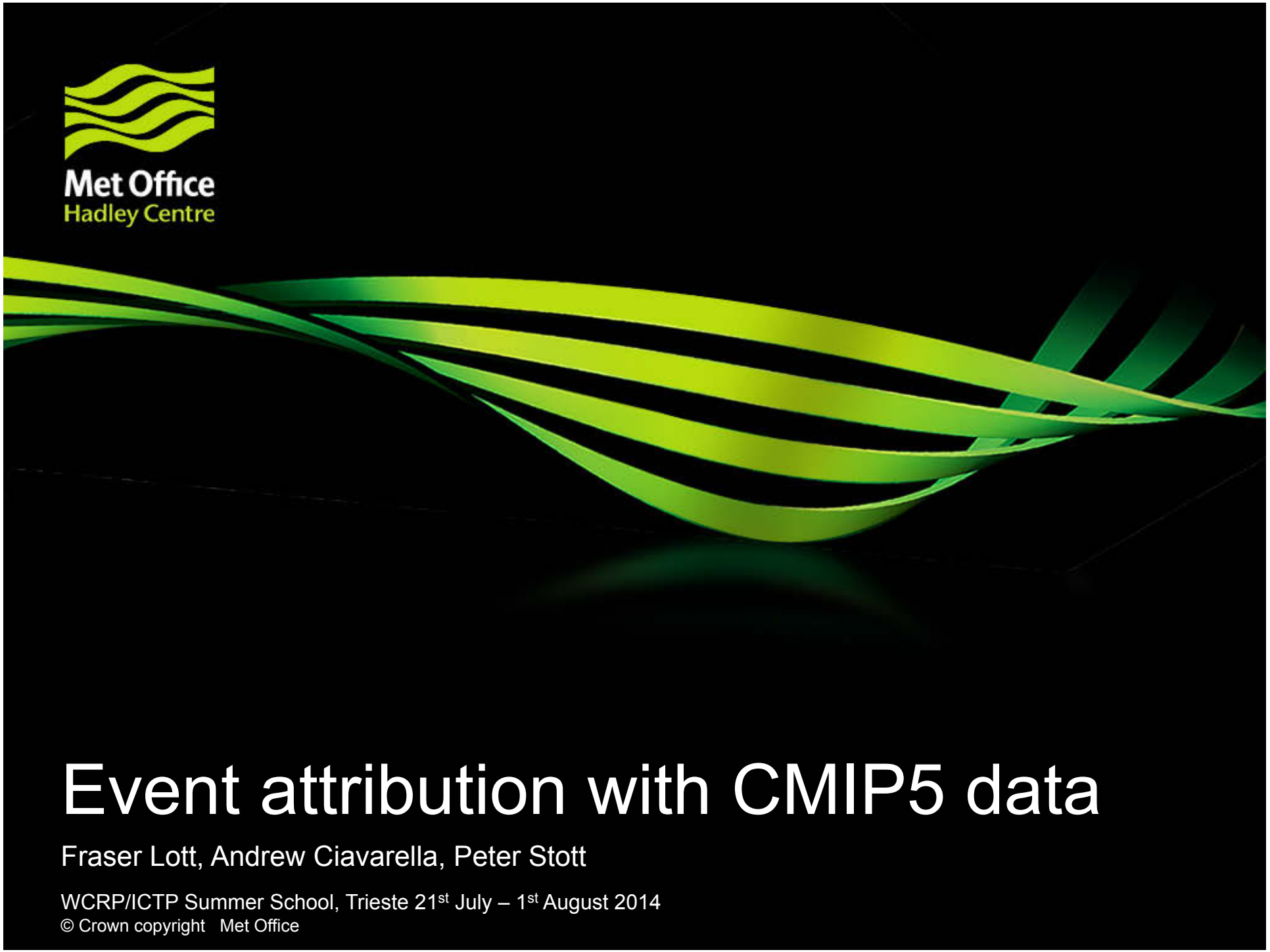


Event attribution with CMIP5 data

Fraser Lott, Andrew Ciavarella, Peter Stott

WCRP/ICTP Summer School, Trieste 21st July – 1st August 2014

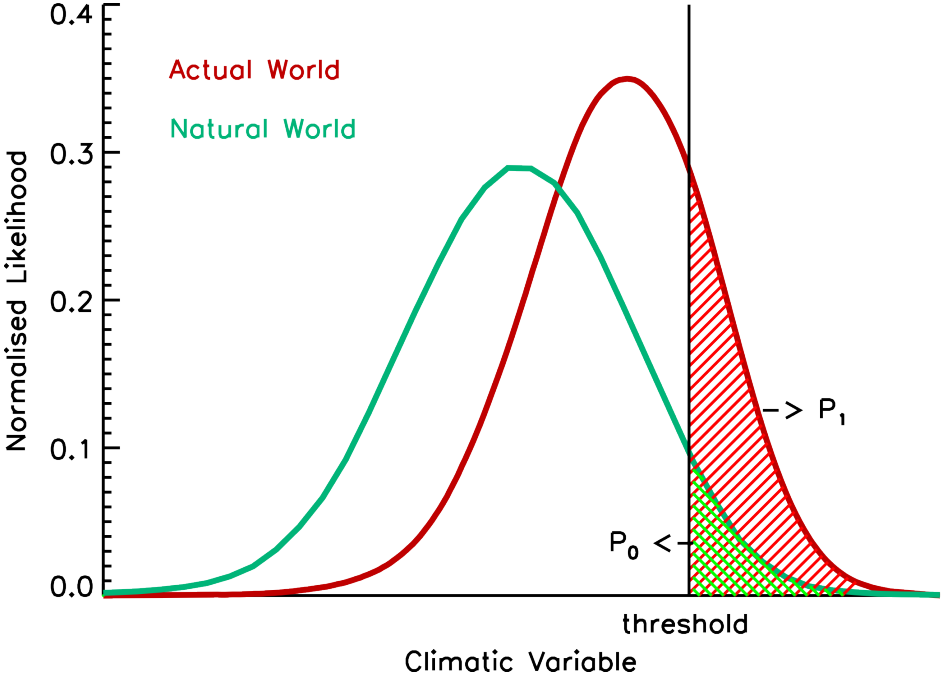
Does climate change cause individual extreme events?

Myles Allen 2003, Nature 421 p891-892

- It is often assumed that individual weather events cannot be ascribed to climate change
