CLIMATE ETHICS

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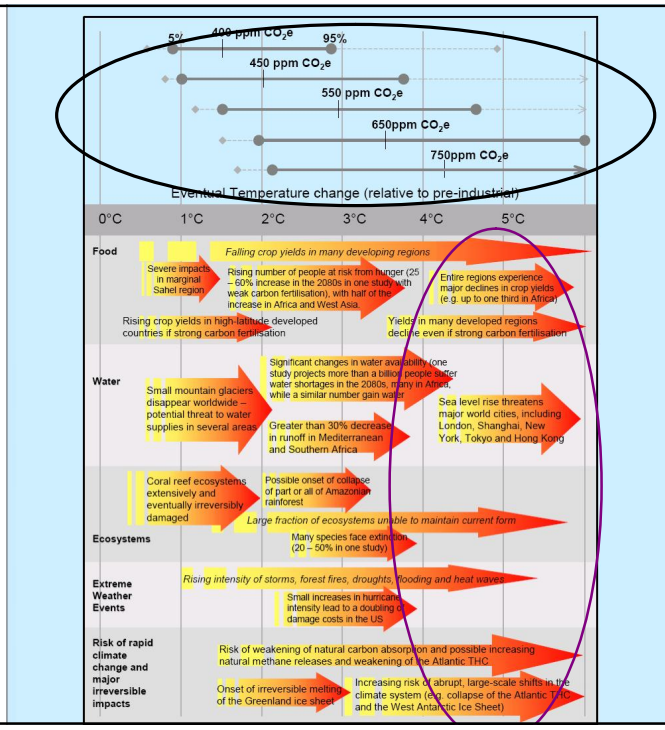


Massive uncertaintity

Huge impacts

The Stern Review

Six Degrees: Our Future on a Hotter Planet by Mark Lynas

- 4C, we have "with global sea levels half a meter or more above current levels, the Egyptian city of Alexandria's long lifespan will be drawing to a close. Even in today's climate, a substantial part of the city lies below sea level, and by the latter part of this century a terminal inundation will have begun. … a rise in sea levels of 50 cm would displace 1.5 million people and cause $35 billion of damage."
- Alarmist? Hardly. A 50 cm rise in sea level, is well within the conservative IPCC projections, even for temperature rises less than four degrees.
- Remaining Amazon forest dies, releasing more carbon and driving global temperatures another 1.5°C higher.

Six Degrees: Our Future on a Hotter Planet by Mark Lynas

- 5C, we have "an entirely new planet is coming into being – one largely unrecognizable from the Earth we know today".
- remaining ice sheets are eventually eliminated from both poles.

Six Degrees: Our Future on a Hotter Planet by Mark Lynas

- 6C “the pump is primed … not for flourishing palm trees in Alaska, but for the worst of all earthly outcomes: mass extinction."

