**Just a c Climate models are bad at capturing normal rainfall and worse at extreme ones. They are better at capturing temperatures, but only at regional scales, not at very local scales. Climate scientists need to address these challenges in the process of assigning probability changes to events in the pastouple of decades ago, the U.N.**

Intergovernmental Panel on Climate Change (IPCC) argued that individual weather events could not be attributed to climate change. The science has since evolved, albeit with all its attendant uncertainties, and now we regularly hear of researchers having been able to attribute some individual extreme events to climate change.

Many scientific and data challenges persist in this exercise even as its outcomes are argued to be usable for estimating richer countries’ historic liability for climate-related “loss and damage” and the legal liability of governments and corporations in precipitating adverse events like floods and droughts. However, researchers have used a variety of methods to evaluate attributability, which raises questions about whether attribution science is mature enough to be used in courts and multilateral fora.

Value of extreme-event attribution

While no formal cost-benefit analysis of an attribution exercise has been reported, many experts have argued that attributions are critical for the ‘loss and damage’ (L&D) process. L&D doesn’t have a unique definition but its place in climate talks under the U.N. Framework Convention on Climate Change has come a long way in the last decade. Economically developing countries, in particular those that are ‘particularly vulnerable’, have demanded the L&D fund to pay for the havoc climate change wreaks within their borders. Obviously, the criteria by which ‘particularly vulnerable’ countries are to be identified are crucial.

For example, India is a developing country in the tropics and is highly vulnerable to climate change’s impacts. But it is unlikely that India will qualify for L&D funding, and herein lies the rub: should climate finance and green funds focus on adaptation and mitigation alone or should they administer L&D funds separately? If the latter, then will attribution exercises help? The developed world is opposed to the idea of being held legally accountable in court for any extreme events since that could open a floodgate of lawsuits.

Against this background, our understanding of whether attribution reports can actually hold up in court as evidence of culpability is very important. A good case in point is a recently published report on heatwaves in Asia.

Attribution of Asian heatwaves

Last week, a team of climate scientists called World Weather Attribution (WWA) reported that heatwaves across Asia, from the west to the southeast, had been rendered nearly 45-times more likely by climate change.

It is worth understanding how these ‘rapid extreme event attributions’ are performed. The most important concept is the change in probability: in this case, the climate scientists contrasted the conditions in which the heatwaves occurred against a counterfactual world in which climate change did not happen. The conditions that prevail in the counterfactual world depend on the availability of data from our world. When there isn’t enough data, the researchers run models for the planet’s climate without increasing greenhouse gas emissions and other anthropogenic forcings. Where there was sufficient data, they used trends in the data to compare conditions today with a period from the past in which human effects on the planet were relatively minimal.

This said, the data are hardly ever sufficient, especially for rainfall, and almost never for extreme rainfall events. Climate models are also notoriously bad at properly capturing normal rainfall and worse at extreme ones. Thus, climate scientists need to address these challenges in the process of assigning probability changes to events in the past. The climate models are better at capturing temperatures and temperature-related events — but again, only at regional scales, not at very local scales.

If, some day, climate scientists are able to perform reliable hyperlocal attribution exercises, they will still be confronted by a moral question: what actions should follow? Because right now, even though the L&D fund and climate jurisprudence are becoming more visible, attribution exercises are happening as if disconnected from governments’ adaptation and mitigation strategies.

Put another way: will people and businesses move away if a place is seen as being a hotspot of extreme events? This is not just a question of science. Governments need to be able to respond to such decisions, and attribution science should in turn, be sufficiently reliable.

Picking extreme events to attribute

Another significant challenge in attribution exercises, is how scientists choose the extreme events for which they will perform attribution exercises.

When evaluating the Asian heatwaves, the WWA scientists used regional scales and different definitions for different regions. They also arbitrarily considered daily, three-day, or monthly average temperatures for attributing likelihoods.

Heatwaves can be exacerbated by natural factors such as an El Niño event or human factors like urbanisation and deforestation. There is also a debate as to whether irrigation affects heatwaves as well.

Further, no weather event will occur in exactly the same form twice in a place, which means an extreme event occurring in that place will likely have no precedent. This is why it is easier to reliably attribute heatwaves at the subcontinent scale but not those at the level of particular areas.

The kind of questions that climate scientists ask also matter. For example, the same analysis can produce different answers to the questions “was the intensity of a heatwave amplified by climate change?” and “was the frequency or return period of a heatwave altered by climate change?”. In the WWA report, the scientists used multiple approaches in their attribution exercise to answer the same question, and have added that the differences between them are immaterial. It is not clear whether these differences will be perceived to be material in a court of law.

Extreme events and human action

The actual impacts of extreme events depend not only on the hazard or the extreme event but also on the vulnerability and the exposure of the population affected. Similarly, the financial consequences are also affected by multiple factors. So, should an attribution exercise only focus on the hazard or should it consider the impacts as well?

This is not a trivial question, especially if L&D negotiations are to be served reliably by attributions.

Considering all these challenges, we must take stock of the international financial aspects of adaptation, mitigation, and L&D. In particular, governments should consider an agreement on historical responsibilities to fund developing countries, close adaptation gaps, build adaptation capacity, and finance mitigation for the global good.

The real world is severely resource-constrained. In a counterfactual world where human, financial, and computational resources are infinite, attribution exercises are a beautiful scientific challenge and could serve as a productive intellectual exercise. But in the real world, we need a cost-benefit analysis based on a clear role for attribution in the overall climate action landscape.