Climate

ltitude

UNDERSTANDING PHYSICAL CLIMATE RISKS

KEY FIGURES AND INSIGHTS

Climate change is both the **direct** and the **indirect consequences** of the **excess GHG** in the atmosphere	**36% more electricity** consumed by households owning **air conditioning**, on average globally	**30 to 50%** decrease of **snow days** projected on French mountain by **2050**
4°C+ of warming expected in **Northern Siberia** by mid-century while **Southern India** is projected to stay below **2°C** rise	**7%** of workers' **productivity** lost in South Asia due to increasing **temperatures** and **humidity**	**Chronic heat** requires long term planning, while **acute heat** relies on emergency response mechanisms

Florian Gallo
PhD Climate Scientist

Why does it matter?

April 2nd, 2026. Winegrowers in Champagne woke up to a very poor April fool's story. For the third night in two weeks, temperatures dropped way below frost limit, destroying around 40% of the buds[1]. In some parts of the region, this number goes up to 80%. But the late frost, not entirely unexpected in these parts of France, is not the only culprit. This year, the bud break started 3 weeks early, due to May-like temperatures (up to 20°C) in February. Early, young buds were therefore more exposed to the impacts of April's frost, leading to the second most severe frost damages in the region.

Yet most people have probably not heard of this, despite it being one of the most visible impacts of climate change in European regions. The reason is simple: this disaster does not involve record-breaking temperatures, nor destroying winds. Just the quiet, persistent consequences of long-term temperature shifts that bring major, and more importantly, repeating impacts in our lives.

As climate scientists and adaptation specialists, we often start our talks with something akin to 'global temperature is not the full story, but temperature shifts will cause more frequent and more intense extreme events'.

This is true.

And that's why a large portion of this series focuses on extremes, as per our first episode on floods (Episode #1: Flood or floods?).

Yet that's not the full story.

While acute events capture headlines, chronic shifts and their associated slow-onset impacts are sometimes overlooked in climate risk assessment, as they tend to bring lower short-term damages. The repetition, month after month, year after year, of these chronic processes brings significant operational and financial impacts, sometimes overweighing the damages caused by extreme events.

Like the proverbial frog that fails to notice the water slowly heating around it, we too tend to overlook gradual changes, until the damage is done.

This slow, continuous shift in temperatures is already reshaping our economies, our landscapes, and our daily lives. And it deserves closer attention. Here we will look more closely at some potential impacts of rising temperatures on populations and activities, how we can identify those risks and start planning to mitigate them.

Champagne, April 2026, Weenat.com

Reminder: physical climate risks can be divided into two categories, acute and chronic risks.

Acute risks are tied to specific, intense events: a heatwave, a flood, a storm. Chronic risks, by contrast, result from long-term, gradual shifts in climate conditions, such as steadily rising average temperatures, changing precipitation patterns, or sea-level rise.

What is it?

Let's take a step back and start from scratch. Human activity has been releasing more and more greenhouse gases (GHG) in the atmosphere for the past century, reaching 53.3 $GtCO_{2eq}$ in 2024[2]. The increasing concentration of GHG is leading to an enhanced greenhouse effect and warmer temperatures all over the globe.

Climate change is both the direct (warmer atmospheric temperatures) and the indirect consequences (rainfall variability, weather extremes…) of the excess GHG in the atmosphere. In this paper, we will focus on the former, looking at how warmer temperature can impact activities and livelihoods.

The amplitude of climate change is described by the shift in global average temperature (the "+1.5°C"). While this global warming value is easy to understand, it hides large disparities.

First,

the amplitude of temperature changes brought by atmospheric warming **varies regionally**.

Higher latitudes are facing larger temperature increases than tropical and equatorial regions. For example, more than 4°C of warming are expected in the first half of the century in Northern Siberia while warming in Southern India or Indonesia is projected below 2°C[3].

