

Loading the Weather Dice

The link between climate change and extreme weather

Myles Allen
School of Geography and the Environment &
Department of Physics
University of Oxford
myles.allen@ouce.ox.ac.uk



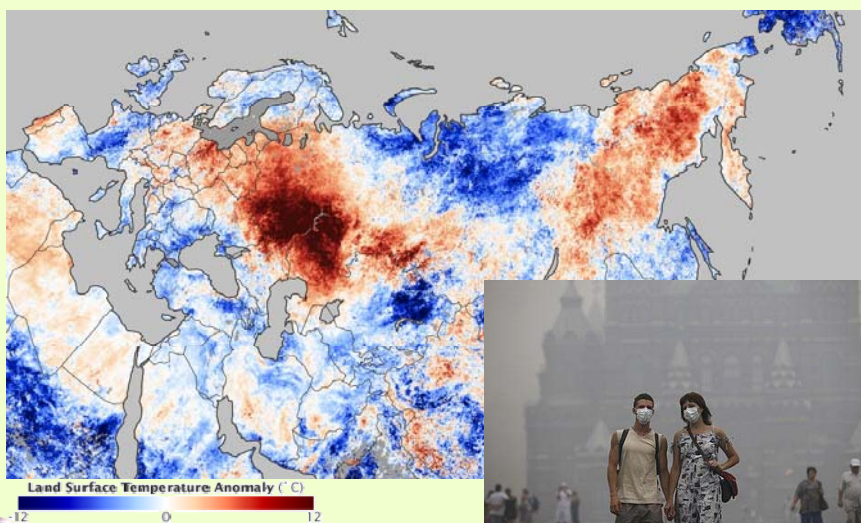
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The 2010 Russian heatwave:

~50,000 deaths, \$15bn cost to Russian economy



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Apparently contradictory statements

- "...the intense 2010 Russian heat wave was mainly due to natural internal atmospheric variability."
 - Dole et al, *Geophysical Research Letters*, 2011
- "we estimate ... an approximate 80% probability that the 2010 July heat record would not have occurred without climate warming."
 - Rahmstorf & Coumou, *Proc. Nat. Acad. Sci.*, 2011
- "we're not only loading the dice, we're painting more dots on the dice. We're not only rolling more 12s, we're rolling 13s and 14s and soon 15s and 16s."
 - Al Gore, September, 2011



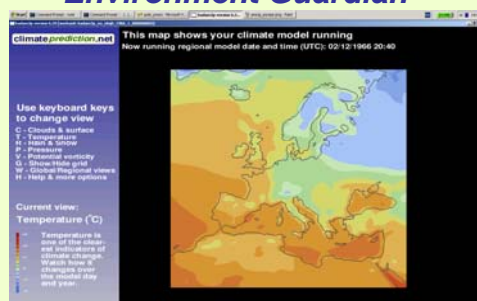
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Simulating the weather that might have been: the climateprediction.net weatherathome project

- Dole et al noted one out of their 50 simulations produced a 2010-like heatwave.
- Need larger ensembles, since the event was unpredictable.
- Run thousands of simulations 1950-2010.
- Compare numbers of heat waves in the 1960s and 2000s.
- Runs performed on personal computers.
- Massey et al, 2011, supported by *Environment Guardian*

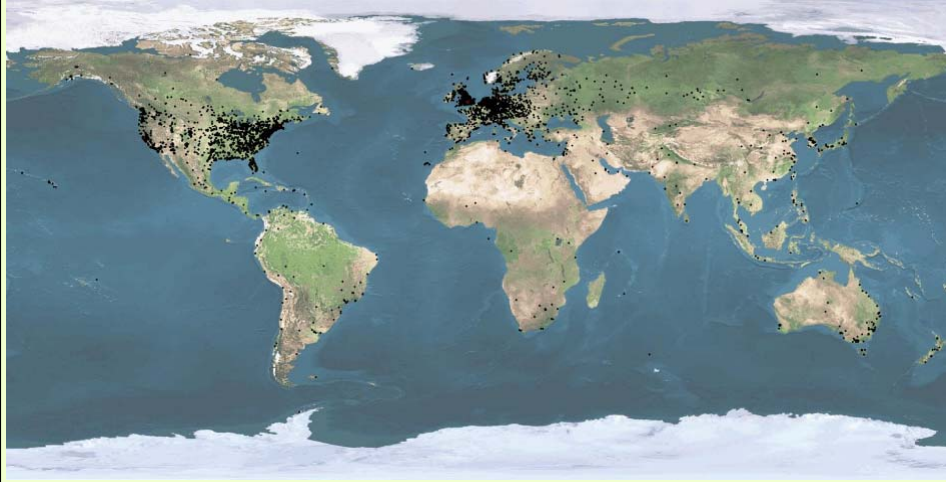


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Our laboratory: the world's largest climate modelling facility



