Internal Survey by the UK's Institute of Actuaries

1. Do you think that, during your career, climate change will have any effect on your work?

	Response Percent	Response Count
No – climate change is a media myth	4.6%	51
No – climate change is real but will have no impact on my work	24.8%	276
Yes – it is likely to have some impact on my work	**57.5%**	639
Don't know – need more information	13.1%	145
answered question		1111
skipped question		3

5. The Stern Review projects that climate change could reduce global GDP by 20%. To what extent should this be taken into account in your work?

	Response Percent	Response Count
Not at all	13.2%	113
To some extent	**42.6%**	366
Fully	8.0%	69
Don't know - need more information	36.2%	311

7. Climate change is predicted to lead to an increase in natural catastrophes and heatwaves, and to more and extended extreme weather. To what extent have you considered these possible effects on your clients?

	Response Percent	Response Count
I've not considered them	**85.9%**	701
I've had some preliminary discussions	10.5%	86
I'm undertaking studies	3.6%	29
Please indicate the type of climate you are studying, and the scope of the studies		40

The clear communication of climate change risks & opportunities is timely.

Communicating Uncertainties
for Those Insuring Future Climate Change

The evolution of applied climate science from a focus on “Has climate changed?” to “How will climate change in the future?” suggests significant changes in the communication of uncertainty and ignorance, of what is precisely defined versus what is relevant, of where vague physical insight is of greater value than high-resolution maps of systematic simulation error. The relevance of multi-model mean values in policy is illustrated.

Decision support is enhanced when both insights and uncertainties propagate from climate science to application, often through one or more layers of computer modelling, experimental statistics, and/or extreme economics, before reaching applications in policy-making and industry.

This exercise would benefit from more aggressive participation from numerate decision makers, helping climate scientists and statisticians not only design future climate research, but also allowing a clear public definition of what information we about the future we expect to be robust, and what (currently) depends on the details of our understanding and our models (which we expect to change significantly as the science advances).

Clear communication uncertainties within the climate sciences, with political and industrial decision makers, and to the general public may prove of great value in facing the challenges posed by anthropogenic climate change.

Communicating Uncertainties
for Those Insuring Future Climate Change

Leonard A Smith
Centre for the Analysis of Time Series, LSE
&
Pembroke College, Oxford

Jochen Broecker, Liam Clarke, Hailiang Du,
Dave Stainforth, Kevin Judd & Ed Tredger
www.lsecats.org


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England smoke ban to start 1 July

Smoking in enclosed public places will be banned in England from 1 July next year, the government has announced.

The ban covers virtually all enclosed public places including offices, factories, pubs and bars, but not outdoors or in private homes.

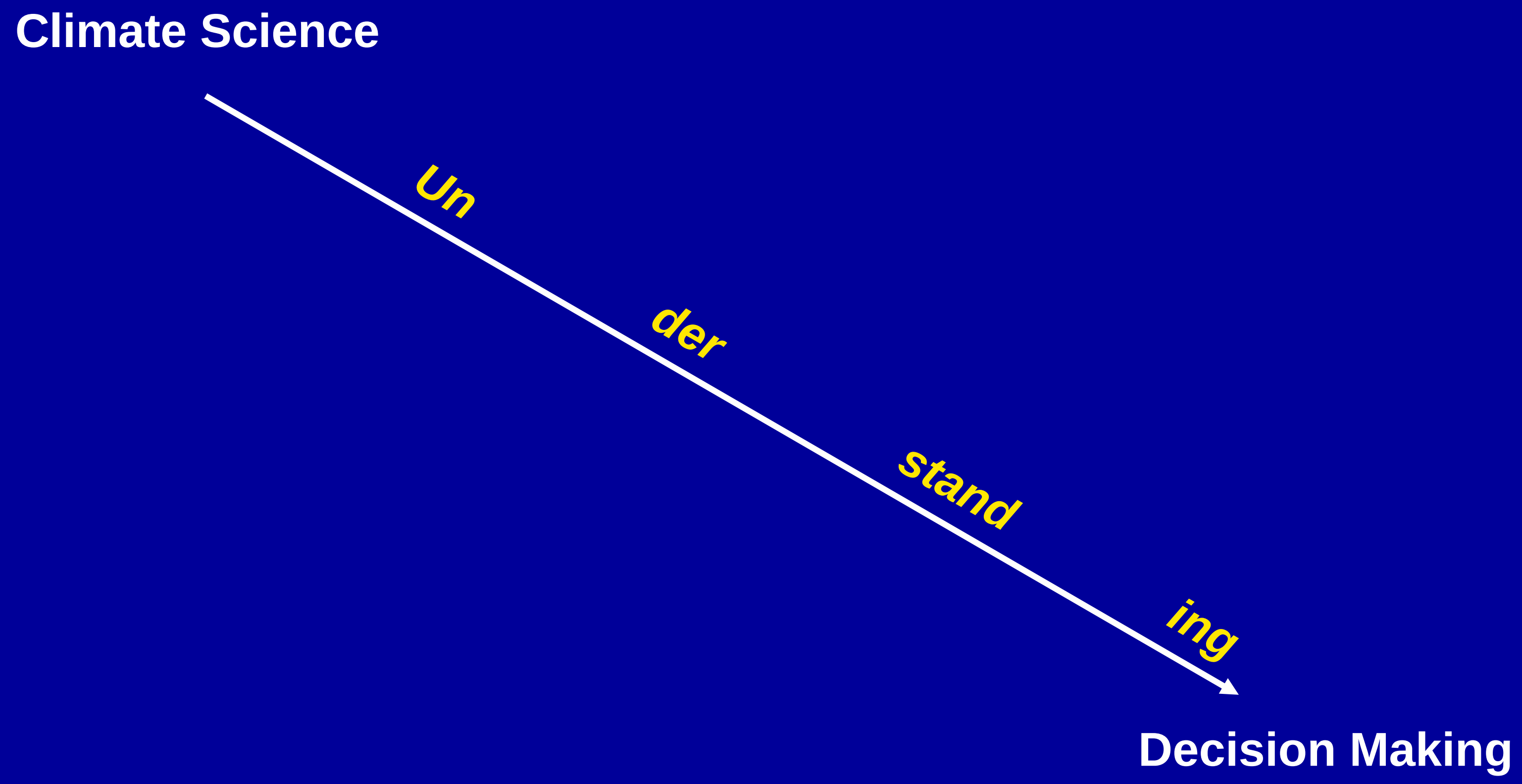
The government says 600,000 people will quit as a result

When can climate science communicate relevant, timely, robust information?

Climate Science

Understanding

Decision Making


Climate Science
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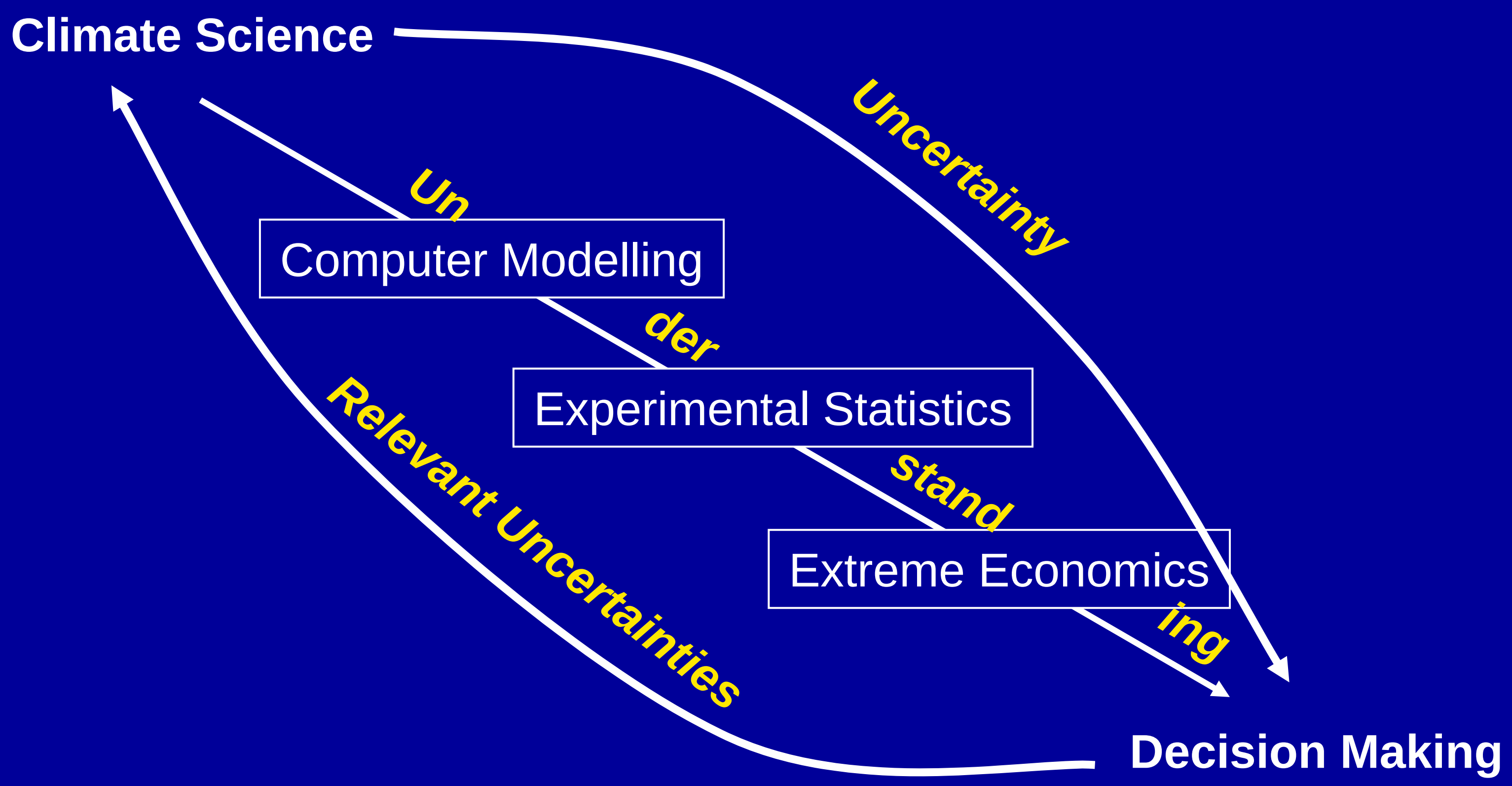
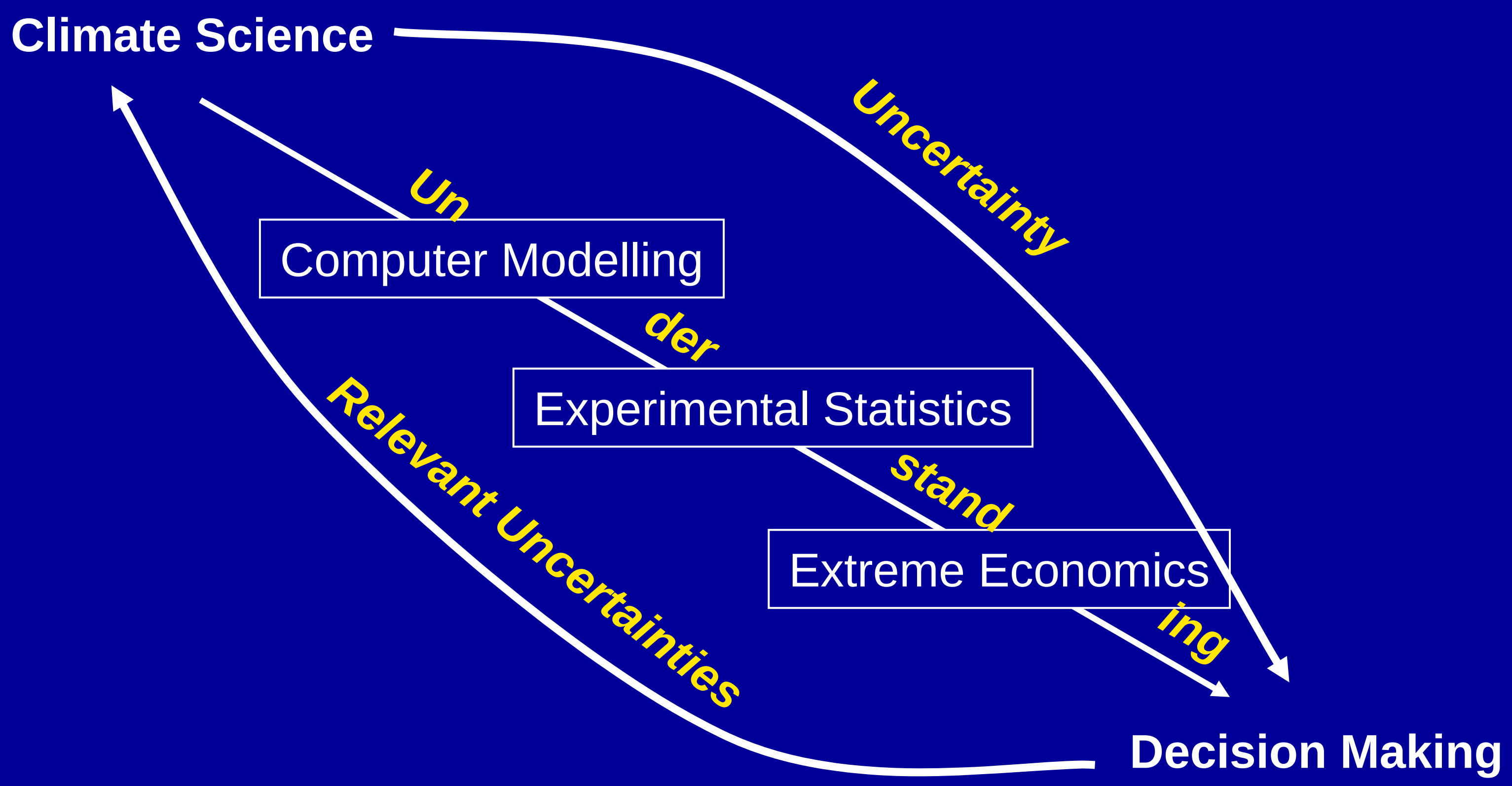


That is a lot to do in half an hour,
so I'll aim to illustrate the kind of challenges that lie between climate science and the insurance sector.
(I am also interested in discussing technical details!)



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Session 6: Communicating climate risk

Climate measurements do not necessarily represent the way people actually perceive climate conditions in their daily life. People may respond to various climate stimuli in different way, and adaptation to changes may be influenced by other rationales rather than seeking climate adaptability and robustness. As such, it can be a challenge communicating the necessity to reduce global warming as well as to prepare society for potential adverse climate conditions. What have we learned about using media campaigns for getting public attention? How can scientists help making people understand uncertainty about regional consequences of climate change derived from global climate models?

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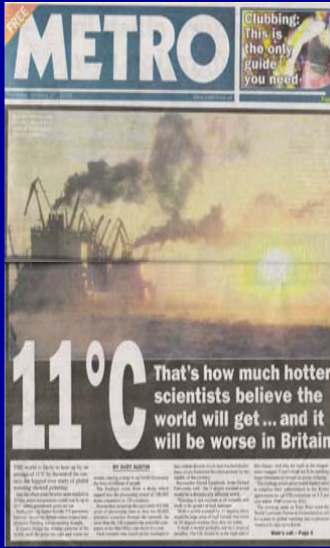

Knowledge does not transfer (well) by itself..

Especially when market share is valued more than reliability

Session 6: Communicating climate risk

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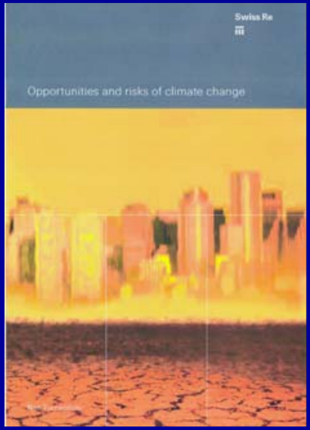

