US exposure to physical climate risk: why every state is different

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The US encompasses highly diverse geographies and climates, which create distinct patterns of physical climate exposure across states.

These differences can lead to substantial variation in long-term temperature-related economic impacts.

EDHEC-CLIRMAP produces temperature-based projections of long-term regional GRP effects. It does not model wildfire probability, severity, burned area or wildfire-specific damages. This note uses wildfire evidence to contextualise those projections.

Tools that translate changes in average temperature into economic impacts are therefore increasingly important.

This article is a shortened version of a longer piece, which also looked at risks stemming from floods, droughts and heatwaves, available here: xxxxxx

The sign and magnitude of predicted economic losses are determined by the intersection between space, through local climate zones and baseline temperature conditions, and the non-linear temperature–GDP structural relationship estimated in the underlying EDHEC-CLIRMAP (EDHEC-CLimate-Induced Regional MAcroimpacts Projector) methodology. The location of a given region therefore matters because it determines where that region sits on the response curve, and whether additional warming is projected to generate limited effects, temporary gains or increasingly negative economic impacts.

EDHEC-CLIRMAP identifies marked differences in projected temperature-related GRP impacts across states. Under the SSP5-RCP8.5 vigorous warming scenario (MPI-ESM1-2-HR model), it projects losses of more than one quarter for Florida and a similar magnitude for California by the end of the century; for Texas, projected losses reach 43% by 2099. These are temperature-based macroeconomic projections and must not be attributed to individual hazards such as storms, wildfires, flooding, drought, heat or sea-level rise.

EDHEC-CLIRMAP is a free online tool developed by the EDHEC Climate Institute (n.d.). Scientists, experts, professional investors, policymakers and ordinary users can use this free user-friendly platform to discover how climate change-induced shifts in average temperature are projected to affect the GRP of individual regions.

Background

Climate change is happening all around us, sparing no region or industry. Its impact will be determined by the urgency with which nations take action to rein in and slow anthropogenic emission drivers and ultimately adapt to gradually reduce its cost to society.

These risks (and their underlying materiality) are expected to vary significantly across regions (and implicitly, climate zones). The US provides an ideal illustration of this observation, with its wide geography and strong climate extremes – from hot to cold deserts, forests, mountains, flat and cliff-edge coasts, the near equatorial regions of southern states and the permafrost of Alaska.

This article examines how the physical climate risk context varies across US states, using wildfires as a case study of an acute hazard. It uses EDHEC-CLIRMAP to present temperature-based long-term GRP projections for selected states. The tool does not model wildfire hazard or damages; the wildfire discussion is contextual and does not attribute the modelled GRP projections to wildfires.

We interpret temperature-related GRP projections alongside external evidence on wildfire risk and economic transmission channels. Wildfire drivers and damages are not directly modelled in EDHEC-CLIRMAP.

Review of the US climate zones

Geographical extremes in the US

North and South:

- ***Alaska:*** northernmost state, just

2,000km south of the North Pole.
- ***Hawaii:*** Southernmost state, just 2,100km north of the Equator.

HIGH AND LOW
- ***Mount Denali, Alaska***: highest peak at 6,190m.
- ***Death Valley, California:*** lowest point at –86m.

HOT AND COLD
- ***Great Basin desert:*** coldest desert in the US due to elevation (mostly above 1,200m with peak at 3,000m) drops as low as –7.3°C in winter.
- ***Chihuahuan desert:*** largest desert in North America at ~360,000km² (though mostly in Mexico).
- ***Sonoran:*** lushest desert, with more plant species than any desert in the world.
- ***Mojave:*** hottest desert, home to Death Valley, the hottest place ever recorded (56.7°C in 1913).
- ***Utqiaġvik, Alaska:*** the coldest inhabited place in the US, with winter temperatures that average –24°C. All-time record low of –62°C was recorded at Prospect Creek Camp in 1971.

WET AND DRY
- ***Hawaii:*** wettest state with a mean average of 161.8cm of rain a year. Its volcanic mountains wring moisture out of trade winds.
- ***Nevada:*** driest state by far with just 24.1cm a year. Mountain ranges block Pacific moisture from the desert or high-altitude region of the interior West.

