CLIMATE RISK COUNTRY PROFILE

COLOMBIA

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.

CONTENTS

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

- **Observed Climate:** Colombia's climate features a wide range of temperature distributions, one to two rainy and dry seasons annually depending on the region, and several strong influencing factors – the Intertropical Convergence Zone (ITCZ), the Andes' complex topography which affects atmospheric circulation patterns, and the El Niño Southern Oscillation (ENSO).
- **Observed Temperature:** Between 1971 and 2020, Colombia's mean temperature increased by 0.22°C per decade.
  - **Caribbean and Northern Andes regions** observed the greatest changes over this period during the winter months.
- **Projected Temperature:** Under the SSP3-7.0 ensemble, Colombia's annual mean temperatures nationwide are homogeneously projected to increase further, from 24.50°C during the historical reference period of 1995–2014 to 25.20°C (24.79°C, 10th percentile, 25.79°C, 90th percentile) for the period 2020–2039, and to 25.99°C (25.32°C, 26.77°C) for the period 2040–2059.
  - Several departments in the **Andes region** are expected to endure conditions characteristic of different climatic zones by midcentury under SSP3-7.0.
- **Extreme Heat Risk:** By midcentury, Colombia 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, and are further detailed in **Table 5**.
  - Number of High Heat Index Days, Days Surpassing Heat Index of 35°C: Colombia's high atmospheric moisture content over certain regions seasonally makes the number of days surpassing the Heat Index >35°C increase by midcentury. This not only exacerbates human health concerns, but also presents risks to the water resources and food and agriculture sectors.
    - **The Caribbean region** observed the greatest increases during the summer and fall months.
    - **The Amazon and Orinoco regions** observed the greatest increases during the spring and fall months by midcentury.
  - Summer Days, T-max >25°C: The number of days with a maximum temperature >25°C increase year-round in the portions of each region with the highest elevations. An increase in the number of summer days with high maximum temperature thresholds coupled with tropical nights with high minimum temperature thresholds present elevated risks of prolonged heat exposure.
    - **The Central Andes** are projected to experience the greatest year-round increases in summer days by midcentury, but **parts of all five regions with higher elevations** are expected to observe increases.
  - Number of Tropical Nights, T-min >20°C: The number of tropical nights with a minimum temperature >20°C is projected to increase across parts of each region across all four seasons. An increase in high Heat Index or summer days coupled with the rise in the number of tropical nights with high minimum temperature thresholds magnify human health risks.
    - **The Andes region** is projected to experience the greatest increases by midcentury during different seasons locally. But **parts of all five regions with higher elevations** are expected to observe increases year-round.
  - Number of Tropical Nights, T-min >26°C: The number of tropical nights with a minimum temperature >26°C, an even higher minimum threshold, is projected to increase in departments along the Caribbean coast. 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.

        - **Departments along the Caribbean coast** are projected to experience increases year-round by midcentury.

    - Warm Spell Duration Index: 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 dramatically increase by midcentury. This shift reflects a longer-term change in daily maximum temperatures, which impact all regions.
        - Parts of the **Caribbean and Pacific regions** are projected to experience the greatest increases in warm spells by midcentury, but significant change occurs in **parts of all five regions**.
- **Observed Precipitation:** Over the 50-year period of 1971–2020, Colombia experienced significant decreases in precipitation per decade across a majority of departments, but precipitation trends varied seasonally both within and across Colombia's regions. Over this period:
    - **Departments in the Orinoco region** were significantly drier, especially during summer months.
    - **Departments in the Caribbean and Northern Andes regions** were significantly drier during spring and fall months.
    - **Departments in the Southern Pacific region and Western Cordillera** were significantly wetter annually.
- **Projected Precipitation:** Projected precipitation patterns under SSP3-7.0 reflect regional shifts in seasonal onset, duration, and intensity by midcentury.
    - The **Amazon, Orinoco, Caribbean, and Eastern Andes (Cordillera Oriental) regions** are expected to experience an annual decrease in precipitation by 2040–2059 under SSP3-7.0, while the **Western Andes (Cordillera Occidental and Central), and Pacific regions** are expected to experience an annual increase in precipitation. Trends in each of their anomalies differ seasonally, but wetter seasons typically become wetter while drier seasons become drier.
- **Precipitation Risk:** By midcentury, Colombia is likely to experience greater precipitation intensities, though the timing and duration of extreme anomalies vary by department. 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: Areas that typically receive low total amounts of precipitation during their dry season(s) can experience greater percent changes in precipitation from their historical reference period that impact water resources management.
        - **The Eastern Caribbean region** is expected to observe notable percent decreases in precipitation during the winter dry season by midcentury.
    - Precipitation Amount During Wettest Days: Projections for the precipitation volumes accumulated during the 5% wettest days monthly by midcentury (2040–2059) compared to the historical reference period of 1995–2014 help indicate the timing of extreme precipitation changes. This measure of precipitation intensity is of interest for both urban and rural management of floods.
        - **The Western Andes (Cordillera Occidental and Central) and Pacific** are expected to observe the greatest annual increases in precipitation intensity by midcentury, with monthly precipitation increases generally occurring during the first half of the year and decreases occurring towards the end of the year, regardless of the department's wet or dry season.

- **<u>Extreme Precipitation Occurrence:</u>** By midcentury, Colombia is likely to more frequently experience extreme precipitation event occurrence. These conditions pose risks for food security, flood-related safety, disease ranges, biodiversity, and living conditions.
    - **Departments in the Central and Northern Andes regions, including parts of the Pacific**, are projected to be nearly twice as likely to experience extreme precipitation events with 100-year historical return periods by midcentury under SSP3-7.0.
- **<u>Climate-Related Hazards:</u>**
    - Sea level rise and coastal inundation will increasingly threaten the **Caribbean coast**. Warmer sea surface temperatures off Colombia's **Pacific coast** would likely result in a southward migration of ITCZ precipitation.
    - The frequency of intense floods and droughts associated with ENSO will likely become more common in the future and are especially critical to monitor in the **Magdalena-Cauca River basins**.
    - Climate variability is an important contributor to seismic risk conditions, which particularly affect departments in the **Andes and Pacific regions**, as well as the **Andes foothills** in Colombia's other regions.

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

COUNTRY OVERVIEW

Colombia, located in the northwest corner of South America, is a topographically diverse country traversed by the Andes Mountains and is subdivided into 32 departments or *departamentos* between 14°N–4°S latitude (**see Figure 1**). The country is considered the 25th largest nation in the world, covering 1,138,910 km^2 of land, and features five main topo-geographic regions: the Amazon in the south, the Orinoco in the east, the Caribbean in the north, the Pacific in the west, and the Andes along the country's central spine. The northwestern edges of the Amazon and Orinoco River basins' tropical rainforests occupy lowland plains in Colombia's south and east. The Caribbean region extends north of the Andean foothills to the Caribbean Sea, while the Pacific region extends from the western Andean slopes to the Pacific Ocean, encompassing a combined 3,208 kilometers (km) of coastline. The Andes Mountains – distinguished in **Figure 1** by the highest elevations – bisect the country from southwest to northeast and geographically include the oil-rich, lower-elevation Magdalena River Valley that splits the chain. The three main branches of the Andes consist of: 1) the Cordillera Occidental in the west, closest to the Pacific and bounded by the Cauca River Valley to the east (rising above 13,000 ft in elevation); 2) the Cordillera Central, bounded between the Cauca and Magdalena River Valleys (hosting several snow-covered volcanoes such as Nevado del Ruiz and Nevado de Santa Isabel, which extend to over 17,000 ft in elevation); and 3) the Cordillera Oriental in the east, closest to the Amazon basin (and rising above 17,000 ft in elevation).[1]

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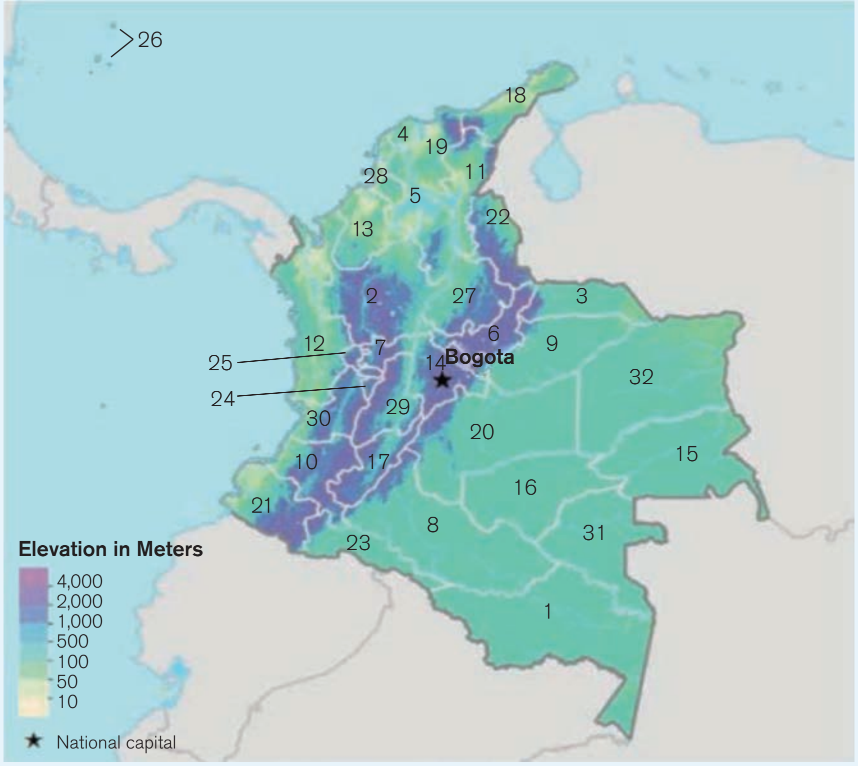
[1] The Cordillera Occidental runs from 21 in the south through 10, 30, 25, 7, and terminates in 2 to the north, sloping towards the Caribbean plain. The Cordillera Central runs from 10 in the south through 17, 29, 24, 25, 7, 2, and terminates in 5 to the north. The Cordillera Oriental runs from 17 in the south, borders 8 and 20, comprises most of 14 and 6, and extends north to 27 and 22. For further detail on Colombia's physical geography, see: Kline, H. F., Parsons, J. J., Garavito, C., Gilmore, R. L., and McGreevey, W. P. (2023). Colombia. Encyclopedia Britannica. URL: https://www.britannica.com/place/Colombia

FIGURE 1. Topography of Colombia with Subnational Departments[2]



According to the World Bank's DataBank,[3] Colombia is the second-most populous country in South America, with an estimated 51.5 million people in 2021 and an annual population growth rate of 1.14%. Most of the country's population is concentrated in the Andean highlands and along the Caribbean coast. The expansive eastern and southern llanos and tropical forests are home to less than 10% of the country's population. Approximately 81.7% of the population (and 88.8% projected in 2050) live in urban areas, with nearly 10% residing in slums as of 2020. Despite its upper-middle-income status, Colombia's wealth is heavily concentrated in the country's capital city, Bogotá, and in cities such as Medellín and Cali. Meanwhile, most rural regions of the country remain severely underdeveloped. Overall, Colombia ranks relatively high on the Human Development index (88 out of 191) for

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2 Colombia's departments are numbered in Figure 1 as follows: 1 – Amazonas, 2 – Antioquia, 3 – Arauca, 4 – Atlántico, 5 – Bolívar, 6 – Boyacá, 7 – Caldas, 8 – Caquetá, 9 – Casanare, 10 – Cauca, 11 – Cesar, 12 – Chocó, 13 – Córdoba, 14 – Cundinamarca, 15 – Guainía, 16 – Guaviare, 17 – Huila, 18 – La Guajira, 19 – Magdalena, 20 – Meta, 21 – Nariño, 22 – Norte de Santander, 23 – Putumayo, 24 – Quindío, 25 – Risaralda, 26 – San Andrés y Providencia, 27 – Santander, 28 – Sucre, 29 – Tolima, 30 – Valle del Cauca, 31 – Vaupés, and 32 – Vichada. CCKP tabulates data for the Distrito Capital (Bogotá) as part of Cundinamarca. The Instituto Geográfico Agustín Codazzi recognizes the following departments in each region, which this profile adopts: 1, 8, 15, 16, 23, and 31 in the Amazon; 3, 9, 20, and 32 in the Orinoco; 4, 5, 11, 13, 18, 19, 26, and 28 in the Caribbean; 10 (split with Andes), 12, 21 (split with Andes), and 30 (split with Andes) in the Pacific; and 2, 6, 7, 14, 17, 22, 24, 25, 27, and 29 in the Andes. See: Instituto Geográfico Agustín Codazzi (1997). Mapa de Regiones Naturales de Colombia. Bogotá, Colombia: Instituto Geográfico Agustín Codazzi.

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

2021 (**see Table 1**), considering factors such as life expectancy, education, and income per capita.[4] The country had a 2021 GDP of $314.5 billion (Gross Domestic Product in current $US), a 2022 annual GDP growth rate of 7.5%, and more than $6,000 in GDP per capita. This reflects how, since the 1990s, Colombia's economy began specializing in the export of natural resources (including oil, coal, minerals, and food and agriculture products), and shifted towards retail, business, financial, and other service sectors, which now employ roughly two-thirds of the country's workers.[5] However, the country is simultaneously struggling with 13.1% (2022) inflation that threatens advancements in poverty reduction since the 2000s.[6] Whereas only 10.3% of the 2021 population was living below a threshold of $1.90 a day purchasing power parity (PPP), 42.5% of its population lives below the nationally-determined poverty line, making it among the highest globally.[7] It also has one of the highest socioeconomic inequality rates globally.

Colombia submitted its Nationally-Determined Contribution (NDC) to the UNFCCC in 2018, its Updated NDC in 2020, and its Third National Communication (NC3) in 2017, in support of the country's efforts to realize its development goals and increase its resilience to climate change through mitigation and adaptation efforts. This agenda was reaffirmed in 2022 under newly elected President Gustavo Petro.[8] The Colombian territory is highly vulnerable to extreme events, particularly flooding from La Niña phenomena. Vulnerability hotspots to climate change impacts by 2040, according to NC3, include departments in the Caribbean and Andean regions (Cesar, Norte de Santander, Tolima, and Caldas) with key prioritized sectors being housing, transport, energy, agriculture and health. Adaptation is guided by the National Adaptation Plan to Climate Change (PNACC in Spanish), which was formulated in 2011 and clarified in 2016, and has been implemented through different territorial and sectorial efforts.[9]

4 UNDP (2022). Human Development Report 2021/2022. URL: https://hdr.undp.org/system/files/documents/global-report-document/hdr2021-22pdf_1.pdf
5 OECD/UNIDO (2019). Production Transformation Policy Review of Colombia: Unleashing Productivity. URL: https://www.oecd-ilibrary.org/development/production-transformation-policy-review-of-colombia_9789264312289-en
6 World Bank (2023). Colombia – Overview. URL: https://www.worldbank.org/en/country/colombia/overview
7 UNDP (2022). Global Multidimensional Poverty Index 2022. URL: https://hdr.undp.org/system/files/documents/hdp-document/2022mpireportenpdf.pdf
8 USAID (2022). Colombia: Climate Change Fact Sheet. URL: https://www.usaid.gov/sites/default/files/2023-03/2022-USAID-Colombia-Climate-Change-Country-Profile.pdf
9 Government of Colombia (2020). Updated Nationally-Determined Contribution. URL: https://unfccc.int/sites/default/files/NDC/2022-06/NDC%20actualizada%20de%20Colombia.pdf

TABLE 1. Key Development Indicators[10]

Key Demographic Indicators	Most Recent Value	Global Rank
Population Density (people per sq km, 2020)	45.90	156 (out of 215)
Life Expectancy (for total population in years, 2021)	72.83	98 (out of 209)
Fertility Rate (total births per woman, 2021)	1.72	135 (out of 210)
Dependency Ratio (dependents per 100 working-age people, 2021)	43.50	189 (out of 217)
Key Economic and Social Development Indicators	**Most Recent Value**	**Global Rank**
GDP per Capita (in current $US, 2021)	$6,104.14	104 (out of 197)
% Population Below National Poverty Line (2020)[11]	42.50%	24 (out of 100)
Unemployment Rate (% of total labor force, 2022)	10.73%	42 (out of 183)
% Employed in Agriculture (2021)	15.93%	95 (out of 185)
% Employed in Industry (2021)	20.15%	83 (out of 185)
% Employed in Services (2021)	63.92%	74 (out of 185)
% Population with Access to Electricity (2020)	100%	1 (tied, out of 215)
% Population Using at Least Basic Sanitation Services (2020)	93.68%	87 (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. Global ranking for the population experiencing multidimensional poverty only includes countries classified as developing by UNDP.

