Detection and attribution science facing the future: the importance of not confusing problem-solving and solution-use

Johannes Persson[1]

[1]Lund University

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Abstract

With a few exceptions extreme weather event attribution is recognised as necessarily oriented towards tracing the history of present (or past) extreme events. However, it must be noted that the usefulness of a true causal claim linking climate change to its specific, local impacts may not be exhausted by its being an answer to a pre-specified scientific question about event attribution. This is because there is an important difference between problem-solving and solution-use. And solution-use can neither be controlled by the problem-solving science nor by its taskmasters. The users can have other questions than the problem-solvers. This commentary defends detection and attribution science's importance for individuals' adaptation decisions.

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J. Persson[1]

[1]Department of Philosophy, Lund University

Corresponding author: Johannes Persson (johannes.persson@fil.lu.se)

Key Points:

- Identifying which problem to solve is central to scientists but must not be confused with what problem the research will be used to solve
- Problem-solving is not the same thing as solution-use.
- This lesson might be especially important in discussions of the value of climate science for adaptation and mitigation.

Abstract

With a few exceptions extreme weather event attribution is recognised as necessarily oriented towards tracing the history of present (or past) extreme events. However, it must be noted that the usefulness of a true causal claim linking climate change to its specific, local impacts may not be exhausted by its being an answer to a pre-specified scientific question about event attribution. This is because there is an important difference between problem-solving and solution-use. And Solution-use can neither be controlled by the problem-solving science nor by its taskmasters. The users can have other questions than the problem-solvers. This commentary defends detection and attribution science's importance for individuals' adaptation decisions.

> Events alone will not be sufficient to make climate change visible, although commented events could (Jézéquel et al. 2020)

This commentary defends detection and attribution science's importance for individuals' adaptation decisions. With some exceptions (e.g. Allen 2003, Pall et al. 2011, Donhauser 2017) extreme weather event attribution is recognised as necessarily oriented towards tracing the *history* of present (or past) extreme events. Detection and attribution science was developed to produce science-based liability claims based on whether past green-house-gas emissions were likely to have increased the risk of an actual extreme weather event over its pre-industrial value (Allen 2003). Liability presupposes an event that has occurred or a fact that is actual and can give rise to the issue of liability. It does not stretch into the unactualized future. A science designed to evidence-base such claims will probably be similarly limited as far as its problem-solving machinery is concerned.

Also the indirect use of detection and attribution science for forward-looking purposes has been challenged. Thompson and Otto (2015) provide two arguments. First, claims about a causal link between climate change and one extreme weather event of type Y does not entail the claim that climate change will cause similar events of type Y in the future. Thus we cannot, unfortunately, derive predictions of future climate impact from successful event attribution.

The implication seems to be that detection and attribution science is unsuited for purposes directed towards the future such as taking climate change adaptation or mitigation measures (see also Lusk 2021). Second, adaptation to reduce future harms requires less sophisticated results than detection and adaptation science aims to produce. It requires only that we can predict that future extreme events will occur more frequently and with greater intensity. In a nutshell: "Event attribution is not designed, nor is it necessary, for making such predictions" (Thompson and Otto 2015). Instead, they claim, detection and attribution science has an important role in connection with loss and damage. I will not spend time arguing against Thompson and Otto's two arguments – even if a case could perhaps be made for the rationality in accepting more powerful tools than necessary if those tools can be used in multiple ways.

I want to highlight another issue. Thompson and Otto modestly and implicitly presume that the role of a detection and attribution science is limited to that of being a *problem-solver* to carefully selected pre-specified problems. Problems, whether internal to science itself or in the form of societal challenges, are certainly important. In this case, many agree that the primary importance of detection and attribution science is extra-scientific: "the primary motivation for event attribution goes beyond science" (NAS 2016, p. 17). Climate science is preoccupied with framing questions that are both relevant for supporting climate related decision-making and being of a type that science has the capacity to answer (see e.g. NAS 2016). So, for instance, has there been a discussion about the value of answering the conditional question: "given the atmospheric circulation that brought about the event, how did climate change alter its impacts?" (Otto et al. 2016).

However, it must be noted that the usefulness of a true causal claim linking climate change to its specific, local impacts may not be exhausted by its being an answer to a pre-specified scientific question about event attribution. This is because *there is an important difference between problem-solving and solution-use* (Thorén and Persson 2013). Solution-use can neither be controlled by the problem-solving science nor by its taskmasters. The users can have other questions than the problem-solvers.