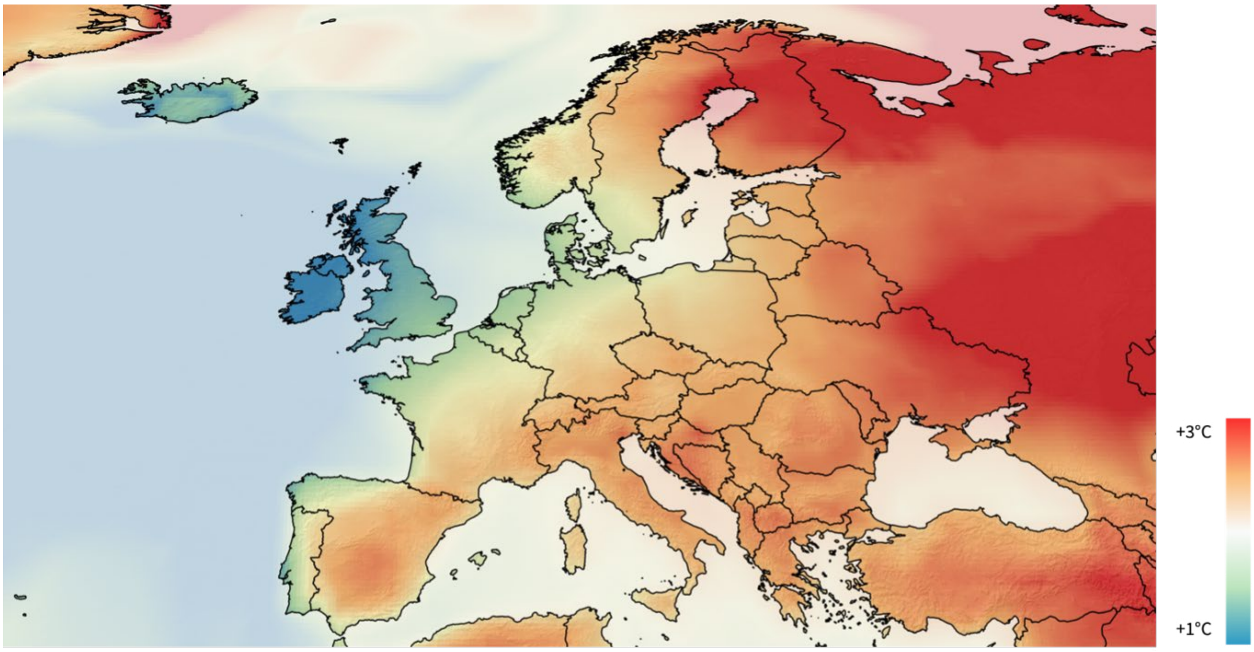

Figure 1 *- Temperature evolution in Europe in the first half of the 21st century (SSP585 - source: Altitude)*

Second,

the indirect impacts of warmer temperatures over the whole climate system (atmospheric and oceanic circulations, precipitations, extreme events) are complex and local phenomena that usually **cannot be summarised in a bullet point**.

Even from a pure temperature perspective, the implications of temperature shift at the local level are not straightforward. Different activities will be impacted in a different way, as they have vulnerabilities to specific temperature ranges.

For example, a local increase of 4°C, as already seen in some parts of Scandinavia, can trigger large landslides on now-unfrozen soils, making villages uninhabitable. Yet the same increase can also lead to lower energy consumption and large savings in the winter.

The key point here is to understand that tolerable, or even pleasant climate conditions can strongly impact human activities through temperature shifts alone, without the need for extremes.

Here, we define as chronic temperature shifts the direct consequences of global warming on temperature distributions and their implications for human lives and activities. In other words, we describe the change in 'normal' temperature distributions that can impact daily operations.

How does it impact us?

The shift towards warmer temperatures can impact every aspect of our lives and activities, from agriculture to industry, from warmer winters to smouldering summers, from Europe to Asia. No one is spared. Below we explore 4 key areas where chronic temperature shifts are already leaving their mark.

Energy consumption

Higher temperatures in spring, summer and autumn will lead to higher cooling needs, often increasing the energy consumption for air conditioning. A recent study[4] highlighted that **air conditioning ownership increases household electricity consumption by 36% on average globally.**

If the opposite effect is expected on heating needs, the overall impact of rising temperatures on household or industrial energy consumption is variable across regions. In the US for example, an 20% increase in household energy consumption is projected in the Southeast[5] (as increasing cooling needs progress faster than decreasing heating needs), while the situation is opposite in the Northwest (fig 2).