The climate of the US varies hugely, not just from north to south, but within individual states, many of which contain multiple climate zones. The standard classification system for climate zones is the Köppen-Geiger framework, which breaks zones into five major groups, each subdivided by temperature and rainfall seasonality:

A – *Tropical:* All months above 18°C. High annual rainfall (+1.5 metres). No true winter. Found in South Florida, Hawaii and US territories. Subdivides into rainforest (Af), monsoon (Am) and savanna (Aw).

B – *Dry (Arid & Semi-Arid):* Evaporation consistently exceeds precipitation. Hot deserts (BWh) in the SW; cold deserts (BWk) at elevation. Semi-arid steppes (BS) cover the Great Plains and Great Basin. Covers roughly a third of the contiguous US.

Table 1. Some states with multiple climate zones

State	Climate zones
Alaska	Maritime Oceanic, Subarctic Continental, Transitional (Southcentral), Maritime-Continental (West), Arctic/Polar (North Slope)
California	Mediterranean Coast, Hot-Summer Mediterranean (Central Valley), Marine West Coast (NW), Hot Arid Desert (SE), Cold Desert/Steppe, Alpine/Highland
Texas	Humid Subtropical (East), Semi-Arid Steppe (North & Central), Arid Desert (West), Highland/Mountain (Trans-Pecos)
Florida	Humid Subtropical (North & Central), Tropical Savanna (South), Tropical Maritime (Keys)

C – *Temperate:* Coldest month between –3°C and 18°C. Includes humid subtropical (Cfa) across the Southeast, Mediterranean (Csa/Csb) along the California coast and oceanic (Cfb) in the Pacific Northwest.

D – *Continental:* At least one month below –3°C; no dry season (f) or dry summer (s). Warm summers (a), cool summers (b) or subarctic (c/d). Dominates the Midwest, Great Lakes and much of Alaska's interior.

E – *Polar:* No month reaches 10°C. Tundra (ET) has at least one month above freezing; ice cap (EF) does not. Found across Arctic Alaska and at high alpine summits.

H – *Highland:* This is a useful supplementary classification for mountainous terrain (such as the Rockies, Sierra Nevada, Cascades and Alaska Range) where rapid changes in elevation create highly localised climates that do not fit neatly into the core groups.

Physical climate risks

While the risks brought by climate change are numerous and interconnected, the National Oceanic and Atmospheric Administration (NOAA) considers the following to be the 10 most major (NOAA, n.d.b), based on its monitoring of 'billion-dollar disasters' and climate impacts:

1 – Increased frequency of severe storms
2 – More intense and wetter hurricanes
3 – Destructive coastal flooding and storm surge
4 – Prolonged and intense drought
5 – Intensified wildfire seasons
6 – Extreme heatwaves
7 – Inland flooding from heavy rainfall
8 – Ocean acidification
9 – Shrinking sea ice and glaciers
10 – Significant ecosystem and biodiversity disruption

Within this array, it's also useful to understand the difference between acute and chronic climate risks.
- Acute risks are event-driven, such as sudden, discrete weather events of short duration but high intensity. Examples include hurricanes, floods, wildfires, heatwaves and extreme precipitation. They tend to cause concentrated, visible damage in a short timeframe.
- Chronic climate risks are gradual, longer-term shifts in climate patterns that progressively alter conditions over years or decades. Examples include rising sea levels, increasing average temperatures, changing rainfall patterns and permafrost melt. The damage is cumulative rather than sudden (TCFD [2017]).

It is also worth noting that the two interact; the frequency and severity of each type of risk may vary considerably and become increasingly difficult to predict, and the drivers may appear with a significant time lag (BCBS [2021]).

