Centre for Climate Change Economics and Policy

The Munich Re Programme: *Evaluating the Economics of Climate Risks and Opportunities in the Insurance Sector*

Grantham Research Institute on Climate Change and the Environment

The Power of Context: Revisiting the Use of Climate Information for Adaptation Decision-Making

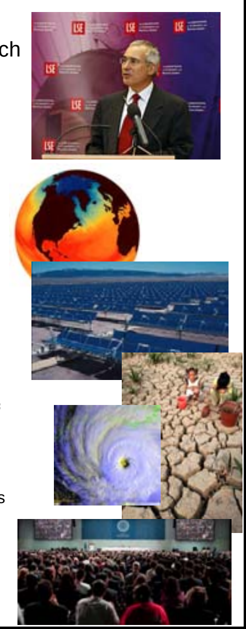
Nicola Ranger with Antony Millner, Falk Niehoerster and colleagues

Grantham Research Institute on Climate Change and the Environment

Centre for Climate Change Economics and Policy

ESRC Economic & Social Research Council · Living With Environmental Change LWEC · Munich RE · LSE The London School of Economics and Political Science · University of Leeds

The Centre for Climate Change Economics and Policy



A **multi-disciplinary ESRC Research Centre** jointly hosted between the London School of Economics (the Grantham Research Institute) and the University of Leeds. Chaired by Lord Stern

Five research programmes:

- **Developing the climate science and economics**
  - Designing modelling experiments to better inform decisions
  - Interpreting climate and economic model information for decision-support in both adaptation and mitigation (conceptual work and case studies).
  - Decision-making under uncertainty/ambiguity
- Adaptation and Human development
- Governments, markets and climate change mitigation
- Climate change governance for a new global deal
- **The Munich Re Programme: evaluating the economics of climate risks and opportunities for the insurance sector**
  - Understanding the drivers of trends in disaster losses
  - Forecast skill in decision-relevant metrics on seasonal to decadal timescales
  - Measuring the economic effectiveness of forecasts
  - The implications of climate change for future risk and the insurance sector; including the role of insurance and disaster risk in adaptation

Centre for Climate Change Economics and Policy

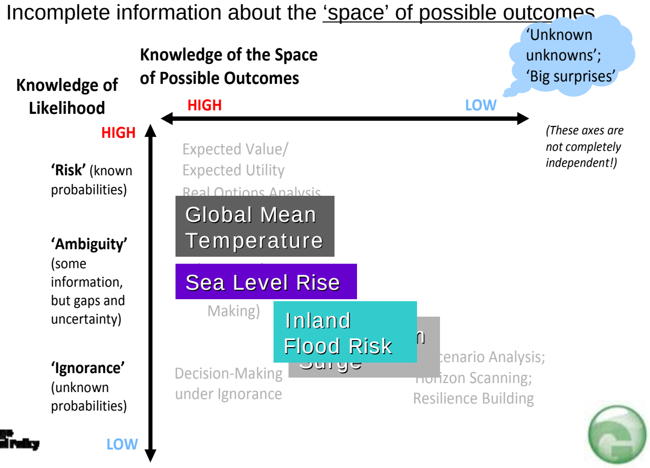
Adaptation in Context

- Adaptation planning and implementation has the same challenges as many other areas of risk management and decision-making; e.g.
  - Differing values and objectives, risk aversion, preferences etc.
  - Risk perception
  - Lack of information and uncertainty
  - Lack of political will, short-termism and institutional inertia
  - Budgetary constraints
- Human and natural systems have been adapting to climate for centuries (to varying extents; albeit reactively)
- What is different about adaptation?
  - Climate change means that decision-making can no longer rely on history as an adequate guide to the future (Hallegatte, 2008) – statistical non-stationarity…
  - Timescales of many decisions and climatic changes means that effective adaptation requires anticipation of changes and investing now for an uncertain future

How can we make 'good' decisions with the information available today?

Uncertainty and Decision Making

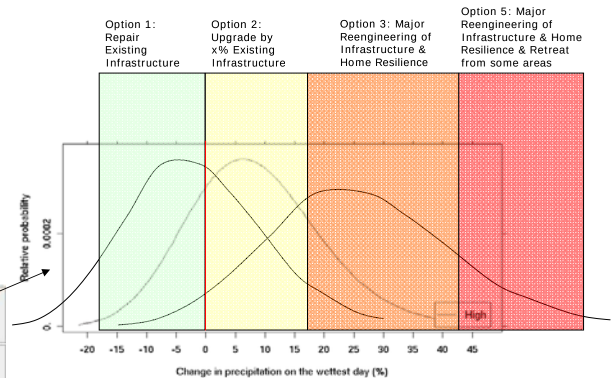
- Adaptation decision-making is not just a process of decision-making under uncertainty… it is a process of **decision-making under deep uncertainty** (ambiguity):
  - Low confidence in estimates of the likelihood of different outcomes;
  - Incomplete information about the <u>'space' of possible outcomes</u>



