CLIMATE RISK COUNTRY PROFILE

DJIBOUTI

WORLD BANK GROUP

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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), Pascal Saura (Task Team Lead, CCKP, WBG) and Megumi Sato (Climate Change Specialist, WBG).

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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

Climate change is a major risk to good development outcomes and presents an existential threat to the World Bank Group's (WBG) twin goals of ending extreme poverty and promoting shared prosperity in a sustainable way. The WBG is thus committed to supporting client countries to invest in a low-carbon and climate-resilient future.

Our approach is outlined in the *WBG Climate Change Action Plan (CCAP) 2021–2025*, which focuses on helping countries integrate climate into their development agendas, with the goal to combine mitigation and adaptation with economic growth and poverty reduction. Guided by the *CCAP*, the WBG prioritizes climate action across five key systems: energy; agriculture, food, water, and land; cities; transport; and manufacturing. Only through transforming these systems can we begin to address climate change, achieve a resilient and low-carbon future, and support natural capital and biodiversity, while achieving development goals.

A key element of this strategy relies on the capacity to systematically incorporate and manage climate risks in development operations. We are thus investing in processes and tools that allow us to inform lending with climate data.

The Climate Change Knowledge Portal (CCKP) is an online 'one-stop-shop' for foundational climate data at the global, regional, and country levels. CCKP provides inputs to the WBG's Climate and Disaster Risk Screening Tool, which contributes to assessing short- and long-term climate and disaster risks in operations as well as national or sectoral planning processes.

Supplementing this effort, the *Climate Risk Country Profile* you are about to read is a signature product of CCKP which supports a better understanding of the impacts of physical climate risks. Guided by the Climate Risk Country Profile, WBG, key external partners, and development practitioners may conduct initial assessments of climate risks and opportunities that will eventually inform upstream country diagnostics, policy dialogue, and strategic planning for developing countries.

It is my hope that these efforts will spur the prioritization of long-term risk management and deepen the WBG's commitment to integrate adaptation planning into strategic country engagements and lending operations.

Jennifer J. Sara
Global Director
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KEY MESSAGES

- **<u>Observed Climate:</u>** Djibouti has a dry tropical climate characterized by high year-round temperatures (average mean temperature of 28.50°C) and evaporation rates, low and irregular amounts of precipitation (224.52 mm annually) in the form of two or three monsoonal rainy seasons per year, and interannual rainfall variation influenced by the El Niño Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD).
- **<u>Observed Temperature:</u>** Between 1971 and 2020, Djibouti's mean temperature increased by 0.21°C per decade, with a significantly increasing number of hot and humid days.
    - **Southern interior regions** observed the greatest mean temperature changes over this period during fall months.
- **<u>Projected Temperature:</u>** Under SSP3-7.0, Djibouti's temperatures are homogeneously projected to increase 0.74°C (0.34°C, 1.22°C), from an annual mean of 28.69°C during the historical reference period to 29.42°C (28.84°C, 30.07°C) for the period 2020-2039 and 1.52°C (0.90°C, 2.06°C) to 30.19°C (29.36°C, 31.06°C) for the period 2040–2059.
- **<u>Extreme Heat Risk:</u>** By midcentury, Djibouti is likely to experience higher minimum and maximum temperatures, and hotter apparent conditions due to high atmospheric moisture content. The following key metrics for temperature illustrate these risks under the SSP3-7.0 scenario for the period of 2040–2059, compared to the historical reference period of 1995–2014.
    - <u>Number of High Heat Index Days, Days Surpassing Heat Index of 35°C:</u> Djibouti's high atmospheric moisture content over certain seasons makes the number of days surpassing the Heat Index >35°C increase 56.70 (31.38, 90.42) from the reference period to 122.58 (97.25, 156.29) total nationwide annually by midcentury. This not only exacerbates human health concerns, but also presents risks to water and food security.
        - **Coastal regions** observed the greatest number of high Heat Index days annually and during summer months by midcentury.
        - **Inland regions** observed the greatest increases in number of high Heat Index days annually and during summer months by midcentury.
    - <u>Number of Tropical Nights, T-min >20°C:</u> The number of tropical nights with a minimum temperature >20°C is projected to increase 44.35 (32.47, 56.21) nationwide from the reference period to 331.75 (312.26, 346.78) total by midcentury, especially during winter months. An increase in high Heat Index days, coupled with the rise in the number of tropical nights with high minimum temperature thresholds, magnify human health risks.
        - **Western interior regions** are projected to experience the greatest increases during winter months by midcentury.
    - <u>Number of Tropical Nights, T-min >26°C:</u> The number of tropical nights with a minimum temperature >26°C, an even higher minimum threshold, is projected to increase 41.54 (23.48, 62.64) nationwide from the reference period to 166.18 (135.20, 194.08) total days annually by midcentury. The combination of increased high heat days and tropical nights disproportionately concern: the elderly, pregnant women, children and newborns, people with chronic illnesses and disabilities, outdoor workers, low-wage earners, and people living in areas with poorly equipped and ill-prepared health services.
        - **All regions** are projected to experience the greatest increases during the spring and fall months by midcentury.
    - <u>Warm Spell Duration Index:</u> This annualized index indicates the number days with consecutive daily maximum temperatures greater than the 90th percentile of daily maximum temperature calculated over a five-day window annually. Warm spell anomalies, measured in number of days annually, are projected to increase

substantially nationwide by 128.65 days (64.76 days, 234.17 days) from the reference period by midcentury. This shift reflects a longer-term change in daily maximum temperatures, which impact **all regions**.

- **Observed Precipitation:** Over the 50-year period of 1971–2020, Djibouti experienced significant decreases in annual precipitation per decade (–22.50 mm), but precipitation trends varied seasonally, regionally, and interannually. Over this period:
  - **Coastal regions** were significantly drier annually, especially during winter months, while **interior regions** were significantly drier during fall months.
- **Projected Precipitation:** Projected precipitation volumes under SSP3-7.0 nationally signal annual increases by midcentury, but divergent seasonal and regional shifts with a wide range of uncertainty.
  - **All regions** are expected to experience an annual increase in precipitation by 2040–2059 under SSP3-7.0, especially during summer months. But the extent and certainty of seasonal increases and decreases differ between regions.
- **Precipitation Risk:** By midcentury, Djibouti is likely to experience larger precipitation intensities – wet and dry – though the timing and severity of extreme anomalies vary by region. The following key metrics for precipitation illustrate these shifts for the period of 2040–2059 under SSP3-7.0, compared to the historical reference period of 1995–2014.
  - Percent Change in Precipitation: Large percent changes in Djibouti's total precipitation amounts, which are already low, can pose interannual and long-term challenges in water resources management. Djibouti's nationwide precipitation is projected to increase from the reference period by 13.59% (–0.63%, 51.99%) by midcentury.
    - **All regions** are expected to observe notable percent increases in precipitation during summer and fall months by midcentury.
  - Average Largest 5-Day Precipitation: Increases in the average highest precipitation amount over a 5-day period, which rise 19.90 mm (–26.79 mm, 88.58 mm) nationwide from the reference period to 46.41 mm (23.62 mm, 107.69 mm) by midcentury, pose risks for flood management and do not always coincide with months experiencing the largest anomalies in total projected precipitation volumes.
    - **Djibouti City and Ali Sabieh** are expected to experience the biggest changes in average largest 5-day precipitation by midcentury, with the greatest increases during fall and winter months and the greatest decreases during May.
  - Maximum Consecutive Dry Days: The maximum length of dry spells annually, with dry days receiving <1 mm, decrease by a median of –13.60 (–105.66, 32.76) days throughout Djibouti by midcentury, but maintain a high annual projected average of 292.78 (200.72, 339.14) days by midcentury, and exhibit interannual and decadal variability.
    - **All regions** are projected to continue experiencing a high maximum number of consecutive dry days annually by midcentury, with the highest number of dry streaks during winter months and additionally during spring months in eastern coastal regions.
- **Extreme Precipitation Occurrence:** By midcentury, Djibouti is likely to more frequently experience extreme precipitation event occurrence. The future return period of a 100-year event associated with 1-day largest cumulative precipitation amounts is projected to become 63.67 (21.71, 213.32) years by midcentury. These conditions pose risks for flood-related safety, health, and critical infrastructure.
  - There is uncertainty over the rates of change of future return periods at the subnational level. However, **all regions except the coastal northeast** are projected to be nearly twice as likely to experience extreme events with 5-day or monthly cumulative precipitation amounts and 100-year historical return periods by midcentury under SSP3-7.0.

- **Climate-Related Hazards:**
  - Sea level rise, inundation, and erosion will increasingly threaten Djibouti's **coastal zones**, causing a significant retreat of the coastline by the end of the century. Sea level rise nationally is projected to increase 0.22 m (0.15 m, 0.31 m) by 2050 and 0.69 m (0.48 m, 0.95 m) by 2100 from the historical baseline.
  - Flooding in **coastal urban areas** and droughts in **eastern regions** have recently increased and will likely continue occurring with greater intensity and frequency.
  - Climate variability can exacerbate Djibouti's moderately high seismic risk conditions. Earthquake hazards pose the greatest **along the coast**, while the **western interior regions** have the highest volcanic and landslide hazard risks.

For National Policies, see key documents linked at the end of this profile.

COUNTRY OVERVIEW

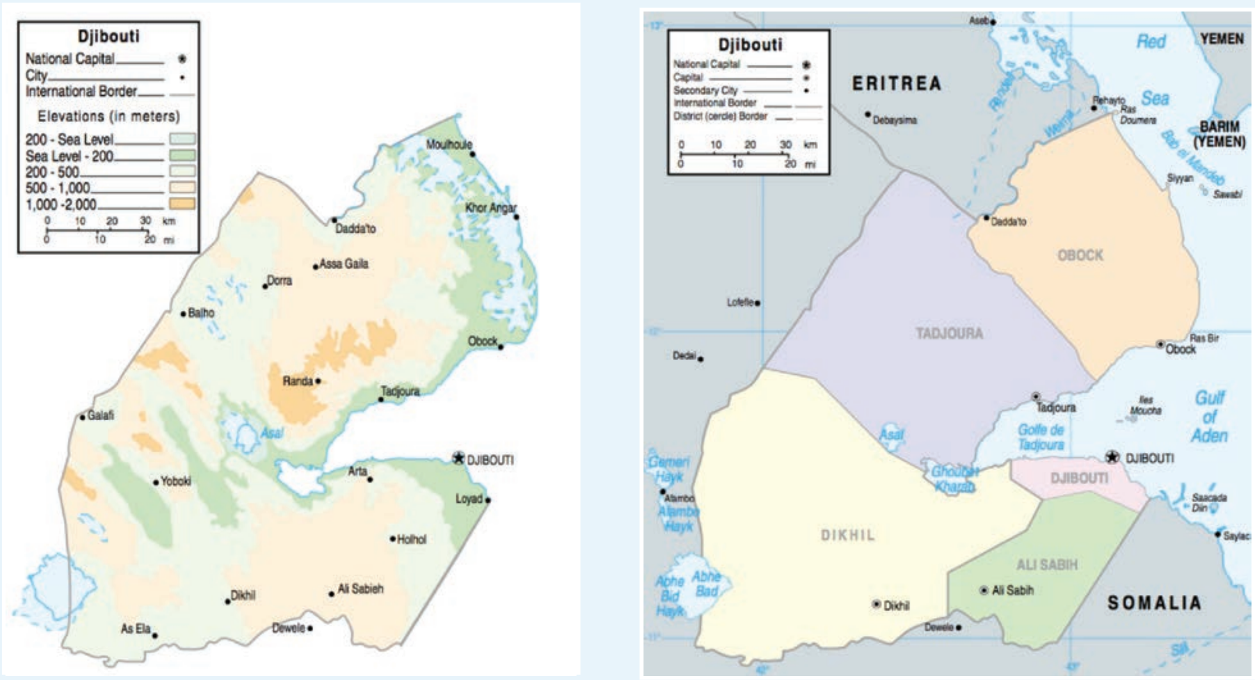
The Republic of Djibouti is a small but geographically strategic country, located between 11–13°N latitude in the Horn of Africa at the southern entrance to the Red Sea. With a land area of 23,200 square kilometers (km^2) and a 372 kilometer (km) coastline along the Gulf of Aden, it is among the smallest countries in Africa.[1] Djibouti shares borders with Eritrea, Ethiopia and Somalia and is subdivided into five administrative regions (**see Figure 1**).[2] Its terrain is mostly comprised of arid shrubland across three zones – the low-altitude eastern coastal plain, the more mountainous northern interior, and the plains and plateaus spanning the southern interior. The coastal plain in the northeast (Obock) comprises narrow beaches and coral reefs while the coastal plain in the southeast houses the country's main port (Djibouti City). The northern interior (Tadjourah) experiences the greatest changes in elevation, from Lake Assal (155 meters below sea level, the lowest point in Africa) to the mountains, ridges, and ravines culminating in the country's highest point Mount Moussa Ali (2,020 meters). The southern interior (Dikhil, Ali Sabieh) extends from Lake Abbé to Lake Ghoubbet in the west, where deep plains and depressions mark geological fracturing, to the Somali Plateau in the east that protrudes northward from the Ethiopia-Somalia border.[3]

1 Ministry of the Environment and Sustainable Development (2021). Third National Communication to the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/DJIBOUTI%20-%20Troisi%C3%A8me%20Communication%20Nationale%20sur%20les%20Changements%20Climatiques.pdf

2 In 2003, a sixth region (Arta) was created by combining parts of Dikhil and Djibouti regions. However, CCKP data still corresponds to the previous boundaries of the five regions.