Hawaii: a special mention

Up to 10 Köppen subtypes on a single island

Hawaii's Big Island is the most climatically diverse place in the US – and arguably on Earth relative to its size (10,430km²), encompassing four of the five major Köppen climate groups and 10 of the 14 subtypes (Luo et al [2024]). You can drive from a lush tropical rainforest (Hilo, windward east) to a scorching hot desert (Kona coast, leeward west) in under two hours – and ascend Mauna Kea (4,205m) for polar tundra conditions with occasional snow. The only major Köppen group absent is the continental (D) group; there are no cold winters at sea level and no landmass big enough to generate continental air masses.

US states through the EDHEC-CLIRMAP lens

Throughout the rest of this article, we use EDHEC-CLIRMAP to present results for specific US state cases. These are temperature-based, long-run GRP projections; they are not estimates of wildfire likelihood or wildfire damages. We examine wildfire evidence separately as external context and do not attribute the model results to that hazard.

EDHEC-CLIRMAP is a top-down macroeconomic methodology that focuses on the relationship between annual average temperature and regional economic growth. Acute climatic events, including wildfires, may be correlated with changes in average temperature and may therefore contribute to the historical GDP responses from which the relationship is estimated. However, they are not directly observed, modelled or separately identified in the framework.

What is the underlying methodology to these losses?

EDHEC-CLIRMAP estimates how regional output per capita has historically responded to changes in local average temperature, using roughly four decades of data for more than 1,500 regions in 87 countries. It then applies that relationship to downscaled climate projections for more than 3,400 sub-national regions, compounding annual growth shocks into a permanent gap in GRP per capita relative to a no additional warming counterfactual. Because the relationship is non-linear, additional warming weighs far more heavily on already-hot regions than on cooler ones. The full methodology is set out in the precedin article, 'Addressing a structural blind spot in sovereign pricing', in this supplement.

Wildfire context

- ***California, most fires:*** the 2025 Palisades fire was one of the most devastating wildfires in the state's history and destroyed over 6,800 structures (CAL FIRE [2025]).
- ***Oregon, most acres:*** More wildfires occur in the east and central states, but western fires are far larger (NIFC, n.d.).
- ***Alaska, high for both:*** the Arctic is warming three to four times faster than the rest of the globe and Alaska has vast tracts of highly flammable black spruce forests (NOAA, n.d.a).

Alaska through the EDHEC-CLIRMAP lens

Alaska is warming rapidly and is experiencing increasing wildfire risk as forest conditions become drier and warmer. Separately, under the stated scenario, EDHEC-CLIRMAP projects a 13.61% reduction in GRP per capita by 2099 relative to a no additional warming counterfactual.

Wildfire damage

Wildfire damage falls into three broad categories: economic, health and environmental. The indirect costs dwarf the direct ones.

Direct structural damage is the most visible. Between 2015 and 2024, wildfires destroyed more than 8,000 structures annually on average.

Health costs are enormous and geographically dispersed. Wildfires now cause approximately 25% of Americans' total exposure to harmful fine particulate matter. Wildfire smoke can lead to lost productivity far from the fire's location and cause premature deaths.

Economic disruption beyond structures includes: power shut-offs, business closures, travel cancellations, supply chain disruptions and steep drops in overall employment and surges in unemployment claims in affected regions (JEC [2023]).

Agricultural and timber losses are substantial: damaged watersheds reduce agricultural productivity, while timber losses represent an economic injury that can take decades, and in some cases up to a century, to reverse (Bousfield et al [2023]).

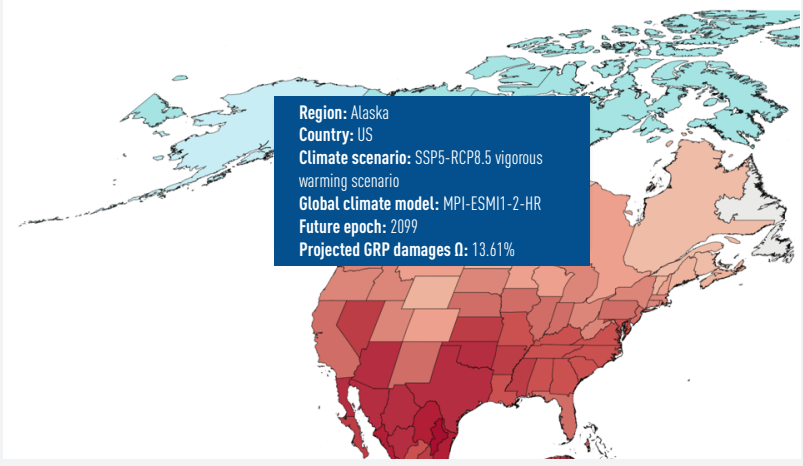
California through the EDHEC-CLIRMAP lens