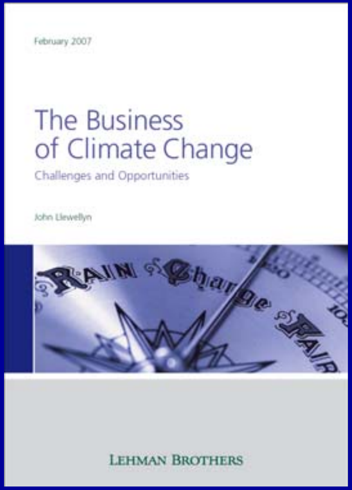

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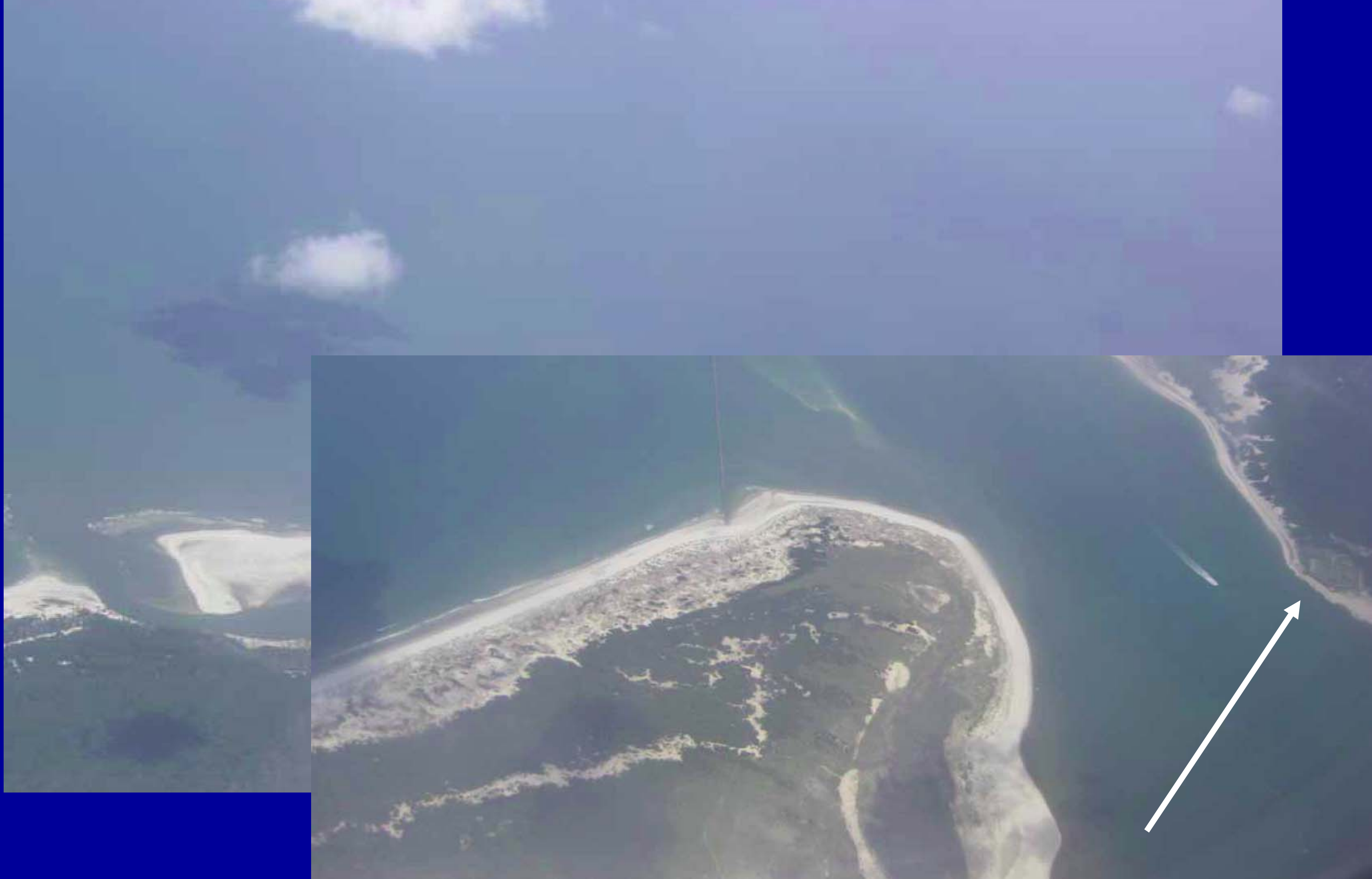
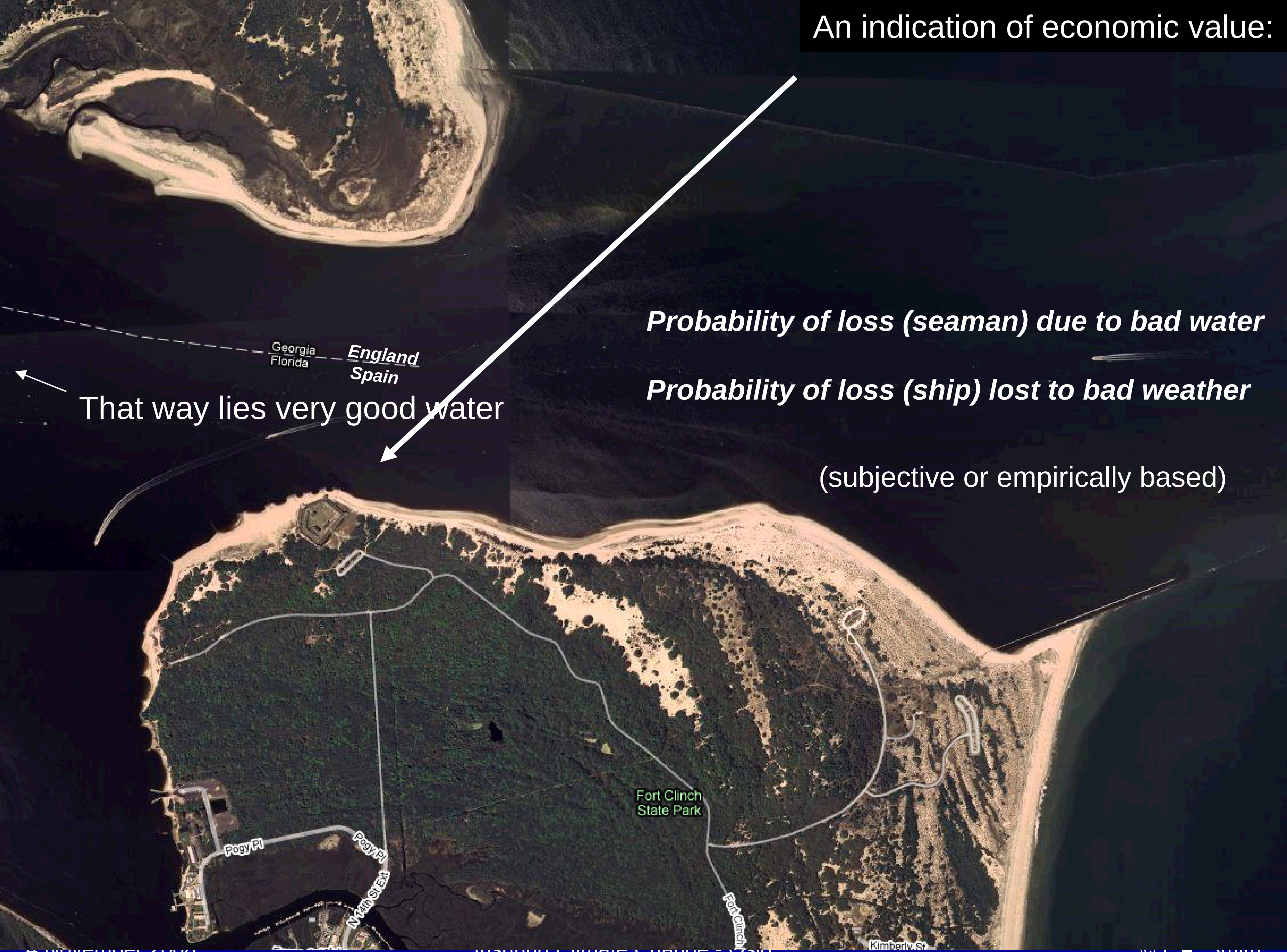


All this is inside one grid box (point); described by ~32 values .
Can we trust such model be adequate/robust for detailed impact studies?

http://maps.google.com/maps?hl=en&q=Maps+Florida+Georgia&ie=UTF8&t=h&ll=30.590637,-82.082977&spn=1.047387,1.636963&z=10&iwloc=addr

An indication of economic value:

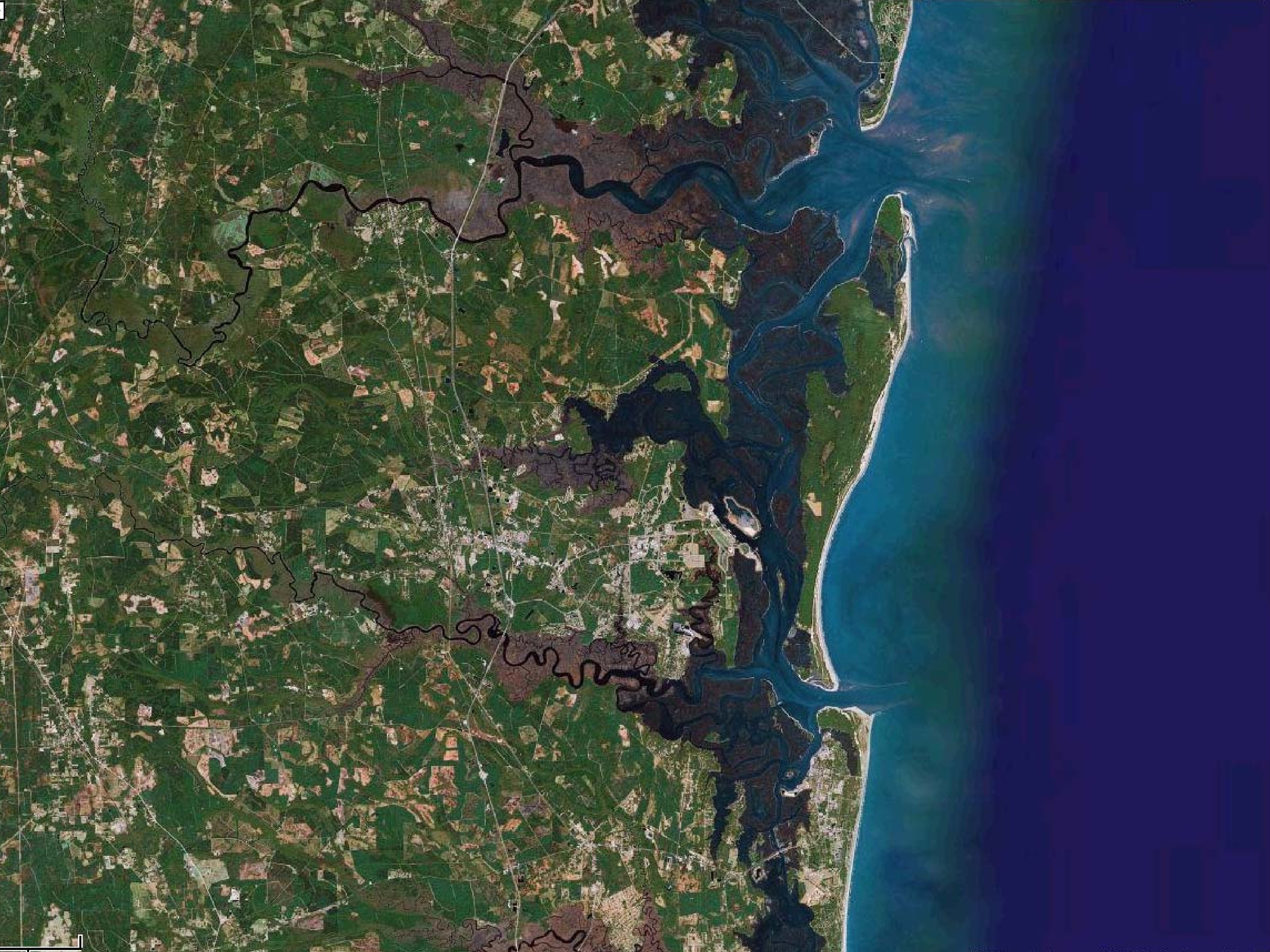


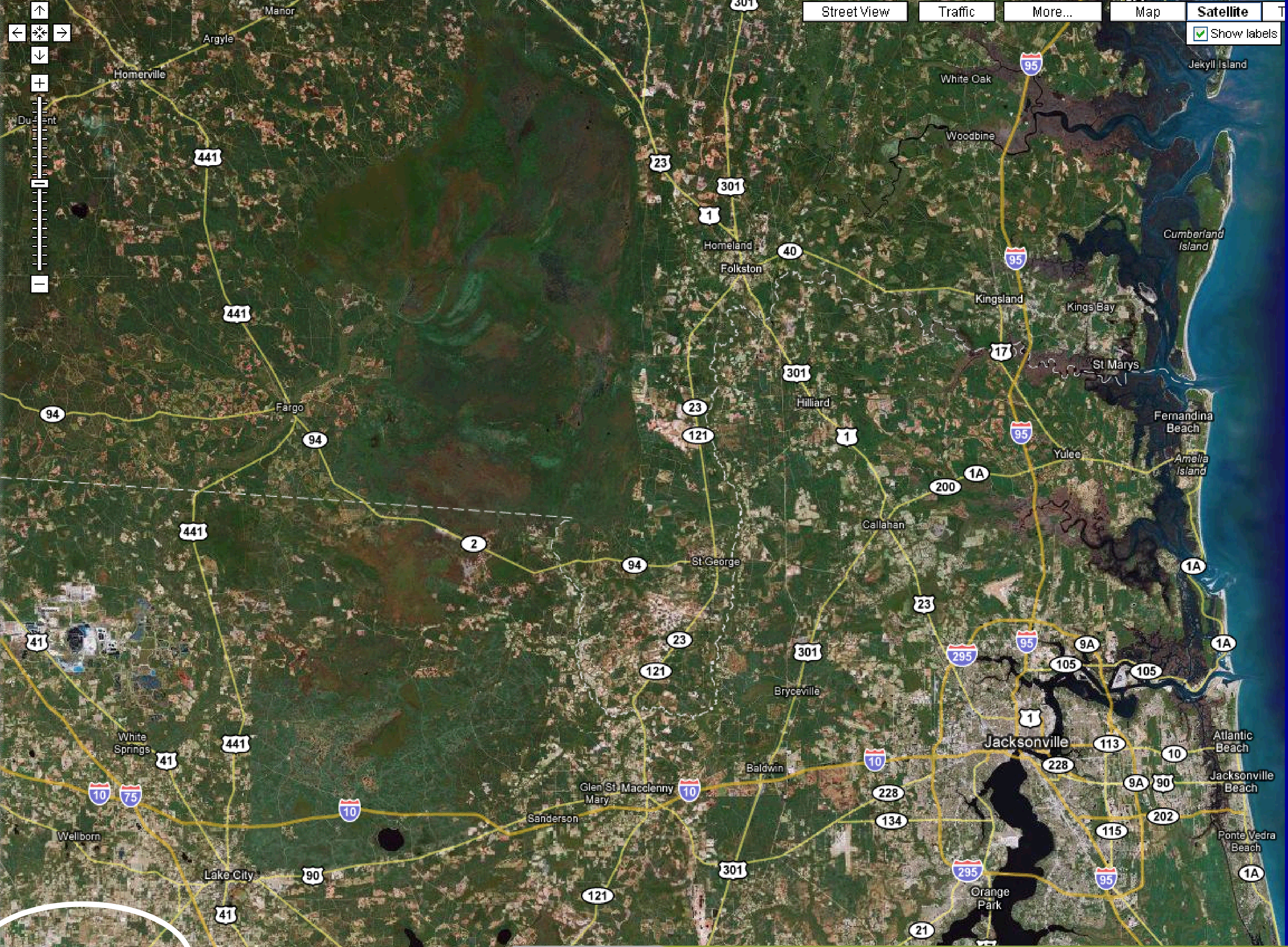
That way lies very good water

Probability of loss (seaman) due to bad water

Probability of loss (ship) lost to bad weather

(subjective or empirically based)



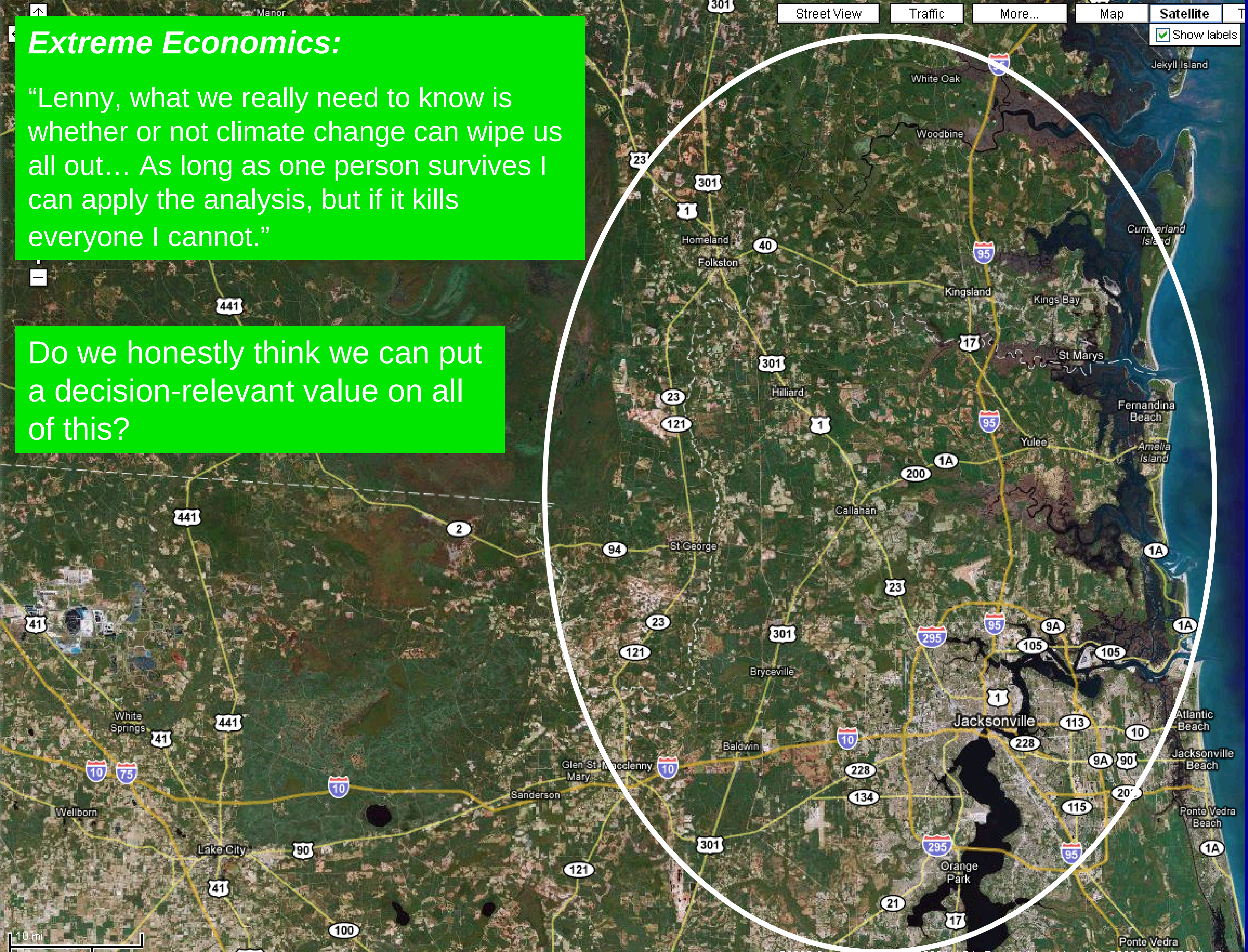


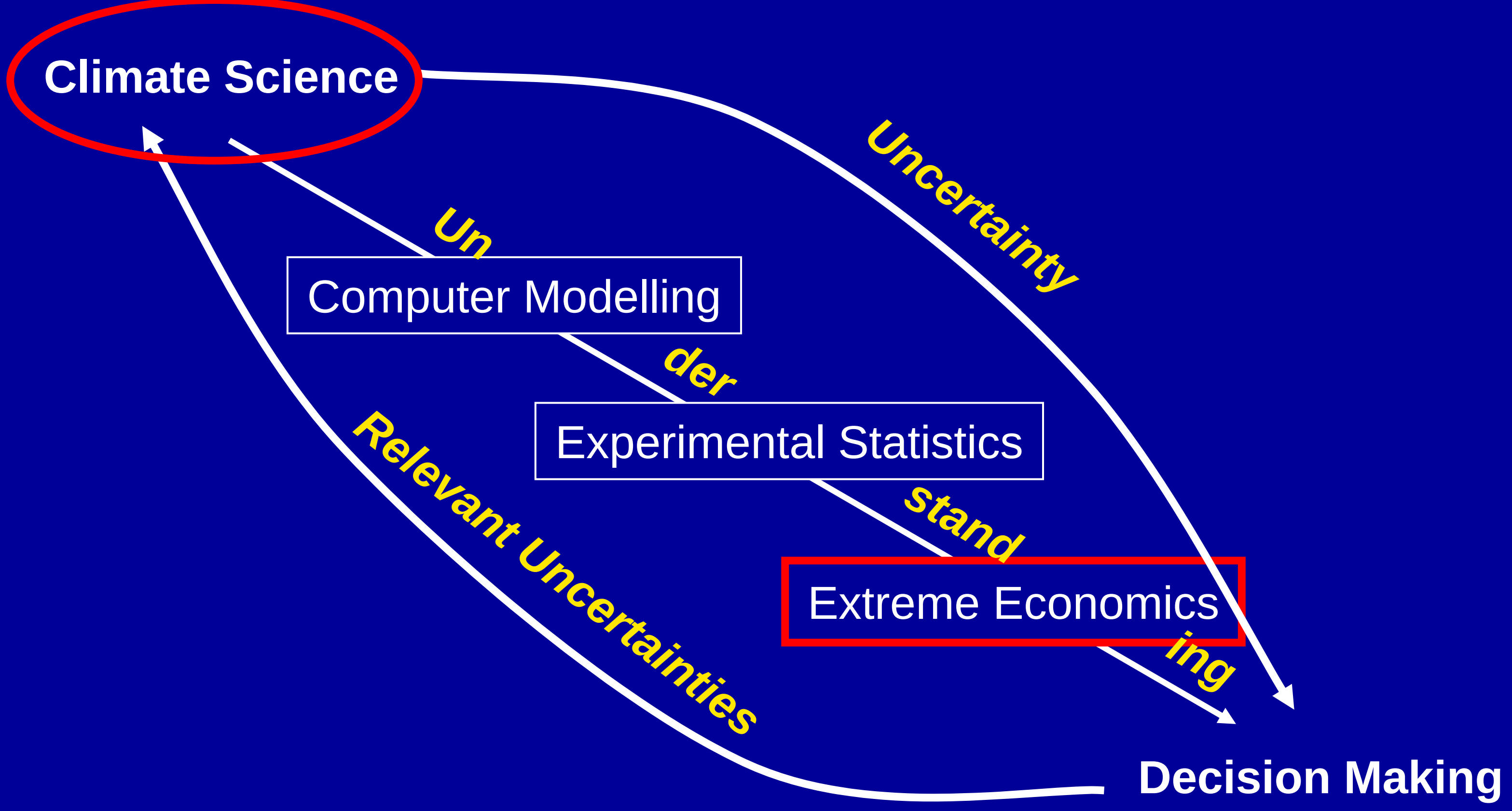
200,000 B.P. Trail Ridge begins to form as a beach ridge at the edge of the Atlantic Ocean

Extreme Economics:

"Lenny, what we really need to know is whether or not climate change can wipe us all out… As long as one person survives I can apply the analysis, but if it kills everyone I cannot."