Sensitivity of Adaptation to Climate PDFs

"Improper consideration of residual uncertainties of probabilistic climate information (which is always incomplete and conditional) in optimisation exercises could lead to mal-adaptation and be far from optimal" Dessai et al. 2009 based on Hall 2007

For illustration only…



Traditional Approach: Apply Expected Utility Analysis to Optimise the Costs versus Benefits of Action under Known Uncertainty

Centre for Climate Change Economics and Policy

Grantham Research Institute on Climate Change and the Environment

'Policy-First' Approach

Structure the Problem

1. Define Adaptation Objectives and Constraints — *Who are the relevant stakeholders? What constraints do I have on my adaptation response? How would I characterise successful adaptation?*

2. Assess Current Vulnerability and Identify Potential Future Sensitivities — *How vulnerable is my system to current weather/climate? Roughly, what future changes might my system be sensitive to over its lifetime?*

3. Define and Characterise Adaptation Options — *What adaptation options are available across the range of possible future changes? What are their characteristics?*

Evaluate Solutions

4. Evaluating Individual Adaptation Options — *How do my options perform under different plausible scenarios? What do we know about the likelihood and timing of those scenarios?*

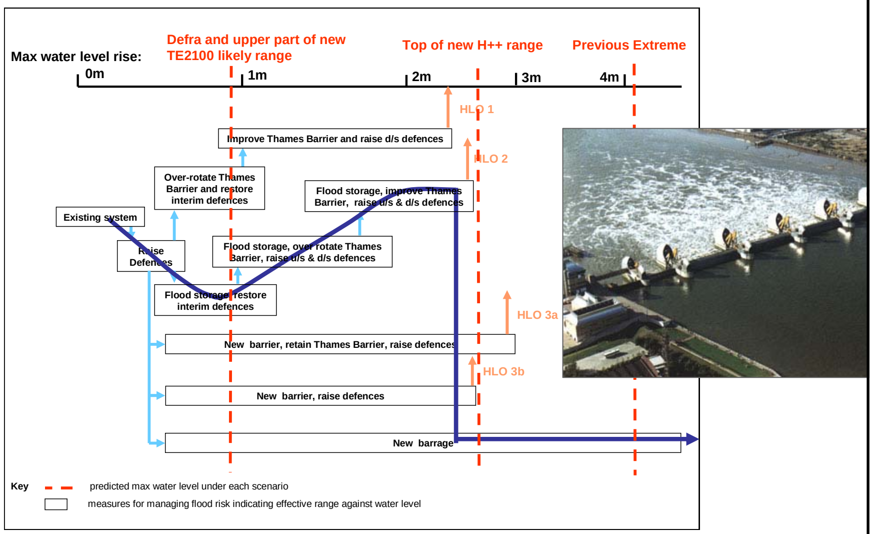
5. Decision Analysis: Rank Options and Generate Conditional Implementation Rules — *Given the performance of the adaptation options as measured by my evaluation criteria, what should I implement and when?*

From forthcoming report "Adaptation in the UK: A Decision-Making Process" Ranger et al.

Centre for Climate Change Economics and Policy

Grantham Research Institute on Climate Change and the Environment

Example 'policy-first' approach



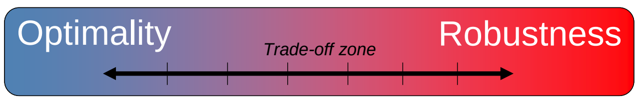
Haigh and Fisher 2010

Learning from a 'policy-first' approach

- **In many cases a range of 'no-regrets' options are available**;
  - Measures to better cope with current climate variability
  - Measures to manage non-climate drivers of risk
  - Short-lived adaptations (i.e. less than timescale of climatic change)
  - Measures to reduce systemic vulnerability or resilience to shocks
  - Some measures with strong co-benefits
- **Across society, there are relatively few potentially 'high-regrets' options** where benefit depend strongly on uncertain future climates
  - Typically limited to long-lived decisions with high sunk costs (e.g. infrastructure and buildings)
  - **In many cases of long-lived decisions, such as public infrastructure projects, flexible options are available and can be shown to be desirable.**

Flexibility versus Optimality

- For potential 'high-regrets' projects, one approach to reducing the chance of maladaptation is to make a decision more robust to climate change uncertainties; through:
  - Use measures that are suitable over a range of climates
  - Build in an option to adjust the adaptation measure if required
  - Build flexibility into the decision process itself by incorporating sequencing, waiting and learning over time (take no-regrets options now and wait for more information before taking more inflexible options)
- Strategies that reduce flexibility can limit robustness
- But there are trade-offs: building in flexibility can often incur a additional cost or productivity trade-off

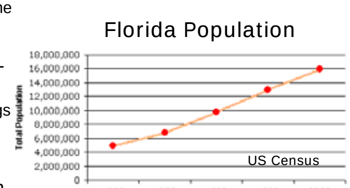


Centre for Climate Change Economics and Policy

Grantham Research Institute on Climate Change and the Environment

Why is Florida so interesting?