OBSERVED AND CURRENT CLIMATE

Data Overview

The data presented are from the World Bank Group's Climate Change Knowledge Portal (CCKP).[12] 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

Colombia's climate features a wide range of temperature distributions, one to two rainy and dry seasons annually depending on the region, and several strong influencing factors – the Intertropical Convergence Zone (ITCZ), the Andes' complex topography which affects atmospheric circulation patterns, and the El Niño Southern Oscillation (ENSO). Over the current climatology (1991–2020,

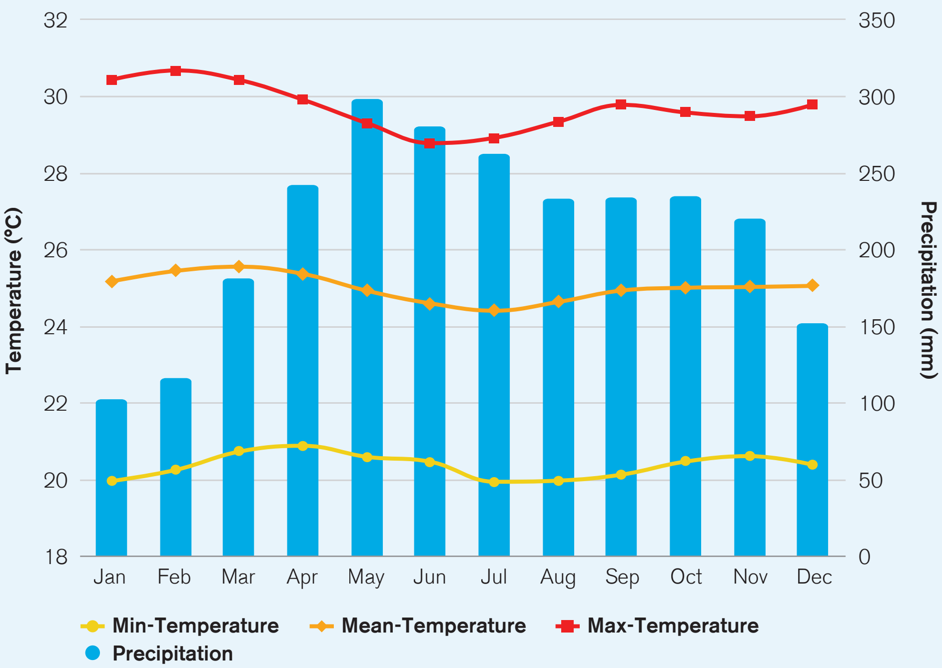
[10] World Bank (2023). DataBank – World Development Indicators. URL: https://databank.worldbank.org/source/world-development-indicators

[11] UNDP (2022). Global Multidimensional Poverty Index 2022. URL: https://hdr.undp.org/system/files/documents/hdp-document/2022mpireportenpdf.pdf

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

see Figure 2a), Colombia experienced a mean annual temperature of 25.00°C. During the 1991–2020 period, the warmest month of March ranged from an average minimum temperature of 20.72°C to an average maximum temperature of 30.43°C, while the coolest month of July ranged from a minimum average temperature of 19.93°C to a maximum average temperature of 28.92°C. However, there is notable subnational variability. Colombia is recognized as a megadiverse country with a wide range of ecosystems, such as páramos, mangroves, wetlands, coral reefs, glaciers, oceans, and tropical forests, as well as significant biodiversity and water resources.[13] Its climate is tropical along the coast and the eastern lowlands, but becomes subtropical, temperate, and polar as one increases in altitude across the highlands and Andes Mountains. Since most departments encompass more than one climatic zone within their boundaries, they tend to reflect a blend of different climatic characteristics. The country's topographic diversity is categorized according to three main climatic zones: the high elevation cold zones (*tierra fría*), located above 2,000 meters (m) in elevation, with mean annual temperatures ranging between 13°C–17°C; a temperate zone (*tierra templada*), located between 1,000 m–2,000 m, with mean annual temperatures of approximately 18°C; and a tropical zone (*tierra caliente*), which covers all areas below 1,000 m and mean annual temperatures of 24°C–27°C. Colombia's five largest population centers occupy all three elevation zones across its different topo-geographic areas, which make it important to understand each of its regional and departmental climates (shown in **Table 2**).[14]

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



This distribution reflects diverse regional temperature and precipitation regimes.

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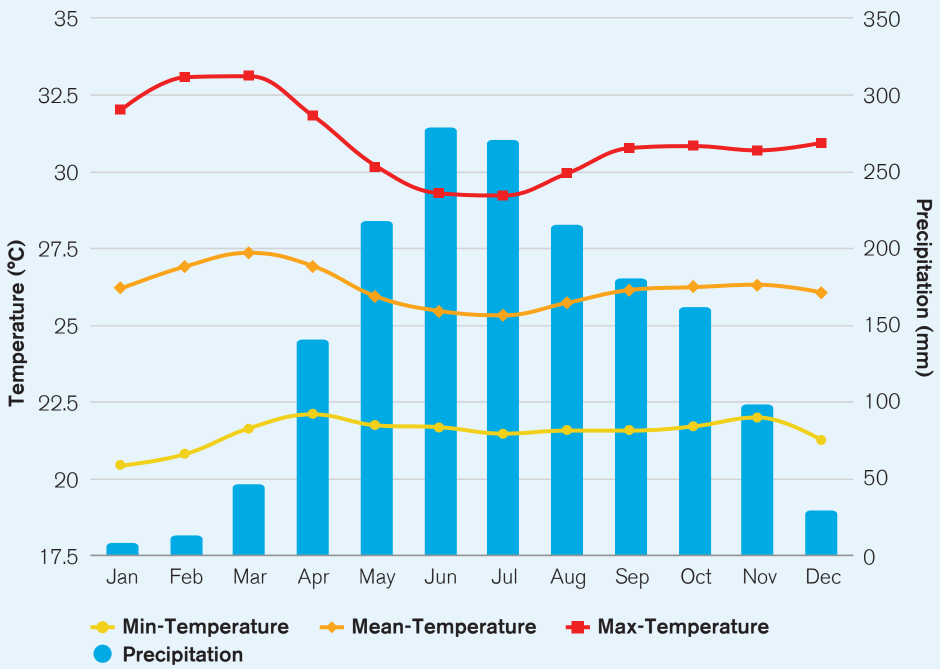
[13] Government of Colombia (2020). Updated Nationally-Determined Contribution. URL: https://unfccc.int/sites/default/files/NDC/2022-06/NDC%20actualizada%20de%20Colombia.pdf

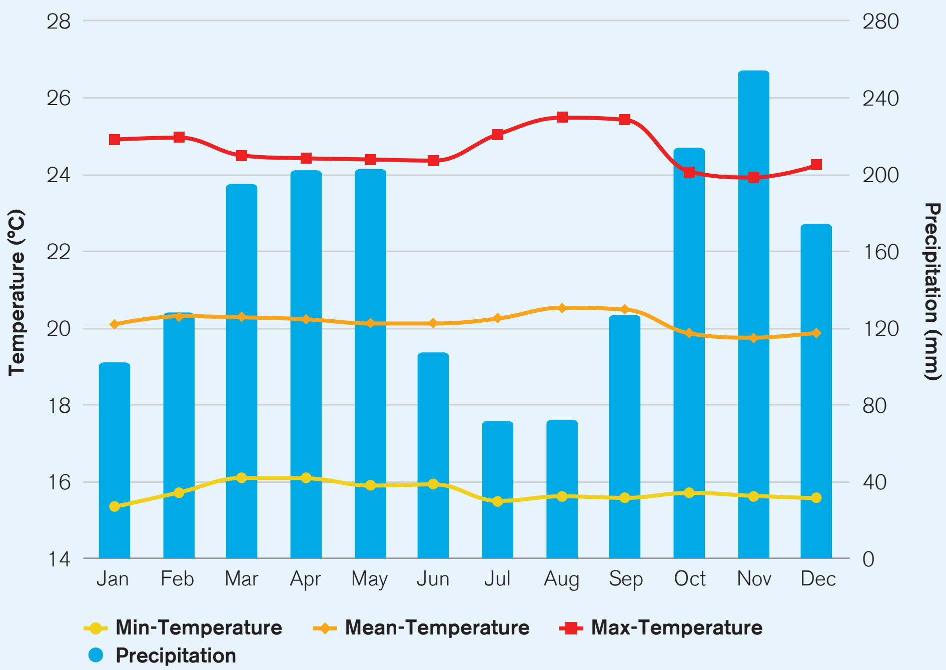
[14] The capital Bogotá is located in the *tierra fría* of Cundinamarca (Central Andes). Medellín is located in the *tierra templada* of Antioquia (Northern Andes). Cali is located in the *tierra templada* of Valle del Cauca (Southern Andes and Pacific). Barranquilla is located in the *tierra caliente* of Atlántico (Western Caribbean), and Cartagena is located in the *tierra caliente* of Bolívar (Western Caribbean).

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



This is a unimodal precipitation regime in the Orinoco lowlands with one wet season and one dry season. The scale on the y-axis reflects warmer than average temperatures. Note the timing and intensity of the warmest months (late winter, early spring) and the driest months (winter).

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



This is a bimodal precipitation regime in the Andes with two wet seasons and two dry seasons. Note the timing of the warmest months (summer) and dry seasons (winter and summer). The scale on the y-axis reflects cooler than average temperatures and lower than average total precipitation values.

Mean annual precipitation over the current climatology (1991–2020) at the national level was 2,562.17 mm, but there are significant regional patterns and seasonal distributions (**see Figures 2b–c**). The Pacific coast and western slopes of the Andes (including Antioquia and Risaralda) received the highest annual rainfall amounts, followed by the Amazon Basin (all greater than 2,600 mm per year), while the drier Northern Caribbean departments received approximately 1,000 mm per year. As illustrated in **Table 2** (see "wettest and driest months per season" column), annual precipitation in the Amazon, Orinoco, and Western Caribbean regions followed a unimodal pattern resulting in one wet season and one dry season.[15] In the Southern and southernmost Central Andes region, annual precipitation followed a bimodal pattern resulting in two distinct wet seasons and two distinct dry seasons. The Northern Andes, northernmost Central Andes, and Eastern Caribbean regions are largely transitional areas featuring mixed precipitation regimes, either with two wet seasons and one dry season, or one dry season and one wet season containing at least one month of notably lower precipitation. In the Pacific, the central coast experienced a bimodal pattern and the northern and southern coasts experienced a unimodal pattern, though some areas lacked seasonality.[16] The rest of this section describes the department characteristics listed in **Table 2** in greater detail, and are useful references for understanding projected climate conditions discussed later in this document.

In Amazonas, the only department almost entirely located south of the Equator, the ITCZ's movement northwest begins in November, reaches Arauca in March, and arrives in the Caribbean islands of San Andrés y Providencia by May (**see Table 2**). The duration of the wet season follows this pattern in the Amazon, Orinoco, and Western Caribbean regions, lasting between 4–9 months. After the passage of the ITCZ, the onset of the dry season follows the same pattern moving northwest, beginning in Amazonas in May and reaching the Western Caribbean region around November and December. The dry season lasts 3–7 months, with the Orinoco and Caribbean observing much sharper precipitation decreases. Between 1991 and 2020, Vichada experienced the warmest month on average in March with a minimum temperature of 24.06°C and a maximum temperature of 34.53°C. This department also had the wettest month on average in the Amazon and Orinoco, receiving 418.99 mm during June. Putumayo experienced the coolest month on average in July with a minimum temperature of 18.73°C and a maximum temperature of 28.08°C. This department also had the wettest annual precipitation in the region, receiving 3,165.04 mm. Arauca recorded the driest monthly precipitation on average during the month of January, with only 7.79 mm, and the driest annual precipitation in the region on average with 1,662.90 mm total or roughly half that of Putumayo.

In the Southern Andes, the onset of the first wet season begins in February and arrives in April further north, following the march of the ITCZ. The first dry season begins in June across the region. The onset of a second wet season begins in August in the Northern Andes and extends to the Southern Andes by September and October. The second dry season begins in December. In the Southern Andes, the first wet and dry seasons are the longest, but the second wet season experiences the wettest month annually.[17] In the Northern and Central Andes, the

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[15] However, one should note that while the label of dry season signifies a relative decrease in seasonal precipitation in Colombia, their heavy annual precipitation totals are still associated with a tropical moist climate compared to other regimes globally.

[16] Urrea, V., Ochoa, A., and Mesa, O. (2019). Seasonality of rainfall in Colombia. Water Resources Research, 55(5), 4149-4162. DOI: https://doi.org/10.1029/2018WR023316

[17] For the Southern and southernmost Central Andes, the first wet season lasts about 3 months, the first dry season lasts 3–4 months, the second wet season lasts 3–4 months, and the second dry season lasts 2 months.

second wet and dry seasons are the longest, but the first dry season experiences the driest month annually.[18] Between 1991 and 2020, Risaralda – located along the western slopes of the Cordillera Occidental – experienced the wettest month on average during November (the second rainy season), with 356.70 mm and the highest annual average precipitation of 2,974.31 mm. For the 1991–2020 climatology, Antioquia in the Northern Andes experienced the warmest month on average during April with a minimum temperature of 19.31°C and a maximum temperature of 28.07°C. Boyacá in the Central Andes, which for the most part lacks tropical and subtropical climate zones, experienced the coolest month on average during July with a minimum temperature of 12.04°C and a maximum temperature of 20.56°C. It also observed the driest month on average in the Andes region during January with 36.41 mm, and the driest annual average precipitation of 1,609.26 mm. This reflects how the high-elevation Andes make it more difficult for moisture-laden winds to penetrate the region's interior.

All five departments in the Northern Andes and two departments in the Eastern Caribbean are located in transitional areas (between zones with bimodal and unimodal patterns) that feature mixed precipitation regimes. Five of these seven departments possess two distinct wet seasons, but only one dry season. By contrast, Antioquia and Boyacá feature precipitation regimes closer to a unimodal pattern, with one dry season and one wet season containing at least a month of declining precipitation, but which does not approach dry season levels. The semiarid Northern Caribbean department of La Guajira is an outlier with a bimodal distribution, influenced by sporadic rain events and the Caribbean trade winds. Over the 1991–2020 climatology in the Caribbean region, Bolívar in the west had the wettest month on average during October, with 304.77 mm. It also had the wettest annual average precipitation with 2,093.56 mm. Atlántico in the west experienced the driest month on average for the region during January, receiving only 2.23 mm and the lowest average annual precipitation of 1,006.92 mm, nearly half that of Bolívar. Cesar in the east experienced the coolest month on average in the region during November with a minimum temperature of 21.01°C and a maximum of 30.18°C. The Western Caribbean department of Sucre had the warmest month on average in the region during April with a minimum temperature of 24.07°C and a maximum temperature of 34.07°C. This is similar to that of the Amazon and Orinoco regions.

The Pacific region reflects a unique mix of precipitation regimes with both coastal and montane topography. Between 1991 and 2020 in the Pacific region, the department of Chocó had the warmest month on average in April with a minimum temperature of 23.56°C and a maximum temperature of 30.39°C. It also observed the wettest month on average during November (806.86 mm) and the highest annual precipitation in Colombia by far (6,966.98 mm). This is due to the combination of the westerly Chocó low-level jet (strongest in November), the northerly Caribbean low-level jet during the late winter and summer months, and topographic uplift along the western slopes of the Andes.[19] By comparison, the southern Pacific department of Cauca with the Andes rising in its east had the lowest annual average precipitation in the region with 2,633.43 mm, less than half of Chocó's. It also had the coolest month on average during November with a minimum temperature of 15.02°C and a maximum temperature of 23.61°C.

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18 The exceptions are Cundinamarca, which has its wettest month in the first rather than second wet season, and Caldas, which has its driest month in the second dry season rather than the first. In the Northern Andes, northernmost Central Andes, and Eastern Caribbean, the first wet season lasts 2–3 months, the first dry season lasts 1–2 months, the second wet season lasts 3–4 months, and the second dry season lasts 3–4 months.

19 Urrea, V., Ochoa, A., and Mesa, O. (2019). Seasonality of rainfall in Colombia. Water Resources Research, 55(5), 4149–4162. DOI: https://doi.org/10.1029/2018WR023316

Colombia's interannual rainfall variability is further influenced by ENSO. During El Niño, dry seasons can become more intense and longer, affecting seasonal onset and leading to droughts and warmer weather.[20] During La Niña, wet seasons can become more intense and longer, affecting seasonal onset. This phase is associated with floods and cooler weather, particularly between June and August.[21] Colombia is highly vulnerable to the impacts of climate variability and change as the country already routinely experiences damaging droughts and floods. The heavy rains in 2010 and 2011, for example, caused over $6 billion in damages to crops and infrastructure, and displaced millions.[22] The economically important coffee industry is also highly vulnerable to rising temperatures and hydrologic events. Water provision is heavily reliant on glacial melt, which under rising temperatures are projected to continue receding.

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

Climatic-Topographic Region and Department	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.
Amazon (Tropical Moist)				
Amazonas	Nov: 27.03°C (22.05°C, 32.06°C)	W: Dec–July	W: Mar (314.34 mm)	2,953.48 mm
	July: 25.57°C (20.57°C, 30.62°C)	D: Aug–Nov	D: Oct (203.28 mm)	
Putumayo	Jan: 24.79°C (19.28°C, 30.35°C)	W: Mar–July	W: May (352.86 mm)	**3,165.04 mm**
	July: 23.39°C (18.73°C, 28.08°C)	D: Aug–Feb	D: Jan (180.03 mm)	
Caquetá	Jan: 26.00°C (20.33°C, 31.72°C)	W: Mar–July	W: May (311.57 mm)	2,666.57 mm
	July: 24.33°C (19.80°C, 28.92°C)	D: Aug–Feb	D: Jan (106.78 mm)	
Vaupés	Mar: 26.77°C (21.75°C, 31.84°C)	W: Apr–July	W: May (339.62 mm)	2,990.21 mm
	July: 25.02°C (20.63°C, 29.46°C)	D: Aug–Mar	D: Jan (141.32 mm)	
Guaviare	Mar: 26.98°C (21.88°C, 32.14°C)	W: Apr–July	W: July (349.73 mm)	2,665.34 mm
	July: 24.74°C (20.54°C, 28.98°C)	D: Aug–Mar	D: Jan (66.19 mm)	
Guainía	Feb: 27.95°C (22.36°C, 33.59°C)	W: Apr–Aug	W: June (407.14 mm)	2,988.04 mm
	July: 26.02°C (21.81°C, 30.29°C)	D: Sept–Mar	D: Jan (102.39 mm)	

[20] Urrea, V., Ochoa, A., and Mesa, O. (2019). Seasonality of rainfall in Colombia. Water Resources Research, 55(5), 4149–4162. DOI: https://doi.org/10.1029/2018WR023316

[21] Government of Colombia (2016). Plan Nacional de Adaptación al Cambio Climático. URL: https://www.minambiente.gov.co/wp-content/uploads/2022/01/PNACC-2016-linea-accion-prioritarias.pdf

[22] USAID (2017). Colombia: Climate Risk Profile. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID%20CCIS_Climate%20Risk%20Profile_Colombia.pdf

TABLE 2. Observed Temperature and Precipitation Trends for 1991–2020 Climatology Across Colombia's Regions (*Continued*)