Do we honestly think we can put a decision-relevant value on all of this?




Climate Science
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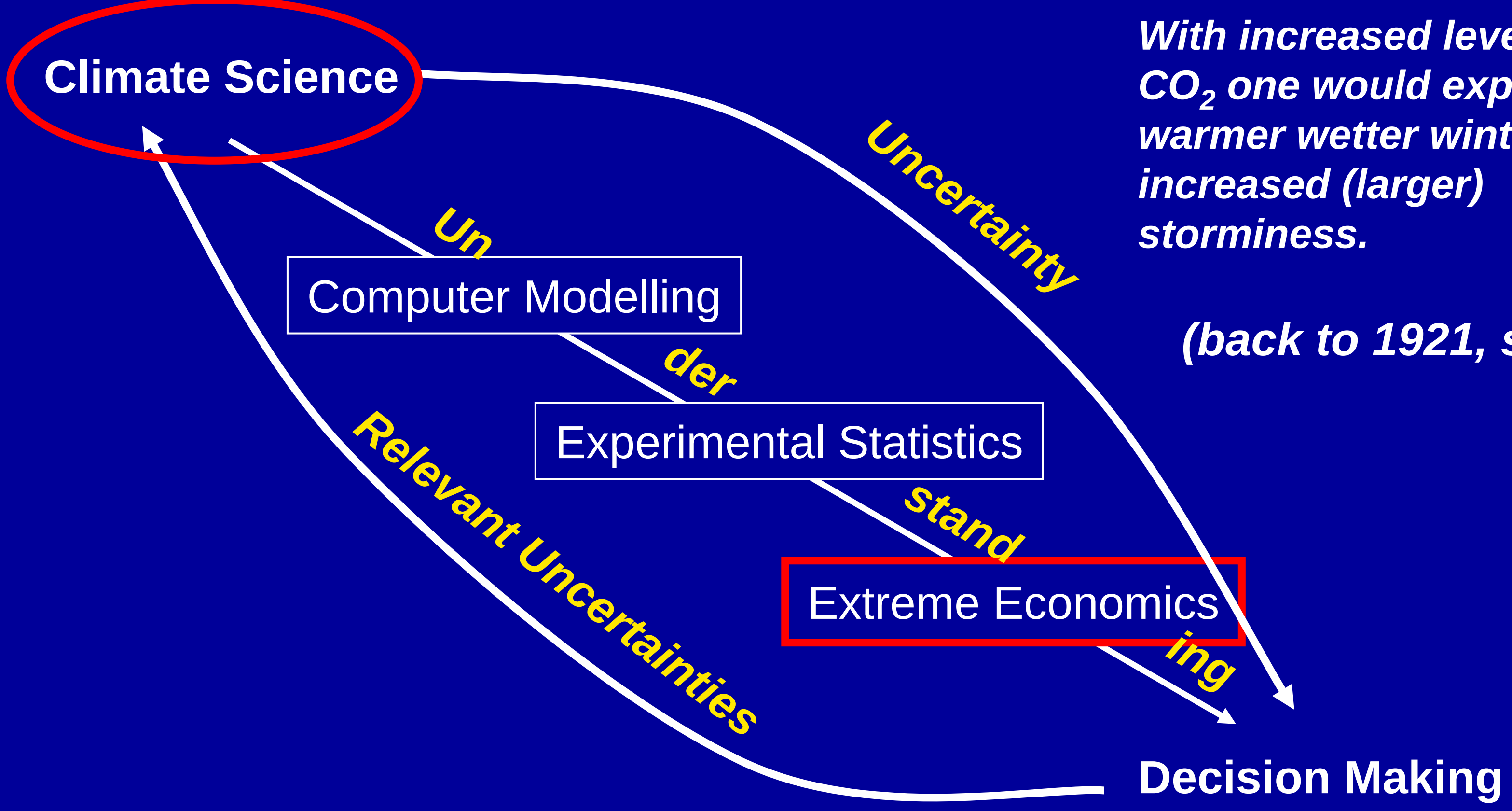
Relevant Uncertainties
Decision Making



With increased levels of CO_2 one would expect warmer wetter winters with increased (larger) storminess.

(back to 1921, so far)

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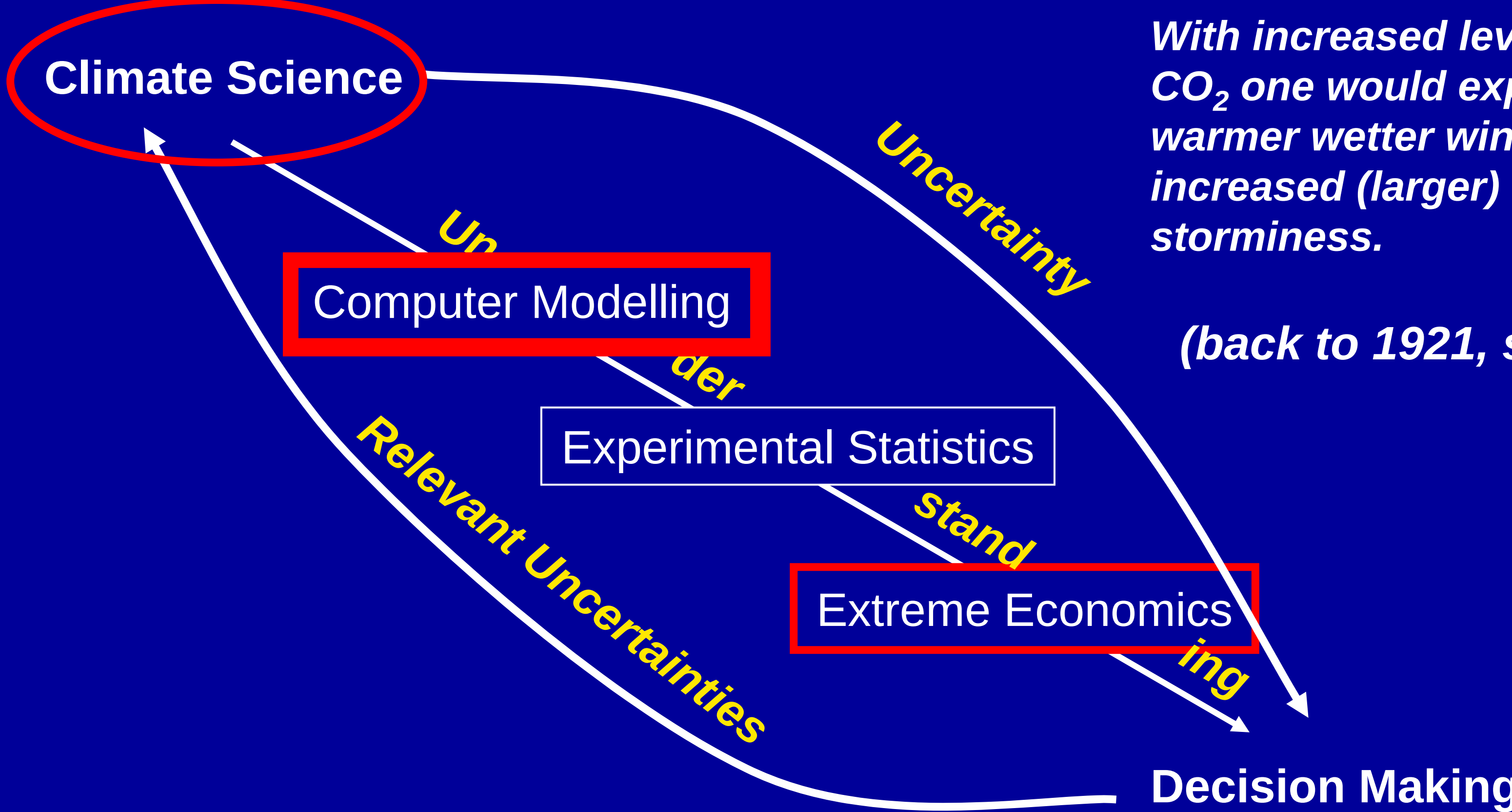
(back to 1921, so far)



What is the value added of large simulation experiments?

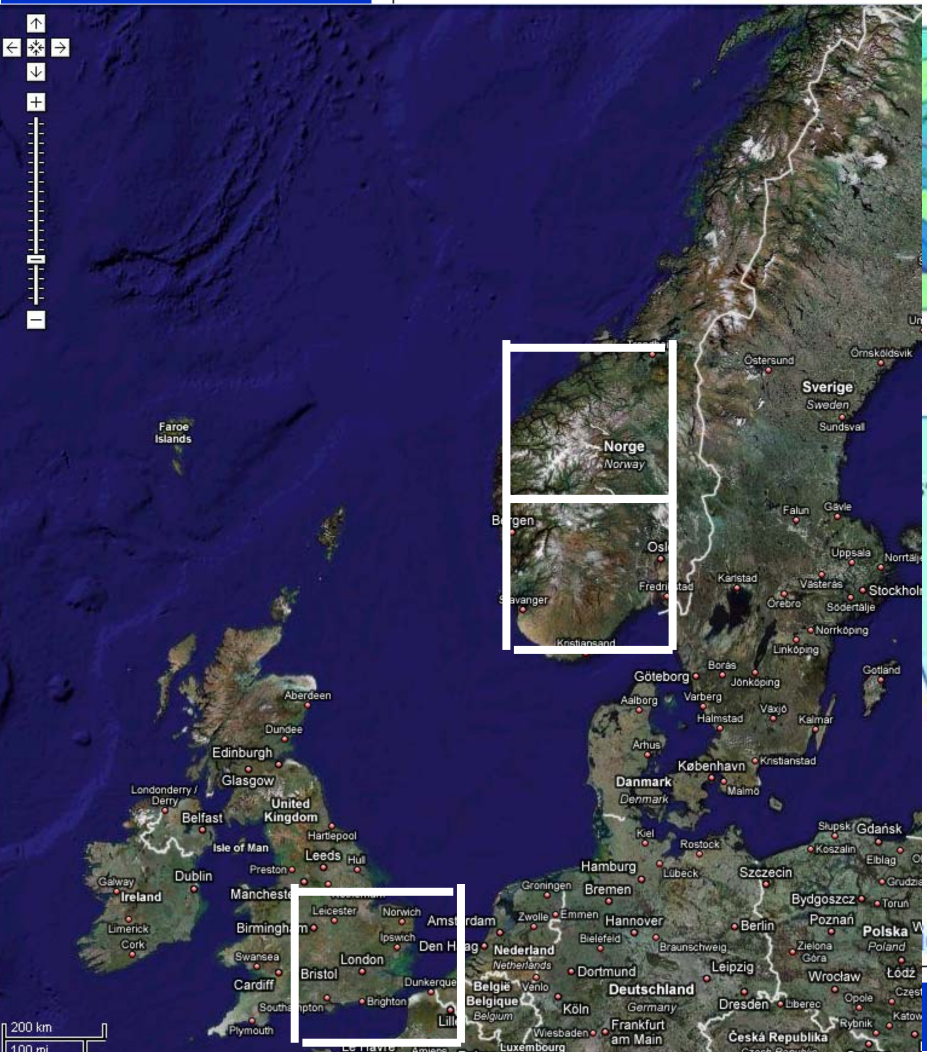
- ***a) can they show us major feedback interactions of which we were previously unaware?***
- ***b) can they provide decision-support relevant quantitative probability forecasts?***
- ***c) can they help us better understand the climate system?***

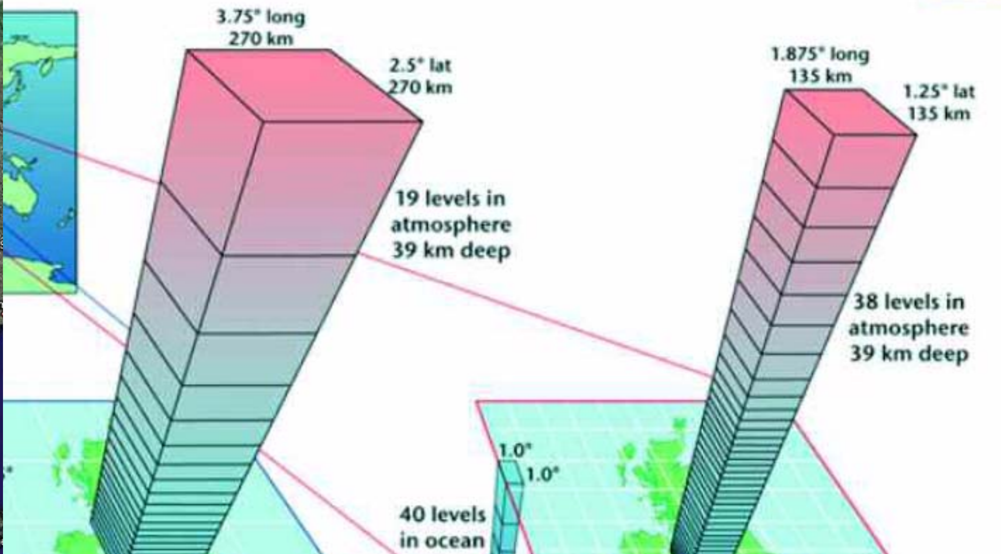
At what space and time scales can 2008-hardware models yield decision-relevant (robust) forecast information?

On what space and time scales *do* we have decision-relevant information?

Climate models continue to be improved

Met Office





What is climate change?

Climate is what you expect, Weather is what you get.

Robert Heinlein (1973)

The climate system is a complex, interactive system consisting of the atmosphere, land surface, snow and ice, oceans and other bodies of water, and living things. The atmospheric component of the climate system most obviously characterises climate; climate is often defined as 'average weather'. Climate is usually described in terms of the mean and variability of temperature, precipitation and wind over a period of time, ranging from months to millions of years (the classical period is 30 years).

A report of Working Group I of the Intergovernmental Panel on Climate Change

Summary for Policymakers

Drafting Authors:

Draft Contributing Authors:

This Summary for Policymakers should be cited as:

GLOSSARY OF METEOROLOGY

Edited by
RALPH E. HUSCHKE

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and
Geophysics Research Directorate
AFCRC, ARDC
U. S. Army
Signal Corps
U. S. Navy
Office of Naval Research

AMERICAN METEOROLOGICAL SOCIETY
Boston, Massachusetts
1959

climate—"The synthesis of the weather" (C. S. Durst); the long-term manifestations of **weather,** however they may be expressed. More rigorously, the climate of a specified area is represented by the statistical collective of its weather conditions during a specified interval of time (usually several decades).

Climate is a distribution of time series!
(It's not just a number or two)

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

IPCC

Languages

IPCC web sites

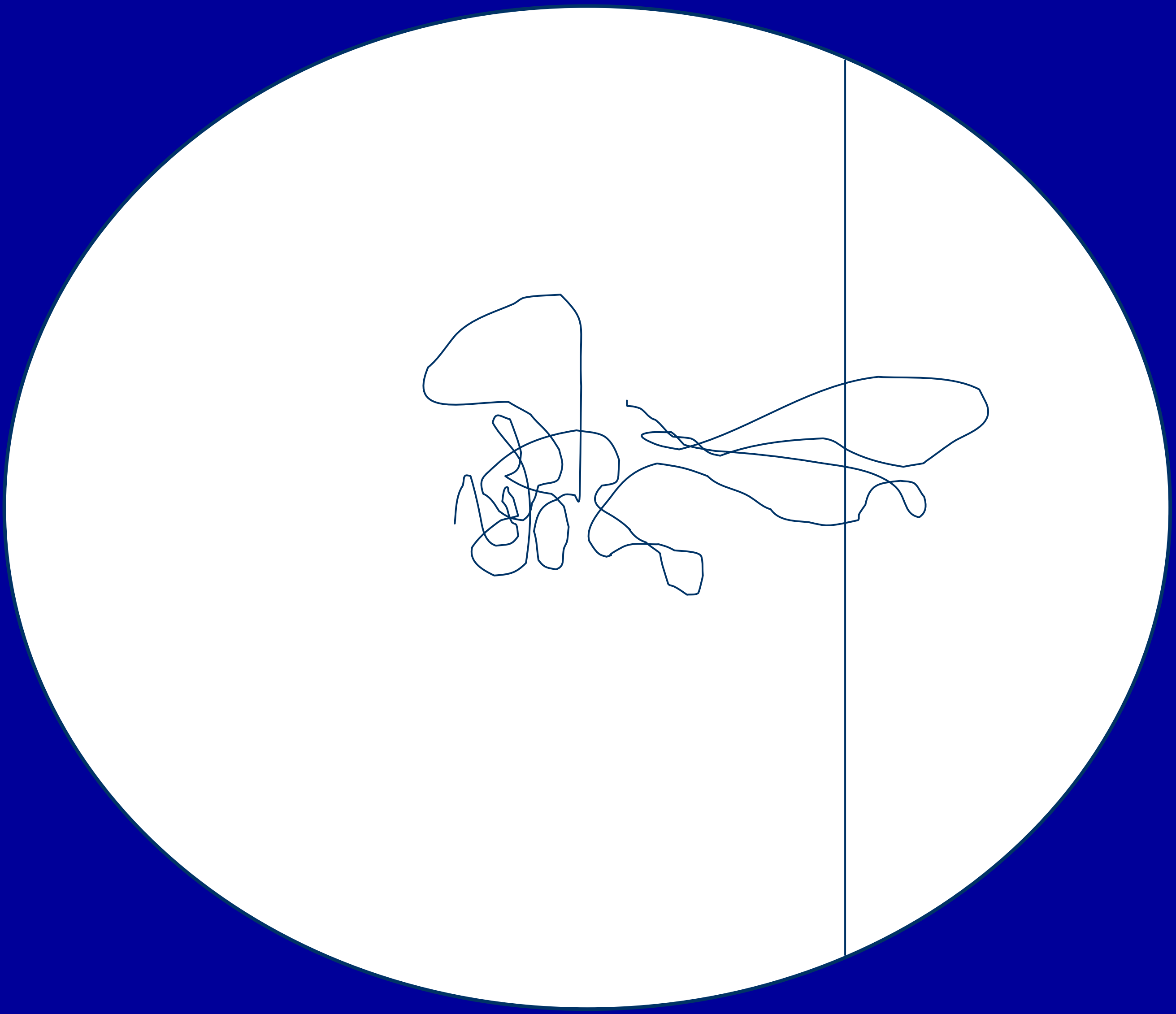
IPCC Glossary

Climate

Climate in a narrow sense is usually defined as the 'average weather', or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the *climate system*. The classical period of time is 30 years, as defined by the World Meteorological Organization (WMO).

