Framing the event attribution question - conditioning probabilities, thermodynamics and circulation, event definition

Friederike Otto, Geert Jan van Oldenborgh, Sebastian Sippel, Robert Vautard, Pascal Yiou, Nathalie Schaller, ....

University of Oxford

friederike.otto@ouce.ox.ac.uk
The risk-based approach

The 2 historic approaches used in weather@home

Otto et al., 2015
More subtle changes due to combined thermodynamic effect and circulation change

Schaller et al., 2016
Disentangling changes in the atmospheric circulation

Schaller et al., 2016
Flow clusters

Flow cluster #1
\[ P_f(F_1) = 0.14 \]
\[ P_c(F_1) = 0.14 \]

Flow cluster #2
\[ P_f(F_2) = 0.21 \]
\[ P_c(F_2) = 0.43 \]

Flow cluster #3
\[ P_f(F_3) = 0.14 \]
\[ P_c(F_3) = 0.14 \]

Flow cluster #4
\[ P_f(F_4) = 0.5 \]
\[ P_c(F_4) = 0.29 \]
Disentangling changes in the atmospheric circulation

- Thermodynamic
- Dynamic

Vautard/van Oldenborgh et al. in prep
Conditional on the model’s ability to simulate the event - a systematic look at biases

Sippel et al. 2016
Multiple lines of evidence

Schaller et al., 2016
Conditioning on “long-term” predictable factors

Conditioning on External forcing

Conditioning on the predictable component of SSTs

van Oldenborgh et al., under review
Conditioning on circulation pattern

Given the weather pattern, how were the temperatures, precipitation and associated impacts influenced by climate change? (Trenberth et al. 2015)

Meredith et al. 2015
Example: simple chaotic system

Otto et al., under review
Event definition

Storm Desmond example (see Geert Jan’s talk tomorrow): Trade-off between what causes the impacts and what we can simulate reliably
FAR dependence from region size

Uhe et al., under review
What is an event? - Heat wave in Serbia 2012

Heat

Heat stress

Sippel and Otto, 2014
COMMENTARY:
Characterizing loss and damage from climate change
Rachel James, Friederike Otto, Hannah Parker, Emily Boyd, Rosalind Cornforth, Daniel Mitchell and Myles Allen

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. 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'.

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. 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.

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). 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, 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, for example by documenting case studies of loss and damage associated with extreme weather events. 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.

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. 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 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.
Holistic event attribution – just one example: drought Sao Paulo

(a) Precipitation anomaly

Population increase + water demand

Otto et al., 2015