

Acts of God, human influence and litigation

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Developments in attribution science are improving our ability to detect human influence on extreme weather events. By implication, the legal duties of government, business and others to manage foreseeable harms are broadening, and may lead to more climate change litigation.

Advances in the science of extreme weather event attribution have the potential to change the legal landscape in novel ways. Identifying the human influence in events once known as ‘acts of God’ is likely to inform litigation relating to claims and liability for damages. Attribution science is also leading to better predictions of the expected severity of certain types of weather-related natural disasters. Such a shift in our understanding of extreme events could have legal implications for decision-makers with a duty to manage foreseeable harm and plan for the future.

Litigation may play an important role in reducing greenhouse gas emissions in the absence of enforceable commitments from government¹. Despite the shifting sands of climate politics — or perhaps because of them — the courts are being asked to play an increasing role in apportioning responsibility for loss and damage resulting from climate change².

Improvements in attribution science are affirming the foreseeability of certain climatic events and patterns in specific locations, and in identifying increasing risks of consequential impacts on property, physical assets and people. Such improvements are key from a legal point of view, because foreseeability of damage is an important requirement to establish a duty of care in many legal systems.

Determining the foreseeability of an action, event or loss may therefore inform common-law-based litigation related to directors’ and officers’ liability, professional, sovereign, premises and product liability, and more. The question is not whether there will be another wave of climate-related litigation — the wave is already in motion. The question instead is whether it will be more successful than previous efforts³.

We expect that evidence from attribution science will catalyse future climate change litigation. Such cases are likely to involve

actors such as local government agencies, built-environment professionals, and companies and their directors alleged to have had duties of care or special knowledge about specific climate-related risk (Box 1).

Claims are likely to arise when those actors fail to share or disclose relevant knowledge, or fail to take adaptation actions that would have protected those to whom they owed a duty of care. Such litigation may become an important driver of both mitigation of greenhouse gas emissions and adaptive action by both public and private sectors.

Attribution science

Probabilistic event attribution is the science of seeking to determine the extent to which anthropogenic climate change has altered the probability or intensity of a particular weather event or class of weather events, with an assignment of statistical confidence⁴. Existing methodologies have been deemed robust by the National Academy of Sciences, though uncertainties remain and confidence is far higher in studies of extreme heat and cold events⁵.

Event attribution is a relatively new discipline that developed in response to interest from outside the scientific community in the extent to which damaging extreme events can be attributed to human-induced climate change or natural climatic variability, or both.

The primary approach used is to compare the changes in the observed record over time with climate model simulations. The ‘real world’, defined through observations and models, is compared to a ‘counterfactual world’ modelled without human forcings (greenhouse gases and aerosols), an approach that allows isolation and analysis of the influence of anthropogenic factors.

In 2004, an attribution study analysed the link between anthropogenic climate change and the 2003 European heatwave (Fig. 1)⁶. Since then, the conclusions of

event attribution studies have become more confident — qualitatively and quantitatively — in their expression of the (probabilistic, not deterministic) causal relationship between anthropogenic greenhouse gas emissions and certain extreme weather events. In addition, the ability of scientists to differentiate between natural and human-caused drivers of temperature extremes, droughts and heavy rain events has improved markedly⁷.

The soundness of the scientific conclusions are evaluated based on the three pillars of attribution science: the quality of the observational record; the ability of models to simulate the event being studied; and scientific understanding of the physical processes that drive the event and how they are being impacted by climate change.

It should be noted that all attribution studies express their findings in probabilistic terms, as scientists reject the notion that deterministic attribution of weather events is ever possible — because it is impossible to say that the event would ‘never’ have occurred in the ‘counterfactual’ world⁸. We wish to emphasize, however, that this does not diminish the utility of attribution science for the law and liability.

In the UK, courts considering occupational exposure to toxic substances have accepted probabilistic evidence as proving causation when such evidence demonstrates that the risk of the event occurring was increased by a factor of 2:1, known as the doubling-of-the-risk test^{9–12}. In the US, toxic tort litigation has adopted similar tests for situations where deterministic causation is impossible, known as proximate cause^{13–16}.

In addition, the law in civil cases accepts as proven any evidence that is shown to be correct ‘on the balance of probabilities’ or ‘more likely than not’ (that is, with certainty of >50%). Indeed, a British judge has stated: “...in the event that the epidemiological

Box 1 | Ongoing examples of climate change litigation.