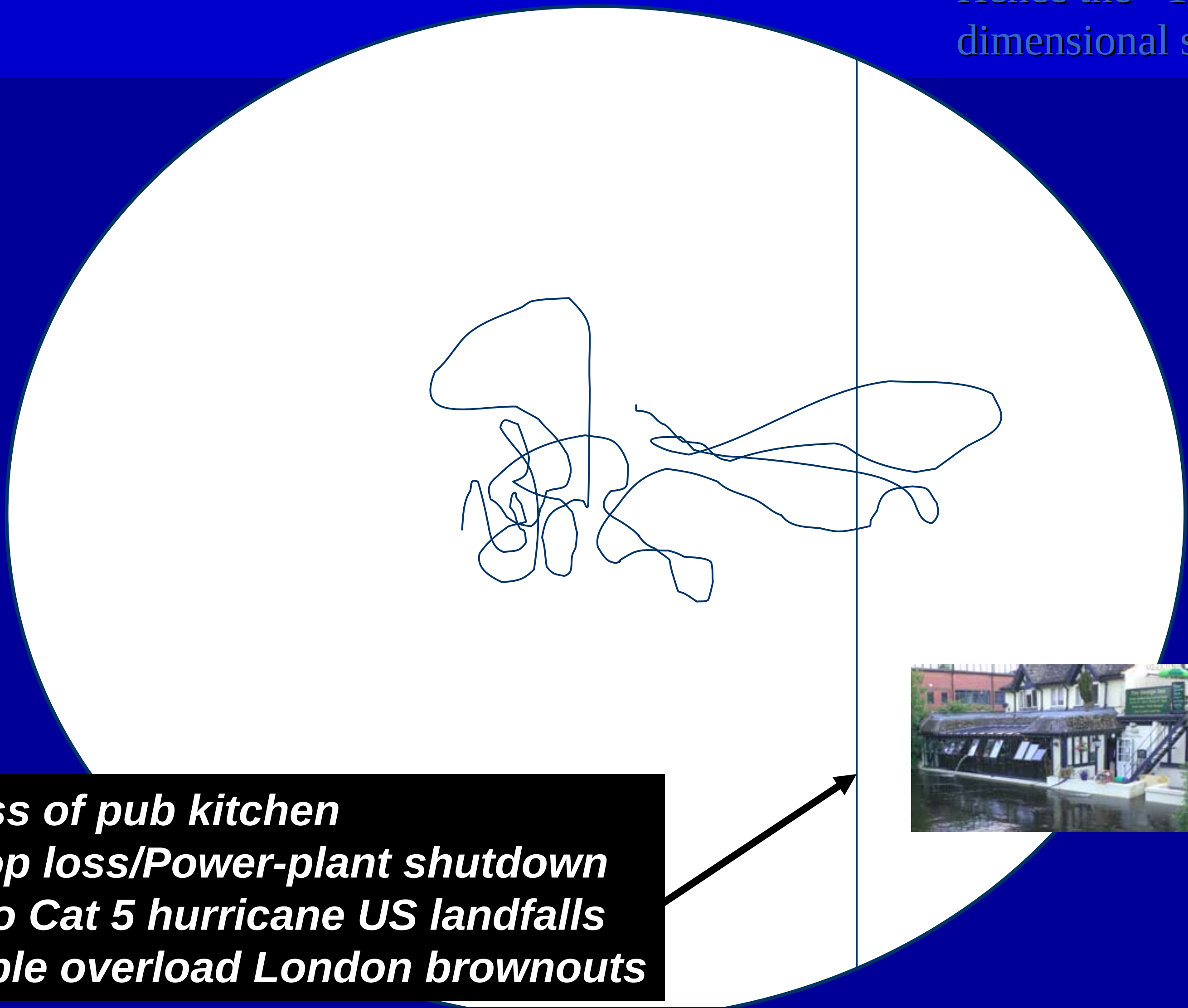
If we "simplify" the fact$_{1959}$ that climate is a "collective of weather conditions" **we lose the ability to provide decision support!**

Most decisions depend neither on ***"average meteorological variables"*** nor ***"standard deviation of the average weather"*** they depend on the trajectory.



As they are nonlinear we have to evaluate them along trajectories. Crops, cables, wind energy and system failures depend on what and even when weather events unfold.

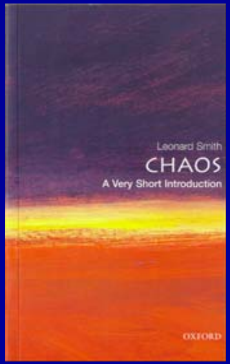
Hence the $\sim 10^6 \times 10^{21}$ dimensional space

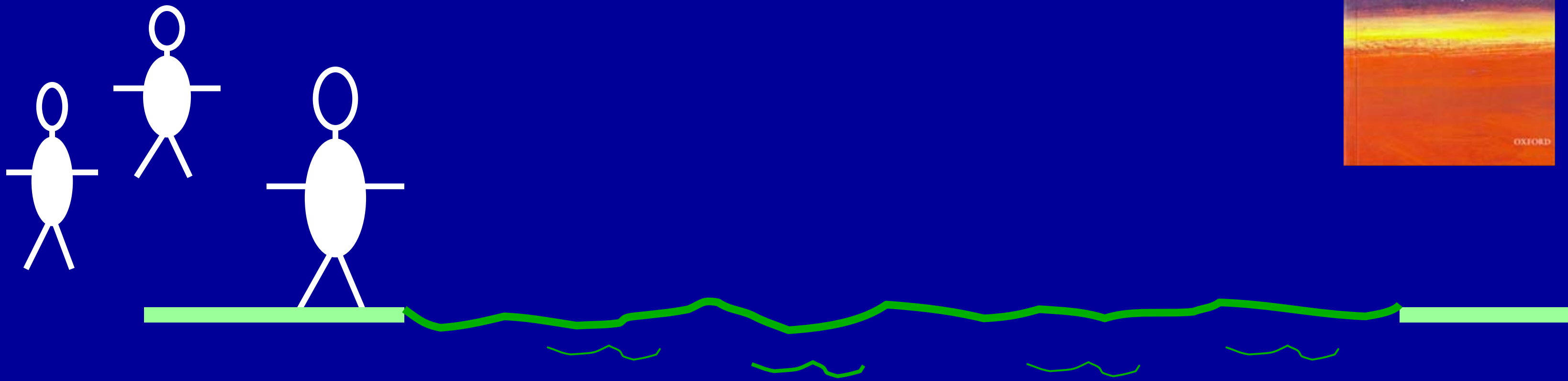


Loss of pub kitchen
Crop loss/Power-plant shutdown
Two Cat 5 hurricane US landfalls
Cable overload London brownouts

This kind of information is not available from today's models, nor will it ever be visible in model mean values!

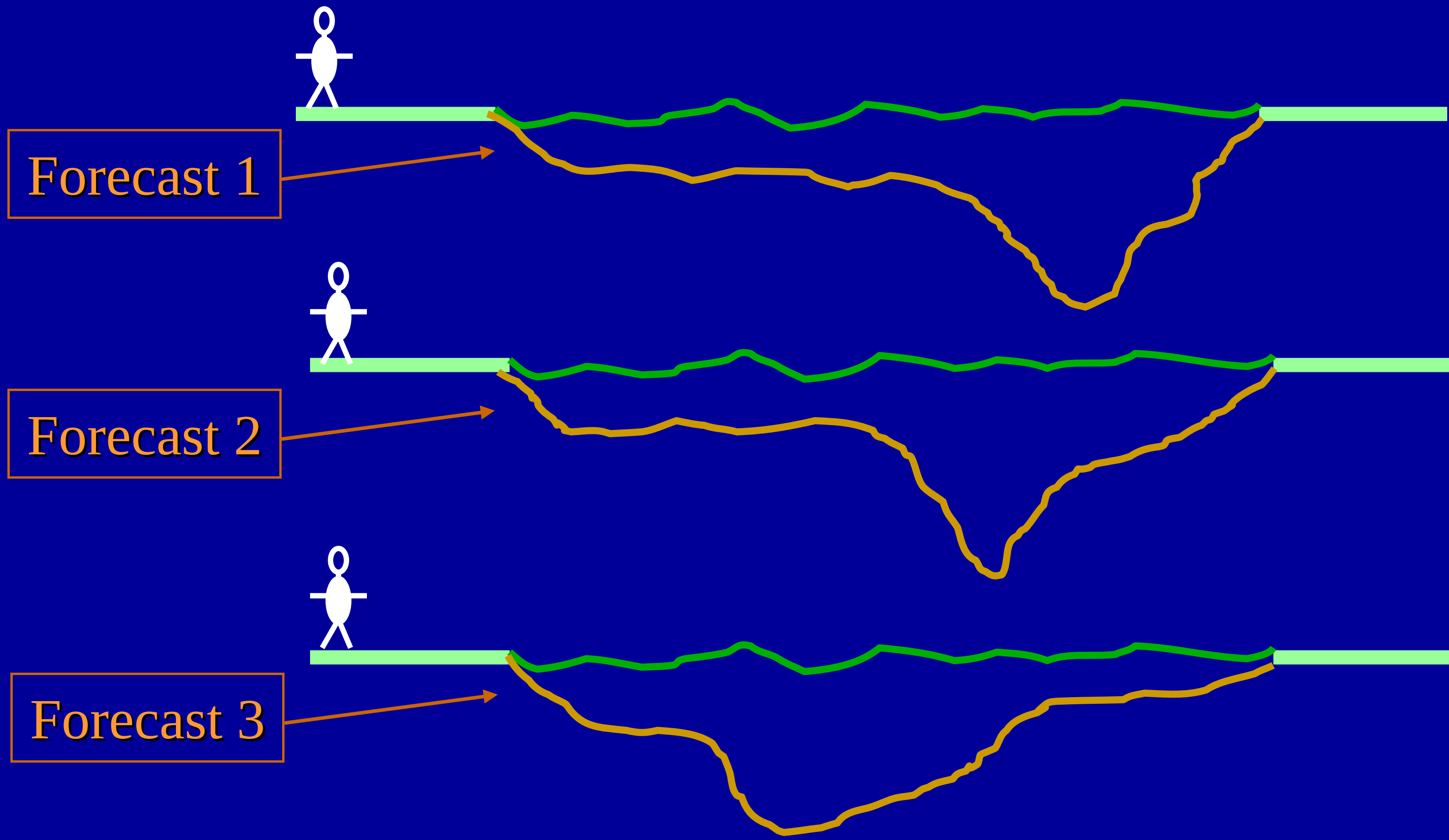
The parable of the three statisticians.



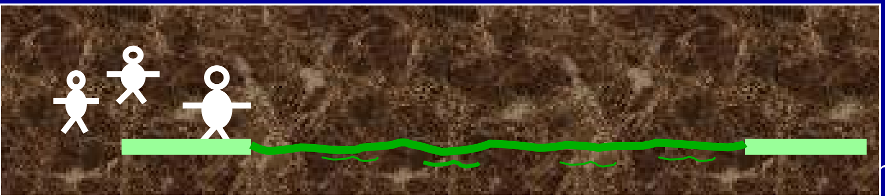


Three non-Floridian statisticians come to a river, they want to know if they can cross safely. (They cannot swim.)

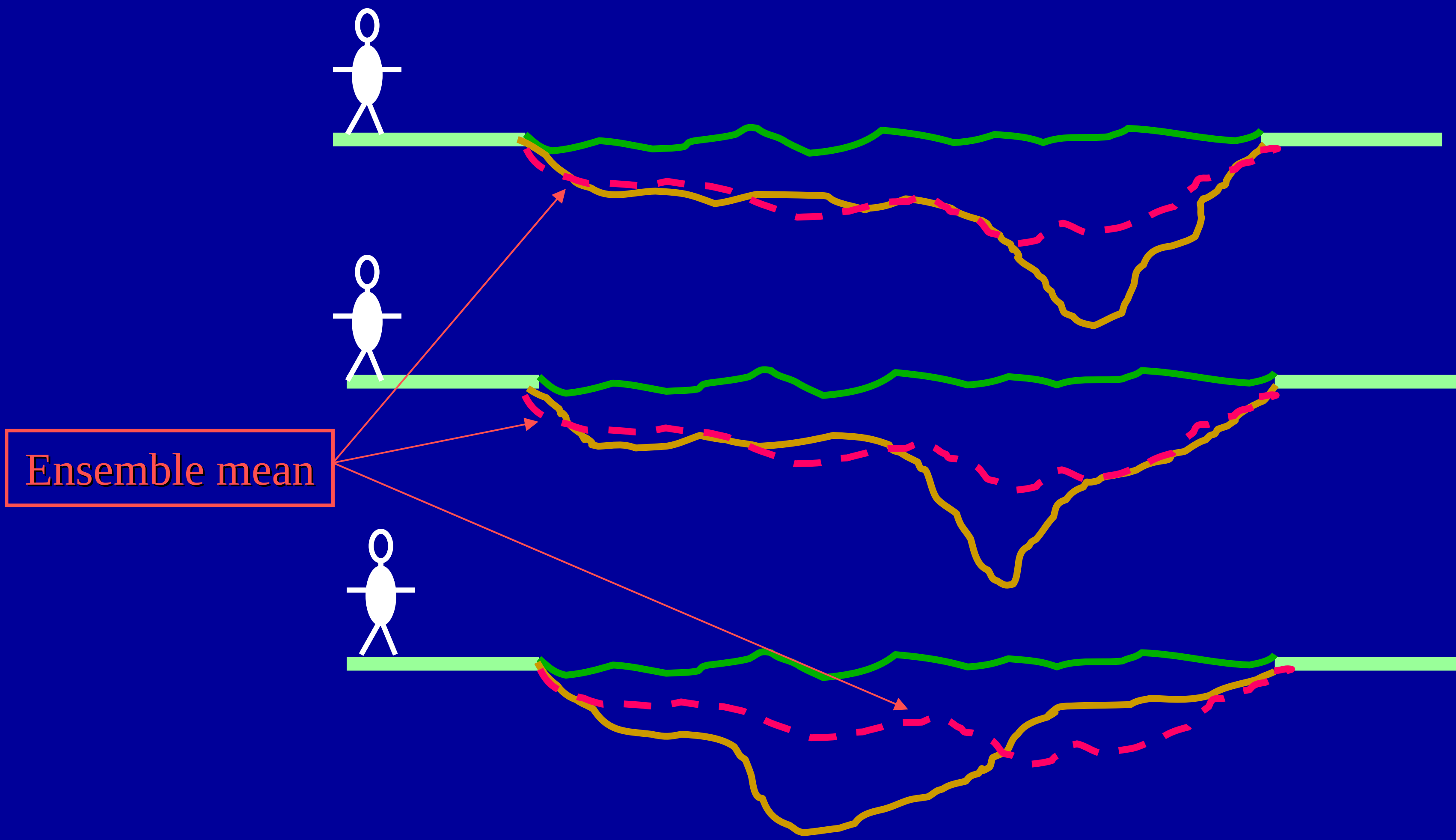
Three non-Floridian statisticians wish to cross a river.
Each has a forecast of depth which indicates they will drown.



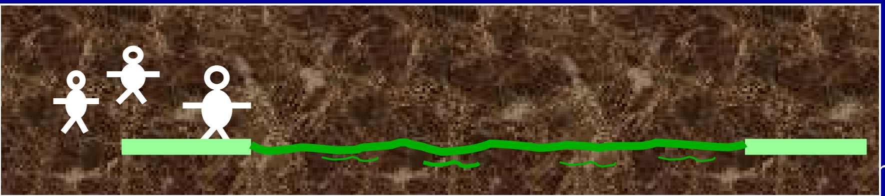
So they have an ensemble forecast,with three members



Three non-Floridian statisticians wish to cross a river.
Each has a forecast of depth which indicates they will drown.
So they average their forecasts and decide based on the ensemble mean…



Is this a good idea?

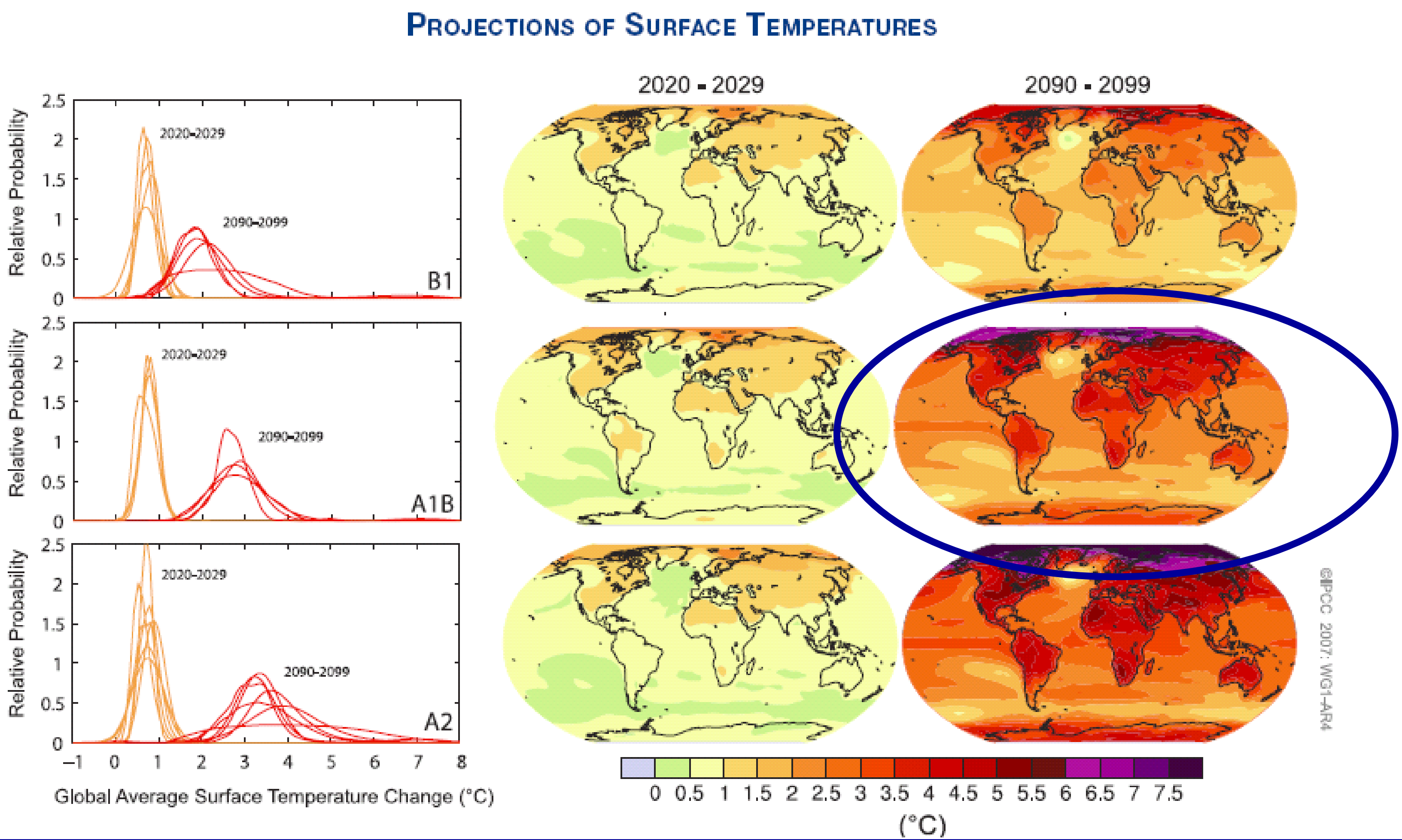


No!

