most of Seychelles Falling Under This Category, While the Obscured Areas Represent Nonsignificant Trends. Gray Contours Depict Country Boundaries, and Blue Contours Outline the Seychelles Exclusive Economic Zone.



the largest 1-day precipitation). However, this trend may not be solely attributable to climate change and could also result from decadal variability or other factors.

Projected Precipitation Changes

Most of the Seychelles is located within a zone of projected increased precipitation, but it lies near the transition between regions expected to experience more precipitation to the north and less to the south (**Fig. 9**).

Nationwide, precipitation is estimated to change from 1308.19 mm (10th percentile: 1167.9 mm; 90th percentile: 1431.49 mm) during the historical period (1995–2014) to 1345.93 mm (10th percentile: 1127.97 mm; 90th percentile: 1584.72 mm) for 2040–2059, less than 3% change with respect to the historical period. Despite this gradual increase, high interannual variability and significant disparities across climate models mean that these annual trends remain statistically insignificant at the national level throughout the 21st century, as they fall within the range of natural variability. (**Fig. 10a**). All scenarios indicate similar seasonal patterns and a slight similar increase in annual precipitation totals by 2050.

Projected precipitation changes in the Seychelles exhibit strong seasonality and significant variability across climate models (**Fig. 10b**). While the middle and later part of the rainy season (January to April) is projected to see increased precipitation, particularly in February, contributing to the overall annual projected increase, the early part of the rainy season, especially December, may experience a decline, indicating a delay in the onset of the wet season and a larger contrast between dry and wet periods.

[9] ERA5 dataset. Figure created using ArcGIS Online.

FIGURE 9. Median Change in Total Annual Precipitation for the Period 2040-2059 with Respect to the Historical Period (1995-2014) for SSP3-7.0

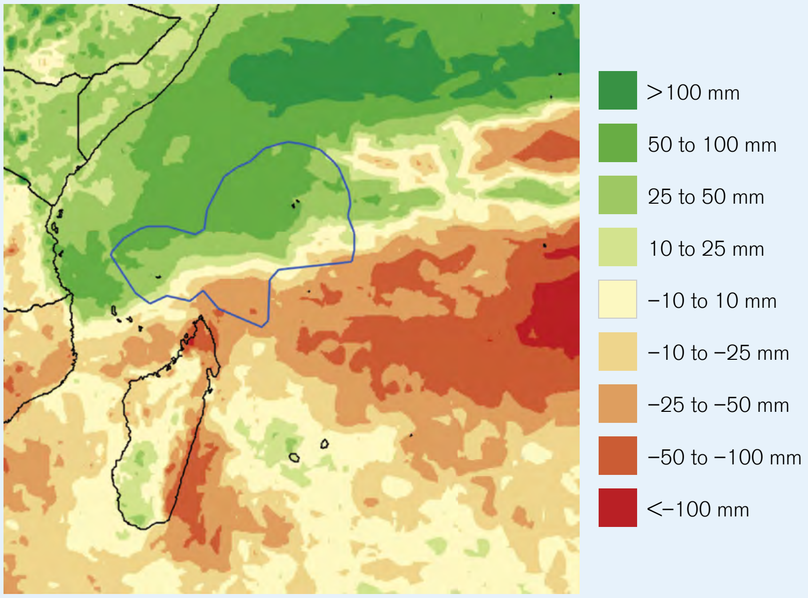


FIGURE 10A. Projected Annual Precipitation for Different Climate Change Scenarios as Labeled

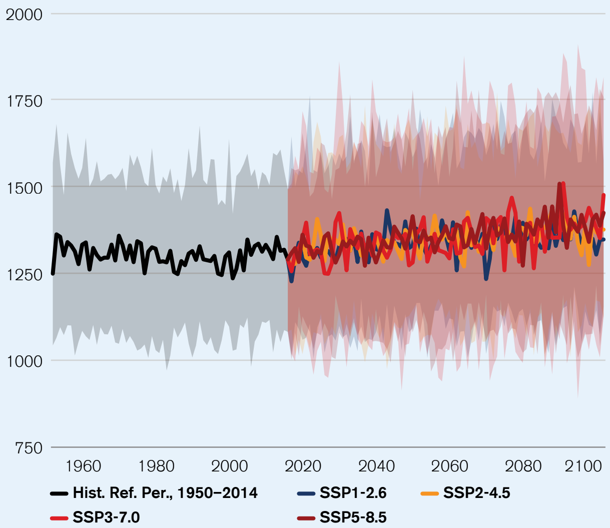
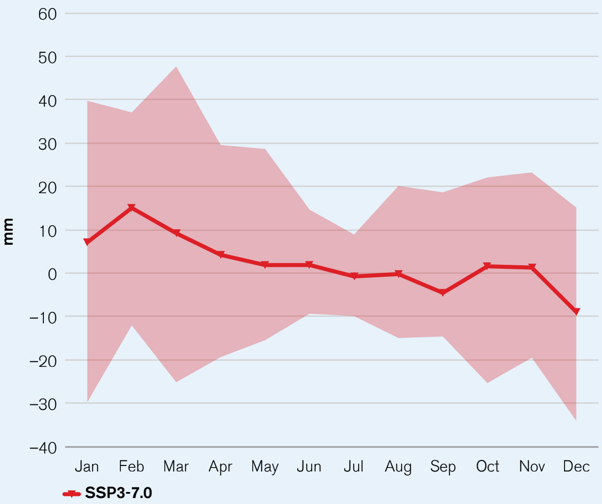


