

The blame game

Who will pay for the damaging consequences of climate change?

Myles R. Allen and Richard Lord

Last year one of us (M.R.A.) wrote a Commentary in *Nature*, asking if it would ever be possible to sue anyone for damaging the climate¹. At the time, this was largely a thought experiment, as the scientific and legal arguments were too immature to provide a satisfactory answer. But in this week's issue, Peter Stott, Daithi Stone and M.R.A. provide some scientific justification for revisiting that question². Their paper considers how much human influence on climate could be 'to blame' for the southern European summer heatwave of 2003.

After the cold and wet summer of 2004, this might seem a bit of a mug's game. But for scientists, the contrast between these two summers graphically illustrates the role of chaos and chance in climate. Stott and colleagues show that using risk and probability analysis makes it possible to quantify a link between external inputs (such as greenhouse gases) and specific weather events.

Linking responsibility for damage directly to greenhouse-gas emissions has always been a taboo subject in the climate-change debate. But some of us may, unwittingly, already be paying the costs of adapting to climate change. As emission targets for greenhouse gases will take decades to have any discernible effect, the critical issue for most people today is not climate treaties, but working out who will pay the costs of adaptation³, and compensation for those who cannot adapt.

Playing the odds

Stott and colleagues do not suggest that 'but for' past greenhouse-gas emissions the 2003 heatwave could not have occurred, nor that such heatwaves will now happen every year. The immediate cause of the heatwave was a persistent anticyclone over northwest Europe⁴ — no one could sensibly claim that greenhouse gases caused that particular anticyclone. Instead, Stott *et al.* argue that we have loaded the weather dice — that human influence on climate has increased the risk of an anticyclone causing a heatwave like that of 2003 by around a factor of four. They also estimate with higher confidence (a 10% chance of being wrong) that more than half the risk of such a heatwave was due to human influence, primarily greenhouse gases. That may sound frustratingly convoluted, but uncertain estimates of relative risk are all that will ever be scientifically defensible.

If a dice is loaded to come up six, and it comes up six, there is a clear sense in which the loading 'helped cause' the result. If the loading doubles the chance of a six, it follows that half the sixes you get are caused by the loading. The question of 'which sixes?' is meaningless. If you throw a one, it does not prove the dice was not loaded, so the 2004 washout has almost no effect on conclusions about 2003. We say 'almost', because if we now get 20 years of summers like that of 2004, the scientific community might have to revise its



The 2004 lawsuit by eight US states and New York City aims to force five power companies to reduce carbon dioxide emissions.

conclusions about the loading in 2003, and a number of people would have egg on their face. Like any scientific statement, Stott and colleagues' claims are falsifiable. But they represent a conservative assessment of what can be said in the light of current knowledge.

Let us assume subsequent studies focusing on smaller scales, such as the Paris region, also find a substantial role for human influence in loading the dice (what studies of smoking and cancer call the 'fraction attributable risk') for the weather that summer. This is by no means guaranteed. On the one hand, the smaller the scale considered, the less predictable will be the relationship between global greenhouse-gas concentrations and local temperatures, and therefore the values of attributable risk might fall¹. On the other hand, local temperature anomalies in 2003 (see map, overleaf) were more extreme than changes to the regional-scale seasonal average, and correspondingly less likely to have occurred by chance in an unmodified climate⁵, which might push up values of attributable risk. So it could go either way. This matters, because the area-averaged temperature for southern Europe studied by Stott and colleagues didn't kill anyone, unlike the temperature in Paris.

The French authorities estimate that the 2003 heatwave caused more than 14,000 'excess deaths' nationwide⁶. The number for which the temperatures were the principal cause of death would be lower, but could still run into thousands. Suppose it is confirmed, at a reasonable level of confidence, that past greenhouse-gas emissions doubled the risk of these local temperature anomalies. This would surely meet or exceed the threshold at which a court might conclude those emissions were, in a loaded-dice sense, likely to have been a 'legally effective' cause of death and hence that some victims might have grounds to claim compensation against those responsible for the emissions⁷. There are complications: mortality rates normally go up in the winter, so it might well be argued that some of the elderly victims would have died in the next few months anyway, although the spike in August 2003 exceeded even the annual cycle⁸.

Dangerous games

The 1992 United Nations Framework Convention on Climate Change commits its signatories to stabilize greenhouse-gas concentrations at levels that would "prevent dangerous anthropogenic interference with the climate system". Evidence that past greenhouse gas emissions are already, in a statistical sense, killing people makes the convention's goals seem more urgent than ever. But it also makes it clear that they are unachievable, at any conceivable stabilization level, if we apply the word 'dangerous' to vulnerable groups such as poor elderly Parisians. The convention makes greenhouse gases sound like any other regulated pollutant — provided we keep levels below some internationally specified limit, all will be well. They aren't, and it won't. Emitting greenhouse gases is dangerous. So are many other productive activities, such as building hydroelectric dams. But those killed or rendered homeless when a dam bursts generally have some legal redress, ideally from those who benefit from the energy produced by the dam. What will happen in the case of those killed or rendered homeless by climate change?

It is important to keep the risks in perspective — Stott *et al.* conclude that 2003 was still an improbable event, even allowing for human influence on climate, although the risks are changing rapidly (their model suggests that by mid-century, 2003 would be an average summer). So you have to be particularly

unlucky and vulnerable to be personally at risk from climate change today. Risks to property may turn out to be much more significant in the short term. The reason is that something has to happen (such as a heatwave) to kill people — the dice has to roll. It could happen next year, or it could not happen for a decade. But in any well-developed financial system, it only takes the discovery that the dice is loaded to reduce the value of property immediately. If you are buying property in the Maldives, it will be hard to argue you are an innocent victim of climate change when the sea level rises, and you would be well advised to take this into account when agreeing a price. Consequently, it is the current owners who may bear the cost of future climate change — even though they won't be around when the islands finally submerge.