- High exposure and risk management systems already under pressure.
- Decisions are made every day that could increase future vulnerability of people, property and economic activity to tropical cyclone-related risks
  - **The population of Florida has grown by between 25 – 40% per decade since 1960**
  - Miami is one of the most exposed cities in the world to storm surge; **$400bn of property are currently exposed to 100yr storm surge and this could increase 6-fold by 2080s as a result of sea level rise and population/economic growth** (Nicholls et al. 2007)
- It is likely to be on the front line for climate change but significant uncertainty over future impacts:
  - Many studies project reductions in basin frequencies
  - Some project significant increases in intense storms
  - This could potentially increase risk in places like Florida and the US Gulf Coast, from wind damages, storm surge and rainfall-driven flooding
- The most effective forms of adaptation for Florida are long-term and so decisions need to be made in the near future:
  - Building codes for new builds & strengthening existing buildings
  - Building of protective infrastructure – e.g. sea walls
  - Land planning – directing new builds out of high risk areas
- Long time frames suggest an urgent need to use long-term projections in adaptation planning today



Centre for Climate Change Economics and Policy

Grantham Research Institute on Climate Change and the Environment

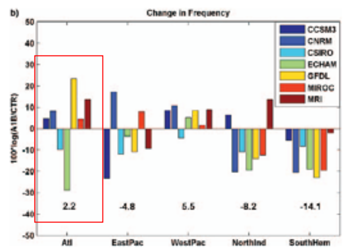
Current Projections: Frequencies

Summary of **projected changes in frequency** (from Knutson et al. 2010)

Study	Details	Findings
Sugi et al. 2002	120km GCM, 1*CO2 to 2*CO2	+61%
McDonald et al. 2005	100km GCM, IS95a, 79-94 to 2082-2097	-30%
Oouchi et al. 2006	20km RCM, A1B, 82-93 to 2080-2099	+34%
Chauvin et al. 2006	50km RCM, 2 GCMs	B2 (+18%) A2 (-25%)
Bengtsson et al. 2007	60km RCM, 2071-2100, A1B	-8%
Bengtsson et al. 2007	40km RCM, 2071-2100, A1B	-13%
Emanuel et al. 2008	Downscaled GCMs, A1B 2180-2200	+4%
Knutsen et al. 2008	Downscaled GCM, A1B 2080-2100	-27%
Semmler et al. 2008	28km RCM, A2 2085-2100	-13%
Zhao et al. 2009	Downscaled GCM, A2	-1 to -62%
Sugi et al. 2009	Downscaled GCMs A1B	-18% to +58%
Bender et al. 2010	Downscaled GCMs A1B 2001-2020 to 2081-2100	-4 to -49%

Knutsen et al. 2010:

"Existing model studies consistently project **decreases in the globally averaged frequency of tropical cyclones**, by 6-34% [by 2100]"



Emanuel et al. 2008 (by 2200)

Centre for Climate Change Economics and Policy

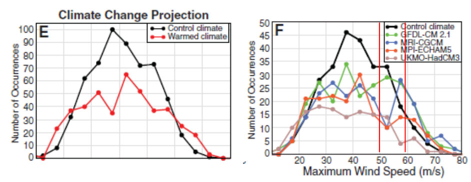
Grantham Research Institute on Climate Change and the Environment

Current Projections: Intensities

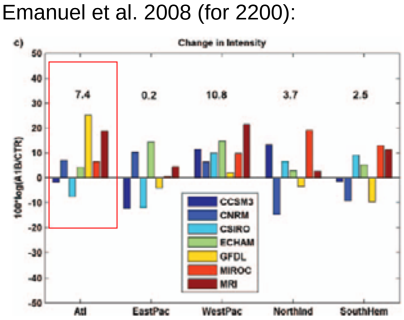
Knutsen et al. 2010:

"future projections based on theory and high-resolution dynamical models consistently indicate that **greenhouse warming will cause the globally averaged intensity of tropical cyclones to shift towards stronger storms**; with intensity increases of 2 – 11% by 2100"

Bender et al. 2010:



