

Extreme global weather is 'the face of climate change' says leading scientist

Exclusive: Prof Michael Mann declares the impacts of global warming are now 'playing out in real-time'

Damian Carrington *Environment editor*

@dpcarrington

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Emergency workers among damaged vehicles in an open parking area of northern Athens after a flash flood struck the Greek capital. Photograph: Angelos Tzortzinis/AFP/Getty Images

The extreme heatwaves and wildfires wreaking havoc around the globe are “the face of climate change”, one of the world’s leading climate scientists has declared, with the impacts of global warming now “playing out in real time”.

Climate change has long been predicted to increase extreme weather incidents, and scientists are now confident these predictions are coming true. Scientists say the global warming has contributed to on the scorching temperatures that have baked the UK and northern Europe for weeks.

The hot spell was made more than twice as likely by climate change, a new analysis found, demonstrating an “unambiguous” link.

Extreme weather has struck across Europe, from the Arctic Circle to Greece, and across the world, from North America to Japan. “This is the face of climate change,” said Prof Michael Mann, at Penn State University, and one the world’s most eminent climate scientists. “We literally would not have seen these extremes in the absence of climate change.”

“The impacts of climate change are no longer subtle,” he told the Guardian. “We are seeing them play out in real time and what is happening this summer is a perfect example of that.”

“We are seeing our predictions come true,” he said. “As a scientist that is reassuring, but as a citizen of planet Earth, it is very distressing to see that as it means we have not taken the necessary action.”

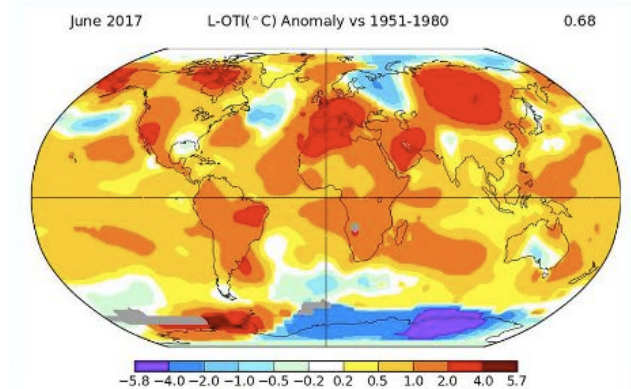
The rapid scientific assessment of the northern European heatwave was done by Geert Jan van Oldenborgh, at the Royal Netherlands Meteorological Institute and also colleagues in the World Weather Attribution (WWA) consortium. “We can see the fingerprints of climate change on local extremes,” he said.

The current heatwave has been caused by an extraordinary stalling of the jet stream wind, which usually funnels cool Atlantic weather over the continent. This has left hot, dry air in place for two months – far longer than than usual. The stalling of the northern hemisphere jet stream is being increasingly firmly linked to global warming, in particular to the rapid heating of the Arctic and resulting loss of sea ice.

Prof Mann said that asking if climate change “causes” specific events is the wrong question: “The relevant question is: ‘Is climate change impacting these events and making them more extreme?’, and we can say with great confidence that it is.”

Mann points out that the link between smoking tobacco and lung cancer is a statistical one, which does not prove every cancer was caused by smoking, but epidemiologists know that smoking greatly increases the risk. “That is enough to say that, for all practical purposes, there is a causal connection between smoking cigarettes and lung cancer and it is the same with climate change,” Mann said.

Other senior scientists agree the link is clear. Serious climate change is “unfolding before our eyes”, said Prof Rowan Sutton, at the University of Reading. “No one should be in the slightest surprised that we are seeing very serious heatwaves and associated impacts in many parts of the world.”



Surface Temperature in 2017 and 2018. Source: GISS/NASA

Surface Temperature in 2017 and 2018. Source: GISS/NASA

It is not too late to make the significant cuts needed in greenhouse gas emissions, said Mann, because the impacts progressively worsen as global warming increases.

“It is not going off a cliff, it is like walking out into a minefield,” he said. “So the argument it is too late to do something would be like saying: ‘I’m just going to keep walking’. That would be absurd – you reverse course and get off that minefield as quick as you can. It is really a question of how bad it is going to get.”

Heatwave made more than twice as likely by climate change, scientists find

Fingerprints of global warming clear, they say, after comparing northern Europe’s scorching summer with records and computer models

Damian Carrington *Environment editor*

@dpcarrington

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The dried-out riverbank of Elbe in Magdeburg, eastern Germany ... climate change link to heatwave proven, scientists say. Photograph: Tobias Schwarz/AFP/Getty Images

The heatwave searing northern Europe was made more than twice as likely by climate change, according to a rapid assessment by scientists.

The result is preliminary but they say the signal of climate change is “unambiguous”. Scientists have long predicted that global warming is ramping up the number and intensity of heatwaves, with events even worse than current one set to strike every other year by the 2040s.