3 For a more detailed description of Djibouti's geological features, see section titled "Earthquake, Volcano, and Landslide Hazards."

FIGURE 1. Terrain (Left) and Administrative (Right) Regions of Djibouti[4]



According to the World Bank's DataBank,[5] Djibouti is the least populous non-island country in Africa, with an estimated 1.12 million people in 2022 and an annual population growth rate of 1.4%. More than three-quarters of its population live in the coastal zone, primarily around the capital city,[6] making it the third most urbanized country in Africa. Djibouti is classified as lower-middle-income, with a 2022 GDP of $3.52 billion (Gross Domestic Product in current $US), annual GDP growth rate of 3.0%, and more than $3,000 in GDP per capita (**see Table 1**). This is relatively low for the Middle East and North Africa but relatively high for the African continent, owing to Djibouti's modern port complex along a globally important shipping route (the Bab el Mandeb Strait). However, its notably high reliance on the transportation, logistics, and public administration service sectors reveals a lack of economic diversification. Most of Djibouti's port activities constitute imports and exports for its landlocked neighbor Ethiopia,[7] which typically enter Djibouti by road from the western Dikhil region.[8] With little arable land and no permanent bodies of freshwater, Djibouti imports nearly all its food. It also has among the highest unemployment rates in the world, as economic development focused on infrastructure has not created sufficient jobs for youth and especially women.[9] While recently volatile GDP growth is expected to recover in the medium term,[10] overall Djibouti ranks low on the

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4 University of Texas Libraries (2021). Djibouti Maps. URL: https://maps.lib.utexas.edu/maps/djibouti.html
5 World Bank (2023). DataBank – World Development Indicators. URL: https://databank.worldbank.org/source/world-development-indicators
6 African Development Bank (2023). Djibouti Country Strategy Paper 2023–2027. URL: https://www.afdb.org/en/documents/djibouti-country-strategy-paper-2023-2027
7 African Development Bank (2016). Djibouti Country Strategy Paper 2016–2020. URL: https://www.afdb.org/en/documents/document/djibouti-country-strategy-paper-csp-2016-2020-87033
8 UNCTAD (2018). The Djibouti City – Addis Ababa Transit and Transport Corridor: Turning Diagnostics into Action. URL: https://unctad.org/publication/djibouti-city-addis-ababa-transit-and-transport-corridor-turning-diagnostics-action
9 African Development Bank (2023). Djibouti Country Strategy Paper 2023–2027. URL: https://www.afdb.org/en/documents/djibouti-country-strategy-paper-2023-2027
10 World Bank (2022) Djibouti Overview. URL: https://www.worldbank.org/en/country/djibouti/overview#1

Human Development index (171 out of 191) for 2021, considering factors such as life expectancy, education, and income per capita.[11] Most recent (2017) estimates indicate that 21.1% of its population live below the nationally determined poverty line. This includes much of its rural pastoralist population, which disproportionately experiences disparities in access to basic services.[12]

Djibouti submitted its Intended Nationally Determined Contribution (NDC) to the UNFCCC in 2015 and it became effective in 2016. The NDC commits to reducing greenhouse gas emissions 40% by 2030, which the national government in part seeks to achieve through a target of 100% renewable energy generation.[13] Djibouti's adaptation priorities of ensuring water access amid drought and rainfall variability, coastal protection amid sea level rise, and rural resilience amid threats to agriculture, livestock, and biodiversity all align with the country's long-term Vision 2035. They are also reiterated in its Third National Communication (TNC) to the UNFCCC in 2021, which updated the Second National Communication (NC2) from 2013. The government streamlined climate adaptation efforts across its medium-term economic plan (SCAPE, 2015) as well as its agriculture, water, livestock, and fishery sectors through the National Programme for Agricultural Investment and Food and Nutrition Security (PNIASAN, 2016).[14]

TABLE 1. Key Development Indicators[15]

Key Demographic Indicators	Most Recent Value	Global Rank
Population Density (people per sq km, 2020)	47.03	152 (out of 215)
Life Expectancy (for total population in years, 2021)	62.31	179 (out of 209)
Fertility Rate (total births per woman, 2021)	2.80	68 (out of 210)
Dependency Ratio (dependents per 100 working-age people, 2022)	53.68	116 (out of 217)
Key Economic and Social Development Indicators	**Most Recent Value**	**Global Rank**
GDP per Capita (in current $US, 2022)	$3,136.11	130 (out of 186)
% Population Below National Poverty Line (2017)	21.10%	93 (out of 157)
Unemployment Rate (% of total labor force, 2022)	27.93%	2 (out of 183)
% Employed in Agriculture (2021)	1.18%	175 (out of 185)
% Employed in Industry (2021)	6.11%	184 (out of 185)
% Employed in Services (2021)	92.70%	1 (out of 185)
% Population with Access to Electricity (2021)	65.44%	179 (out of 215)
% Population Using at Least Basic Sanitation Services (2020)	66.72%	138 (out of 188)

Data for each indicator's most recently measured year is ranked compared to all countries and entities globally in the far-right column, as tracked by the World Bank's DataBank.

[11] UNDP (2022). Human Development Report 2021/2022. URL: https://hdr.undp.org/system/files/documents/global-report-document/hdr2021-22pdf_1.pdf

[12] African Development Bank (2023). Djibouti Country Strategy Paper 2023–2027. URL: https://www.afdb.org/en/documents/djibouti-country-strategy-paper-2023-2027

[13] Ministry of the Environment and Sustainable Development (2021). Third National Communication to the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/DJIBOUTI%20-%20Troisi%C3%A8me%20Communication%20Nationale%20sur%20les%20Changements%20Climatiques.pdf

[14] UNDP (2019). National Adaptation Plans in Focus: Lessons from Djibouti. URL: https://www.adaptation-undp.org/sites/default/files/resources/nap_in_focus_lessons_from_djibouti_eng_final_web.pdf

[15] World Bank (2023). DataBank – World Development Indicators. URL: https://databank.worldbank.org/source/world-development-indicators

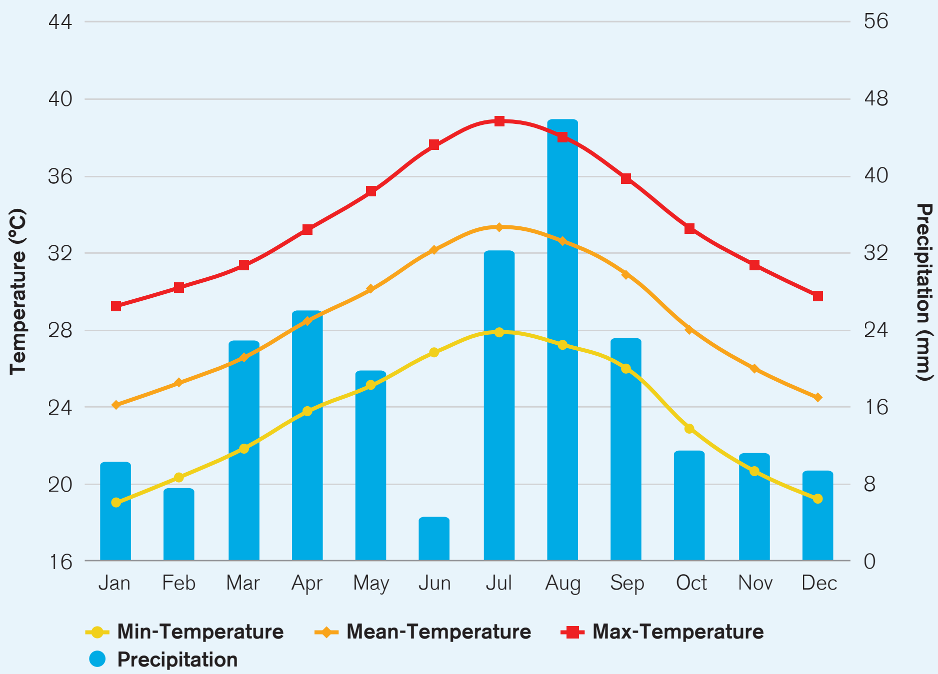
Data Overview

The data presented are from the World Bank Group's Climate Change Knowledge Portal (CCKP).[16] Historical, 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) and ERA5 reanalysis collection from ECMWF (1950–2020).

Climate Overview

Djibouti has a dry tropical climate characterized by high year-round temperatures and evaporation rates, as well as low and irregular amounts of precipitation in the form of two or three monsoonal rainy seasons per year.[17] Over the current climatology (1991–2020, **see Figure 2**), Djibouti experienced a mean annual temperature of 28.50°C. Average seasonal temperatures observed during this 30-year period's coolest and most humid months (October–April) ranged from a minimum of 18.98°C in January to a maximum of 33.25°C

FIGURE 2. Observed Monthly and Seasonal Climatology of Djibouti's Temperature and Precipitation, 1991–2020



Note the differences in precipitation between the cool rainy season in spring and the hot rainy season in summer, as well as the differences in mean temperature between the transitional dry period in June and the variable dry season in winter.

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[16] World Bank Climate Change Knowledge Portal (2023). Djibouti Climatology. URL: https://climateknowledgeportal.worldbank.org/country/djibouti/climate-data-historical

[17] Seregina, L. S., Fink, A. H., van der Linden, R., Elagib, N. A., and Pinto, J. G. (2019). A new and flexible rainy season definition: Validation for the Greater Horn of Africa and application to rainfall trends. International Journal of Climatology, 39(2), 989–1012. DOI: https://doi.org/10.1002/joc.5856

in October. Whereas, in the hottest months (June – September), average seasonal temperatures during the same period ranged from a minimum of 25.95°C in September to a maximum of 38.85°C in the hottest month of July. Normally, northeasterly trade winds from the Arabian Sea and Gulf of Aden result in variable rainfall between the cool months of October and February, followed by a short but more reliable rainy season between March and May.[18] These spring rains, when the Intertropical Convergence Zone (ITCZ) moves north over the Horn of Africa, account for roughly one-third of Djibouti's yearly precipitation average (224.52 mm for the latest climatology). The driest season June receives less than 5 mm on average, during which southerly winds strengthen and can produce often violent sandstorms (*khamsin*).[19] A southwesterly monsoon flow drives Djibouti's main rainy season between July and September, amounting to a little less than half of the yearly precipitation average for the latest climatology.[20] During this time, the ITCZ begins moving southward over the Red Sea and Arabian Peninsula. Across both spring and summer rainy seasons, the interior region of Dikhil receives roughly twice as much precipitation as the eastern coastal desert region of Obock. Djibouti City's annual and seasonal precipitation is roughly the average of these two relative extremes. These differences are further detailed in **Table 2**, which presents observed temperature and precipitation trends (1991–2020) across Djibouti's five administrative regions.

While national-level annual averages convey generalized climate conditions, **Table 2** identifies important subnational and seasonal variations. The eastern coastal plain (Obock) observes higher maximum temperatures in the summer months (July) and the interior (Ali Sabieh) observes cooler minimum temperatures in the winter months (January). However, since the region of Tadjourah has diverse topography ranging from mountains with a subtropical climate to basins with much hotter conditions, its average may mask more extreme local variations in temperature. All five regions experience at least two wet and two dry seasons; they each receive more monthly precipitation in summer months than spring months and less precipitation in the June dry season than in the February minimum of the winter dry season. While Obock (northeast coast) experiences the driest June and Dikhil (southwest interior) experiences the wettest August, Obock and Djibouti City receive a greater relative proportion of their average yearly precipitation (one-quarter) during the variable winter months and Dikhil receives a greater relative proportion of its annual precipitation average (half) during the summer rainy season.