- However, climate change may change the probability of that event having taken place

What is the fraction of attributable risk?

- What is a fraction of attributable risk?



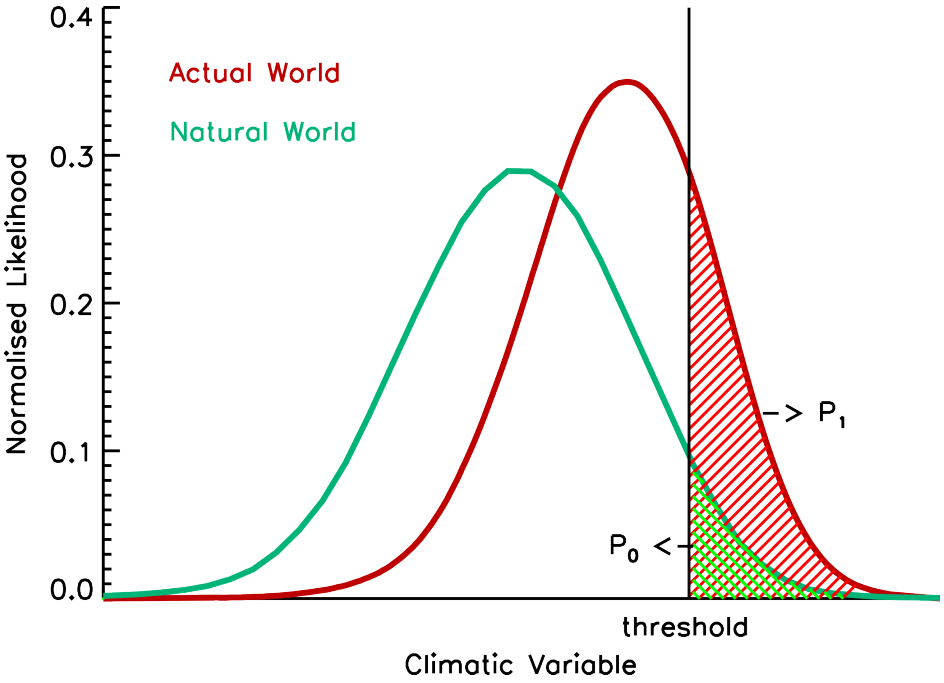
P_0: Probability of exceeding a threshold in a "natural world" (no human influence on climate forcings).

