

# Human influence on weather risk: The 2003 European Heat-wave

**Myles Allen**

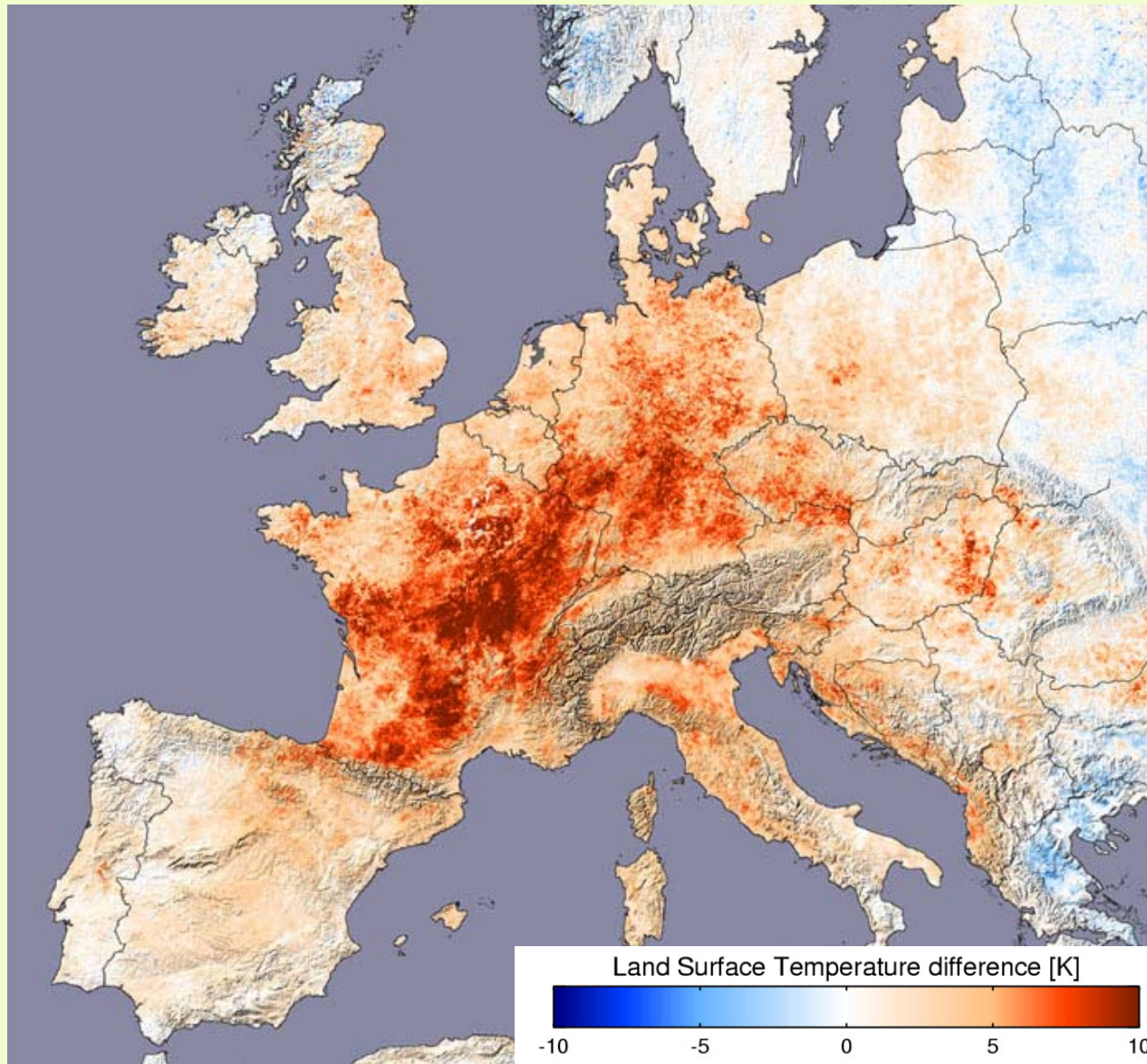
Department of Physics, University of Oxford

[myles.allen@physics.ox.ac.uk](mailto:myles.allen@physics.ox.ac.uk)