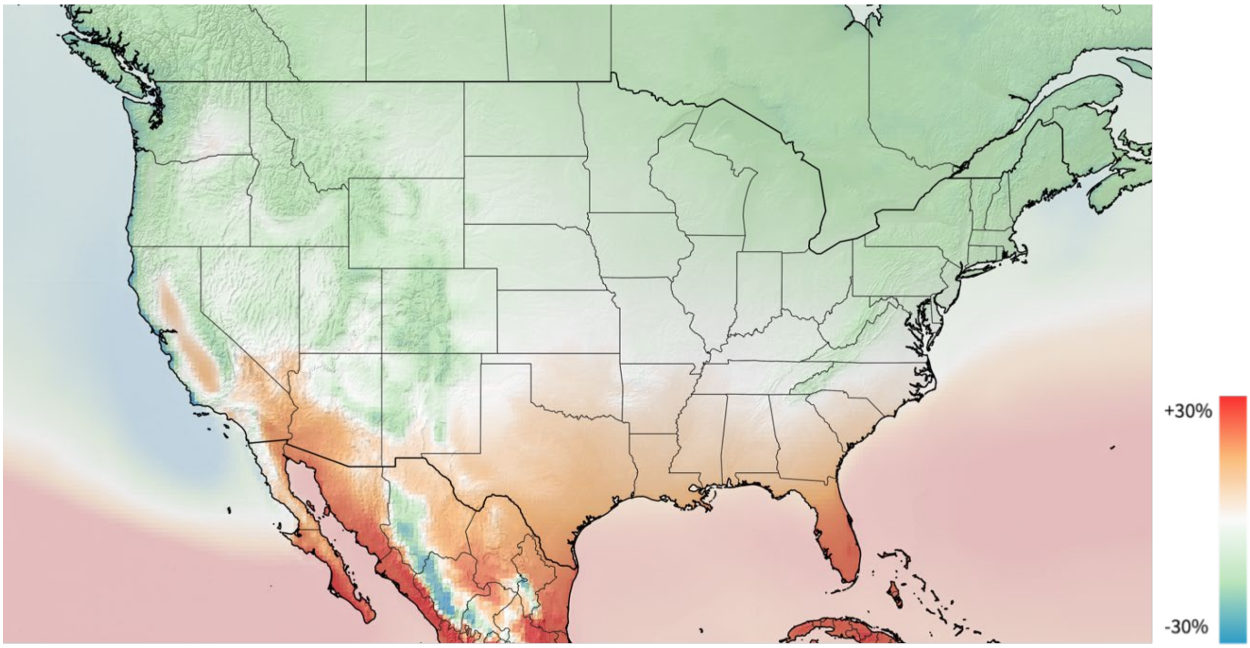

Figure 2 *- Evolution of households energy needs for heating and cooling by 2050 (SSP585 – source : Altitude)*

Agriculture and food production

Warmer days at the end of the winter can trigger early blossoming in fruit trees, which exposes buds and flowers to potential frost later in the season (like what just happened in Champagne), and can impact the pollination success[6]. For orchards or vineyards, this can lead to catastrophic yields during summer. In 2021, warmer-than-usual temperatures in the spring followed by a severe frost in April led to a 30% decrease in wine production in some French regions[7].

To go further and explore how climate change is reshaping the future of French winemaking, you can read our dedicated analysis: Will we still be making wine in France in 2050?

Heat stress can also affect milk production in dairy farm, especially in combination with high humidity. In the US alone, heat-related impacts on the dairy industry are estimated to $900 million from decreased milk production, compromised reproduction, and increased culling[8].

These two examples barely scratch the surface. From cereal crops to fisheries, from pollination to soil moisture, the impacts of heat stress on food systems are as varied as they are underestimated.

Workers productivity

The combination of warm temperatures and high humidity also brings significant impacts on human health, wellbeing and economic output[9]. Prolonged exposure can exacerbate chronic health issues, like cardiovascular or respiratory problems[10].
High heat index negatively impacts workers productivity, especially in labour-intensive industries. Here, we are not talking about heatwaves or extreme conditions on workers, as an apparent temperature of 25-26°C already impacts productivity[11]. Our analysis indicates an additional loss of up to 7% of workers' productivity in South Asia, due to increasing temperatures and humidity.