P_1: Probability of exceeding a threshold in the real world.

$$F_{AR} = 1 - (P_0 / P_1)$$

$$= 1 - (P_{NAT} / P_{ALL})$$

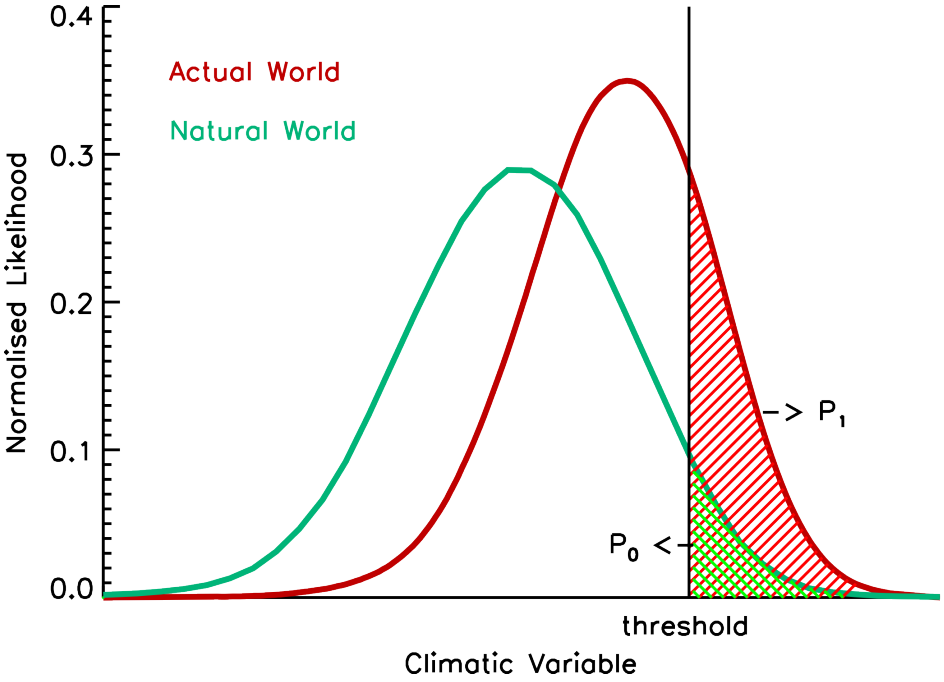
What do we need to calculate the FAR of an event?



- A large enough set of model data with all historical forcings, covering the region, period and variable of interest
- A second set with natural-only forcings, or with the effect of anthropogenic changes removed

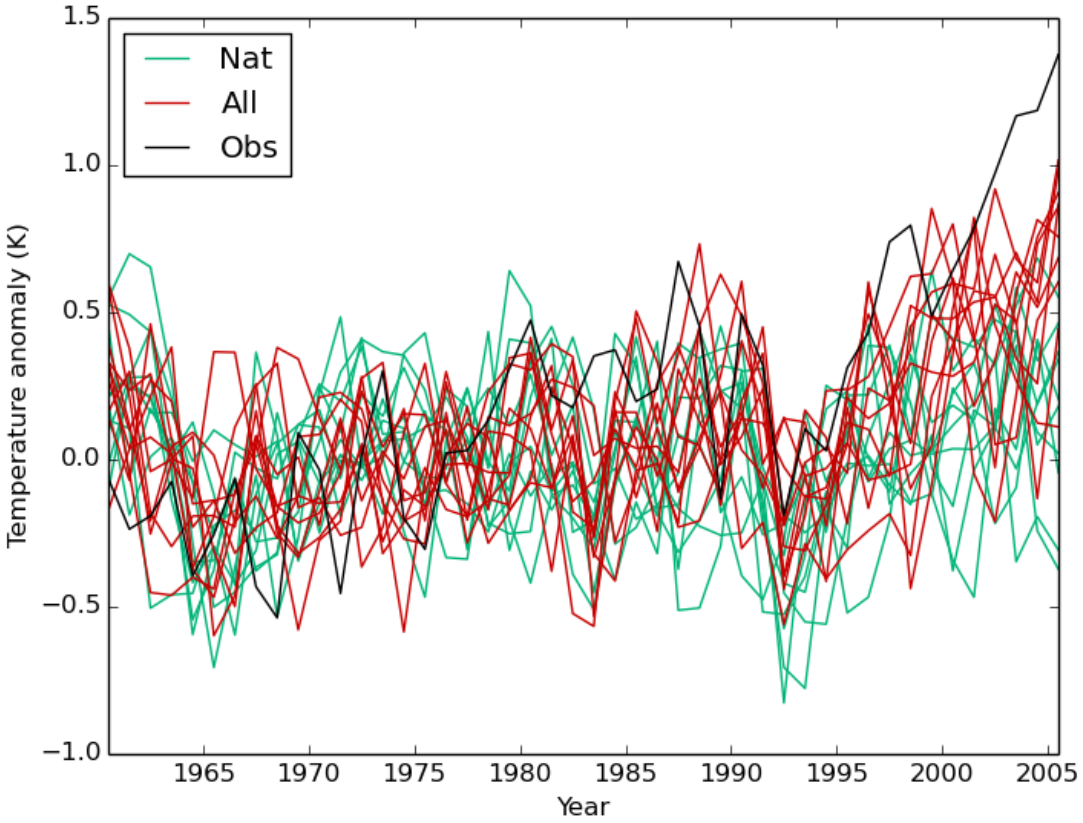
These can both be obtained from ensembles of CMIP5 model runs

