Climate Change and Extreme Weather Events

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Why we need a new perspective on the climate change issue

- There are three major stakeholders in this issue:
  - Fossil fuel producers.
  - Fossil fuel consumers.
  - Everyone at risk from climate change (“the impacted”).

- The mantra “climate change affects us all” is misleading: it affects some much more than others.

- Impacts are increasingly clear and will likely lead to meaningful action to reduce emissions by the 2020s.
Myth: Climate has always varied, so the present trend is nothing to worry about

Khadijateri cave paintings
Fact: we cannot explain the past century without both human and natural influence on climate

Observations

Colours: Simulations with human and natural influences
Fact: we cannot explain the past century without both human and natural influence on climate.

Observations

Colours: Simulations with natural influences alone
Regional Temperatures for the IPCC AR4 Models

Daithi Stone, 2007
Myth: not all scientists agree that this warming will continue if GHG levels continue to rise

Climate response to the IS92a scenario of future emissions, predicted by 2001 IPCC models and by Patrick Michaels, a prominent critic of the IPCC.
Myth: the most significant impacts of climate change only affect people living in photogenic places

Exotic island under water due to Sea-level rise

Melting of polar ice caps threatening the habitat of polar bears and other polar wildlife.
Fact: the most significant impacts of climate change are changing risks of extreme weather.
Myth: climate change was to blame for Hurricane Katrina
Myth: climate change was not to blame for Hurricane Katrina
Myth: scientists have no idea whether climate change was to blame for Hurricane Katrina
Fact: we can establish a causal link between individual weather events and climate change

- The drivers of climate change (greenhouse gases, volcanic eruptions…) affect weather in the way that the loading on a dice helps the dice to come up six.

“Climate is what you expect, weather is what you get”  
(Lorentz, 1982)

Updated for the 21st century…

“Climate is what you affect, weather is what gets you”  
(Myles Allen 2003)

- But we cannot roll the weather dice many times to work out how the loading is changing, so we have to use computer simulation.
A more challenging example: flood risk in the United Kingdom

River Trent, Nottingham, Autumn 2000
A more challenging example: flood risk in the United Kingdom

South Oxford on January 5th, 2003
A more challenging example: flood risk in the United Kingdom

West Oxford on July, 2007
It has happened before: Shillingford historic flood levels
Autumn 2000 floods in the UK

Sep-Nov 2000 was wettest Autumn in England & Wales since records began in 1766, with almost double (196%) the 1961-1990 average seasonal precipitation.

Nationwide impact: £1.3bn of insured loss. Over 10,000 properties flooded.
Standard climate models may be good enough for heat-waves, but not for precipitation.
Precipitation in a higher-resolution (1.25x0.8°) version of HadAM3
The climateprediction.net seasonal attribution experiment (Pall et al, 2007)

Aim: to quantify the role of increased greenhouse gases in precipitation responsible for 2000 floods.
Autumn 2000 as observed (ERA-40 reanalysis)...

...and in one of the wetter members of our ensemble.
Changing flood risk in the United Kingdom due to greenhouse gas increase 1900-2000

Return levels of England & Wales Autumn 2000 total precipitation, for an Industrial Vs Non-industrial climate [1776 A2000 Vs 629a 604b 632c 604d NIA2000 simulations]

ERA-40 1st wettest (2000) = 315.2mm
ERA-40 2nd wettest (1976) = 267.7mm
Why action to control greenhouse gas emissions may be coming sooner than you expect

- We estimate that there is a better than 9 in 10 chance that past human influence has more than doubled the risk of a heat-wave equal or greater than the summer of 2003 (Stott et al, 2004).

- Soon (not yet) we may be able to do the same for floods in Oxford, droughts in Libya and hurricanes in Louisiana.

- "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)
The world’s largest climate modelling facility:
www.climateprediction.net

~260,000 volunteers, 170 countries
Simulating the climate that might have been on your desktop: http://attribution.cpdn.org
Questions?
Myth: observed temperature changes can be explained by solar variability