FIGURE 10B. The Projected Monthly Anomaly of Precipitation for 2040–2059 (relative to the reference period 1995–2014) under SSP3-7.0, Along with the 10th–90th Percentile Dispersion Across Models



Hot Days

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 days (Tmax > 30°C) is projected to increase rapidly starting from 2040 (zero before), driven by rising temperatures. During the period 2040–2059, the number of hot days is expected to average 8 days per year (just over a week) under the SSP3-7.0 scenario. By the end of the century (2080–2099), this number is projected to rise to 119 days per year, nearly 4 months.

Models predict that every day of the year will be classified as a summer day (Tmax > 25°C) by 2030–2035. Although most months in the historical period were already warm (320 days annually) and will continue to warm, climate change will extend summer temperatures into the cooler months of July to September.

While the country is projected to experience an increase in the number of hot days (Tmax > 30°C), it is not expected to endure extreme hot days (Tmax > 35°C) at any point during the 21st century. As a result, the population is unlikely to face significant impacts from extremely high temperatures during this period.

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 nights, called tropical nights (Tmin > 26°C), is rising rapidly. Historically, only three months per year experienced tropical nights. By 2020, this had already increased to five months annually, a trend that is expected to continue. Under high emissions scenarios, tropical nights are predicted to occur year-round by the end of the century. Tropical nights with temperatures exceeding 29°C become significant starting around 2050. As illustrated in **Fig. 11**, tropical nights (Tmin > 26°C) become prevalent from October to June by 2050, and by 2090, they extend into the typically cooler months of July to September. Moreover, by the end of the century, half of March and April will experience even hotter tropical nights, with minimum temperatures exceeding 29°C.

Next, we examine the percentage of the population at high health risk due to hot nights. High-risk areas are locations where the 50-year return level[10] of the annual number of days with night temperatures exceeding 29°C is greater than 20[11]. By the second half of the 21st century, the entire population of Seychelles will be exposed to dangerous levels of tropical nights.

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

11 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. 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.

FIGURE 11A. Projected Seasonal Cycle of the Number of Tropical Nights, Tmin Exceeding 23°C, 26°C, 29°C, for SSP3-7.0 by 2040–2059

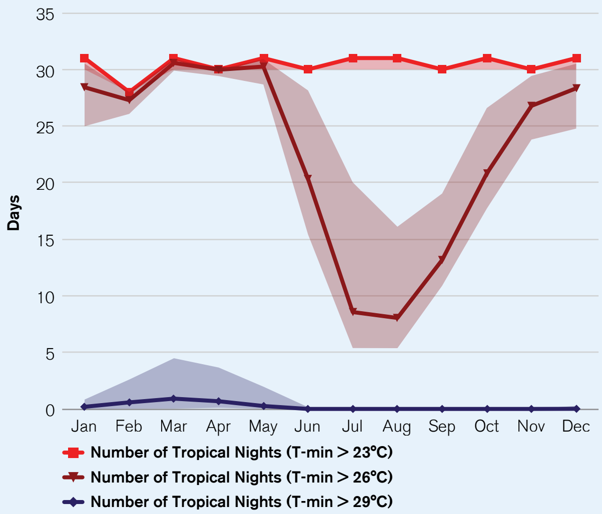
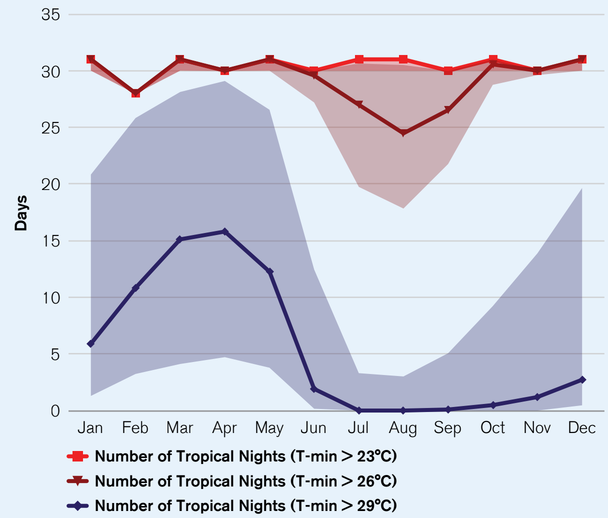


FIGURE 11B. Projected Seasonal Cycle of the Number of Tropical Nights, Tmin Exceeding 23°C, 26°C, 29°C, for SSP3-7.0 by 2080–2099



Humid Heat

The Heat Index is a measure of perceived temperature that combines both air temperature and humidity in the shade[12]. 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 significant around 2040, particularly during the hot months (January to May). For the period 2040–2059, the SSP3-7.0 scenario projects an average of 18 days per year with a Heat Index above 35°C. From 2051 to 2100, this number is expected to increase by an additional 39.26 days per decade, potentially reaching up to six months per year by 2081–2100. Furthermore, the number of days with a Heat Index above 39°C is projected to rise starting from 2060 under high-emission scenarios.