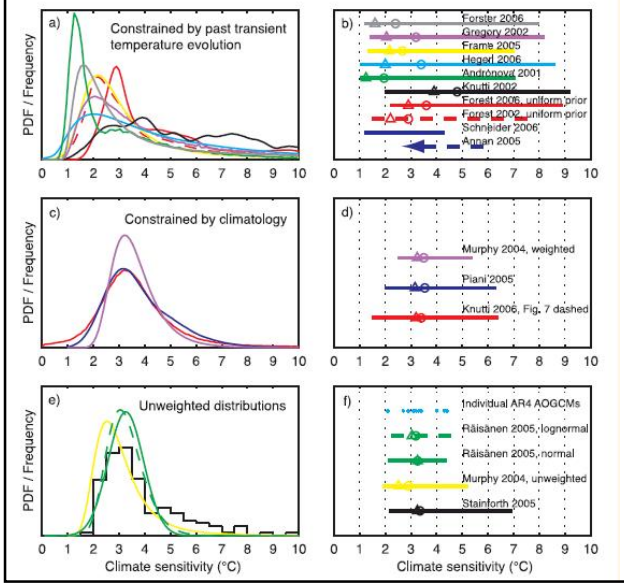
Large risks

- highly-unlikely poorly-understood threshold-crossing disasters associated with abrupt large-scale irreversible changes in the climate system:
- sudden collapse of the Greenland and West Antarctica ice sheets,
- weakening or even reversal of thermohaline circulations that might radically affect such things as the Gulf Stream and European climate,
- runaway climate-sensitivity amplification of global warming due to positive-reinforcing multiplier feedbacks (including, but not limited to, loss of polar albedo, weakened carbon sinks, and rapid releases of methane from the thawing of arctic permafrost

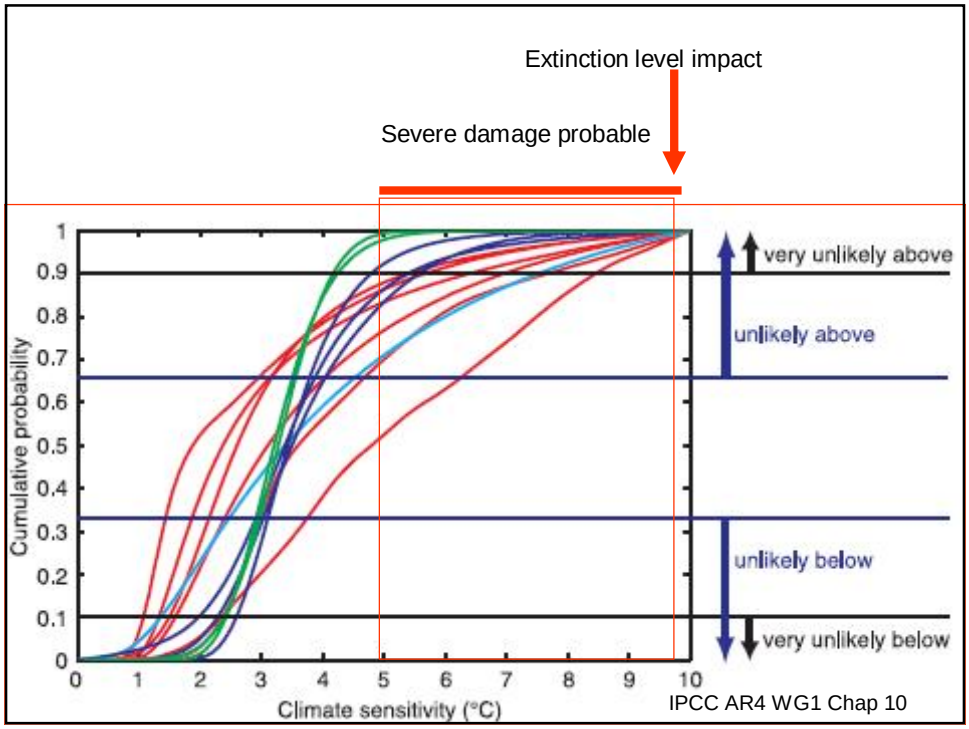
More gradual but still very serious

- sea-level dynamics, drowned coastlines of unknown magnitude,
- very different and possibly extreme weather patterns including droughts and floods,
- ecosystem destruction, mass species extinctions,
- big changes in worldwide precipitation patterns and distribution of fresh water,
- tropical-crop failures,
- large-scale migrations of human populations,
- humidity-nourished contagious diseases

