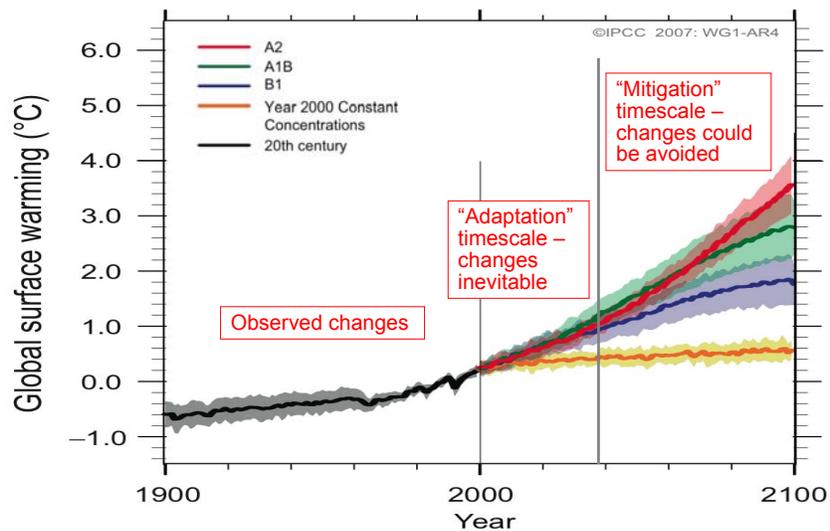


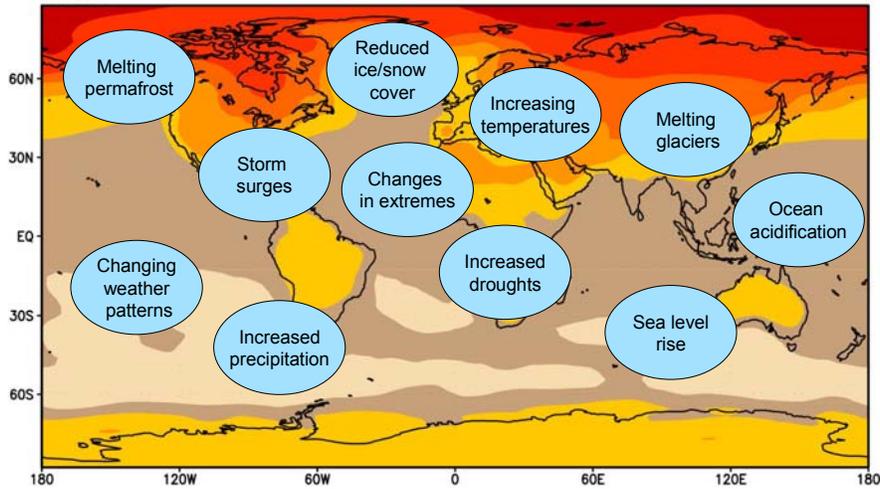
# Seamless weather and climate for security planning

Kirsty Lewis, Principal Climate Change Consultant, Met Office Hadley Centre  
28 June 2010

## Global Climate Models

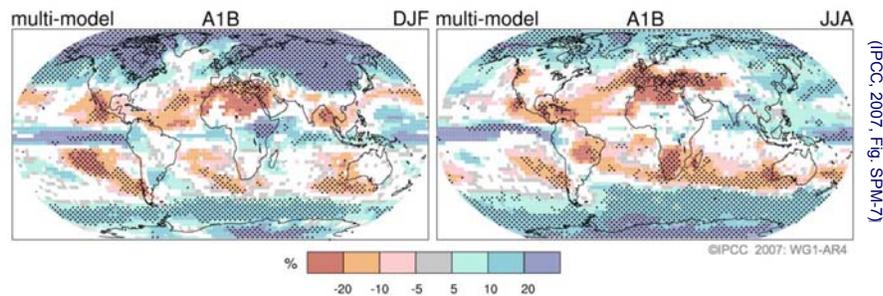


## Confident – Widespread impacts



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## Comparing Global Climate Models Multi-model ensembles



### Projected precipitation changes 2090s (% relative to 1980-99)

White: <2/3 of models agree on *sign* of change (+ or -)

