

The event

The winter of 2015/16 was exceptionally warm and remarkably stormy (Figure 1). Long observational records suggest it was the fourth warmest and third wettest winter in the United Kingdom since 1900. Rainfall from nine named storms since mid-November led to extensive flooding damaging 16,000 homes in England alone. During storm Desmond on 5 December, 341.4 mm of rain fell in 24-hours, a new UK rainfall record.

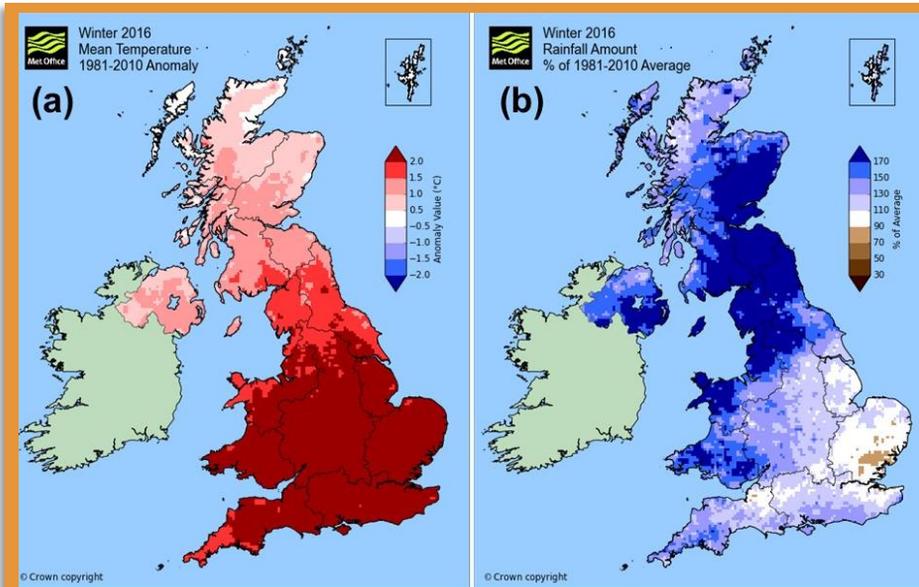


Figure 1. The 2015/16 winter (a) temperature and (b) rainfall in the UK with respect to the period 1981-2010. Source National Climate Information Centre (NCIC).

Looking at the state of the atmosphere around the world, scientists identified a number of factors that favoured the formation of characteristic weather patterns over warmer parts of the Atlantic that brought warm and wet conditions as they travelled across the British Isles. The interplay between a strong El Niño (associated with abnormally warm seas in the eastern Pacific) and vigorous westerly winds high in the atmosphere in the tropics and around the North Pole is a known recipe for such extreme winters in the UK. Besides these meteorological factors, attribution scientists also question whether manmade climate change could make these events more frequent. Attribution science has developed a range of methodologies (see box) that utilise long records of weather observations and state-of-the-art climate models to estimate the chances of an extreme event at present, but also in a 'natural' world where humans have no influence on the climate.

The science of event attribution

Observation-based approaches to attribution use long data records to work out changes in the likelihood of observed events with time. For example, intense present-day heatwaves would be expected to occur less frequently in the colder climate of the early 20th century (but more frequently in a warmer future world). Scientists also try to identify "analogues" in the records, i.e. events with similar characteristics, to determine how similar types of events have changed.

Model-based approaches use a large number of climate model simulations of the "real world" and of a hypothetical "natural world" without human influence on the climate. Changes in the risk of extreme events because of manmade climate change are then estimated by comparing the number of events in these two types of simulations. Model-based approaches can be conditional, so that the change in the risk is estimated given a set of other possible drivers that might be at work when the event happens, or unconditional, which determines the change in the risk of the event under any possible conditions.

The effect of climate change

Winters in the UK that are 0.8 °C warmer and 80 mm wetter than in the recent past used to occur on average once every ten years (reference period 1961-1990). Using this definition of warm and wet events attribution scientists ask:

Has the chance of such winters increased under anthropogenic climate change?

Analysing data from hundreds of simulations with thirty-nine climate models, scientists found that warm winters have become at least 3 times more likely and wet winters about 2 times more likely under the effect of human influence (Figure 2). This increase in the risk applies to any given winter.

Besides climate change, the chance of warm and wet events is also found to significantly increase in winters with atmospheric patterns over the UK similar to the one in 2015/16. Global phenomena, like a strong El Niño, are not found to directly affect UK winters on their own, though, when they work together, their combination may produce the right conditions for extremes.

Conclusion

In summary, while weather patterns during winter 2015/16 favoured warm and wet extremes, attribution research also establishes a significant anthropogenic signal associated with an increase in the likelihood of this kind of extreme winters in the UK.

Looking forward

Recently published climate projections for the UK (UKCP18) show an increased chance of milder, wetter winters over the course of the 21st century. By the end of the century all areas of the UK are projected to be warmer, but more so in the summer than in winter. While projected increases in temperature are largely uniform, increases in winter rainfall vary more from region to region.

For more information on the event:

<https://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-17-0464.1>

Warm Winters

Wet Winters

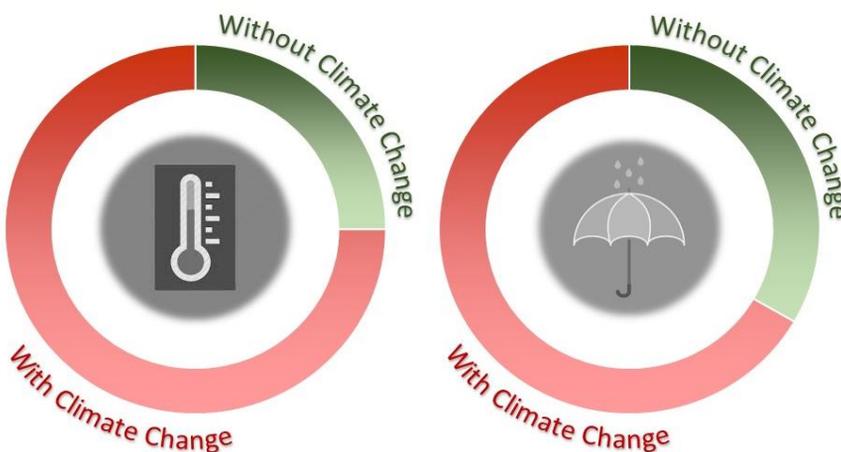
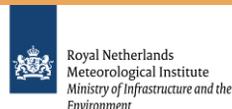


Figure 2. Anthropogenic climate change has increased the likelihood of warm and wet winters in the UK.

The Eupheme Project



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