



A local resident gestures as he holds an empty water hose during an attempt to extinguish forest fires approaching the village of Pefki on Evia (Euboea) island, Greece's second largest island Photograph: Angelos Tzortzinis/AFP/Getty Images

Climate crisis

Climate crisis to blame for dozens of 'impossible' heatwaves, studies reveal

Exclusive: Analyses are stark evidence of how global heating is already supercharging deadly weather beyond anything ever experienced by humanity

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At least 24 previously impossible heatwaves have struck communities across the planet, a new assessment has shown, providing stark evidence of how severely human-caused global heating is supercharging extreme weather.

The impossible heatwaves have taken lives across North America, Europe and Asia, with scientific analyses showing that they would have had virtually zero chance of happening without the extra heat trapped by fossil fuel emissions.

Further studies have assessed how much worse global heating has made the consequences of extreme weather, with shocking results. Millions of people, and many thousands of newborn babies, would not have died prematurely without the extra human-caused heat, according to the estimates.

In total, studies calculating the role of the climate crisis in what are now unnatural disasters show 550 heatwaves, floods, storms, droughts and wildfires have been made significantly more severe or more frequent by global heating. This roll-call of suffering is only a glimpse of the true damage, however. Most extreme weather events have not been analysed by scientists.



People rest under a bridge to avoid scorching heat in Delhi, India, in May 2022. Photograph: Rajat Gupta/EPA

The new database of hundreds of studies that analyse the role of global heating in extreme weather was compiled by the website Carbon Brief and shared with the Guardian. It is the only comprehensive assessment and provides overwhelming proof that the climate emergency is here today, taking lives and livelihoods in all corners of the world.

The studies have examined the impacts resulting from about 1.3C of global heating to date. The prospect of 2.5C to 3.0C, which is where the world is

headed, is therefore catastrophic, warn the scientists. They urge the world's nations meeting at the Cop29 climate summit in Azerbaijan to deliver deep and rapid cuts to carbon emissions and to fund the protection desperately needed by many communities against now-inevitable climate disasters.



Environmental activists protest to urge world leaders to commit to a strong climate finance deal during the Cop29 conference, in Baku, Azerbaijan. Photograph: Maxim Shemetov/Reuters

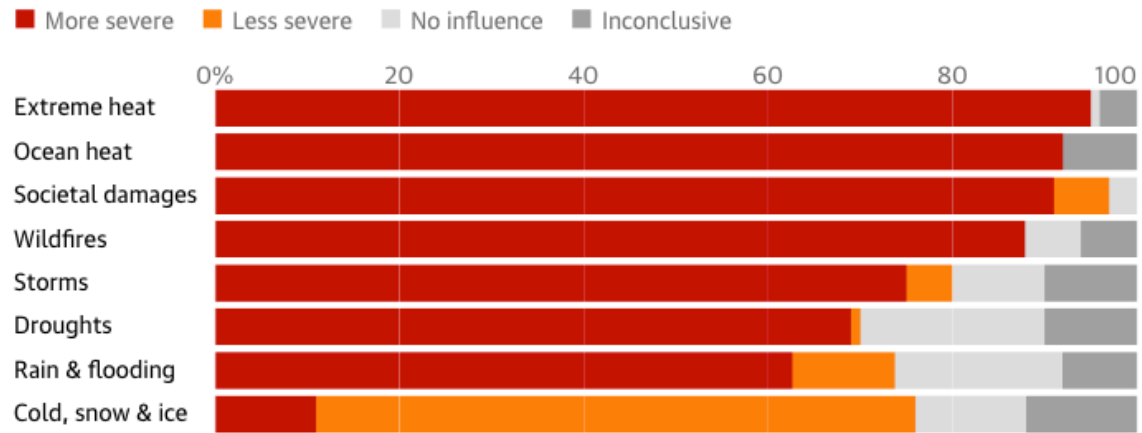
The science of determining the role of global heating in extreme weather events is called attribution. In its early days, more than a decade ago, the relatively subtle influence detected was likened to finding the fingerprints of climate change. Today, the influence is so obvious that the researchers are instead like eye witnesses to a crime.

“Some say climate scientists shouldn’t paint a picture of doom and gloom. But we are humans, we have feelings, we have children,” said Dr Joyce Kimutai at Imperial College London, UK, part of the World Weather Attribution group and an adviser with Kenya’s Cop29 delegation.

“The increasing role of climate change in the intensities of extreme weather events is definitely worrying,” she said. “And if this continues it’s really going to be difficult for everyone. The climate crisis is not discriminating how it affects people. It’s hitting every part of the world.”

Human-caused global heating is making extreme weather more severe and frequent

Percentage of studies that found a strong link to global heating for a range of types of extreme weather



Guardian graphic. Source: Carbon Brief

Kimutai said the attribution studies show the “critical need” for a huge increase in the funding for protecting people from extreme weather, especially those communities already vulnerable to heatwaves, floods and storms. She said levels of funding were “strikingly and painfully insignificant compared with needs”. Delivering at least a trillion dollars of finance is a key task for negotiators at [COP29](#) in Azerbaijan.

