COMMENTARY:

Characterizing loss and damage from climate change

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Policymakers are creating mechanisms to help developing countries cope with loss and damage from climate change, but the negotiations are largely neglecting scientific questions about what the impacts of climate change actually are.

Mitigation efforts have failed to prevent the continued increase of anthropogenic greenhouse-gas emissions. Adaptation is now unlikely to be sufficient to prevent negative impacts from current and future climate change[1]. In this context, vulnerable nations argue that existing frameworks to promote mitigation and adaptation are inadequate, and have called for an international mechanism to deal with residual climate change impacts, or 'loss and damage'[2].

In 2013, the United Nations Framework Convention on Climate Change (UNFCCC) responded to these calls and established the Warsaw International Mechanism (WIM) to address loss and damage from the impacts of climate change in developing countries[3]. An interim executive committee of party representatives has been set up and is currently drafting a two-year workplan comprising meetings, reports and expert groups. This aims to enhance knowledge and understanding of loss and damage, strengthen dialogue among stakeholders, and promote enhanced action and support. Issues identified as priorities for the WIM thus far include how to deal with non-economic losses — such as loss of life, livelihood and cultural heritage — and linkages between loss and damage and patterns of migration and displacement[2]. In all this, one fundamental issue still demands our attention: which losses and damages are relevant to the WIM? What counts as loss and damage from climate change?

Defining loss and damage

The UNFCCC defines loss and damage as "the actual and/or potential manifestation of impacts associated with climate change in developing countries that negatively affect human and natural systems," including impacts from extreme events (for example heatwaves, flooding and drought) and slow-onset events (including sea-level rise and glacial retreat)[4]. This implies that the WIM will deal with current and future changes in the risk of loss and damage, rather than only addressing losses that have actually occurred. In addition, the definition suggests that the WIM will specifically handle changes in risk that can be attributed to climate change. In the language of the UNFCCC, which has a mandate to tackle "anthropogenic interference with the climate system,"[5] this means human-induced climate change.

From a scientific perspective, therefore, the first challenge in implementing the WIM would be to estimate where and when loss and damage can be attributed to anthropogenic climate change. This would require attributing losses to weather and climate events, and attributing these weather and climate events to anthropogenic emissions. Policymakers and observers of the WIM have paid more attention to the former of these, for example by documenting case studies of loss and damage associated with extreme weather[6].

The link between weather and climate events and anthropogenic forcing, however, has been largely neglected, despite the increasing availability of scientific research addressing this question[7–9]. This imbalance has potentially led to an incomplete understanding of the evidence base. Interestingly, with the focus on investigating the impacts rather than the causes of disasters, the work programme emphasises information gaps surrounding slow-onset events[2]. Of course, strategies to cope with the long-term effects of climate change are less well established than risk management plans for extreme weather events. Yet, in terms of the influence of climate change on loss and

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Typhoon Haiyan was cited in Warsaw as an example of loss and damage due to climate change, but we still have no hard numbers on how much, if at all, human influence on climate actually contributed to this event.

damage, uncertainties are greater for extreme events than for the long-term processes behind slow-onset events[7]. If the WIM is to address changes in climatic risk, the capabilities and limitations of climate change attribution research deserve greater attention.

Climate change attribution science

Climate scientists have well-established techniques to attribute long-term trends in mean climate over large regions of the globe[10,11], which could provide evidence about loss and damage from slow-onset processes. In the past ten years, there have also been efforts to investigate human influence on extreme weather events[7–9]. Extreme event attribution is the subject of considerable debate and some confusion in the media, with many commentators either claiming that nothing can be said about extreme events, or that every extreme event that occurs is due to global warming. The scientific position is slightly more nuanced.

