# FIBRASHOP REPORTS THE RESULTS OF THE STUDY ON PHYSICAL RISKS FROM CLIMATE CHANGE CONDUCTED AT ALL OF ITS PROPERTIES

**Mexico City, April 20, 2022---** FibraShop (FSHOP) (BMV: FSHOP13), CI Banco S.A. Institución de Banca Múltiple Fideicomiso Irrevocable Número F/00854, a real estate investment trust specializing in shopping malls, informs the investing public of the results of the physical risk analysis from climate change using the TCFD ("Task Force on Climate-Related Financial Disclosures") methodology, which was performed at all properties in the portfolio.

As part of our strategy to implement TCFD, we decided to start with an exhaustive professional analysis by an independent firm.

In 2021, we conducted a preliminary study at three of our properties. That study focused mainly on projected exposure to climate risk through the years 2030, 2050, and 2100, for each location.

This new study provides additional validation to the existing results, and a complete evaluation of all of FibraShop's properties, along with an interactive visualization tool to assist in ongoing, independent climate risk analyses of its properties using different time horizons. The scope of this report includes:

- A complete study of all of FibraShop's properties in Mexico
- Analysis of relevant acute and chronic risks arising from climate change
- Changes regarding exposure compared to the recent past, under various climate scenarios and time horizons
- Vulnerabilities are based on potential impacts of climate change on operations, personnel, and clients

Physical climate risks, such as decreased precipitation, heat waves, floods, cyclones, and rising sea levels, have direct impacts on infrastructure, health, agriculture, and productivity. Prospective tools were used in this new study, such as scenario analysis and climate models.

The results of the new study reflect the impacts and consequences that climate change might have on our operations. With the data obtained, we will improve our strategies to consider the risks and opportunities arising from climate change, so that we can adapt to climate change before the onset of a crisis.

FibraShop maintains its commitment to continue moving forward with its ESG project, seeking to attain the highest international standards under the guidance of independent experts, and with a strong commitment to transparency.

The full study is attached to this communication.

**ABOUT FIBRASHOP**

FibraShop (BMV: FSHOP 13), is a unique real estate investment option in Mexico due to its specialization, its management team with vast experience in the commercial real estate sector, and its solid operating structure and corporate governance, which together ensure transparency, efficiency, and safe and profitable growth.

FibraShop is an infrastructure and real estate trust vehicle that was formed principally to acquire, own, administer, and develop real estate properties in shopping centers in Mexico. FibraShop is administered by industry specialists with extensive experience, and it is advised externally by FibraShop Portafolios Inmobiliarios S.C.

Our objective is to provide attractive returns to our investors who hold CBFIs by means of stable distributions and capital appreciation.

**FORWARD-LOOKING STATEMENTS**

This communication may include forward-looking statements. Such statements are not based on historical facts, but on management's current vision. The reader is advised that such statements or estimates imply risks and uncertainties that may change as a function of various factors that are outside of the Company's control.

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# Physical Climate Risk Assessment

March 2022

FIBRA SHOP

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# Disclaimer and Assumptions

**Limitation of Use**
This report is intended solely for the information and internal use of ***FIDEICOMISO IRREVOCABLE NUMERO F/00854 (Fibra Shop)*** in accordance with our letter of engagement of 29 October 2021 and is not intended to be and should not be used by any other person or entity. No other person or entity is entitled to rely, in any manner, or for any purpose, on this report. We do not accept or assume responsibility to anyone other than ***Fibra Shop*** for our work, for this report, or for any reliance which may be placed on this report by any party other than ***Fibra Shop***.

**Climate scenario analysis**
This analysis is intended to give insight into the historic and potential future projections of trends and exposures to physical climate hazards across different sites where Fibra Shop operates leveraging global and regional climate models as referenced in this document. Additional analysis of localized data and orographic conditions may need to be considered at a site-level to understand specific risks related to assets, infrastructure and operations, and inform resilience and adaptation planning decisions.

Climate projections are based on assumptions about future greenhouse gas emissions associated with human activity and other policy choices. Climate projections are not predictions and they do not attempt to predict the timing of meteorological events such as storms, droughts, or El Niño. Projections vary from model to model: the best projection dataset for one location and purpose may not be the best for other situations. Considering a range of projections from multiple models may help you gain a more complete picture of potential future risks. Global climate projections used in this analysis are on multiple scales, primarily at a scale of 100km x 100km and utilizing the latest IPCC AR6 models. This granularity means that models are a summary of the climate within each grid box and can average out large variations (e.g., a mountain region with high rain adjacent to a coastal region with no rain).

**Scenarios and horizons**
Many climate metrics, particularly acute metrics associated with extreme weather events, are not outputted directly from climate models and are estimated post-modelling by specialised climate research groups. As such, not all scenarios and horizons are available for all metrics, as detailed here.

**Inter-annual variability**
Climate is driven by multiple atmospheric processes that vary the temperature and rainfall on annual to decadal timescales, such as El Niño/La Niña cycles. The natural variability in the climate system means that there are wet and dry decades, and some years are hotter than others. We take 20 year averages around each horizon (2030, 2050 and 2070) to provide long term climate trends and an indication of climate risk, and this reduces the inter-annual variability signals.
However, it is important to note that the climate system does not change linearly and does not always increase in signals under future climate scenarios. A key example is rainfall – the hydrological cycle is amplified under future climates in various ways and so there are many instances where the trends are larger under a future where the globe aligns with the Paris Agreement, compared to one with no climate action.

# Executive Summary

# Executive Summary | Future change in 2030 under a high emission scenario

A multi-hazard summary of projected physical climate exposure for each assessed region is presented below for future states in 2030 under a high emission scenario. The Detailed Findings and accompanying Tableau tool provide further information for a low emission scenario and 2050 & 2070 horizons. Overall Mexico is exposed to multiple physical hazards across the northern and southern regions, and example impacts are provided for selected plazas.

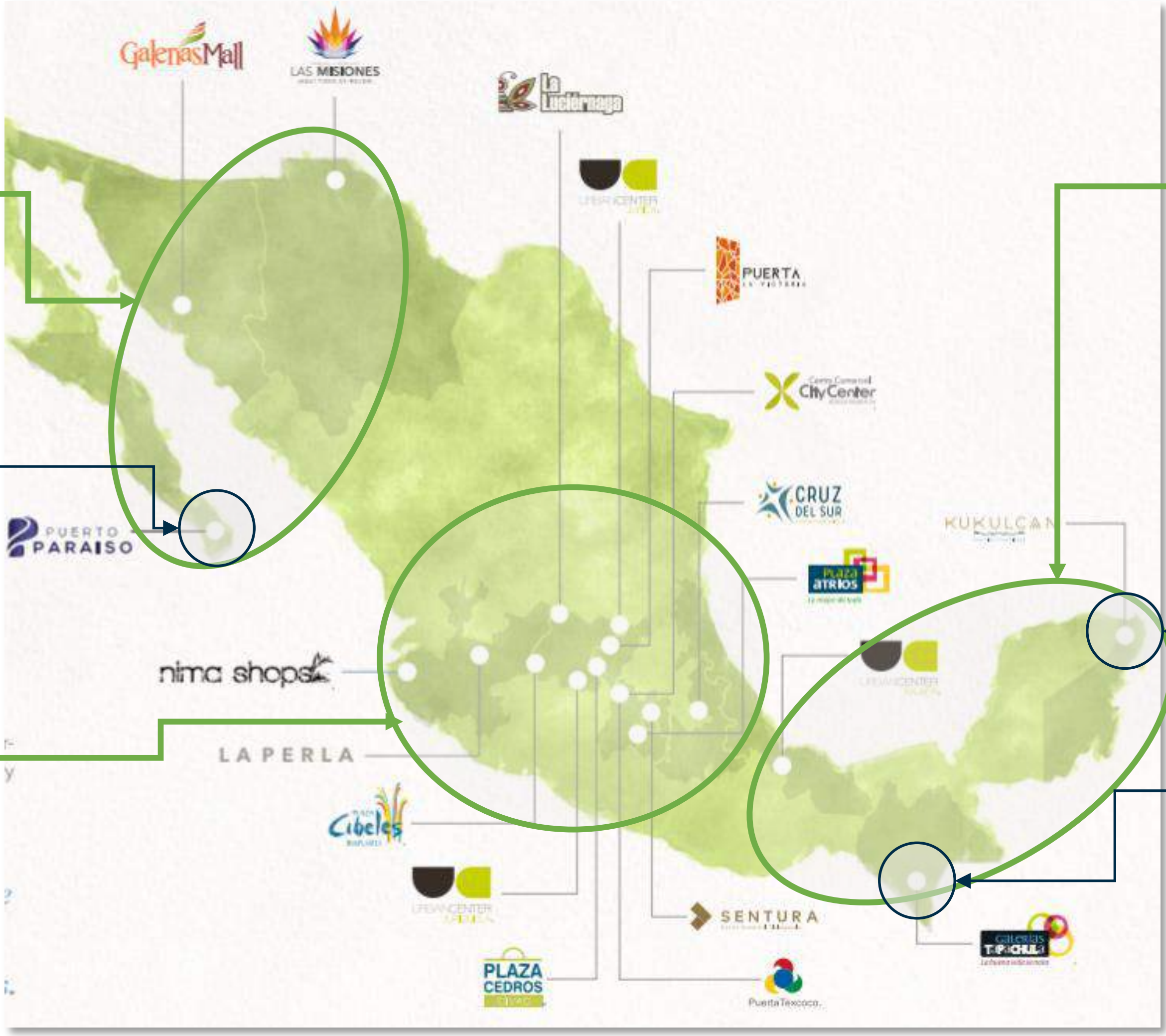
**Northern Mexico**

Plazas here are exposed to future increases in **hot days, extreme fire days, hurricanes, extreme rain and water stress**, particularly for Puerto Paraiso. CAT4/5 Hurricane frequency increases the most along the Pacific coastal regions.