Wildfire risk is material in California. Separately, under the stated scenario, EDHEC-CLIRMAP projects a 27.3% reduction in GRP per capita by 2099 relative to a no additional warming counterfactual. This is a temperature-related macroeconomic projection, not an estimate of wildfire damage.

How climate change is evolving wildfire damage

Warmer, dryer conditions are dramatically extending fire seasons and increasing fire intensity. While the annual number of fire ignitions declined approximately 10% between 1990 and 2024, the annual area burned increased substantially, meaning

Figure 1. Alaska – projected temperature-related GRP loss by 2099, not a wildfire loss estimate



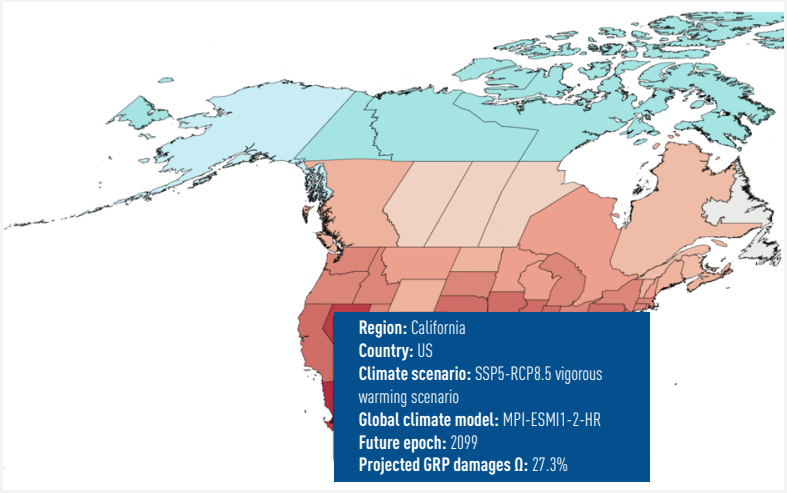
Note: this forecast uses the MPI-ESM1-2-HR model under the SSP5-RCP8.5 vigorous warming scenario

Table 2. Alaska – projected temperature-related GRP loss under the stated scenario

Future epoch	Projected GRP loss
2021–40	1.81%
2051–70	9.06%
2099	13.61%

Note: this forecast uses the MPI-ESM1-2-HR model under the SSP5-RCP8.5 vigorous warming scenario

Figure 2. California – projected temperature-related GRP loss by 2099, not a wildfire loss estimate



Note: this forecast uses the MPI-ESM1-2-HR model under the SSP5-RCP8.5 vigorous warming scenario

Table 3. California – projected temperature-related GRP loss under the stated scenario

Future epoch	Projected GRP loss
2021–40	3.76%
2051–70	10.53%
2099	27.3%

Note: this forecast uses the MPI-ESM1-2-HR model under the SSP5-RCP8.5 vigorous warming scenario

fewer but far larger and more destructive fires (NOAA, n.d.c). The insurance system has been hard hit, with some regions now facing uninsurability challenges (Swiss Re Institute [2026]). Of the nearly $150bn in damages caused by California's 2018 wildfires, approximately 60% were indirect economic losses from disruption to economic activity (JEC [2023]). Under a middle-of-the-road climate scenario, federal fire suppression costs alone are projected to rise 42% by 2050, and that is before accounting for the cascading economic damage that follows each fire (C2ES [2026]).

