TOP 10

THINGS TO KNOW ABOUT EXTREME EVENT ATTRIBUTION

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IT'S POSSIBLE

The science of extreme event attribution has rapidly advanced in the last ten years, changing the status quo from, "no individual extreme event can be attributed to climate change" to, "we can now calculate the influence of climate change on some extreme weather events."

A summary of this advancement was published by the National Academy of Sciences in their Special Report on Attribution released in 2016.

We can now calculate the influence of climate change on some extreme weather events.

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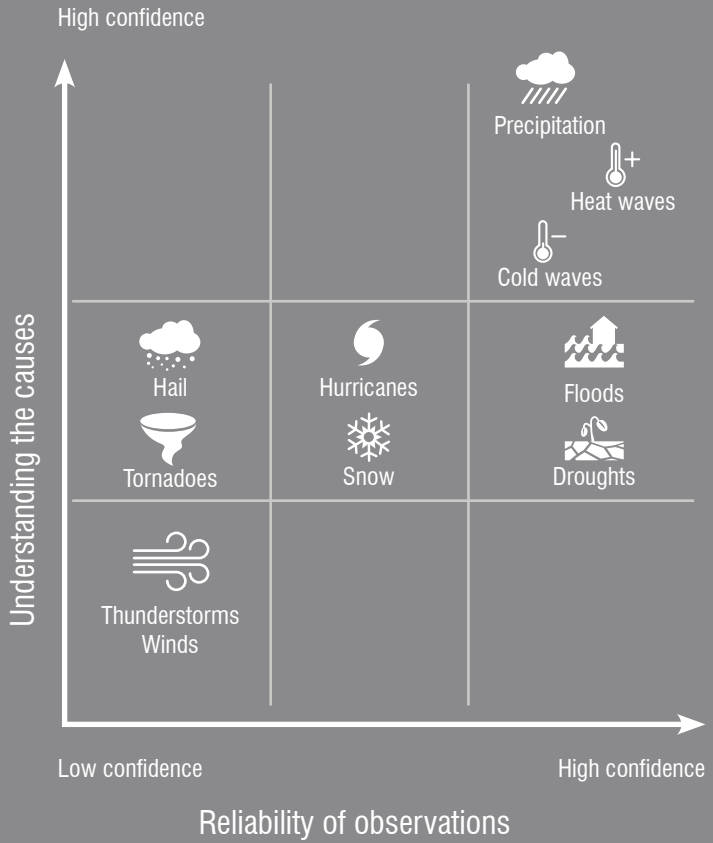
NOT ALL TYPES OF EXTREME WEATHER EVENTS ARE ATTRIBUTABLE WITH CONFIDENCE

There are some types of extreme weather events that we have higher confidence in attributing to climate change than others, such as extreme cold and heat.

Other events, such as thunderstorms, cyclones and wildfires, are currently difficult to attribute to climate change because we currently lack the tools to do so.

Scientists are rapidly developing new methodologies to improve our capability to analyse and understand the role of climate change in these events.



Source: Peterson et al. 2013

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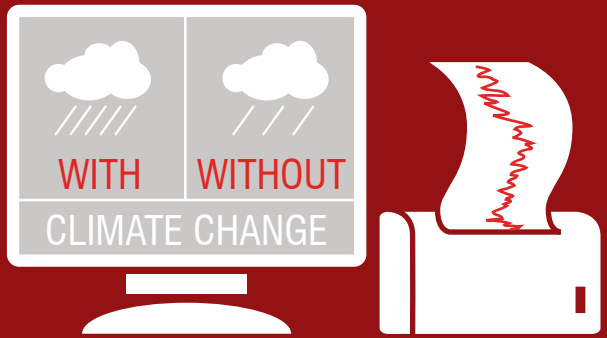
THERE ARE MANY METHODOLOGIES FOR EXTREME EVENT ATTRIBUTION ANALYSES

Scientists have been developing new methodologies to attribute extreme weather events to climate change since 2003, when the first method was pioneered.

This includes using observations and model simulations of climate variables, such as temperature and rainfall in the past and present, as well as simulations of our current world and a "world that could have been" without greenhouse gas emissions. This data is used to study whether extreme weather events are occurring more or less often in our current climate by examining whether meteorological variables exceed a critical level.

Other methods serve a research purpose by trying to understand whether climate change was important in the evolution of the weather system leading to the extreme weather event.



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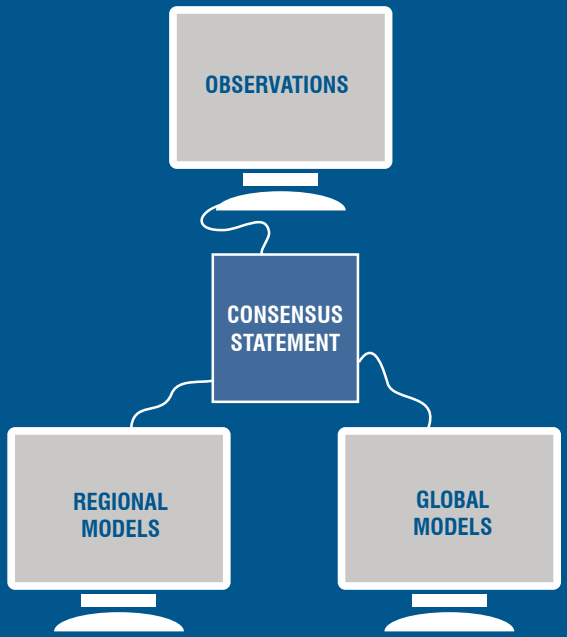
CONFIDENCE IN RESULTS IS ESTIMATED BY COMBINING METHODS

Attribution studies are more reliable when multiple, independent methods are used.