Climatic-Topographic Region and Department	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.
Orinoco (Tropical Moist)				
Meta	Mar: 26.42°C (21.62°C, 31.27°C)	W: Mar–Nov	W: May (334.23 mm)	2,598.24 mm
	July: 24.34°C (20.25°C, 28.49°C)	D: Dec–Feb	D: Jan (41.73 mm)	
Vichada	**Mar: 29.27°C** (24.06°C, 34.53°C)	W: Apr–Oct	**W: June (418.99 mm)**	2,522.02 mm
	July: 26.87°C (23.06°C, 30.72°C)	D: Nov–Mar	D: Jan (33.03 mm)	
Casanare	Mar: 27.94°C (22.72°C, 33.21°C)	W: Apr–Nov	W: June (378.14 mm)	2,463.84 mm
	July: 25.61°C (21.71°C, 29.57°C)	D: Dec–Mar	D: Jan (16.66 mm)	
Arauca	Mar: 27.35°C (21.63°C, 33.11°C)	W: Apr–Nov	W: June (279.40 mm)	**1,662.90 mm**
	July: 25.31°C (21.45°C, 29.22°C)	D: Dec–Mar	**D: Jan (7.79 mm)**	
Western Caribbean (Tropical Moist)				
Córdoba	Apr: 27.52°C (23.15°C, 31.94°C)	W: Apr–Nov	W: Aug (248.04 mm)	1,913.33 mm
	Nov: 26.53°C (22.95°C, 30.17°C)	D: Dec–Mar	D: Feb (35.73 mm)	
Sucre	**Apr: 29.05°C** (24.07°C, 34.07°C)	W: Apr–Nov	W: Aug (238.70 mm)	1,672.83 mm
	Oct: 27.48°C (23.41°C, 31.61°C)	D: Dec–Mar	D: Jan (11.49 mm)	
San Andrés y Providencia	May: 28.55°C (25.61°C, 31.49°C)	W: May–Nov	W: Oct (273.29 mm)	1,802.50 mm
	Jan: 26.77°C (23.79°C, 29.81°C)	D: Dec-Apr	D: Mar (21.45 mm)	
Western Caribbean (Tropical Moist and Dry)				
Bolívar	Apr: 28.06°C (23.22°C, 32.95°C)	W: Apr–Nov	**W: Oct (304.77 mm)**	**2,093.56 mm**
	Oct: 26.85°C (22.75°C, 31.00°C)	D: Dec–Mar	D: Jan (25.96 mm)	

(*continues*)

TABLE 2. Observed Temperature and Precipitation Trends for 1991–2020 Climatology Across Colombia's Regions (*Continued*)

Climatic-Topographic Region and Department	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.
Western Caribbean (Tropical Dry)				
Atlántico	Apr: 28.99°C (24.46°C, 33.58°C)	W: May–Nov	W: Sept (170.71 mm)	**1,006.92 mm**
	Jan: 27.82°C (23.22°C, 32.47°C)	D: Dec–Mar	**D: Jan (2.23 mm)**	
Eastern Caribbean (Tropical Moist and Dry)				
Magdalena	Apr: 27.36°C (21.90°C, 32.87°C)	W1: Apr–May W2: Aug–Nov	W1: May (200.92 mm) W2: Oct (226.70 mm)	1,414.70 mm
	Oct: 26.05°C (21.44°C, 30.70°C)	D: Dec-Mar	D: Jan (9.39 mm)	
Cesar	Apr: 26.80°C (21.40°C, 32.25°C)	W1: Apr–May W2: Aug–Nov	W1: May (237.49 mm) W2: Oct (288.37 mm)	1,775.63 mm
	Nov: 25.57°C (21.01°C, 30.18°C)	D: Dec-Mar	D: Jan (19.96 mm)	
Eastern Caribbean (Tropical Dry)				
La Guajira	July: 28.31°C (23.50°C, 33.16°C)	W1: Apr–May W2: Aug–Nov	W1: May (144.30 mm) W2: Oct (240.50 mm)	1,072.17 mm
	Jan: 25.81°C (21.26°C, 30.42°C)	D1: June–July D2: Dec–Mar	D1: July (41.36 mm) D2: Feb (8.25 mm)	
Southern Andes (Tropical Dry, Subtropical and Temperate Moist)				
Huila	Oct: 19.90°C (15.52°C, 24.33°C)	W1: Mar–May W2: Oct–Dec	W1: Apr (176.32 mm) W2: Nov (215.40 mm)	1,622.27 mm
	July: 19.41°C (14.84°C, 24.04°C)	D1: June–Sept D2: Jan–Feb	D1: Aug (70.77 mm) D2: Jan (92.78 mm)	
Southern Andes (Tropical, Subtropical, Temperate, and Polar Moist)				
Tolima	Aug: 20.52°C (15.60°C, 25.48°C)	W1: Mar–May W2: Oct–Dec	W1: May (203.23 mm) W2: Nov (254.72 mm)	1,853.08 mm
	Nov: 19.74°C (15.61°C, 23.92°C)	D1: June–Sept D2: Jan–Feb	D1: July (71.51 mm) D2: Jan (102.06 mm)	

TABLE 2. Observed Temperature and Precipitation Trends for 1991–2020 Climatology Across Colombia's Regions (*Continued*)

Climatic-Topographic Region and Department	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.
Central Andes (Subtropical and Temperate Moist)				
Quindío	Feb: 18.35°C (13.41°C, 23.33°C)	W1: Mar–May W2: Oct–Dec	W1: May (210.83 mm) W2: Nov (260.11 mm)	2,001.77 mm
	Nov: 17.80°C (13.35°C, 22.29°C)	D1: June–Sept D2: Jan–Feb	D1: July (94.04 mm) D2: Jan (117.86 mm)	
Risaralda	Mar: 21.27°C (16.76°C, 25.84°C)	W1: Mar–May W2: Oct–Dec	W1: May (294.27 mm) **W2: Nov (356.70 mm)**	**2,974.31 mm**
	Nov: 20.59°C (16.30°C, 24.92°C)	D1: June–Sept D2: Jan–Feb	D1: July (172.96 mm) D2: Feb (189.63 mm)	
Central Andes (Subtropical, Temperate, and Polar Moist)				
Caldas	Apr: 20.16°C (15.83°C, 24.53°C)	W1: Mar–May W2: Sept–Dec	W1: May (264.46 mm) W2: Nov (281.32 mm)	2,352.41 mm
	Nov: 19.60°C (15.40°C, 23.84°C)	D1: June–Aug **D2: Jan–Feb**	D1: July (130.77 mm) D2: Jan (118.99 mm)	
Central Andes (Subtropical Moist, Temperate Dry and Moist, and Polar Moist)				
Cundinamarca	Apr: 18.87°C (14.56°C, 23.23°C)	W1: Mar–July W2: Sept–Nov	W1: May (224.31 mm) W2: Oct (190.63 mm)	1,797.30 mm
	July: 18.15°C (13.66°C, 22.69°C)	D: Dec–Feb	D: Jan (57.80 mm)	
Central Andes (Temperate and Polar Moist)				
Boyacá	Apr: 17.41°C (12.98°C, 21.88°C)	W: Mar–Nov	W: May (210.43 mm)	**1,609.26 mm**
	July: 16.27°C (12.04°C, 20.56°C)	D: Dec–Feb	**D: Jan (36.41 mm)**	
Northern Andes (Tropical, Subtropical, and Temperate Moist)				
Antioquia	**Apr: 23.67°C** (19.31°C, 28.07°C)	W: Apr–Dec	W: May (301.95 mm)	2,701.21 mm
	Oct: 23.02°C (19.04°C, 27.06°C)	D: Jan–Mar	D: Feb (103.63 mm)	

(*continues*)

TABLE 2. Observed Temperature and Precipitation Trends for 1991–2020 Climatology Across Colombia's Regions (*Continued*)

Climatic-Topographic Region and Department	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.
Northern Andes (Tropical, Subtropical, and Temperate Moist)				
Santander	Mar: 23.30°C (18.66°C, 27.99°C)	W1: Mar–June W2: Aug–Nov	W1: May (263.30 mm) W2: Oct (272.78 mm)	2,207.78 mm
	Oct: 22.68°C (18.21°C, 27.20°C)	D: Dec–Feb	D: Jan (70.01 mm)	
Northern Andes (Tropical Moist and Dry, Subtropical Moist)				
Norte de Santander	Aug: 22.33°C (17.03°C, 27.68°C)	W1: Apr–May W2: Aug–Nov	W1: May (194.93 mm) W2: Oct (226.10 mm)	1,611.70 mm
	Jan: 21.02°C (15.60°C, 26.50°C)	D: Dec–Mar	D: Jan (46.03 mm)	
Southern Andes and Pacific (Tropical, Subtropical, Temperate, and Polar Moist)				
Nariño	Apr: 21.64°C (17.31°C, 26.03°C)	W: Oct–Jun	W: May (318.08 mm)	2,739.16 mm
	Dec: 21.10°C (16.99°C, 25.24°C)	D: July–Sept	**D: Aug (128.33 mm)**	
Cauca	Apr: 19.81°C (15.41°C, 24.27°C)	W1: Mar–May, W2: Oct–Dec	W1: May (262.70 mm) W2: Nov (319.32 mm)	**2,633.43 mm**
	Nov: 19.29°C (15.02°C, 23.61°C)	D1: June–Sept D2: Jan–Feb	D1: Aug (131.81 mm) D2: Jan (181.32 mm)	
Central Andes and Pacific (Tropical Moist and Subtropical Dry and Moist)				
Valle del Cauca	Apr: 22.07°C (17.83°C, 26.36°C)	W1: Mar–May W2: Sept–Dec	W1: May (286.02 mm) W2: Nov (353.00 mm)	2,921.97 mm
	Nov: 21.37°C (17.23°C, 25.55°C)	D1: June–Aug D2: Jan–Feb	D1: July (173.79 mm) D2: Jan (173.85 mm)	
Northern Pacific (Tropical Moist)				
Chocó	**Apr: 26.96°C** (23.56°C, 30.39°C)	W: May–Dec	**W: Nov (806.86 mm)**	**6,966.98 mm**
	Nov: 25.80°C (22.88°C, 28.78°C)	D: Jan–Apr	D: Feb (377.56 mm)	

Climatic zones are classified according to characteristics in Sayre et al. and grouped by topo-geographic region (Amazon and Orinoco shaded green, Caribbean shaded light blue, Andes shaded purple, and Pacific shaded dark blue).[23] Departments listed in each region are approximately sorted from south to north. Each department's warmest month generally corresponds with the period before the onset of the ITCZ and the coolest month with the end of the rainy season. 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.

[23] 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

Temperature

Between 1971 and 2020, Colombia's average mean temperature increased by 0.22°C per decade, with the greatest changes observed in the Caribbean and North Andes regions, especially during the winter months. Nationwide, average minimum temperatures increased 0.19°C per decade between 1971–2020, while average maximum temperatures increased 0.24°C per decade over the same period. The Caribbean department of Córdoba recorded the highest annual average mean temperature increase per decade (0.35°C), minimum temperature increase per decade (0.34°C), and maximum temperature increase per decade (0.39°C). By comparison, the lowest significant temperature increases over this period occurred in the Amazon region. For example, Guaviare observed a 0.13°C mean increase per decade, 0.11°C minimum increase per decade, and 0.15°C maximum increase per decade. Winter months exhibited the greatest seasonal increase in temperature per decade, with changes greater than 0.30°C extending beyond the Caribbean and Northern Andes regions to the Central Andes and Pacific coast. During winter months, Córdoba recorded a minimum temperature increase of 0.38°C per decade, an average mean temperature increase of 0.44°C per decade, and average maximum temperature increase of 0.51°C per decade. Average maximum temperature increases above 0.30°C per decade also extended to the Amazon and Orinoco regions during fall months, illustrating the expanse across which maximum temperature changed. Mean, minimum, and maximum temperatures nationwide increased significantly and at a much faster rate between 1991 and 2020, compared to 1971–2020. At the national level between 1991 and 2020, Colombia's mean temperature rose 0.36°C per decade, minimum temperature rose 0.26°C per decade, and maximum temperature rose 0.41°C per decade. While the trend of observed single-day maximum of daily maximum temperatures and minimum of daily minimum temperatures from 1950–2020 do not reach 95% statistical significance (**see Figures 3a–b**), the increase in maximum of maximum event intensity and decrease in minimum of minimum intensity in the last two decades may hint at future trends.

FIGURE 3A. Observed Change in Event Intensity of Maximum of Daily Maximum Temperature, 1950–2020

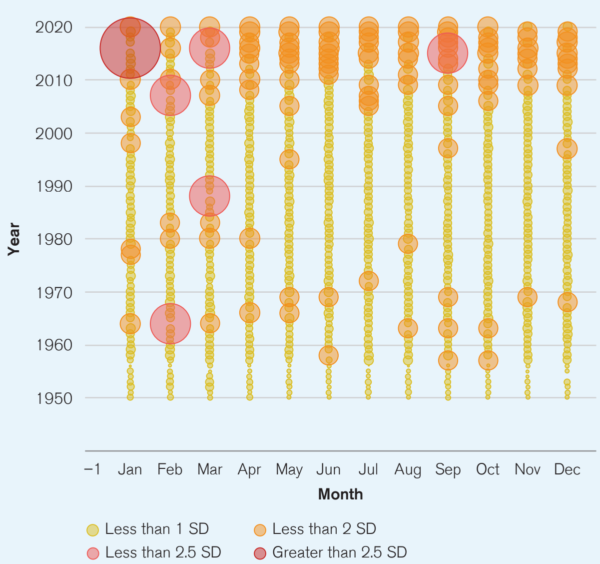
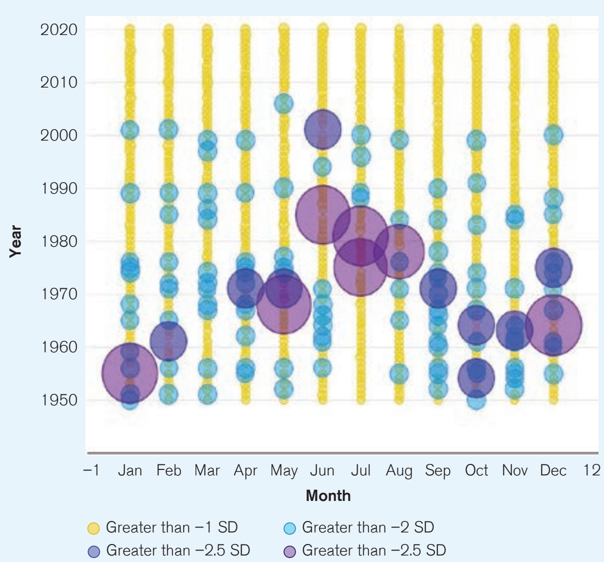


FIGURE 3B. Observed Change in Event Intensity of Minimum of Daily Minimum Temperature, 1950–2020

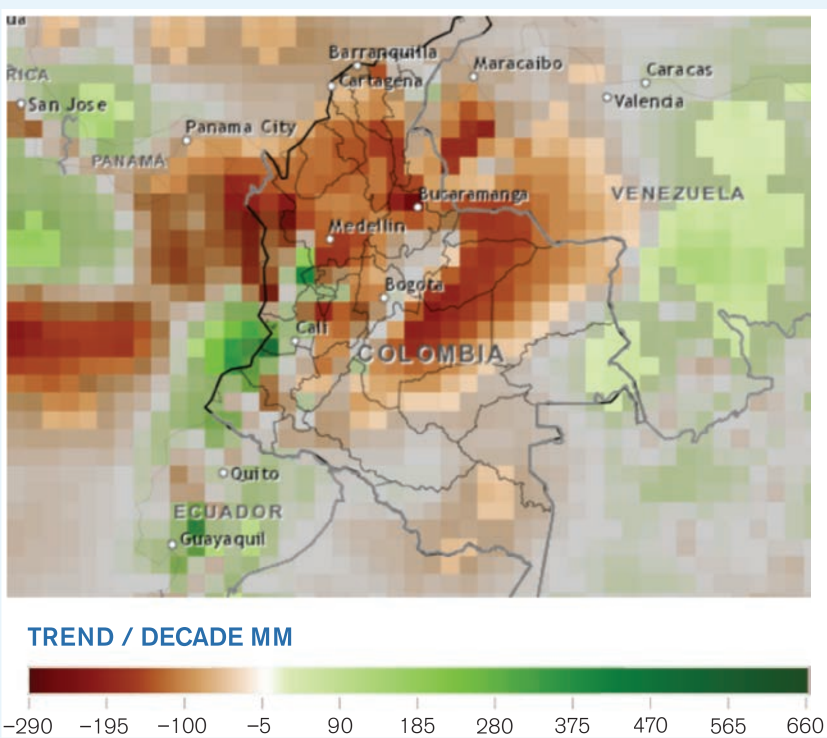


Note the shift after 2000 in number and change (measured by standard deviation from monthly mean of current climatology) of observed events beyond one standard deviation from the climatology's mean values.

Precipitation

Over the 50-year period of 1971–2020, Colombia experienced significant decreases in precipitation per decade across the Orinoco, Caribbean, and Northern Andes regions, but precipitation trends varied seasonally both within and across Colombia's departments. During the 1971–2020 climatology (**see Figure 4**), the Orinoco region observed the largest total decreases in precipitation per decade in Casanare (–149.72 mm), Arauca (–141.23 mm), and Meta (–113.93 mm), with the strongest effects during the summer months. The Caribbean region, except for its northernmost departments, also observed a significant decline in precipitation per decade with greater effects moving west. This includes: Córdoba (–120.46 mm), Sucre (–122.05 mm), Bolívar (–120.37 mm), and Magdalena (–90.79 mm). While departments along the Eastern Cordillera of the Andes, such as Boyacá, did not observe any significant change, the Northern Andes, parts of the Central Andes, and the Magdalena River Valley also experienced precipitation decreases. Antioquia received –125.40 mm per decade, followed by Santander (–117.57 mm per decade), Norte de Santander (–93.02 mm per decade), Caldas (–91.43 mm per decade), and Tolima (–90.56 mm per decade). For departments in the Caribbean and Northern Andes regions, spring and fall months experienced the greatest precipitation declines. However, a few departments observed significant precipitation increases over the same time period, including along the southwest Pacific coast (Buenaventura, Valle del Cauca) and Western Cordillera (Risaralda, +156.29 mm per decade). This did not include Chocó, which observed a net decrease along its coast, especially during spring months. Overall, there were no significant observed changes for the largest 1-day and 5-day precipitation events, especially given the historical influence of interannual ENSO variability.