**Puerto Paraiso** is projected to **double** in water stress by 2030 and also has high fire risk.

**Central Mexico**

Plazas here are exposed to future increases in **extreme dry and extreme wet conditions**. Water stress increases particularly at Plaza Ciebeles and La Perla plazas. Many plazas are exposed to around 25% additional **extreme fire days**, particularly UC Nima Shops, La Perla, Plaza Ciebeles, Cruz del Sur and UC Xalapa.




**Southern Mexico**

Plazas here are exposed to future increases in **hot days and hurricanes** (Kukulcan), **storm surge events** and **extreme rain intensity** (Galerias Tapachula), and **water stress** (UC Xalapa).

**Kukulcan Plaza** is at the greatest risk of high intensity CAT4/5 hurricanes now and in the future

**Galerias Tapachula** is at the greatest risk of increased frequency of 1-in-100 year storm surge events that are projected to occur annually by 2050.

# Executive Summary | Potential Impacts

All plazas are exposed to climate-related impacts, whether they be operational, financial, or affecting personnel and consumer preferences. Many impacts have already been experienced across Fibra Shop's portfolio and most will increase in severity in the future.

### Extreme Heat

Across the globe, impacts of heatwave intensity and temperature rise have been noted on retail sales, albeit varying across different jurisdictions. Daily weather conditions, are known to be key influences on many economic sectors, estimated to affect as much as 35% of GDP in industrialised countries. Extreme heat is increasing across all of Fibra Shop's sites.

### Water Stress

Due to the already low water supply across most of Mexico, rainfall decline and warmer temperatures can increase water stress levels. As Mexico becomes increasingly affected by the ongoing drought affecting 80-85% of the country, water shortages have also worsened amid extreme heat. This has placed extreme pressure on water availability and import costs.

### Wildfires

In 25 March 2021, there were 61 active fires across Mexico's 20 states burning approximately 14,160 hectares of land. Wildfires are expected to have an increasing socioeconomic impact in the form of population displacement, infrastructure damage (roads, pipelines, electricity transmission lines, etc.). This risk is particularly high across plazas in central Mexico.

### Extreme Rain

Extreme rain has meant Mexico has experienced inundated infrastructure. These will also have potential flow-on impacts of consumer behaviour changes, migration, supply chain disruptions, changes in seasonal products and higher insurance premiums for businesses against flood damages. Extreme rain intensity and frequency will increase particularly for plazas in central and northern Mexico.

### Hurricanes

Hurricanes contribute up to 60% of extreme rainfall along Mexico's coastlines, and impact infrastructure, transport & logistics, property development and personnel, and can have major consequences on the tourism and retail industries in Mexico. CAT4/5 hurricanes are projected to increase in frequency and intensity in the future, particularly along the Pacific-facing coastline.

### Storm Surge Events

Storm surge events often coincide with tropical storms and hurricanes. These extreme events similarly can have major consequences on the tourism and retail industries in Mexico. For example, Category 3 Hurricane Grace in August 2021 caused dangerous storm surges to the Veracruz state (where UC Xalapa is currently located) causing $US330 million damage. The most southern Mexico regions are most exposed to more frequent storm surge events (e.g., Galerias Tapachula).

# Introduction & Approach

# Introduction

Businesses are under increased pressure from governments, investors, suppliers, consumers, employees, and financiers to act on climate change. At the same time, the risks posed by our changing climate are materializing, and the associated physical climate risks are evaluated in this report.

## Context and Background

In June 2021, Fibra Shop performed an preliminary physical climate risk assessment, in line with its 2020 sustainability report, on three of its key plazas: Kukulcán Plaza, Puerta la Victoria and Puerto Paraíso. The assessment was primarily focused on the projected exposure levels of climate risks across 2030, 2050 and 2100 horizons for each site. Notable findings of this assessment include:

- ❖ Extreme risk of rising sea levels by 2100 for Kukulcán Plaza
- ❖ Elevated heat and drought stress across 2030, 2050 and 2070 for all properties
- ❖ Projected increase in category 4 hurricanes across all RCP4.5* and RCP8.5 by 2050

This current report is intended as an extension of the previous Fibra Shop physical climate risk assessment. The report provides further validation of existing results, and a full assessment of all Fibra Shop plazas with an accompanying interactive visualisation tool to assist with ongoing and independent climate risk analysis of its properties under different time horizons. As such, the scope of this report will include:

- All Fibra Shop plazas across Mexico
- Assessment of relevant acute and chronic physical climate hazards
- Change in exposure compared to the recent past under various climate scenarios/ & time horizons
- Vulnerabilities are based on potential impacts of climate on operations/personnel/customers

## Evaluating physical climate risk

The international climate risk framework is a combination of **hazards, exposures and vulnerabilities & impacts**. This report quantifies change in exposure to physical climate hazards across Fibra Shop sites and describes the potential impacts at a regional scale.

Physical climate risks, such as rainfall decline, heatwaves, floods, cyclones and sea level rise, have direct impacts on infrastructure, health, agricultural, productivity. We use forward looking tools such as scenario analysis and climate models to adapt to climate change before the crises emerges, that is, building climate resilience. The long-term chronic climate changes (e.g., temperature, rainfall) drive the changes in acute climate extremes.

## CLIMATE RISK

**HAZARDS**

The identified climate events/processes impacting assets and operations

+

**EXPOSURES**

The geographic asset locations that may be affected by hazards

+

**VULNERABILITIES**

The extent that the operations, personnel, and/or value chain are affected by hazards

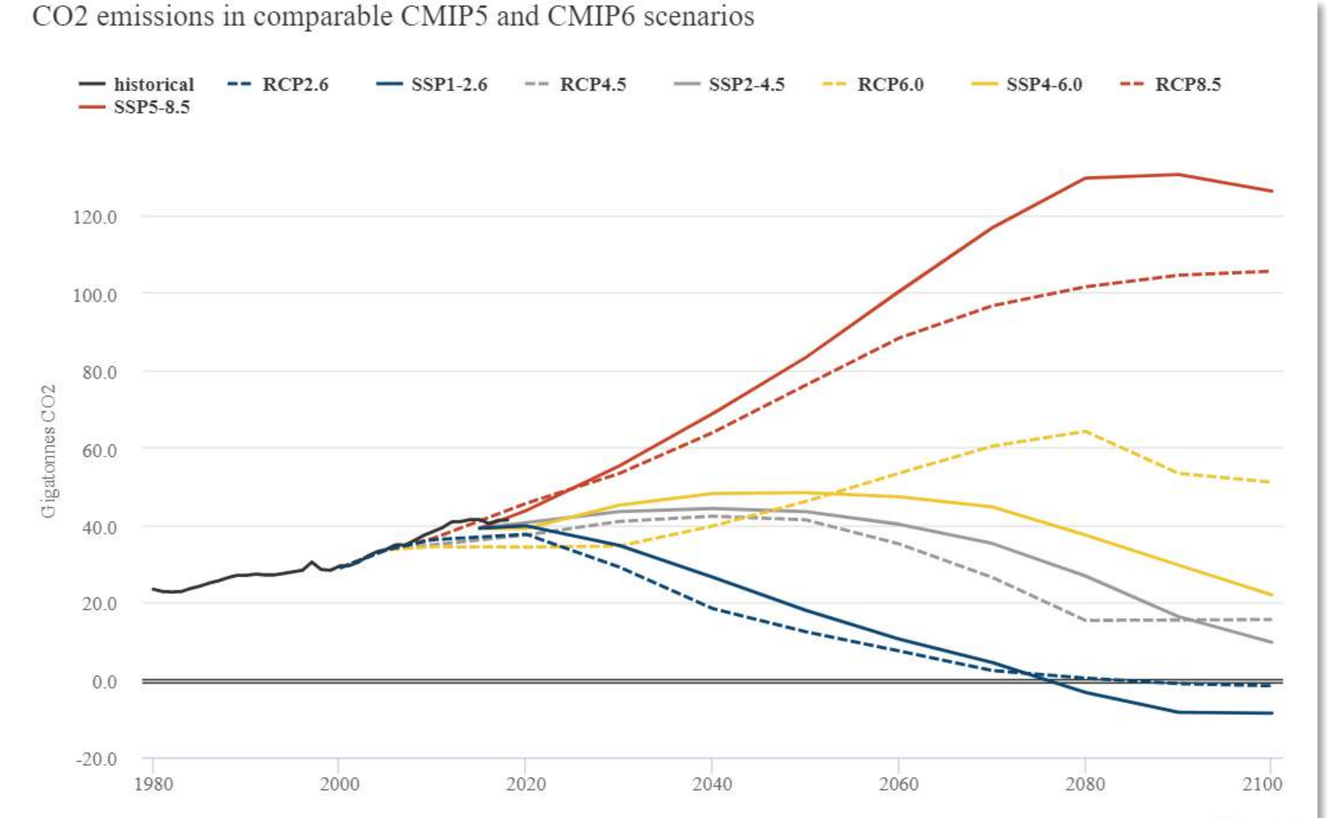
# Approach | Locations of retail sites assessed