Talk of stabilization targets and 'dangerous climate change' focuses attention on the relatively distant future, but in fact, much of the financial adjustment to climate change may be happening right now, under our noses. As with the deaths from the heatwave, individual cases will be hard to pin down. Is it hard to sell the house because of rumours of increasing flood risk, or because the neighbours built that hideous conservatory? Is it hard to sell the farm because of concerns over water supplies for the next 20 years, or because cotton prices happen to be low? In the world of markets and perceptions, things can happen much faster than the pace of climate change itself. As markets race to adjust residential, commercial and agricultural property values to reflect new risks due to climate change, there will be winners as well as losers, but it seems unlikely that the winners will rush to give away their windfall, whereas we can be sure the losers will be looking for someone to blame.

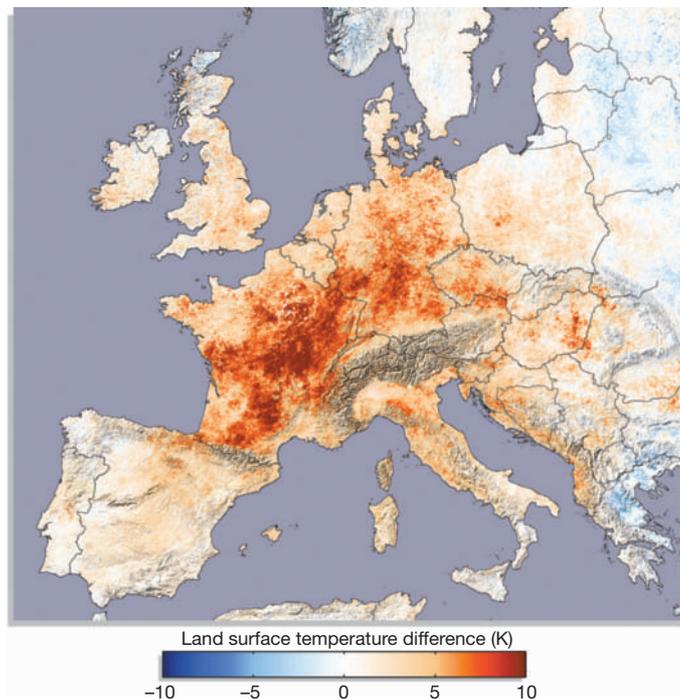
Other legal questions about whether emitters should have foreseen damage, and their fault or negligence, will present formidable hurdles to claimants. If European summer temperatures continue to evolve as Figure 1 in Stott and colleagues' paper suggests, it will become increasingly hard to argue that any resulting damage was unforeseeable. But fundamental issues will remain. As there are no direct observations of what the European climate of 2003 would have been like if greenhouse-gas emissions had not occurred, quantifying human contributions to risks will always depend on computer simulations. How would a court view this kind of evidence? In principle it should be admissible: computer simulations are not unknown in the courtroom, however unnerving climate modellers may find it to have the tools of their trade being picked over by skilled defence lawyers.

Cause, chaos and the courts

They may not have to look very far. Preliminary studies suggest that a substantial fraction of our current elevated level of carbon dioxide might be traced to products produced, sold or used by only a few dozen major companies⁹. Until now, most of the legal focus has been on regulations, but litigation in relation to greenhouse-gas emissions is increasingly likely, and has already started. Over this summer, eight US states and New York City filed a lawsuit against five US power companies for their contribution to climate change.

A key objection raised by defendants in

such cases¹⁰ is that the plaintiffs cannot demonstrate actual harm arising from greenhouse-gas emissions. This situation may be changing as the science of attribution matures, although the study by Stott and colleagues shows that — even for highly unusual events — it will almost always be impossible to say that 'but for' greenhouse-gas emissions this event would never have occurred. Notably, English law takes a more flexible approach to questions of causation, with a 2002 case in the House of Lords (*Fairchild v. Glenhaven*) suggesting that "material increase in risk" may sometimes be an appropriate test.



Land surface temperatures for summer 2003, relative to the summers of 2000–04. From NASA's Moderate Resolution Imaging Spectrometer, courtesy of R. Stockli.

Litigation and regulation on climate change will become increasingly intertwined,

as court decisions will be influenced by regulatory policy and regulators will increasingly have to consider how their decisions affect liability. In the United States, the power generators sued have argued that government policies are responsible for controls on climate change, whether pursued domestically or internationally, and so this precludes private lawsuits¹⁰ (what one might call the 'relax, the federal government is in control' defence). In Britain, a private law of right to compensation can only be excluded by a regulation or statute that clearly has this effect. Current UK policy is to persuade emitters to do something rather than nothing, even if that something does little to avoid damage or maximize its mitigation. So, it seems unlikely that implementing and complying with current and proposed emission regulations will take away anyone's right to sue.

How can current emitters best respond? To begin with, they could seek clarification of what participation in a carbon emissions trading scheme actually means. As the law stands at present, such participation should probably not be seen as an insurance policy against future liability, although many may like to think of it that way. In responding, governments will have to consider the implications carefully. If they grant indemnity from liability to encourage participation in emission trading, are they prepared to take on that liability themselves (apart from the obvious 'moral hazard' issue of transferring the cost from today's emitters to tomorrow's taxpayers)?

Although these ideas may seem far-fetched now, we could one day see Californian farmers suing member states of the European Union for authorizing emissions that threatened the security of their water supplies. Whatever the weather in Europe next summer, we can be sure that the argument over who pays for the cost of climate change is here to stay.

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