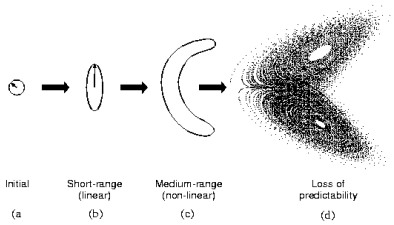
Climate sensitivity estimates



IPCC AR4 WG1 Chap 10

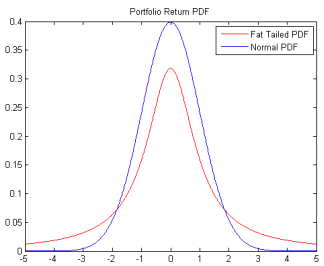


Uncertainty Error Growth…

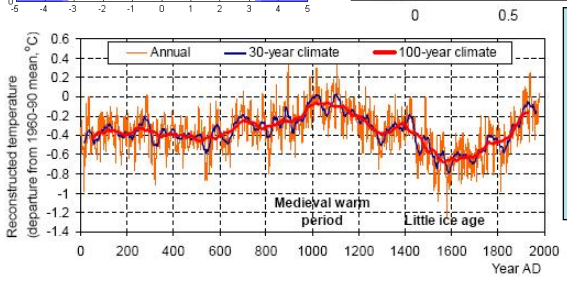


- Early error growth is governed by linear dynamics
- Followed by a weakly nonlinear stage
- Followed by strong nonlinear growth and loss of predictability
- Rate of error growth depends on the stability of the evolving flow

The climate system has unknown probability density function



Climate mechanistic analysis can explore the pdf of climate variability Complimenting model estimation



Need good noise models to estimate significance of past and on-going events

Koutsoyiannis & Cohn, The Hurst phenomenon and climate 25

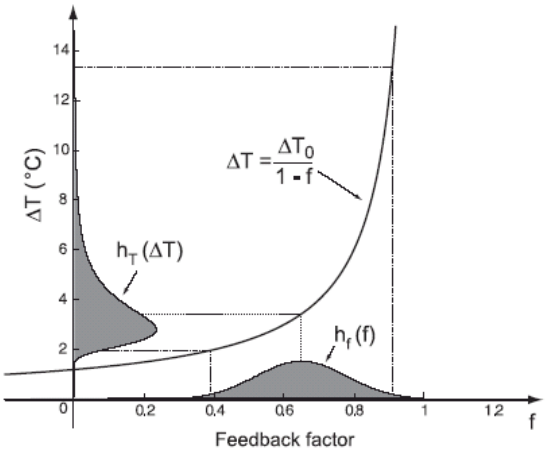
A Catastrophe?

- *Catastrophe: Risk and Response*, by Richard A. Posner defines the word catastrophe .... To designate an event that is believed to have a very low probability of materializing but that if it does materialize will produce a harm so great and sudden as to seem discontinuous with the flow of events that preceded it..

Fat-tailed distributions

- In the low-probablity tails of distributions, extreme events are far, far more likely than in fat-tailed distributions thin-tailed ones –
- Since the costs of catastrophies are enormous, cutting the tails at a arbitrary point (e.g. At p=0.05 or 0.01) fails to approximate to the risk if the real tail is included
- By implication, the policy advice coming out of conventional thin-tailed CBAs of climate change must be treated with (possibly severe) scepticism.

Where does the fat tail come from?



Because of feedback effects.

Any uncertainity in feedback amplification to pure radiative forcing by CO2 will lead to skewed sensitivity distributions

(Roe and Baker, 2007)

Why is climate sensitivity unknowable

- Once the world has warmed by 4C, conditions will be so different from anything we can observe today (and still more different from the last ice age) that it is inherently hard to say where the warming will stop - Allen and Frame (2007)

Weitzman fat-tailed CBA – the Dismal Theorem

- *Generalized precautionary principle*.
- With fat-tailed distributions the probability of a disaster declines polynomially in the scale of the disaster, while the marginal-utility impact of a disaster increases exponentially in the scale of the disaster.
- Irrespective of the actual distribution. It is the uncertainity that results in fat-tailedness

How much caution is needed

- Was the industrial revolution worth the risk?
- Are we already too late because of inertia in the system to affect change?
- How much should we try to prevent climate chnage catastrophe?
- How do other potential catastrophies compare with climate change?