All 19 plaza sites are assessed in this report for the physical hazards described on the next page. The current and future exposures vary per region, however there are some of the plazas that are in close proximity and have similar exposures, and thus are described together in the report.

| Sites | Location |
|---|---|
| Plaza Cibeles | Irapuato, Guanajuato |
| La Luciérnaga | San Miguel de Allende, Guanajuato |
| Puerto Paraíso | Cabo San Lucas, Baja California Sur |
| Kukulcán Plaza | Cancún, Quintana Roo |
| Galerías Mall Sonora | Hermosillo, Sonora |
| Las Misiones | Ciudad Juárez, Chihuahua |
| La Perla | Guadalajara, Jalisco |
| UC Nima Shops | Puerto Vallarta, Jalisco |
| Los Atrios | Cuautla, Morelos |
| Galerías Tapachula | Tapachula, Chiapas, |
| City Center Esmeralda | Chiluca, Estado de México |
| Sentura Tlanepantla | Estado de México |
| Puerta Texcoco | Texcoco, Estado de México |
| Cruz del Sur | Puebla , Puebla |
| Plaza Cedros | Cuernavaca, Morelos |
| UC Jurica | Santiago de Querétaro, Querétaro |
| UC Juriquilla | Santiago de Querétaro, Querétaro |
| Puerta La Victoria | Santiago de Querétaro, Querétaro |
| UC Xalapa | Xalapa, Veracruz |

# Approach | Climate scenarios

Scenarios are rich, data-driven stories about tomorrow that can help organisations make better decisions today. They are not predictions about the future, but rather hypotheses that describe a range of possibilities for the future. In order to be a scenario, they need to be plausible, distinctly different and internally consistent. Due to data availability, two types of climate scenarios – capturing both low and high emission futures - have been used in this report from the IPCC AR5 (Representative Concentration Pathways; RCPs) and IPCC AR6 (Shared Socio-economic Pathways; SSPs) reports. More details on physical climate scenarios can be found in the Appendix.




*Source: CarbonBrief*

**High emissions scenario**

**RCP8.5/SSP5-8.5**

The high emissions scenario with no climate action, aligned with **over 4ºC global average increase by 2100**

**Low emissions scenario**

**RCP4.5/SSP2-4.5**

Strong mitigation (**2.5 to 3ºC warming by 2100**) where current climate targets and policies are met

# **Approach** | Detailed metrics and data sources for physical climate hazards

The physical hazards assessed, and available climate scenarios and horizons data are detailed below, including data sources and granularity. The physical climate hazards were selected based on the availability of robust and comprehensive data.

| Theme | Physical climate hazard | Description | Climate Scenarios | Time Horizons* | Data Source | Granularity |
|---|---|---|---|---|---|---|
| **Hot & dry conditions** | Mean temperature | The average temperature across the year | • Low emission (RCP4.5)<br>• High emission (RCP8.5) | 2030, 2050 and 2070 | ESGF CMIP6 (IPCC AR6 models) | 100km |
| | Hot days | The number of days per year where the maximum daily temperature exceeds 30°C | • Low emission (RCP4.5)<br>• High emission (RCP8.5) | 2030, 2050 and 2070 | | |
| | Water Stress | The ratio of water supply to demand | • Low emission (RCP4.5)<br>• High emission (RCP8.5) | 2030 and 2040 | WRI Aqueduct Water Risk Atlas | 10km |
| | Extreme Fire Days | The number of days per year where the fire weather index exceeds the historical 95th percentile. | • High emission (RCP8.5) | 2030, 2050 and 2070 | Copernicus Fire Weather Index<br>Abatzoglou et al. 2019 | Local scale to 250km |
| | Fire Season Length | The number of days per year when fire danger is above half its midrange | • High emission (RCP8.5) | 2030, 2050 and 2070 | Copernicus Fire Weather Index<br>Abatzoglou et al. 2019 | Local scale to 250km |
| **Extreme wet conditions** | Extreme rain intensity | The maximum daily rainfall experienced across a year | • Low emission (RCP4.5)<br>• High emission (RCP8.5) | 2030, 2050 and 2070 | ESGF CMIP6 (IPCC AR6 models) | 100km |
| | Extreme rain frequency | The number of days with more than 20mm rainfall | • Low emission (RCP4.5)<br>• High emission (RCP8.5) | 2030, 2050 and 2070 | | |
| | Storm surge event | The extreme sea level event that combines sea level rise, tides, extreme wave height, and storm surge activity. | • Low emission (RCP4.5)<br>• High emission (RCP8.5) | 2050 | Vousdoukas et al. 2018 | 100km |
| | Hurricane frequency | The frequency and intensity of hurricanes | • High emission<br>(~2°C world at 2050) | Approximately 2050 under a high emission scenario | NASA Earth Data<br>Knutson et al. (2020) | Local to 100km |

*The future horizons are twenty year averages around the nominated year. That is, 2030 = 2021 to 2040 averaged and 2050 = 2041 to 2060 averaged.*

# Approach | Tableau tool visualising findings

**The Physical Climate Risk Tool** provides Fibra Shop with insights on exposure to climate-related physical risks and help inform strategic decisions. Using the historical and future change values, a Tableau tool is developed for an interactive assessment of assets over time in relation to physical climate change.

The tool is part of the Deloitte Decarbonisation Solutions™ Physical Climate Risk Module, that is tailored to include Fibra Shop specific data. The tool is placed on a secure online server here. Data is analysed via the Tableau tool; however, we also cross-check findings with peer-reviewed literature sources on sign, magnitude and general trend.

Users can filter by state, city, plaza, climate hazard, scenario and time horizon to drill down on results and answer specific questions.
See the accompanying Tableau User Guide for further details on tool functionality.

**Click** to view the dashboard

## 1. Current State Assessment

**Key questions answered:**

- How exposed are each of Fibra Shop's plaza sites to each hazard today?
- What are the conditions for each location (e.g., wildfire exposure)?


## 2. Future Scenario Analysis

**Key questions answered:**

- How will each asset's exposure to hazards change over time (i.e., 2030 to 2070)?
- How does this change in exposure vary between high, mid and low emissions scenario?

# Detailed Scenario Analysis

# Hot & Dry Conditions

Average temperature

Hot days per year

Water stress

Wildfires

# Mean temperature and Hot days

## HOT & DRY CONDITIONS

### Context and Potential Impacts

Temperatures are expected to consistently rise unless large-scale mitigation activities are implemented on a global scale. Rising temperatures are associated with increases in the frequency of very hot days, leading to impacts on air conditioning and insulation requirements, changes in consumer behaviour, faster deterioration of power systems, and increases in water demand.

**Across the globe, impacts of heatwave intensity and temperature rise have been noted on retail sales, albeit varying across different jurisdictions. Daily weather conditions, are known to be key influences on many economic sectors, estimated to affect as much as 35% of GDP in industrialised countries (Rose & Dolega, 2021).**

### Insights into Current and Future Exposures

#### Current Exposure:

- Currently, the highest **annual mean temperatures** occurs at Kukulcan Plaza and Puerto Paraiso (>25°C), followed by Gallerias Tapachula and UC Nima Shops (>22°C). Mean temperatures at other sites are between 16° and 20°C.
- The regions experiencing the most **hot days per year (i.e., days over 30°C)** are in northern Mexico at Galerias Mall Sonora, Puerto Paraiso and Las Misiones (>100 days per year).

#### Future changes under the low emission scenario:

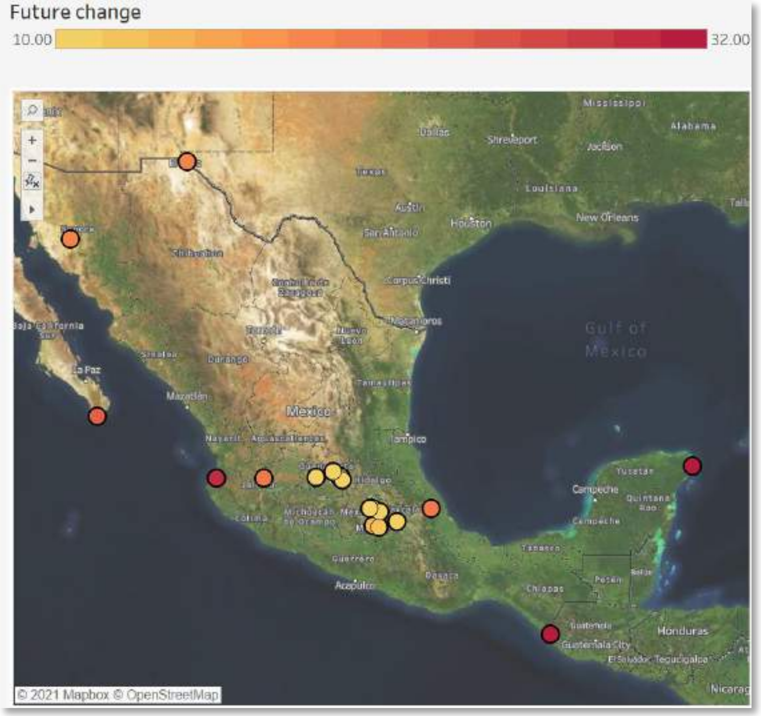
- **Annual mean temperatures** increase by 0.7-1°C , 1-1.8°C, and 1.5-2.4°C (highest increase at Las Misiones in northern Mexico followed by areas in central Mexico) around 2030, 2050 and 2070.
- **Hot days per year** are projected to increase by 8-31 additional days (9-52%) by 2030 and 27-78 additional days (23-131%) by 2070, especially across central and southern Mexico.