Stippled: >90% of models agree on *sign* of change

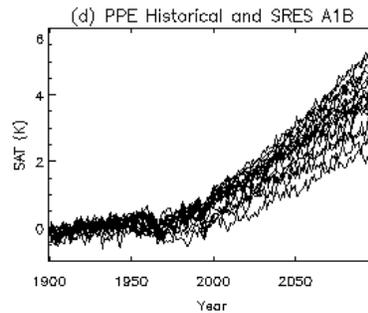
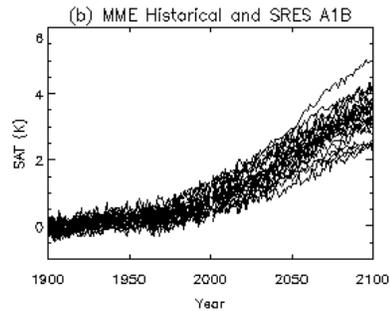
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## Perturbed Physics Ensembles

- Exploring the range of uncertainty with a single model itself
- Alter some of the assumed values within the model that are uncertain, within a plausible range, to test the sensitivity of that model to those assumptions



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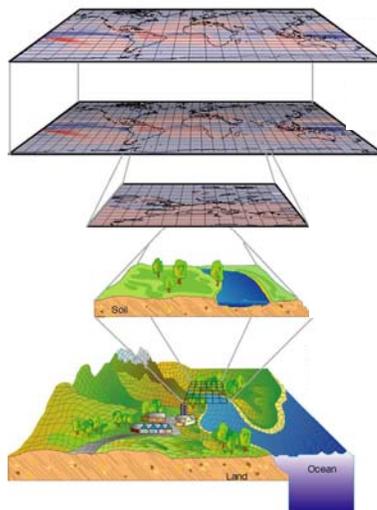
## Increasing spatial resolution

Global model

Regional model

Country model

Site specific model



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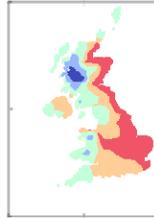


## Generating regional information

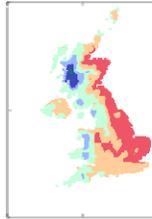
300km Global Model



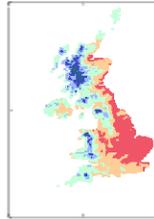
50km Regional Model



25km Regional Model



5km Observed



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Winter precipitation for 1961-2000



## Climate models and decision making

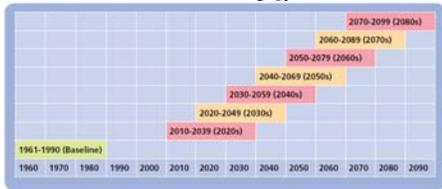
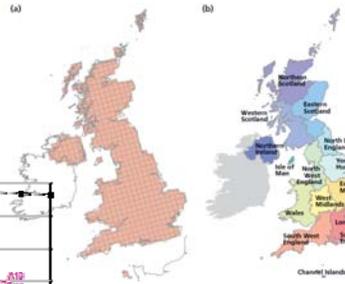
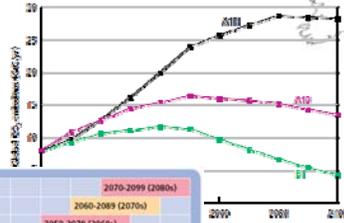
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# UKCP09 – UK climate change projections

25km grid, 16  
admin regions, 23  
river-basins and 9  
marine regions

Three different  
emission scenarios



Seven different  
time frames

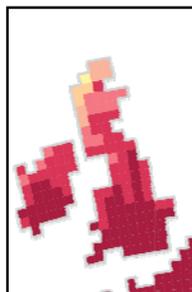
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# Moving from uncertainty to probability

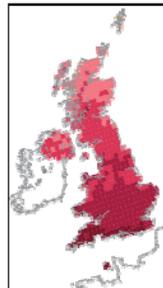
UKCIP02

Single  
projection



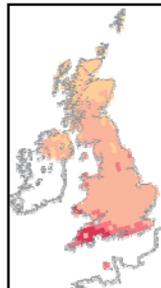
Summer Rainfall 2080's

Very unlikely  
to be less  
than (10%)

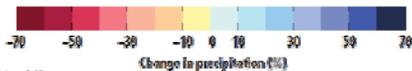


UKCP09

Central  
estimate  
(50%)



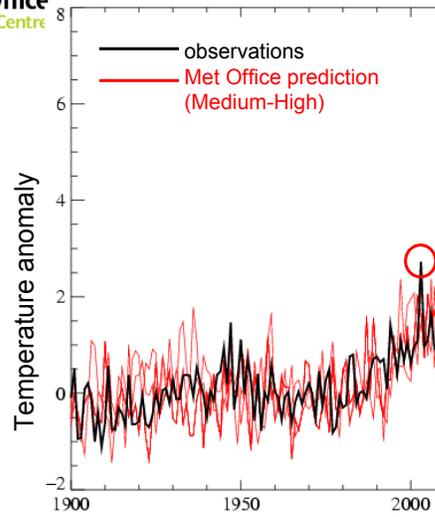
Very unlikely  
to be more  
than (90%)