What else do we need to calculate the FAR of an event?



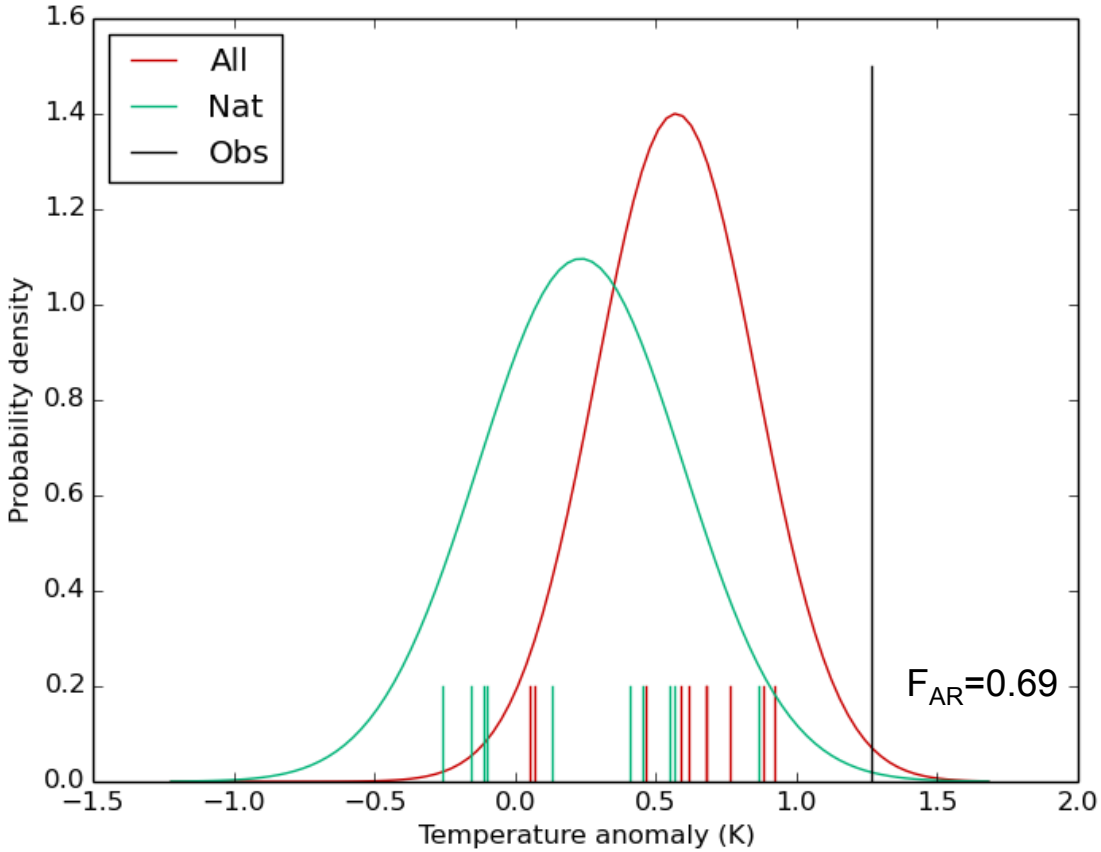
- Real-world observations to establish thresholds and correct biases in the model
- The threshold can be taken as “as bad as the event, or worse”, “beyond the second-worst” or as lying in an upper quantile of observed events

Where do we start the project?