Peter Stott, The Met Office; Dáithí Stone, Univ. Oxford;  
Richard Lord, QC, Brick Court Chambers, London;  
Christoph Schär, ETH Zürich; Gerd Jendritzky, German  
Weather Service; Reto Stöckli, ETH Zürich



# Summer 2003 temperatures relative to 2000-2004



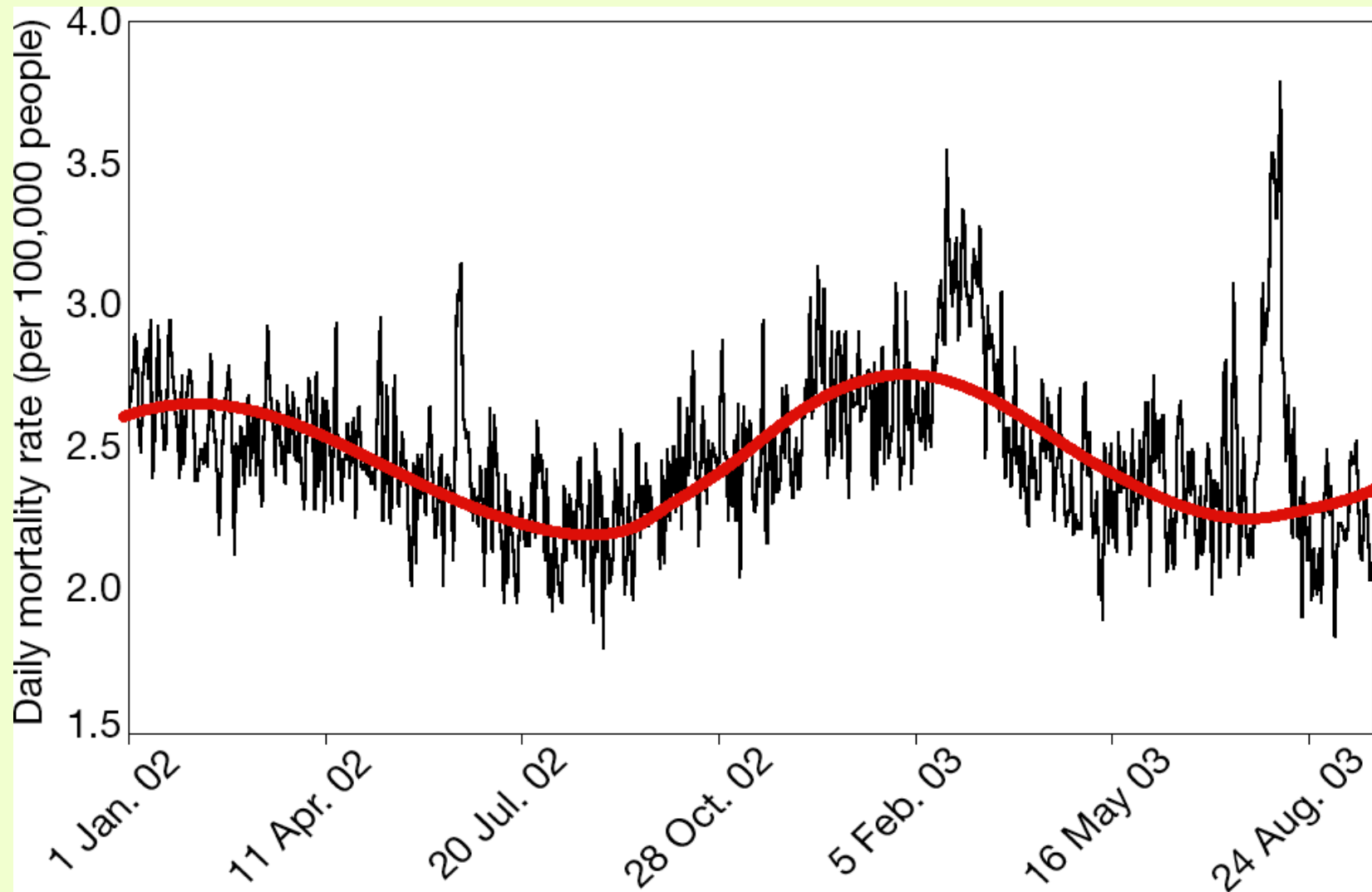
From NASA's  
Moderate  
Resolution Imaging  
Spectrometer,  
courtesy of Reto  
Stöckli