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## Europe 2003



Estimated 900 people died in London  
35,000 deaths overall in Europe

photo: AP



France: 17 nuclear plants shut or reduced capacity

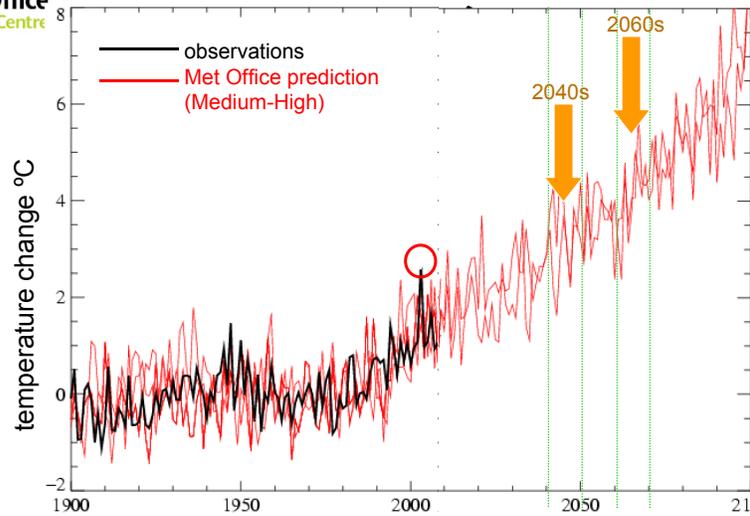
EDF paid (€300m) 10 x normal rates to buy electricity on open market

...and £4.5bn missed retail sales

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## Europe 2003 and beyond



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# Climate models and impacts



Global and Regional  
Climate models

Climate data: T, P etc

Impacts data:  
runoff, heat  
stress, flooding,  
etc.



Impacts

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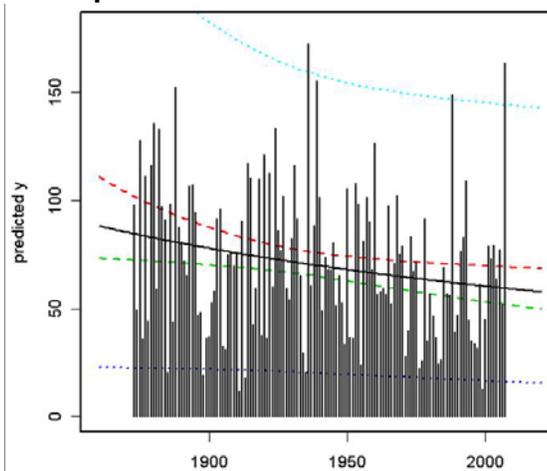


## Higher temporal resolution – Seasonal to decadal prediction systems

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## Trend in SW England/Wales July Precipitation



Model trend (black line)  
95% confidence interval on trend (red/green)  
95% prediction interval for precipitation (blue)

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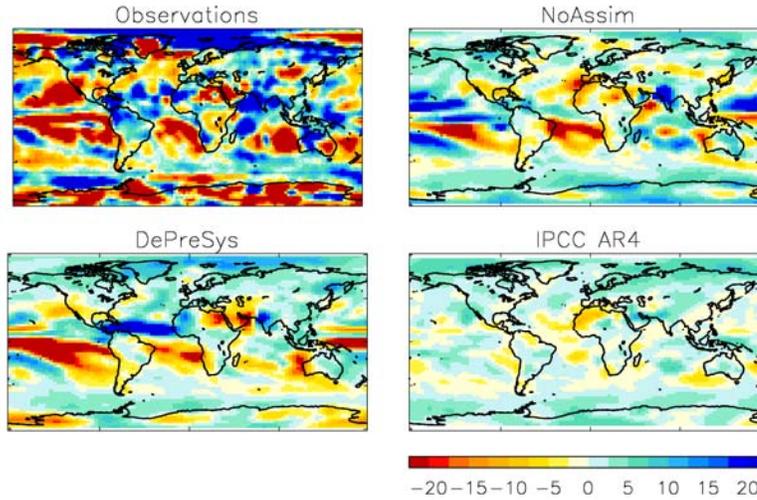
## DePreSys – Decadal Prediction

- Includes initial condition information to predict internally generated natural variability
  - Atmospheric winds, temperature, surface pressure
  - Ocean temperature and salinity
- As well as accounting for projections of external forcing, both natural and anthropogenic
  - Including changes in greenhouse gases and aerosols  
Incorporates 11 year solar cycle to project changes in irradiance
  - Decays volcanic aerosols from the start of the forecast.