#### Future changes under the high emission scenario:

- **Annual mean temperatures** increase by 0.7-1.3°C, 1.5-2.4 and 2.4-3.7°C around 2030, 2050 and 2070, respectively with the highest increase at Galerias Mall and Las Misiones in Northern Mexico followed by central parts of Mexico.
- **Hot days per year** are projected to increase by 10-32 additional days in 2030, 26-78 additional days by 2050, and 47-128 additional days in 2070. The highest increases are in central and southern Mexico.

**Key findings**

- The highest mean temperatures occur in central and southern coastal Mexico, and the highest number of hot days are in northern Mexico.
- Mean temperatures and hot days are projected to increase over central and southern Mexico including the Yucatan peninsula.

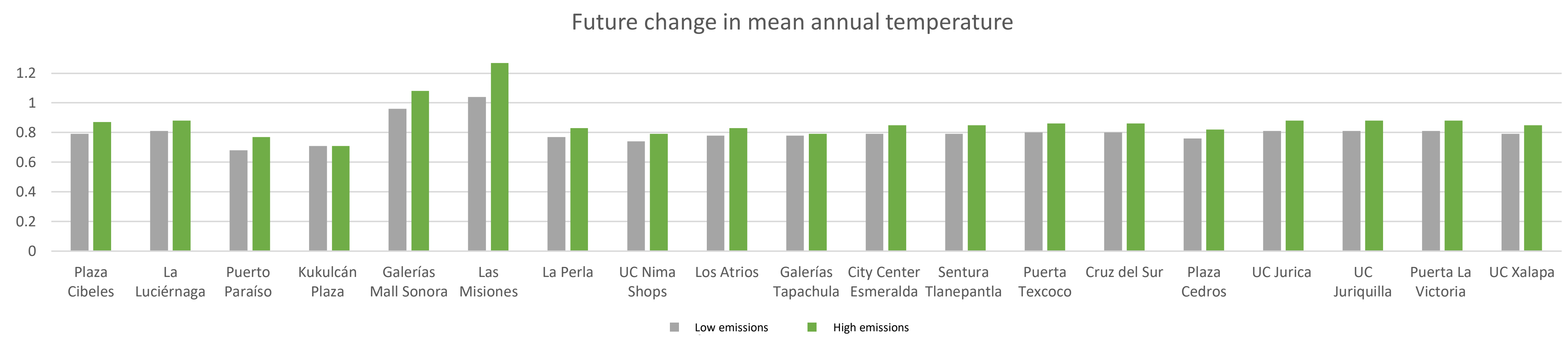



**2030 High Emission**

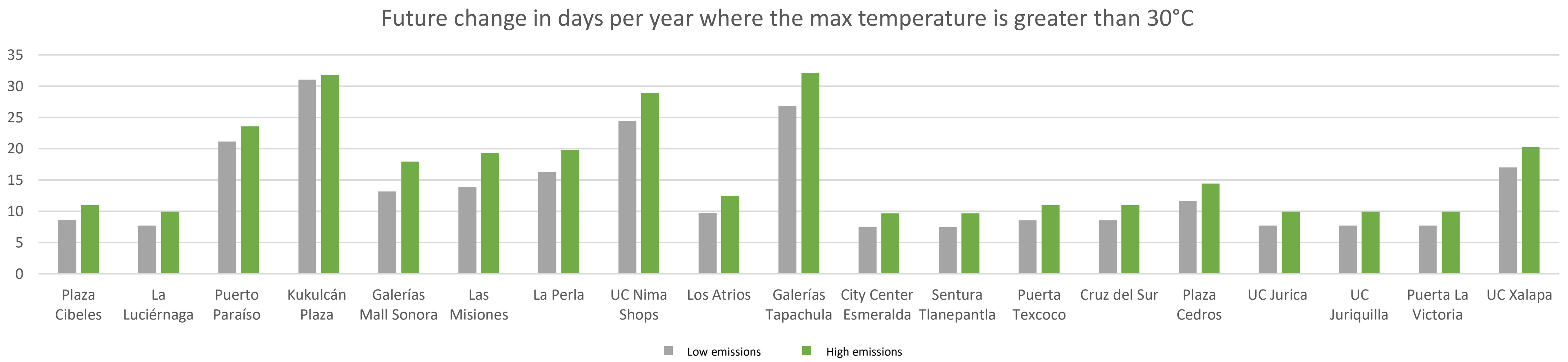
***The 2030 future change in hot days per year over 30°C compared to 1995-2014 under the high emission scenario. Units are days.***

2030 horizon

# Mean temperature




# Hot days



# Water stress

## HOT & DRY CONDITIONS

**Key findings**
Water stress is projected to double across 2030, except for plazas along the Pacific Central Coast and Southern Central America.

### Context and Potential Impacts

Water stress is an indicator of extreme dryness. It is competition for water resources and is defined informally as the ratio of *demand* for water by human society divided by the available (*supply* of) water. The impact of global warming on rainfall is complex, as it is driven by numerous large-scale atmospheric processes, with some on 3-to-7-year timescales (e.g., El Niño and La Niña), while others are longer (e.g., Indian Ocean Dipole).

**Due to the already low water supply across most of Mexico, rainfall decline and warmer temperatures can increase water stress levels. As Mexico becomes increasingly affected by the ongoing drought affecting 80-85% of the country, water shortages have also worsened amid extreme heat. This has placed extreme pressure on food availability, higher import costs.**

### Insights into Current and Future Exposures

#### Current Exposure:

- Generally, since the 1920s, rainfall has increased in the arid and semi-arid regions of northern parts of Mexico and decreased in the dry and humid regions of the south (Mendez et al. 2008).
- Currently, all sites are exposed to high to extremely high water stress. However, Puerto Paraiso is exposed to arid conditions.

#### Future change:

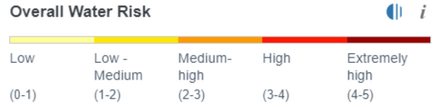
Under future climate, all of Mexico is projected to dry. Under a high emission scenario, there is a projected 13% decrease in summer precipitation across Central and Southern Mexico (Colorado-Ruiz et al. 2018).

**Future changes under the low emission scenario:** The least change is projected to occur for Kukulcan, UC Nima Shops along the Pacific central coast and Galerias Tapachula in southern Mexico. All other sites show a 1.4x-2x increase in water stress by 2030.

**Future changes under the high emission scenario:** Puerto Paraiso is projected to double in water stress by 2030 primarily due to increases in water demand. By 2040, the water stress at this site is projected to increase by 2.8x, due to a combination of decreases in water supply and increases in demand. All other plazas show a 1.4x to 2x increase in water stress by 2030. The smallest change in water stress is projected to occur at UC Nima Shops, Galerias Tapachula and Kukulcan Plaza in the Yucatán Peninsula.

