A personal take on science and society

# World view

By Richard A. Betts

## Heed blame for extreme weather

**Now that specific floods, heatwaves and more can be attributed to our actions, decision makers can act.**

In 2019, daily maximum temperatures met or broke historical records in more than 24 cities in southwest China. In Yunnan province, a severe drought from March to June caused drinking-water shortages for 2 million people and crop failures over at least 13,500 square kilometres of farmland, with a direct economic loss of about 6.6 billion yuan (about US$1 billion). The chances of those extreme levels of hot and dry conditions occurring concurrently are an estimated 43% higher owing to anthropogenic climate change. A forest fire in the region killed 31 firefighters. The conditions favouring such fires have been made around 7 times more likely by climate change.

In Canada that year, heavy rainfall led to floods that caused thousands of people to evacuate and about Can$200 million (US$157 million) in insured losses; this event was up to 3 times more likely owing to climate change. That August, Hurricane Dorian dropped half a metre of rain on the Bahamas; climate change increased the chances of such precipitation by 5–10%.

These are just a few of the specific heatwaves, floods and events that my colleagues who work on 'climate attribution' can now show were made more likely by human impact (these and more are showcased this week in a special issue of *Bulletin of the American Meteorological Society*; S. C. Herring *et al. Bull. Am. Meteorol. Soc.* **102**, S1–S112; 2021). Now, these techniques should be applied routinely to help governments, organizations and communities to act on their responsibilities and improve resilience to extreme weather.

For too long, weather's randomness has kept events such as these from being blamed squarely on climate change. Reporters in the late 1990s and early 2000s would ask climate scientists about climate change's role in a weather-related disaster. All we could say was that we'd expect to see more of these events. Now, we can specify increased chances for specific events. This extends to forecasts: we can identify the places that are more likely to see wildfires, mudslides and fish die-offs. Such calculations dent both climate denial and a false sense of security. They take away the argument that 'extreme weather happens anyway, so we don't need to worry about it'. Extreme weather happens — and these metrics pinpoint what is becoming more likely, by how much and why.

The randomness of weather is still a challenge, but physics-based calculations of the workings of the global atmosphere can simulate numerous ways in which the weather could have played out, and compare that with versions of how the weather would have looked in the 'world that might have been' without human influence. This lets us estimate how anthropogenic climate change shifted the odds of a drought, heatwave or heavy rain event.

> **"Knowing how much more likely heavy rains or heatwaves are can help to prepare for events that are no longer too improbable."**

The most crucial use of this information is to make planning more pragmatic. Putting numbers on the increased likelihood of weather extremes increasingly informs my work on climate-change risk assessments, which in turn helps policymakers and planners to apply these methods to saving lives and livelihoods.

Knowing how much more likely heavy rains or heatwaves are can help those who manage grids, roads and rivers to prepare for events that are no longer too improbable to worry about. After major flooding in 2007, UK electricity-transmission and electricity-distribution companies implemented flood-protection measures for substations; quantifying how climate change is increasing flood risk helped to convince the industry regulator that the investment was necessary.

This sort of planning needs to happen as a matter of course. One thing I have found particularly frustrating is that, although houses in my area are now rightly made to be energy-efficient, many are not yet able to cope with hotter weather. (Happily, the UK government launched a consultation related to the topic this month.) Building codes and highway designs are set locally, and are often based on past weather patterns. Drains are built to cope with a certain level of heavy rainfall, say, the highest seen in the past century. Railways and electricity-distribution networks are designed to withstand certain temperatures. For example, in the United Kingdom, a well-maintained railway track should not be vulnerable to buckling below 39 °C. Poorly maintained tracks buckle at lower temperatures. As yet, the highest UK temperature officially on record is 38.7 °C on 25 July 2019 in the Cambridge Botanic Garden, but exceeding 35 °C is now a one-in-5-year event rather than one in 10–15 years, and the chances of 40 °C are no longer negligible.

Such evidence is also useful for legal proceedings when citizens call corporations or governments to account for their role in climate change, or are on trial for taking the law into their own hands. Although the courts, not climate scientists, make judgements on these matters, the legal process needs to be informed by objective, authoritative scientific evidence; published, peer-reviewed science is crucial. I relied on this to provide an expert-witness statement for the trial of an Extinction Rebellion activist arrested after obstructing the main road on Waterloo Bridge in London. For a case against 33 European countries brought by 6 Portuguese youth applicants, the non-profit science and policy institute Climate Analytics prepared an expert report (see go.nature.com/3qmv) centring on the evidence for climate change's rising threat to their lives.

The latest set of extreme-event attribution studies provides yet more evidence, and a reminder that these risks will continue to rise until emissions fall to net zero. We must also learn to adapt, and fast.

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