FIGURE 4. Observed Precipitation Trend per Decade (1971–2020) Annually



Areas shaded gray indicate where a statistical significance of 95th percentile is not met. Note decreases in Western Caribbean, Northern Andes, and Orinoco, but increases along Southern Pacific.

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[24] 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.[25] 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° × 1.00° (100km × 100km) resolution.[26]

Temperature

Under SSP3-7.0, Colombia's temperatures are homogeneously projected to increase further (see Figure 5). Mean temperature nationwide increases from 24.50°C during the historical reference period of 1995–2014 to 25.20°C (24.79°C, 10th percentile, 25.79°C, 90th percentile) for the period 2020–2039, and to 25.99°C (25.32°C, 26.77°C) for the period 2040–2059. Minimum temperature nationwide increases from 20.74°C during the historical reference period to 21.45°C (21.04°C, 22.00°C) for the 2020–2039 period, and 22.22°C (21.56°C, 22.99°C) for 2040–2059. Maximum temperature increases from 28.25°C to 28.94°C (28.47°C, 29.61°C) for the 2020–2039 period, and 29.74°C (29.04°C, 30.62°C) for 2040–2059. However,

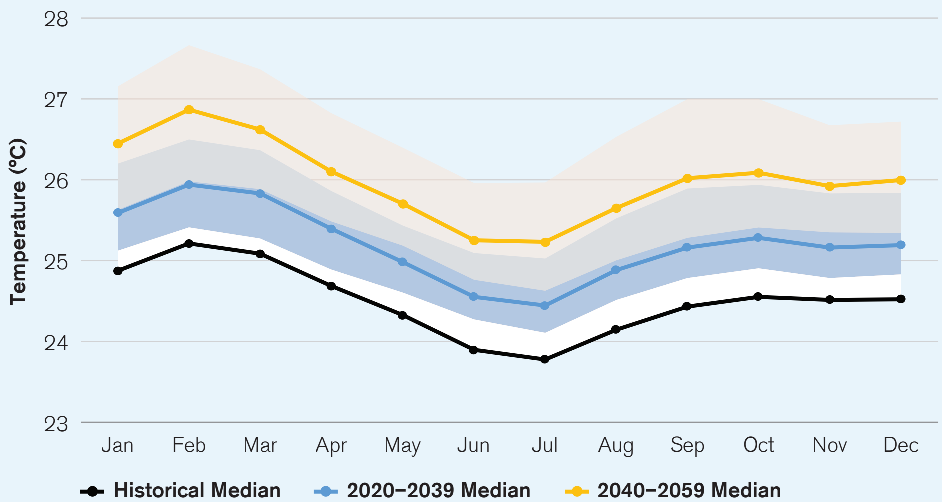
[24] SSP3-7.0 represents a higher emissions scenario and is considered a more realistic worst-case scenario in which warming reaches ~3.5–4°C by 2100. When considering 'risk' it is most prudent to use higher scenarios in order to not dangerously under-estimate potential changes and risk conditions.

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

[26] World Bank Climate Change Knowledge Portal (2023). Colombia Extreme Events. URL: https://climateknowledgeportal.worldbank.org/country/colombia/extremes

projected temperature changes under SSP2-4.5 and SSP1-2.6 are lower.[27] Under SSP3-7.0, the largest seasonal change occurs during winter months in the Eastern Andes and Orinoco regions, where Norte de Santander's mean temperature increases 1.83°C from the reference period by midcentury, compared to 1.14°C in San Andrés y Providencia. Minimum and maximum temperatures increase homogeneously, but during winter months there is a large increase in maximum temperatures across the Caribbean, Central and Northern Andes, and Orinoco regions. By midcentury under SSP3-7.0, Boyacá is projected to observe a 1.87°C increase in its median maximum temperature during winter months compared to 1.15°C in San Andrés y Providencia.

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



Areas shaded yellow indicate 10th and 90th percentiles for 2040–2059, while areas shaded blue indicate 10th and 90th percentiles for 2020–2039. The projected climatology of mean temperature countrywide for each month (2040–2059 period) increases more than two times the projected climatology for 2020–2039 above the reference period.

Projected mean temperatures under SSP3-7.0 underscore how several departments in the high-elevation Andes are expected to endure conditions characteristic of different climatic zones by midcentury (**see Table 3**). Boyacá and Quindío, largely in the *tierra fría*, observe future median temperatures characteristic of the *tierra templada*. Medellín, the largest city located in Antioquia's *tierra templada* elevations reaches a mean temperature of above 24°C, characteristic of the *tierra caliente*. Cundinamarca and Risaralda meanwhile observe higher increases above the *tierra templada* median. Notably, even under the lower-emission SSP1-2.6 scenario, Antioquia, Boyacá, and Quindío's mean temperatures still exceed the same thresholds that SSP3-7.0 does by midcentury.

[27] Under SSP1-2.6, minimum temperature nationwide only increases to 21.77°C (21.23°C, 22.50°C) and under SSP2-4.5, increases to 22.03°C (21.51°C, 22.77°C) by 2040–2059. Under SSP1-2.6, maximum temperature increases nationwide to 29.28°C (28.68°C, 30.07°C), and under SSP2-4.5, increases to 29.51°C (28.94°C, 30.37°C) by 2040–2059.

TABLE 3. Projected Annual Mean Temperatures in High-Elevation Departments for 2020–2039 and 2040–2059 (from Ref. Period 1995–2014) Under SSP3-7.0

Department (Region)	Mean Annual Temperature		
	1995–2014	2020–2039	2040–2059
Colombia	24.50°C	25.20°C (24.79°C, 25.79°C)	25.99°C (25.32°C, 26.77°C)
Nariño (S. Pacific)	20.89°C	21.55°C (21.26°C, 21.94°C)	22.28°C (21.75°C, 22.71°C)
Cauca (S. Pacific)	19.23°C	19.91°C (19.58°C, 20.30°C)	20.68°C (20.07°C, 21.10°C)
Valle del Cauca (C. Pacific)	20.75°C	21.42°C (21.08°C, 21.83°C)	22.17°C (21.59°C, 22.62°C)
Tolima (S. Andes)	20.43°C	21.10°C (20.70°C, 21.52°C)	21.90°C (21.20°C, 22.41°C)
Quindío (C. Andes)	16.61°C	**17.28°C** (16.88°C, 17.69°C)	**18.07°C** (17.38°C, 18.54°C)
Risaralda (C. Andes)	18.93°C	19.57°C (19.19°C, 19.98°C)	20.34°C (19.69°C, 20.83°C)
Caldas (C. Andes)	19.66°C	20.31°C (19.93°C, 20.71°C)	21.08°C (20.42°C, 21.59°C)
Cundinamarca (C. Andes)	18.65°C	19.36°C (18.94°C, 19.80°C)	20.17°C (19.45°C, 20.78°C)
Distrito Capital (C. Andes)	12.82°C	13.56°C (13.12°C, 13.99°C)	14.38°C (13.62°C, 14.98°C)
Boyacá (C. Andes)	16.07°C	16.80°C (16.41°C, 17.34°C)	**17.63°C** (16.93°C, 18.31°C)
Antioquia (N. Andes)	23.04°C	23.68°C (23.27°C, 24.12°C)	**24.44°C** (23.83°C, 24.99°C)
Santander (N. Andes)	21.72°C	22.43°C (22.03°C, 22.97°C)	23.26°C (22.57°C, 23.90°C)

10th percentile and 90th percentile values shown in parentheses. Median temperatures projected to increase above 17°C (upper threshold for *tierra fría*), 18°C (median annual temperature for *tierra templada*), and 24°C (lower threshold for *tierra caliente*) from the reference period are shaded orange and bolded. Other departments with high elevations not listed here (including Norte de Santander, Huila, and Magdalena) have most of their populations already residing in *tierra caliente* elevations. Note the departments reaching thresholds for different climatic zones include Quindío, Boyacá, and Antioquia.

Colombia is projected to experience spatially and seasonally heterogeneous shifts in hotter conditions by midcentury. High atmospheric moisture content – during the summer and fall months nationwide, and in the Pacific, Amazon, and Western Caribbean annually – makes the number of days surpassing the Heat Index >35°C increase dramatically in many departments for the 2040–2059 climatology. **Table 4** details the departments in regions with the greatest increases (Amazon, Orinoco, Caribbean), with Atlántico in the Western Caribbean projected to increase 169.55 days (69.74 days, 215.44 days) annually by midcentury.[28] High heat days during the summer and fall months in particular are projected to rise above 30 days across the Caribbean (61.96 days during summer months and 51.98 days during fall months in Atlántico), and during the spring and fall months in parts of the eastern lowlands (53.00 days in Vichada and 51.22 days in Amazonas during fall months).

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

TABLE 4. Projected High Heat Index Days and Tropical Night Anomalies for 2020–2039 and 2040–2059 (from the Ref. Period 1995–2014) Under SSP3-7.0 in Departments with the Greatest Change

Department	2020–2039					2040–2059				
	Annual	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)	Annual	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)
High Heat Index Days (No. Days T-max >35°C)										
Amazonas (Amazon)	25.89 (8.59, 102.12)	3.67 (–0.70, 32.41)	12.29 (–1.43, 27.26)	0.97 (0.08, 4.37)	12.35 (5.69, 46.15)	119.47 (45.20, 192.37)	29.71 (6.20, 68.00)	36.49 (3.11, 54.81)	10.34 (2.31, 16.41)	51.22 (25.88, 78.76)
Vichada (Orinoco)	40.61 (18.40, 92.14)	4.44 (0.21, 14.66)	21.02 (0.91, 28.11)	3.11 (0.11, 6.68)	18.46 (2.47, 36.60)	124.74 (62.33, 171.37)	17.48 (8.83, 50.10)	40.66 (17.44, 55.18)	13.69 (2.88, 31.53)	53.00 (17.53, 66.24)
Atlántico (Caribbean)	**69.63** (12.13, 127.98)	1.98 (0.69, 4.71)	20.79 (0.44, 28.77)	**25.93** (9.82, 53.58)	20.47 (0.10, 49.64)	**169.55** (69.74, 215.44)	14.95 (4.85, 19.90)	46.72 (10.88, 56.29)	**61.96** (30.26, 78.38)	51.98 (14.22, 78.43)
Tropical Nights (No. Nights T-min >20°C)										
Norte de Santander (Andes)	**29.92** (14.09, 47.01)	**7.39** (2.85, 14.14)	7.16 (2.29, 13.35)	7.04 (2.47, 11.87)	7.38 (3.09, 12.39)	**55.01** (32.37, 78.51)	**15.54** (7.50, 24.50)	13.74 (7.27, 20.92)	11.18 (5.69, 17.14)	13.16 (5.75, 20.47)
Tolima (Andes)	19.85 (4.50, 36.75)	4.55 (1.24, 8.88)	5.16 (0.60, 9.40)	4.84 (1.33, 8.75)	4.88 (1.31, 9.52)	39.87 (15.55, 60.10)	9.41 (3.98, 14.54)	10.12 (4.12, 15.63)	10.54 (3.53, 15.40)	9.84 (4.23, 14.90)
Valle del Cauca (Pacific)	9.82 (3.33, 24.16)	1.95 (0.56, 5.00)	3.43 (1.07, 7.72)	2.32 (0.85, 6.55)	1.82 (0.53, 5.46)	33.59 (12.06, 54.25)	6.98 (2.20, 13.70)	10.14 (4.01, 15.81)	8.24 (2.86, 14.34)	7.32 (2.47, 11.80)
Tropical Nights (No. Nights T-min >26°C)										
Sucre (Caribbean)	50.93 (16.26, 95.05)	9.61 (3.03, 21.20)	19.13 (4.81, 34.52)	12.96 (3.66, 32.80)	6.63 (1.14, 15.90)	148.72 (64.03, 224.66)	32.89 (13.12, 48.59)	47.01 (18.40, 66.86)	41.22 (15.92, 66.34)	30.55 (6.15, 47.70)
San Andrés y Providencia (Caribbean)	**112.54** (62.60, 154.04)	32.43 (17.40, 54.70)	30.24 (12.44, 40.62)	20.86 (10.69, 28.15)	29.99 (16.82, 38.49)	165.69 (139.24, 191.04)	**59.42** (44.33, 70.75)	38.41 (29.43, 48.21)	24.63 (17.26, 33.23)	39.85 (32.49, 48.87)
Atlántico (Caribbean)	101.49 (38.92, 160.99)	15.06 (4.38, 35.14)	**32.67** (7.09, 45.49)	30.40 (14.51, 46.89)	20.14 (6.47, 40.07)	**198.75** (123.61, 257.83)	39.93 (22.80, 67.12)	52.92 (32.29, 69.13)	52.71 (26.04, 62.04)	48.73 (27.61, 65.02)

10th percentile and 90th percentile values shown in parentheses. Bolded values highlight the highest seasonal and annual anomalies per metric. Largest anomalies (>50 days) are shaded orange and smallest relative anomalies from the reference period are shaded gray (<5 days). Note that the greatest anomalies for tropical nights with minimum temperatures >20°C tend to occur in departments with higher elevations, while the greatest anomalies for tropical nights with minimum temperatures >26°C occur in departments along the Caribbean coast, though according to different seasonal peaks. See text for interpretation.

Heat-related risks can be compounded when considering both day temperature conditions and night temperature conditions. On nights temperatures do not go below 20°C, the human body reaches a biophysiological threshold where it cannot adequately cool down to achieve restorative sleep. The number of tropical nights with a minimum temperature >20°C (**see Table 4**) increases across much of the high-elevation Andes. Such tropical nights increase nearly 30 days annually in Norte de Santander by 2020–2039 and 55.01 (32.37, 78.51) nights by 2040–2059 under SSP3-7.0, with changes highest during the winter months. In departments along the Caribbean coast, the number of tropical nights with a minimum temperature >26°C, an even higher threshold, increase year-round with dramatic increases during every season except winter months by midcentury (2040–2059) compared to the historical reference period. Atlántico is projected to experience the largest annual increase of 101.49 (38.92, 160.99) nights by 2020–2039 and 198.75 (123.61, 257.83) nights by 2040–2059. The SSP3-7.0 scenario forecasts a higher number of tropical nights >20°C and >26°C by midcentury compared to the SSP1-2.6 scenario. Projected anomalies for Heat Index days and tropical nights, among other key metrics to monitor, are detailed for all of Colombia's departments in **Table 5.**

TABLE 5. Key Department-Level Projected Anomalies to Monitor for 2040–2059 (Ref. Period 1995–2014) Under SSP3-7.0

Department	Projected Anomalies for 2040–2059 Under SSP3-7.0 (Ref. Period 1995–2014) High Heat Index Days (No. Days T-max >35°C) Annually	Max. of Daily Max. Temp. Anomaly Annually	Summer Days (No. Days T-max >25 °C) Annually	Tropical Nights (No. Nights T-min >20°C) Annually	Tropical Nights (No. Nights T-min >26°C) Annually	Warm Spell Duration Index (No. Days) Annualized
Colombia	63.90 (26.56, 110.06)	1.84°C (0.48°C, 3.56°C)	14.93 (7.42, 21.67)	14.11 (6.61, 21.76)	23.11 (7.70, 58.69)	144.03 (43.49, 238.06)
Amazon						
Amazonas	**119.47** (45.20, 192.37)	2.16°C (0.69°C, 5.17°C)	1.35 (0.42, 2.53)	3.56 (1.53, 7.80)	10.99 (1.01, 70.81)	143.84 (33.43, 232.89)
Putumayo	62.52 (20.89, 100.39)	1.45°C (–0.55°C, 3.90°C)	**10.56** (6.36, 14.80)	**18.71** (8.34, 27.15)	5.57 (0.38, 26.46)	**165.36** (20.69, 249.53)
Caquetá	71.10 (25.62, 135.16)	1.64°C (0.01°C, 4.20°C)	10.48 (5.88, 15.44)	16.38 (8.03, 25.61)	4.76 (0.51, 30.54)	137.97 (20.42, 232.28)
Vaupés	61.72 (20.65, 154.58)	**2.17°C** (0.51°C, 4.39°C)	1.64 (0.56, 3.18)	4.58 (1.81, 8.63)	6.64 (0.52, 50.09)	125.13 (20.44, 228.40)
Guaviare	35.71 (8.87, 126.72)	1.65°C (–0.08°C, 3.53°C)	2.09 (0.98, 3.88)	8.42 (3.67, 13.16)	5.56 (0.35, 35.20)	115.13 (21.32, 219.84)
Guainía	100.68 (46.92, 173.00)	1.94°C (0.34°C, 4.18°C)	0.89 (0.24, 2.05)	1.63 (0.36, 3.31)	**18.49** (1.25, 75.64)	136.39 (25.11, 236.34)
Orinoco						
Meta	33.62 (8.47, 80.57)	1.65°C (0.24°C, 3.36°C)	5.27 (2.59, 8.32)	**19.62** (7.94, 29.00)	11.90 (0.85, 38.18)	140.37 (34.22, 232.31)
Vichada	**124.74** (62.33, 171.37)	1.97°C (0.65°C, 3.79°C)	0.46 (0.09, 1.22)	0.71 (0.15, 2.04)	41.90 (10.91, 108.56)	135.95 (39.49, 221.08)
Casanare	54.04 (17.65, 100.61)	**2.03°C** (0.54°C, 3.48°C)	5.54 (2.85, 8.40)	6.52 (2.54, 10.30)	39.61 (8.85, 88.35)	151.03 (69.28, 227.78)
Arauca	68.14 (26.80, 85.61)	1.81°C (0.59°C, 3.49°C)	**7.37** (3.64, 11.58)	4.60 (1.40, 9.60)	**44.11** (15.74, 100.65)	**161.56** (66.60, 223.93)

(*continues*)

TABLE 5. Key Department-Level Projected Anomalies to Monitor for 2040–2059 (Ref. Period 1995–2014) Under SSP3-7.0 (*Continued*)