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18 Assowe Dabar, O., Camberlin, P., Pohl, B., Mohamed Waberi, M., Osman Awaleh, M., and Silah-Eddine, S. (2021). Spatial and temporal variability of rainfall over the Republic of Djibouti from 1946 to 2017. International Journal of Climatology, 41(4), 2729–2748. DOI: https://doi.org/10.1002/joc.6986

19 Ministry of Housing, Urban Planning, and the Environment (2014). Second National Communication to the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/djinc2.pdf

20 Assowe Dabar, O., Camberlin, P., Pohl, B., Mohamed Waberi, M., Osman Awaleh, M., and Silah-Eddine, S. (2021). Spatial and temporal variability of rainfall over the Republic of Djibouti from 1946 to 2017. International Journal of Climatology, 41(4), 2729–2748. DOI: https://doi.org/10.1002/joc.6986

TABLE 2. Observed Temperature and Precipitation Trends for 1991–2020 Climatology Across Djibouti's Regions

Climatic-Topographic and Administrative Regions	Observed Warmest (Top) and Coolest (Bottom) Months by Mean Temp.	Duration of Wet and Dry Seasons	Observed Wettest and Driest Months per Season	Observed Annual Precip.
East Coastal Plain and Interior Plateaus (Tropical Desert, Tropical Dry)				
Obock (northeast)	**July: 34.48°C** (29.43°C, 39.58°C)	W1: Mar–May W2: July–Sept	W1: Apr (15.45 mm) W2: Aug (24.25 mm)	**148.72 mm**
	Jan: 24.70°C (20.15°C, 29.30°C)	D1: June D2: Oct–Feb	**D1: June (3.24 mm)** D2: Feb (5.56 mm)	
East Coastal Plain and Interior Plateaus (Tropical Dry)				
Djibouti City (southeast)	July: 34.11°C (28.72°C, 39.55°C)	W1: Mar–May W2: July–Sept	W1: Apr (24.58 mm) W2: Aug (35.59 mm)	201.76 mm
	Jan: 24.19°C (19.50°C, 28.94°C)	D1: June D2: Oct–Feb	D1: June (4.18 mm) D2: Feb (6.37 mm)	
North Coastal Plain and Interior Mountains, Plains, and Plateaus (Tropical and Subtropical Dry)				
Tadjourah (northwest)	July: 32.95°C (27.51°C, 38.43°C)	W1: Mar–May W2: July–Sept	W1: Apr (25.47 mm) W2: Aug (47.74 mm)	231.13 mm
	Jan: 23.69°C (18.54°C, 28.90°C)	D1: June D2: Oct–Feb	D1: June (5.22 mm) D2: Feb (7.93 mm)	
South Interior Plains and Plateaus (Tropical Dry)				
Dikhil (southwest)	July: 32.92°C (27.17°C, 38.71°C)	W1: Mar–May W2: July–Sept	W1: Apr (31.32 mm) **W2: Aug (58.48 mm)**	**259.35 mm**
	Jan: 24.19°C (18.70°C, 29.72°C)	D1: June D2: Oct–Feb	D1: June (4.43 mm) D2: Dec (8.03 mm)	
Ali Sabieh (southeast)	July: 32.93°C (27.41°C, 38.52°C)	W1: Mar–May W2: July–Sept	W1: Apr (32.49 mm) W2: Aug (49.95 mm)	257.73 mm
	Jan: 23.53°C (18.42°C, 28.68°C)	D1: June D2: Oct–Feb	D1: June (5.84 mm) D2: Feb (8.18 mm)	

Climatic zones are classified according to characteristics in Sayre et al. and grouped by topo-geographic region (coastal east shaded light yellow, interior north shaded light green, and interior south shaded dark yellow).[21] The coastal east is the hottest and driest, while the interior regions furthest from the coast are relatively cooler and wetter. For the column listing mean monthly temperatures, the minimum (left) and maximum (right) temperatures are shown in parentheses. Precipitation regimes indicate wettest (W) and driest (D) months by first (W1, D1) and second (W2, D2) season if relevant, and are further interpreted in the text.

[21] Sayre, R., Karagulle, D., Frye, C., Boucher, T., Wolff, N. H., Breyer, S., et al. (2020). An assessment of the representation of ecosystems in global protected areas using new maps of World Climate Regions and World Ecosystems. Global Ecology and Conservation, 21, e00860. DOI: https://doi.org/10.1016/j.gecco.2019.e00860

Annual seasonal fluctuations are also influenced interannually by the strength of a potential El Niño Southern Oscillation (ENSO) or Indian Ocean Dipole (IOD) event.[22] During El Niño years, Djibouti tends to receive lower rainfall, particularly in the west during summer months, though other contributing factors likely play a simultaneous role. Conversely, during La Niña years, Djibouti tends to receive more rainfall, especially in the east during summer months. The eastern coastal region additionally tends to experience greater rainfall during positive IOD phases – that is when sea surface temperatures in the western Indian Ocean area anomalously warm – in October, November, and December. The intense rains and flooding that occurred in the capital in November 2019, which resulted in nearly a dozen casualties and affected more than 200,000 people in Djibouti, underscore the potentially devastating effects that can manifest during a positive IOD phase.[23] Water access, health and sanitation, rural livelihoods, and disruptions to infrastructure and economic activities are critical concerns stemming from drought and flood conditions that coincide with ENSO and IOD.

Temperature

Between 1971 and 2020, Djibouti's mean annual temperature increased by 0.21°C per decade, with relatively small regional and seasonal differences but a significantly increasing number of hot and humid days.[24] Nationwide, average minimum temperatures increased 0.15°C per decade between 1971–2020, while average maximum temperatures increased 0.20°C per decade over the same period. Dikhil in the southwest interior recorded the highest annual average mean temperature increase (0.24°C) and maximum temperature increase (0.22°C) per decade, while Ali Sabieh in the southeast interior recorded the highest minimum temperature increase (0.18°C) per decade. Coastal Obock observed the lowest average temperature increases (mean of 0.16°C mean, minimum of 0.11°C, and maximum of 0.16°C) per decade. Djibouti City meanwhile experienced a mean, minimum, and maximum temperature increase below the national average over this 50-year time period (0.17°C per decade, 0.14°C per decade, and 0.18°C per decade, respectively). The greatest differences in seasonal mean temperature increases occurred between Obock and Dikhil during spring months (0.14°C per decade and 0.25°C per decade, respectively). The greatest significant differences in minimum temperature increases occurred between Obock and Ali Sabieh during fall months (0.17°C per decade

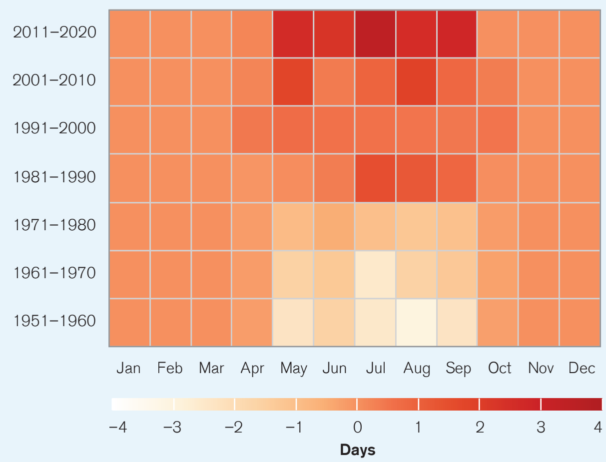
[22] Assowe Dabar, O., Camberlin, P., Pohl, B., Mohamed Waberi, M., Osman Awaleh, M., and Silah-Eddine, S. (2021). Spatial and temporal variability of rainfall over the Republic of Djibouti from 1946 to 2017. International Journal of Climatology, 41(4), 2729–2748. DOI: https://doi.org/10.1002/joc.6986

[23] U.N. and Djibouti Interior Ministry (2019). Flash Flood Update #3. URL: https://reliefweb.int/report/djibouti/djibouti-flash-update-3-humanitarian-impact-flooding-17-december-2019

[24] Observational records by meteorological stations in Djibouti are neither historically continuous nor geographically representative during this 50-year period.

and 0.27°C per decade, respectively) and during winter months for maximum temperatures (0.13°C per decade and 0.22°C per decade, respectively). However, the most notable trend over the 1971–2020 historical period may be the statistically significant (>95%) increase of 4.34 days per decade with a Heat Index >35°C (**see Figure 3**), which accounts for both temperature and atmospheric moisture content. This trend is discussed further below under projected temperature conditions.

FIGURE 3. Heatplot of Historically Observed Days per Month Nationally (1951–2020) with Heat Index > 35°C



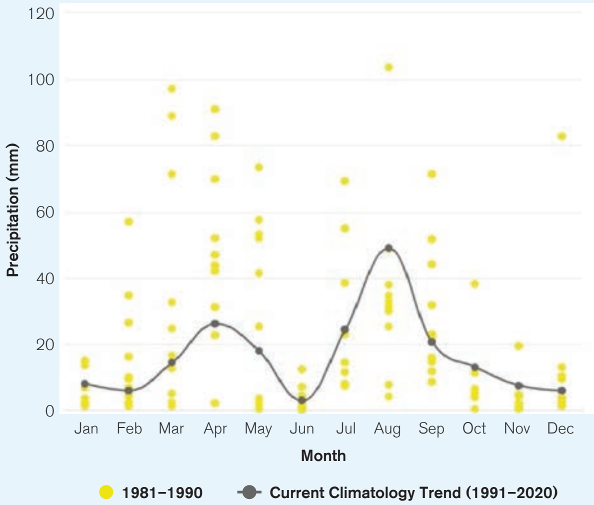
While one must consider gaps in Djibouti's observational record, note the increase in number of hot and humid days from May to September during the latest decade (2011–2020) compared to previous decades.

Precipitation

Over the 50-year period of 1971–2020, Djibouti experienced significant decreases in annual precipitation per decade, but precipitation trends varied seasonally, regionally, and interannually. For the period of 1971–2020, Djibouti's mean annual precipitation decreased –22.50 mm per decade, with Djibouti City along the coast declining the most (–27.34 mm per decade) and Dikhil in the interior declining the least (–19.81 mm per decade). The greatest regional difference occurred during winter months over this period between Djibouti City (–12.76 mm per decade) and Dikhil (–4.84 mm per decade). However, no other significant seasonal declines occurred during spring, summer, and fall months (except in the western interior) and there were no significant observed changes for the largest 1-day and 5-day precipitation events. This points to Djibouti's high annual and interannual variability, as well as the historical influence of ENSO and IOD.

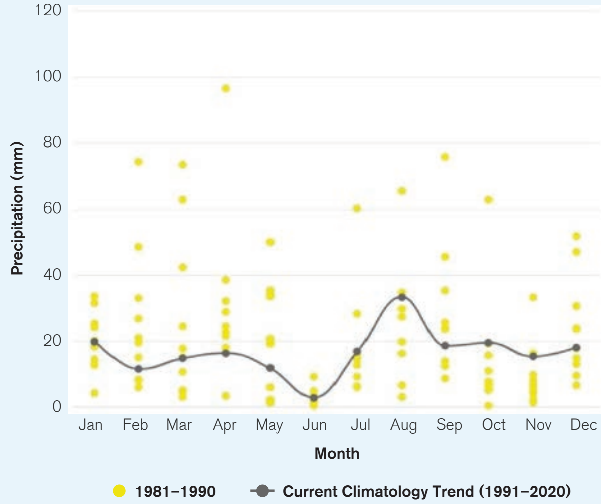
Figures 4a-d provide an illustration not only of Djibouti's regional precipitation variability, but also its interannual precipitation variability. The two regions Obock and Dikhil represent subnational extremes within Djibouti compared to other regions such as Djibouti City. During 1981–1990 (**Figure 4a**), Dikhil observed particularly high variability across the short spring rainy season compared to the current climatology trend (1991–2020). By comparison, Obock (**Figure 4b**) observed much greater variation in winter months such as December and February, but tighter and less pronounced seasonal peaks associated with the short spring and main summer rainy seasons. Comparing 1981–1990 and 2011–2020, the peaks and valleys of observed interannual precipitation and how close they adhere to the current climatology trend vary widely by month and location. During the 1980s, several ENSO events influenced the interannual variability shown in **Figures 4a** and **4b**. However, over 2011–2020, Dikhil's precipitation variability (**Figure 4c**) generally decreases from 1981–1990 and only experiences a greater range of variability during August. Obock maintains high precipitation variability over 2011–2020 (**Figure 4d**) and experiences a greater range of variability during August, October, and November compared to 1981–1990. These examples demonstrate the complexity of identifying conclusive interannual precipitation trends and contributors, as well as predicting future patterns, especially given the gaps in Djibouti's observational record.

FIGURE 4A. Historical Precipitation Variability in Dikhil (1981–1990)



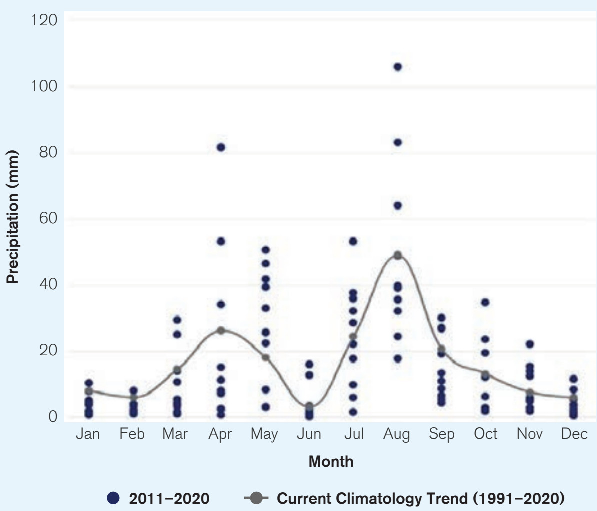
Note variability during spring months compared to 1991–2020 and compared to Obock for the same time period.