>300,000 volunteers, 40,000 active, 127M model-years

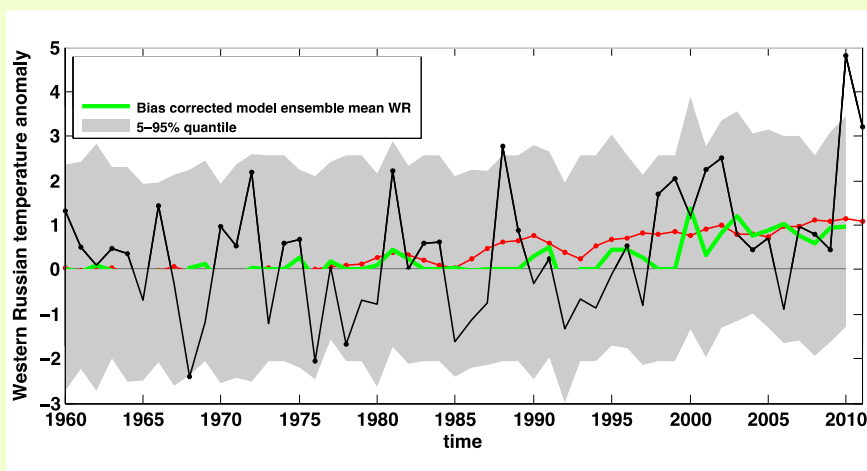


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July temperatures in Western Russia as observed, explained by global trends & modeled by W@H



F. Otto, G-J van Oldenburg et al, 2011, submitted

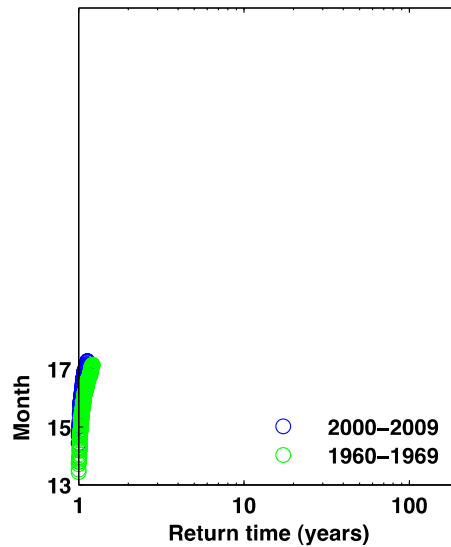


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The role of large-scale warming in the 2010



2000s

“Mainly externally driven”

“Mainly internally generated”



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Was the 2010 Russian heat-wave really “mainly natural in origin”?

- July temperatures in 2010 were 6°C above normal, of which <2°C can be “blamed” on warming since 1960.
- But the warming that occurred since 1960 increased the probability of a heat wave of this magnitude from one-percent-per-year to three-percent-per-year.
- So, two-thirds of current risk is attributable to the large-scale warming...
- ...and most of the large-scale warming is attributable to anthropogenic greenhouse gas emissions.



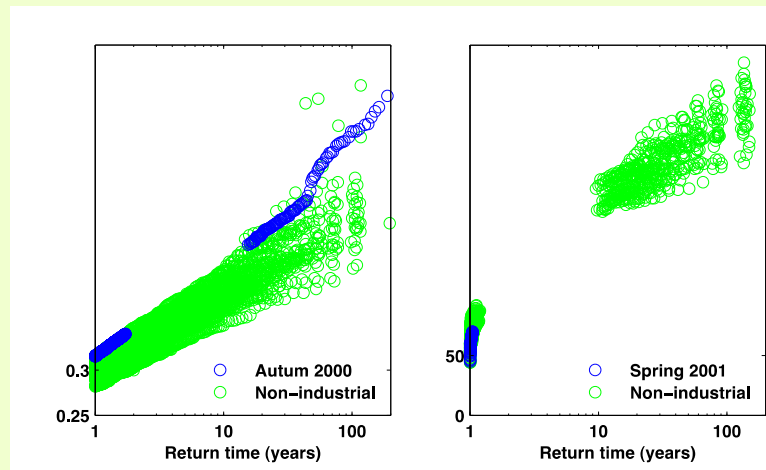
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Not all events are being made more likely

A flood that happened – and one that did not



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Pall et al, 2011 and Kay et al, 2011

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Why we need probabilistic event attribution (Stott et al, 2011)

- Most present-day potential impacts of climate change are related to extreme weather events.
- Quantifying how risks are changing allows us to
 - Better quantify (and insure against) present-day risks.
 - Build resilience to events that are becoming more probable.
 - Quantify the overall cost of human influence on climate.
 - Justify spending on climate change adaptation.



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Why we need probabilistic event attribution (Stott et al, 2011)

- Probabilistic analysis of rare events requires large numbers of runs with realistic weather models, such as: http://eearth.knmi.nl/Rain_Rhine-basin_0.wmv
- A significant challenge, but cheap compared to making wrong decisions on adaptation.



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Why the numbers matter

- “Plaintiffs ... must show that, more probably than not, their individual injuries were caused by the risk factor in question, as opposed to any other cause. This has sometimes been translated to a requirement of a relative risk of at least two.” (Grossman, 2003)
 - European heatwave of 2003 exceeds this threshold at the 90% confidence level (Stott et al, 2004).
 - UK floods of Autumn 2000 do not (Pall et al, 2011).
 - We are still working on the 2010 Russian heat wave.



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Why the numbers matter

- When will those harmed by climate change begin to claim compensation from those who benefit from the production and use of fossil fuels?



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The climate front line is not in Durban: *Native Village of Kivalina v. ExxonMobil*



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