Projected Anomalies for 2040–2059 Under SSP3-7.0 (Ref. Period 1995–2014)						
Department	High Heat Index Days (No. Days T-max >35°C) Annually	Max. of Daily Max. Temp. Anomaly Annually	Summer Days (No. Days T-max >25 °C) Annually	Tropical Nights (No. Nights T-min >20°C) Annually	Tropical Nights (No. Nights T-min >26°C) Annually	Warm Spell Duration Index (No. Days) Annualized
Caribbean						
Córdoba	41.59 (8.54, 87.14)	1.73°C (0.81°C, 2.74°C)	2.11 (1.28, 3.03)	13.25 (8.01, 17.24)	74.94 (25.39, 126.63)	138.51 (38.67, 236.61)
Sucre	137.52 (50.64, 188.50)	1.70°C (0.86°C, 2.89°C)	0.00 (0.00, 0.00)	0.00 (0.00, 0.09)	148.72 (64.03, 224.66)	132.09 (61.17, 229.18)
San Andrés y Providencia	86.41 (16.50, 137.10)	1.37°C (0.72°C, 1.85°C)	0.14 (0.00, 0.54)	0.00 (0.00, 0.00)	165.69 (139.24, 191.04)	**250.78** (206.57, 253.59)
Bolívar	130.10 (59.40, 178.99)	1.82°C (0.79°C, 3.04°C)	2.58 (1.28, 3.83)	21.54 (14.64, 27.51)	97.64 (50.06, 147.46)	141.21 (67.46, 236.07)
Atlántico	**169.55** (69.74, 215.44)	1.49°C (0.38°C, 2.11°C)	0.00 (0.00, 0.02)	0.00 (0.00, 0.00)	**198.75** (123.61, 257.83)	145.23 (79.57, 260.10)
Magdalena	155.33 (74.47, 200.41)	1.82°C (0.76°C, 2.73°C)	**17.00** (10.81, 24.33)	9.83 (5.71, 16.34)	106.38 (59.28, 166.46)	123.14 (71.03, 231.09)
Cesar	125.49 (58.82, 178.70)	**2.00°C** (1.07°C, 3.14°C)	14.01 (9.54, 18.54)	**32.91** (20.96, 48.08)	47.78 (21.35, 85.44)	116.62 (64.03, 197.61)
La Guajira	52.45 (26.03, 71.01)	1.65°C (0.91°C, 2.38°C)	2.18 (1.25, 3.73)	21.17 (15.33, 27.75)	83.46 (44.96, 121.38)	176.90 (94.78, 247.06)
Andes						
Huila	0.25 (0.01, 1.43)	1.91°C (0.04°C, 3.13°C)	56.47 (28.01, 78.89)	25.62 (7.95, 40.62)	0.06 (0.00, 0.54)	162.42 (26.47, 271.65)
Tolima	0.00 (0.00, 0.00)	2.02°C (0.37°C, 3.04°C)	27.09 (13.92, 38.89)	39.87 (15.55, 60.10)	0.64 (0.00, 3.30)	167.74 (38.12, 277.32)
Quindío	0.00 (0.00, 0.00)	2.07°C (0.18°C, 2.79°C)	47.79 (11.68, 70.12)	0.30 (0.02, 0.95)	0.00 (0.00, 0.00)	166.00 (35.00, 285.00)
Risaralda	21.33 (6.39, 62.33)	1.92°C (0.21°C, 2.90°C)	**113.94** (49.88, 157.66)	7.26 (2.02, 17.25)	0.00 (0.00, 0.00)	156.92 (47.88, 283.66)
Caldas	0.00 (0.00, 0.00)	2.04°C (0.42°C, 2.91°C)	46.86 (15.97, 72.68)	9.31 (2.59, 19.79)	0.21 (0.00, 1.37)	151.89 (41.55, 266.77)
Cundinamarca	0.00 (0.00, 0.00)	**2.12°C** (0.60°C, 3.41°C)	31.03 (15.33, 47.86)	24.80 (7.93, 38.10)	0.35 (0.01, 2.10)	171.67 (45.54, 259.15)
Distrito Capital	NA	2.08°C (0.41°C, 3.43°C)	0.76 (0.01, 4.53)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	NA
Boyacá	0.01 (0.00, 0.04)	2.05°C (0.86°C, 3.27°C)	19.43 (8.31, 30.22)	12.33 (4.43, 18.79)	2.23 (0.44, 5.09)	**186.23** (67.10, 254.98)
Antioquia	10.07 (1.69, 31.40)	1.83°C (0.76°C, 2.78°C)	43.69 (21.18, 65.43)	24.54 (12.02, 36.93)	**16.56** (5.71, 31.18)	143.51 (42.94, 257.51)
Santander	36.54 (13.27, 59.48)	1.97°C (0.92°C, 3.25°C)	45.19 (21.53, 62.56)	28.70 (12.03, 42.95)	15.73 (2.58, 32.41)	164.45 (72.16, 244.92)
Norte de Santander	**53.71** (22.10, 87.63)	1.95°C (0.99°C, 3.32°C)	33.33 (17.40, 44.21)	**55.01** (32.37, 78.51)	3.47 (0.27, 10.56)	135.13 (63.76, 207.09)

TABLE 5. Key Department-Level Projected Anomalies to Monitor for 2040–2059 (Ref. Period 1995–2014) Under SSP3-7.0 (*Continued*)

Projected Anomalies for 2040–2059 Under SSP3-7.0 (Ref. Period 1995–2014)						
Department	High Heat Index Days (No. Days T-max >35°C) Annually	Max. of Daily Max. Temp. Anomaly Annually	Summer Days (No. Days T-max >25 °C) Annually	Tropical Nights (No. Nights T-min >20°C) Annually	Tropical Nights (No. Nights T-min >26°C) Annually	Warm Spell Duration Index (No. Days) Annualized
Pacific						
Nariño	1.40 (0.14, 15.51)	1.54°C (0.33°C, 2.66°C)	30.77 (17.50, 41.73)	19.93 (11.64, 29.99)	8.20 (3.01, 21.21)	166.15 (37.12, 284.25)
Cauca	2.23 (0.35, 21.90)	**1.63°C** (0.14°C, 2.59°C)	55.09 (26.55, 75.73)	14.42 (5.48, 26.19)	1.56 (0.27, 6.65)	157.64 (35.64, 279.38)
Valle del Cauca	2.98 (0.35, 19.02)	1.52°C (0.37°C, 2.65°C)	**75.16** (34.93, 103.25)	**33.59** (12.06, 54.25)	5.93 (1.84, 15.87)	146.95 (57.23, 291.47)
Chocó	**9.89** (2.06, 57.96)	1.50°C (0.63°C, 2.46°C)	17.12 (9.28, 24.81)	13.95 (6.27, 20.88)	**9.85** (1.89, 42.08)	**233.79** (80.46, 301.00)

10th percentile and 90th percentile values shown in parentheses. Largest anomalies (>50 days or >1.80°C) are shaded orange and smallest relative anomalies from the reference period are shaded gray. The largest anomaly in each region is bolded. Note that the maximum of daily maximum anomalies apply least to the coasts, High Heat Index anomalies apply most to the eastern lowlands and Caribbean, and summer day anomalies apply most to the Andes. High Heat Index day and warm spell anomalies use 1.00° × 1.00° (100km × 100km) data resolution and consider Distrito Capital as part of Cundinamarca. See text for interpretation.

In the high-elevation Andes, summer days with a maximum temperature >25°C increase year-round. Risaralda in the Central Andes is projected to experience the highest increase of 113.94 (49.88, 157.66) summer days by 2040–2059 under SSP3-7.0. Single-day maximum of daily maximum temperatures increase the highest annually in the Andes, around 2°C from the reference period, especially during fall and winter months. Most departments experience an increase of more than 150 days on the Warm Spell Duration Index by midcentury according to SSP3-7.0,[29] with an increase of more than 200 days expected annually in San Andrés y Providencia and Chocó. However, an SSP1-2.6 scenario forecasts an increase of at least 50 fewer days annually. Populous Bogotá's (Distrito Capital and Cundinamarca Departments) increase in number of days with high maximum temperatures point to elevated risks associated with prolonged heat exposure. For further detail on how Colombia's projected temperature changes under SSP3-7.0 compare to other scenarios, see the profile's Annex.

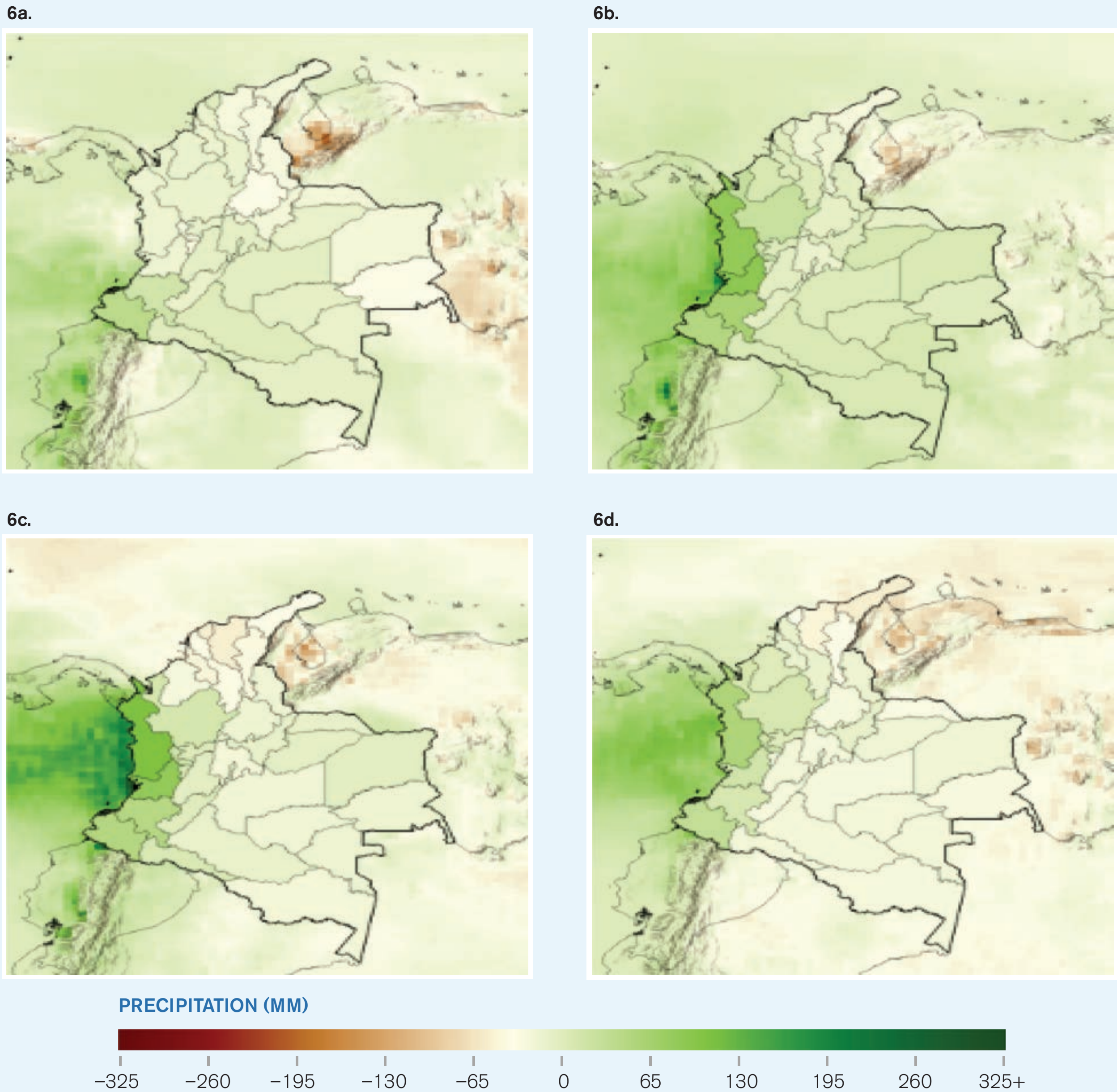
Precipitation

Projected precipitation patterns under SSP3-7.0 reflect regional shifts in the annual onset, duration, and intensity by midcentury. Detailed precipitation trends in each of the given regions are discussed in turn below. Some seasonal and regional precipitation trends, while present by midcentury, have wide probability distributions. Many of these trends also shift when compared to different climate change scenarios. Drier regions (Caribbean, Eastern Andes) tend to become drier and wetter regions (Pacific, Western Andes) tend to become wetter, though deviations from this pattern are noted. The timing and duration of extreme precipitation intensities vary by department.

[29] This value 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 Duration Index projections use 1.00° × 1.00° (100km × 100km) data resolution.

As **Figures 6a–d** and **Table 6** illustrate, both the Amazon and Orinoco regions are expected to observe an annual decrease in precipitation by 2040–2059 under SSP3-7.0. Trends, represented by the departments of Guainía and Arauca in **Table 6** with the largest annual anomalies, differ little seasonally. During winter months by midcentury (**Figure 6a**), the department of Guainía (Amazon region) is projected to have the driest monthly anomaly with –18.94 mm (–57.93 mm, +34.56 mm) in February. Projected precipitation levels in the Orinoco region vary little during these months. Slightly wetter conditions in Guainía are expected at the beginning of its spring wet season by 2040–2059

FIGURES 6A–D. Projected Seasonal Precipitation Anomalies for Colombia, 2040–2059 (Ref. Period 1995–2014) Under SSP3-7.0



Top left, a, winter. Top right, b, spring. Bottom left, c, summer. Bottom right, d, fall. Note generally higher projected precipitation anomalies in the Pacific and West Andes across seasons. In contrast, positive precipitation anomalies during spring months in the Caribbean, eastern lowlands, and eastern Andes are largely reversed by negative precipitation anomalies in the remaining seasons.

TABLE 6. Median Projected Precipitation Anomalies (in Millimeters) for 2020–2039 and 2040–2059 from Ref. Period 1995–2014 Under SSP3-7.0 in Key Departments

Department (Region)	Annual 2020–2039	Annual 2040–2059	Winter (Dec–Jan–Feb) 2020–2039	Winter (Dec–Jan–Feb) 2040–2059	Spring (Mar–Apr–May) 2020–2039	Spring (Mar–Apr–May) 2040–2059	Summer (June–July–Aug) 2020–2039	Summer (June–July–Aug) 2040–2059	Fall (Sept–Oct–Nov) 2020–2039	Fall (Sept–Oct–Nov) 2040–2059
Colombia	4.40 (–181.76, 202.21)	**–16.35** (–300.06, 235.29)	2.08 (–75.24, 59.71)	**–11.33** (–99.68, 59.81)	7.74 (–85.91, 109.99)	11.52 (–103.32, 118.56)	–3.15 (–71.94, 53.85)	–3.95 (–105.19, 94.13)	–4.63 (–79.82, 60.78)	**–14.27** (–136.84, 69.60)
Guainía (Amazon)	–32.72 (–197.88, 142.80)	**–88.50** (–322.16, 110.69)	–8.62 (–99.09, 57.38)	**–31.87** (–122.78, 47.50)	–9.01 (–110.93, 90.51)	**–0.99** (–133.07, 101.19)	–13.48 (–69.11, 35.13)	–16.39 (–122.55, 70.32)	–15.22 (–72.92, 27.82)	**–26.97** (–123.54, 27.89)
Arauca (Orinoco)	–42.94 (–254.52, 179.05)	**–88.54** (–396.25, 152.30)	–5.36 (–43.78, 22.11)	**–21.38** (–65.42, 10.18)	–6.83 (–113.37, 146.80)	–6.99 (–159.03, 120.63)	–16.11 (–99.98, 33.94)	**–9.23** (–137.60, 56.94)	–13.90 (–72.57, 61.63)	**–28.61** (–144.75, 36.56)
Magdalena (Caribbean)	–13.82 (–165.97, 212.94)	**–111.95** (–376.63, 83.41)	–0.18 (–39.18, 32.23)	**–22.87** (–62.63, 14.15)	16.10 (–71.50, 105.97)	**–15.85** (–108.51, 67.83)	–14.40 (–76.91, 39.89)	**–53.18** (–150.93, 28.57)	–17.03 (–82.09, 105.06)	**–47.38** (–155.92, 64.38)
Santander (Andes)	5.99 (–244.66, 246.11)	**–76.47** (–357.35, 235.16)	–0.36 (–88.88, 49.96)	**–33.74** (–114.56, 37.20)	18.87 (–114.76, 139.54)	**–7.01** (–122.76, 129.72)	–1.76 (–88.38, 54.45)	**–14.60** (–112.76, 90.35)	–13.80 (–86.82, 100.44)	**–25.13** (–153.87, 107.94)
Chocó (Pacific)	159.74 (–208.37, 552.21)	**256.64** (–398.06, 774.05)	18.24 (–139.67, 125.07)	**–14.22** (–158.91, 141.30)	34.49 (–114.87, 225.35)	**87.10** (–106.55, 243.45)	68.15 (–122.70, 205.16)	**107.81** (–99.92, 348.19)	31.10 (–112.70, 175.34)	**54.47** (–181.06, 239.32)

Anomalies bolded in red indicate a lower anomaly for 2040–2059 than for 2020–2039, whereas anomalies bolded in green indicate a higher anomaly for 2040–2059 than for 2020–2039 when compared to the historical reference period. Anomalies shaded gray indicate minimal change in median anomalies between 2020–2039 and 2040–2059 climatologies. See text for interpretation.

(**see Figure 6b**), with the wettest spring monthly anomaly expected for Meta (Orinoco) in April, increasing by +8.09 mm (–42.91 mm, +73.65 mm) by midcentury. During summer months of 2040–2059, the peak of the Orinoco's wet season (**Figure 6c**) is expected to become wetter than 2020–2039. While Putumayo (Amazon) along the Andes experiences a seasonal increase in precipitation from the reference period by midcentury, the Amazon's dry season becomes anomalously dry. During early fall months by midcentury (**Figure 6d**), regional precipitation anomalies synchronize – the dry season in the Amazon (Guaviare, Guainía, and Caquetá) intensifies and the end of the wet season in the Orinoco (Casanare and Meta) becomes drier. Both scenarios SSP1-2.6 and SSP2-4.5 predict less drying in the eastern lowlands than SSP3-7.0 by midcentury, with positive annual precipitation anomalies for all of the regions' departments under SSP1-2.6 by midcentury except for Amazonas.