- Historical, natural and future forcing runs in CMIP5 give a good starting point
- Global simulations can be sub-selected to focus on given regions
- Comparison with observational datasets give a simple detection study

But what about events?

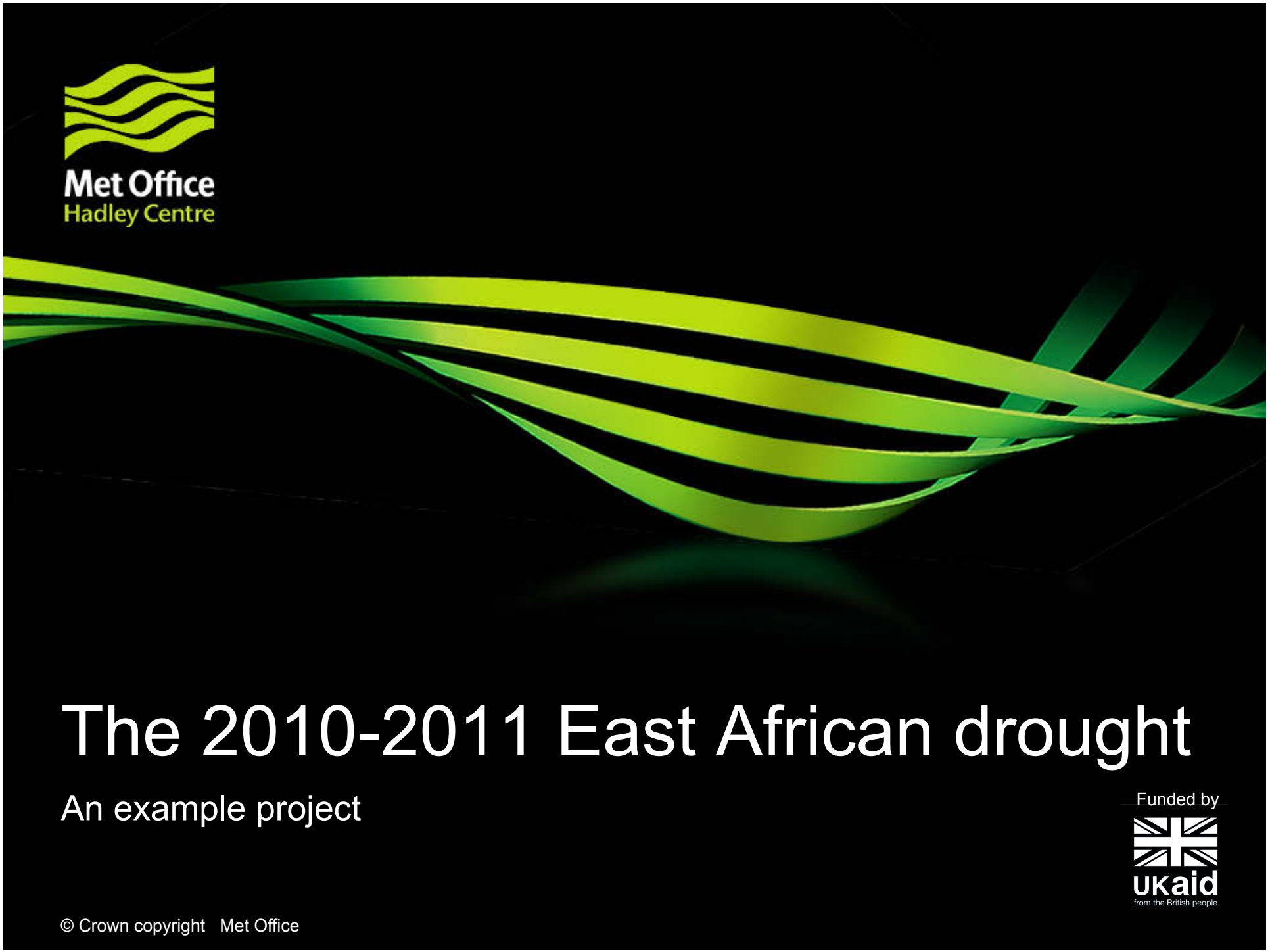


- We can focus on a single season and year to study how a variable's probability has changed with the climate
- Comparison to an observed extreme gives a measure of the fraction of attributable risk

What can we do?