Figure 12 shows how the number of days with a high Heat Index rises most dramatically in March, the hottest month, and during the surrounding season. This increase is especially pronounced by the end of the century (right plot), with most of March and April expected to experience a heat index greater than 35°C and 37°C, and around one-third of the month reaching Heat Index levels above 39°C. Hence, the risk due to the increased Heat Index is projected to become moderate by mid-century and extreme by the end of the century during the hot months.

[12] 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

FIGURE 12A. Projected Seasonal Cycle of the Number of Days with a Heat Index Exceeding 35°C, 37°C, 39°C, and 41°C for SSP3-7.0 by 2040–2059

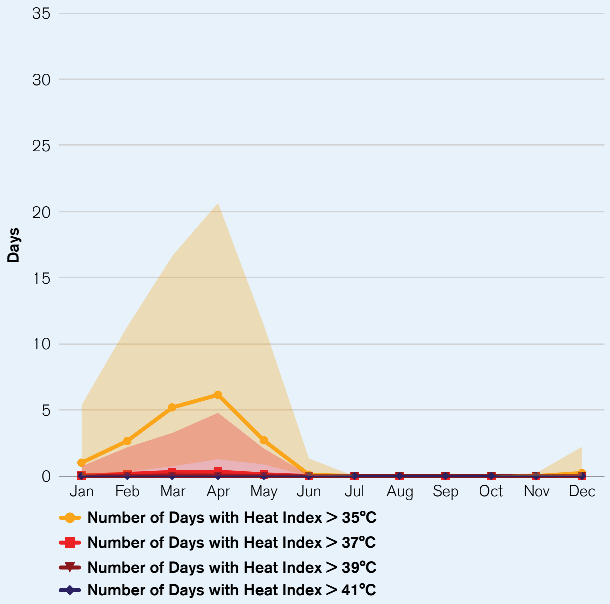
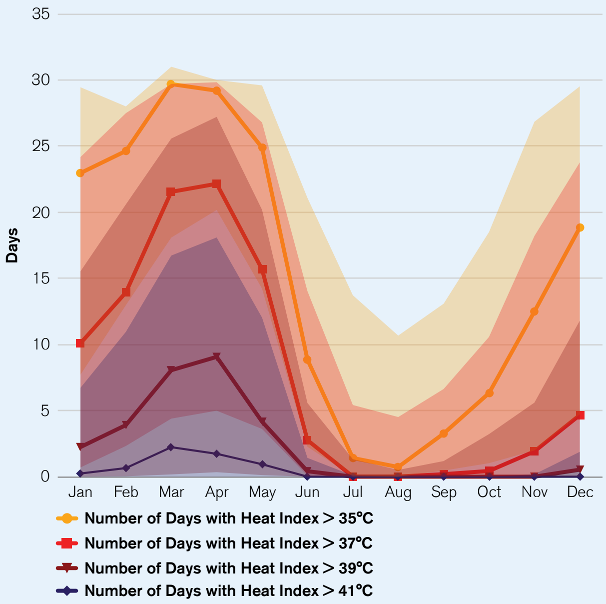


FIGURE 12B. Projected Seasonal Cycle of the Number of Days with a Heat Index Exceeding 35°C, 37°C, 39°C, and 41°C for SSP3-7.0 by 2080–2099



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. For Seychelles, this exposure increases from 0% during the period 1975–2025 (historical + SSP3-7.0) to 100% between 2010 and 2059, with the central year being 2035. Moreover, by the end of the century (2050–2099, central year 2075), 100% of the population is projected to be exposed to dangerous wet bulb temperatures under the SSP3-7.0 scenario, where the 50-year return level of the annual number of days with wet bulb temperatures exceeding 27°C is greater than 15.. Wet bulb temperatures[13] also indicate extreme heat and humid conditions, which are particularly hazardous for outdoor workers.

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. Despite an observed increase in precipitation over the past five decades, ERA5 historical data shows that the yearly maximum number of consecutive dry days[14], fluctuating between 10 and 20 days from 1950 to 2020, has on average increased. However, these trends are not statistically significant when compared to the high interannual natural variability.

[13] Wet Bulb Temperature formulation by Stull (2011) - Stull R., 2011: Wet-bulb temperature from relative humidity and air temperature. J. Appl. Meteorol. Climatol., 50(11), 2267–2269, doi: 10.1175/JAMC-D-11-0143-1

[14] This statistic measures the maximum length of a dry spell, computed sequentially for the entire time series, then taking the maximum value during each year in the data period (a dry day is defined as any day in which the daily accumulated precipitation < 1 mm)

Into the future, the maximum number of consecutive dry days is projected to increase slightly in October and November (transition towards rainy season) and decrease from February to April (second half of rainy season), but the trend is minimal (less than one day per decade for the scenario SSP3-7.0) and variability remains high so the projected trends are not significant.