There is clearly an issue of problem-solution coordination between the context where the problem is solved and where the solution is used in relation to climate change and its impact. A few years ago, the uncertainties involved in extreme weather event attribution were considered a minefield for scientists. "I've advocated for many years that extreme events should not be part of the public dialogue", says a science policy scholar in Kerr (2013). Why, one might ask. Because of two things: the motivational force of extreme weather and the uncertainties involved in attribution. Yes, extreme weather has strong motivational force but it is unreliable. Noteworthy storms are followed by quieter weather, and we do not want climate-related concerns and decision-making to vary accordingly. And the uncertainties involved in attribution are greater than in climate science in general. The rational decision-maker, the experts think, would be better off if she asked the scientists than if she acted on perceived climate change impacts. *But is it realistic to suppose that individuals will always consult science in their decision-making, and that science on a direct question would have anything intelligible to say about the local context the individual users are interested in?* It cannot be denied that there is sometimes a considerable gap between solution-use and problem-solving. It is, of course, important to guide solution users so that they do not commit too many and too grave errors where a correct answer to one type of question is wrongly used as the correct answer to another (a family of problems relating to type III errors in statistics exemplify this – see e.g. Wahlberg & Persson 2017 and Persson et al. 2018). If possible, for the best of everyone such gaps between problem-solving and solution-use should be controlled.

However, what makes the interface between problem-solving and solution-use particularly interesting in this case is that attribution knowledge might be indispensable for adaptation. The crux of the matter is the (in)visibility of climate change (e.g. Rudiak-Gould 2013) and the importance of knowing of its local effects for taking measures to adapt. For instance, climate change mitigation and adaptation behaviour among private forest owners depend on their beliefs in that they have experienced local effects of climate change (Blennow et al. 2012). Whether or not one intends to strengthen the association between extreme weather events and climate in the minds of non-scientists, it seems clear that right- or wrongfully connecting climate change with its visible local consequences has an effect on adaptive behaviour. It seems that Jézéquel et al. (2020) are right in observing that although detection and attribution approaches have been formulated with users in mind, their development has been driven by scientists rather than by users. The importance of knowledge of the mechanisms of problem-solution coordination particular to this problem has been underrated.

The science policy scholar in Kerr (2013) is afraid that we might act on mistaken beliefs if we rely on perceived climate change impacts. But could not attribution science (also) be *used* for knowing when we would be right and when we would be wrong in claiming that a certain event truly is an impact of climate change? Thompson and Otto (2015) argue that attribution science is an essential tool if we want to establish a causal link between the action and a loss. To the extent that it is essential for this purpose it seems that it might be essential also for much of individual decision-making. A true causal claim linking climate change to its specific, local impacts makes adaptation possible. Not because it provides accurate predictions but because it has an indispensable motivational role. "Events alone will not be sufficient to make climate change visible, although commented events could" (Jézéquel et al. 2020). But, it might be objected, the same would be true for a false causal claim of that kind. Would it matter for individual, sustainable decision-making if we could make sure that a certain perception of a local climate change impact was veridical?

I think it would matter if we could see the impacts of climate change *qua* impacts of climate change with the aid of the reliable instruments provided by detection and attribution science. Certainly, it would matter to the loss and damage context. But probably also in a wider context of individuals' future-directed decision-making. Perhaps we would need several versions of it for the sake of the latter. Versions that are flawless but require data and instruments that are not available in remote environments. And other versions – *light* – that are enough for linking local effects to climate change with a sufficient degree of certainty for the local decision-maker and roughly sort out mistaken beliefs.

There are further interesting aspects to consider. There are currently at least two approaches to attribution problems: The Standard approach (which both Allen 2003 and Thompson and Otto 2015 have been instrumental to) and The Storyline approach (e.g. Shepherd 2016 and van Garderen et al. 2021). The Standard approach is forward-looking in the limited sense that it determines the increase in risk of the extreme event (that has happened) in the actual world compared with a counterfactual world. The Storyline approach instead ''examines the role of the various factors contributing to the event as it unfolded, including the anomalous aspects of natural variability'' (Shepherd 2016, 1), given the atmospheric circulation that brought about the event. It is in that sense more backwards-looking. It is plausible that for those who become more informed by the science of attribution science the two approaches will provide clues to different problems. The Standard approach will be closer to most decision-making problems; the Storyline approach might enhance knowledge of the local mechanisms and provide more understanding. However, it is probably not worthwhile to try to figure out these phenomena from the scientific or taskmaster perspectives alone. That would probably lead to new problem-solution coordination issues. Studies of solution-use in this field are wanted – and they might perhaps enhance the perceived value of attribution science from a humanities and social science perspective. However, the extent of this probably depends on the opportunities for developing *light* versions that can be used for attribution in environments where data availability may be less than ideal.

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