FIGURE 4B. Historical Precipitation Variability in Obock (1981–1990)



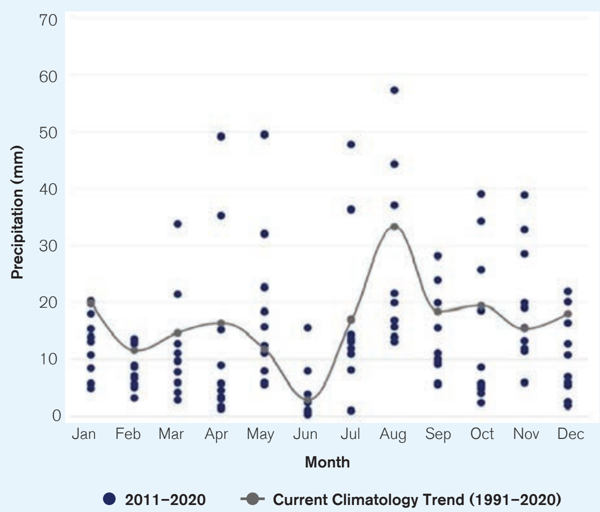
Note variability during winter months compared to 1991–2020 and compared to Dikhil for the same time period.

FIGURE 4C. Historical Precipitation Variability in Dikhil (2011–2020)



Note the limited variability – except for April, May, and August – compared to 1991–2020, 1981–1990, and Obock for the same time period.

FIGURE 4D. Historical Precipitation Variability in Obock (2011–2020)



Note the limited variability – except for May, August, October, and November – compared to 1991–2020, 1981–1990, and Dikhil for the same time period. Also, note Figure 4d has a smaller vertical axis scale.

PROJECTED CLIMATE

Data Overview

Modeled climate data is derived from CMIP6, the Coupled Model Intercomparison Project, Phase 6. The CMIP efforts are overseen by the World Climate Research Program, which supports the coordination for the production of global and regional climate model compilations that advance scientific understanding of the multi-scale dynamic interactions between the natural and social systems affecting climate. CMIP6 is the foundational data used to present global climate change projections presented in the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC). CMIP6 relies on the Shared Socioeconomic Pathways (SSPs), which represent possible societal development and policy scenarios for meeting designated radiative forcing (W/m^2) by the end of the century. Scenarios are used to represent the climate response to different plausible future societal development storylines and associated contrasting emission pathways to outline how future emissions and land use changes translate into responses in the climate system. Model-based, climate projection data is derived from the Coupled Model Inter-comparison Project-Phase 6 (CMIP6). CMIP is a standard framework for the analysis of coupled atmosphere-ocean general circulation models (GCMs) providing projections of future temperature and precipitation according to designated scenarios. CMIP6 projections are shown through five shared socio-economic pathway (SSP) scenarios defined by their total radiative forcing (a cumulative measure of GHG emissions from all sources) pathway and level by 2100. These represent possible future greenhouse gas concentration trajectories adopted by the IPCC.

The following assessment explores projected climate conditions and changes under multiple scenarios[25] for the near (the 2030s; 2020–2039) and medium term (2050s; 2040–2059) using data presented at a 0.25° × 0.25° (25km × 25km) resolution.[26] This risk profile focuses primarily on SSP3-7.0. Other SSPs are highlighted where appropriate given different trends and outlooks that should be noted. Projections for extreme precipitation events use data presented at a 1.00° x 1.00° (100km x 100km) resolution.[27]

Temperature

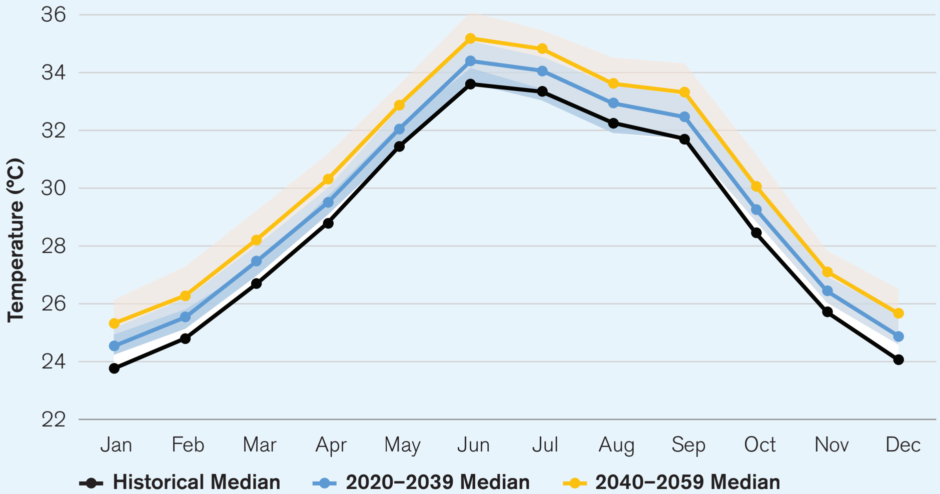
Under SSP3-7.0, Djibouti's temperatures are homogeneously projected to increase (see Figure 5). The national-level mean annual temperature increases from 28.69°C during the historical reference period of 1995–2014 to 29.42°C (28.84°C, 10th percentile, 30.07°C, 90th percentile) for the period 2020–2039, and to 30.19°C (29.36°C, 31.06°C) for the period 2040–2059. Minimum temperature increases nationwide from 23.71°C during the historical reference period to 24.51°C (23.90°C, 25.22°C) for the 2020–2039 period, and to 25.32°C (24.48°C, 26.23°C) for the 2040–2059 period. Maximum temperature increases from 33.66°C to 34.32°C (33.69°C, 35.03°C) for the 2020–2039 period, and to 35.05°C (34.15°C, 36.00°C) for the 2040–2059 period.

[25] SSP3-7.0 represents a higher emissions scenario and is considered a more realistic worst-case scenario in which warming reaches ~3.5–4°C by 2100. When considering 'risk' it is most prudent to use higher scenarios in order to not dangerously under-estimate potential changes and risk conditions.

[26] World Bank Climate Change Knowledge Portal (2023). Djibouti Climate Projections. URL: https://climateknowledgeportal.worldbank.org/country/djibouti/climate-data-projections

[27] World Bank Climate Change Knowledge Portal (2023). Djibouti Extreme Events. URL: https://climateknowledgeportal.worldbank.org/country/djibouti/extremes

FIGURE 5. Projected Climatology of Mean Temperature Countrywide for 2020–2039 and 2040–2059 (Ref. Period 1995–2014) Under SSP3-7.0



Areas shaded blue indicate 10th and 90th percentiles for 2020–2039, while areas shaded orange indicate 10th and 90th percentiles for 2040–2059. Note that during the months of May and July in particular, the 2040–2059 projected climatology of mean temperature countrywide increased more than two times the 2020–2039 projected climatology above the reference period.

Projected temperature changes under SSP2-4.5 and SSP1-2.6 are relatively lower (see Annex more details).[28] Under SSP3-7.0, the largest seasonal change generally occurs during winter months across administrative regions. Compared to the historical reference period during winter months, Obock has a minimum temperature anomaly of 1.55°C (1.10°C, 2.22°C) for 2040–2059 and Dikhil (southern interior) has a minimum temperature anomaly of 1.72°C (1.31°C, 2.36°C). Djibouti City's minimum temperature anomaly of 1.57°C (1.15°C, 2.34°C) during these months is closer to Obock's. Also, projected summer temperatures have a much wider range of uncertainty. For the 2040–2059 climatology, SSP3-7.0 projects a mean temperature anomaly nationally of 1.20°C for the month of August compared to the historical reference period but ranges from 0.01°C (10th percentile) to 1.98°C (90th percentile). Similarly, the maximum August temperature anomaly nationally ranges from –0.57°C (10th percentile) to +1.99°C (90th percentile) with a median of 1.11°C above the historical reference period.

By midcentury, Djibouti's population is likely to experience greater extreme heat risk, but the characteristics and pace of these changes will vary between coastal and inland areas. While the number of hot days above 35°C will increase during transitional months (March, April, and September) across subnational regions by the 2040–2059 period, temperature changes with atmospheric moisture content will dramatically affect the number of days per month characterized by an effective temperature above 35°C on the Heat Index (**see Table 3**).[29] For example, compared to the reference climatology (1995–2014) median of 57.04 days surpassing this key threshold during summer months (out of 82.86 mean days annually), the eastern coastal region of Obock is expected to witness 80.25 days (49.54 days, 82.92 days) in summer months for the period 2040–2059 and 129.40 days (107.38 days, 157.89 days) annually. The capital and most populous city Djibouti (southeast coast) more than

[28] Under SSP1-2.6, minimum temperature nationwide only increases to 24.88°C (24.21°C, 25.75°C) and under SSP2-4.5, increases to 25.11°C (24.39°C, 25.94°C) by 2040–2059. Under SSP1-2.6, maximum temperature increases nationwide to 34.69°C (34.03°C, 35.44°C), and under SSP2-4.5, increases to 34.91°C (34.10°C, 35.69°C) by 2040–2059.

[29] Projected Heat Index days >35°C under the SSP3-7.0 scenario use 1.00° × 1.00° (100km × 100km) data resolution.

doubles its annual number of Heat Index days from roughly half the annual number of Obock's during the historical reference period to nearly matching Obock's values by midcentury. Compared to the historical reference period, the mean annual number of Heat Index days – the bulk of which occur during the summer months – also rise dramatically in Tadjourah, Dikhil, and Ali Sabieh by midcentury. The inland region of Dikhil will likely see a drastic increase in hot, humid days by midcentury compared to its historical median of 2.49 days above the 35°C Heat Index threshold during summer months (2.96 days annually) – during summer months (2040–2059), it will experience 51.07 days (26.29 days, 60.19 days), and annually (2040–2059), it will experience 65.39 days (43.16 days, 113.58 days).

TABLE 3. Number of Historical (1995–2014) and Projected Heat Index Days >35°C (2020–2039 and 2040–2059) under SSP3-7.0 by Subnational Region

Region	Historical (1995–2014)				2020–2039				2040–2059			
	Annual	Spring (MAM)	Summer (JJA)	Fall (SON)	Annual	Spring (MAM)	Summer (JJA)	Fall (SON)	Annual	Spring (MAM)	Summer (JJA)	Fall (SON)
Heat Index Days (Mean Annual No. Days >35°C)												
Djibouti (National)	65.87 (42.33, 78.17)	6.71 (1.46, 11.50)	45.27 (20.15, 54.00)	13.57 (5.37, 18.58)	88.51 (70.96, 114.88)	11.66 (3.80, 22.02)	58.03 (34.69, 70.08)	20.44 (12.76, 29.82)	122.58 (97.25, 156.29)	21.00 (9.55, 35.21)	77.32 (46.64, 81.19)	28.35 (19.74, 42.60)
Obock	82.86 (57.21, 88.28)	7.65 (1.27, 13.93)	57.04 (28.58, 62.03)	17.02 (6.65, 21.75)	100.65 (87.00, 126.73)	13.27 (3.74, 24.74)	66.69 (40.85, 75.25)	24.46 (15.66, 32.38)	129.40 (107.38, 157.89)	22.15 (9.04, 35.50)	80.25 (49.54, 82.92)	31.78 (22.90, 44.34)
Djibouti (City)	45.86 (16.80, 70.66)	4.02 (0.59, 7.33)	34.90 (7.58, 49.98)	8.39 (0.54, 14.81)	79.97 (56.47, 109.43)	9.13 (3.53, 19.98)	54.10 (32.80, 68.73)	15.70 (8.57, 28.13)	120.02 (92.63, 162.28)	21.27 (10.34, 37.56)	77.99 (47.73, 82.45)	24.67 (16.84, 40.65)
Tadjourah	3.93 (0.44, 22.94)	0.07 (0.01, 0.35)	3.39 (0.15, 16.96)	0.29 (0.01, 3.55)	28.06 (12.21, 54.35)	0.97 (0.06, 6.03)	20.96 (9.36, 45.44)	2.56 (0.44, 14.39)	77.41 (50.98, 116.67)	6.69 (2.77, 21.67)	61.39 (33.68, 68.72)	11.39 (4.69, 29.63)
Dikhil	2.96 (0.22, 25.52)	0.00 (0.00, 0.29)	2.49 (0.04, 18.42)	0.18 (0.00, 3.85)	25.07 (9.69, 43.62)	1.13 (0.00, 6.70)	16.54 (8.73, 36.34)	2.24 (0.32, 12.60)	65.39 (43.16, 113.58)	8.01 (3.44, 22.56)	51.07 (26.29, 60.19)	9.86 (4.54, 27.08)
Ali Sabieh	24.94 (8.56, 51.98)	2.01 (0.30, 3.86)	19.13 (3.82, 36.96)	4.32 (0.27, 9.92)	56.59 (34.70, 82.49)	5.32 (1.77, 14.34)	37.96 (22.22, 57.39)	9.36 (4.51, 22.31)	100.31 (74.04, 148.18)	15.77 (7.46, 32.33)	70.39 (40.44, 76.55)	18.63 (11.44, 36.34)

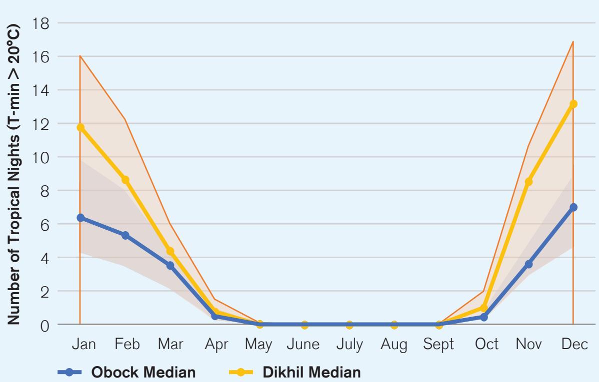
10th percentile and 90th percentile values are shown in parentheses. Number of days for winter months (DJF) are excluded because they are negligible (their medians do not exceed 0.05 days annually). High median number of days (>50 days) are shaded red and low median number of days (<10 days) are shaded gray. Note the increase in red and decrease in gray from 1995–2014 to 2040–2059.