The Western Caribbean region is projected to experience less of an annual drying trend annually by midcentury under SSP3-7.0 compared to the Eastern Caribbean. During the winter dry season, every department in the Eastern Caribbean is expected to observe a more than 10% decrease in total precipitation for at least one month,[30] with the

[30] During winter dry months, departments in the Eastern Caribbean region are expected to receive median precipitation percent changes of the following: La Guajira (–20.44% during February), Cesar (–18.94% during January), and Magdalena (–15.36% during January).

greatest change for La Guajira in February at –20.44% (–35.11%, +4.12%). La Guajira also experiences a notable precipitation decrease in its second fall wet season, with –26.14 mm in September (–64.28 mm, +7.60 mm). During summer months for the 2040–2059 period, the Western Caribbean islands of San Andrés y Providencia are expected to observe a sizable decrease in precipitation, with –27.88 mm (–74.72 mm, +19.38 mm) in July. This is accompanied by a decrease in the fall wet season of –21.62 mm (-66.78 mm, +19.40 mm) in October. However, there is less of a decrease in precipitation moving west across the region on the mainland (**see Figures 6c–d**). Córdoba is expected to observe a decrease of -23.20 mm (-94.61 mm, +69.49 mm) during summer months and a small increase of 1.95 mm (-67.48 mm, +80.44 mm) during fall months. In the Eastern Caribbean by contrast, Magdalena is expected to receive –47.38 mm (-155.92 mm, +64.38 mm) in the fall months compared to the historical reference period of 1995–2014 by midcentury. These trends suggest a strengthening of easterly trade winds in the summer, which would decrease summer precipitation in La Guajira and San Andrés y Providencia.[31] For 2040–2059 under SSP2-4.5, the Western Caribbean except Atlántico would experience positive annual precipitation anomalies and for the same period under SSP1-2.6, the entire Western and Eastern Caribbean would experience an annual increase in precipitation.

The wet Pacific region is projected to experience precipitation increases year-round by midcentury under SSP3-7.0. In Colombia's wettest department of Chocó, precipitation is expected to increase 107.81 mm (–99.92 mm, +348.19 mm) during its wettest summer months and 54.47 mm (–181.06 mm, +239.02 mm) during fall months (**see Table 6**). However, it is projected to decrease –14.22 mm (–158.91 mm, +141.30 mm) during winter months. Ultimately, it is expected to increase 256.64 mm (–398.06 mm, +774.05 mm) annually. These seasonal shifts suggest potential changes in the strength of westerly Chocó winds.[32] For 2040–2059 under SSP2-4.5, Chocó would observe a greater increase in precipitation annually.

The Andes region is projected to experience divergent trends between its western and eastern, northern and southern slopes, with generally wetter trends during spring months and drier trends during other seasons. Departments in the Cordillera Oriental are projected to experience a decrease in annual precipitation by midcentury while Antioquia, Caldas, Risaralda, and Quindío in the Cordillera Occidental and Central are projected to experience an increase in annual precipitation. In summer months, Risaralda in the western Andes is forecasted to observe precipitation increases by midcentury. In fall months, the greatest decreases are in the north and east, with –25.13 mm (–153.87 mm, +107.94 mm) in Santander and –23.07 mm (–99.48 mm, +72.48 mm) in Cundinamarca. But during fall months, Antioquia and Risaralda experience increases. For 2040–2059 under both SSP2-4.5 and SSP1-2.6, the entire Andes region experiences positive precipitation anomalies annually.

The Western Andes (Cordillera Occidental and Central) and Pacific regions are expected to observe the greatest annual increases in precipitation amounts during the 5% wettest days by midcentury (**see Figures 7a–d**, bottom panel), with monthly precipitation increases generally occurring during the first half of the year and decreases occurring towards the end of the year, regardless of the department's wet or dry season.[33] For example, in Risaralda (Central Andes with a bimodal regime, **see Figure 7c**), precipitation amounts during the 5% wettest days increase 41.38 mm (–3.67 mm, +106.02 mm) in the first wet season during April; 43.76 mm (–34.44 mm, +115.82 mm) in June, the start

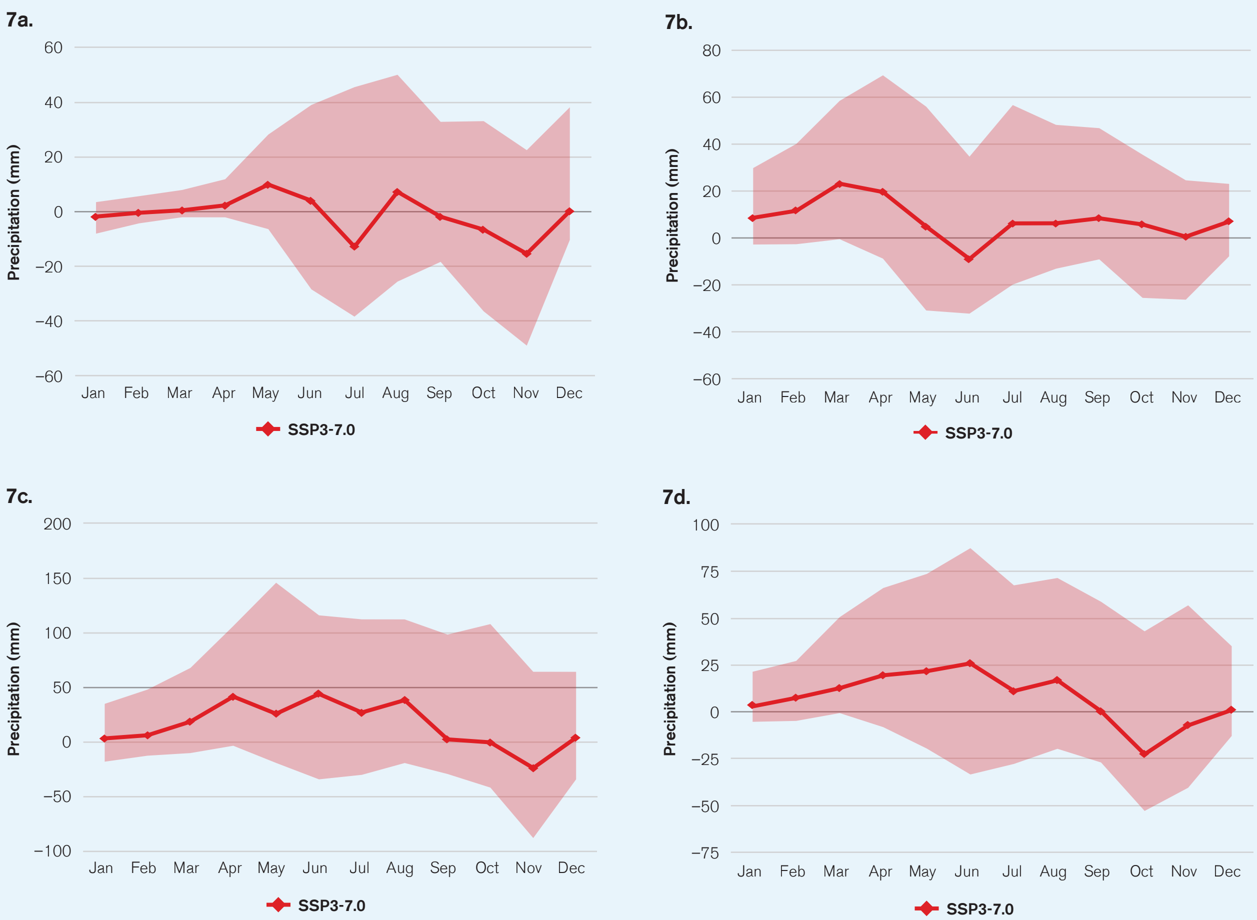
[31] Cook, K. H., and Vizy, E. K. (2010). Hydrodynamics of the Caribbean low-level jet and its relationship to precipitation. Journal of Climate, 23(6), 1477–1494. DOI: https://doi.org/10.1175/2009JCLI3210.1

[32] Valencia, J., and Mejía, J. F. (2022). Projected Changes of Day-to-Day Precipitation and Choco Low-Level Jet Relationships over the Far Eastern Tropical Pacific and Western Colombia from Two CMIP6 GCM Models. Atmosphere, 13(11), 1776. DOI: https://doi.org/10.3390/atmos13111776

[33] This metric under the SSP3-7.0 scenario uses 1.00° × 1.00° (100km × 100km) data resolution.

of the first dry season; and 38.12 mm (–19.49 mm, +112.09 mm) in August, near the end of the first dry season. However, they decrease –24.07 mm (–88.23 mm, +64.10 mm) in November, near the end of the second wet season. In Santander (Northern Andes with a mixed regime, **see Figure 7d**), the most intense precipitation amounts follow the same trend – increasing at the end of the first wet season but decreasing at the end of the second wet season. However, in Vaupés (Amazon with a unimodal regime, **see Figure 7b**), precipitation intensities decrease in the middle of the wet season, and in San Andrés y Providencia (Caribbean with a unimodal regime, **see Figure 7a**), intensities also decrease at the end of the wet season in the fall. Changes in sea surface temperatures in the East Pacific Ocean, which tend to correlate with ENSO events among many other factors, will continue to be a notable influence on the interannual strength and temporal variation of Colombia's future precipitation (see subsection on sea surface temperature below). For further detail on how Colombia's projected precipitation changes under SSP3-7.0 compare to other scenarios, see the profile's Annex.

FIGURES 7A–D. Projected Precipitation Anomalies (in Millimeters) During 5% Wettest Days for 2040–2059 (Ref. Period 1995–2014) Under SSP3-7.0 in Departments with Different Annual Precipitation Regimes



Top left, a, San Andrés y Providencia (Caribbean) is a unimodal regime. Top right, b, Vaupés (Amazon) is a unimodal regime. Bottom left, c, Risaralda (Central Andes) is a bimodal regime. Bottom right, d, Santander (Northern Andes) is a mixed regime. Shaded areas indicate 10th and 90th percentiles. Note different scales of precipitation anomalies on the y-axes and timing of highest and lowest intensities between the top and bottom panel. See text for interpretation.

Extreme Precipitation Events

By midcentury, Colombia is likely to more frequently experience extreme precipitation event occurrence. For the projected period of 2035–2064, the largest 1-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 Western Caribbean, the Central and Northern Andes, and parts of the Pacific coast (see change factors shaded orange in **Table 7** and corresponding future return periods in **Table 8**). The greatest change is projected in Antioquia, Santander, and Córdoba. However, the rate of change is lower for 10-year and 25-year events. SSP1-2.6 and SSP2-4.5 do not forecast extreme event frequencies at significantly different rates than SSP3-7.0 for 2035–2064. More frequently occurring extreme precipitation events underscore future health risks related to flood impacts, agricultural yields, disease ranges, and critical infrastructure, including for water, sanitation, and hygiene.

TABLE 7. Department-Level Projected Change in Annual Exceedance Probability (Change Factors in Occurrence per Year) of Largest 1-Day Precipitation for Different Event Recurrence Intervals (SSP3-7.0, 2035–2064, Center 2050)

Change in Annual Exceedance Probability (Change Factors in Occurrence per Year)				
Department	**10-yr**	**25-yr**	**50-yr**	**100-yr**
Colombia	1.49 (0.82, 2.39)	1.63 (0.78, 2.90)	1.75 (0.76, 3.40)	1.87 (0.75, 4.03)
Amazon				
Amazonas	1.42 (0.71, 2.48)	1.52 (0.66, 2.96)	1.59 (0.61, 3.39)	1.66 (0.55, 3.97)
Putumayo	1.49 (0.67, 2.83)	1.62 (0.60, 3.89)	1.79 (0.60, 5.24)	2.02 (0.56, 7.14)
Caquetá	1.41 (0.72, 2.48)	1.51 (0.66, 3.09)	1.60 (0.63, 3.67)	1.71 (0.60, 4.36)
Vaupés	1.54 (0.75, 2.54)	1.67 (0.71, 3.09)	1.80 (0.69, 3.59)	1.90 (0.66, 4.17)
Guaviare	1.46 (0.82, 2.17)	1.60 (0.77, 2.51)	1.70 (0.72, 2.89)	1.81 (0.64, 3.44)
Guainía	1.48 (0.73, 2.54)	1.61 (0.70, 3.14)	1.76 (0.67, 3.75)	1.90 (0.70, 4.47)
Orinoco				
Meta	1.34 (0.78, 2.08)	1.46 (0.70, 2.39)	1.54 (0.65, 2.74)	1.63 (0.62, 3.22)
Vichada	1.47 (0.85, 2.39)	1.67 (0.82, 2.86)	1.80 (0.80, 3.40)	1.98 (0.80, 4.10)
Casanare	1.38 (0.86, 2.12)	1.51 (0.78, 2.51)	1.58 (0.73, 2.94)	1.67 (0.74, 3.60)
Arauca	1.42 (0.81, 2.14)	1.58 (0.76, 2.52)	1.67 (0.71, 2.91)	1.77 (0.67, 3.36)
Caribbean				
Córdoba	1.77 (1.03, 2.89)	2.00 (1.02, 3.61)	2.20 (1.02, 4.25)	2.39 (1.02, 5.07)
Sucre	1.52 (0.75, 2.21)	1.67 (0.71, 2.58)	1.80 (0.68, 2.92)	1.94 (0.65, 3.42)

TABLE 7. Department-Level Projected Change in Annual Exceedance Probability (Change Factors in Occurrence per Year) of Largest 1-Day Precipitation for Different Event Recurrence Intervals (SSP3-7.0, 2035–2064, Center 2050) (*Continued*)

Change in Annual Exceedance Probability (Change Factors in Occurrence per Year)				
Department	**10-yr**	**25-yr**	**50-yr**	**100-yr**
San Andrés y Providencia	1.27 (0.24, 1.79)	1.34 (0.20, 2.42)	1.40 (0.18, 3.11)	1.47 (0.16, 3.59)
Bolívar	1.54 (0.75, 2.25)	1.69 (0.75, 2.63)	1.81 (0.73, 2.97)	1.93 (0.72, 3.36)
Atlántico	1.28 (0.57, 1.78)	1.34 (0.53, 1.97)	1.39 (0.52, 2.12)	1.43 (0.50, 2.29)
Magdalena	1.34 (0.60, 1.89)	1.42 (0.57, 2.12)	1.49 (0.56, 2.30)	1.55 (0.53, 2.52)
Cesar	1.53 (0.73, 2.07)	1.67 (0.74, 2.38)	1.77 (0.73, 2.64)	1.88 (0.71, 2.94)
La Guajira	1.16 (0.47, 1.72)	1.20 (0.45, 1.96)	1.23 (0.42, 2.17)	1.28 (0.39, 2.43)
Andes				
Huila	1.34 (0.78, 2.50)	1.43 (0.73, 3.23)	1.53 (0.69, 3.92)	1.61 (0.68, 4.83)
Tolima	1.47 (0.97, 2.33)	1.62 (0.93, 2.83)	1.79 (0.90, 3.33)	1.89 (0.93, 3.96)
Quindío	1.59 (1.08, 2.64)	1.77 (1.07, 3.12)	1.93 (1.06, 3.52)	2.07 (1.05, 4.09)
Risaralda	1.74 (0.95, 2.60)	1.93 (0.90, 3.10)	2.04 (0.88, 3.67)	2.14 (0.86, 4.44)
Caldas	1.69 (1.00, 2.52)	1.92 (0.94, 2.95)	2.03 (0.94, 3.35)	2.19 (0.94, 3.87)
Cundinamarca	1.54 (0.93, 2.33)	1.74 (0.94, 2.83)	1.83 (0.94, 3.36)	1.98 (0.92, 4.01)
Boyacá	1.55 (1.00, 2.44)	1.69 (1.03, 2.94)	1.79 (1.05, 3.42)	1.96 (1.07, 3.97)
Antioquia	1.81 (1.03, 2.94)	2.05 (1.03, 3.72)	2.25 (1.03, 4.42)	2.46 (1.04, 5.26)
Santander	1.70 (1.00, 2.44)	1.98 (1.01, 3.02)	2.23 (1.01, 3.62)	2.50 (1.02, 4.24)
Norte de Santander	1.54 (0.86, 2.25)	1.69 (0.87, 2.67)	1.81 (0.86, 3.02)	1.95 (0.84, 3.42)
Pacific				
Nariño	1.65 (1.02, 3.87)	1.85 (1.01, 5.38)	2.02 (1.00, 7.06)	2.16 (0.97, 9.09)
Cauca	1.50 (0.92, 2.86)	1.61 (0.91, 3.68)	1.70 (0.91, 4.47)	1.79 (0.90, 5.38)
Valle del Cauca	1.63 (1.02, 2.76)	1.80 (1.02, 3.41)	1.97 (1.02, 3.97)	2.13 (1.01, 4.64)
Chocó	1.52 (1.15, 2.70)	1.65 (1.20, 3.25)	1.75 (1.23, 3.72)	1.86 (1.26, 4.27)

The largest 1-day precipitation amounts associated with an event of a certain historical return period would be 2 times more likely to occur by midcentury (or have a change factor of 2). Change factors >2 are shaded orange and increase with higher return periods. The largest change factors are projected for the Central and Northern Andes, including Pacific departments that partly encompass the Andes.

TABLE 8. Future Return Period of Largest 1-Day Precipitation for Different Event Recurrence Intervals (SSP3-7.0, 2035–2064, Center 2050) in Departments with Greatest Projected Change

Future Projected Return Period (in Years)				
Department	**10-yr**	**25-yr**	**50-yr**	**100-yr**
Colombia	6.83 (3.97, 11.47)	15.69 (8.14, 29.70)	29.50 (14.03, 61.10)	55.43 (23.63, 126.76)
Amazon				
Putumayo	6.79 (2.97, 16.00)	15.65 (5.26, 47.30)	28.55 (8.09, 108.19)	51.62 (12.38, 249.28)
Caribbean				
Córdoba	5.76 (3.49, 9.53)	12.84 (6.79, 23.90)	23.49 (11.34, 48.06)	43.45 (18.67, 97.22)
Andes				
Quindío	6.31 (3.78, 9.25)	14.16 (7.95, 22.19)	25.86 (13.94, 42.93)	48.37 (23.24, 88.26)
Risaralda	5.79 (3.54, 9.20)	13.04 (7.16, 22.39)	24.55 (12.21, 43.94)	46.77 (20.39, 88.26)
Caldas	5.94 (3.71, 9.42)	13.04 (7.58, 23.49)	24.64 (13.00, 47.06)	45.79 (22.20, 95.25)
Antioquia	5.57 (3.29, 9.16)	12.28 (6.42, 22.10)	22.48 (10.31, 44.01)	41.31 (16.70, 87.25)
Santander	5.90 (3.88, 9.02)	12.75 (7.57, 21.32)	22.71 (12.74, 41.48)	40.84 (20.79, 81.75)
Pacific				
Nariño	6.09 (2.35, 9.01)	13.65 (4.10, 22.70)	25.12 (6.35, 45.80)	46.99 (9.70, 94.99)
Valle del Cauca	6.14 (3.17, 9.64)	13.97 (6.51, 24.49)	25.47 (11.24, 49.44)	47.09 (19.31, 101.08)

Return periods with highest change factors in Table 7 are shaded orange. Antioquia and Santander have the most frequent return periods for future 50-year and 100-year events, compared to the national medians.