Extreme Precipitation

Despite the observed recent increase in precipitation, the yearly maximum number of consecutive wet days[15] has been steadily decreasing, with a significant reduction of 2.02 days per decade from 1951 to 2020 (ERA5 historical dataset). This trend indicates an increase in erratic weather patterns. In 1950, the longest wet spells typically lasted around 35 days on average, but by 2020, their duration had shortened to about 20 days. In contrast, in the future, the maximum number of consecutive wet days is not projected to change significantly due to climate change.

On the other hand, intense and rare precipitation events are expected to become more frequent, with their return periods decreasing. This will likely increase the risk of flooding and pose significant threats to infrastructure, human safety, and agriculture. In the Seychelles, extreme precipitation events with return periods of 25, 50, and 100 years are projected to occur more than twice as often by the end of the 21st century (2070–2099) under the SSP3-7.0 scenario, compared to historical values from 1985–2014 (**Table 1**). Extreme precipitation events with return periods of 100 years are projected to occur 62% 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 62 years in the future. Similarly, 50-year return events are projected

FIGURE 13. Yearly Maximum Number of Consecutive Dry Days for the Historical Period (1951–2020) and Linear Trends Over the Labeled Periods, ERA5 Dataset

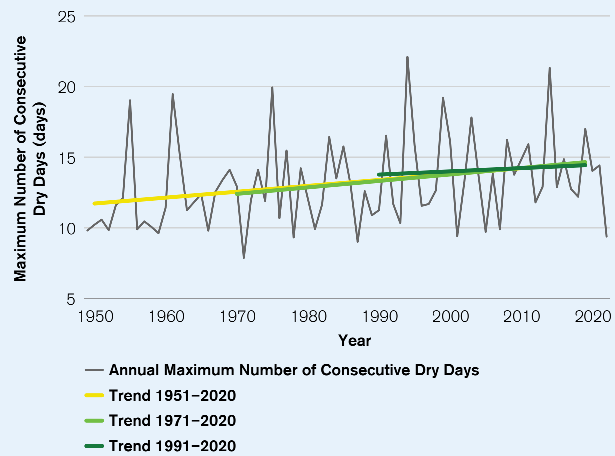
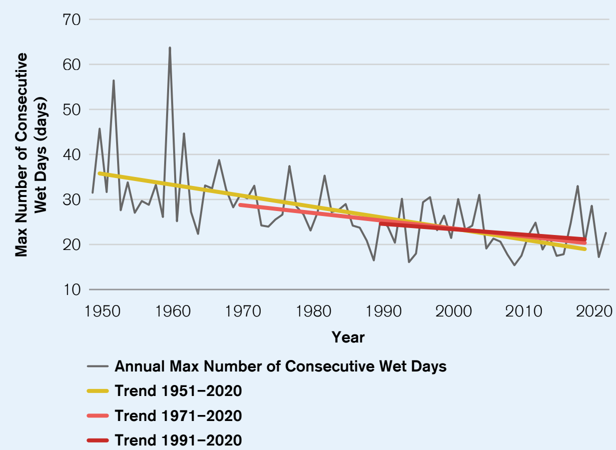


FIGURE 14. Maximum Number of Consecutive Wet Days for the Historical Period (1951–2020) and Linear Trends Over the Labeled Periods, ERA5 Dataset



[15] This statistic measures the maximum length of a wet spell, computed sequentially for the entire time series, then taking the maximum value during each year in the data period (a wet day is defined as any day in which the daily accumulated precipitation ≥ 1 mm)

to increase by nearly 52%, 25-year events by 42%, and 10-year events by 32% by mid-century. In Seychelles, a 100-year precipitation event equates to 140 mm of rain falling in a single day, an amount historically observed over an entire month in March or April, on average.

This trend aligns with the Clausius-Clapeyron equation, which states that in a warmer climate, the air's capacity to hold moisture increases exponentially, leading to a higher potential for heavier rainfall. However, the uncertainty in these projections remains high (see **Table 1**). As a result, the entire population is and will continue to be exposed to dangerous levels of extreme rainfall. High-risk areas are locations where the 25-year return level of the largest 5-day precipitation exceeds 130 mm.

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
	Future Return Period (years) - Median (10th, 90th percentiles) - SSP3-7.0					
2035–2064 center 2050	3.95 (2.32–5.39)	7.58 (4.08–10.98)	14.39 (7.08–23.30)	17.55 (8.41l–29.49)	32.98 (14.59–62.13)	62.18 (25.34–133.29)
2070–2099 center 2085	3.23 (1.74–5.60)	5.81 (2.67–11.33)	10.33 (3.78–22.93)	12.23 (4.23–28.78)	22.15 (6.48–58.29)	40.2 (9.87–118.14)
	Fractional Change - SSP3-7.0 - Median (10th, 90th percentiles) - SSP3-7.0					
2035–2064 center 2050	1.26 (0.88–2.08)	1.32 (0.85–2.41)	1.39 (0.80–2.67)	1.42 (0.77–2.74)	1.52 (0.67–3.01)	1.61 (0.59–3.43)
2070–2099 center 2085	1.55 (0.84–2.75)	1.72 (0.81–3.56)	1.94 (0.71–4.42)	2.05 (0.68–4.74)	2.26 (0.60–5.89)	2.49 (0.57–7.61)

For example, a fractional change of 1.61 indicates a 61% increase in the probability of suffering 100-year extreme precipitation events in the future, or 1.6 more likely.