The World Weather Attribution initiative, an international partnership of scientists who have pioneered near real-time extreme event attribution studies, has developed an approach using multiple methods that looks at the results of at least three independent attribution methodologies to develop a consensus statement.

This scientific approach combines observational data, analysis of a range of models, peer-reviewed research, and on-the-ground reports. This increases our confidence in the results.



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EVENT DEFINITION MATTERS

Event definition means defining when the event started and stopped, as well as where the event occurred.

For humanitarian aid and development practitioners, a risk-based definition is most relevant if it asks the question, “Has climate change altered the chances of the occurrence of extreme weather events like this one?”

Event Definition 1:
Area: Horn of Africa
Time: March - May
Event Type: Drought
Variables: Rainfall

Event Definition 2:
Area: Kenya
Time: March - May
Event Type: Drought
Variables: Rainfall, soil moisture

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THERE ARE FOUR POSSIBLE OUTCOMES FROM AN ATTRIBUTION STUDY

↑ (1) The likelihood or strength of the event was increased due to climate change

↓ (2) The likelihood or strength of the event was decreased due to climate change

= (3) The likelihood or strength of the event was not changed due to climate change

? (4) We are unable to determine the influence of climate change on the event

CASE STUDY:
EXTREME RAINFALL IN FRANCE AND GERMANY

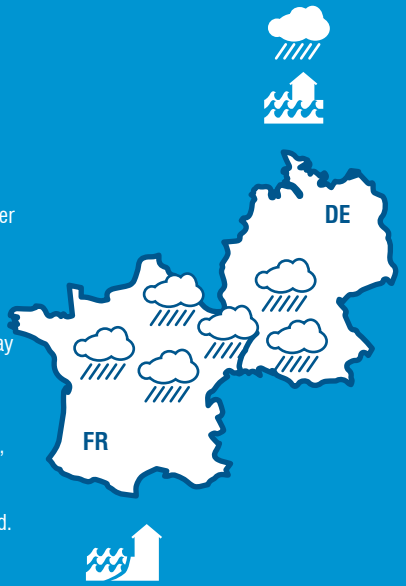
In May 2016. torrential rainfall led to flooding in central and northeastern France and southern Germany.

Although part of the same larger weather system, the event took different forms over France and Germany.

In France, riverine flooding occurred over Loire River Basin due to a three-day period of extreme rainfall.

In Germany, flash flooding occurred due to meso-scale convective systems, which are clusters of very powerful thunderstorms, that dropped a large amount of rainfall over a one-day period.

Scientists concluded that the extreme rainfall event in France was made more likely by climate change but, methods using observations and models regarding the extreme rainfall event in Germany did not agree, so no attribution statement could be made.



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ATTRIBUTION STUDIES AND CLIMATE CHANGE PROJECTIONS DON'T ALWAYS AGREE

It is possible for climate change projections and attribution findings to disagree.

Although climate models can project that a certain type of event will increase in frequency or intensity due to climate change, we might learn from an attribution study that this change has not yet occurred or is masked by other factors in our current climate.

Importantly, almost all climate projections project changes in average weather and climate and, even if the average weather does not change, the extremes can change and vice versa.

This is the case in parts of India where the climate change signal is not currently detectable in very extreme heat events.

CASE STUDY:
HEAT WAVES IN INDIA

It is likely that tiny particles from air pollution, known as aerosols, help to offset the surface warming trend over parts of India.

Worsening air pollution causes less sunshine to reach the ground and, thus, has an overall cooling influence.

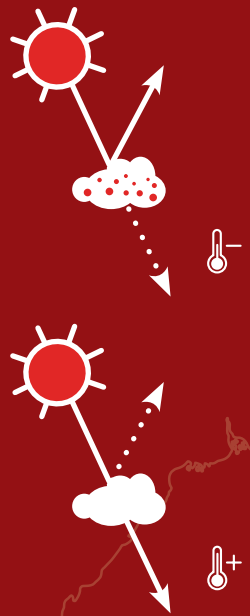
Despite long term projections indicating increasing frequency and intensity of heat wave events, there is currently no significant, detectable trend in maximum temperatures in northwestern India, so far.

Research indicates that high temperatures combined with polluted air kill many more people than heat alone.

This means that India must enact necessary air pollution controls, and manage heat wave risk.

It's possible that when the solar dimming effect of air pollution is removed, temperatures will spike as a result.