- Litigation is currently ongoing before the US District Court of Oregon against the United States Federal Government under the constitution and public trust doctrine (ref. 33). The case is being brought by a group of youth plaintiffs who allege, *inter alia*, that the United States is violating their fundamental rights protected under the US Constitution by failing to regulate greenhouse gas emissions so as to preserve a safe and habitable climatic system.
- A suit was filed by the Conservation Law Foundation against Exxon Mobil in late 2016 regarding adaptation to sea-level rise at the company's refinery on the Mystic River.
- An investigation of Exxon Mobil by the New York Attorney General (NY AG) under the Martin Act is ongoing. The Martin Act gives the NY AG powers to investigate corporate fraud, including allegations of misleading shareholders in financial filings and other information published by a company.
- In March 2017, three Californian coastal counties filed suit against 20 of the world's largest fossil fuel producers, seeking damages for their contribution to expected damages from sea-level rise. The suit claims that the companies obscured the harm caused by their products, violating both consumer protection and property protection torts at common law.

evidence clearly establishes that the relative risk is greater than 2:1, the concepts of 'increasing the risk' and 'causing the damage' are, in effect, synonymous ... In purely scientific terms one may not 'know' that to be so, but anyone using that verb in such a context is implicitly applying a higher standard of proof¹⁷.

Event-attribution science is therefore theoretically capable of establishing sufficient 'causal' connection in the law, provided it satisfies applicable tests for admissibility.

Scientists should of course continue to express their findings probabilistically, maintaining all appropriate scientific standards necessary to achieve consensus and meet the professional standard of care. However, they should be aware that neither the law nor, arguably, the general public, adopts such rigorous standards when drawing conclusions about cause and effect.

For example, the temperature anomalies of the record hot summer of 2017 in southeastern Australia were found to be at least 50 times more likely in the current climate than in the past (<http://go.nature.com/2uNbElb>). The researchers also found that: "In the past, a summer as hot as 2016–2017 was a roughly 1-in-500-year event. Today, climate change has increased the odds to roughly 1-in-50 years — a tenfold increase in frequency. In the future, a summer as hot as this past summer in New South Wales is likely to happen roughly once every five years".

This demonstrates that attribution science is not only linking human greenhouse gas emissions to specific physical impacts happening today, but that it is producing clear evidence and warnings about increased risk of extreme events in the future.

Implications for government

States have duties to avoid harm to their citizens or those in their care under a range of constitutional, common law and/or statutory rights. Although attribution science could play a role in providing evidence of particularized harm in such cases, we focus on the implications for adaptation, as the legal basis of claims seeking mitigation have been discussed in detail elsewhere.

Government agencies often own and manage a wide range of public infrastructure and assets, including utilities, roads and public housing. All of these may require upgrades to ensure resilience to future climates. The state of climate science and attribution science is particularly important to subnational governments, including cities that may have cause to consider scientific evidence when carrying out their duties.

In the US, claims against governments for failing to adapt to climate change may be brought under existing statutory obligations¹⁸, negligence, fraud, or takings (land acquisition) theories¹⁹. Lawsuits have already been filed seeking damages for government failing to adapt to climate change^{20,21}, whereas insurers have already brought claims highlighting government failure to adequately prepare for foreseeable flood events²².

In 2011, the Australian Local Government Association commissioned a private law firm to complete a comprehensive review of the liability risks to local government that may arise as a result of climate change²³. The report concluded that in order to mitigate liability risks: "Councils must ensure they keep up to date with general climate change science and information related to mitigation and adaptation strategies and also information particular to their

specific local government area. Councils will require localized information on impacts on which they can rely when making planning decisions and specialist advice on planning and engineering options for other aspects of adaptation."

It is also interesting to note that the UK 2008 Climate Change Act contains provision for the national government to request adaptation plans from agencies to demonstrate their preparation and planning for the impacts of climate change²⁴, thereby arguably assisting those agencies to mitigate litigation risk.

Good communication between the scientific community and those responsible for public infrastructure is essential to ensure appropriate adaptation and resilience and to avoid liability.

Risks for professionals

The same liability risk that applies to governments that own and operate assets applies to private professionals and companies that may design, construct, manage or maintain public assets threatened by climate change; for example, by wildfire or heatwaves.