The perception that specific events cannot be attributed, or that the relevant science is not robust[12], is generally based on one of three arguments. First is that natural variability generates extreme weather, and therefore we cannot say that a specific flood or drought would not have occurred without climate change. Event-attribution research does not seek to counter this statement, but rather investigates the contribution of anthropogenic climate change to the probability of occurrence of specific events[7]. The second argument is that the climate change signal cannot be detected for extreme events because they are rare. The technique of probabilistic event attribution overcomes this challenge using ensembles of simulations of climate models[13]. The third opposition is that climate model experiments cannot adequately reproduce the dynamics associated with extreme weather events, or the conditions in a world without anthropogenic emissions, which are simulated to estimate the climate change signal[13]. Model capability is an important consideration, but the presence of uncertainty does not imply that the results cannot be useful for policy. In principle, the limitations of the experiments used for attribution are no different from those of climate model experiments used for future projections, which are routinely employed by adaptation decision-makers. Provided that uncertainties are communicated, attribution results also have the potential to be useful for policymakers.

Extreme event attribution cannot, however, provide evidence of an anthropogenic signal for every damaging event. This is in part because the work has not yet been conducted: to date, the literature has focused on a small number of disasters, mainly in developed countries[8,9]. As research progresses, however, there will remain substantial variations in attribution evidence. For some events, attribution studies show that climate change has increased the risk of occurrence[13], but for others there is a decrease in risk[14] or no change[15]. Importantly, there are also cases where it is not possible to assess the climate change signal due to model limitations or a lack of observational data. In a recent study of the 2010 floods in Pakistan, the influence of anthropogenic forcing could not be determined because the model could not reliably simulate the event[16]. In addition, attribution studies cannot currently be conducted for tropical cyclones. Future model developments and access to greater computing power will improve this, but model ability will never be equal for all events.

Policy outlook

Attribution science is clearly potentially relevant to the WIM, but there are challenges in using the results to support policy decisions due to their uncertainty and the variation in evidence between events, regions and countries. Political controversy exacerbates these challenges. The loss and damage process is often seen as a route to compensation, but party representatives and observers to the WIM are working hard to shift the emphasis from compensating for loss to building capacity to deal with risk[17]. In this context, attribution questions raise unwelcome issues of responsibility, blame and liability.

Given the uncertainties associated with attribution, and the perceived link to compensation, some argue that policy mechanisms should not be guided by attribution results, but instead focus on the most vulnerable regions[12,18]. However, this begs the question: vulnerable to what? Should the WIM address loss and damage in regions highly vulnerable to cold winters or flooding from snowmelt, which may become less likely because of climate change? The question of causality cannot be ducked indefinitely. Scientific research into the changing probability of extreme weather events is fundamental to understand which regions are exposed to the current and future impacts of climate change, and to inform adaptation strategies to manage that change in risk. Attribution studies need not only be used to support compensation mechanisms, but could also be a valuable source of information for other strategies to build climate resilience.

Our motivation in writing this Commentary is not to bolster support for attribution research. Interest in event attribution is already growing among scientists, decision-makers, donors, the media and the public, and there is a rise in the number of event attribution studies each year[8,9]. It is equally not our intention to be policy prescriptive. Our concern is, rather, that a body of scientific evidence is growing, which is highly relevant to the WIM, yet is seen as a distraction from the negotiations. Whether the WIM tackles attribution questions or not, those questions, and answers, will soon emerge in some form. If policymakers and scientists work together now, to establish whether and how the science might be useful for policy, and to identify and frame attribution questions, the science might be developed to address stakeholder concerns and support climate change policy. Science–policy collaboration on attribution issues could be an important anticipatory strategy for adaptation that is complementary to, and intertwined with, efforts to build resilience in regions with low adaptive capacity. ❐

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Correction

In the Commentary 'Characterizing loss and damage from climate change' (*Nature Clim. Change* **4,** 938–939; 2014) it is incorrectly implied that the UNFCCC has an official definition for loss and damage. Whilst the definition is correctly quoted from a UNFCCC literature review, this was a working definition for the purpose of that review. There has been no formal discussion under the UNFCCC on what the term 'loss and damage' signifies. This correction notice has been published after print 7 January 2015.