CLIMATE-RELATED NATURAL HAZARDS

Geological and hydrometeorological events in Colombia between 1990 and 2010 caused an average annual loss of US$177 million, with a noticeable increase in climate-related disasters over time.[34] The highland areas, where a majority of the country's population is concentrated, are subject to landslides and significant flooding due to increased surface runoff from snow melt and extreme rainfall. As temperatures continue to rise, critical glaciers are likely to disappear, further contributing to water shortages in the highlands. The frequency of intense floods and droughts associated with ENSO will also likely become more common in the future. In coastal areas, rising seas,

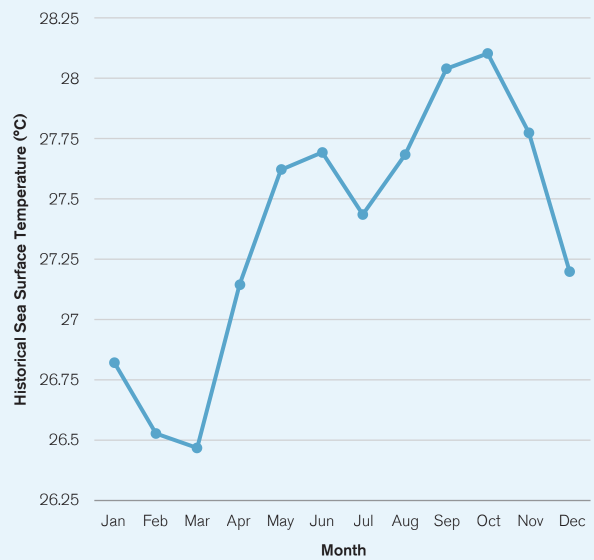
[34] Campos Garcia, A., Holm-Nielsen, N., Diaz G, C., Rubiano Vargas, D. M., Costa P, C. R., Ramirez Cortes, F., and Dickson, E. (2011). Analysis of disaster risk management in Colombia: a contribution to the creation of public policies. World Bank. URL: https://www.gfdrr.org/sites/default/files/publication/Analysis_of_Disaster_Risk_Management_in_Colombia.pdf

coupled with increased storm surges pose heightened risks of localized flooding, particularly along the Caribbean coast. Past and future impacts associated with each of Colombia's notable hazards are discussed below.

Sea Level Rise and Sea Surface Temperature

Historically observed sea surface temperatures (1992–2010) for coastal Colombia fluctuated between a seasonal peak in October (28.11°C) at the end of the (second) wet season for most departments, coinciding with cooler mean temperatures, and a low point during March (26.47°C) near the end of the (second) dry season, coinciding with warmer mean temperatures for most departments (see Figure 8).[35] Sea surface temperature anomalies in the East Pacific are one of the primary drivers of interannual and decadal climate variability in Colombia. On average, El Niño produces warmer and drier conditions, while La Niña produces cooler and wetter conditions. However, a trend of warmer sea surface temperatures in the East Pacific Ocean reduces thermal differences between land and sea, weakens the strength of southerly cross-equatorial circulation, and ultimately reduces the northward extent of ITCZ precipitation on Colombia's Pacific coast.[36] If the El Niño phase becomes more frequent compared to the La Niña phase, moisture transport from the Atlantic to the Amazon during spring and summer would likely strengthen.[37]

FIGURE 8. Historical Observed Sea Surface Temperature (1992–2010)



Note temperature values include both Caribbean and Pacific coastal regions. Note annual monthly low in March, end of the dry season, and annual monthly peak in November, end of the wet season.

Sea level rise and coastal inundation will increasingly threaten Colombia's coastal zones. Colombia's coastal region covers 3,208 km, with 1,760 km along the Caribbean Sea and 1,448 km along the Pacific Ocean. Coastal erosion is rampant, with approximately 50% of the Caribbean coastline suffering from erosion due to extreme waves, rising seas, and ecosystem destruction brought about by a growing tourism industry centered around the cities of Cartagena, Barranquilla, Santa Marta and Riohacha.[38] Under SSP3-7.0 with a historical

[35] World Bank Climate Change Knowledge Portal (2023). Colombia Sea Level Rise. URL: https://climateknowledgeportal.worldbank.org/country/colombia/impacts-sea-level-rise

[36] Valencia, J., and Mejía, J. F. (2022). Projected Changes of Day-to-Day Precipitation and Choco Low-Level Jet Relationships over the Far Eastern Tropical Pacific and Western Colombia from Two CMIP6 GCM Models. Atmosphere, 13(11), 1776. DOI: https://doi.org/10.3390/atmos13111776

[37] Montini, T. L., Jones, C., and Carvalho, L. M. (2019). The South American low-level jet: A new climatology, variability, and changes. Journal of Geophysical Research: Atmospheres, 124(3), 1200–1218. DOI: https://doi.org/10.1029/2018JD029634

[38] Rangel-Buitrago, N. G., Anfuso, G., and Williams, A. T. (2015). Coastal erosion along the Caribbean coast of Colombia: Magnitudes, causes and management. Ocean and Coastal Management, 114, 129–144. DOI: https://doi.org/10.1016/j.ocecoaman.2015.06.024

baseline of 1995–2014, sea level rise is projected to increase 0.19 m (0.14 m, 0.26 m) by 2050 and 0.64 m (0.46 m, 0.90 m) by 2100 in Buenaventura (Valle del Cauca) on Colombia's Pacific coast.[39] Under SSP3-7.0 (1995–2014 baseline), Cartagena (Bolívar) has the highest projected sea level rise along Colombia's Caribbean coastline, increasing 0.34 m (0.28 m, 0.43 m) by 2050 and 0.94 m (0.77 m, 1.21 m) by 2100. Rising sea levels are projected to flood 4,900 km^2 of low-lying coasts and 5,100 km^2 inland, affecting between 1.4 to 1.7 million people, 80% of which are living along the Caribbean coast and the other 20% along the Pacific coast.[40] The island of San Andrés would see significant flooding across its marshes, ridges, and mangroves, with over 10% of its land area flooded by a one-meter rise in sea levels. Furthermore, more than 45% of Colombia's areas of coastal mangroves, grasslands, scrub and lagoons are vulnerable, particularly in the departments of Magdalena, Nariño and La Guajira.[41]

Flood and Drought Risk

Colombia is technically among one of the most water-rich countries of the world, with nearly 50,000 cubic meters of water available per person, per year.[42] Nevertheless, the unequal distribution of the population across the Caribbean coast and the highlands, coupled with pollution, deforestation, and a highly variable rainfall regime make water resources management a critical challenge for the country. The Magdalena-Cauca River basins, which traverse the Andes chains throughout much of Colombia, are critically important surface water sources in Colombia. Covering a total land area of approximately 273,000 km^2, or 24% of the Colombian territory, the basins house 80% of the country's population and support a majority of the country's GDP.[43] However, infrastructure development intended to safeguard water supplies have further increased the geographical imbalance of water resources.

Altered rainfall patterns will likely impact water resource availability across Colombia. Riverine floods, already a hazard across the country, are likely to get more pronounced as snow melts faster due to rising temperatures from the country's glaciers. Rising temperatures are already leading to rapid de-glaciations, particularly in the last 30 years, with losses of 3–5% of coverage per year and a retreat of glacial volumes of 20–25 m per year.[44] La Niña impacts along the Cauca River can further result in flows exceeding their normal level by 60%. On the other hand, the reduction of river flows due to the El Niño phenomenon are significant, particularly in the Magdalena-Cauca River basins, which can see reductions of 26% in flows, the Middle Cauca River basin with reductions of 38%, the Sogamoso and Suárez River basins with reductions of 30%, and rivers in Cundinamarca and Antioquia with reductions of 30–40%.[45] Abnormal climatic conditions associated with the El Niño phenomenon can produce high temperatures and severe droughts in Colombia, damaging agricultural output and threatening operations at the hydroelectric power projects

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39 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.

40 Government of Colombia (2016). Plan Nacional de Adaptación al Cambio Climático. URL: https://www.minambiente.gov.co/wp-content/uploads/2022/01/PNACC-2016-linea-accion-prioritarias.pdf

41 Government of Colombia (2017). Third National Communication to the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/TCNCC%20COLOMBIA%20A%20LA%20CMNUCC%202017.pdf

42 Stratfor (2016). Water-Rich Colombia Still Faces Water Stress. URL: https://worldview.stratfor.com/article/water-rich-colombia-still-faces-water-stress

43 Vega-Viviscas, C. and Rodriguez, E. (2019). Evaluation of reanalysis data in the study of meteorological and hydrological droughts in the Magdalena-Cauca river basin, Colombia. DYNA, 86(211), 268–277. DOI: https://doi.org/10.15446/dyna.v86n211.80530

44 World Bank (2017). Environmental Priorities and Poverty Reduction – A Country Environmental Analysis for Colombia. URL: https://openknowledge.worldbank.org/bitstream/handle/10986/6700/405210Env0prio101OFFICIAL0USE0ONLY1.pdf?sequence=1&isAllowed=y

45 García, M. C., Piñeros Botero, A., Bernal Quiroga, F. A., and Ardila Robles, E. (2012). Climate variability, climate change and water resources in Colombia. Revista de Ingeniería, (36), 60–64. URL: http://www.scielo.org.co/scielo.php?pid=S0121-49932012000100012&script=sci_abstract&tlng=pt

which generate most domestic energy supplies. Drought-related conditions have become approximately 2.2 times more frequent than in previous years and are particularly common between January and March, as well as July and September.[46] For example, La Guajira experienced a more intense El Niño phenomenon and an extreme multiyear drought (2012–2015) that resulted in substantial losses in the agricultural sector and numerous communities without water supply.[47] As temperatures rise, droughts will likely (i) exacerbate existing tensions for water between agricultural and livestock needs as well as human populations needs, especially during the dry seasons; (ii) alter water quality from available surface sources; and (iii) increase pressures on urban zones as urbanization rates grow. Small-scale farmers are particularly vulnerable to the effects of climate change due to their dependency on rainfed agriculture for food production and income generation, as well as their limited capacity to adapt. Extreme weather events such as droughts negatively impact agro-pastoralists' livelihoods due to the loss of productive assets, severely affecting their food security.[48]

Earthquake, Volcano, and Landslide Hazards

Climate variability has significant effects on seismic risk conditions, at least in certain regions of Colombia.[49] Colombia is located along the Pacific Ring of Fire at the intersection of three major tectonic plates: the Nazca, Caribbean, and South American. Uplift at the confluence of these plates continues to shape the three main branches of the Andes which lie along highly active fault zones. The Romeral Fault System extends between the Cordillera Occidental and Central Ranges from the border with Ecuador in the south to Bolívar in the north. The Eastern Frontal Fault System runs from Colombia's border with Ecuador to the border with Venezuela along the Cordillera Oriental Range. Additionally, the Pacific region – which encompasses coastal municipalities home to roughly 1 million people – has an elevated risk of seismic hazards (including tsunamis) due to the subduction zone along Colombia's west coast.

The Colombian government's 2018 *Risk Atlas*, which maps the risk of a seismic event with a 475-year return period (**see Figure 9**), identifies the greatest potential for seismic movement in departments comprising each of the zones mentioned – Nariño and Chocó (affected by coastal subduction), Antioquia and Risaralda (along the Romeral Fault System), and Boyacá and Norte de Santander (along the northern portion of the Eastern Frontal Fault System). According to the Global Facility for Disaster Risk Reduction (GFDRR), 86% of Colombia's population lives in high or medium-risk seismic areas.[50] In addition to Nariño, Chocó, and Risaralda, roughly 95% of the land area in Cauca, Valle del Cauca, Huila, and Quindío are also exposed to high seismic hazards. GFDRR identifies several cities in particular with economic assets exposed to high seismic vulnerability – Bogotá (Cundinamarca), Medellín (Antioquia), Cali (Valle del Cauca), Villavicencio (Meta), and Bucaramanga (Santander). Departments with high social vulnerability to seismic hazards include Nariño, Cauca, Chocó, Santander and Norte de Santander.

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46 Government of Colombia (2016). Plan Nacional de Adaptación al Cambio Climático. URL: https://www.minambiente.gov.co/wp-content/uploads/2022/01/PNACC-2016-linea-accion-prioritarias.pdf; Arora, D. (2019). Extreme weather events (drought) and its impact on assets, livelihoods and gender roles: Case study of small-scale livestock herders in Cauca, Colombia. CCAFS Working Paper. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). URL: https://cgspace.cgiar.org/bitstream/handle/10568/99725/LivestockPlus%20%20 Gender%20%28002%29.pdf?sequence=5&isAllowed=y

47 Velasquez, C. (2016). Disaster Risk Management in Colombia – Working Paper. DOI: http://dx.doi.org/10.13140/RG.2.2.18780.39046

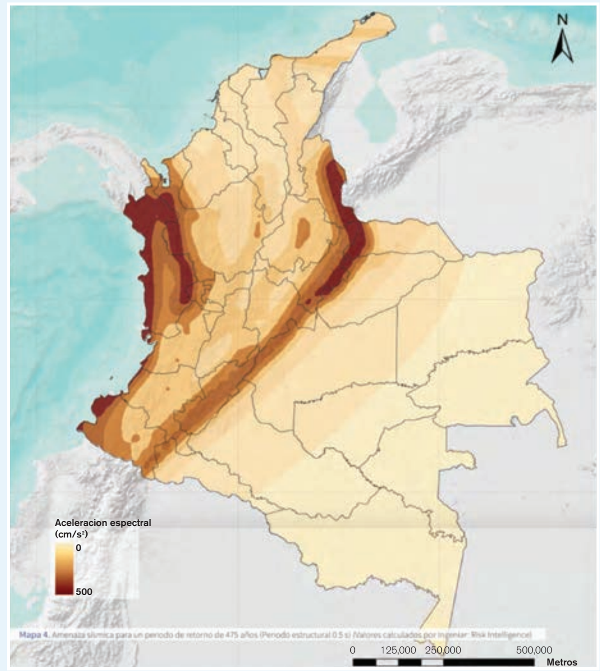
48 FAO (2017). Colombia Resilience Programmer – 2017–2020. URL: http://www.fao.org/3/a-i7584e.pdf

49 Campos Garcia, A., Holm-Nielsen, N., Diaz G, C., Rubiano Vargas, D. M., Costa P, C. R., Ramirez Cortes, F., and Dickson, E. (2011). Analysis of disaster risk management in Colombia: a contribution to the creation of public policies. World Bank. URL: https://www.gfdrr.org/sites/default/files/publication/Analysis_of_Disaster_Risk_Management_in_Colombia.pdf

50 Campos Garcia, A., Holm-Nielsen, N., Diaz G, C., Rubiano Vargas, D. M., Costa P, C. R., Ramirez Cortes, F., and Dickson, E. (2011). Analysis of disaster risk management in Colombia: a contribution to the creation of public policies. World Bank. URL: https://www.gfdrr.org/sites/default/files/publication/Analysis_of_Disaster_Risk_Management_in_Colombia.pdf

Over the last 50 years, some notable seismic events with heavy loss of life and property damage include the: Popayán earthquake (1983), volcanic eruption of and avalanche from Nevado del Ruiz (1985), Villa Tina landslide (1987), Páez earthquake (1994), Tauramena earthquake (1995), and Coffee Growing Region earthquake (1999).[51] A seismic event in Bogotá with a 500-year return period was estimated in 2004 to result in US$12.7 billion, 48,000 injured, and 20,000 fatalities.[52]

FIGURE 9. Seismic Event Threat with a Return Period of 475 Years Across Colombia's Departments[53]



Areas of greatest potential movement, measured by spectral acceleration and illustrated in darker brown, highlight the principal areas of seismic risk along the coast, Romeral Fault System (Cordillera Occidental and Central), and Eastern Front System (Cordillera Oriental).

Landslides and various types of mass movement can be influenced by an array of factors, ranging from seismic activity, geology, water saturation, and erosion, all of which have the potential to be exacerbated by human activities. The national government identifies how the departments with the greatest percentage of land area exposed to high-hazard landslides are located in northern parts of the Cordillera Oriental (Norte de Santander, Santander, Boyacá, Cundinamarca) and Cordillera Occidental (Chocó, Antioquia, Caldas, Risaralda, Cauca).[54] The Caribbean, Amazon, and Orinoco regions have the lowest risk, aside from in the Andes foothills. Between 1970 and 2011, volcanic eruptions resulted in more than 24,000 fatalities, earthquakes resulted in more than 2,200 fatalities, and landslides resulted in over 5,200 fatalities, compared to floods which led to almost 1,500 fatalities.[55] More recently, a mudslide driven by heavy rain and erosion caused by deforestation in Mocoa, Putumayo (Amazon) led to 273 deaths, underscoring the role of precipitation and land management in pinpointing landslide hazard risk.[56]

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[51] Campos Garcia, A., Holm-Nielsen, N., Diaz G, C., Rubiano Vargas, D. M., Costa P, C. R., Ramirez Cortes, F., and Dickson, E. (2011). Analysis of disaster risk management in Colombia: a contribution to the creation of public policies. World Bank. URL: https://www.gfdrr.org/sites/default/files/publication/Analysis_of_Disaster_Risk_Management_in_Colombia.pdf

[52] Cardona, O. D., Ordaz, M. G., Moreno, A., M., Yamí'n, L. E. and Wilches-Chaux, G. (2004). Study report on the definition of the State's responsibility, its exposure facing natural disasters, and mechanisms designed to cover the State's residual risks. Consortium ERN - Colombia, ACCI, DNP, and World Bank.