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## Two year forecast from June 2005: Precipitation anomalies with respect to 1979-2001

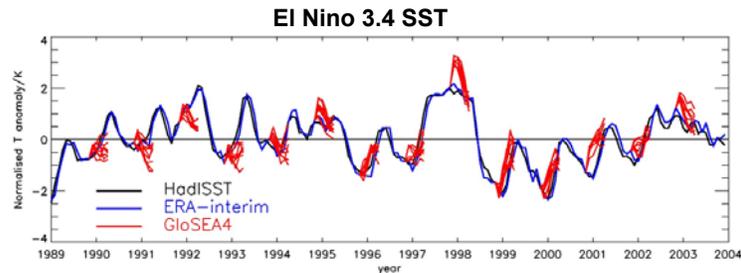


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## GloSea4 - Seasonal Prediction

- GloSea4 is a system of running the Met Office HadGEM3 Global Climate Model each week, multiple times, initialised using observed ocean temperatures.
- Predictability comes from initial conditions and boundary forcings
- Uncertainty comes mainly from the model itself



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# Climate change and security studies

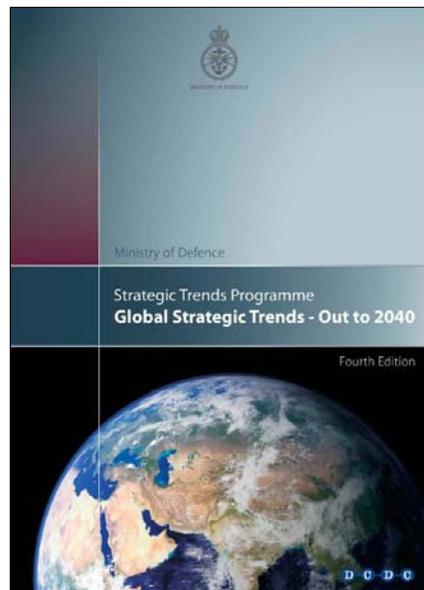
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## UK Met Office and MoD

Met Office has also provided support to MoD policy and planning on issues relating to climate change. E.g.

- DCDC Global Strategic Trends
- Strategy think-pieces on the Arctic, Antarctic, Arabian Peninsula



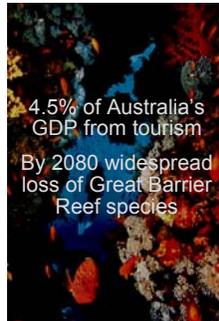
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## Impacts Summaries

### Climate change and impacts



Provided primarily to the FCO, but other government departments have found these useful

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## Climate Security Projects

Scenario planning for MoD



- Used climate model output to constrain a set of meteorological scenarios for the 2040s for a particular region.
- Scenarios were consistent with natural variability and the long term climate trend, but not predictive.
- It allowed security planners to test the resilience of the region in 'thought experiments'

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## Climate Security Projects

### Sahel - Climate change and security

- Joint project with OECD Sahel and West Africa club.
- Inter-disciplinary study, to analyse climate and non-climate variables to identify long term trends, rates of change, consequences and adaptation responses.
- Looked for relationship between climate variables and economic and social indicators of conflict.
- Now the project is developing a range of scenarios for possible climate evolutions to 2040s, and outlining possible impacts on non-climate variables and their conflict-linkages.



[www.oecd.org/swac/climatechange](http://www.oecd.org/swac/climatechange)

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## Climate Security Projects

### Vulnerability of global energy infrastructure to climate change - Scoping study



Working with the energy industry to explore sensitivity and to map out global distribution of energy infrastructure.

Use GCM model output and an evaluation of uncertainty to identify where the climate hazard could be fully explored.

This was combined with an evaluation of the availability of information on vulnerability, to identify productive research projects.

Government planners can apply knowledge of strategic interest and invest efficiently in research.

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## Future plans

### Extending Energy project methodology

- Climate change information tailored to the subject, which includes uncertainty and natural variability.
- Allows analysts and policymakers to evaluate when climate change is important and what are the best tools available understand more.

### Visualisation system

- Ambitious plans to integrate climate monitoring and attribution, seasonal to decadal predictions and climate change projections in a visualisation system for decision-makers.

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# Questions

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# Informing decision makers

## Risk-based approach

**Risk = Hazard x Vulnerability**

**Hazard** is a combination of the **Magnitude** of an **Event** and the **Likelihood** of it occurring.

**Vulnerability** is a combination of **Exposure, Resilience and Adaptive Capacity**

