Climate Change Plays Significant Role in Europe Heat

Initial Analysis - July 2, 2015, 5:00pm ET

A team of international scientists says it is virtually certain that climate change increased the likelihood of the ongoing heat wave stretching across much of Europe. The risk increased by a factor of two or more over a large part of Europe, up to more than a factor of four in some of the hottest cities. The results are a part of the developing field of "weather attribution" that uses observational weather and climate data, weather forecasts and climate models.

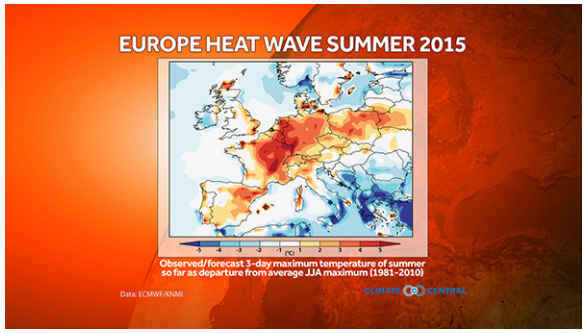
It is widely accepted that climate change, in general, will increase the frequency, intensity and duration of heat waves (Meehl and Tebaldi, 2004 [1]; IPCC, 2014 [2]). The field of extreme event attribution aims to analyze individual weather events over a smaller region (Stott et al., 2004 [3]). In the case of the ongoing heat wave in Europe, Climate Central convened an international team of scientists from Oxford University, KNMI, Red Cross Red Crescent Climate Centre, along with regional partners from CNRS and MeteoSwiss in order to assess the potential role of global warming on a specific extreme 3-day event, while the event is happening.

The team looked specifically at a few European cities (De Bilt in The Netherlands, Madrid, Mannheim in Germany, Paris, and Zürich in Switzerland). For the purposes of this analysis, the heat wave was defined as the average of the maximum temperatures over 3 consecutive days (heat wave definitions vary from country to country, but this definition has been shown to be a good measure of the impacts, notably on health). Using a combination of observed and forecast data, scientists from the team computed the annual maximum of 3-day maximum temperature (observations up to July 1, forecasts up to July 5). "For instance, in De Bilt, a heat wave like this has become at least four times more likely. This is a relatively rural area. In big cities urban heat effects are also included in this number, although these are not very large in the maximum temperature," said Geert Jan van Oldenborgh, a climate scientist at KNMI.

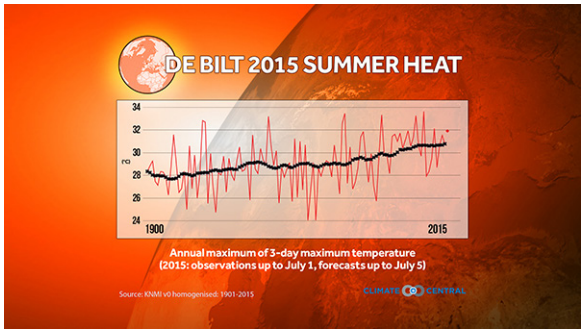
The team then compared this summer's heat with summers during the early part of the century, before global warming played a significant role in our climate. They found that:

- In De Bilt, a 3-day period as hot as forecast these days was a roughly 1-in-30 year event in the 1900s. It is now likely to happen roughly 1 in 3 years.
- In Madrid, a 3-day period as hot as forecast for the next few days would have been exceptionally rare in the 1920s. It is now likely to happen roughly 1 in 40 years.
- In Mannheim, a 3-day period as hot as the last few days would have been a once in a century event in the 1900s. It is now likely to happen roughly 1 in 15 years.
- In Zürich, a 3-day period as hot as forecast for the weekend would have been a 1-in-350 year event around 1900. It is now likely to happen roughly 1 in 70 years.

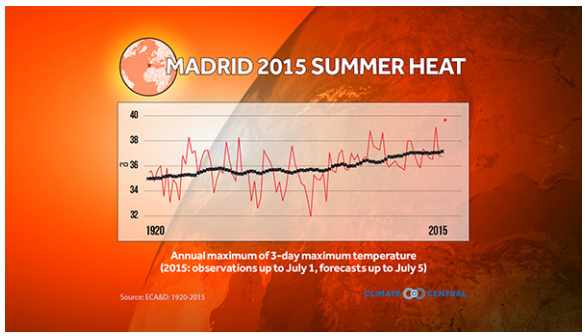
"There is a strong upward trend in 3-day maximum temperatures over the area affected by this heat wave," said van Oldenborgh. "The trend is clear both in station data and in reanalysis data." Because the heat wave is ongoing, the analysis partly relies on forecasts for the next few days. A statistical analysis of the observations shows that the probability of observing such a heat wave has more than doubled over the past 37 years in most of the affected region. In the selected cities the increase is even stronger.