Ensembles contain information, we must be careful not to destroy or discard it!

Why then is climate information communicated as this:

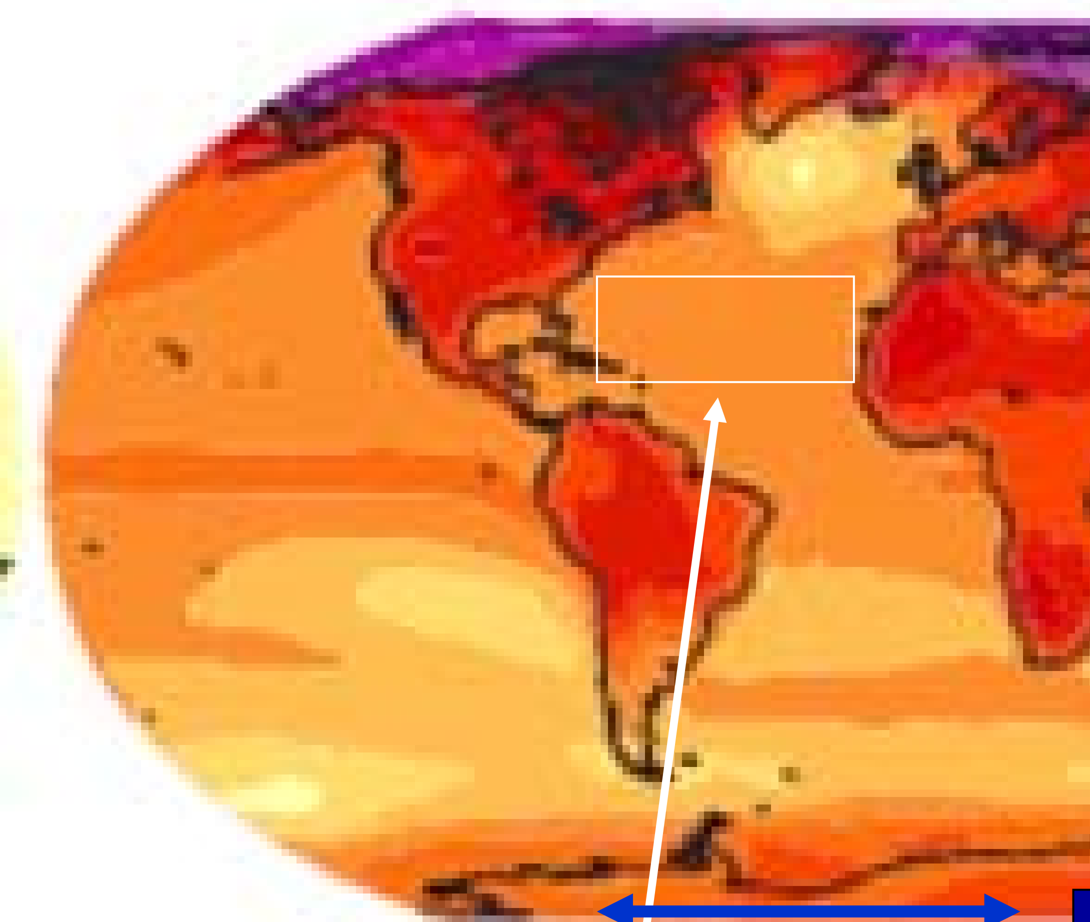
What does a mean mean? Say, for changes in Atlantic hurricanes?



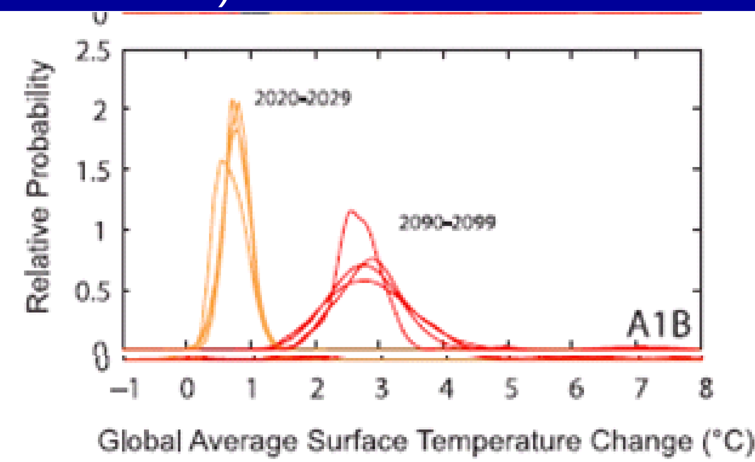
Today's state of the art climate models do not resolve things as small as a hurricane, but if the model temperatures were thought to be decision-support relevant, we could look at projected temperatures in the Atlantic and apply some experimental statistics…

studies for the same periods. Some studies present results only for a subset of the SRES scenarios, or for various model versions. Therefore the difference in the number of curves shown in the left-hand panels is due only to differences in the availability of results. {Figures 10.8 and 10.28}

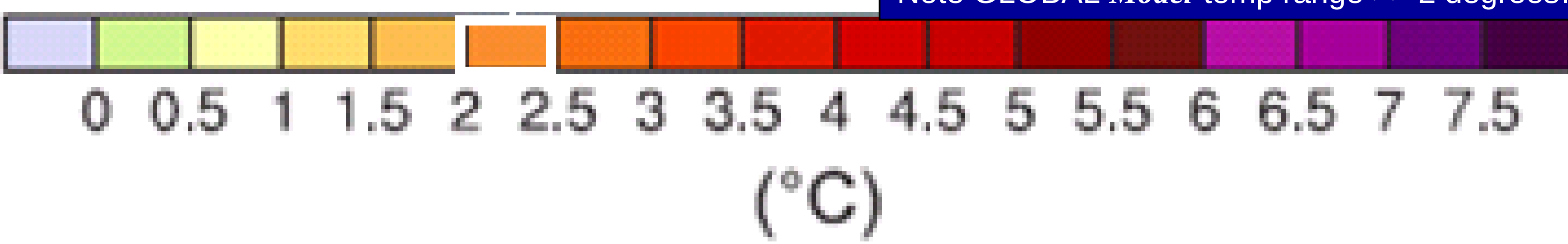
What does a mean mean? Say, for changes in Atlantic hurricanes?



As in the case of the three statisticians, Rather than averaging first and then computing the impact on hurricane numbers, one should first compute hurricane numbers, and then (if you must) average. (or better still look at the distribution).



Note GLOBAL ***Model***-temp range >> 2 degrees…



The basic question for using these results regards how probabilities based on ensembles of climate models should be interpreted:

a) Like the probability of a driver having an accident given their age and gender?

b) Like the probability that the next government will rule nuclear power "green"

In the first case we can "integrate out" the uncertainty, while in the second case we have to think more carefully.

I expect the climate case falls between the two.

Next note we already have to deal with different kinds of uncertainty…

Multi-model means over time

The grey bands on the far right "the likely range."

The coloured bands represent the widths of multi-model ensembles.

These distributions violate the law of large numbers!

The grey band represents traditional observational uncertainty.

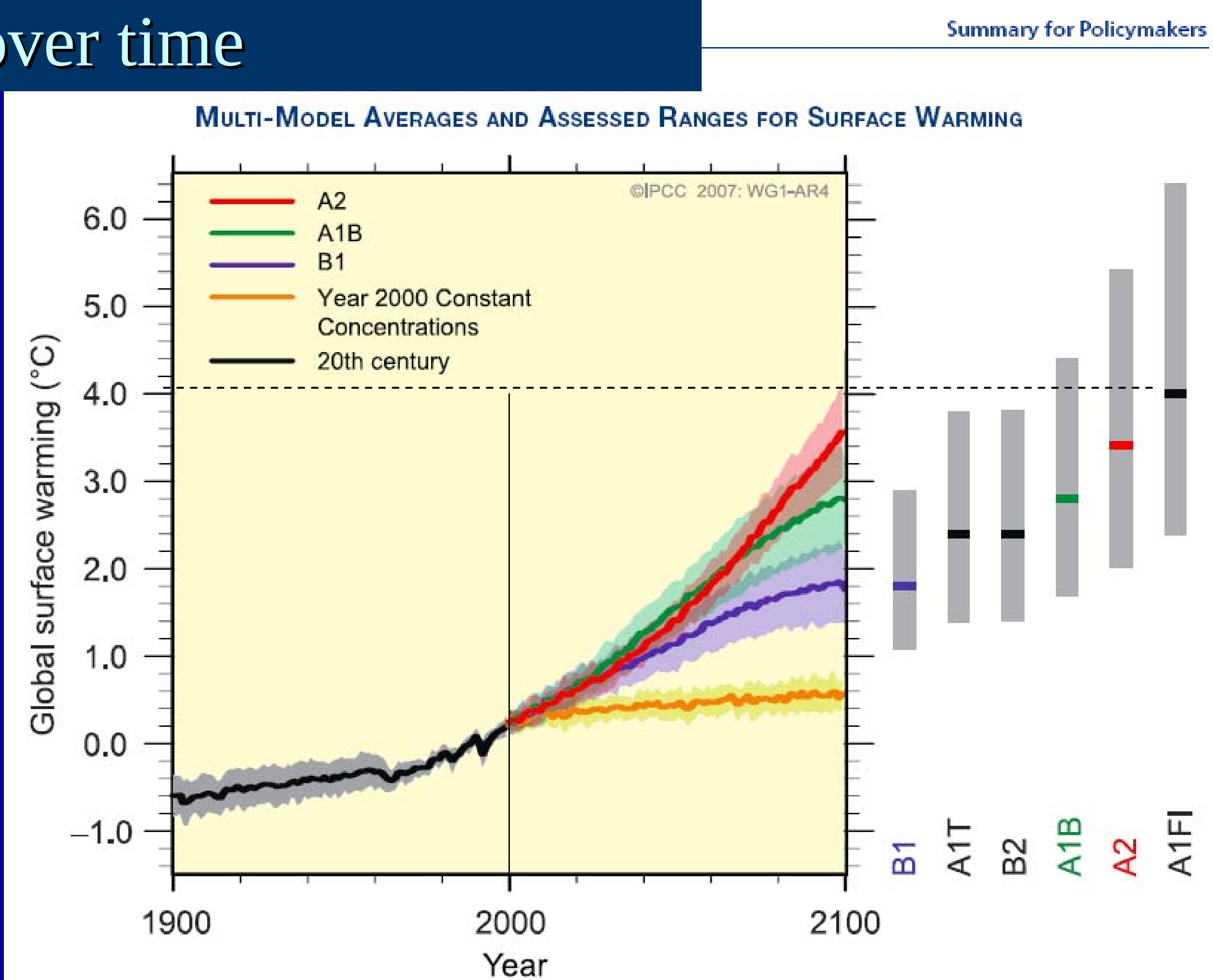
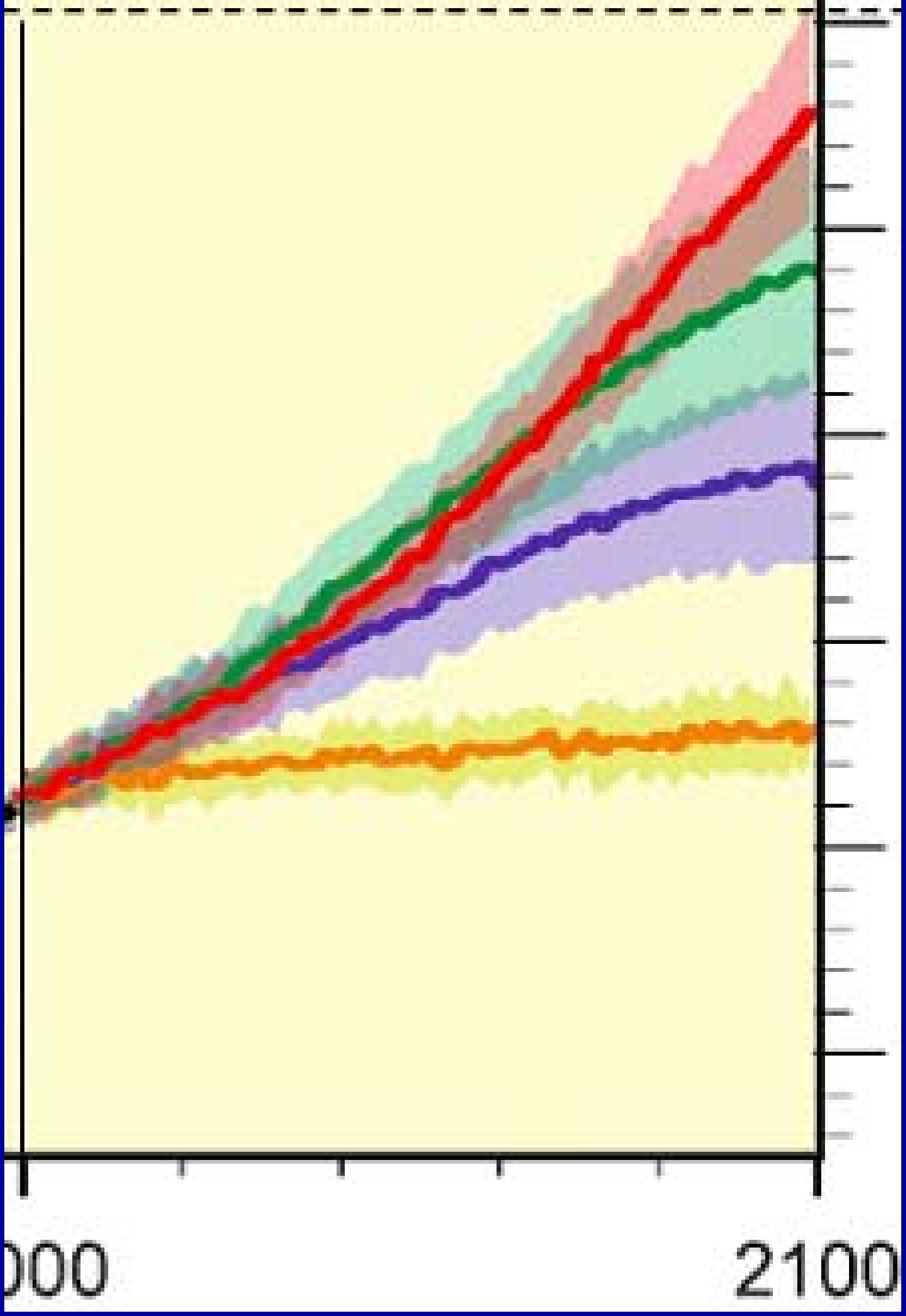


Figure SPM.5. *Solid lines are multi-model global averages of surface warming (relative to 1980–1999) for the scenarios A2, A1B and B1, shown as continuations of the 20th century simulations. Shading denotes the ±1 standard deviation range of individual model annual averages. The orange line is for the experiment where concentrations were held constant at year 2000 values. The grey bars at right indicate the best estimate (solid line within each bar) and the* ***likely*** *range assessed for the six SRES marker scenarios. The assessment of the best estimate and* ***likely*** *ranges in the grey bars includes the AOGCMs in the left part of the figure, as well as results from a hierarchy of independent models and observational constraints. {Figures 10.4 and 10.29}*

How can we more clearly communicate this level of (66%) uncertainty?
What does it imply for calculations at 5km and 15 min scales?



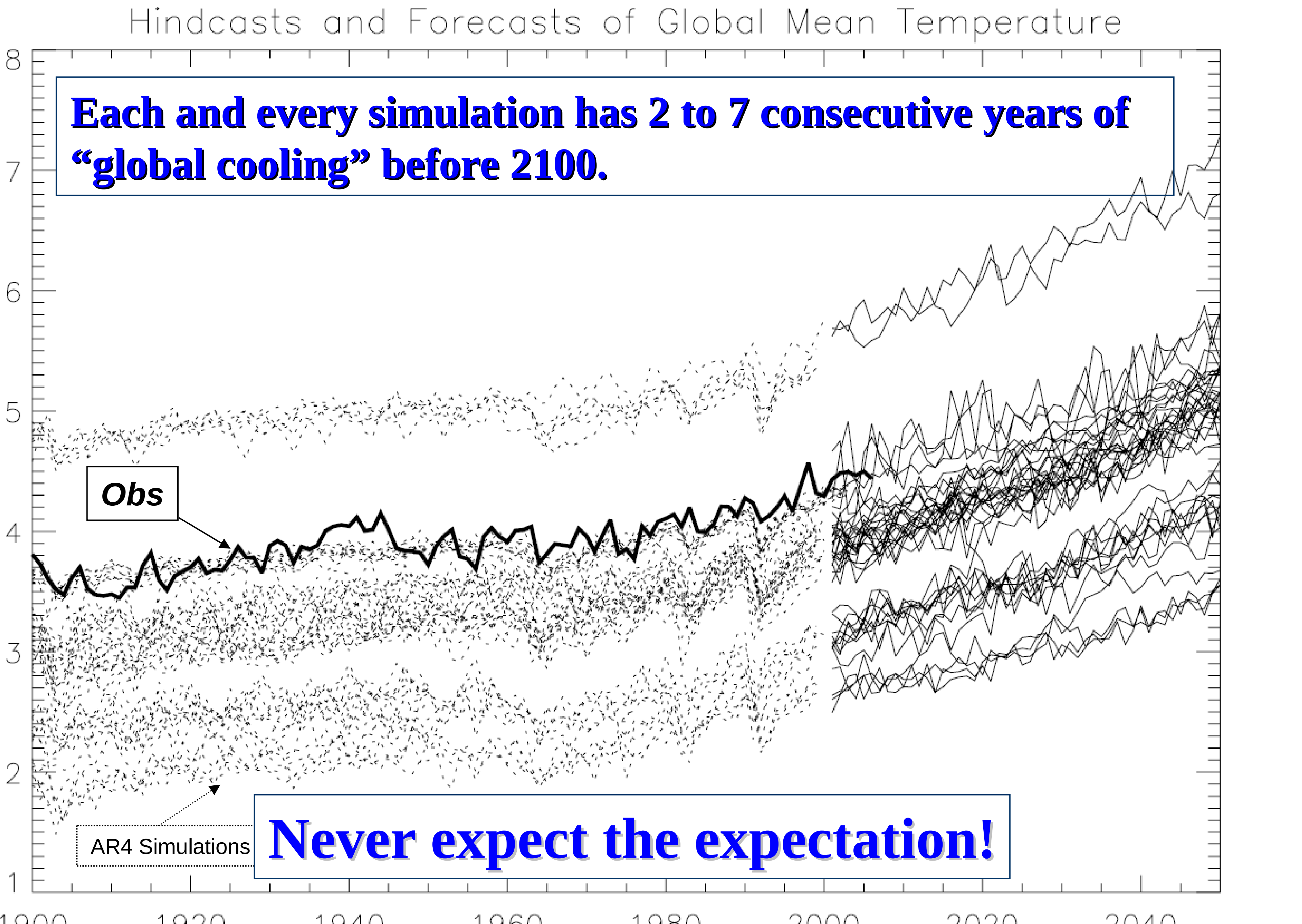
Time evolution of the multi-model mean can also mislead!