[53] UNGRD and Ingeniar Risk Intelligence (2018). Atlas de Riesgo de Colombia: revelando los desastres latentes. URL: https://www.preventionweb.net/files/62193_atlasriesgo1.pdf

[54] UNGRD and Ingeniar Risk Intelligence (2018). Atlas de Riesgo de Colombia: revelando los desastres latentes. URL: https://www.preventionweb.net/files/62193_atlasriesgo1.pdf

[55] Campos Garcia, A., Holm-Nielsen, N., Diaz G, C., Rubiano Vargas, D. M., Costa P, C. R., Ramirez Cortes, F., and Dickson, E. (2011). Analysis of disaster risk management in Colombia: a contribution to the creation of public policies. World Bank. URL: https://www.gfdrr.org/sites/default/files/publication/Analysis_of_Disaster_Risk_Management_in_Colombia.pdf

[56] UNDRR (2017). 500 Colombian Towns Face Landslide Risk. URL: https://www.preventionweb.net/news/500-colombian-towns-face-landslide-risk

KEY NATIONAL DOCUMENTS

- Long-Term Climate Strategy (2021) (Spanish)
- Updated Nationally Determined Contribution (2020) (Spanish)
- Second Biennial Update Report (2018) (Spanish)
- Colombia's First Nationally Determined Contribution (2018)
- Third National Communication to the UNFCCC (2017)
- National Climate Change Policy (2017) (Spanish)
- First Biennial Update Report (2016) (Spanish)
- Updated National Adaptation Plan (PNACC) (2016) (Spanish)
- Climate and Health Country Profile (2015)
- Climate-Smart Agriculture Profile (2015)
- National Adaptation Road Map (2013) (Spanish)
- National Adaptation Plan (PNACC) (2012) (Spanish)
- Second National Communication to the UNFCCC (2010)
- First National Communication to the UNFCCC (2001)

ANNEX OF PROJECTED CLIMATE SCENARIOS

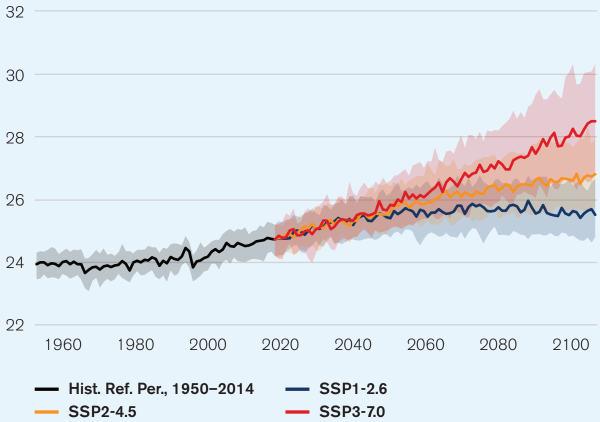
Compared to the most likely scenario SSP3-7.0, which results in the greatest temperature and precipitation shifts nationally across all key metrics by the end of the century (see Table 9), SSP1-2.6 and SSP2-4.5 demonstrate Colombia's lower overall rates of change and severity of climate impacts as a result of carbon emission reductions. The differences between projected temperatures under the three scenarios are particularly pronounced (**see Figure 10a**). SSP1-2.6 has the lowest annual mean temperature increase – 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. The minimal increase in number of tropical nights (T-min >20°C) experienced nationally by the end of the century under SSP1-2.6 and SSP2-4.5 (<20 nights above the reference period annually) contrasts that of SSP3-7.0 by the end of the century, rising significantly by roughly one month more than the reference period annually. While most of the change in tropical nights (T-min >20°C) is concentrated in the Andes, the already high year-round mean prevents further increases in this temperature range across much of the country. The most dramatic shift by the end of the century occurs for the metric of tropical nights with a higher threshold (T-min >26°C), disproportionately affecting the Caribbean and Orinoco regions. At the national level under SSP2-4.5, the number of such tropical nights increase by roughly one and a half months above the reference period by the end of the century, compared to a negligible change under SSP1-2.6. However, under SSP3-7.0, the annual number of anomalous nights rises by roughly four months above the reference period over the same time period. The anomalous annual number of summer days above the reference period for 2080-2099 likewise increases the most under SSP3-7.0 nationally by roughly one month, concentrated in higher elevation areas.

TABLE 9. Key National-Level Projected Anomalies Through End-of-Century (Ref. Period 1995–2014) Under SSP1-2.6, SSP2-4.5, and SSP3-7.0 Scenarios

Metric	SSP1-2.6 Projection		
	2020–2039	2040–2059	2080–2099
Annual Mean Temperature	0.69°C (0.37°C, 1.10°C)	1.02°C (0.58°C, 1.73°C)	1.11°C (0.46°C, 1.95°C)
Tropical Nights (No. Nights T-min >20°C) Annually	7.60 (3.10, 12.38)	10.47 (4.75, 17.71)	11.02 (4.19, 19.31)
Tropical Nights (No. Nights T-min >26°C) Annually	6.43 (1.75, 15.93)	11.04 (2.84, 34.76)	13.14 (2.80, 45.37)
Summer Days (No. Days T-max >25°C) Annually	7.12 (2.99, 10.93)	10.59 (4.89, 17.08)	11.36 (4.33, 19.08)
Annual Precipitation (mm)	46.86 (–108.93, 185.81)	51.56 (–165.95, 234.83)	**42.66** (–142.15, 219.86)
Metric	**SSP2-4.5 Projection**		
	2020–2039	**2040–2059**	**2080–2099**
Annual Mean Temperature	0.72°C (0.41°C, 1.12°C)	1.25°C (0.86°C, 2.08°C)	**2.10°C** (1.26°C, 3.13°C)
Tropical Nights (No. Nights T-min >20°C) Annually	7.68 (3.52, 12.85)	12.84 (6.67, 20.40)	18.98 (9.79, 29.98)
Tropical Nights (No. Nights T-min >26°C) Annually	6.63 (2.35, 16.45)	17.33 (6.53, 50.64)	**45.19** (13.72, 122.97)
Summer Days (No. Days T-max >25°C) Annually	7.24 (3.67, 11.32)	12.86 (7.42, 20.40)	20.65 (10.55, 29.96)
Annual Precipitation (mm)	25.28 (–112.19, 155.19)	**39.35** (–186.47, 209.46)	**36.79** (–216.99, 307.98)
Metric	**SSP3-7.0 Projection**		
	2020–2039	**2040–2059**	**2080–2099**
Annual Mean Temperature	0.72°C (0.27°C, 1.29°C)	1.48°C (0.75°C, 2.19°C)	**3.34°C** (1.77°C, 4.72°C)
Tropical Nights (No. Nights T-min >20°C) Annually	7.51 (2.34, 13.08)	14.11 (6.61, 21.76)	**28.80** (14.13, 42.02)
Tropical Nights (No. Nights T-min >26°C) Annually	6.80 (1.58, 18.06)	23.11 (7.70, 58.69)	**133.41** (40.55, 225.14)
Summer Days (No. Days T-max >25°C) Annually	7.26 (2.42, 12.39)	14.93 (7.42, 21.67)	**30.56** (17.94, 40.90)
Annual Precipitation (mm)	4.40 (–181.76, 202.21)	**–16.35** (–300.06, 235.29)	**–55.34** (–550.02, 373.91)

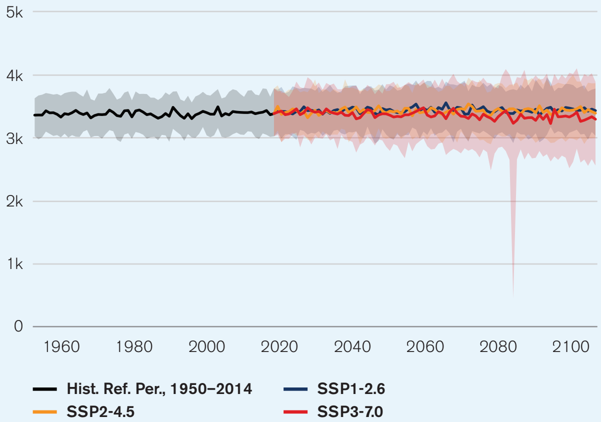
10th percentile and 90th percentile values are shown in parentheses. Key values or shifts over time are shaded orange and bolded. See text for interpretation.

FIGURE 10A. 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 10B. Projected Precipitation in Millimeters Nationwide (Ref. Period 1995–2014) Under Various Scenarios



Shaded areas indicate ranges of 10th–90th percentiles. Note relative decrease under SSP3-7.0 and increase under SSP1-2.6 and SSP2-4.5 by the end of the century. Probability ranges for all scenarios extend above and below the historical reference period, indicating a potential likelihood for precipitation decreases or increases.

The projected precipitation patterns countrywide under the three scenarios produce noticeable differences by end of century, with potential annual reductions according to the higher emission trajectories and annual increases according to the lower emission trajectories (**see Figure 10b**). By the period 2080–2099, Colombia is expected to experience a rise in annual precipitation greater than 40 mm from the reference period under SSP1-2.6, although this trend begins and holds constant starting from the 2020-2039 period. Under SSP2-4.5, nationwide precipitation totals increase slightly less above the reference period by the end of the century, but overall continue to increase from the 2020–2039 anomaly. The median precipitation anomalies under SSP3-7.0 trend quite different, decreasing below the reference period by midcentury and surpassing –50 mm by the end of the century. The range of probability generally widens under higher emission scenarios and climatologies later in the century (e.g., 2080–2099) but they cannot rule out a precipitation increase or decrease even in the near term (2020–2039) under the lowest emission scenario.

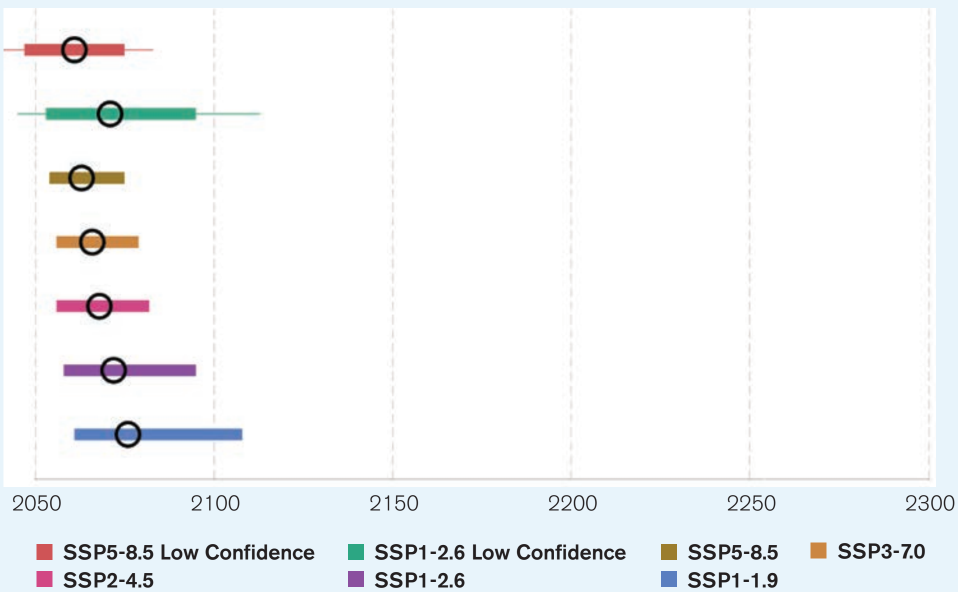
Sea level rise along Colombia's coastlines exhibit notable differences between the Caribbean and the Pacific regions.[57] Under SSP3-7.0, sea level rise is projected to increase 0.50 meters above the historical baseline along the Caribbean coast of Cartagena (Bolívar) before 2070 (**see Figure 11a**). This rapid rate of change does not differ much under SSP1-2.6 and SSP2-4.5, with all scenarios displaying relatively low uncertainty. However, total sea level rise varies under each trajectory by 2100. Compared to SSP3-7.0 which rises 0.94 m (0.77 m, 1.21 m) by 2100, SSP1-2.6 rises 0.69 m (0.53 m, 0.90 m) and SSP2-4.5 rises 0.82 m (0.65 m, 1.07 m) over the same timeframe. In the same basin, sea level rise along the low-lying islands of San Andrés y Providencia is expected to increase 0.50 m above the historical baseline by around 2075, similar to Cartagena, except with much higher ranges of uncertainty (**see Figure 11b**). Under SSP3-7.0, sea level could potentially rise 0.50 m above the reference

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

period after 2100. The rapid and more certain rate of increase in Cartagena is primarily due to its vertical land subsidence, which accounts for 0.18 m (0.13 m, 0.23 m) of effective sea level rise across all scenarios by 2100 compared to 0 m (–0.16 m, 0.16 m) for the Caribbean islands.

On the Pacific coast, Buenaventura (Valle del Cauca, **see Figure 11c**) is projected to experience a much slower rate of sea level rise, reaching the threshold of 0.50 meters above the historical baseline by around 2090 (median) under SSP3-7.0, though with greater uncertainty than Cartagena. Under SSP2-4.5, sea level rise does not reach this threshold until around 2100 (median) and under SSP1-2.6, sea level rise does not reach this threshold until after 2100 (median). This is partly because of Buenaventura's net vertical land motion under all scenarios instead of subsidence. Additionally, changes in ocean currents, temperature, and salinity play less of a role as factors increasing sea level rise in the Pacific compared to the Caribbean. Buenaventura is projected to experience sea level rise of 0.64 m (0.46 m, 0.90 m) above the historical reference by 2100.

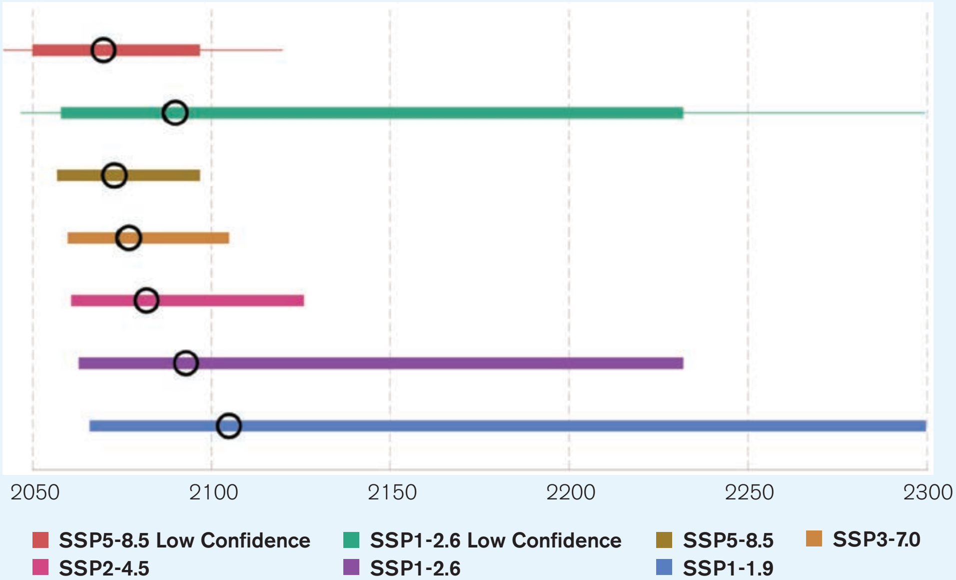
FIGURE 11A. Projected Timing of 0.5-Meter Sea Level Rise Along Cartagena's (Bolívar's) Coast Under Various Scenarios (Ref. Period 1995–2014)[58]



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.

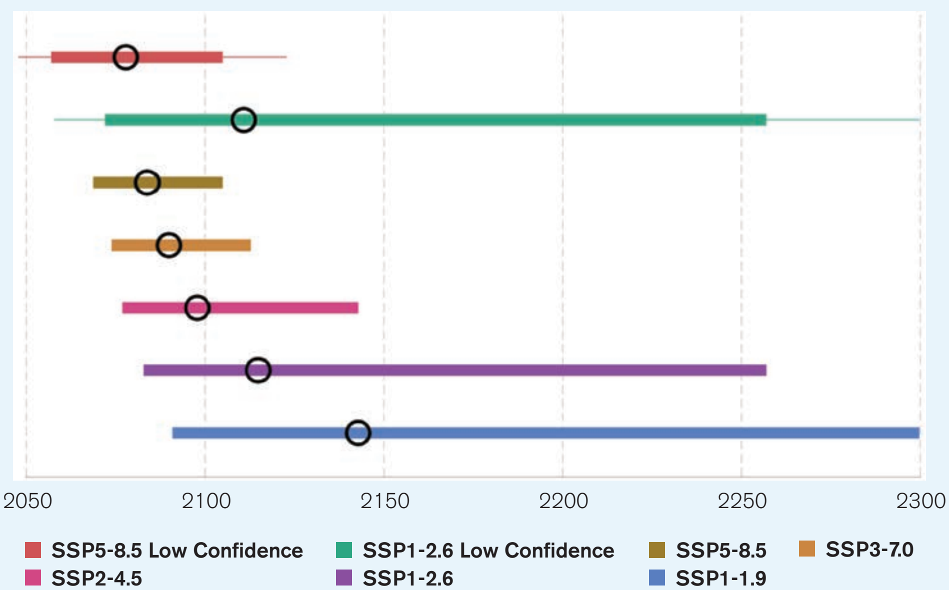
[58] NASA (2023). Sea Level Projection Tool. URL: https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool

FIGURE 11B. Projected Timing of 0.5-Meter Sea Level Rise Along San Andrés y Providencia's Coast Under Various Scenarios (Ref. Period 1995-2014)[59]



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. Note the similar thresholds for higher emission scenarios but wider ranges of uncertainty compared to Cartagena (Figure 11a). Data reflects grid at 12°N, –82°W.

FIGURE 11C. Projected Timing of 0.5-Meter Sea Level Rise Along Buenaventura's (Valle del Cauca's) Coast Under Various Scenarios (Ref. Period 1995-2014)[60]



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. Note much later thresholds with wider ranges of uncertainty compared to Cartagena (Figure 11a).

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

CLIMATE RISK COUNTRY PROFILE

COLOMBIA

WORLD BANK GROUP