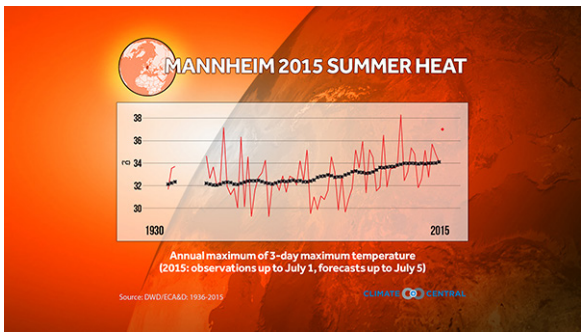
EUROPE



DE BILT, NETHERLANDS



MADRID, SPAIN



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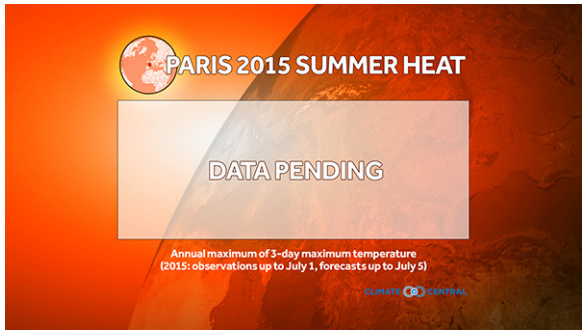
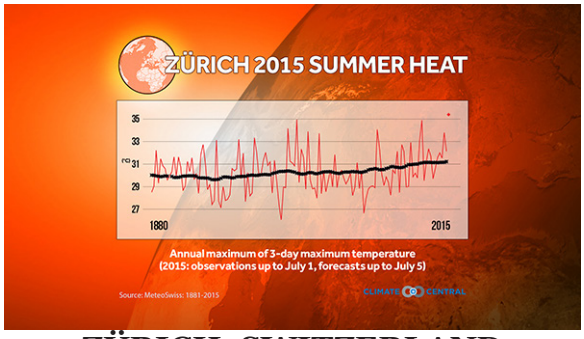


PARIS, FRANCE



ZÜRICH, SWITZERLAND

Using a large computing network (weather@home), Oxford scientists simulated the likelihood of seeing days as hot as as those Europe is experiencing now. At the same time, they also simulated a summer without human-influenced climate change. Comparing those two "worlds" they found that in the 5 cities analyzed, the current conditions are now at least twice as likely due to climate change. Their model does not include urban effects.

"The regional weather@home model serves as a nice way to do an independent check on the observational analysis," said Oxford's team lead Friederike Otto. "Think of the combined results as a good first step towards answering the climate question." In this case the Oxford team was a bit limited because the observed sea surface temperatures that drive the model are not yet available. Instead, the summer of 2014 was used as a proxy. The team felt the choice was solid because the influence of the exact sea surface temperatures in Europe is small compared to the overall effect of global warming.

European heatwaves in 2003 and 2006 had major impacts, especially among vulnerable groups such as the elderly in urban areas. Excess mortality due to the 2003 heatwave was estimated at 70,000; in 2006 the Netherlands made it into the global top-5 of most deadly disasters. Maarten van Aalst, director of the Red Cross Red Crescent Climate Centre said, "too often, people are still caught unawares by the rising risks. It's essential to provide clear information on the risks and how they can be managed, often by simple measures such as drinking enough water, or checking to make sure your older neighbors are safe."

The methodology used in these two approaches is drawn from peer reviewed literature. For more details on each approach please refer to the Methodology outlined for our previous analysis on the record heat in Europe in 2014.

NOTE: This initial analysis uses a combination of forecast and observational temperature data. We will update our results over the weekend incorporating the latest available observational data. This update will take place on on Monday July 6th.

References:

[1] IPCC (2014). Fifth Assessment Report. Cambridge University Press.

[2] Meehl, G.A. and C. Tebaldi (2004). More intense, more frequent, and longer lasting heatwaves in the 21st century. Science 305:994-997.

[3] Stott, P.A., Stone, D.A., and Allen, M.R. (2004) Human contribution to the European heatwave of 2003. Nature, 432:7017.

For more information contact: Climate Central - Heidi Cullen hcullen@climatecentral.org