“The logic that climate change will do this is inescapable – the world is becoming warmer, and so heatwaves like this are becoming more common,” said Friederike Otto, at the University of Oxford and part of the **World Weather Attribution** (WWA) consortium that did the work.

“What was once regarded as unusually warm weather will become commonplace, and in some cases, it already has,” she said. “So this is something that society can and should prepare for. But equally there is no doubt that we can and should constrain the increasing likelihood of all kinds of extreme weather events by restricting greenhouse gas emissions as sharply as possible.”

The **new analysis is a climate-change attribution study**. By comparing extreme weather with historical measurements and with computer models of a climate unaltered by carbon emissions, researchers can find how much global warming is increasing the risk of dangerous weather.

The researchers analysed records of the hottest three-day period at seven weather stations in northern Europe, from Ireland to the Netherlands to Scandinavia, where data was easily accessible.

“We found that for the weather station in the far north, in the Arctic Circle, the current heatwave is just extraordinary – unprecedented in the historical record,” said Geert Jan van Oldenborgh, at the Royal Netherlands Meteorological Institute and also part of WWA.

Across northern Europe, the group found global warming more than doubled the risk of scorching temperatures. “We can see the fingerprints of climate change on local extremes,” he said. “It is amazing now that it is something you can really see at a local level.”

“Most heatwave studies have been done on large scale averages, so European-wide temperatures,” said Otto. “In this study, we have looked at individual locations, where people live, to represent the heatwave people are actually experiencing.” The analysis is a preliminary study as a full study requires many climate models to be run on high-powered computers, which takes months.

Previous attribution analyses have shown very strong connections between climate change and extreme weather events. The scorching summer in New South Wales, Australia, in 2016-17 was made **at least 50 times more likely** by global warming, meaning it can be “linked directly to climate change”, said the scientists.

The “Lucifer” heatwave across Europe’s Mediterranean nations in 2017 summer was made **at least 10 times more likely** by climate change, while the unprecedented deluge delivered in the US by Hurricane Harvey also in 2017 was made **three times more likely by climate change**, new research has found. However, other events, such as storms Eleanor and Friederike, which hit western Europe in January, **were not made more likely by climate change**, according to the scientists.

In Europe, the heatwave has been caused by the stalling of the jet stream wind, which usually funnels cool Atlantic weather over the continent. This has left hot, dry air in place for two months – far longer than usual. The stalling of the northern hemisphere jet stream is being **increasingly firmly linked to global warming**, in particular to the rapid heating of the Arctic and resulting loss of sea ice.

The role of climate change in driving extreme weather events may actually be underestimated by these attribution studies, according to **Prof Michael E Mann** at Penn State University in the US. The work is good, he said, but computer models cannot yet reliably account for the complex jet stream changes caused by global warming, making the attribution studies “inherently conservative”.

Serious climate change is “unfolding before our eyes”, said Prof Rowan Sutton, director of climate research at the University of Reading. “No one should be

in the slightest surprised that we are seeing very serious heatwaves and associated impacts in many parts of the world.”

The wide geographical spread of the heatwave, right across four continents, points to global warming as the culprit, **said** Prof Peter Stott, a science fellow at the UK’s Met Office: “That pattern is something we wouldn’t be seeing without climate change.”

The heatwave across northern Europe has seen **wildfires in the Arctic Circle** and prolonged heat across the UK and the European continent. In the south, fierce blazes have **devastated parts of Greece**, with **scores of people killed**.

But extreme weather has struck across the globe. **Severe floods** killed at least 220 people in Japan in early July, with the nation then hit by an **“unprecedented” heatwave** that peaked at 41.1C and left 35,000 people in hospital. In the US, **extreme heat in the west is feeding wildfires**, with Yosemite national park being evacuated, while flooding is affecting the east.

Temperature records have also fallen in Taiwan, with a temperature of 40.3C in Tianxiang, and in Ouargla in Algeria’s Sahara desert, which reported a maximum temperature of 51.3C, the highest temperature ever reliably recorded in Africa. The first six months of the 2018 are the hottest recorded for any year without an El Niño event, a natural climate cycle that raises temperatures.

Why is Europe going through a heatwave?

Scientists say this ‘extreme’ weather in the northern hemisphere may soon be the norm

Adam Vaughan

@adamvaughan_uk
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Green Park in London belies its name as extreme heat turns grass brown. Photograph: Facundo Arrizabalaga/EPA

Why is it so hot?