- Choose the event and variable that interests your group
- Examine using larger datasets
- More and different regions
- Better statistical techniques for calculating FAR

…or something completely new!



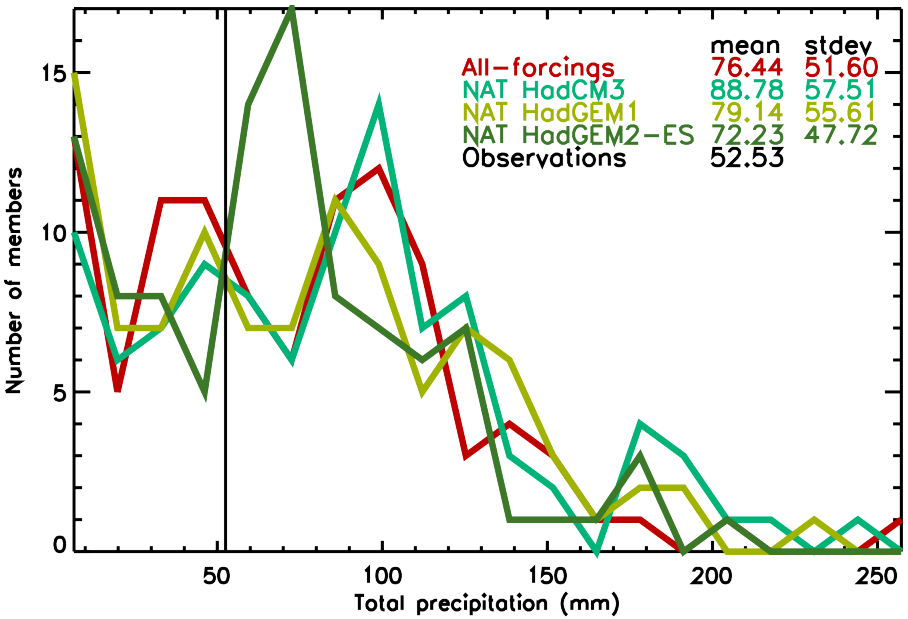
The 2010-2011 East African drought

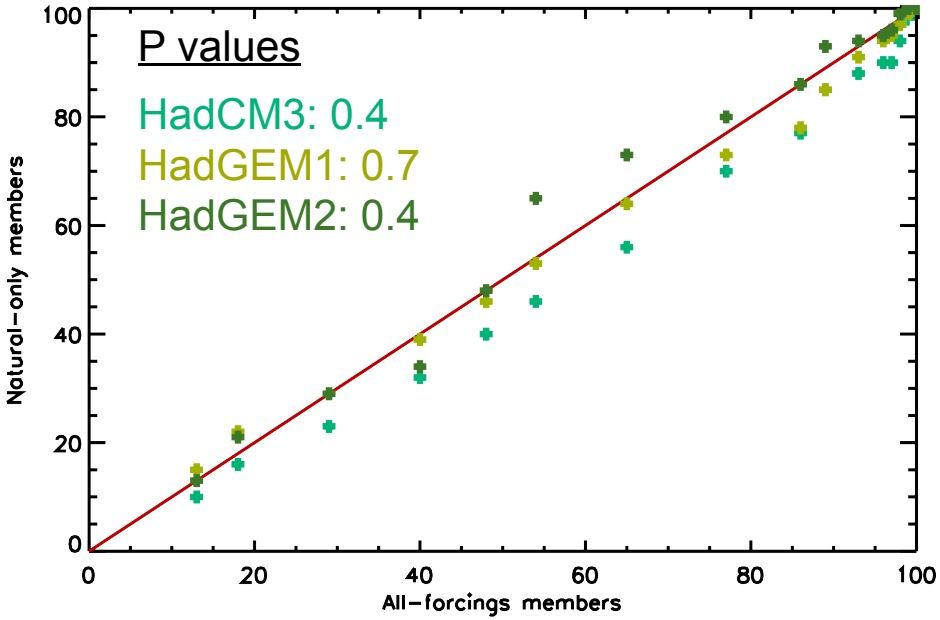
An example project

Funded by
UKaid
from the British people

Short rains 2010

•Histograms created from distribution of seasonal accumulated rainfall for each set of simulations