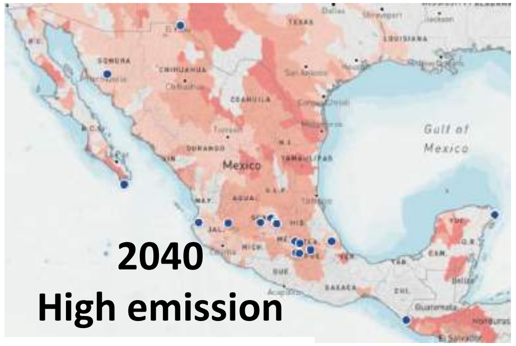

***LEFT: Baseline water stress (measures the ratio of total water withdrawals to available renewable surface water and groundwater supplies)***

***BOTTOM: Projected future change in water stress for 2030 and 2040 under low emission and high emission scenarios. Source: WRI Aqueduct Water***



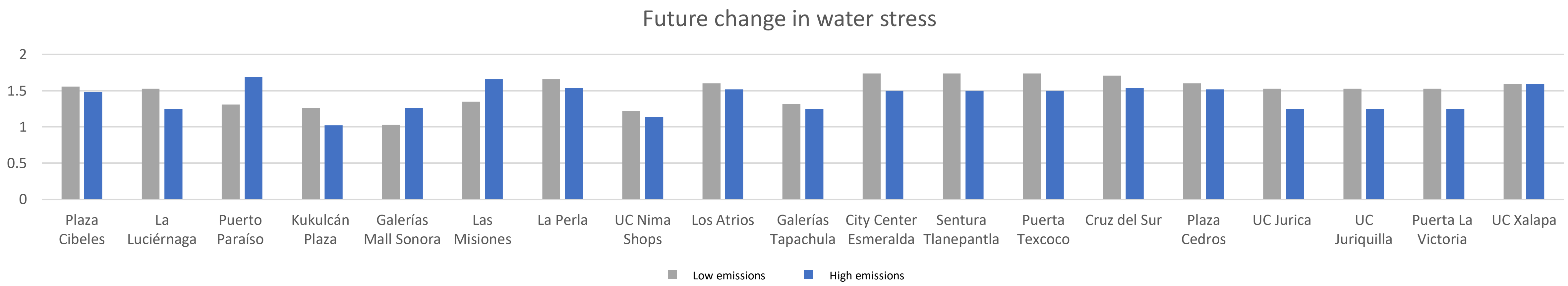




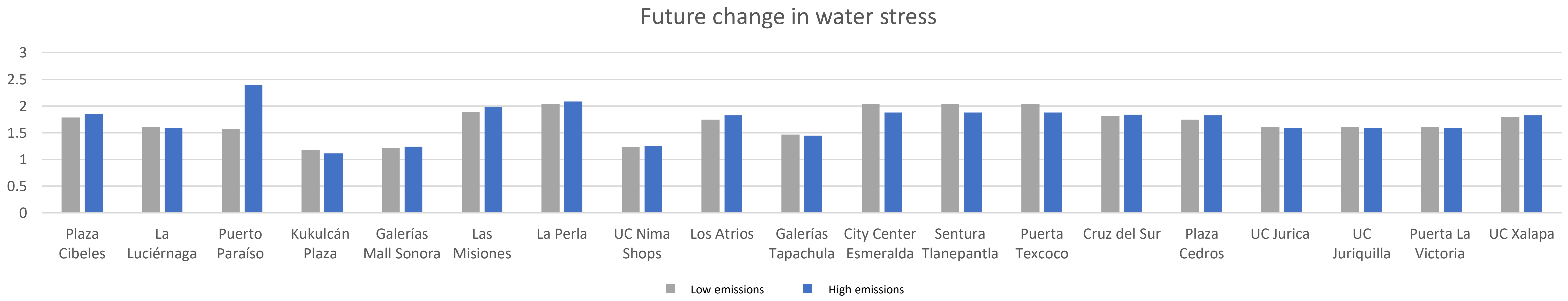



# Water stress

2030 horizon




2040 horizon




Future times increase in water stress

# Extreme fire days and Fire season length

## HOT & DRY CONDITIONS

### Context and Potential Impacts

Rising temperatures and subsequently longer hot and dry seasons due to climate change is a key driver of wildfire prevalence. These conditions enhance the drying of organic matter in forests, and resulting wildfires may also be further exacerbated by high wind speeds.

**In 25 March 2021, there were 61 active fires across Mexico's 20 states burning approximately 14,160 hectares of land (source). Compounded with a budget cut of 2.76 billion pesos for 2021 for wildfire damage recovery, wildfires (source) are expected to have an increasing socioeconomic impact in the form of population displacement, infrastructure damage (roads, pipelines, electricity transmission lines).**

### Key findings

- The extreme fire weather days per year and the fire season length increases over time due to warmer and drier conditions, and the southern Mexico sites are most exposed.
- By 2030, six Fibra Shop sites are projected to have 25 to 28% more extreme fire weather days per year.
- By 2050, six Fibra Shop sites are projected to have more than 50% more extreme fire weather days per year
- By 2070, Puerto Paraiso, Cruz del Sur, UC Xalapa and UC Nima Shops are projected to experience double the severe fire days.

### Insights into Current and Future Exposures

**Current Exposure:** Mexico's wildfire season is typically during the dry season from December to May, with a low to moderate fire weather rating compared to the global average. The fire weather index rating estimates fire danger and accounts for fuel moisture, and wind impacting fire behaviour and spread.

Across the Fibra Shop sites, the southern sites have the shortest fire weather season (33 to 76 days) and 23 to 35 extreme fire days per year (season length defined as days per year exceeding midrange point). The central Mexico sites have the longest modelled fire weather season of 126 to 151 days (UC Nima Shops, La Perla, Plaza Cibeles, Puerto Paraiso and Galerias Mall Sonora) and most of these sites have 39 to 43 extreme fire weather days (i.e., days above the historical 95th percentile for that location).

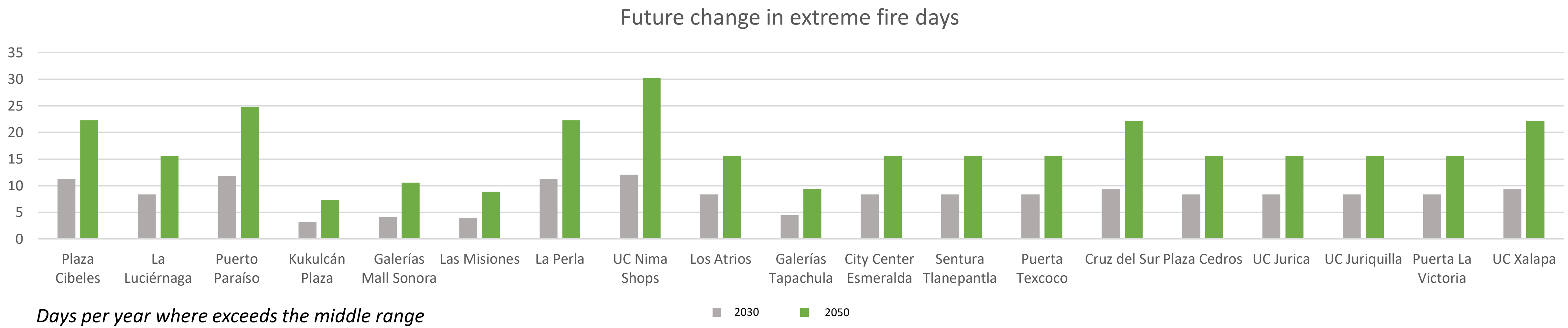
**Future changes under the high emission scenario (only):** Overall, the number of extreme fire weather days is projected to increase over time.

- By **2030**, six Fibra Shop sites (UC Nima Shops, Puerto Paraiso , La Perla, Plaza Cibeles, Cruz del Sur and UC Xalapa) are projected to have 25% more extreme fire weather days, and many of these already have the highest historical days per year.
- By **2050**, UC Nima Shops, Puerto Paraiso La Perla, Plaza Cibeles, Cruz del Sur and UC Xalapa are projected to have more than 50% more extreme fire weather days.
- By **2070**, UC Nima Shops, Puerto Paraiso, Cruz del Sur and UC Xalapa plazas reach double their historical extreme days (around 40 to 50 additional days) and double the fire season length.


**2030 High Emission**

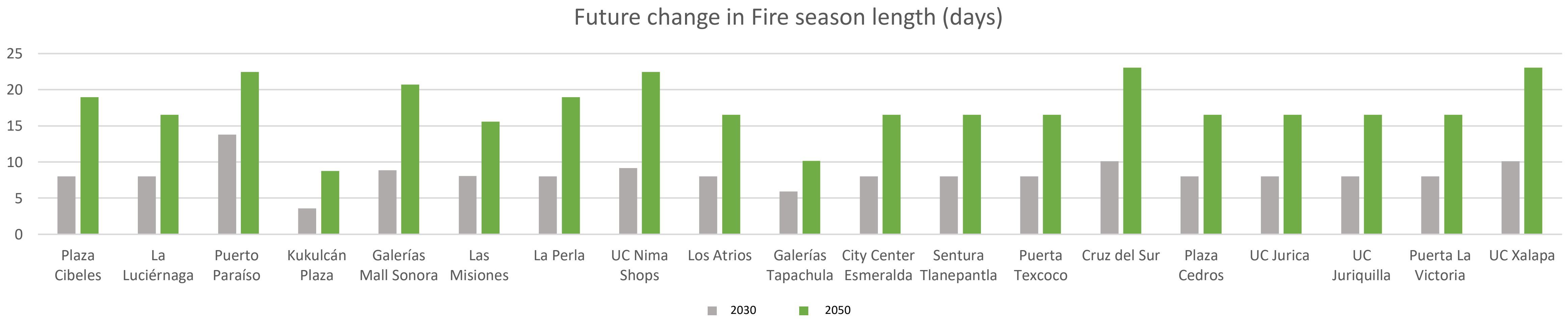
***The 2030 future change in severe fire weather days compared to 2001-2020 under the high emission scenario. Units are in days.***

# Extreme fire days




*Days per year where exceeds the middle range*

# Fire season length




*Future change in the fire season length above the median*

*The information in the tableau only takes into account the high emissions scenario*

# Extreme Wet Conditions

Extreme rain intensity

Extreme rain frequency

Hurricanes

1-in-100 year storm surge events

# Extreme rain intensity and frequency

## EXTREME WET CONDITIONS

### Context and Potential Impacts

While extreme rainfall does not necessarily imply flooding, it is a proxy for greater flood risk. Flood risk also increases with drier soils and changes in erosion. Unlike temperature, rainfall does not increase linearly over time. Under global warming, the hydrological cycle is enhanced because a warmer atmosphere can hold more moisture. In general, dry and arid regions get drier, and wetter regions get wetter.