“The sheer weight of this evidence reinforces the impact that human-caused warming is having today – not at some far-off point in the future,” said Robert McSweeney, at Carbon Brief, who compiled the database.



People look at the damage caused by freak floods in Derna, eastern Libya, in September 2023. Photograph: AFP/Getty Images

The impossibles

The impossible extreme weather events, ie those with a vanishingly low probability of happening without the turbocharge of human-caused global heating, are particularly striking.

They show that the burning of fossil fuels has so dramatically changed the climate that heatwaves are hitting communities with a severity and frequency never seen during the entire development of human civilisation over the past 5,000 years. It is a new world, for which cities, hospitals, roads and farms are unprepared, and a world that gets even more dangerous every day as carbon emissions continue to be pumped into the atmosphere.



Military personnel stand next to El Poyo ravine in the flood-hit municipality of Picanya, Valencia. Photograph: Villar López/EPA

Nowhere is safe. In the last two years, previously impossible heat struck from the Mediterranean to Thailand, and from the Philippines to the highly vulnerable populations in Sahel in Africa at the end of Ramadan. In the two years before that, both North America and Europe sweltered in unprecedented heat, along with South Korea and even the icy Tibetan plateau.

The trail of impossibly scorched earth stretches back even further: China and Russia and the Arctic – where one town recorded 38C – in 2020, Europe again in 2019 and swathes of the northern hemisphere in 2018.

The earliest recorded impossible heatwaves were in 2016, when in fact the heat the entire planet then endured could not have occurred without global heating. The oceans have also suffered, with impossible marine heatwaves striking the Tasman Sea, north-east Pacific and Arctic ocean in recent years.

Many other extreme events have been made far more likely, heavily loading the weather dice. The sweltering heat in northern India and Pakistan in May 2022 was made 100 times more likely, as was the torrential rain that caused appalling flooding in Libya in September 2023 and the Amazon river basin drought in 2023.

The consequences

Attribution scientists are no longer only analysing the extreme weather events themselves but also making the human cost tangible by estimating how much of the damage caused would have been avoided if fossil fuel burning had not heated the world.

One study has found that one in three newborn babies that died due to heat would have survived if global heating had not pushed temperatures beyond normal bounds – that is about 10,000 lost babies a year. The study assessed low and middle income countries from 2001-2019.

Another study of heat-related deaths in summer from 1991-2018 also found a deadly impact of global heating in the 43 countries assessed. Extrapolating these findings to a global figure is not straightforward, but an approximate estimate given by the scientists is more than 100,000 deaths a year. Over the two decades, that implies a toll of millions of lives due to the climate crisis.



Water flows into neighbourhoods from Tropical Storm Harvey in Houston, Texas, in August 2017. Photograph: David J Phillip/AP

The deadly supercharging of extreme weather is not new – it has existed for at least 20 years, largely undetected. But more than 1,000 people who died prematurely in the UK in the 2003 heatwave would have lived without global heating.

More recently, the increased intensity of 2017's Hurricane Maria, fuelled by climate change, was the reason for 3,700 deaths in Puerto Rico, while 13,000 people would not have been forced from their homes by Tropical Cyclone Idai in Mozambique in 2019 without global heating.

Global heating is destroying homes as well as lives. Hurricane Harvey would not have flooded 30%-50% of the US properties that it did submerge in 2017 without global heating.



A man walks amid destruction on a street September 23, 2017 in Roseau on the Caribbean island of Dominica following passage of Hurricane Maria. Photograph: Cedrick Isham Calvados/ AFP/Getty Images

It has driven up the price tags of hurricane destruction by billions of dollars, such as Hurricane Sandy in the US in 2012 and Typhoon Hagabis in Japan in 2019. Four major floods in the UK would have caused only half the \$18bn of wrecked buildings were it not for human-caused climate change.

Adding to this litany of destruction is the loss of crops in the US and Southern Africa, with global heating responsible for taking billions of dollars worth of food off people's table. It is changing cultural events too, playing a major part in the early flowering of the famous cherry trees in Kyoto, Japan, the earliest date in more than 1,200 years of records.

The details

The 744 attribution studies collated by Carbon Brief used weather data to compare extreme events in today's heated climate with the same events in computer models of the climate that existed before large-scale fossil fuel burning. This comparison allows the scientists to calculate how much more likely and severe the extreme event was today, revealing the role of human-caused global heating in worsening the event.

Three-quarters of the analyses of extreme weather events found global heating made them more severe or more likely to occur. A further 9% were made less likely, as would be expected as these were mostly extreme cold and snow events. The rest found either no discernible influence of global heating or were inconclusive, in part due to lack of sufficient data. The analysis includes studies published up to the end of September 2024.

Major parts of the world, outside Europe, North America and China, have been little studied by attribution scientists, leaving the true impacts of the climate crisis underreported. Issues include lack of long term weather data and scientific capacity. There are particularly few in the Middle East and North Africa, despite these regions being both among the hardest hit and the biggest fossil fuel producers.