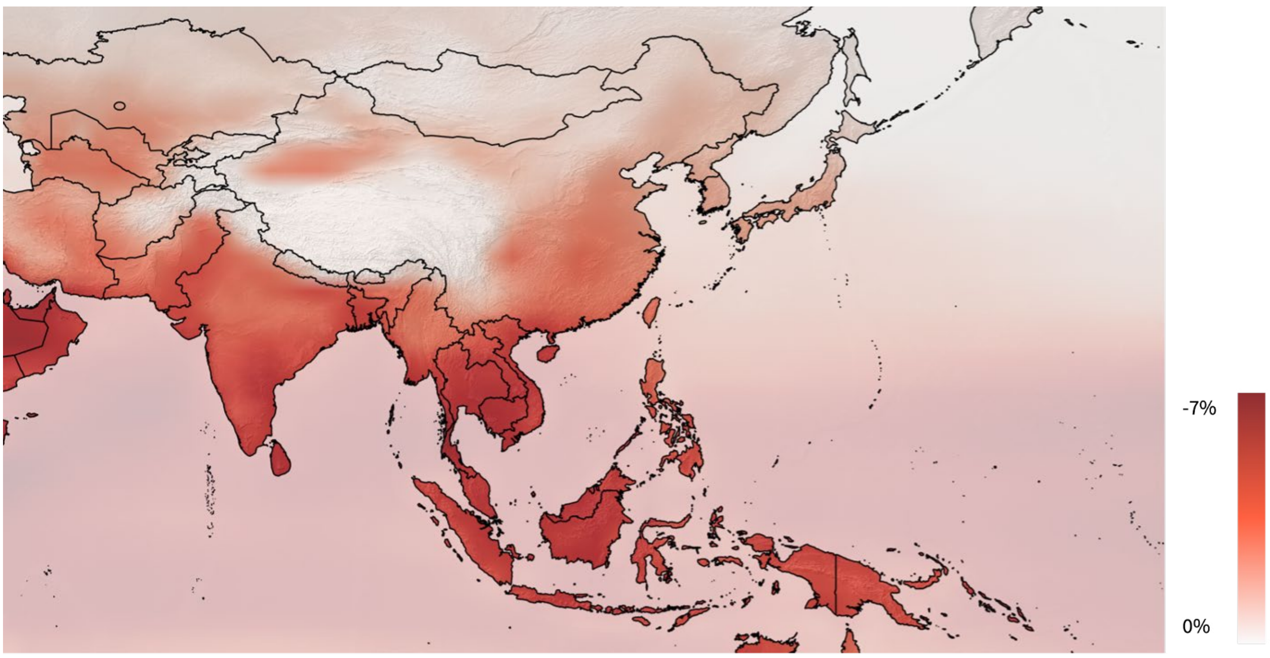

Figure 3 *- Additional heat stress-related loss of productivity in Asia, by 2050 (SSP585 – source : Altitude)*

Tourism

Warmer temperatures will also affect mountain areas, sometimes irreversibly. Water availability for consumption or electricity generation is decreasing due to lower water storage as snow or ice during winter[12]. In India, more than half of the hydropower production is directly depending on Himalayan glaciers, and therefore at risk in a rapidly electrifying country[13]. Winter tourism might be one of the most obvious examples of chronic temperature risk: in a warming climate, snowfall becomes increasingly rare, especially in low- and medium-altitude ski areas, as the altitude of the snow line rises[14]. A 30 to 50% decrease of snow days is projected on French mountain ranges[15], threatening the economic viability of most French ski resorts by 2050, without costly artificial snow production.

To go further and explore how climate change is reshaping the future of mountain sports and winter tourism, you can read our dedicated analysis: The future of sport in a changing climate (available only in French).

How do we adapt as citizens, investors and corporates?

Adapting to chronic temperature shifts is not just an environmental imperative; it is an economic one. Unlike acute events that trigger emergency responses, chronic heat requires long-term planning, systemic thinking, and tailored strategies across sectors and scales.

A tailored analysis is required

Zangmu Hydropower Station, China | AFP | Scroll.in

For investors or corporates, chronic temperature shifts introduce a new layer of risk assessment. Unlike sudden events covered by traditional insurance mechanisms, the gradual erosion of productivity, rising energy costs, and declining agricultural yields require a forward-looking, data-driven approach to portfolio and site management. According to the World Economic Forum, by 2035, extreme heat is projected to cause $2.4 trillion in annual productivity losses and $448 billion in annual fixed-asset losses for publicly listed companies.

From a climatology point-of-view, the analysis of temperature shifts is less a scientific challenge than a tailoring issue. It is important to understand the specific vulnerabilities of assets and sectors to temperatures, to define the relevant climate indicators. In other words, the definition of chronic heat stress for lactating cows, vines or households will be different, as each of those have their own optimal temperature thresholds.

Understanding sector-specific temperature vulnerabilities is therefore essential to evaluate asset exposure. A hotel infrastrucutre in Europe, a dairy farm in the US Midwest, and a hydropower plant in the Himalayas will each face distinct chronic heat profiles. Climate analytics platforms can enable investors to quantify these exposures at the asset level, identify concentration risks, and stress-test portfolios under different warming scenarios.

