POLICY BRIEF

How climate shapes the world, why science is an art, and why free data access and international collaborations are essential

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Understanding the Geopolitics of the Energy Transition –
a new world in the making

LSE !deas

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Together with colleagues all over the world, he aims to better understand the causes and consequences of past and present changes in the Earth's climate and environmental systems, and how tree-ring research can be optimised to contribute to biology, ecology, (paleo)climatology and human history. Ulf's credo is "Ask the right question(s) and let the data speak".

INTRODUCTION

On Wednesday 28 May 2025, at 15:24 local time, a substantial part of the Birch glacier in the Lötschen valley of the Swiss Alps detached and triggered a catastrophic rock-ice avalanche that obliterated most of the village of Blatten and nearby settlements (Büntgen *et al*., 2025a). An estimated 20 million tonnes of ice and rock travelled at a speed of up to 200 km per hour over 1200 m vertical distance to the valley floor and then nearly 200 m up the opposite slope of the valley. Preserved in Switzerland's collective memory as the largest and most devastating ever monitored rock-ice avalanches, the Blatten disaster reveals the urgent need to improve research-based policy guidance for detecting, preventing, and managing multi-hazard cascades in steep terrain, including avalanches, debris flows, and glacial lake outburst floods. While continuous monitoring and effective risk management prevented mass casualties, most parts of the world lack the means and expertise to establish such early warning systems.

This policy brief addresses the increasingly critical challenges that climate brings as it shapes our data-driven and globalised world, recommending pathways forward for policymakers to include harnessing both data and global cooperation.

CLIMATE CHANGE IN CONTEXT

The pace of recent anthropogenic warming has been described as unparalleled throughout the past 2,000 years (Esper *et al*., 2024), with more projected warming in the pipeline, and consequences for ecological and societal systems likely irreversible. Thousands of summer temperature-sensitive tree-ring measurements from undisturbed, high-elevation, sub-Alpine forest sites were used to place the Blatten disaster in the context of long-term climate change. Precise dendrochronological evidence demonstrates that the rock-ice avalanche followed the warmest decade in the European Alps since at least the early medieval era. The warmest ten-year period since 742 CE occurred from 2015 to 2024, with June-September temperatures 4.22°C warmer than the coldest ten-year period of the Little Ice Age (1812–1821). The paleoclimatic record not only stresses the rarity and fragility, as well as the importance of high-resolution, long-term climate reconstructions for contextualising current trends and extremes against past changes but also underlines the potential impact of climate warming on people and heritage.

Robust investigation of current trends and extremes in the Earth's climate system, however, requires high-resolution proxy archives, of which an insufficiently small number of well-replicated tree-ring chronologies provide annual resolution and absolute dating over the Common Era and beyond (Büntgen and Esper, 2025). In fact, our understanding of past temperature variations and our capacity to disentangle the relative contributions of anthropogenic and natural climate forcing hinges on the quality and quantity of temporally precise, seasonally distinct and spatially explicit proxy records that continuously span from centuries to millennia and exist on most continents.

The combined statistical assessment of annually resolved and absolutely dated increments of radial stem growth of forest trees can provide such information (i.e., dendroclimatology is a subfield of dendrochronology, in which precise tree-ring width, wood density and/or tree-ring stable isotopic measurements are used to reconstruct past, pre-industrial climate variability across different spatiotemporal scales). However, tree ring-based climate reconstructions are typically derived from different datasets and techniques, the ramifications of which have hitherto been little explored (Büntgen *et al*., 2021). Intriguingly, a double-blind experiment that yielded 15 Northern Hemisphere summer temperature reconstructions from a common network of regional tree-ring width datasets, revealed strong influence of subjectivity in the reconstruction process. Since science is never objective and at its best an art, policymakers should engage in routine uses of ensemble climate reconstruction approaches to provide a more consensual picture of past climate variability.

CLIMATE-DISEASE RISKS OF GLOBALISATION

The first wave of the second known plague pandemic, the Black Death, claimed much of Europe's human population in just a few years after 1347 CE. While it is accepted that the causative bacterium *Yersinia pestis* originated from wildlife rodent populations in central Asia and reached Europe via the Black Sea region, the combined assessment of tree ring-based climate reconstructions and written historical sources suggests that the timing, spread and virulence of the onset of the Black Death were not a random walk (Bauch and Büntgen, 2025). A post-volcanic climate downturn and trans-Mediterranean famine from 1345–1347 CE arguably forced the Italian maritime republics of Venice, Genoa and Pisa to activate their well-established, supra-regional supply network and import grain from the Mongols of the Golden Horde around the Sea of Azov in 1347. This famine-driven change in long-distance grain trade not only prevented large parts of Italy from starvation but also introduced the plague bacterium via grain cargo to Mediterranean harbours and fuelled its rapid dispersal across much of Europe.