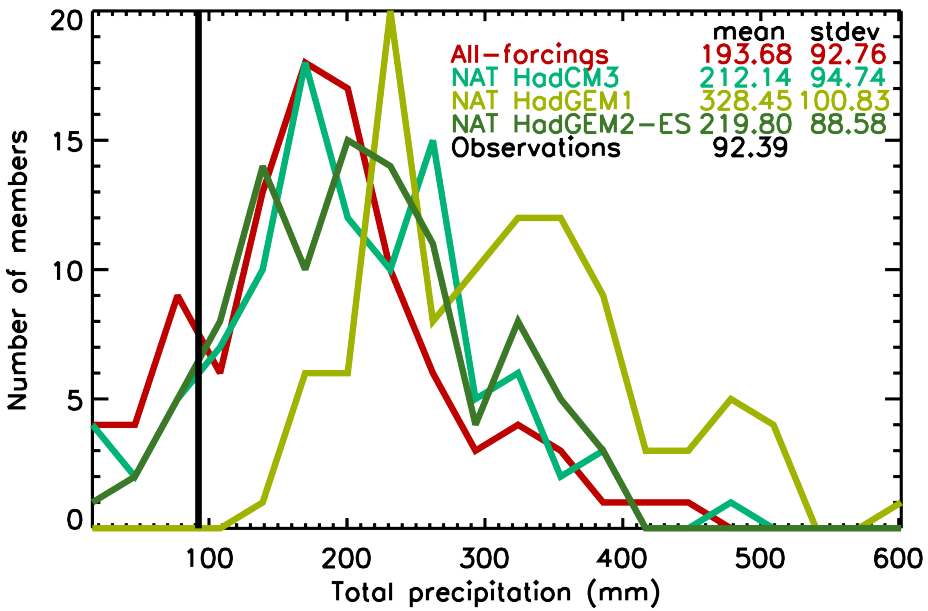


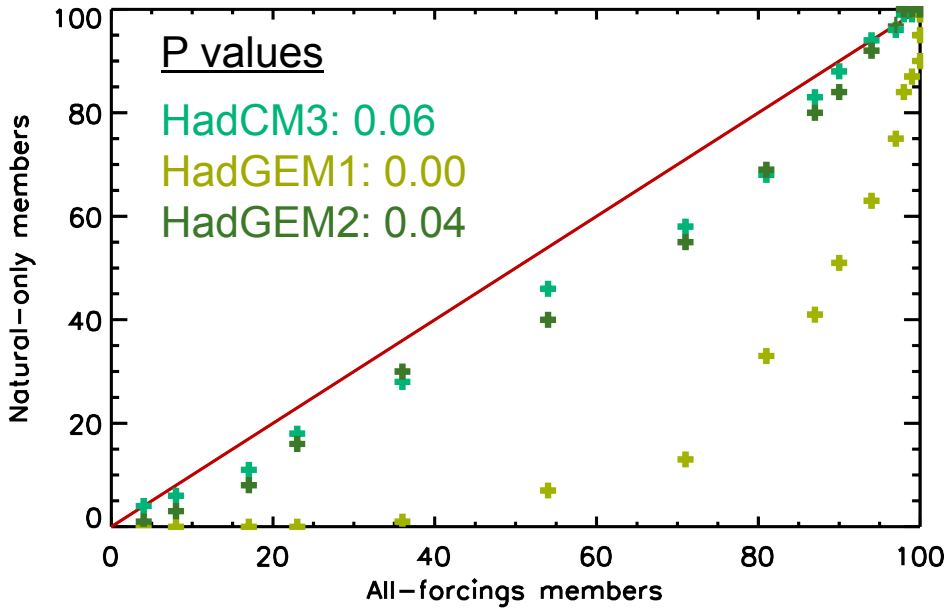


- 2-sided Kolmogorov-Smirnov (KS) test shows no significant difference in the curves at the 10% level
- No evidence for any effects of human-induced climate change on 2010 short rains

Long rains 2011

All three sets of natural world simulations are wetter than the all-forcings world





- One-sided KS test determines 2 of 3 shifts significant at 5% level, the third at 10% level
- This is evidence that 2011 long rains failure was more probable due to human influence (F_{AR} = 0.46 / 0.99 / 0.24)

Questions and answers