Sea Surface Temperatures

Since the 1950s, the Indian Ocean and western boundary currents have experienced the most rapid surface warming. Additionally, there has been a noticeable trend of decreasing salinity in the Indian Ocean[16].

The West Indian Ocean maintains a warm average sea surface temperature of approximately 27°C. Sea surface temperatures typically range from around 26°C in August–September to approximately 28°C in April (historical, 1995–2014, multi-model CMIP6 average). The high temperatures in February and March are known to fuel more

[16] IPCC AR6 WGI, Chapter 9: Ocean, Cryosphere, and Sea Level Change

intense cyclones, although these rarely reach the populated islands of the Seychelles, as they are located too close to the tropics for cyclones to impact them directly. With climate change, the West Indian Ocean is already suffering more marine heatwaves, with fatal consequences for coral reefs and impacts and marine biota. Under the scenario SSP3-7.0, sea surface temperatures are projected to increase 1.2°C (0.9°C, 10th percentile, 1.4°C, 90th percentile) near-term (2021–2040), 1.7°C (1.4°C, 2.1°C) by mid-century (2041–2060), and 3.2°C (2.4°C, 3.9°C) long term (2081–2100), relative to the pre-industrial period (1850–1900)[17].

Sea Level Rise

Tide gauge measurements indicate an historical increase of 4.02 ± 2.04 mm per year in Mahé from 1993 to 2019[18]. According to altimetry (satellite) data, sea level rose 12 centimeters from 1993 to present[19]. Under the SSP3-7.0 scenario, sea level is expected to rise 19 centimeters from 2020 to 2050, with a likely range from 13 to 26 centimeters[20]. This means that by 2050, sea level rise is projected to reach 0.25 meters, and by 2100, it is expected to reach 0.78 meters, under the SSP3-7.0 scenario relative to the historical period (1995–2014)[21] (**Fig. 15**). Over the next three decades, sea level rise is expected to be roughly the same across all emission and warming scenarios. However, beyond that period, high-emission scenarios predict significantly higher sea level rise. Although there are still high uncertainties, it is certain that sea levels will continue to rise in all scenarios for centuries, driven by the long-term inertia of the oceans. This makes long-term planning essential.

Under the SSP3-7.0 scenario, there is a 92% chance of global sea level rise exceeding half a meter, and a 9% chance of surpassing 1 meter by 2100. This rise in sea levels will contribute to increased inundation. There were a total of 283 days exceeding the minor high-water level between 1980 and 1990, and 427 between 2005 and 2015 in Point La Rue (Mahé). In 2050 under the SSP3-7.0 scenario, Point La Rue will have up to 84 minor high-water days per year[22]. 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.

Note that he human-induced influence on regional sea level changes is expected to become apparent first in areas with relatively low internal variability, such as the tropical Indian Ocean[23]. Extreme sea level surge events are projected to become significantly more frequent across much of the tropics. In the Seychelles, a sea level event with a 100-year return period, currently reaching 1.38 meters, is expected to occur as often as once every 5 years by 2050 under the RCP4.5 scenario, with approximately 2°C of warming[24]. Tebaldi et al. (2021)[25] project that 100-year sea level events will become annual occurrences with just 1.5°C of global warming (in the Seychelles).

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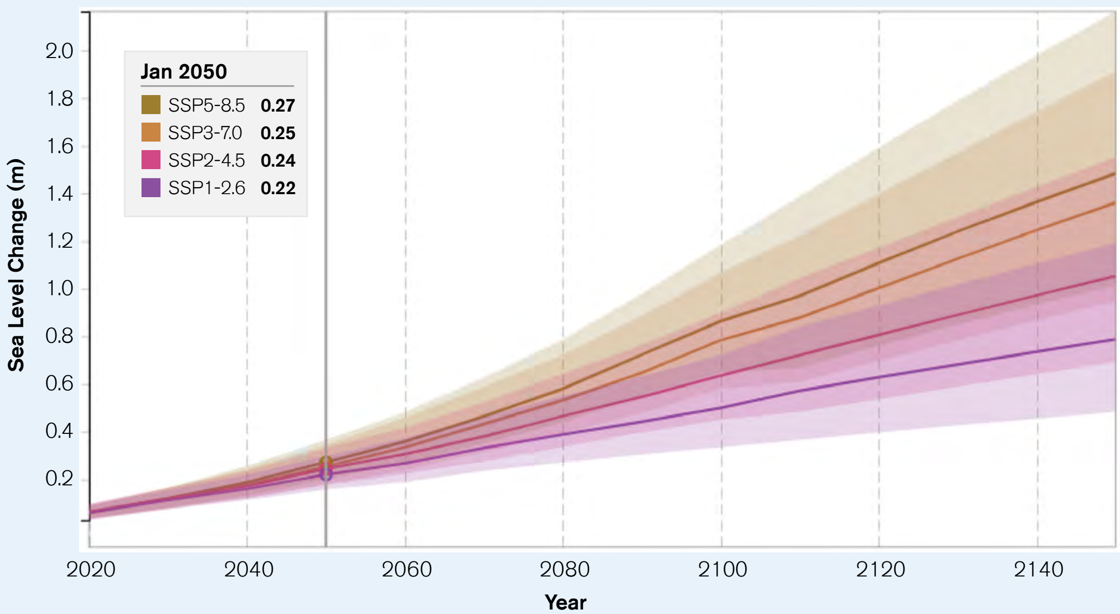
17 Data/plots from the IPCC Interactive Atlas WGI, https://interactive-atlas.ipcc.ch/regional-information
18 NASA https://sealevel.nasa.gov/sea-level-evaluation-tool
19 NASA https://earth.gov/sealevel/sea-level-explorer/
20 NASA https://earth.gov/sealevel/sea-level-explorer/
21 NASA https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool?psmsl_id=1846&data_layer=scenario Point La Rue, Seychelles, 1995–2014 baseline
22 NASA https://earth.gov/sealevel
23 IPCC AR6 WGI, Chapter 9, Ocean, Cryosphere and Sea Level Change
24 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
25 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