Potential economic transmission channels of wildfire losses

The following pathways explain how wildfire events can affect economic activity. They are based on external evidence and are not variables or outputs of EDHEC-CLIRMAP; they should not be used to attribute the modeled GRP projections to wildfires. Wildfires damage regional economies through a set of transmission channels that are unusually broad and deeply interconnected. The immediate destruction of physical capital (homes, businesses, energy infrastructure and timber) removes productive assets from the economy, while forced evacuations halt economic activity across entire regions even in areas that escape direct burning. The damage then ripples outward: smoke travels thousands of miles, suppressing labor productivity and driving health costs far beyond the fire perimeter. Real estate values fall in affected areas, eroding household wealth, the local tax base, and access to credit simultaneously. Watersheds are contaminated, raising water treatment costs and threatening agricultural productivity for years after the flames are extinguished. Insurance markets come under structural strain as claims surge and insurers withdraw from fire-prone markets entirely, compounding costs for those who remain.

Acute risks

- ***Direct asset destruction*** to property, timber, and infrastructure costs the US $394bn–893bn annually, equivalent to 2–4% of US GDP (JEC [2023]).
- ***Labour market disruption*** is amplified by smoke, which extends far beyond the fire zone. It slashes labour market earnings by an estimated $93bn per year across the entire US (Bayham et al [2022]).
- ***Supply chain disruption*** dominates the total cost. In California's 2018 wildfires, indirect supply chain losses accounted for 59% of total damages, dwarfing direct capital losses of 19% (Wang et al [2021]).
- ***Sectoral impacts*** fall hardest on real estate, insurance, forestry and tourism (Luo [2023]).

Chronic risks

- ***Permanent natural capital erosion*** as rising fire frequency depresses the long-run value of western forestry, recreation, and watershed services (Wang and Lewis [2024]).
- ***Persistent air quality drag*** as smoke seasons lengthen, reducing earnings across manufacturing, healthcare, real estate and transport (Borgschulte et al [2022]).
- ***Insurance market retreat*** renders high-risk areas effectively uninsurable, depressing property values and undermining local tax bases over the long term (Tavor [2024]).

A real world example of the financial impact of acute wildfire damage

Los Angeles fires, January 2025

Driven by exceptional Santa Ana winds and prolonged drought conditions, the Palisades and Eaton fires tore through Los Angeles County in January 2025, destroying more than 16,000 structures. Insured losses alone amounted to $40bn, making them the costliest wildfires on record globally (Swiss Re Institute [2026]), and total economic loss to $250bn–275bn (AccuWeather [2025]). Property and capital losses of $76bn–131bn helped fuel a 0.48% decline in county-level GDP for 2025, equivalent to approximately $4.6bn (Li and Yu [2025]).

Conclusion: discussing the true damage figure does not negate the threat

EDHEC-CLIRMAP supports analysis of the spatial distribution of temperature-related macroeconomic impacts. This article combines those projections with external evidence on wildfire risk and economic transmission channels. It does not estimate wildfire occurrence, severity or wildfire-specific economic loss.

These estimates should nevertheless be interpreted as partial measures of risk. Current damage functions and integrated assessment models often do not fully capture cascading failures, threshold effects, compound shocks or climate tipping points. In particular, many models assume that damages increase smoothly with temperature, while some physical and economic impacts may become non-linear beyond certain warming levels.

This limitation is especially relevant for compound events. A wildfire following a drought and heatwave, or a storm affecting a coastal city already exposed to sea-level rise, can generate larger and more persistent losses than the same hazard considered in isolation. Future research therefore needs to better account for interacting hazards, tipping points and propagation channels across regions and sectors.

The implication is that the damage estimates discussed in this article, while already material, may remain conservative (Dietz et al [2021]; Carbon Tracker Initiative and University of Exeter [2026]).

From regional projections to sovereign ratings

EDHEC-CLIRMAP shows how temperature-related impacts vary within a single country. The Sovereign Climate Risk Rating builds on the same sub-national foundation: it translates regional damages across nine NGFS-aligned scenarios, weights them by probability and aggregates them into a country-level expected impact on GDP per capita, which feeds an A–G rating. Like CLIRMAP, it measures chronic, temperature-driven risk rather than hazard-specific exposure such as wildfire.

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