Importantly, this shift accompanies not only an increase in warm spells, but also maximum of daily maximum temperatures and tropical nights. Warm spells are defined as when the daily maximum temperature rises above the 90th percentile, measured using 5-day intervals. Warm spells will increase nationally from the historical reference period (1995–2014) by an anomaly of 128.65 days (64.76 days, 234.17 days) for the projected period 2040–2059.[30] Meanwhile, the single-day monthly maximum of temperature maximums will likewise increase from the same reference-to-projected period by an annual anomaly of 1.66°C (0.43°C, 2.71°C) and 1.75°C (1.09°C, 2.80°C) for Obock and Dikhil, respectively. Djibouti City's anomaly for the same time period is 1.74°C (0.32°C, 2.80°C), with a median value closer to Dikhil but a wider probable range matching that of Obock.

[30] Warm Spell Duration Index projections use 1.00° × 1.00° (100km × 100km) data resolution.

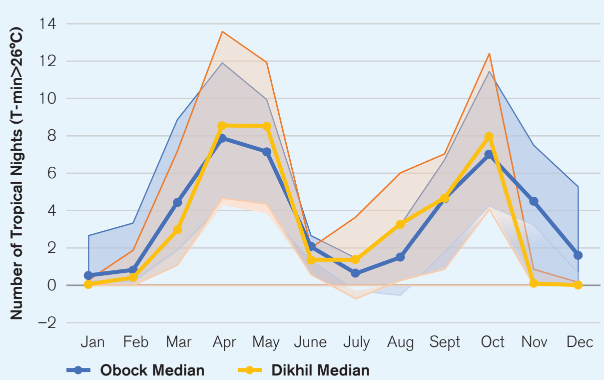
These shifts also accompany an increase in tropical nights, when a minimum >20°C or >26°C is surpassed and the human body cannot adequately cool down from a raised biophysiological threshold to achieve restorative sleep. **Figure 6a** depicts the increase in number of tropical nights >20°C. In coastal Obock, the number of tropical nights >20°C is projected to increase by a median anomaly of 6.99 nights in December (4.63 nights, 8.78 nights) and by slightly lower amounts for the cooler months of January and February by 2040–2059 (compared to the historical reference period of 1995–2014).[31] But further inland, Dikhil experiences a median increase almost twice that of Obock's by 13.14 nights (9.47 nights, 16.82 nights) for the same period during the month of December. As **Figure 6b** illustrates, the anomalous number of tropical nights >26°C in Dikhil increase slightly more than Obock during the peak months of April and October for the 2040–2059 period. Dikhil is projected to reach 8.55 nights in April (4.66 nights, 13.58 nights) and 7.97 nights in October (4.07 nights, 12.41 nights). However, compared to Dikhil, Obock has a much higher range of uncertainty in November with a distributional spread from 3.21 nights to 7.48 nights possible. Djibouti City's projected number of tropical nights >26°C by midcentury increases by an anomaly of 10.12 (5.86, 13.68) nights in April and by 10.36 (5.31, 13.32) nights in October, higher and with a wider probability range than in both Dikhil and Obock for the same time period. The spatially and seasonally heterogeneous increase in Djibouti's future extreme heat risk, reflected across the suite of metrics mentioned, points to potential corresponding effects on food and water availability, the extent of disease ranges, and year-round energy demands. For further detail on how Djibouti's projected temperature changes under SSP3-7.0 compare to other scenarios, see the profile's Annex.

FIGURE 6A. Tropical Night (T-min >20°C) Anomalies from Historical Reference (1995–2014), Projected for 2040–2059 According to SSP3-7.0, in Obock (Eastern Coast) and Dikhil (Southern Interior)



Shaded areas indicate 10th–90th percentile ranges. Compared to Obock, Dikhil is projected to experience a dramatic increase in anomalously warm nights >20°C from November to February by midcentury.

FIGURE 6B. Tropical Night (T-min >26°C) Anomalies from Historical Reference (1995–2014), Projected for 2040–2059 According to SSP3-7.0, in Obock (Eastern Coast) and Dikhil (Southern Interior)



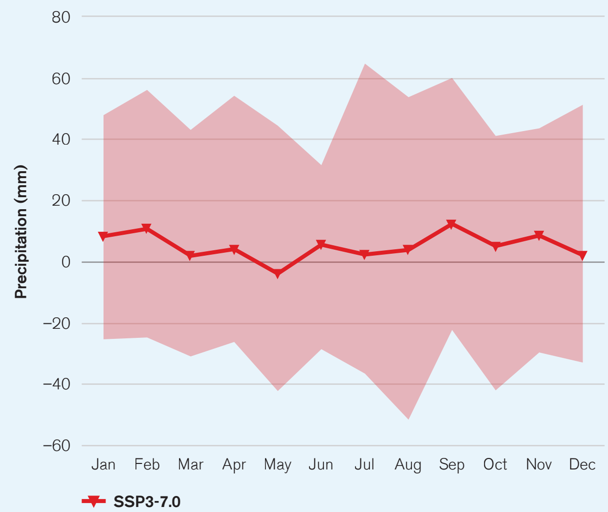
Shaded areas indicate 10th–90th percentile ranges. Both Obock and Dikhil are projected to experience sizable increases in anomalous tropical nights >26°C in April, May, and October, which indicate a more prolonged and intense hot season by midcentury. Obock's anomalous increase is notably higher than Dikhil's only in November.

[31] Djibouti City's projected number of tropical nights >20°C by midcentury increases during the peak month of January by only 4.44 (2.88, 6.57) nights, less than Obock's for the same time period.

Precipitation

Projected precipitation patterns under SSP3-7.0 nationally signal annual increases by midcentury, but divergent seasonal and regional shifts with a wide range of uncertainty. The amount of precipitation Djibouti receives during the main summer rainy season is projected to increase with a large distribution range by 2040–2059, with an August anomaly above the historical reference period (1995–2014) of 10.75 mm (–5.49 mm, 58.39 mm). This contributes to a net annual precipitation increase of 33.25 mm (–6.45 mm, 133.14 mm) nationally for the same timeframe. Considering Djibouti's low overall annual rainfall totals, these increases are notable. **Figure 7** depicts changes in precipitation intensity across multiple seasons nationally for the 2040–2059 period, when measured according to the largest average 5-day precipitation anomaly from the historical reference period. Djibouti's September anomaly increases 12.29 mm (–22.37 mm, 59.98 mm) above the reference period and matches a roughly equal increase during the month of February, with higher increases in Djibouti City and Ali Sabieh during fall and winter months. However for 2040–2059, the country is also projected to experience a May decrease in the largest average 5-day precipitation totals of –3.96 mm (–42.33 mm, 44.39 mm) from the reference period, pointing to diverging seasonal trends in precipitation intensity.

FIGURE 7. Nationally Projected Average Largest 5-Day Cumulative Precipitation Anomaly 2040–2059 Under SSP3-7.0 (Ref. Period 1995–2014)



The largest 5-day cumulative anomalies increase most during September, November, January, and February, while decreasing during the month of May. Note the wider range on the y-axis.

Upon analyzing Djibouti's projected percent change in total precipitation by midcentury, seasonally and regionally complex precipitation shifts become more evident (**see Table 4**). Annual precipitation totals increase by more than 10% across every region from the 1995–2014 reference period under SSP3-7.0. Obock and Tadjourah are expected to experience the greatest percent increases annually, but all regions experience the largest percent increases over summer and fall months.[32] The summer season's greatest precipitation percent change for 2040–2059 above the historical reference period is projected for Dikhil at a rate of 32.42% (–12.57%, 115.83%). Notably, all regions are projected to experience percent changes greater than 10% during summer months by 2020–2039. In contrast, median projected percent changes for 2040–2059 decrease across regions during winter and spring months (highlighted red in **Table 4**) compared to their projected 2020–2039 anomalies.

[32] Djibouti City's annual projected precipitation percent increase from the reference period by midcentury, like Dikhil, is only 1% below that of Obock and Tadjourah. The capital's precipitation percent increase during summer months by midcentury is by comparison the lowest of all regions at a rate of 24.36% (–3.93%, 120.41%).

TABLE 4. Projected Median Percent Change in Total Precipitation for 2020–2039 and 2040–2059 from Ref. Period 1995–2014 Under SSP3-7.0

Region	Winter (Dec–Jan–Feb)		Winter (Dec–Jan–Feb)		Spring (Mar–Apr–May)		Summer (June–July–Aug)		Fall (Sept–Oct–Nov)	
	2020–2039	2040–2059	2020–2039	2040–2059	2020–2039	2040–2059	2020–2039	2040–2059	2020–2039	2040–2059
Djibouti	9.28% (–4.17%, 34.12%)	13.59% (–0.63%, 51.99%)	2.30% (–23.13%, 29.22%)	1.25% (–24.43%, 46.00%)	7.22% (–18.16%, 33.87%)	0.66% (–17.38%, 41.62%)	17.21% (–4.58%, 61.32%)	29.97% (–7.95%, 102.71%)	7.57% (–8.99%, 38.40%)	23.51% (–7.65%, 74.31%)
Obock (northeast)	9.55% (–3.88%, 37.96%)	**14.48%** (1.09%, 52.94%)	3.56% (–26.84%, 26.83%)	1.21% (–27.39%, 47.96%)	6.79% (–17.03%, 30.02%)	0.25% (–15.17%, 36.62%)	16.09% (–3.97%, 67.14%)	25.37% (–0.60%, 94.84%)	7.96% (–8.98%, 41.82%)	26.11% (–7.45%, 90.94%)
Djibouti City (southeast)	9.49% (–4.05%, 37.54%)	13.08% (2.66%, 57.40%)	8.14% (–25.64%, 31.11%)	7.20% (–30.12%, 62.20%)	8.33% (–14.91%, 36.48%)	0.24% (–14.39%, 47.27%)	13.26% (–7.49%, 63.35%)	24.36% (–3.93%, 120.41%)	9.52% (–10.64%, 43.50%)	27.09% (–3.90%, 64.05%)
Tadjourah (northwest)	8.98% (–2.52%, 34.62%)	**14.48%** (–1.29%, 52.48%)	2.05% (–18.97%, 28.64%)	2.08% (–24.04%, 55.73%)	6.30% (–24.19%, 33.69%)	–0.60% (–20.01%, 42.17%)	16.41% (–4.33%, 56.94%)	30.91% (–10.10%, 87.74%)	8.01% (–8.52%, 39.15%)	21.87% (–8.41%, 77.31%)
Dikhil (southwest)	9.62% (–5.55%, 30.83%)	12.64% (–2.31%, 49.80%)	–0.58% (–23.20%, 28.61%)	–1.80% (–22.81%, 29.43%)	7.80% (–15.55%, 34.97%)	**1.93%** (–17.97%, 42.11%)	19.90% (–4.93%, 60.87%)	**32.42%** (–12.57%, 115.83%)	6.02% (–9.13%, 33.30%)	22.04% (–8.90%, 66.43%)
Ali Sabieh (southeast)	8.36% (–4.75%, 35.42%)	12.79% (2.69%, 54.58%)	8.86% (–26.76%, 37.42%)	**7.76%** (-23.28%, 67.25%)	8.32% (–13.05%, 37.34%)	0.83% (–12.93%, 46.44%)	13.60% (–4.20%, 63.36%)	29.72% (–1.27%, 109.49%)	10.37% (–9.37%, 45.78%)	**27.17%** (–2.62%, 63.51%)

10th percentile and 90th percentile values are shown in parentheses. Anomalies bolded in black for 2040–2059 indicate the greatest increases from the historical reference period. Median percentages bolded in red indicate anomalies for 2040–2059 that decreased from those projected for 2020–2039. Medians shaded orange indicate positive anomalies >10%. See text for interpretation.