This granular, asset-level understanding is precisely what enables decision-makers to move from risk assessment to concrete adaptation strategies.

A multi-level adaptation strategy

The diversity of temperature sensitivities brings a broad range of adaptation solutions. A large proportion of these are initially aimed at mitigating extreme heat impacts[16] but can also be applied to chronic heat stress. Governance and organisational adaptation are often discussed, including changes in work patterns (e.g. bringing the Mediterranean daily schedule, with afternoon breaks, to more northern latitudes, shifting construction work earlier in the day). However, a significant difference in the response to chronic and extreme heat is the timescale of action: chronic heat requires long term planning, while acute heat often relies on more emergency response mechanisms[17]. This does not mean that one should systematically oppose chronic and extreme heat adaptation, but rather that chronic heat should be better defined and included in heat adaptation strategies[18], at national, local, organisational or individual level.

To better understand how these vulnerabilities translate into concrete operational decisions, let us take the example of the recommendations we share with a client operating in the hotel sector in Europe.

In the short term, Altitude recommended the operator define a threshold temperature for activating safety protocols, such as: automatically adapting working hours, overnight flushing, closing curtains or shutters during the day, relocating staff from sun-exposed working areas, setting up extra hydration points for clients and teams, or activating cooling in key areas. Forecasts were also recommended to be monitored on an ongoing basis, with a designated person responsible for triggering the heat response plan when necessary.

In the long term, the recommended strategy shifted towards harnessing sun and heat rather than simply reacting to them. Key equipment such as HVAC or data storage units were recommended to be protected protected from direct sun through permanent architectural shading and adequate ventilation. Fixed external solar-shading devices were recommended to be integrated into the building. When renovating assets, future temperature projections were recommended to be embedded into the design to enable passive cooling (reflective materials, cool roofing, high-albedo finishes, protection of sun-exposed façades). Green spaces were also recommended to be incorporated as a natural air conditioning lever during heat episodes, and connected into broader urban freshness corridors. This case illustrates how a structured, phased set of recommendations, combining short-term operational protocols with long-term infrastructure planning, provides a pathway to meaningfully reduce exposure and build lasting resilience at the asset level.

Beyond individual operators and asset-level decisions, adaptation must also be considered at a broader societal scale, including at the household level (e.g., insulation, work patterns). Chronic heat disproportionally affects vulnerable populations with less resources or agency to adapt (e.g. poorer households with often larger occupational exposure, tropical and equatorial developing countries)[19]. For example, the implementation of air conditioning (the major driver in the decline of heat-related mortality in the US over the past decades[20]) can be costly and relies on accessible and reliable access to electricity. Larger, systemic solutions, including changes in infrastructures and urban planning (e.g. development of urban parks, shaded areas in workplaces), are required to ensure that all communities are included in heat adaptation strategies. The improvement of information dissemination, especially in developing countries, is also very important[21].

Conclusion

If climate change is often quantified through the lenses of increasing global temperature, extreme heat has taken centre stage when thinking about heat adaptation. Chronic heat exposure should not be underestimated, as it can bring an array of impacts on health, wellbeing, productivity and energy consumption than can greatly exceed the effects of extreme temperatures. A large proportion of adaptation solutions can be used to address both extreme and chronic heat exposure, but their design and implementation should consider the social and behavioural characteristics of chronic heat, to ensure systemic, long-term adaptation for all communities.

Understanding chronic temperature shifts is essential to build resilience. As with floods, adaptation needs to be at the centre of every decision. This requires being able to access, use and understand the relevant climate information, tailored to each activity, each location, and each community.

So, are we frogs in boiling water? Only if we choose to be. The difference between the frog and us is not the rising temperature, it is the awareness. We can measure the warming, model the thresholds, and plan before they are crossed. That is precisely what adaptation is: the decision to jump before the water boils.