**In historical events of extreme rainfall events, Mexico has experienced inundated homes and infrastructure, and destroyed crops, with insurance costs reaching 700 million USD from the Tabasco floods in 2007 (source). These will also have potential flow-on impacts of consumer behaviour changes, migration, supply chain disruptions, changes in seasonal products and higher insurance premiums for businesses against flood damages.**

### Insights into Current and Future Exposures

- **Current Exposure:** The **maximum extreme rain intensity** occurs at UC Nima Shops (81 mm in a day) followed by sites in inland central Mexico (~55-70 mm in a day). The **number of extreme rain days** (over 20mm in a single day) **per year is greatest** at sites in central and southern Mexico (over 14 days annually).

- **Future changes under the low emission scenario:** The **extreme rain intensity** increases by up to 11% across 2030 and 2050. Around 2070, the largest increases are projected to occur at Kukulcan Plaza and Galerias Tapachula in southern Mexico (more than 10% increase) and plazas in inland central Mexico (6 to 8% increase).
- The **number of extreme rain days** decreases by a maximum of 6% in 2030 (Las Misiones and Galerias Tapachula). In 2050, extreme rain days increase and decrease across the plaza sites. By 2070, the majority of sites show a decrease in extreme rain days by up to 8%.

- **Future changes under the high emission scenario:** The changes in **rain intensity** vary from -3-4%, 1-9% and -2-14% across sites around 2030, 2050 and 2070, respectively.
- The **number of extreme rain days** decreases across Mexico across all horizons, by up to 8% in 2030, 12% in 2050 an d16% in 2070.

**Key findings**

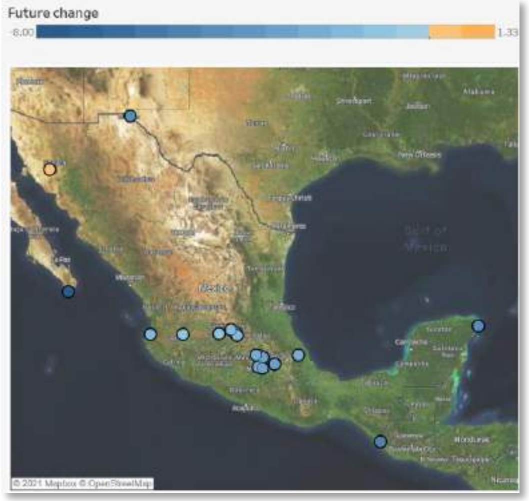
- The sites with the wettest day rainfall of the year (>60 mm) and the maximum length of the wet spell (>16 days) occur in central Mexico and Galerias Tapachula.
- Under future warming scenarios, extreme rain intensity increases, however the frequency of extreme rain days decreases.

**2030 High Emission**

***The 2030 future change in the intensity of extreme rain. Units are % and red colours indicate an increase in intensity.***

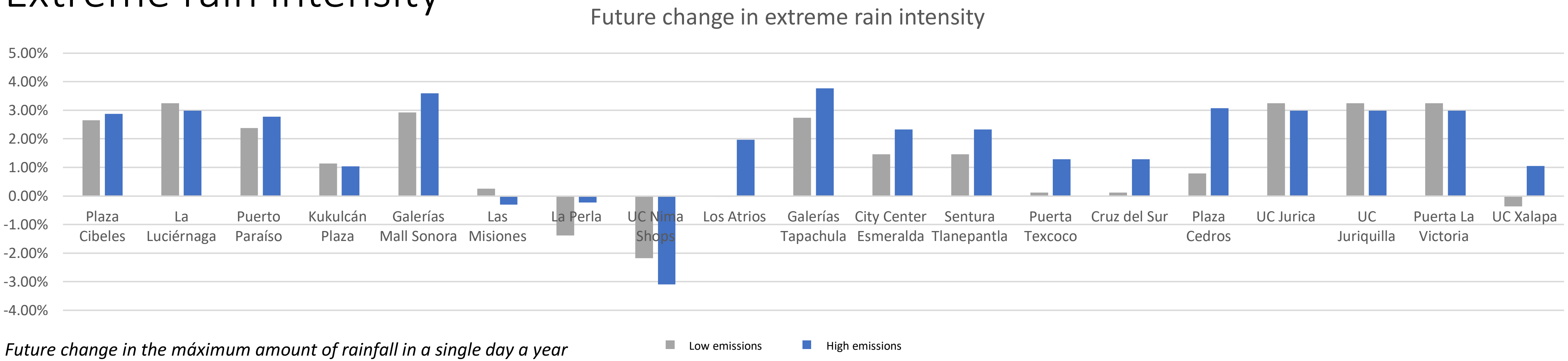

**2030 High Emission**

***The 2030 future change in the frequency of extreme rain days. Units are % and blue colours indicate reduced days per year.***



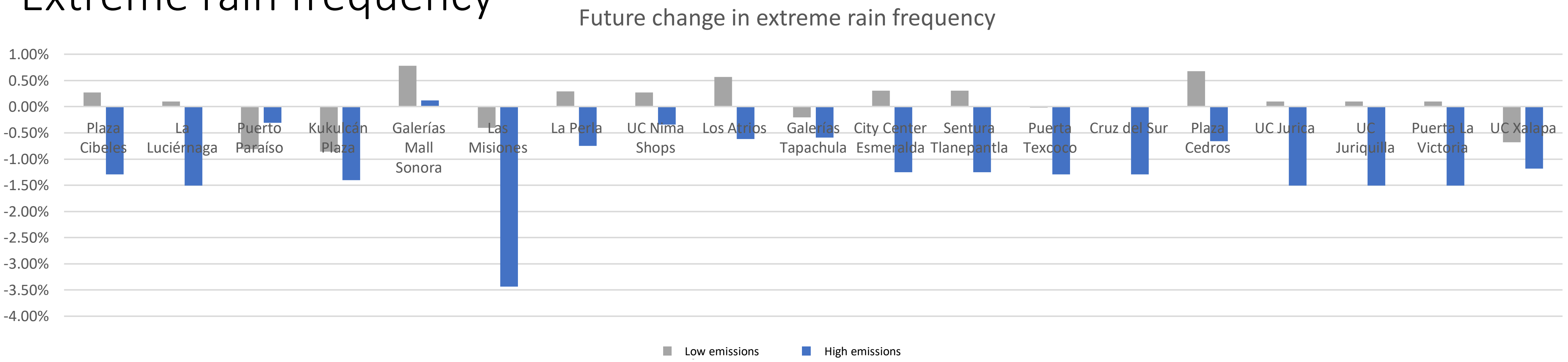
2030 horizon

# Extreme rain intensity




*Future change in the máximum amount of rainfall in a single day a year*

# Extreme rain frequency




*Future change in days per year where the total rainfall in a day is greater than 20 mm*

# Hurricane Frequency

## EXTREME WET CONDITIONS

### Context and Potential Impacts

Given its location, Mexico is prone to storm surge (see next page), hurricanes and tropical storms, particularly between August and October, regularly originating in the Pacific and Atlantic ocean basins. Around 120 hurricanes and tropical storms made landfall across Central America between 1950 and 2000 (Jauregui 2003), contributing to 10 to 60% of extreme rainfall experienced across Mexico coastlines (Franco-Diaz et al. 2019).

**These extreme events impact infrastructure, transport & logistics, property development and personnel, and can have major consequences on the tourism and retail industries in Mexico. For example, Category 4 Hurricane Wilma in October 2005 caused approximately $US442 million in damages across Quintana Roo (where the Kukulcan Plaza is situated) and $US1.3 billion in tourism disruption indirect costs.**

### Insights into Current and Future Exposures

**Current Exposure:** Tropical storms, hurricanes and storm surge often occur together, but are separately assessed below and at right. Under the current climate, **UC Nima Shops** and **Puerto Paraiso** are exposed to **moderate** risk (2% and 3% Exceedance Probability (EP), respectively) and **Kukulcan Plaza** is exposed to a **higher** risk (7% EP) of exceeding CAT4 (>56 m/s) hurricanes/tropical storms in a 30 year period.