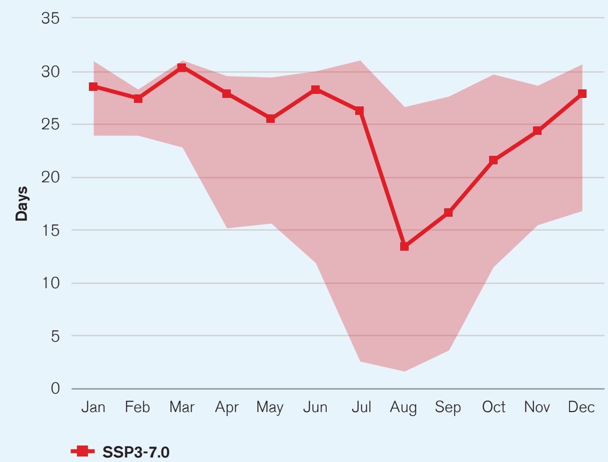
These patterns not only reflect interannual and decadal variability associated with ENSO and IOD (see subsection on sea surface temperature for more detail), but also spatially and temporally uneven changes across dominant rainy and dry seasons. For 2040–2059, Djibouti's annual and August monthly precipitation projections under both SSP2-4.5 and SSP1-2.6 are nearly equivalent to those of SSP3-7.0.

Critically, projected annual increases in precipitation at the national level do not preclude more frequent or severe dry periods from occurring. All regions are projected to continue experiencing a high maximum number of consecutive dry days by midcentury (between 270 and 300 days annually and generally at least 25 days per month between November to July, **see Figure 8**).[33] Coastal Obock possesses 16 more consecutive dry days than Dikhil during summer months and Djibouti City possesses 7 more than Dikhil during the summer season by midcentury. Recent studies suggest severe droughts are becoming longer and more frequent (see subsection on climate-related hazards for more detail). The fact that Djibouti maintains its high number of maximum consecutive dry days annually by midcentury reflects its continued susceptibility to experiencing drought episodes. More extreme wet and dry precipitation events will impact

[33] These projections use 1.00° × 1.00° (100km × 100km) data resolution.

food and livestock security, water access, health and sanitation, and infrastructure-dependent economic activities. For further detail on how Djibouti's projected precipitation changes under SSP3-7.0 compare to other scenarios, see the profile's Annex.

FIGURE 8. Nationally Projected Annual Number of Maximum Consecutive Dry Days for 2040–2059 (Ref. Period 1995-2014) Under SSP3-7.0



Area shaded red indicates 10th–90th percentiles. Note the months between November and July maintain high monthly probabilities for maximum consecutive dry days, though with greatest certainty for January and February.

Extreme Precipitation Events

By midcentury, Djibouti is likely to more frequently experience extreme precipitation event occurrence, but there is still uncertainty over the rates of change of future return periods at the subnational level. For the projected period of 2035–2064 under SSP3-7.0, the largest 5-day precipitation amounts associated with 50-year and 100-year historical return periods will be nearly two times more likely or more to occur in the three interior regions. The region with the greatest changing future return periods under this projection is Tadjourah. However, as **Table 5** illustrates, equivalent changes

TABLE 5. Future Return Periods of Largest 1-Day Precipitation Amounts (SSP3-7.0, 2035–2064, Center 2050) by Region

	Future Return Period (in Years) for 1-Day Precip. Event			
Region	**10-yr**	**25-yr**	**50-yr**	**100-yr**
Djibouti (National)	6.27 (3.04, 10.94)	14.69 (6.50, 33.33)	29.64 (11.97, 80.66)	63.67 (21.71, 213.32)
Eastern Coast				
Obock	6.56 (2.94, 10.64)	15.85 (6.17, 32.11)	32.57 (11.51, 77.40)	68.54 (20.65, 204.24)
Djibouti (City)	5.99 (3.34, 11.53)	13.02 (7.42, 36.03)	25.24 (13.35, 89.46)	55.88 (24.48, 254.05)
Northern Interior				
Tadjourah	5.85 (2.99, 11.17)	13.39 (6.63, 33.84)	26.41 (12.30, 79.95)	59.20 (22.72, 190.12)
Southern Interior				
Dikhil	5.42 (3.15, 11.10)	12.46 (7.03, 30.18)	24.21 (13.23, 62.90)	57.16 (25.00, 130.77)
Ali Sabieh	5.61 (3.22, 11.45)	12.42 (7.05, 33.74)	24.24 (12.92, 77.72)	57.42 (24.37, 195.16)

The return periods that would be at least 2 times or more likely to occur by midcentury are shaded orange. Note the fastest rates of change for experiencing 1-day precipitation amounts occur in the southern interior for 25-year and 50-year events.

in the future return periods of the largest 1-day precipitation events over 2035–2064 only occur for Dikhil and Ali Sabieh's 25-year and 50-year historical return periods. Meanwhile, equivalent changes in the future return periods of the largest monthly cumulative precipitation events over the same midcentury timeframe additionally include Djibouti City for 50-year and 100-year historical return periods. These different regional patterns for each precipitation event frequency highlight the country's complex natural interannual variability. Compared to SSP3-7.0, SSP1-2.6 and SSP2-4.5 forecast more frequent future return periods for Djibouti City's 50-year and 100-year 5-day precipitation events by midcentury. SSP1-2.6 projects more frequent future return periods for Djibouti City's 100-year 1-day precipitation amounts and Obock's 100-year monthly cumulative precipitation amounts by midcentury. SSP2-4.5 projects lower rates of change than SSP3-7.0 for all regions and future return periods associated with 1-day precipitation amounts by midcentury. While regional differences in extreme precipitation event frequencies vary by scenario, every frequency across all five regions experiences greater rates of change after midcentury. More frequently occurring extreme precipitation events and their associated flood impacts in Djibouti underscore future health and economic risks, especially as they relate to critical infrastructure.

CLIMATE-RELATED NATURAL HAZARDS

Between 1980 and 2010, geophysical and climate-related hazards in Djibouti affected approximately 1.5 million people according to the Centre for Research on the Epidemiology of Disasters.[34] The country faces a relatively high risk of heat waves, droughts, floods, sea level rise, and seismic activity, all of which climate change will likely exacerbate. Temperature increases and extreme heat not only pose direct human health risks (e.g., heatstroke, malaria, cholera, diarrheal diseases), but also affect economic activities, energy demand, water security, and livestock. Droughts and floods are expected to occur more frequently and with greater intensity, often alternating with each other in ways that magnify adverse impacts.[35] Flash floods threaten critical infrastructure, water quality, economic activities, and human health and mortality, and are more likely to occur over the southwest region's sandier soil.[36] Any future seasonal increases in precipitation also do not eliminate Djibouti's high extant drought risk, which threatens food and water security. As one of the most water-scarce countries in the world, Djibouti lacks permanent surface freshwater and endures extreme rates of evaporation, which require it to rely on dwindling underground water tables that make its populace vulnerable to periods of severe drought. Coastal areas, where the majority of the country's population is concentrated, are subject to localized flooding, inundation, and salinization worsened by sea level rise. Impacts associated with sea level rise affect the country's critical infrastructure and port activities, as well as the essential ecosystem services from mangroves and coral reefs. Coastal areas additionally assume the greatest asset losses and casualty risks from frequent seismic activity. These hazard risks are discussed in turn below.

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[34] GFDRR (2011). Djibouti Climate Risk and Country Adaptation Profile. URL: https://www.uncclearn.org/wp-content/uploads/library/wb127.pdf

[35] Ministry of the Environment and Sustainable Development (2021). Third National Communication to the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/DJIBOUTI%20-%20Troisi%C3%A8me%20Communication%20Nationale%20sur%20les%20Changements%20Climatiques.pdf

[36] GFDRR (2011). Djibouti Climate Risk and Country Adaptation Profile. URL: https://www.uncclearn.org/wp-content/uploads/library/wb127.pdf

Sea Level Rise and Sea Surface Temperature

Historically observed sea surface temperatures (1958–2017) in the Red Sea and Gulf of Aden reflect different seasonal patterns and rates of warming. Mean annual sea surface temperature in the southern Red Sea during this period (bordering the northern coast of Obock, north of the Bab el Mandeb Strait) was approximately 28.5°C and fluctuated between one seasonal maximum anomaly in July and August (~ +2–3°C warmer) during the warm season and one seasonal minimum anomaly in February (~ –4°C) during the cool season.[37] However, mean annual sea surface temperature in the western Gulf of Aden during this period (including the Gulf of Tadjoura bordering southern Obock, Tadjourah, and Djibouti City, south of the Bab el Mandeb) was approximately 28°C and exhibited two seasonal maxima and minima. In addition to a maximum anomaly in September (~ +3°C) and minimum anomaly in January (~ –4°C), respectively, the basin also featured an earlier relative maximum anomaly in June (~ +3°C) and later minimum anomaly in August (~ –2°C), likely due to seasonal upwelling of colder, deeper water.[38] Annual sea surface temperature anomalies displayed an increasing trend in both basins across all seasons since 1993, with the highest increase of 0.64°C per decade in the Red Sea (1993–2009) and <0.40°C per decade in the Gulf of Aden over the same time period.[39] Sea surface temperature anomalies are important contributors to interannual and decadal climate variability in Djibouti. On average, El Niño is correlated with warmer sea surface temperatures and wetter conditions over the Gulf of Aden, while La Niña is correlated with cooler sea surface temperatures and drier conditions. While a warm IOD phase tends to occur during El Nino and a cool IOD phase tends to occur during La Nina, these patterns do not always hold.

Sea level rise, inundation, and erosion will increasingly threaten Djibouti's coastal zones, causing a significant retreat of the coastline by the end of the century. Under SSP3-7.0 with a historical baseline of 1995–2014, sea level rise is projected to increase 0.22 m (0.15 m, 0.31 m) by 2050 and 0.69 m (0.48 m, 0.95 m) by 2100 for the closest geographic coordinate to Djibouti's coastline (11°N, 44°E).[40] This rate of sea level rise would affect a majority of its population and half of its economic activities.[41] **Figure 9a** illustrates how much of Djibouti's coastline has a high risk of long-term inundation, with the greatest effects near the Bab el Mandeb in the north and near the capital city in the south. Much of the same expanse is also subject to at least moderate coastal flooding (**see Figure 9b**), with very high localized flood hazard in parts of Obock settlement and Djibouti City. Coupled with groundwater extraction, sea level rise increases the risk of saltwater intrusion particularly during the northeast monsoon season (October-May), when the predominant tides originate from the more saline Red Sea.[42] For further detail on how Djibouti's projected sea level rise under SSP3-7.0 compares to other scenarios, see the profile's Annex.

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[37] Agulles, M., Jordà, G., Jones, B., Agustí, S., and Duarte, C. M. (2020). Temporal evolution of temperatures in the Red Sea and the Gulf of Aden based on in situ observations (1958–2017). Ocean Science, 16(1), 149–166. DOI: https://doi.org/10.5194/os-16-149-2020

[38] Agulles, M., Jordà, G., Jones, B., Agustí, S., and Duarte, C. M. (2020). Temporal evolution of temperatures in the Red Sea and the Gulf of Aden based on in situ observations (1958–2017). Ocean Science, 16(1), 149–166. DOI: https://doi.org/10.5194/os-16-149-2020

[39] Nandkeolyar, N., Raman, M., and Kiran, G. S. (2013). Comparative analysis of sea surface temperature pattern in the eastern and western gulfs of Arabian Sea and the Red Sea in recent past using satellite data. International Journal of Oceanography: 501602. DOI: https://doi.org/10.1155/2013/501602

[40] NASA (2023). Sea Level Projection Tool. URL: https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool; note the figures inside parentheses represent 17th and 83rd percentiles, respectively.

[41] Kireyev, M. A. P. (2018). Macro-fiscal implications of climate change: the case of Djibouti. IMF Working Paper Issue 233. URL: https://www.elibrary.imf.org/view/journals/001/2018/233/article-A001-en.xml

[42] GFDRR (2011). Djibouti Climate Risk and Country Adaptation Profile. URL: https://www.uncclearn.org/wp-content/uploads/library/wb127.pdf

FIGURE 9A. Hazard Risk Associated with Gradual Coastal Inundation[43]

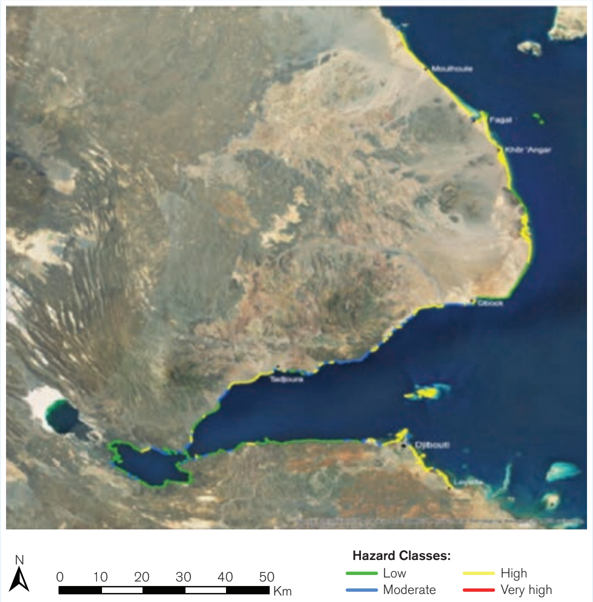

FIGURE 9B. Hazard Risk Associated with Coastal Flooding[44]

Note the highest coupled risk for coastal flooding and long-term inundation includes the coastline from Obock north to the Eritrean border and Djibouti City southward.