Although this unique spatiotemporal coincidence of many natural and societal influences seems rare, interdisciplinary study argues for an increased likelihood of zoonotic infectious diseases to suddenly emerge and rapidly translate into pandemics, in both a globalised and warmer world – COVID-19 is just the latest warning sign. Moreover, the Black Death was not just as a striking interaction of climate, famine and disease, but an early ramification of globalisation. Modern risk assessments may therefore incorporate knowledge from well-documented climate-disease interactions that affected past societies, because the assurance and improvement of societal resilience require holistic approaches to address and tackle the wide spectrum of health risks that are likely to emerge in a warmer and more variable future climate.

ENVIRONMENTAL DRIVERS OF HUMAN BEHAVIOUR

Identifying societal and environmental factors that have influenced human history requires rational interpretation of diverse strands of reliable evidence. Cross-disciplinary studies drawing on combinations of instrumental and proxy-based climate data – as well as archaeological, historical and econometric evidence – may range from assessments of societal 'collapse' in deep history (for which the depth of underpinning arguments is often limited) to considerations of

environmental triggers of social unrest in modern times (for which the importance of interacting factors is often unclear). Far less prevalent in scientific literature are investigations of the influence of climate change on popular culture and sport.

A holistic perspective on the rise of professional skateboarding explains why the sport and its attendant cultural and behavioural qualities developed in southern California in the 1970s and not somewhere else before or after (Büntgen *et al*., 2023). In 1977 California, authorities responded to an extreme drought with an unprecedented state order to drastically reduced domestic water usage and leave countless newly-built swimming pools empty. These curved pools became 'playgrounds' for inspired surfers to develop professional vertical skateboarding in the Los Angeles area. Industrial production of polyurethane, and the advent of digital photography, laser printing and high gloss mass media further contributed to the explosive popularisation of skateboarding, creating a global subculture and multi-billion-dollar industry that still impacts music, fashion, and lifestyle worldwide.

Thorough investigation into the entanglements between cultural, commercial, environmental, and political factors in 1970s southern California shows that neither the timing nor the geographic origin of professional vertical skateboarding was random. Any drought before the 1970s could not have had the same effect, because (i) the many thousands of empty kidney-shaped pools with curved bottoms and walls were only built in the 1960s (ii) polyurethane and ball bearings had only recently become commercially available, and (iii) digital photography, video cameras, laser printing and colourful mass media did not exist. Moreover, California was the only place worldwide where an intertwined surf community and entrepreneurship were able to transform local freestyle skateboarding into professional halfpipe skateboarding. The 2001 documentary film *Dogtown and Z-boys* (directed by Stacy Peralta) already exposed the complex spatiotemporal co-dependencies of a variety of environmental, technological, and societal factors that jointly propelled a local phenomenon into a global subculture and industry. The movie not only provides an aesthetic perspective on the rise of professional skateboarding but also depicts why the sport and its attendant cultural and behavioural qualities developed in southern California in the 1970s and not somewhere else before or after (see also Reisner, 1993 for the role of *Water Wars*).

The rise of skateboarding is an example that demonstrates how even small environmental changes in the Anthropocene can influence human behaviour, and thus stimulate cultural and technical innovation, if relevant factors coincide geographically and temporally. Further to modern evidence (Kelley *et al*., 2015), there have been several studies arguing for the role of climate change in understanding human history of the distant past (deMenocal, 2001), including the rise and fall of empires (Norman *et al*., 2025), the movement of people (Hakenbeck and Büntgen, 2022), and the outbreak of pandemics (Bauch and Büntgen, 2025). The resolution, quality and/or dating of the available evidence, however, often remain debatable (Büntgen *et al*., 2022), and the causal connections between climatic changes and the functioning and productivity of ecological and agricultural systems, alongside socio-political, cultural and economic structures, are typically not understood.[1]

1 See Büntgen *et al*. (2026) for a review of the complexity of the volcano-climate-society nexus that still puzzles scholars from various disciplines.

DISTINGUISHING CLIMATE SCIENCE FROM CLIMATE ACTIVISM

While there is no doubt that past natural climate variability has played a role for societies and that there is great urgency for tackling recent anthropogenic climate change, the possiblity of climate scientists becoming climate activists is concerning. This conceptual scepticism is mainly grounded in the fundamental believe that scholars should not have *a priori* interests in the outcome(!) of their studies (Büntgen, 2024). Likewise, it is slightly worrying that activists may occasionally pretend to be scientists, as this can trigger a misleading form of instrumentalisation.