# Heat-wave blamed for US\$12.3 billion uninsured crop losses + US\$1.6 billion forest fire damage



# Excess mortality rates in early August 2003 indicate 22,000 and 35,000 heat-related deaths



Daily mortality in Baden-Württemberg

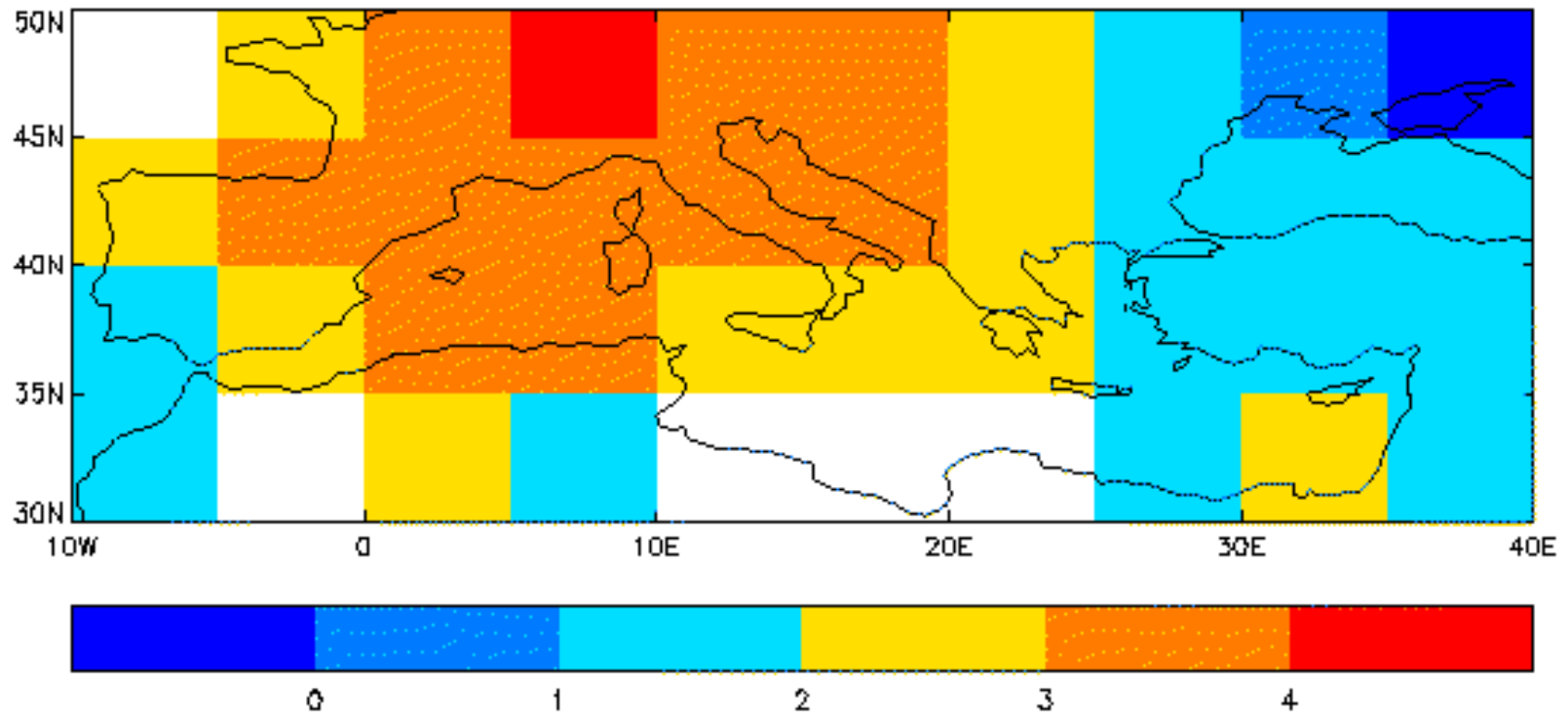


# But a single heat-wave is a weather event: how can we pin down the role of climate change?

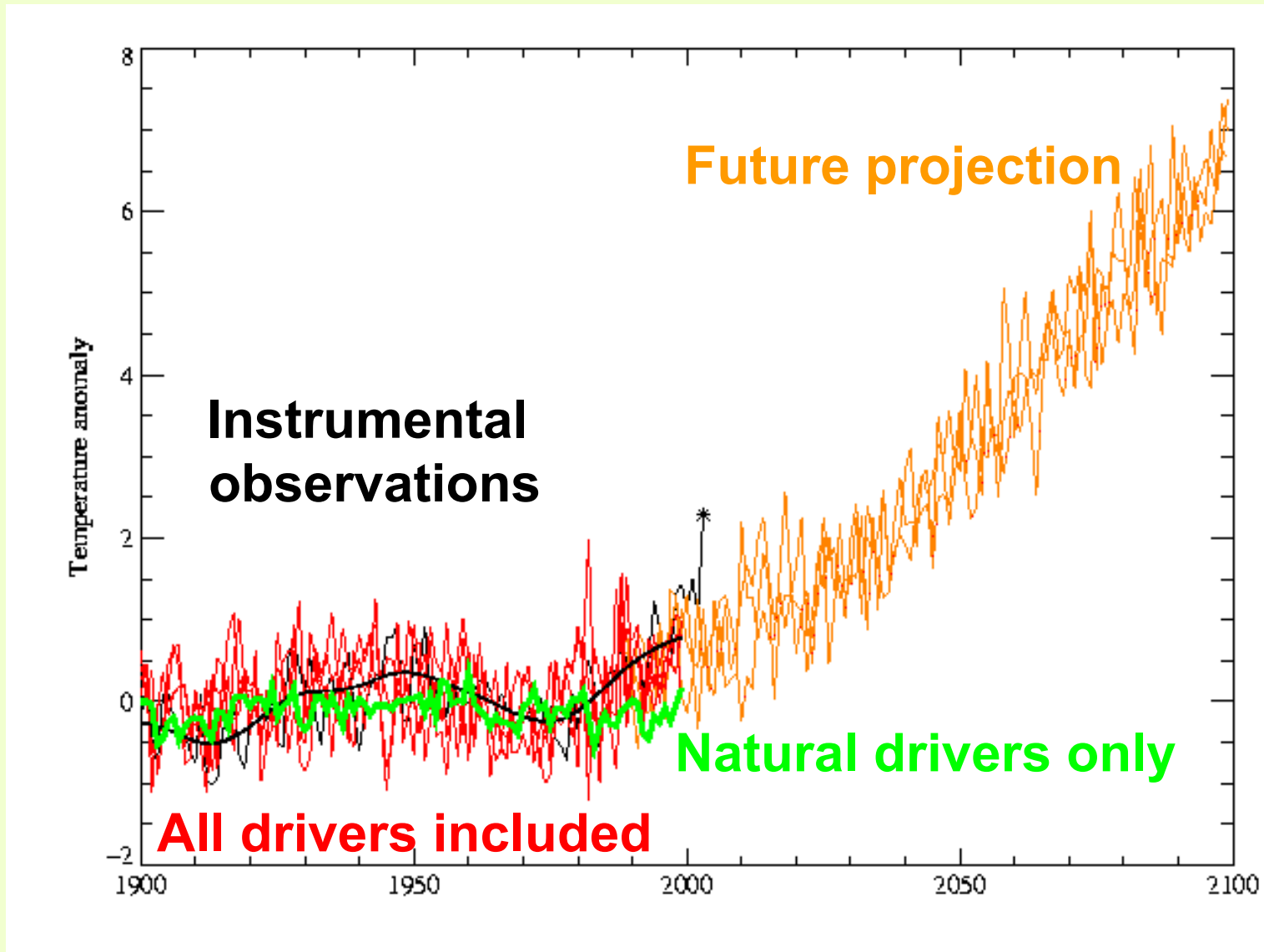
- Lorenz's definition of climate:
  - “Climate is what you expect, weather is what you get.”
- Updated for the 21st century:
  - “Climate is what you affect, weather is what gets you.”
- The immediate cause of the heat-wave was a persistent anti-cyclone over Northwest Europe.
- No evidence that human influence on climate makes such circulation patterns more likely.
- Instead, we ask how has human influence on climate affected the *risk* of such an anti-cyclone (however induced) causing such an intense heat-wave?