Flood and Drought Risk

Incidents of flooding, especially in coastal urban areas, have recently increased and will likely occur with greater intensity and frequency. For example, a year's worth of rain fell during one storm event in May 2018 and affected roughly half of Djibouti City, damaging homes, businesses, and infrastructure.[45] Intense rainfall during October– December, such as in 2019, typically correlates with warmer sea surface temperatures in the Gulf of Aden (a positive IOD phase), which especially affects eastern coastal regions.[46] Flood hazard risks threaten sanitation, hygiene, safety, and critical infrastructure access.

[43] Appelquist, L. and Balstrøm, T. (2014). Application of the Coastal Hazard Wheel methodology for coastal multi-hazard assessments and management in the state of Djibouti. Climate Risk Management, 3, 79–95. DOI: https://doi.org/10.1016/j.crm.2014.06.002

[44] Appelquist, L. and Balstrøm, T. (2014). Application of the Coastal Hazard Wheel methodology for coastal multi-hazard assessments and management in the state of Djibouti. Climate Risk Management, 3, 79–95. DOI: https://doi.org/10.1016/j.crm.2014.06.002

[45] Kireyev, M. A. P. (2018). Macro-fiscal implications of climate change: the case of Djibouti. IMF Working Paper Issue 233. URL: https://www.elibrary.imf.org/view/journals/001/2018/233/article-A001-en.xml

[46] Dabar, O. A., Adan, A. B. I., Ahmed, M. M., Awaleh, M. O., Waberi, M. M., Camberlin, P., Pohl, B., and Mohamed, J. (2022). Evolution and Trends of Meteorological Drought and Wet Events over the Republic of Djibouti from 1961 to 2021. Climate, 10(10), 148. DOI: https://doi.org/10.3390/cli10100148

According to recent studies that attempt to circumvent Djibouti's lack of observational data, drought frequency, intensity, and duration (as measured by SPEI) increased in Djibouti after 2003 and will likely increase 20% by 2050.[47] Twelve extreme droughts between 2003 and 2021 accounted for more than 80% of extreme dry events in Djibouti since 1961, with 2010–2011 and 2013–2015 being the most severe.[48] Severe dry periods increasingly result in widespread effects. For example, chronic drought between 2008 and 2011 affected half of the rural population and resulted in livestock die-offs, food and water shortages, and a 4% a loss of GDP. Though droughts tended to affect the entire country at once, they are longer and more severe in eastern coastal region.[49] More recent droughts tended to affect rainfall during October-November and March-May, which disproportionately affect the eastern coastal region. If this trend continues, annual precipitation projections will have a greater likelihood of increasing from the historical reference period in Dikhil compared to Djibouti's other regions. However, El Niño phases may correlate with drier than average summer rain seasons in Djibouti, particularly in the western inland regions. Future changes in this phenomenon's frequency and intensity would strongly affect interannual and decadal trends. Furthermore, scientists caution that any projected seasonal and annual increases in precipitation nationally by midcentury may be offset by higher rates of temperature-driven potential evapotranspiration.[50] This effect would suggest that Djibouti continues to experience intense floods and droughts regardless of the trend in total annual precipitation.

Earthquake, Volcano, and Landslide Hazards

Djibouti is located in the Afar Triangle of the Afro-Arabian Rift System, a tectonically active region spanning roughly 200,000 km^2 with moderately high seismic risk conditions that climate variability can exacerbate. The geological features of the Afar Triangle are a result of three plates diverging at the triple-junction centered near Djibouti's Lake Abbé (**see Figure 10a**).[51] Bounding the region's west is an escarpment at the edge of the Ethiopian Plateau (~3,000 meters in altitude), which is located on the Nubian Plate stretching northward from the East African Rift Valley to the Red Sea. To the south-southeast is the Somali Plateau that delineates the Somali Plate and extends into Ali Sabieh. To the north-northeast is the elevated Danakil range (~2,100 meters above sea level), which abuts the Arabian Plate and runs along the Ethiopia-Eritrea border to Obock and eastern Tadjourah. The three diverging plates create deep plains and depressions, rifts and faults along an east-west axis through Djibouti and into the Gulf of Aden (**see Figure 10b**). This is where the country's seismic activity is concentrated.

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47 Kireyev, M. A. P. (2018). Macro-fiscal implications of climate change: the case of Djibouti. IMF Working Paper Issue 233. URL: https://www.elibrary.imf.org/view/journals/001/2018/233/article-A001-en.xml

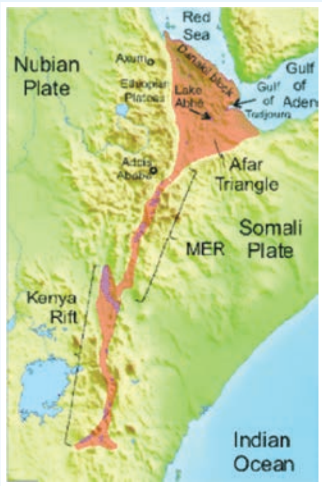
48 Dabar, O. A., Adan, A. B. I., Ahmed, M. M., Awaleh, M. O., Waberi, M. M., Camberlin, P., Pohl, B., and Mohamed, J. (2022). Evolution and Trends of Meteorological Drought and Wet Events over the Republic of Djibouti from 1961 to 2021. Climate, 10(10), 148. DOI: https://doi.org/10.3390/cli10100148

49 Dabar, O. A., Adan, A. B. I., Ahmed, M. M., Awaleh, M. O., Waberi, M. M., Camberlin, P., Pohl, B., and Mohamed, J. (2022). Evolution and Trends of Meteorological Drought and Wet Events over the Republic of Djibouti from 1961 to 2021. Climate, 10(10), 148. DOI: https://doi.org/10.3390/cli10100148

50 Netherlands Ministry of Foreign Affairs. (2018). Climate Change Profile: Greater Horn of Africa. URL: https://reliefweb.int/report/world/climate-change-profile-greater-horn-africa

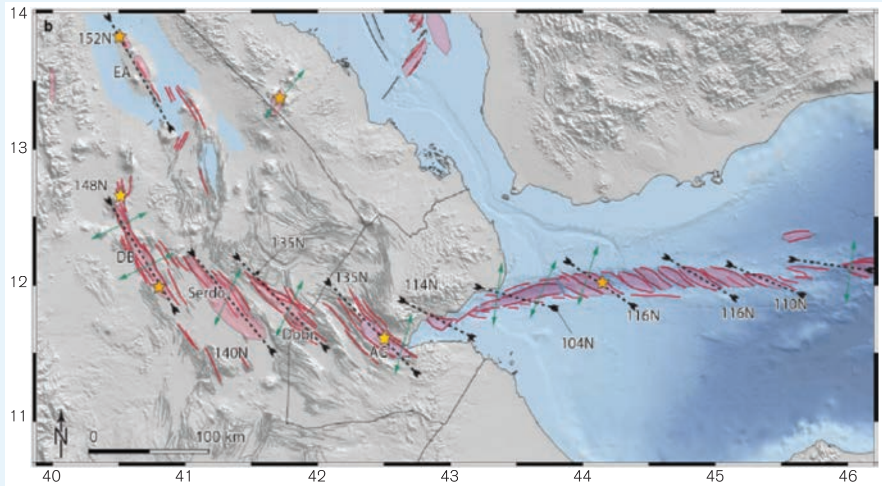
51 Beyene, A., and Abdelsalam, M. G. (2005). Tectonics of the Afar Depression: A review and synthesis. Journal of African Earth Sciences, 41(1–2), 41–59. DOI: https://doi.org/10.1016/j.jafrearsci.2005.03.003

FIGURE 10A. Map of the East African Rift System and the Afar Triangle[52]



Note the bounds of the Afar Triangle in red which diverge from Lake Abbé: the East African Rift Valley (Kenya Rift and Main Ethiopian Rift or MER) to the south, the Ethiopian Plateau and Nubian Plate to the west, the Danakil range and the Red Sea to the north (including the Arabian Plate), the Somali Plate to the southeast, and the Gulf of Tadjourah and Gulf of Aden to the east.

FIGURE 10B. Djibouti's Active Tectonic Rift Zones[53]



Inset from Figure 10a. Red lines and shaded areas indicate active rift zones. Yellow stars indicate sites of volcanic eruptions. Dashed lines illustrate rift orientation and green lines indicate the direction of extension. From west to east, Djibouti's main rift zones are: the Dobi rift (~40 km) from Ethiopia into the Dikhil region; the Assal-Ghoubbet rift (labelled AG, ~40 km) from the Manda Inakir fissure system near the Ethiopia-Eritrea-Djibouti border through Lake Assal, the Ardoukoba volcano, and Lake Ghoubbet; Gulf of Tadjourah rift (south of Tadjourah region); and Obock rift (south of Obock region) which extends eastward into the Gulf of Aden.

According to the Global Earthquake Model Foundation, Djibouti has a moderately high risk of earthquakes, with the greatest potential for ground movement (over a 50-year period) in the capital city and along Djibouti's more populous coastal areas.[54] Seismic activity in Djibouti's divergent rift system is characterized by earthquake swarms – series of earthquakes that display a similar magnitude (usually magnitude 3 to 5 on the Richter Scale) and recur every few decades, rather than one large event followed by smaller aftershocks.[55] However, sometimes events of magnitude 6 or higher occur, such as near Dobi in 1989. The most active fault boundaries are along the Gulf of Aden, as demonstrated by the earthquake swarms observed near Tadjourah and Obock regions (onshore and offshore) throughout the mid- and late-2000s.

[52] Boschetti, T., Awaleh, M. O., and Barbieri, M. (2018). Waters from the Djiboutian Afar: a review of strontium isotopic composition and a comparison with Ethiopian waters and red sea brines. Water, 10(11), 1700. DOI: https://doi.org/10.3390/w10111700
[53] Ruch, J., Keir, D., Passarelli, L., Di Giacomo, D., Ogubazghi, G., and Jonsson, S. (2021). Revealing 60 years of earthquake swarms in the southern red sea, Afar and the Gulf of Aden. Frontiers in Earth Science, 9, 664673. DOI: https://doi.org/10.3389/feart.2021.664673
[54] Global Earthquake Model Foundation (2019). Djibouti. URL: https://downloads.openquake.org/countryprofiles/DJI.pdf
[55] Ruch, J., Keir, D., Passarelli, L., Di Giacomo, D., Ogubazghi, G., and Jonsson, S. (2021). Revealing 60 years of earthquake swarms in the southern red sea, Afar and the Gulf of Aden. Frontiers in Earth Science, 9, 664673. DOI: https://doi.org/10.3389/feart.2021.664673

The Afar Triangle occasionally experiences volcanic activity and landslides. Notable past events in Djibouti include the eruption at Manda Inakir rift in 1928 and Ardoukôba in 1978 along the Assal Ghoubbet rift. The Global Facility for Disaster Risk Reduction (GFDRR) classifies the regions of Dikhil and Tadjourah with high volcanic hazard risk.[56] These regions also have a high risk of landslide hazards according to GFDRR, partly due to their steeper terrain and complex geology. However, flood-induced landslides are also known to occur in Djibouti, including the three other administrative regions classified with medium landslide hazard risk. For example, in November 2019, the equivalent of two years of rainfall fell in just one day in the capital city, resulting in a landslide that killed 11 people.[57]

KEY NATIONAL DOCUMENTS

- AfDB Country Strategy Paper 2023–2027 (2023)
- Third National Communication to the UNFCCC (2021) (French)
- AfDB Country Strategy Paper 2016–2020 (2016)
- First Nationally Determined Contribution (2015)
- Strategy of Accelerated Growth and Promotion of Employment (SCAPE) 2015–2019 (2015)
- Vision Djibouti 2035 (2014) (French)
- Second National Communication to the UNFCCC (2013) (French)
- National Health Development Plan 2013–2017 (2013) (French)
- National Adaptation Programme of Action (2004) (French)
- Initial National Communication to the UNFCCC (2001) (French)

[56] GFDRR (2020). Djibouti. URL: https://thinkhazard.org/en/report/70-djibouti/VA
[57] U.N. and Djibouti Interior Ministry (2019). Flash Flood Update #3. URL: https://reliefweb.int/report/djibouti/djibouti-flash-update-3-humanitarian-impact-flooding-17-december-2019

Compared to the most likely scenario SSP3-7.0, which results in relatively extreme temperature and precipitation shifts nationally across all key metrics by the end of the century (see Table 6), SSP1-2.6 and SSP2-4.5 demonstrate Djibouti's lower overall rates of change and severity of climate impacts as a result of carbon emission reductions. The differences between projected temperatures under the three scenarios are particularly pronounced (**see Figure 11a**). SSP1-2.6 has the lowest annual mean temperature increase from 28.69°C to 29.90°C (29.10°C, 30.81°C), or an anomaly greater than 1°C, by 2080-2099. Mean temperature rises by an anomaly greater than 2°C by end-of-century under SSP2-4.5 and greater than 3°C by end-of-century under SSP3-7.0. For SSP1-2.6, the number of high Heat Index days during the reference period roughly doubles by the end of the century, whereas the number roughly doubles *by midcentury* under SSP2-4.5 and SSP3-7.0, and triples by end-of-century under SSP3-7.0. The difference in the number of tropical nights (T-min >26°C) experienced nationally by the end of the century under the different scenarios varies by a magnitude of months – an increase of roughly one month from the reference period under SSP1-2.6, two months under SSP2-4.5, and three months under SSP3-7.0. The number of days consisting of warm spells increases drastically from the reference period under SSP3-7.0, roughly tripling *by midcentury* and spanning a majority of an average year by the period 2080-2099. By comparison, the number of warm spell days does not triple from the reference period until the end of the century under SSP2-4.5 and instead comprises only half of an average year by the end of the century under SSP1-2.6.