FIGURE 15. Sea Level Rise Projected to 2150 for Different Scenarios in Seychelles[26]



Tropical Cyclones

While the most populated area of the Seychelles (Mahé, in the northeast) lies close to the tropics (less than 5°S) and hence experiences few cyclones, the archipelago remains vulnerable to cyclones, especially in its less populated western and southern islands, during the cyclone season (October to May) (see **Fig. 16**). These events can cause coastal damage, infrastructure destruction, biodiversity loss, landslides, and the displacement of communities.

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[27]), 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 capture the full extent of the cyclones.

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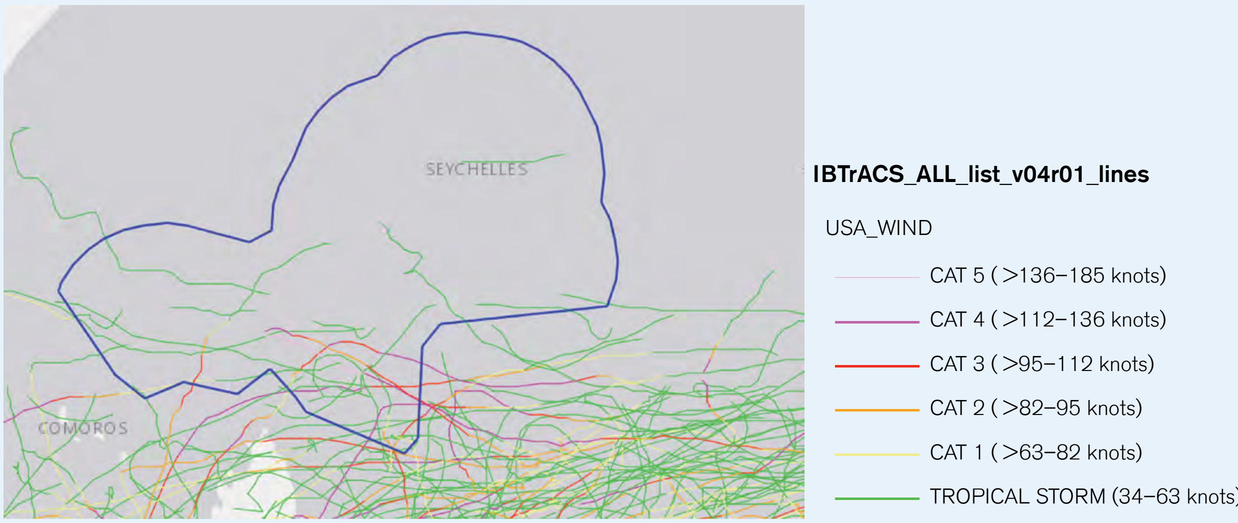
[26] NASA https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool?psmsl_id=1846&data_layer=scenario Point La Rue, Seychelles, 1995–2014 baseline

[27] 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

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)[28].

FIGURE 16. Observed Historical Cyclones from the International Best Track Archive for Climate Stewardship (IBTrACS)[29]. All Recorded Cyclones Have Been Classified According to the Saffir-Simpson[30] Scale Using the Variable "USA_wind", Which Records Sustained Maximum Winds Every 3 Hours (in knots). The IBTrACS Historical Data Covers Cyclones Recorded from 1840 to the Present, with the Caveat That Records Prior to 1980 May Be Incomplete. In Blue, the Exclusive Economic Zone of the Seychelles.



Tropical Cyclones are classified using the Saffir-Simpson Hurricane Scale, which is based on maximum sustained wind speeds (see **Fig. 16**). Historically, the frequency of tropical cyclones (maximum wind speeds above 34 knots) in the entire Seychellois Exclusive Economic Zone (EEZ) is 2.768 cyclones per year, corresponding to a return period of 0.36 years. Of these, 0.791 cyclones per year make landfall on the Seychelles islands, equivalent to a return period of about 1.26 years. Nearly half of the cyclones that intersect with the full EEZ are tropical storms, 19% are Category 1 cyclones, and only 3% reach Category 5 intensity. At landfall, the proportion of lower-intensity cyclones increases, with tropical storms accounting for 61%, while the proportion of high-intensity cyclones, such as Category 5, decreases to just over 1% (**Fig. 17 and Table 2**).