Note that the ensemble means each show a steady increase of temperature.

Several years of decreasing global mean temperatures might widely be interpreted (or portrayed) as in conflict with this figure.

Could that cause difficulties policy makers? Or with regulators?

Again, just as with our non-Floridian statisticians, the mean does not tell us anything about brief periods of global cooling in the simulations that defined the mean!



Hindcasts and Forecasts of Global Mean Temperature
Each and every simulation has 2 to 7 consecutive years of "global cooling" before 2100.
Obs
AR4 Simulations
Never expect the expectation!
8
7
6
5
4
3
2
1

How relevant is the change in global mean temperature for policy?

All climate change is local:

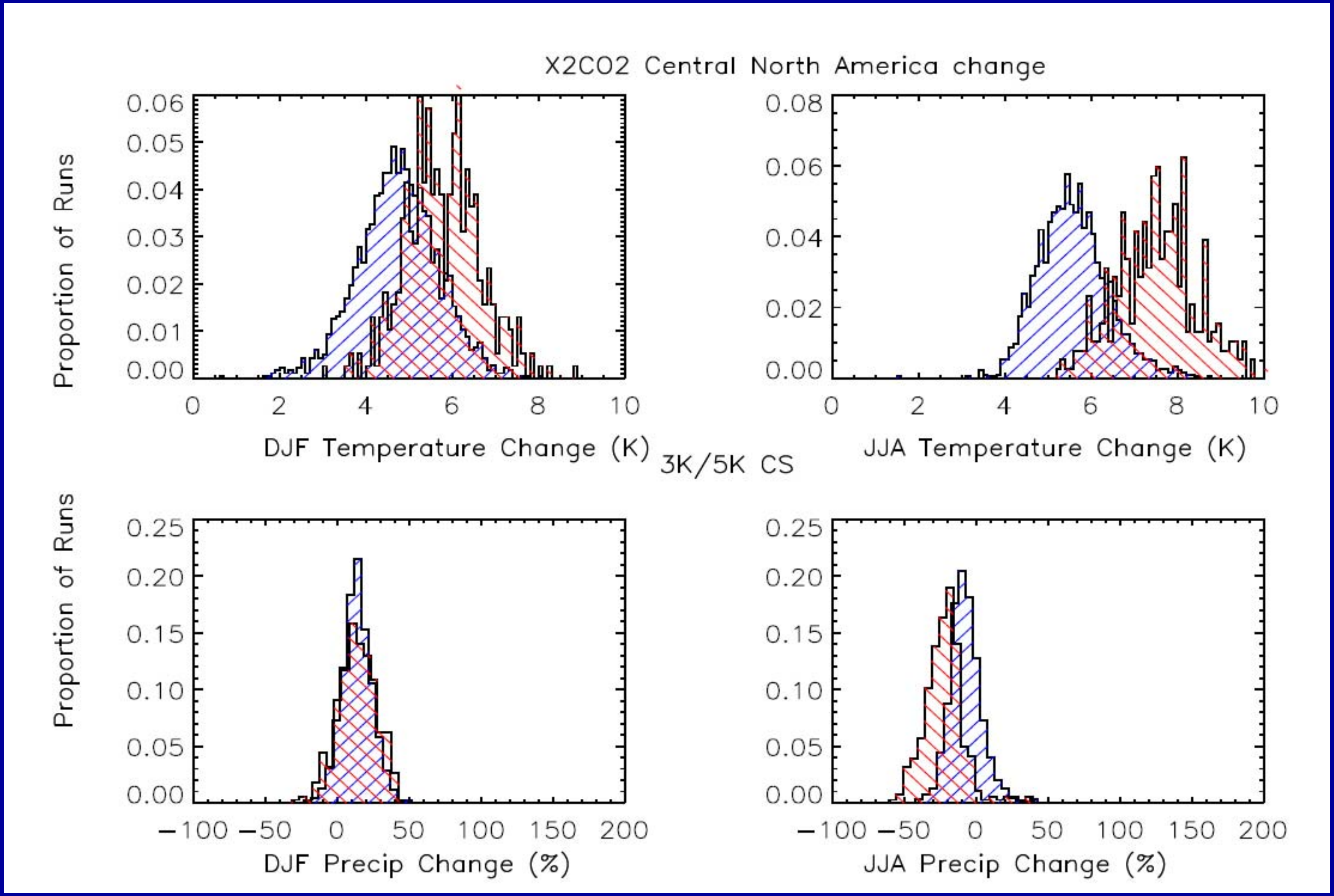
Global Mean Temperature is not informative for local changes (even if the models are perfect!)

Multi-model average is not informative for changes in time (even if the models are perfect!)

Global statistics are only relevant to decision making if they inform the decision maker about something that happens which she would like to take into account before making the decision.

What is the chance a model with a 3 degree Climate Sensitivity is "worse" (that is: yields a greater increase in temperature) than a model with a Climate Sensitivity of 5 degrees?

What's the chance a 3 degree globally is "worse" than 5 degrees?

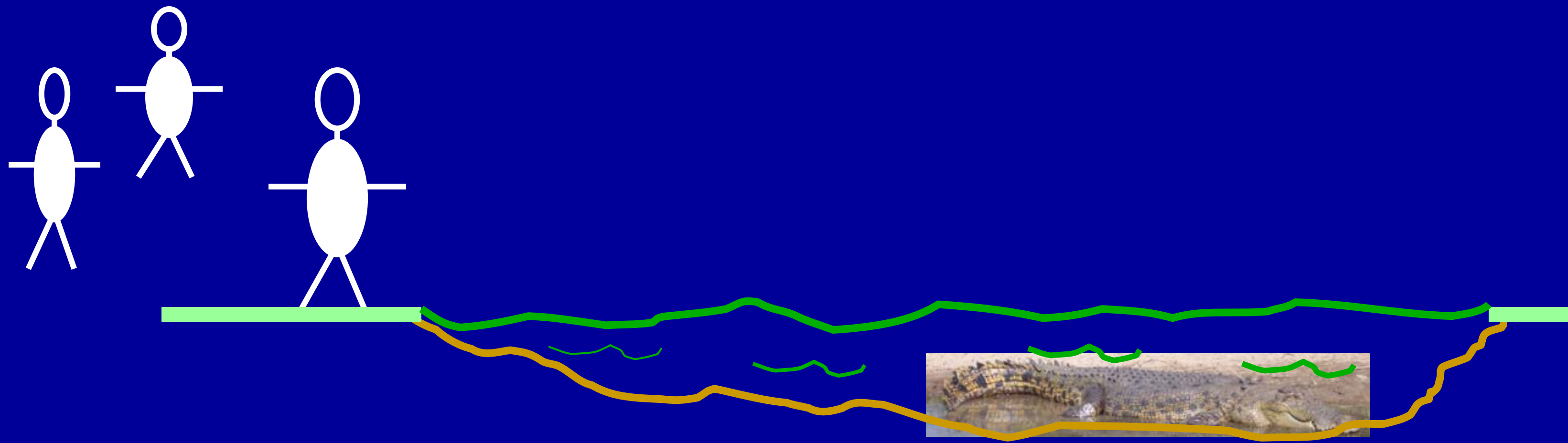


For Central North America, for instance, there is about a one in five chance that a random draw from CS=3 is hotter than one from CS=5

Assuming the model is perfect!

Distributions for Giorgi regions
CS = 3 +/- 0.1 runs (1835) in blue
CS = 5 +/- 0.1 runs (385) in red
Final 8 year means (years 8-15), Phase 3 – Phase 2.

Model Inadequacy and our three non-Floridian statisticians.



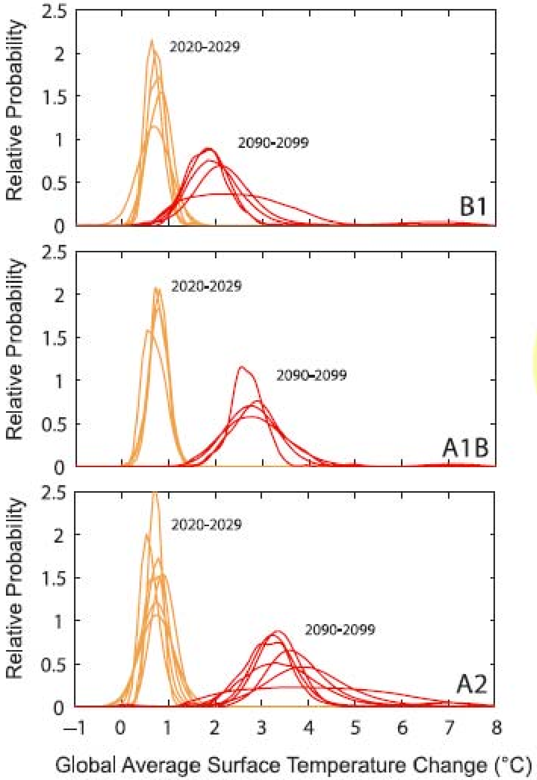
As it turns out, the river is rather shallow.

Model inadequacy covers things in the system that are not of the model.

The decision-relevant question was could they make it across, the depth of the river was only one component…

If we expect non-statistical updates before 2020 (due to blocking, T-rain Atlantic SST gradient, "hurricanes"…), *what should we be saying now?*

Projections of Surface Temperatures



10

Global Climate Projections

The effects of uncertainty in the knowledge of Earth system processes can be partially quantified by constructing ensembles of models that sample different parametrizations of these processes. However, some processes may be missing from the set of available models, and alternative parametrizations of other processes may share common systematic biases. Such limitations imply that distributions of future climate responses from ensemble simulations are themselves subject to uncertainty (Smith, 2002), and would be wider were uncertainty due to structural model errors accounted for.

797

I would like you to think on the potential damage done (to science and society) if distributions which are not decision-support relevant probabilities are used as if they were.
And to think of alternatives for packaging uncertainty so that it can better inform policy and decision support.
(allowing the advancement of science to be seen as a "good thing")

Climate Science

Un der stand ing

Uncertainty

Computer Modelling

Experimental Statistics

Extreme Economics

[redacted]

Decision Making

Now that we know the policy question:
How many CO_2 levels were tested explicitly?

The red shading indicates a 60 per cent chance of exceeding the temperat… amber shading a 40 per cent chance; yellow shading a 10 per cent chance; a… shading a less than a 10 per cent chance.

Stabilisation Level (CO_2e)	Maximum	Hadley Centre Ensemble	IPCC TAR 2001 Ensemble	Mini…
Probability of exceeding 2 ℃ (relative to pre-industrial levels)				
400	57%	33%	13%	8…
450	78%	78%	38%	2…
500	96%	96%	61%	4…
550	99%	99%	77%	6…
650	100%	100%	92%	8…
750	100%	100%	97%	9…
Probability of exceeding 3 ℃ (relative to pre-industrial levels)				
400	34%	3%	1%	1…
450	50%	18%	6%	4…
500	61%	44%	18%	1…
550	69%	69%	32%	2…
650	9[illegible]	94%	57%	4…
750	[illegible]	99%	74%	6…
Probability of exceeding 4 ℃ (relative to pre-industrial levels)				
400	17%	1%	0%	0…
450	34%	3%	1%	0…
500	45%	11%	4%	2…
550	53%	24%	9%	6…
650	66%	58%	25%	1…
750	82%	82%	41%	2…
Probability of exceeding 5 ℃ (relative to pre-industrial levels)				
400	3%	0%	0%	0…
450	21%	1%	0%	0…
500	32%	3%	1%	0…
550	41%	7%	2%	1…
650	53%	24%	9%	5…
750	62%	47%	19%	1…

What Does a 2°C Target Mean for Greenhouse Gas Concentrations? 273

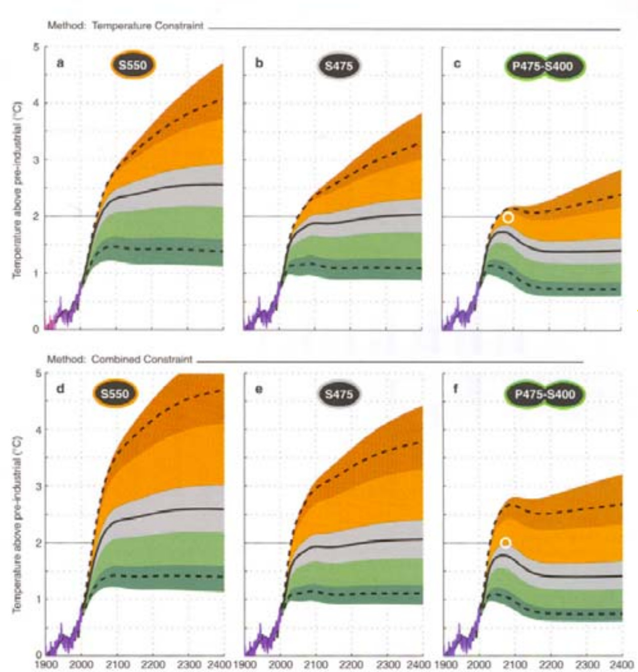


Figure 28.7 The probabilistic temperature implications for pathways that stabilize at (a,d) 550 ppm, (b,e) 475 ppm, and (c,f) 400 ppm CO_2 equivalent concentrations, based on the climate sensitivity PDF that is derived from the conventional IPCC uncertainty range 1.5°C to 4.°C (Wigley and Raper, 2001). The upper (lower) panels depict results when applying the maximum likelihood estimates for ocean mixing and sulphate aerosol forcing as derived by Method A (B). Shown are the median (solid lines), and 90% confidence interval boundaries (dashed lines), as well as the 1%, 10%, 33%, 66%, 90%, and 99% percentiles (borders of shaded areas). The historic temperature record and its uncertainty are shown from 1900 to 2003.

What Does a 2°C Target Mean for Greenhouse Gas Concentrations? 267

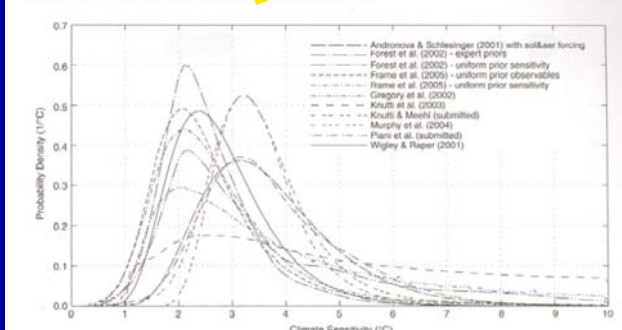


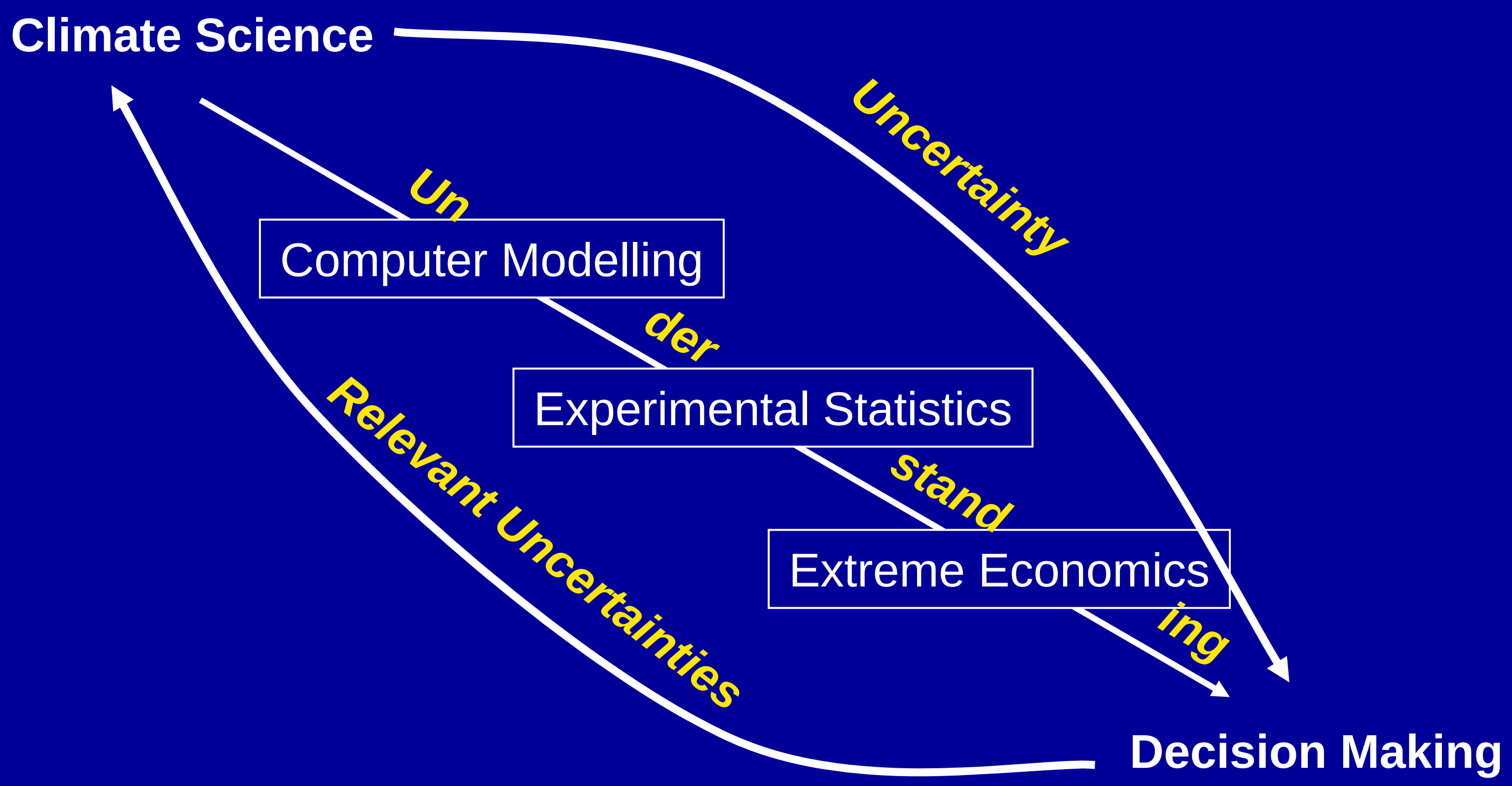
Figure 28.1 Probability density functions of climate sensitivity used in this analysis.

CHAPTER 28

What Does a 2°C Target Mean for Greenhouse Gas Concentrations? A Brief Analysis Based on Multi-Gas Emission Pathways and Several Climate Sensitivity Uncertainty Estimates

Malte Meinshausen

Swiss Federal Institute of Technology (ETH Zurich), Environmental Physics, Department of Environmental Sciences, Zurich, Switzerland



We understand a great deal about the Earth's climate system.
That does not imply we can make detailed (decision relevant) projections.
As our understanding grows further still, how can we communicate risks and uncertainties so that the advancement is science is seen as "a good thing"?

Refinement and falsification of previous results, along with information *from* the numerate user community on how to proceed is desperately needed.