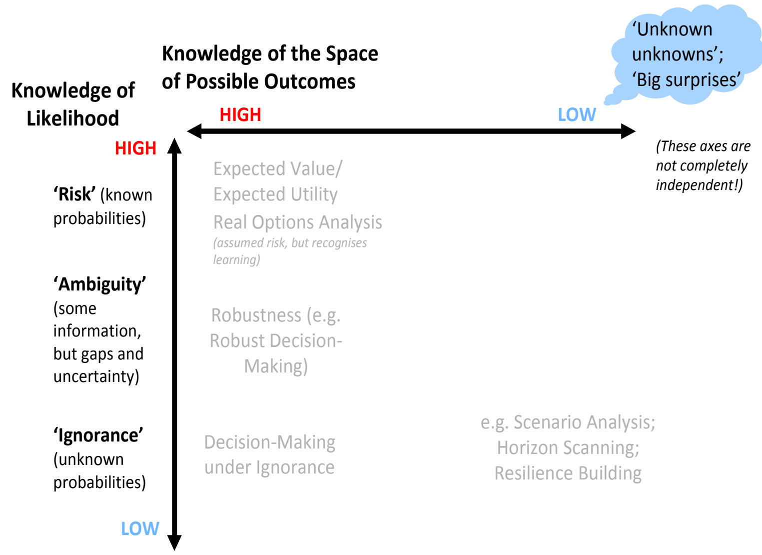
Emanuel et al. 2008 (for 2200):



Centre for Climate Change Economics and Policy

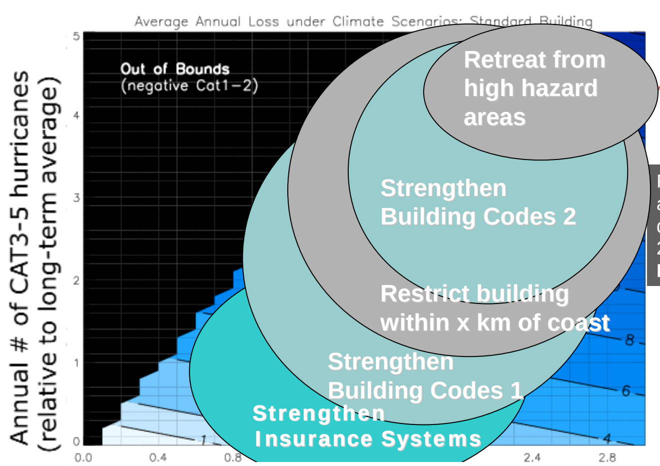
Grantham Research Institute on Climate Change and the Environment

Mapping the State of Uncertainty



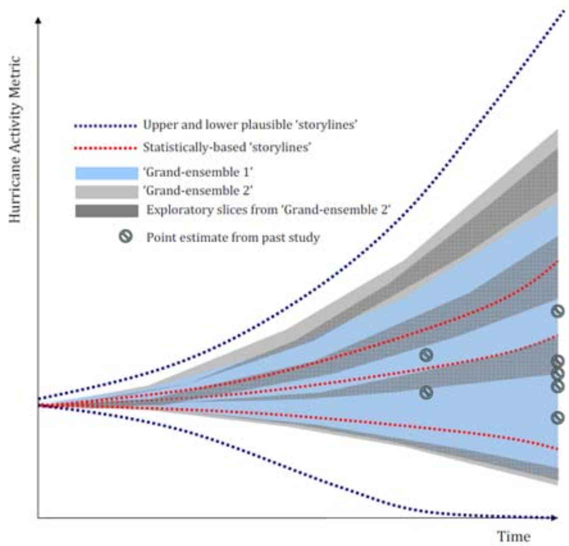
Mapping the Space of Plausible Futures

Estimated Average Annual Losses for the 'status quo' building stock ($billions)



Preliminary analyses using data from the 2009 **RMS® US Hurricane Model**

Building Plausible Hazard Storylines



Centre for Climate Change Economics and Policy

Grantham Research Institute on Climate Change and the Environment

Florida Case Study

- Important questions are:
- **What measures should be undertaken in the next five years to respond effectively to climate change?**
  - What actions would be beneficial irrespective of future climate change?
  - Which decisions undertaken today could increase future vulnerability and how can these be avoided?
  - What further research and monitoring could be undertaken to improve adaptive responses?
- **What might be the key elements of a robust long-term strategy?**
  - Where can we wait for better information before acting? What do we need to do now versus waiting?
  - What are the key indicators of change and key decision points?

Centre for Climate Change Economics and Policy

Grantham Research Institute on Climate Change and the Environment

Conclusions

- Thinking about the adaptation context can often help to simplify decision-making (at least to the point of other types of decisions!)
- Urgent actions in adaptation:
  - Identifying and managing risks that are highly sensitive to climate in the near-term; e.g. irreversibility; tipping points etc.
  - Identify decisions today that could increase future vulnerability or reduce flexibility to adapt and re-evaluate these
- Beneficial early adaptations:
  - Take desirable no-regrets options
  - Consider measures and policies to promote autonomous adaptation (e.g. risk awareness and information)
  - Identify any desirable options with long lead-times (e.g. monitoring, research and development)