[28] 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.

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

[30] We classify Tropical Cyclones using the Saffir-Simpson Hurricane Scale, which uses maximum sustained wind speed.
Tropical Storm (green): 34 to <64 knots (63 to <118.5 km/h)
Cat 1 (yellow): 64 to <83 knots (118.5 to <154 km/h)
Cat 2 (orange): 83 to <96 knots (154 to <178 km/h)
Cat 3 (red): 96 to <113 knots (178 to <209 km/h)
Cat 4 (pink): 113 to <137 knots (209 to <254 km/h)
Cat 5 (light pink): ≥ 137 knots (≥254 km/h)

FIGURE 17. Simulated Percentage of Cyclone Types for Global Oceans, Indian Ocean, Seychellois Exclusive Economic Zone, Seychelles (landfalls), CHAZ, historical (1951–2014)

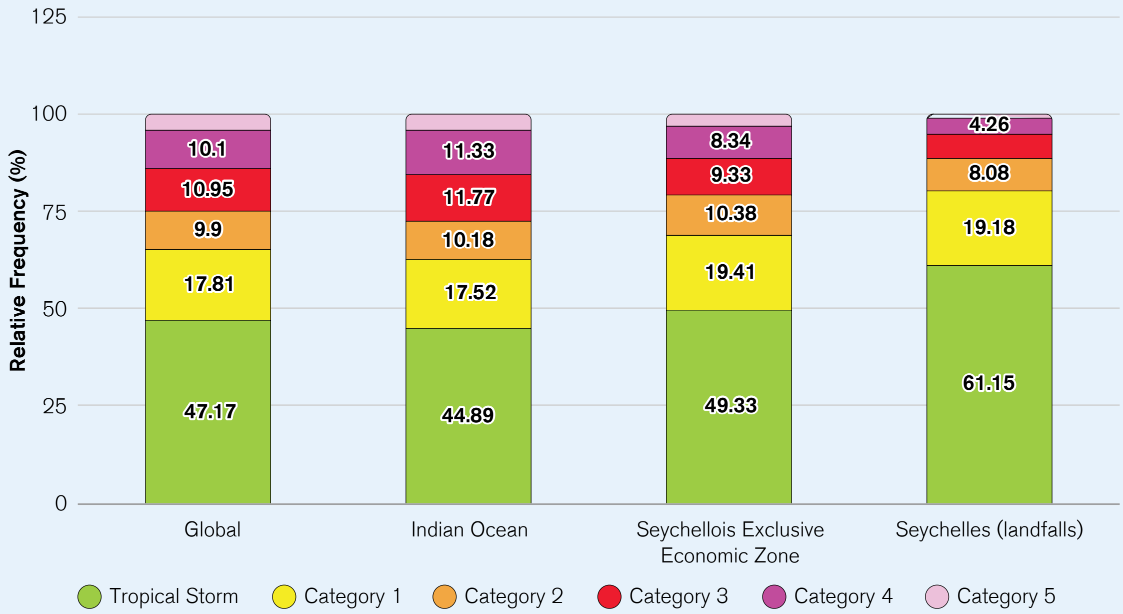


TABLE 2. Median Value (with 10th and 90th percentiles) of Counts of Cyclones per Year for Historical (1951–2014) and Projected Future Period (2035–2064, central year 2050) Along with the Fractional Changes for the Full EEZ Area and for Landfall (< 1 means a decrease in the frequency of storms, > 1 means an increase in the frequency of storms). Note That the Reported Median of Fractional Change is Not Necessarily the Future Median Divided by the Historical Median Value. Values are Rounded to One Thousands.

	Seychellois Exclusive Economic Zone			Seychelles (landfalls)		
	Historical Cyclone Count per Year	SSP2-4.5 Cyclone Count per Year	SSP2-4.5 Fractional Change	Historical Cyclone Count per Year	SSP2-4.5 Cyclone Count per Year	SSP2-4.5 Fractional Change
Cat 5	0.089 (0.050, 0.102)	0.087 (0.060, 0.096)	0.990 (0.810, 1.280)	0.010 (0.006, 0.014)	0.010 (0.006, 0.012)	0.950 (0.770, 1.350)
Cat 4	0.231 (0.138, 0.282)	0.217 (0.188, 0.237)	0.960 (0.800, 1.280)	0.034 (0.023, 0.044)	0.034 (0.025, 0.045)	1.040 (0.760, 1.330)
Cat 3	0.258 (0.161, 0.308)	0.232 (0.205, 0.263)	0.890 (0.770, 1.260)	0.048 (0.031, 0.061)	0.043 (0.034, 0.056)	0.960 (0.740, 1.360)
Cat 2	0.287 (0.179, 0.322)	0.252 (0.224, 0.274)	0.910 (0.780, 1.210)	0.064 (0.040, 0.078)	0.062 (0.048, 0.068)	0.930 (0.790, 1.370)
Cat 1	0.537 (0.332, 0.582)	0.472 (0.410, 0.511)	0.940 (0.760, 1.200)	0.152 (0.089, 0.177)	0.139 (0.099, 0.157)	0.930 (0.790, 1.230)
Tropical Storm	1.366 (0.928, 1.442)	1.300 (1.079, 1.353)	1.030 (0.860, 1.230)	0.484 (0.295, 0.530)	0.423 (0.325, 0.484)	0.960 (0.770, 1.290)
Total	2.768 (1.788, 3.038)	2.561 (2.167, 2.735)	0.980 (0.830, 1.230)	0.791 (0.484, 0.903)	0.711 (0.537, 0.822)	0.940 (0.790, 1.290)