**Future changes:**

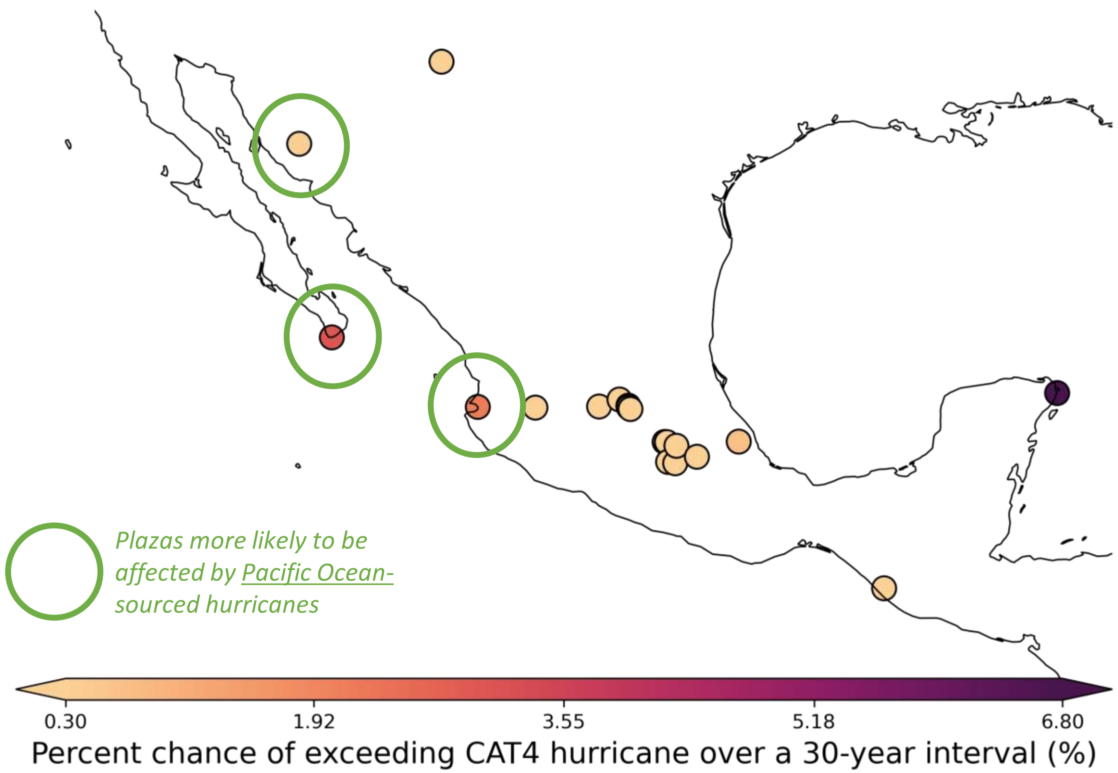
**Under a high emission scenario by 2050, models project that:**

- **Hurricanes along the western Mexico adjacent to the Pacific Ocean** (circled green) **will** increase in frequency by 23%, increase in intensity by 5%, and increase in landfall rain rate by 21%.
- **Hurricanes along the eastern Mexico adjacent to the North Atlantic Ocean will** increase in frequency by 12%, increase in intensity by 3%, and increase in landfall rain rate by 16%.

**Key findings**

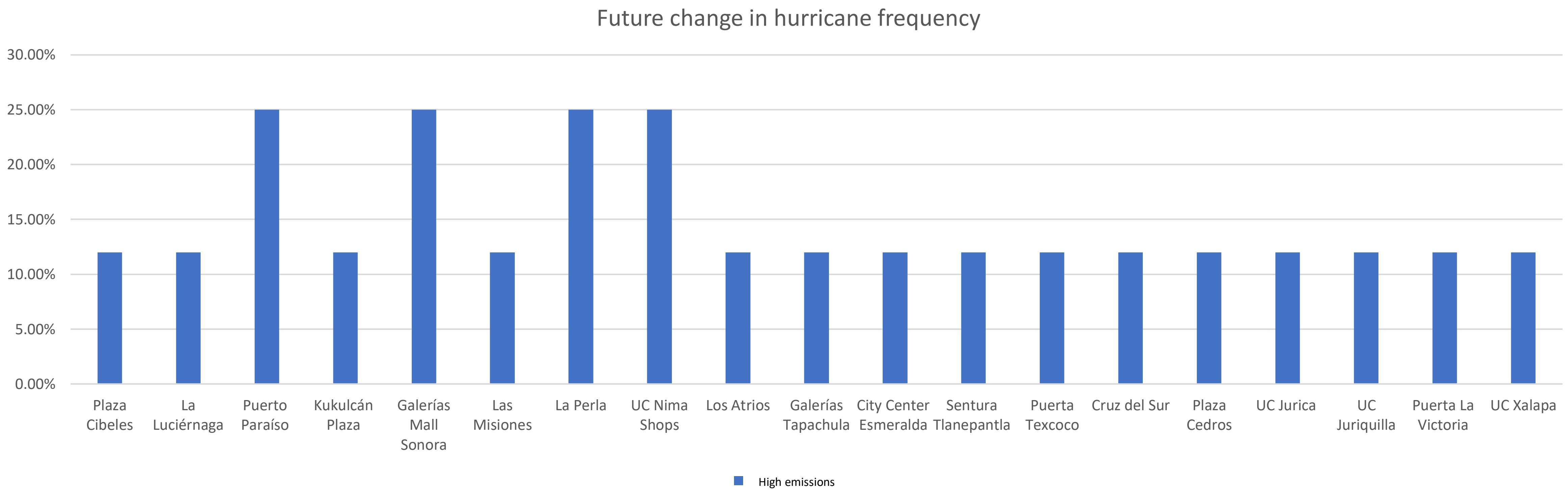
- Currently, Kukulcan Plaza is currently at the greatest risk of CAT4/5 hurricanes. By 2050, the frequency of CAT4/5 hurricanes will increase by 23% (western Mexico) and 12% (eastern Mexico).

**CURRENT (1980-2018) FREQUENCY OF CAT4 HURRICANES**



# Hurricane frequency

2050 horizon




*Future change in CAT4/5 hurricane frequency*
*The information in the tableau only takes into account the high emissions scenario*

# Storm surge event

## EXTREME WET CONDITIONS

### Context and Potential Impacts

Storm surge events often coincide with tropical storms and hurricanes. These extreme events impact infrastructure, transport & logistics, property development and personnel, and can have major consequences on the tourism and retail industries in Mexico.

**For example, Category 3 Hurricane Grace in August 2021 caused dangerous storm surges to the Veracruz state (where UC Xalapa is currently located) causing $US330 million damage (source).**

### Insights into Current and Future Exposures

**Current Exposure:** Four sites are within 50km of the coastline and were assessed for frequency of the 1-in-100 year storm surge event (associated with a 1 to 2m extreme sea level rise and Category 1 or 2 hurricanes). The most significant future exposure to storm surge events is near Galerias Tapachula the furthest south of the four assessed sites.

**Future exposure:**

**Under both a low and high emission scenario, the 1-in-100 year storm surge event is projected to occur at least once annually by 2050 along the southern coastline at Galerias Tapachula.** The other three assessed coastal sites are also projected to experience more frequent storm surge events every 42 to 74 years by 2050.
The return periods at right are also expressed as the Annual Exceedance Probability (AEP), meaning the likelihood of occurrence. A 1-in-100 year event has an AEP of 1%.

By 2050 under both a low and high emission scenario, all sites depicted in the map to the right are also projected to experience an increase in **hurricane frequency** and **intensity**, as well as **landfall rain rate** (see previous page).

**Key findings**

- Southern Mexico (Galerias Tapachula) is at greatest risk of increases in frequency of 1-in-100 year storm surge events that are projected to occur annually by 2050.

**STORM SURGE FREQUENCY | Now versus 2050**

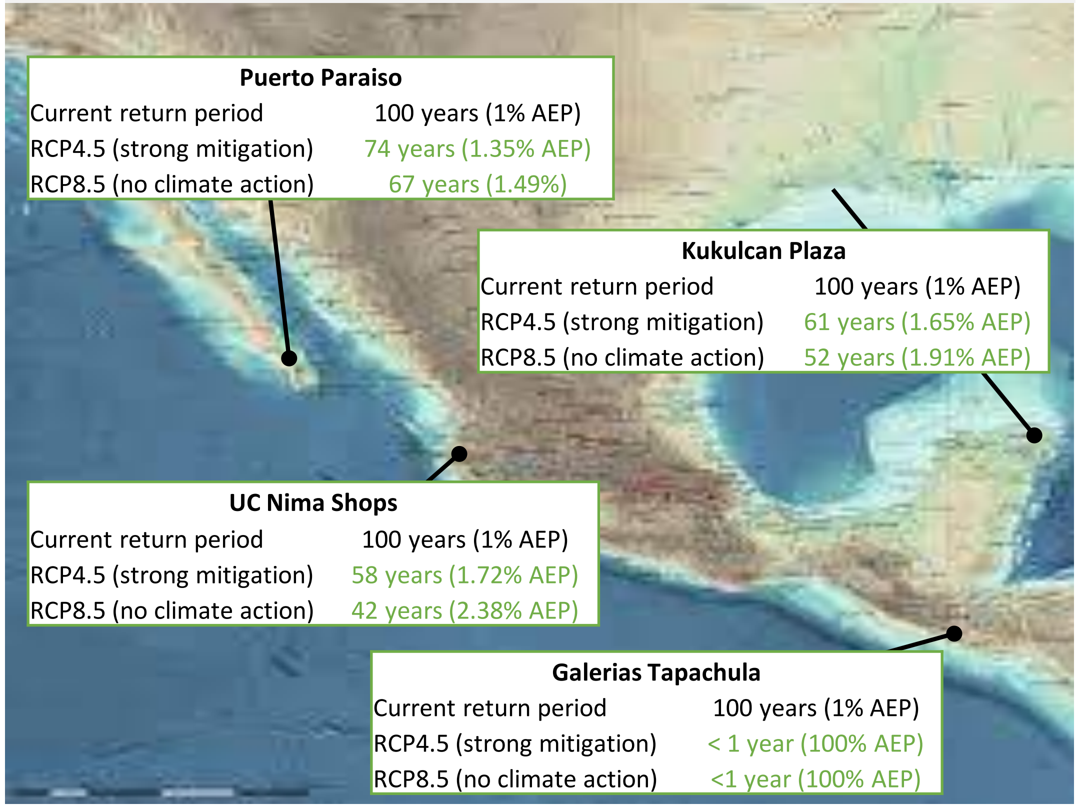



*Figure source*.