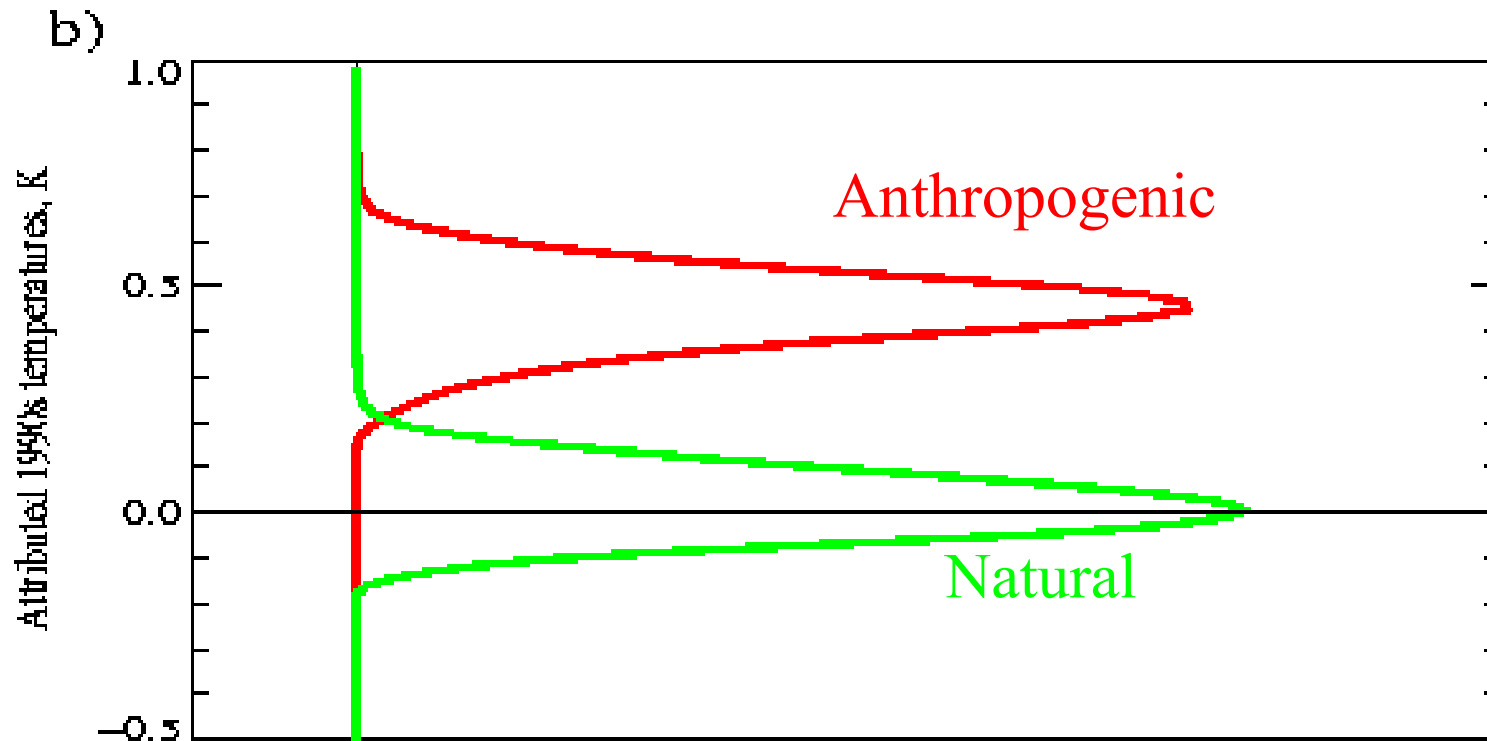
# June-August temperatures in 2003, relative to 1961-90 mean, Mediterranean region