This transition was observed in Europe where, following necessary pollution controls in the mid-1980s, temperatures increased.



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VULNERABILITY AND EXPOSURE ARE IMPORTANT

Disasters are a combination of the hazard, vulnerability, exposure and capacity.

Attribution analyses focus on an extreme weather event – the hazard; however, vulnerability and exposure are also key to understanding the severity and extent of impacts from an extreme weather event.

In an attribution study, exposure refers to the people, housing, infrastructure and other tangible assets located where the extreme weather event occurred. Vulnerability refers to how susceptible people, assets and systems were to being impacted by the extreme weather event. Trends in vulnerability and exposure are important in assessing how risk has changed over time.

Local demographic, cultural, political, and economic factors, among others, need to be assessed and combined with scientific hazard information in order for attribution results to add value to decision-making.

CASE STUDY:
DROUGHT IN SAO PAULO, BRAZIL

Exposure and vulnerability were critical factors in the water rationing and other impacts that resulted from the 2014-15 drought in Sao Paulo.

Starting in November 2014, dry conditions over a 14-month period led to water shortages in Brazil's most populous city.

During this time reservoirs dried up and the city enacted water rationing in order to cope with the drought.

An attribution of this dry period found that human-caused climate change was not a major influence on this drought, and dry periods like this have occurred in the past in Sao Paulo.

A significant factor that led to more impacts during this dry period than before was Sao Paulo's rapid growth – 20% expansion in 20 years.

This growth **exposed** more people to the drought than ever before.

Water use also increased at an even faster rate over the same period, while the city's water management systems did not expand to meet increased demand.

This mismatch of supply and demand increased the **vulnerability** of people living in the city.

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NEAR REAL-TIME ATTRIBUTION OF EXTREME WEATHER EVENTS IS POSSIBLE

Rapid attribution studies can inform many disaster decisions that are made soon after an extreme event occurs, including decisions on the allocation of scarce resources and rebuilding infrastructure and services.

Near real-time studies use established, peer-reviewed methods to operationalise attribution so that it can be performed quickly after an event occurs. In the future, rapid attribution studies may be operationalised and performed by regional or national meteorological centres.

With the knowledge of how the risk of the extreme weather event and vulnerability and exposure context is changing, these decisions can be better informed by managing changing risks.

CASE STUDY:
REAL-TIME CLIMATE RISK MANAGEMENT

Near real-time attribution studies can inform the non-scientific post-event review of extreme weather events.

For example, a Parliamentary Standing Committee was convened by the Indian government to investigate the causes of the extreme rainfall and subsequent flooding in Chennai and present potential solutions.

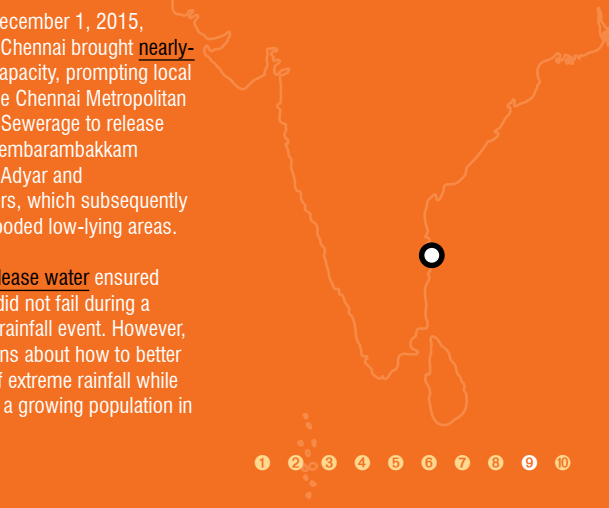
If provided in near real-time, when the government is making decisions about disaster recovery and reconstruction, attribution information, including vulnerability and exposure has the potential to inform policy and practice.

For example, on December 1, 2015, extreme rainfall in Chennai brought nearly-full reservoirs to capacity, prompting local authorities from the Chennai Metropolitan Water Supply and Sewerage to release water from the Chembarambakkam Reservoir into the Adyar and Kosasthalayar rivers, which subsequently overflowed and flooded low-lying areas.

The decision to release water ensured that the reservoir did not fail during a very rare extreme rainfall event. However, this raises questions about how to better manage the risk of extreme rainfall while providing water to a growing population in the future.

The Chennai attribution study concluded that no effect of human-induced climate change was detected, instead adding that this was a very rare event that has occurred in the past.

This information can shift the focus from a perceived “external threat” like climate change to the city planning and management systems in place that can be improved to prevent future disasters.



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ATTRIBUTION SCIENCE AND ITS APPLICATIONS ARE RAPIDLY EVOLVING

The frontiers of attribution science include developing methodologies for attributing additional types of events, like thunderstorms.

Importantly, they also include building a network of scientists from other disciplines and relevant stakeholders to allow attribution studies to move from meteorological assessments to attribute the impacts people care about.

Further integrating the science of extreme event attribution in the humanitarian and development sectors will also be increasingly important in a world where climate change is already changing the likelihood and intensity of extreme weather events.

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