TABLE 6. Key National-Level Projected Trends Through End-of-Century (Ref. Period 1995–2014) Under SSP1-2.6, SSP2-4.5, and SSP3-7.0 Scenarios

	SSP1–2.6 Projection			
Metric	**1995-2014**	**2020–2039**	**2040–2059**	**2080–2099**
Annual Mean Temperature	28.69°C (28.45°C, 28.94°C)	29.46°C (28.84°C, 30.03°C)	29.80°C (29.14°C, 30.55°C)	29.90°C (29.10°C, 30.81°C)
High Heat Index Days (No. Days T-max >35°C) Annually	65.87 (42.33, 78.17)	88.86 (70.09, 113.62)	**102.48** (74.07, 133.59)	**112.26** (83.28, 141.47)
Tropical Nights (No. Nights T-min >26°C) Annually	123.70 (107.30, 136.28)	145.75 (119.82, 167.11)	155.02 (128.79, 182.29)	158.00 (127.61, 187.43)
Warm Spell Duration Index (No. Days Annually)	67.62 (20.17, 145.73)	111.32 (55.32, 178.43)	**153.64** (81.94, 240.58)	**161.41** (95.03, 245.09)
Percent Change in Annual Total Precipitation	–	10.63% (–3.09%, 31.34%)	17.85% (0.80%, 40.49%)	12.83% (–3.62%, 41.27%)
Average Largest 5-Day Cumulative Precipitation (mm) Annually	39.42 (20.62, 76.77)	42.42 (23.65, 80.29)	45.30 (25.11, 105.05)	44.05 (23.83, 95.78)
Max. No. Consecutive Dry Days Annually	**306.38** (218.87, 344.99)	**301.76** (211.03, 343.15)	**295.54** (207.63, 342.37)	**301.66** (207.05, 343.64)

(*continues*)

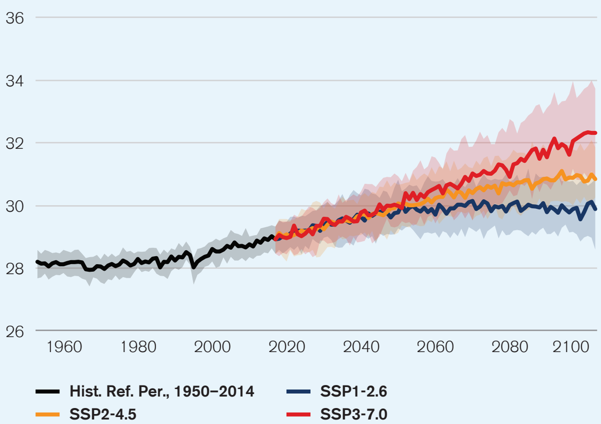
TABLE 6. Key National-Level Projected Trends Through End-of-Century (Ref. Period 1995–2014) Under SSP1-2.6, SSP2-4.5, and SSP3-7.0 Scenarios (*Continued*)

Metric	SSP2-4.5 Projection			
	1995–2014	2020–2039	2040–2059	2080–2099
Annual Mean Temperature	28.69°C (28.45°C, 28.94°C)	29.40°C (28.82°C, 30.01°C)	**30.02°C** (29.32°C, 30.81°C)	**30.87°C** (29.97°C, 31.81°C)
High Heat Index Days (No. Days T-max >35°C) Annually	65.87 (42.33, 78.17)	89.80 (68.70, 116.64)	**116.94** (84.94, 142.95)	**150.45** (112.98, 186.77)
Tropical Nights (No. Nights T-min >26°C) Annually	123.70 (107.30, 136.28)	143.59 (115.60, 166.50)	**160.89** (132.24, 187.21)	**184.78** (150.96, 215.09)
Warm Spell Duration Index (No. Days Annually)	67.62 (20.17, 145.73)	106.76 (65.98, 166.65)	**178.83** (108.24, 269.39)	**249.32** (168.18, 316.51)
Percent Change in Annual Total Precipitation	–	10.63% (–0.48%, 29.36%)	13.11% (–0.05%, 35.43%)	17.12% (–1.74%, 50.90%)
Average Largest 5-Day Cumulative Precipitation (mm) Annually	39.42 (20.62, 76.77)	44.38 (24.62, 88.99)	45.06 (24.13, 94.13)	45.24 (23.81, 94.92)
Max. No. Consecutive Dry Days Annually	**306.38** (218.87, 344.99)	**299.00** (214.76, 343.88)	**297.77** (209.86, 341.47)	**297.57** (203.39, 341.11)
Metric	**SSP3-7.0 Projection**			
	1995-2014	**2020–2039**	**2040–2059**	**2080–2099**
Annual Mean Temperature	28.69°C (28.45°C, 28.94°C)	29.42°C (28.84°C, 30.07°C)	**30.19°C** (29.36°C, 31.06°C)	**31.95°C** (30.52°C, 33.39°C)
High Heat Index Days (No. Days T-max >35°C) Annually	65.87 (42.33, 78.17)	88.51 (70.96, 114.88)	**122.58** (97.25, 156.29)	**189.91** (119.03, 226.84)
Tropical Nights (No. Nights T-min >26°C) Annually	123.70 (107.30, 136.28)	144.55 (117.38, 168.07)	**166.18** (135.20, 194.08)	**218.06** (174.15, 262.29)
Warm Spell Duration Index (No. Days Annually)	67.62 (20.17, 145.73)	105.60 (49.93, 201.12)	**196.27** (132.38, 301.79)	**302.66** (231.15, 352.88)
Percent Change in Annual Total Precipitation	–	9.28% (–4.17%, 34.12%)	13.59% (–0.63%, 51.99%)	**29.74%** (3.30%, 86.60%)
Average Largest 5-Day Cumulative Precipitation (mm) Annually	39.42 (20.62, 76.77)	46.67 (23.82, 89.29)	46.41 (23.62, 107.69)	**54.74** (26.25, 132.13)
Max. No. Consecutive Dry Days Annually	**306.38** (218.87, 344.99)	**297.33** (213.83, 340.97)	292.78 (200.72, 339.14)	282.91 (187.04, 330.40)

10th percentile and 90th percentile values are shown in parentheses. Key values or shifts over time are shaded orange and bolded. Projected high Heat Index days, warm spells (according to the Warm Spell Duration Index), and maximum consecutive dry days use 1.00° × 1.00° (100km × 100km) data resolution. See text for interpretation.

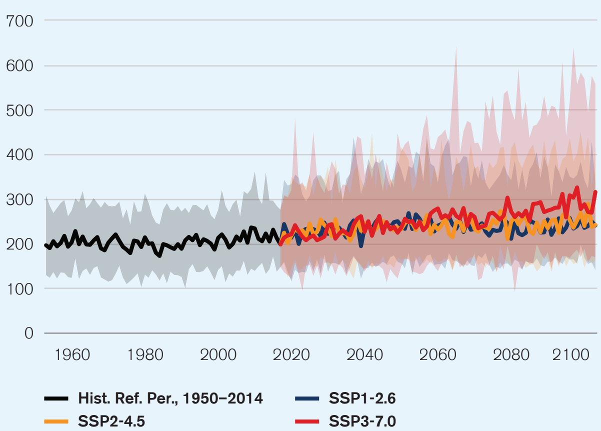
The differences between projected precipitation patterns under the three scenarios are more nuanced and complex, but they underscore greater potential ranges of precipitation duration and intensity under higher emission trajectories (**see Figure 11b**). By end-of-century, Djibouti is expected to experience a modest percent increase in precipitation from the reference period (a median of <20% nationally) under SSP1-2.6 and SSP2-4.5. But under SSP3-7.0, precipitation increases by a median of nearly 30% from the reference period with a high upper range of probable percent increase (3.30%, 86.60%) by the end of the century. Similarly, the average largest 5-day cumulative precipitation increases only marginally from the reference period under all three scenarios by end-of-century. However, under SSP3-7.0, the upper threshold of probable precipitation (median 54.74 mm) is much higher for 2080-2099 (26.25 mm, 132.13 mm). A key measure of meteorological drought – maximum consecutive dry days annually – already has a high median over the reference period (306.38 days) and decreases only slightly under all scenarios. Yet all scenarios, again have a wide range of probability. SSP3-7.0, the scenario with the lowest number of maximum consecutive dry days by the end of the century (282.91 days), has a probability range between 187.04 days (10th percentile) and 330.30 days (90th percentile).

FIGURE 11A. Projected Average Mean Temperature in Degrees Celsius Nationwide (Ref. Period 1995-2014) Under Various Scenarios



Shaded areas indicate ranges of 10th–90th percentiles. Note clearly higher increase of SSP3-7.0 starting midcentury.

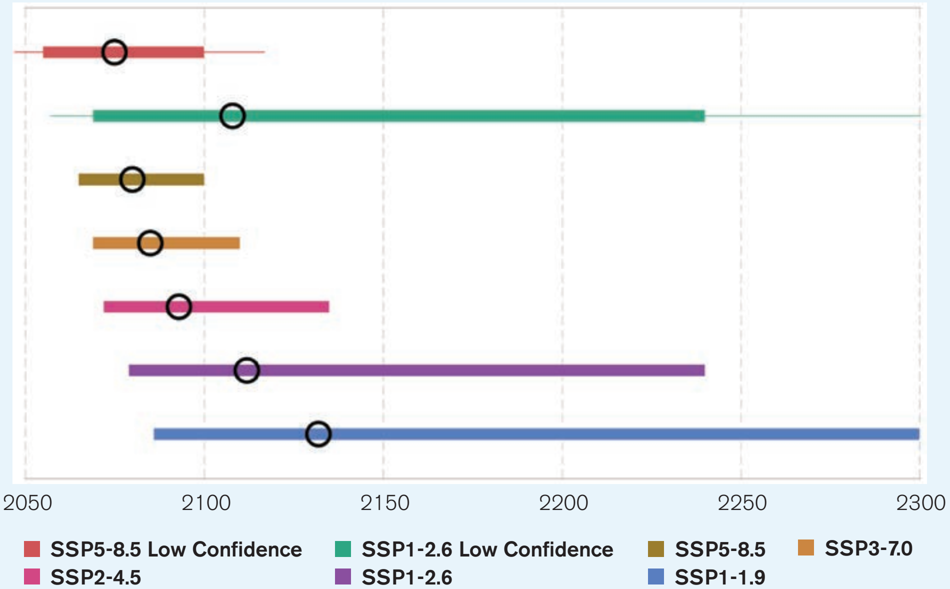
FIGURE 11B. Projected Precipitation in Millimeters Nationwide (Ref. Period 1995-2014) Under Various Scenarios



Shaded areas indicate ranges of 10th–90th percentiles. Note relatively higher increase under SSP3-7.0 by the end of the century, but probability ranges also extend below the historical reference period decreasing for all scenarios, indicating a potential likelihood for precipitation decreases rather than increases.

Sea level rise under SSP3-7.0 (**see Figure 12**) is projected to increase 0.50 meters from the historical reference period along Djibouti's coast before 2090. While SSP1-2.6 and SSP2-4.5 reach this threshold closer to or after the end of the century, they have much wider ranges of uncertainty. Compared to SSP3-7.0 which rises 0.22 m (0.15 m, 0.31 m) by 2050, SSP1-2.6 rises 0.19 m (0.12 m, 0.27 m) and SSP2-4.5 rises 0.21 m (0.14 m, 0.30 m).

FIGURE 12. Projected Timing of 0.5-Meter Sea Level Rise Along Djibouti's Coast Under Various Scenarios (Ref. Period 1995-2014)[58]



Thick bars show 17th-83rd percentile ranges, and black circles show median value. Thin bars also show 5th–95th percentile ranges for SSP1-2.6 Low Confidence and SSP5-8.5 Low Confidence scenarios. Data reflects grid at 11°N, 44°E.

[58] NASA (2023). Sea Level Projection Tool. URL: https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool

CLIMATE RISK COUNTRY PROFILE

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