# Modelling Southern European summer temperatures

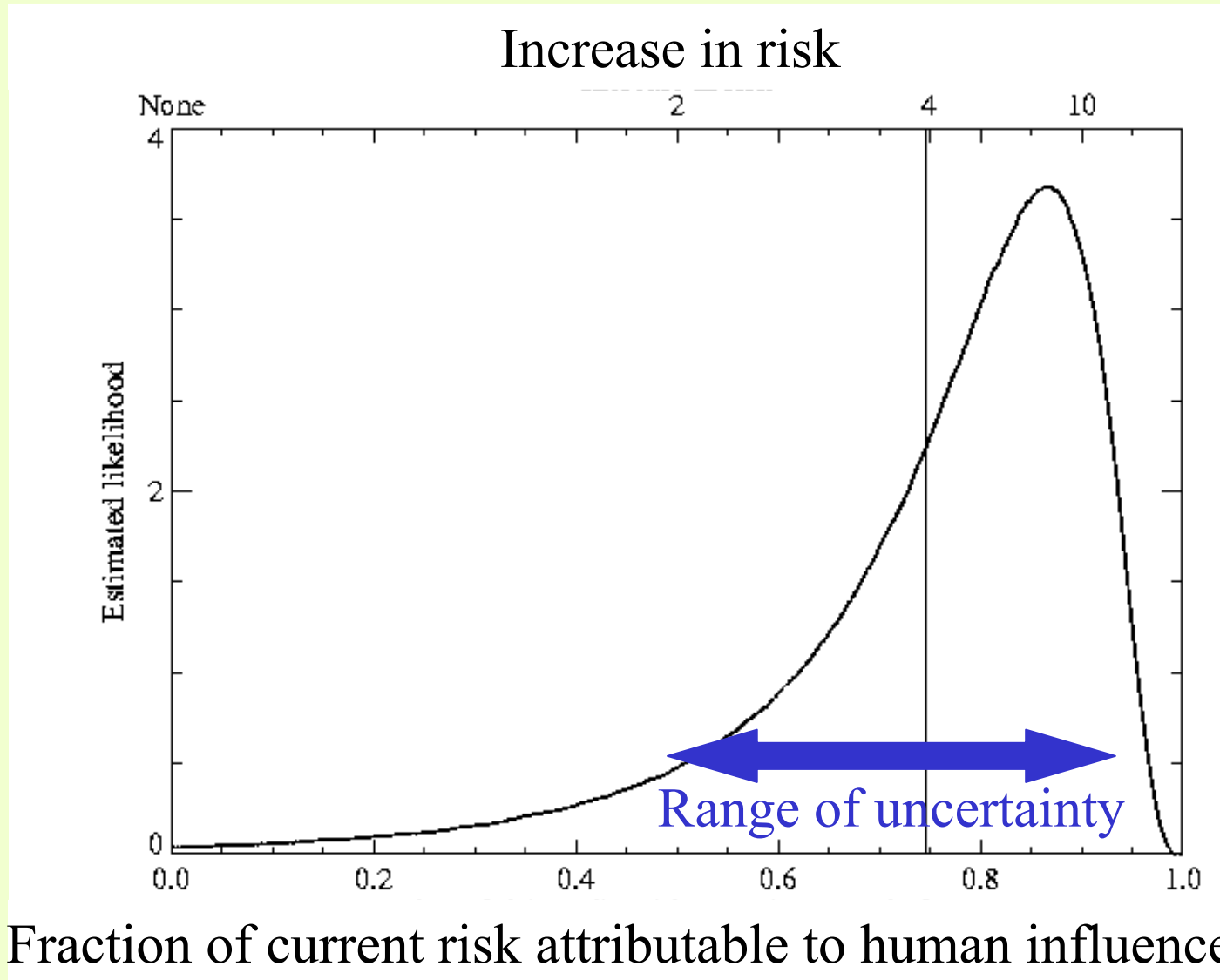


# External contributions to European summer temperatures, relative to pre-industrial





# Human contribution to the risk of the 2003 heat-wave: loading the weather dice

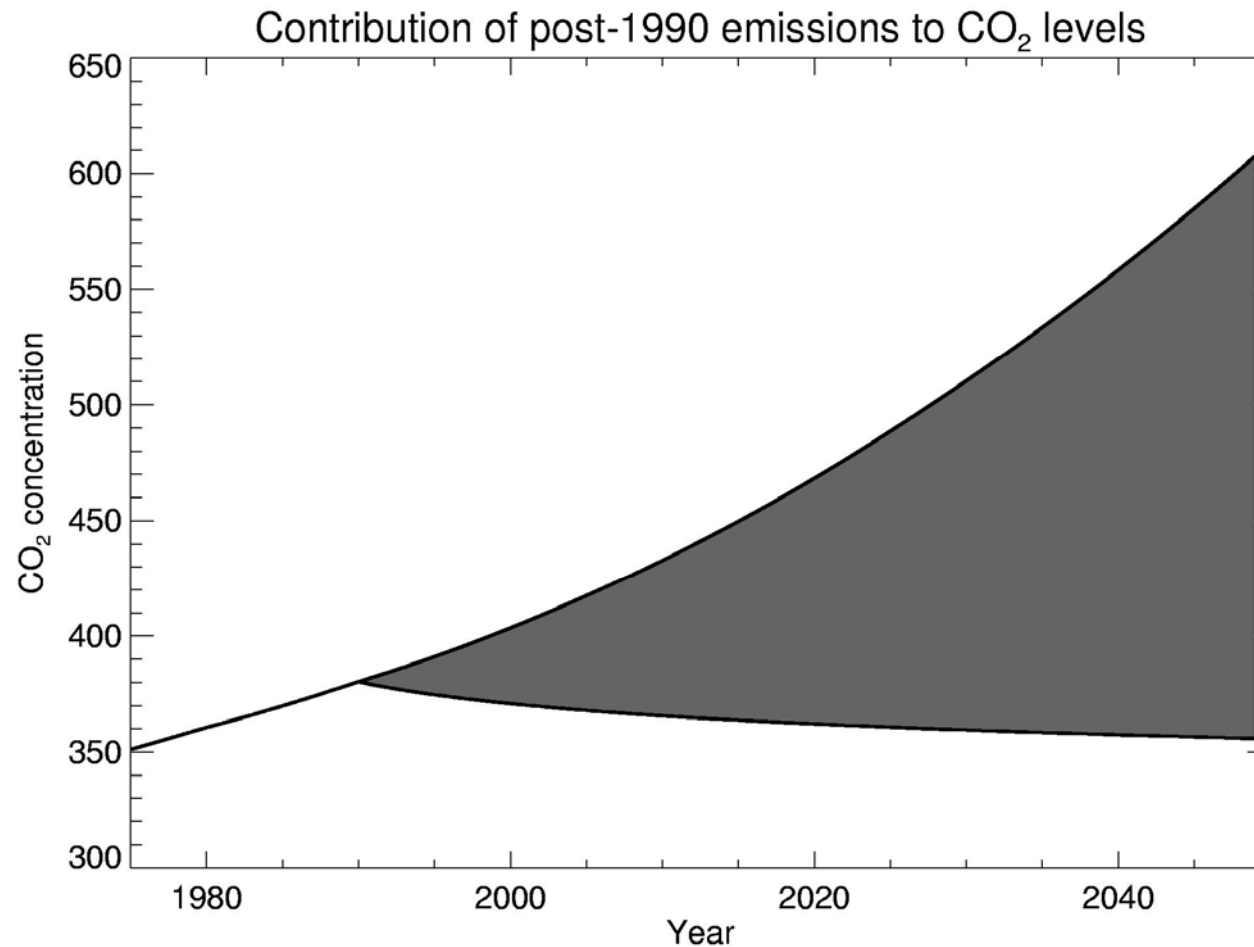


# Why this matters

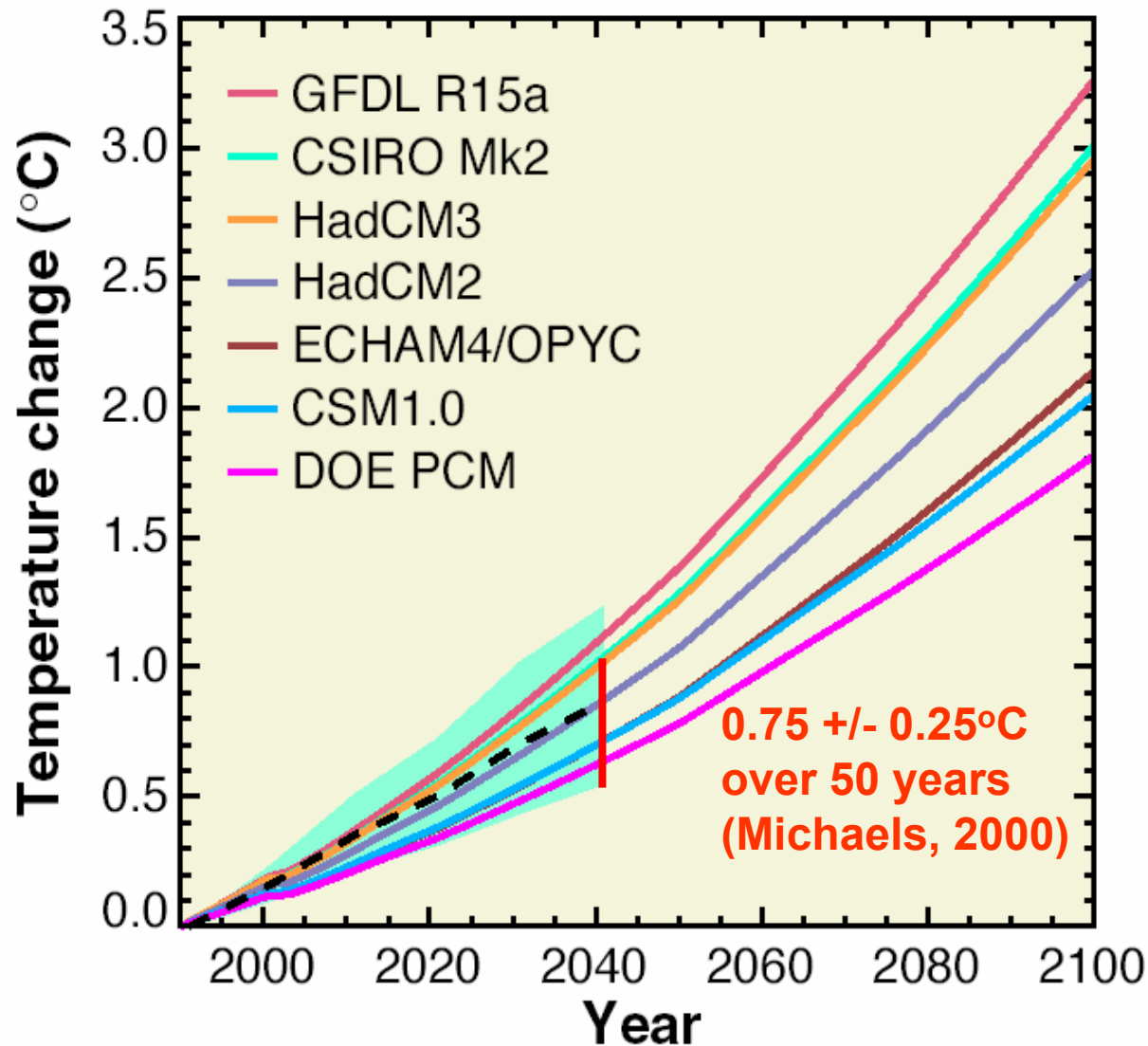
- Modest (0.5°C) background warming substantially increases the risk of extreme high temperatures.
- It is likely (90% confidence) that past human influence on climate was responsible for at least half the risk of the 2003 European summer heat-wave.
- “Plaintiffs ... must show that, more probably than 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)



# By the 2030s, most anthropogenic GHGs with have been emitted post-1990



# Emerging consensus on 50-year response to a given emission scenario



0.75 +/- 0.25°C  
over 50 years  
(Michaels, 2000)



# Summary

- It will always be impossible to say that “but for” greenhouse gas emissions a particular weather event would not have occurred.
- The best science can offer is to quantify a “material increase in risk.”
- The contribution of past greenhouse gas emissions to some current climate risks may already exceed 50%, the threshold for civil tort actions.
- Over the coming decade, both the cost and the inevitability of climate change will become clearer, fuelling demands for compensation.