The Grantham Research Institute on Climate Change and the Environment

Münchener Rück
Munich Re Group

We believe that on-going collaboration at national and regional scales between sectoral partners and climate information providers will benefit all parties.
We note further that the practice of climate-related risk management is not widespread within many sectors and that there is a lack of awareness of climate-related risk management opportunities among numerous communities that would benefit.

We recognise the need for efforts to assemble disparate knowledge, to identify good practice, and to assess the value of and give visibility to climate-related risk management.

We recommend that collaborative mechanisms be developed that facilitate needs and requirements driven activities in climate-related risk management, and that they be used to improve the quality of climate-related risk management to the benefit of all.

These mechanisms could promote:

- evaluation of current climate-related risk management in all relevant sectors
- better assessments of the value of climate-related risk management
- establishment of data sets necessary to inform decision making
- research to improve climate-related risk management
- development of decision-support tools
- capacity building in climate-related risk management
- on-going evaluation of outcomes
- the use of suitable financial mechanisms in support climate-related risk management.

We request that these recommendations be considered by WMO, other UN System organisations, and sectoral and development organisations operating at national, regional and international levels.

The rational interpretation, use and advancement of climate science would benefit from more communication with the users of climate science.

This is well recognized by the UN and WMO.

Overview

- As climate science shifts its focus from the past to the future, we need to be a bit more careful communicating the various flavours of uncertainty.
- Working more closely with you would help us, you, and perhaps everyone else too!
- Model inadequacy severely limits the value of implied-probability distributions for decision-support.
  - Model diversity does not quantify future uncertainty
  - We might do well to avoid oversell and better manage expectations!

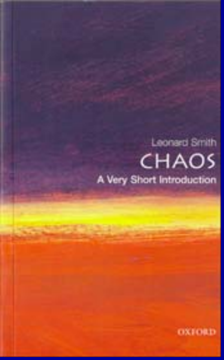
Climate science is science (not engineering)

It has provided hugely important information

and has much to offer in the future on the future.

Together, we can aim to extract robust information for the insurance sector.

And make better decisions based upon everything we know (but not more).



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www.lsecats.org

lenny@maths.ox.ac.uk

Insuring Future Climate Change

Scope

The insurance sector faces considerable challenges ahead. Projections of increased occurrence and intensity of extreme weather events caused by humanly induced climate change may amplify payouts and administrative costs considerably.

Recent trends in weather extremes, with the 11 warmest years worldwide recorded during the last 13 years, means that society must take sensible steps to prepare and act already now.

Insurers are at the frontline of climate change, as they meet their clients directly after damages occur. Climate risk management requires mapping vulnerability towards climate change, encouraging adaptation measures and initiating concerted actions within the sector regarding the distribution of responsibility for damages between key-stakeholders and Governments.

This conference brings together researchers, stakeholders and decision-makers from insurance, science and politics in order to stimulate discussion and dialog. The aim is to promote pro-active actions for reducing risks before serious impacts of climate change are upon us.

The conference sessions intend to present theoretical knowledge as well as practical tools on calculating climate risk, mapping risk geographically, possibilities and limits of adaptation, and communicating risk. Collaboration between the public and private sector is discussed as well as a philosophical approach to the issue of who should bear responsibility for adaptation and damage reduction. Case-studies from different regions in Europe and the most central types of climate extremes are presented to round off each topical session. The studies present experience on mapping, prediction and damage reduction of climate events such as storms, flooding, sea-level rise and snow-blizzards.

While society as a whole must bear the cost of climate change - in the form of higher insurance premiums or infrastructure repairs financed by taxes, knowledge on the effects of climate change on the business and climate protection can bring huge economic opportunities. Thanks to new technologies, increased energy efficiency, and new products within risk management, it is possible to be prepared by acting and planning today.

Session 1: Estimating climate risk in a world of insecurity

Climate change will be felt both by gradual and sudden changes, as well as by changes in the intensity and frequency of extreme events. Global and regional climate models projecting the spatial distribution of these changes give a coarse idea of the expected changes. Nevertheless, the uncertainties in these projections need to be incorporated in statistical models for estimating the risk, as well as in the calculation of insurance premiums. What do we know so far, where are the challenges?

Session 2: Insurers adaption - the precautionary principle

A precautionary approach implies that actions are undertaken which try to minimize harm even when the absence of scientific certainty makes it difficult to predict the likelihood of harm occurring, or the level of harm should it occur. What philosophical views imply that the lack of full scientific certainty should not be used to postpone cost-effective damage prevention? What are the practical approaches when it comes to damage prevention with various stakeholders involved? A case-study on river management discusses the effect of preventive actions. Another study reviews the climate robustness of buildings from a Scandinavian perspective.

Session 3: Responsibility: Society or the individual?

The responsibility for climate adaptation has to be assigned to various actors in society - individuals, the public and private sector. How can the burden be distributed fairly and economically reasonable? What incentives can be provided through political action? How may the thresholds for damage claims change and be distributed if the intensity and frequency of extreme weather events increases? Experiences from vulnerability studies of the Swedish society, as well as a case-study on storm behaviour and public/private response in Northern/Central Europe shows practical perspectives on these issues.

Session 4: Mapping risk

It has been suggested that geographic information systems can support traditional statistical analyses to localize and give insight into areas that are vulnerable to climatic hazards. What kind of spatial patterns and unique regional conditions can be unveiled and thus, will allow for precautionary action and adaptation strategies? A case-study from flood risk management in the Netherlands shows how risk maps can be used for policy development.

Session 5: Collaboration between the business and the public

Risk management of climate change can be only achieved by concerted action of various stakeholders in the private and public sector. How can private-public interactions organise a financial robust insurance system for unequally distributed climate risk? In addition, an example from the UK on the complex collaborative process in spatial planning for climate change is discussed. Another case-study on mud- and snow slide hazards in the Alps presents the increase in vulnerability of the local population as a result of both environmental and social factors.

Session 6: Communicating climate risk

Climate measurements do not necessarily represent the way people actually perceive climate conditions in their daily life. People may respond to various climate stimuli in different way, and adaptation to changes may be influenced by other rationales rather than seeking climate adaptability and robustness. As such, it can be a challenge communicating the necessity to reduce global warming as well as to prepare society for potential adverse climate conditions. What have we learned about using media campaigns for getting public attention? How can scientists help making people understand uncertainty about regional consequences of climate change derived from global climate models?

Session 7: Reinsuring climate risk and emerging business

Traditionally, insurance companies will reinsure their own risk in the international market. What are the thoughts of the reinsurance industry on a forthcoming increase in climate damage related payouts and what management strategies are applied to encourage primary insurers to reduce the risk? How may the content of the coverage change in a changing world and what expertise and knowledge can reinsures provide? A case-study on the change in the global risk landscape will discuss these issues in further details. Climate changes will give room for new business solutions. This session includes a presentation of emerging markets and customer groups as well as new hazards which need special attention in the decades to come.

Focus on how uncertainties and risk are communicated.

IPCC AR4, pointing toward various insurance related applications

Robust information:

Uncertainty: *Quantifiable (probabilistic), not necessarily by probabilities!*

Probabilities *are conditioned on what we know, and often on the assumption that our model(s) are fit for purpose.*

Decision makers **require** very little.
Clear expression of current limits is of great value.

FREE

METRO

Wednesday, September 10, 2008 www.metro.co.uk

If you're reading this... the world hasn't ended

BY FRED ATTEWILL

IF YOU spot a swirling worm-hole in the space-time continuum this morning, you know who to thank.

It's those crazy scientists, deep underneath the Franco-Swiss border, tinkering around with the largest machine mankind has ever created.

At 9.15am precisely, the £5billion Large Hadron Collider will whirr into action – with the intention of re-creating the conditions of the Big Bang.

But it has struck fear into the hearts of several scientists, some of whom claim the LHC could create a black hole which might swallow the planet.

'Nothing will happen for at least four years. Then someone will spot a light-ray coming out of the Indian Ocean,' said German chemist Otto Rossler. 'The weather will change completely, wiping out life. There will be a Biblical Armageddon.'

Inside a 27km (17-mile) tunnel, scientists will accelerate beams of protons to 99.99 per cent of the speed of light using giant magnets.

Protons will then be fired in the opposite direction, resulting in trillions of collisions, creating a temperature 100,000 times hotter than the Sun. The aim is to discover whether concepts such as dark matter, extra dimensions and even the elusive Higgs boson (also known as God's particle) actually exist.

British physicist Peter Higgs came up with the 'boson' idea in 1964 to explain how particles acquire mass.

He theorised the Higgs boson is a background field that acts like treacle, dragging particles down and giving them mass. But Prof Stephen Hawking revealed he had bet £50 that God's particle would elude even the LHC.

'It will be more exciting if we don't find the Higgs. That will show we need to think again,' he said.

Others seemed unfazed about the possible end of life on Earth. Prof Brian Cox, who works on the project, said: 'Anyone who thinks the LHC will destroy the world is a t**t.'

Share your thoughts on the Big Bang experiment in our chatroom at www.metro.co.uk/bigbangchat

How long is long?
Large Hadron Collider: 27km
(that's 2,812-and-a-half London buses)
Circle line: 22.5km

Large Hadron Collider

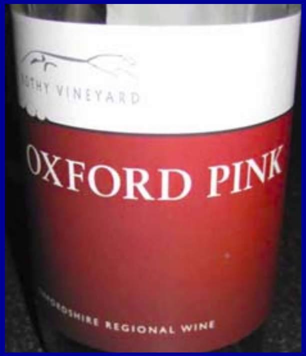
Circle line

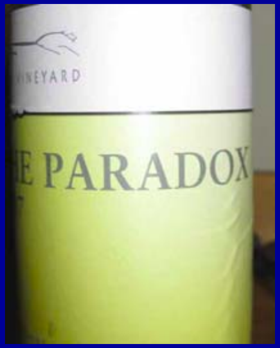
FRANCE

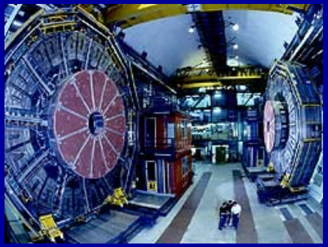
SWITZERLAND

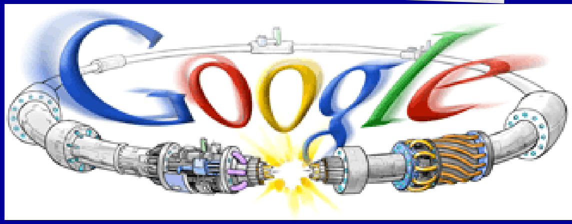
Geneva

Smashing: The Large Hadron Collider is readied for the big test









Fallacy of Misplaced Concreteness

"The advantage of confining attention to a definite group of abstractions, is that you confine your thoughts to clear-cut definite things, with clear-cut definite relations. …

The disadvantage of exclusive attention to a group of abstractions, however well-founded, is that, by the nature of the case, you have abstracted from the remainder of things.

... it is of the utmost importance to be vigilant in critically revising your *modes* of abstraction.

Sometimes it happens that the service rendered by philosophy is entirely obscured by the astonishing success of a scheme of abstractions in expressing the dominant interested of an epoch."

A N Whitehead. Science and the Modern World. Pg 58/9

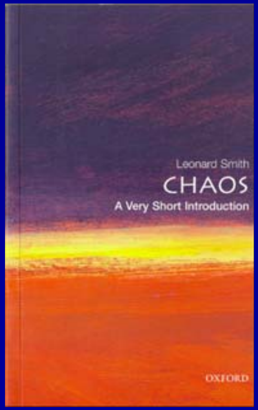
In the case of physical dynamical systems, probability forecasts based on model simulations provide excellent realisations of this fallacy, drawing comfortable pictures in our mind which correspond to nothing at all, and which will mislead us if we carry them into decision theory.

You don't have to believe everything you compute!

Improving Predictions of Climate Change:
Living with an Inconvenient Ignorance

Leonard A Smith
Centre for the Analysis of Time Series, LSE
&
Pembroke College, Oxford

Jochen Broecker, Liam Clarke, Hailiang Du,
Dave Stainforth, Kevin Judd & Ed Tredger
www.lsecats.org



In UNESCO Munich Re

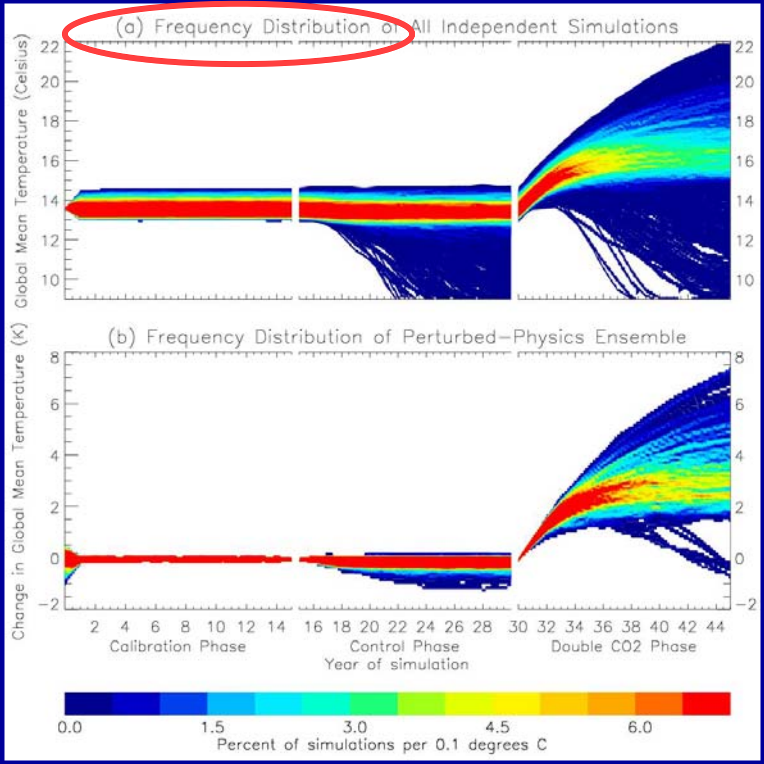
Climate is Harder than Weather

By definition: Climate Science is extrapolation.

(in a ~10^6x10^{21} D model-space)

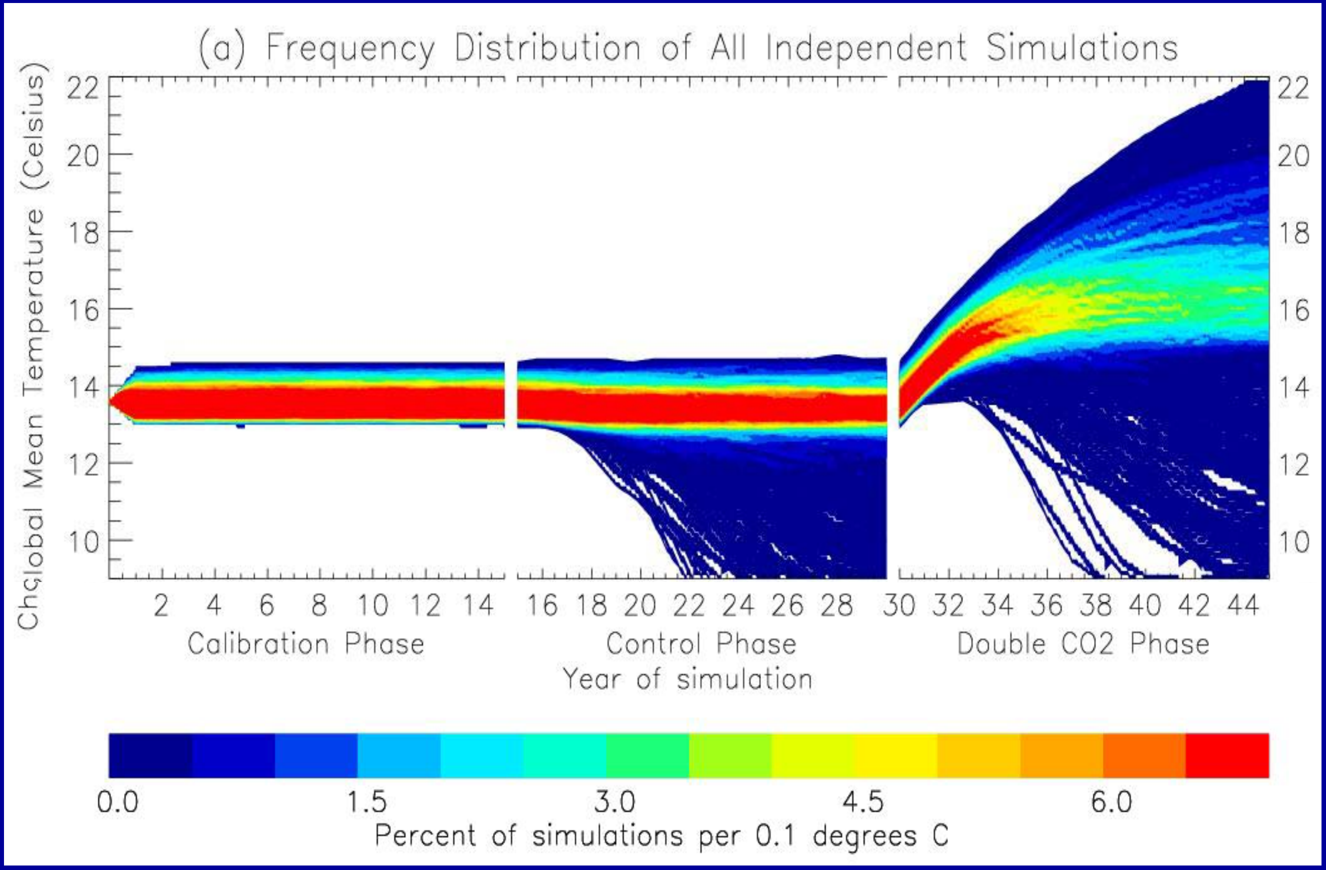
This is a very very hard problem.

And we are forced to work (mostly) in-sample.
Below is a distribution of many runs under the same mathematical model structure, parameters and ICs vary.



How exactly?

Single model structure: vary paramete

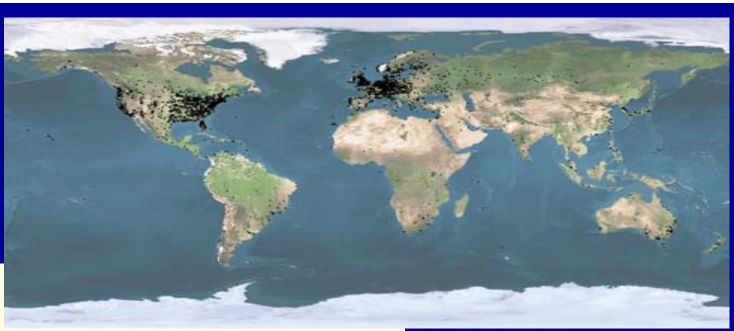


This is the range of 2xCO2 global average temperature in one model!

Experiment has three phases:

Quality control is required!

What does the relative frequency distribution of model global temperatures tell us about the world?