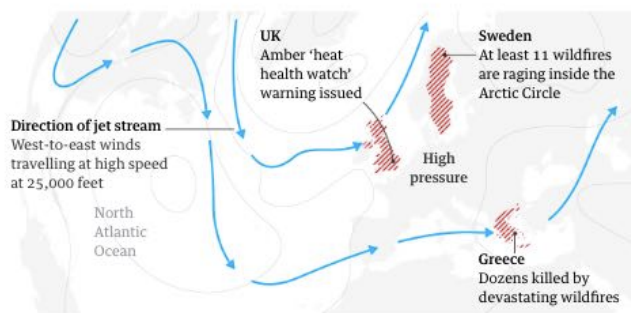
Partly, it’s just the luck of the weather. The jet stream – the west-to-east winds that play a big role in determining Europe’s weather – has been further north than usual for about two months. A stationary high-pressure weather system has left the **UK and much of continental Europe sweltering**. Iceland, by contrast, has been hit with clouds and storms that would normally come further south.

The jet stream’s northerly position may have been influenced by temperatures in the north of the Atlantic, which have been relatively warm in the subtropics and colder south of Greenland.

“The current hot and dry spell in the UK is partly due a combination of North Atlantic ocean temperatures, climate change and the weather,” said Len Shaffrey, a professor of climate science at the University of Reading.

The influence of climate change on the jet stream is still being explored.

The jet stream has been further north than usual allowing high pressure to develop without being swept away



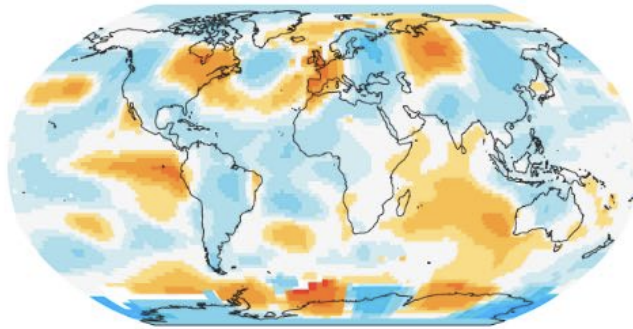
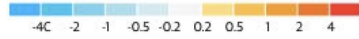
Guardian graphic. Source: Accuweather

Is climate change to blame?

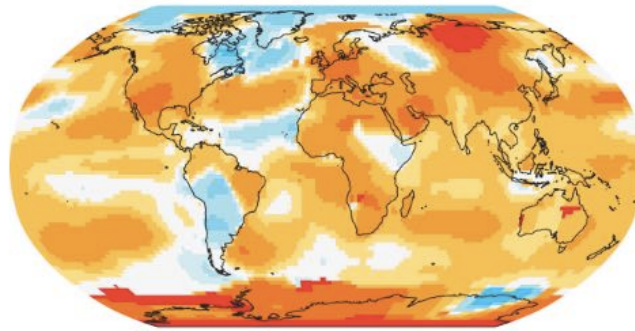
The heatwaves in the northern hemisphere are undoubtedly linked to global warming, scientists say. “There’s no question human influence on climate is playing a huge role in this heatwave,” said Prof Myles Allen, a climate scientist at the University of Oxford.

During the **1976** heatwave UK temperatures were further above the average than in most parts of the world

Variation from 1951 - 1980 average



But the heatwave of **2018** is much more widespread, with most of the world hotter than usual



Source: NASA Goddard Institute for Space Studies | Maps compare June 1976 to June 2018

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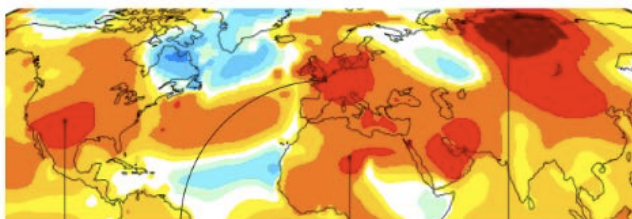
On Thursday the university will publish an analysis of how much more likely climate change made Europe's current heatwave. Similar heatwaves have happened in the past when the planet was cooler – the world was two-thirds of a degree celsius cooler in 1976, a notably hot year in the UK. But climate change made them happen more often, Allen said.

Prof Peter Stott, a science fellow at the Met Office, said global warming of 1C since the industrial revolution was clearly making extreme heat more likely. "It is increasing quite significantly the risk of such a heatwave. The temperatures of 30C (86F) and above this week have gone from being a very rare occurrence to, not a frequent occurrence, but much more likely," he said.

The wide geographical spread of the heatwave, right across four continents, also points to global warming as the culprit. "That pattern is something we wouldn't be seeing without climate change," Stott said.

Global surface temperatures in June 2018 averaged 0.78C higher than normal

Variation from 1951 - 1980 average



North America
2018 ranked as the sixth warmest June since continental records began in 1910

Europe
Several countries had temperatures that ranked among the six warmest Junes on record

Africa
Fourth highest June temperatures since 1910

Asia
Seventh highest June temperature on record

Guardian graphic. Source: Nasa, NOAA

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Guardian graphic. Source: Nasa, NOAA