Unlike government agencies, private professionals such as engineers may not benefit from sovereign immunity. They could be exposed to greater liability risk if they fail to take increased extreme weather events into account. Similarly, private owners of critical infrastructure such as ports, airports and toll roads may be contractually obliged to assess and manage foreseeable climate-related risks.

In common-law jurisdictions (including the US, UK, Canada and Australia), the typical case for negligence requires proof that the defendant owed the plaintiff a duty, that the duty was breached and the breach was the cause of damages suffered by the plaintiff. Foreseeability affects each of these elements and therefore attribution science will probably change the reasonableness of adhering to existing design standards that have, at their core, assumptions about the continued relevance of stationarity that may no longer hold. This may have implications for a range of contractual terms governing the management or maintenance of both private and public infrastructure, including fitness for purpose and defect clauses, warranties or indemnities.

Some professional organizations are helping their members mitigate these risks by producing guidance on how to adapt their practice in the face of climatic change^{25,26}. However, where old and arguably out-of-date building codes and standards are applied automatically by architects, engineers, planners and builders, or where standards are not updated based on the best



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Figure 1 | Attribution studies are predicting more severe heatwaves in some regions with high confidence.

available climate science, these construction professionals may expose themselves to litigation.

Impacts on company directors

In general, corporate directors and officers are fiduciaries and owe a series of special duties to the corporation and its shareholders. Fiduciary duties of due care and disclosure are similar (though not identical) around the world (<http://go.nature.com/2wP0RIA>), these often require company directors to act in good faith in the best interests of the corporation, and also with the requisite level of care, due diligence and skill.

Companies are also often required to disclose information about material risks to shareholders. Consideration of these laws is beyond the scope of this paper; however, attribution science will also be relevant to what information a company discloses about the risks climate change poses to its assets.

Prudential regulators around the world have recently begun to recognize the threat to companies and the economy from climate change^{27–30}. Increased extreme weather events are likely to pose physical risks to corporate assets, may cause loss of productivity due to forced periods of shutdown, and may have secondary impacts such as “higher energy

costs, legal risks from emissions regulation and private litigation, an inability to transfer risk (via mechanisms such as insurance), and market risks as investors and credit providers limit their own exposures to emissions-intensive sectors³¹.

The degree of care and diligence required of a director in any given context will depend on the nature and extent of the foreseeable risk of harm to the company that would otherwise arise. Recent Australian legal opinion concluded that: “If the country is to experience more frequent and intense storms, for example, of the type that might cause flooding and power outages, then directors of companies exposed to such risks should be considering them regardless of whether or not they are perceived to be brought about by climate change, and regardless of the regulatory outlook. In this sense, ‘climate change’ has the potential to be a distracting label. The question is really whether there is a foreseeable risk to the interests of a company³².”

The evidence cited above demonstrating that extreme heat such as that seen in the summer of 2017 will be a one-in-five-year event in the future clearly engages the above paragraph, and implies that company directors should be planning for such a

future. Scientists are warning corporate directors about these risks, which are now clearly foreseeable.

A call to science

Attribution science is poised to play an increasingly important role in climate change litigation. In particular, the state of attribution science — what is accepted as consensus versus what is debated — will substantially determine the foreseeability of previously unexpected events, a critical factor in determining liability under contract, tort and duties law.

We therefore reiterate the critical importance of continuing developments in attribution science. We also suggest the following actions to enable attribution scientists to inform and assist courts in their efforts to determine climate change liability: (i) areas of agreement should be clearly stated before discussion of areas of disagreement; (ii) methodology and results should be quantitatively and qualitatively transparent to enable interpretation and assessment of credibility by the courts; (iii) assumptions and uncertainties should be stated in a simple, concise and transparent manner; and (iv), results should discuss implications for foreseeability; that is, whether

and to what extent a study can opine on the impact of anthropogenic emissions on the future likelihood of occurrence or severity of the event.

Clear and confident expression of science in a manner that can be applied by non-scientists, including lawyers — while maintaining scientific integrity — can inform some of the most pressing economic decisions of our time; that is, what to mitigate, what to make resilient and above all, in which activities to invest, in an environment of scarce resources. Be bold. The law needs your insights. □

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