Other nightmares:

- biotechnology,
- nanotechnology,
- asteroids,
- strangelets,
- pandemics,
- run-away computer systems,

All seem much less likely than extreme climate risk <<1%

- nuclear proliferation

- During the Cuban Missile Crisis, U.S. President Kennedy estimated the probability of a nuclear holocaust as “somewhere between one out of three and even”

- John von Neumann, as Chairman of the U.S. Air Force Strategic Missiles Evaluation Committee, predicted that it was “absolutely certain (1) that there would be a nuclear war; and (2) that everyone would die in it”

Probablity of extinction

- Britain's Astronomer Royal, Sir Martin Rees gives humanity 50-50 odds on surviving the 21st century;
- Philosopher Nick Bostrom argues that it would be "misguided" to assume that the probability of extinction is less than 25%;
- Philosopher John Leslie assigns a 30% probability to extinction during the next five centuries.
- The "Stern Review" for the U.K. Treasury assumes that the probability of human extinction during the next century is 10%.
- May explain the "Fermi Paradox" - a high probability (close to100%)of extinction among technological civilizations

What are the risks?

- **Species extinction?**
- Mamalian species survive on average about 2 million years
- About 100 billion homo sapiens have ever lived. Statistically the best estimate is that we are half way through the total that ever will live.
- H. Sapins then will exist, with 95% confidence for between 5000 and 8 million years
- Potentially "we" – h. Sapiens or descendents could live for the duration of stable atomic matter – 10^{32} to 10^{41} years

- *The Earth will remain habitable for at least another billion years. Civilization began only a few thousand years ago. If we do not destroy mankind, these thousand years may be only a tiny fraction of the whole of civilized human history.*

Discounting

- Commonly used for goods, like money, whose value predictably decreases in time.
- Valuing future lives less than current ones ("intergenerational discounting") has been justified by arguments about time preference, growth in consumption, uncertainty about future existence, and opportunity costs
- discounted at a 5% annual rate, a life today would have greater intrinsic value than a billion lives 400 years hence.
- Even Rees's pessimistic 50-50 odds on human extinction by 2100 would be equivalent to an annual discount rate under 1% for this century
- the higher the interest rate the stronger the desire to move towards getting more pleasure now at the expense of postponing more pain until later.

- “Our actions over the coming few decades could create risks of major disruption to economic and social activity, later in this century and in the next, on a scale similar to those associated with the great wars and economic depression of the first half of the 20th century.” Stern review, 2006
- “what to do about global warming depends over-whelmingly on the imposed interest rate” Martin Weitzman, 2007

Discount rates

- Fairly dubious macro-economic equations relate growth, savings and compute cost-benfits.
- Typical depreciation (interest) rates of 6% do not apply to macro-economic guaranteed returns e.g. Treasury bills have 1% interest
- Correlation across economic fields determines interest rate
- Stern assumes 1.4% interest rates – average compounding rates leads to low rates

- UNCERTAINTIES DOMINATE – DOES CLIMATE DAMAGE AFFECT SECTORS DIFFERENTLY?
- YES!
- outdoors more affected than indoor economy
- This may give optimism for robustness at least economically, provided catastrophies are avoidable

Stern review - costs

- 1% of global GDP now
- Ammended to 2% in June 2008

Costs

• Doing a lot about global warming	”$Trillions”
• Total military spending in 1 year	$1 Trillion
• Homeland security	$900 billion
• Galileo spacecraft	$1.4 billion

Nature loss 'dwarfs bank crisis‘ – BBC news on-line 10 Oct 2008
Teeb review puts the annual cost of forest loss at between $2 trillion and $5 trillion.

Current financial sector losses: $1-$1.5 trillion

Conclusion

- Mathematically it is clear that risk of extreme climate change cannot be modelled by traditional cost-benefit analysis because of the unknowable nature of the climate system
- Discounting future lives relative to our is both morally reprehensible and economically unsound
- It is unethical and irresponsible not to invest in preventing climate change now