Disclaimer

This document is for informational purposes only and does not constitute investment research or financial analysis relating to transactions in financial instruments as per MIF Directive (2014/65/ EU), nor does it constitute on the part of AXA Climate an offer to buy or sell any investments, products or services, and should not be considered as solicitation or investment, legal or tax advice, a recommendation for an investment strategy or a personalised recommendation to buy or sell securities. Due to its simplification, this document is partial, and opinions, estimates, and forecasts herein are subjective and subject to change without notice. There is no guarantee that forecasts made will come to pass. Data, figures, declarations, analyses, predictions, and other information in this document are provided based on our state of knowledge at the time of creation of this document. While every care is taken, no representation or warranty (including liability towards third parties), express or implied, is made regarding the accuracy, reliability, or completeness of the information contained herein. Reliance upon information in this material is at the sole discretion of the recipient. This material does not contain sufficient information to support an investment decision. Issued in France by AXA Climate, registered with the Trade and Companies Registry of Paris under the number B 493 363 378, registered as an insurance intermediary at the French single register of insurance, banking, and finance intermediaries under the number 07029015 (www.orias.fr) and whose registered office is at 14-16 Boulevard Poissonnière, 75009, Paris – France.

Author

Florian Gallo

PhD Climate Scientist

Florian is the lead climate scientist for Altitude, ensuring scientific robustness on the platform and building knowledge among users. After a PhD in geosciences, working on landslides dynamics in mountain ranges, he spent the past 15 years trying to bridge the gap between climate science and real-world users, especially in the public and financial sectors. His focus is on the development and the dissemination of usable, understandable, and useful climate information for all.

Visit our website

www.AXA-altitude.com

And our LinkedIn page

AXA Altitude

Contact us if you have any inquiry at

altitude@axaclimate.com

Sources

[1] https://terroirchampagne.substack.com/p/frost-taking-champagne-on-the-road

[2] Crippa, M., Guizzardi, D., Pagani, F., Banja, M., Muntean, M. et al., GHG emissions of all world countries - 2025 Report, Publications Office of the European Union, Luxembourg, 2025, doi:10.2760/9816914, JRC143227

[3] Altitude

[4] Mazzone, A., De Cian, E., Falchetta, G. et al. Understanding systemic cooling poverty. Nat Sustain 6, 1533–1541 (2023). https://doi.org/10.1038/s41893-023-01221-6

[5] Altitude

[6] Lake Diver DA, Savage JA. Weighing the risks and benefits of flowering early in the spring for the woody perennial Prunus pumila. Am J Bot. 2024 Nov;111(11):e16417. doi: 10.1002/ajb2.16417. Epub 2024 Oct 18. PMID: 39425253; PMCID: PMC11584043

[7] https://www.larvf.com/prepares-face-au-gel-les-vignerons-ont-limite-la-casse-dans-les-vignobles,4785186.asp

[8] St-Pierre et al., 2003

[9] https://heathealth.info/news/the-unseen-risk-chronic-heats-growing-threat-to-public-health/#:~:text=Prolonged%20exposure%20can%20cause%20ongoing,kidney%20disease%20of%20unknown%20origin

[10] Oppermann, Elspeth, et al. «Establishing intensifying chronic exposure to extreme heat as a slow onset event with implications for health, wellbeing, productivity, society and economy.» Current Opinion in Environmental Sustainability 50 (2021): 225-235

[11] Altitude

[12] IPCC

[13] https://glaciers.nichols.edu/glacier-runoff-hydropower/

[14] https://mountainresearchinitiative.org/news/scientists-warn-mountain-climate-change-is-accelerating-faster-than-predicted-putting-billions-of-people-at-risk/

[15] François, Hugues ; Samacoïts, Raphaëlle ; Carmagnola, Carlo ; Soubeyroux, Jean-Michel ; Lafaysse, Matthieu ; Morin, Samuel. Enneigement des massifs montagneux et stations de sports d'hiver dans une France à +2,7 et +4 °C. La Météorologie, 129, 46-55, 2025. 10.37053/lameteorologie-2025-0036

[16] Oppermann, Elspeth, et al. «Establishing intensifying chronic exposure to extreme heat as a slow onset event with implications for health, wellbeing, productivity, society and economy.» Current Opinion in Environmental Sustainability 50 (2021): 225-235

[17] https://heathealth.info/news/the-unseen-risk-chronic-heats-growing-threat-to-public-health/

[18] Cruz, Mayra, et al. «Where heat does not come in waves: a framework for understanding and managing chronic heat.» Environmental Research: Climate 4.2 (2025): 023002

[19] Ditto

[20] Barreca, A. et al., 2016. Adapting to climate change: The remarkable decline in the US temperature-mortality relationship over the twentieth century. Journal of Political Economy 124.1: 105-159

[21] https://www.braced.org/resources/i/local-and-scientific-knowledge-systems-for-weather-and-climate-services