# Appendix

# Appendix | Understanding physical climate scenarios

## Motivation to explore future physical climate risk

The global average temperature has risen around 1ºC since the late 19th century, primarily due to human activity. At the present warming rate, global temperatures may likely reach 1.5°C around 2040. This warming means the Earth is more sensitive to climate extreme events, and that these extremes occur more frequently, intensely and are more volatile. The Earth is already experiencing unprecedented climate extreme events numerous times a year, regardless of future scenarios. Impacts from extremes "will exceed the limits of resilience and adaptation of ecosystems and people, leading to unavoidable loss and damage".

## What are the Representative Concentration Pathways?

The four future Representative Concentration Pathways (RCPs) used for understanding changes in physical climate risks stem from the Intergovernmental Panel on Climate Change Fifth Assessment Report (IPCC AR5), published in 2013. The RCPs describe the top-of-the-atmosphere energy imbalance, associated with warming of the planet Earth These climate scenarios are named RCP2.6, RCP4.5, RCP6.0 and RCP8.5. **The RCP4.5 and RCP8.5 scenarios are used for assessment in this report.**

## What are the Shared Socio-economic Pathways?

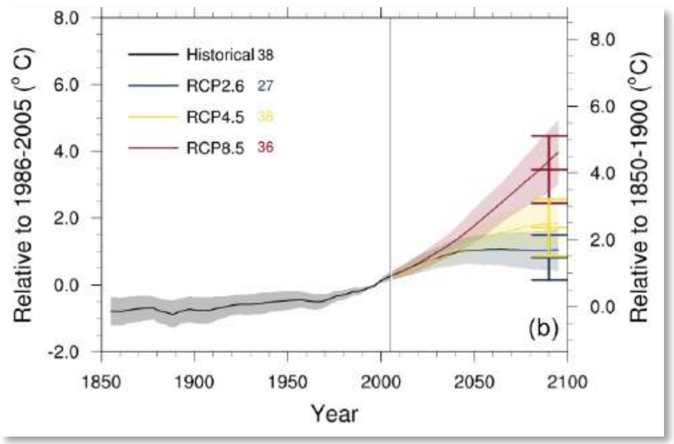
The five Shared Socio-economic Pathways (SSPs) used for understanding changes in physical climate risks stem from the Intergovernmental Panel on Climate Change Sixth Assessment Report (IPCC AR6), published in 2021. The SSPs describe pathways of how society, demographics, technology and economics evolve over time. They are combined with the energy imbalance values from the RCPs, allowing a comparison of SSP and RCP scenarios. These climate scenarios are named SSP1-2.6, SSP2-4.5, SSP4-6.0, SSP3-7.0, and SSP5-8.5. **The SSP2-4.5 and SSP5-8.5 scenarios are used for assessment in this report.**

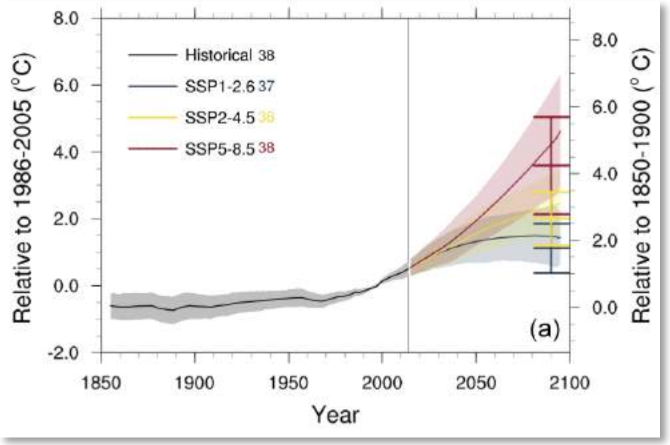
## Which climate scenario is most likely?

The RCP climate scenarios represent plausible futures. The RCPs are NOT predictions and are NOT accompanied by a likelihood rating. RCPs are a tool to help decision makers understand the breadth of plausible physical risks.

Long term physical climate risk is dependent on transition pathways and choices such as policy, market trends, technology, legalities and decarbonisation on a global scale. COVID-19 reduced some greenhouse gas concentrations (e.g., carbon dioxide), but no more than year-to-year variability, meaning that greenhouse gas emissions are still rising.

***The global average temperature rise compared to the recent past (left axis) and pre-industrial era (right axis) for selected RCP (top) and SSP (bottom) scenarios.*** Adapted from Tebaldi et al. (2021).



# Appendix | What is a Global Climate Model?

Global climate models are four-dimensional (latitude, longitude, time and height) representations of the climate system at every point in time and globally for the past, present and future. A summary can be found here.

*Models do better at representing the climate in some areas than others, so **it's important to capture the spread across many models** when assessing global climate change. Here we use the **median of ten global climate models** for each metric.*

### What can climate models be used for?

- Filling gaps in our measurement
- Helping us understand why a climate process occurs
- Provide estimations which we could not measure (e.g., winds)

### What can't climate models tell us?

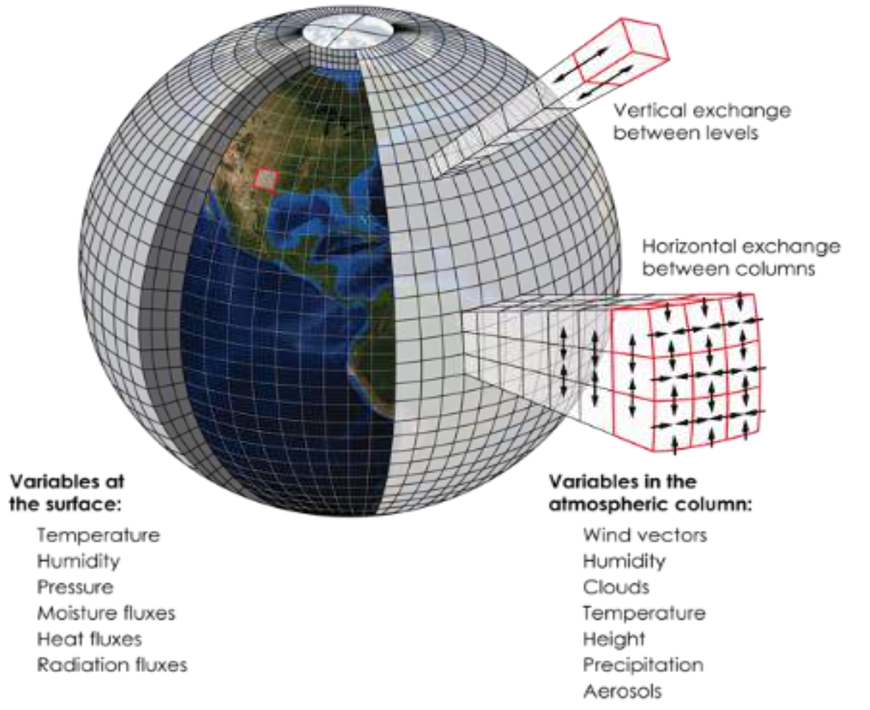
- Health of the population,
- Food and water security
- Species distribution changes
- Economic consequences

### How often are global climate models updated?

- Global climate models are released every 5 to 7 years.
- CMIP5 (Coupled Model Intercomparison Projects 5) are associated with the IPCC Fifth Assessment Report that was released in 2013, and many acute climate metrics only exist using this climate model generation
- The latest IPCC Sixth Assessment Report was released in 2021, and with it the next generation of climate models (CMIP6)
- **The findings will be valid until at least 2025.**

### How are the climate models different and what is model uncertainty?

Each global climate model is different in its atmosphere, land, ocean and sea-ice components and the underlying physics used to simulate climate dynamics operates at a finer scale than the individual model grid scale (e.g., a thunderstorm or single cloud). Thus, there is a range in magnitude (and sign) in how the climate evolves at each simulated point on Earth in each model – this leads to a spread in climate model projections and model 'uncertainty'. The uncertainty is often largest in metrics that are hard to measure and model, particularly those associated with mean and extreme rain (and global climate models are used for these metrics at 100 to 250km scale). A multi-model average is used to capture the overarching trends and has been shown to outperform individual models across multiple metrics[1]. We also compare the multi-model global model findings with literature and other data sources.




Credit: K. Cantner, American Geosciences Institute

*[1]This has been demonstrated in both CMIP3 and CMIP5 models (e.g., Reichler and Kim 2008; Gleckler et al. 2008; Knutti 2010; Loikith and Broccoli 2015)*

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