Motivated by the continuous inability of an international agreement to reduce greenhouse gas emissions to tackle global warming – despite an alarming recent rise in surface temperatures and associated hydroclimatic extremes – quasi-religious beliefs in, rather than understanding of, the complex causes and consequences of climate and environmental changes undermine academic principles. Climate science and climate activism should be separated conceptually and practically, and the latter should not be confused with science communication and public engagement. Unrestricted faith in scientific knowledge is, however, problematic because science is neither entitled to absolute truth nor ethical authority. The notion of science to be explanatory rather than exploratory is a naïve overestimation that can fuel the complex field of global climate change to become a dogmatic ersatz religion for the wider public. Even a clear-cut case like anthropogenically-induced climate change does not justify the deviation from long-lasting scientific standards, which have distinguished the academic world from socio-economic and political spheres.

As a way forward, neutral science should remain unbiased and avoid any form of selection over attribution and reductionism that would reflect a type of activism. Policymakers should continue seeking and considering nuanced information from an increasingly complex media landscape of overlapping academic, economic and public interests. Advice from a diversity of researchers and institutions beyond the Intergovernmental Panel on Climate Change and other supra-national organisations that seek to assess the state of knowledge in specific scientific fields should include critical investigations of all subjects, including anthropogenic climate change. A successful and global climate agenda requires reliable reporting of detailed and trustworthy certainties and uncertainties, whereas any form of scientism and exaggeration will be counterproductive.

CONCLUSIONS: CLIMATE DATA FOR CLIMATE ACTION

The above examples highlight the importance of high-resolution, high-quality climate reconstructions for contextualising trends and extremes of recent climate change, for disentangling the relative roles of anthropogenic and natural climate forcing factors, and for including environmental information in historical argumentation. However, political instability and geopolitical tension, together with rising nationalism, bureaucracy and economic pressure, increasingly challenge free access to, and exchange of, scientific data (both physical and digital), knowledge transfer (within and beyond academia), and research campaigns (of national and international teams around the world). To counter this, an open-data convention should be implemented by universities and institutions, academies and organisations, journals and editors, as well as funding agencies and national administrations (Büntgen *et al*., 2025b).

Further to the impacts of rising nationalism, bureaucracy and economic pressure, and the effects of academic acceleration itself (e.g., ever-growing administrative tasks and economic demands), recent geopolitical tensions hinder scientific relations and collaborations with scholars and institutions in many countries around the world. Addressing and tackling the grand challenges of global climate change, however, requires involvement of data and expertise from all regions and nations. For instance, as the world's largest country that has the longest Arctic shoreline and the largest forest biome, peatland and permafrost zones, Russia plays an important role in global climate change research (Büntgen and Rees, 2023; Rees and Büntgen, 2024). While justified and unavoidable, Russia's geopolitical and economic isolation is hindering the generation, curation and interpretation of scientific data, both space-born and ground-based. Without question, changes in the Earth's biosphere and climate system cannot fully be understood without data from the terrestrial and marine Arctic and sub-Arctic, of which more than half lies within Russian territory. Similarly, climatological and environmental insights from the boreal forest in northern North America cannot simply be extrapolated to the high-northern latitudes of Eurasia.

In line with the Russian dilemma (Rees *et al*., 2023; Rees and Büntgen, 2024), data and knowledge transfer for scholars from the western hemisphere is also becoming increasingly difficult with colleagues from China and countries in Africa and the Middle East (and vice versa). The recent rise in academic nationalism and scientific competition, rather than global cooperation, must be considered an impeding feature of modern geopolitics (Büntgen and Rees, 2023), in which short-term economic and military interests are likely to destabilise long-term transnational scientific collaborations.

Political instability in different parts of the word has impeded, and may even cease, the exchange of climate and environmental data within and between various regions, with no foreseeable improvement. For example, national and international drought monitoring programmes not only in sub-Saharan Africa but also in large parts of inner Eurasia and the Americas are dependent on real-time data access; any reduction in the quality and quantity of meteorological measurements implies potential long-term and large-scale consequences for food security and wildfire prevention, amongst others. Early action needs early warning and early warning needs detailed monitoring and rapid knowledge transfer. Counterintuitively, and in contrast to the overall exploding volume of climate data, the number of freely available meteorological measurements at the global scale has been declining during the last decade (Büntgen *et al*., 2025b).

In line with a new paradigm of more open, user-friendly access to climate data, it is necessary to establish a coordinated open-data policy far beyond existing protocols, such as those of the World Meteorological Organisation. The policy must be implemented jointly and rigorously by universities and institutions, academies and organisations, journals and editors, as well as funding agencies and governments. A universal and legally-binding climate data convention, endorsed by the majority of relevant actors, could deepen our understanding of the Earth's climate system and foster the adaptation to and mitigation of anthropogenic climate change. Free data access and exchange, as well as rigorous science communication and knowledge transfer are needed to address the grand challenges society is facing under a warmer and more variable climate. ▪

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