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

The IPCC AR6 report[31] states that in a warming world, the average and maximum rainfall rates associated with tropical cyclones (TCs), extratropical cyclones, atmospheric rivers, and severe convective storms in some regions are projected to increase (high confidence). Peak rainfall rates from TCs are expected to rise with local warming, at least at the rate of mean water vapor increase over oceans (approximately 7% per 1°C of warming), and in some cases, may exceed this rate due to increased low-level moisture convergence driven by stronger TC winds (medium confidence). It is likely that the global proportion of Category 3–5 tropical cyclones has increased over the past four decades. As global warming intensifies, the proportion of intense TCs, average peak TC wind speeds, and the peak wind speeds of the most intense TCs will continue to rise (high confidence). However, the total global frequency of TC formation is expected to either decrease or remain unchanged with increasing global warming (medium confidence).

Caveat: The predictability of future tropical cyclones is accompanied by significant uncertainties due to several factors. These include discrepancies between climate models, the inherent complexity of processes integrated into Tropical Cyclone Models, and regional variations in cyclone formation, behavior, and dispersal. Furthermore, Tropical Cyclone Models are predominantly calibrated for current climate conditions, which could introduce additional biases when applied to future scenarios. In summary, the complex and often conflicting interactions among ocean temperatures, wind patterns, and atmospheric conditions that drive cyclone formation, movement, and landfall are still not fully understood, making it difficult to predict which trends will ultimately dominate. For further details on the current understanding of tropical cyclones and their frequency, refer to Sobel et al. (2021)[32].

Blue Economy Impacts

The main critical marine ecosystems in the Seychelles are coral reefs, seagrass beds and mangrove forests. These provide multiple benefits to biodiversity, fisheries, blue carbon, and resilience to floods, and indirectly to tourism.

The IPCC AR6 WGII Chapter 15 on Small Islands[33] states that coral reefs are most at risk. "Scientific evidence has confirmed that globally and in small islands tropical corals are presently at high risk (high confidence). Severe coral bleaching, together with declines in coral abundance, has been observed in many small islands, especially those in the Pacific and Indian oceans (high confidence)."

By the period 2090–2099, marine animal biomass along Seychelles's coast is expected to decline (Tittensor et al., 2021[34]). Under the low emissions scenario RCP2.6 (+1.8°C), the decrease could be up to 8%, while under the high-emissions scenario RCP8.5 (+4.4°C), the decline is much larger, of 24%, relative to levels observed during 1990–1999.

[31] IPCC WGI Chapter 11: Weather and Climate Extreme Events in a Changing Climate

[32] Sobel, A. H., Wing, A. A., Camargo, S. J., Patricola, C. M., Vecchi, G. A., Lee, C.-Y., & Tippett, M. K. (2021). Tropical cyclone frequency. *Earth's Future*, 9, e2021EF002275. https://doi.org/10.1029/2021EF002275

[33] Chapter 15 - Small Islands, IPCCWG2, https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Chapter15.pdf

[34] 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

The historical maximum sustainable yield from 2012 to 2021 is 170 metric tons for the Seychelles entire 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 by 30% compared to historical levels (Free et al., 2020[35]).

Temperate tuna species such as albacore, Atlantic bluefin, and southern bluefin are anticipated to decline in tropical regions (where Seychelles is part of) and migrate poleward. Conversely, skipjack and yellowfin tunas are expected to increase in abundance within tropical areas (Erauskin-Extramiana et al., 2019)[36].

Trisos et al. (2020)[37] 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. Under a high-emissions scenario (RCP 8.5), these abrupt exposure events are expected to begin before 2030, with tropical oceans, including the Seychelles, being particularly affected.

Tropical small islands have particularly rich ecosystems. Protecting biodiversity is essential for adapting to climate change, among other reasons (e.g. Sala et al., 2021[38] or Zhao et al., 2020[39]).

Note that this summary provides a broad overview of external sources and is not an exhaustive list.

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35 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

36 Erauskin-Extramiana M, Arrizabalaga H, Hobday AJ, et al. Large-scale distribution of tuna species in a warming ocean. Glob Change Biol. 2019; 25: 2043–2060. https://doi.org/10.1111/gcb.14630

37 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

38 Sala, E., Mayorga, J., Bradley, D. *et al.* Protecting the global ocean for biodiversity, food and climate. *Nature* **592**, 397–402 (2021). https://doi.org/10.1038/s41586-021-03371-z

39 Zhao et al. (2020), Where Marine Protected Areas would best represent 30% of ocean biodiversity, Biological Conservation, Volume 244, 108536, https://doi.org/10.1016/j.biocon.2020.108536

CLIMATE RISK COUNTRY PROFILE

SEYCHELLES

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