> 100,000 participants from 150 countries
> 70,000 simulations (each 45 years long)
> 8,000 years of computing time

Projected Patterns of Precipitation Changes

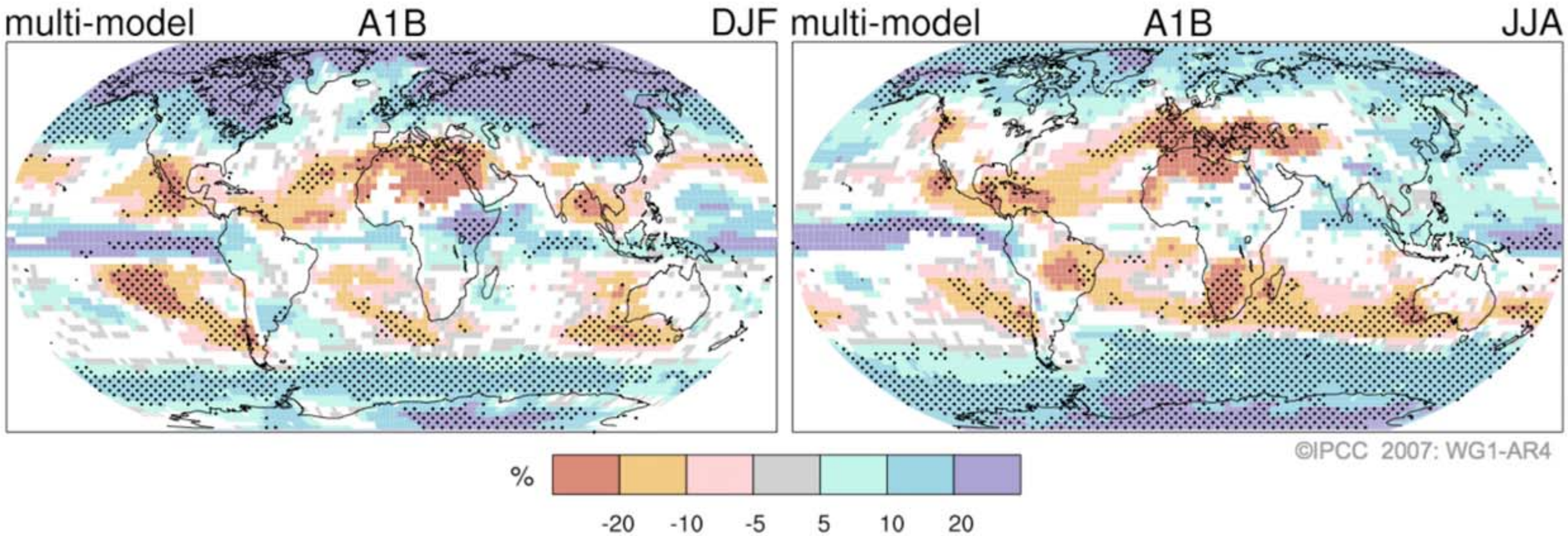
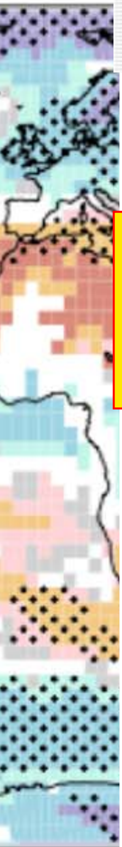
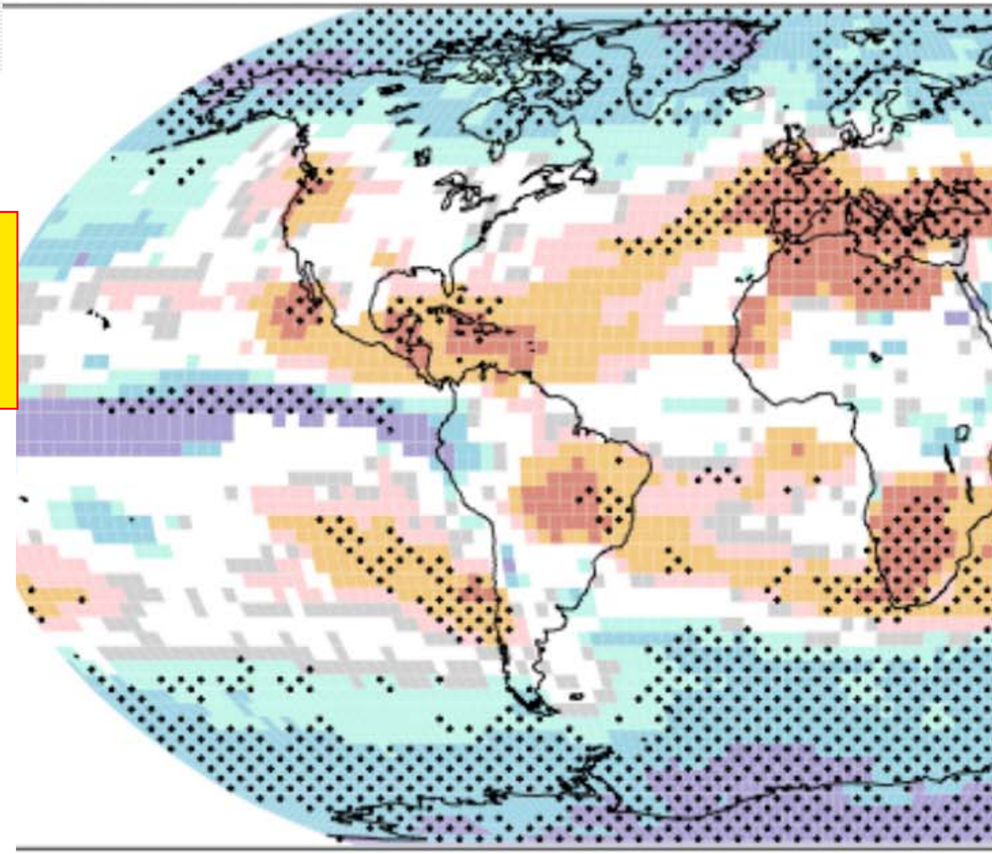


FIGURE SPM-6. Relative changes in precipitation (in percent) for the period 2090–2099, relative to 1980–1999. Values are multi-model averages based on the SRES A1B scenario for December to February (left) and June to August (right). White areas are where less than 66% of the models agree in the sign of the change and stippled areas are where more than 90% of the models agree in the sign of the change. {Figure 10.9}

Do not worry about the values of the numbers (yet):
Think first about the meaning of this kind of number!

A1B multi-model A1B





UK Climate Impacts Programme

UKCIP08 will provide climate change scenarios for the UK :

- for 25 x 25 km grid squares, plus some aggregated results for administrative regions and river catchments

- The weather generator will allow future time daily (and sub-daily) time-series to be simulated, which will be of use to any user who is interested in daily weather variables, thresholds and sequences or extreme events.

events.
- relative to a baseline period of 1961–1990
- including extra information such as marine scenarios and changes to river flows

UKCIP02

FIGURE SPM-7. Relative changes in precipitation (in percent) for the period 2090–2099, relative to 1980–1999. Values are multi-model averages based on the SRES A1B scenario for December to February (left) and June to August (right). White areas are where less than 66% of the models agree in the sign of the change and stippled areas are where more than 90% of the models agree in the sign of the change. {Figure 10.9}

Fallacy of Misplaced Concreteness

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In the case of physical dynamical systems, probability forecasts based on model simulations provide excellent realisations of this fallacy, drawing comfortable pictures in our mind which correspond to nothing at all, and which will mislead us if we carry them into decision theory.

You don't have to believe everything you compute!

We know the Newtonian model is (known to be) structurally incorrect, its parameters have no precise empirical values to find, but it can shadow relevant observed trajectories on time scales much longer than 50 years.

Decision support: potential collisions with near Earth asteroids over the next 500 years. Three models:

Ptolemaic
Newtonian
General Relativistic

Main point: Utility (probabilistic similarity) does not require a perfect model, merely one fit for purpose. (?or at least plausibly fit for purpose?)

And if Model Structure is still an issue?
The Climate-Bayesians reply is to take several models and compute Discrepancy:

- Runge-Kutta 6th order
- Runge-Kutta 4th order (smaller time step)
- Predictor-corrector
- Hamiltonian (numerically exact energy conservation scheme)

Probabilistic Similarity does not require a perfect model, merely one fit for purpose.

But are Newton's Laws fit for *this* purpose?

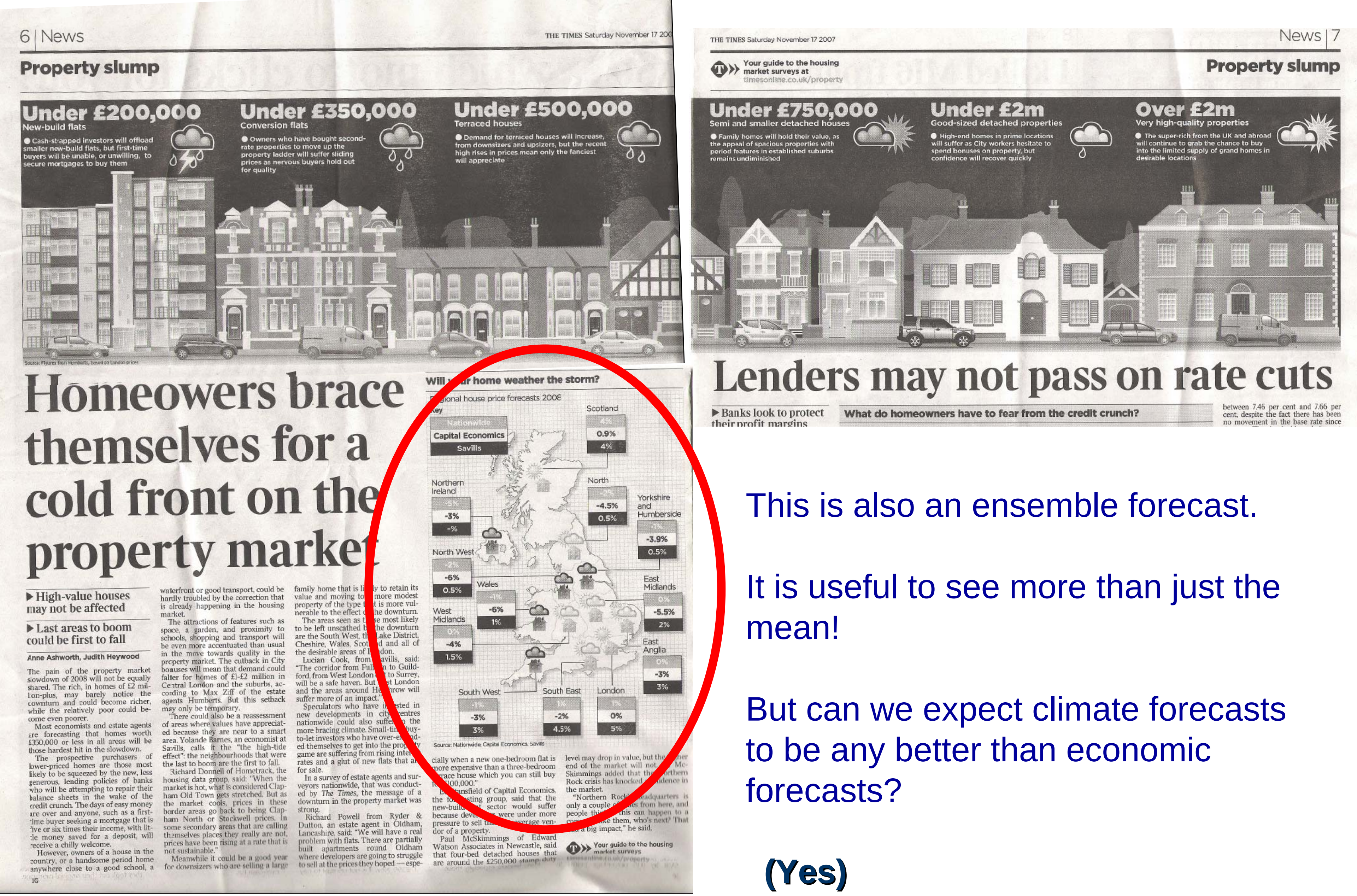
Why might one think:

"relationships between *model errors* for different climate variables can reasonably be expected to follow relationships between *inter-model differences* for different variables." Murphy et al 2007

"are unlikely to be fundamentally compromised"

?@ 5 km, hourly extremes of precip in 2080? In Y2007 models?

But are Newton's Laws fit for *this* purpose?



6 | News THE TIMES Saturday November 17 2007

Property slump

Under £200,000 New-build flats — Cash-strapped investors will offload smaller new-build flats, but first-time buyers will be unable, or unwilling, to secure mortgages to buy them

Under £350,000 Conversion flats — Owners who have bought second-rate properties to move up the property ladder will suffer sliding prices as nervous buyers hold out for quality

Under £500,000 Terraced houses — Demand for terraced houses will increase, from downsizers and upsizers, but the recent high rises in prices mean only the fanciest will appreciate

Homeowers brace themselves for a cold front on the property market

▸ High-value houses may not be affected

▸ Last areas to boom could be first to fall

Anne Ashworth, Judith Heywood

Will your home weather the storm?

Regional house price forecasts 2008

Key: Nationwide / Capital Economics / Savills

	Nationwide	Capital Economics	Savills
Scotland	4%	0.9%	4%
Northern Ireland	-5%	-3%	-%
North	-2%	-4.5%	0.5%
Yorkshire and Humberside	-1%	-3.9%	0.5%
North West	-2%	-6%	0.5%
Wales	-1%	-6%	1%
West Midlands	0%	-4%	1.5%
East Midlands	0%	-5.5%	2%
East Anglia	0%	-3%	3%
South West	-1%	-3%	3%
South East	1%	-2%	4.5%
London	1%	0%	5%

Source: Nationwide, Capital Economics, Savills

THE TIMES Saturday November 17 2007 News | 7

Your guide to the housing market surveys at timesonline.co.uk/property

Property slump

Under £750,000 Semi and smaller detached houses — Family homes will hold their value, as the appeal of spacious properties with period features in established suburbs remains undiminished

Under £2m Good-sized detached properties — High-end homes in prime locations will suffer as City workers hesitate to spend bonuses on property, but confidence will recover quickly

Over £2m Very high-quality properties — The super-rich from the UK and abroad will continue to grab the chance to buy into the limited supply of grand homes in desirable locations

Lenders may not pass on rate cuts

▸ Banks look to protect their profit margins

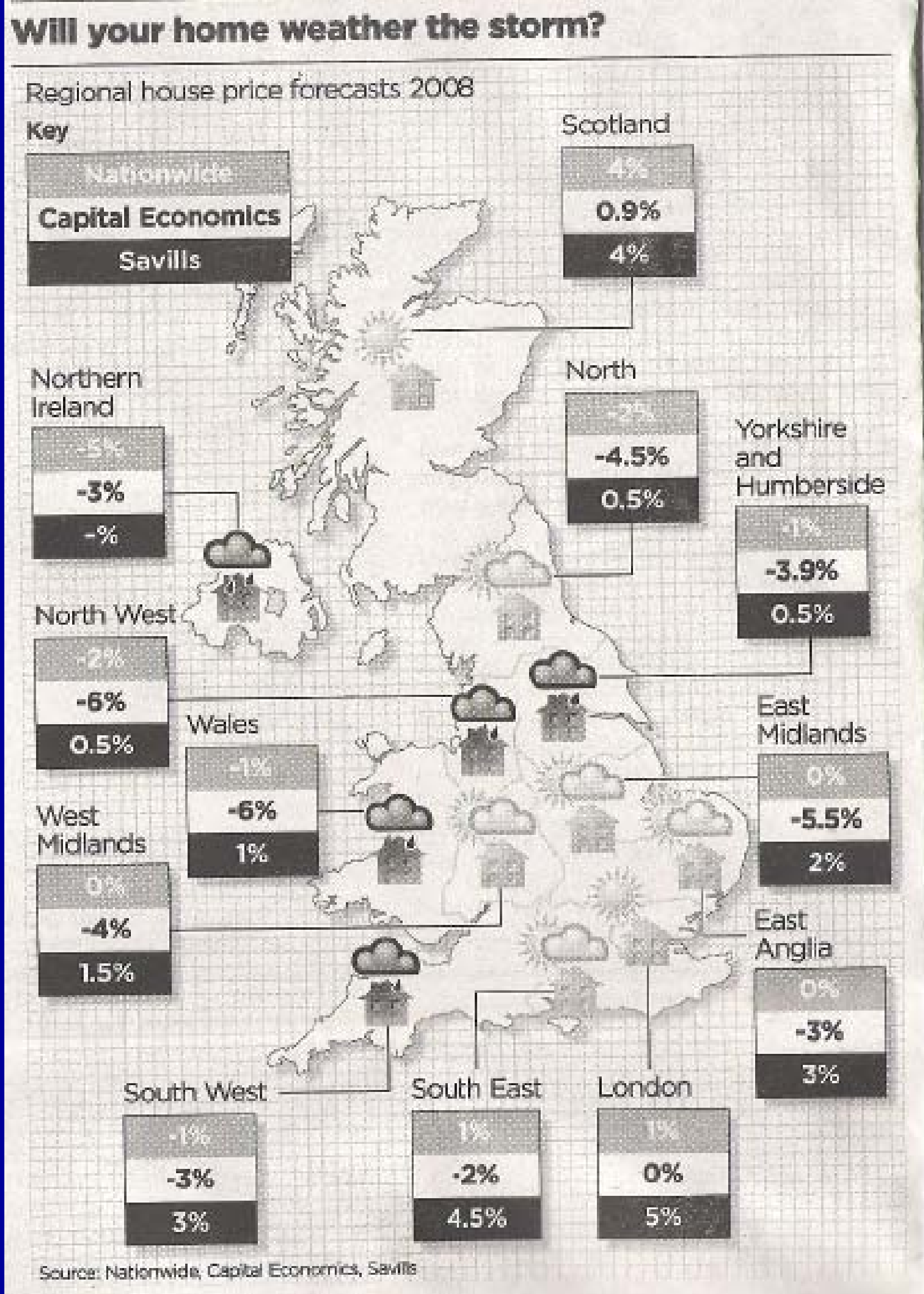
What do homeowners have to fear from the credit crunch?

This is also an ensemble forecast.

It is useful to see more than just the mean!

But can we expect climate forecasts to be any better than economic forecasts?

(Yes)



Scotland: all forecasts positive.

London: None negative

Northern Ireland: one missing

All others mixed: positive and negative

All these issues are mirrored in climate modelling, including the fact that the forecasts are not really independent.

But are scientific forecasts more reliable than economic forecasts?

Yes.

The Scottish Play

BANQUO: If you can look into the seeds of time,
And say which grain will grow and which will not,
Speak then to me, who neither beg nor fear
Your favours nor your hate.

Banquo

And remember: each prediction told to Macbeth proves accurate. Nevertheless the story is not one of optimal decision support.

Macbeth:

And be these juggling fiends no more believed,
That palter with us in a double sense;
That keep the word of promise to our ear,
And break it to our hope.

BANQUO: And oftentimes, to win us to our harm,
the instruments of darkness tell us truths, win us with honest trifles,
to betray's in deepest consequence.

Arguably, there is no general (much less elegant) solution, given current levels of models skill, the “9 of each” ENSEMBLE (DEMETER, PROVOST, ...) ensemble design, and a forecast archive of only a few dozen points.

Improved design of the ensemble (size, formation, ...) and better informed model improvement may allow us turn model simulations into more generally useful forecasts (on the STD timescales)...

...and get more users to the other side beyond week two without waiting for bigger computers or better models they will allow.