International ENEP meeting on Urban governance in climate change adaptation
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Urban governance in climate change adaptation

Strategies on dealing with uncertainties

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Stationarity Is Dead: Whither Water Management?

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Climate change undermines a basic assumption that historically has facilitated management of water supplies, demands, and risks.

Science **319** (5863): 573, 2008

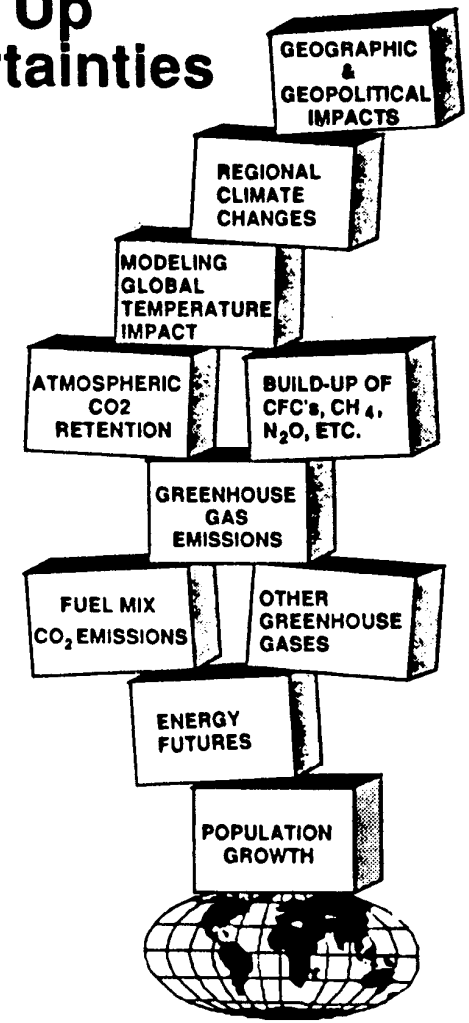
Current exceedance frequencies of local water levels in Rotterdam [40].

Frequency (times/year)	Water level (m above NAP)
	Coast (Hoek van Holland)
1/10000	5.05
1/4000	
1/1000	4.30
1/100	3.60
1/50	3.40
1/20	3.15
1/10	3.00
1/5	2.80
1/2	2.60
1	2.45
2	2.30
5	2.10

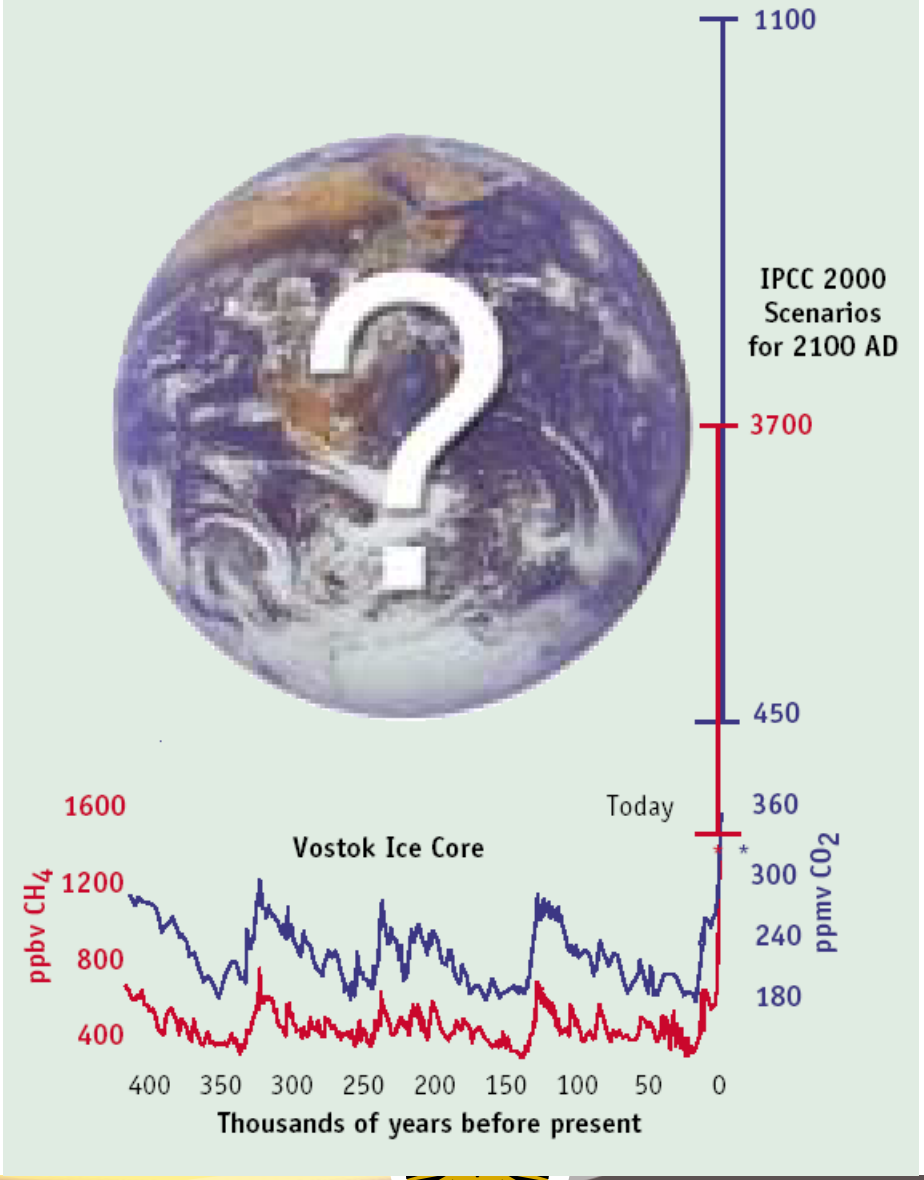
PROBLEM:
Policy makers seem to expect that scientists can **calculate** such **frequencies** for **2050**, **2100**, etc.

GLOBAL CLIMATE CHANGE

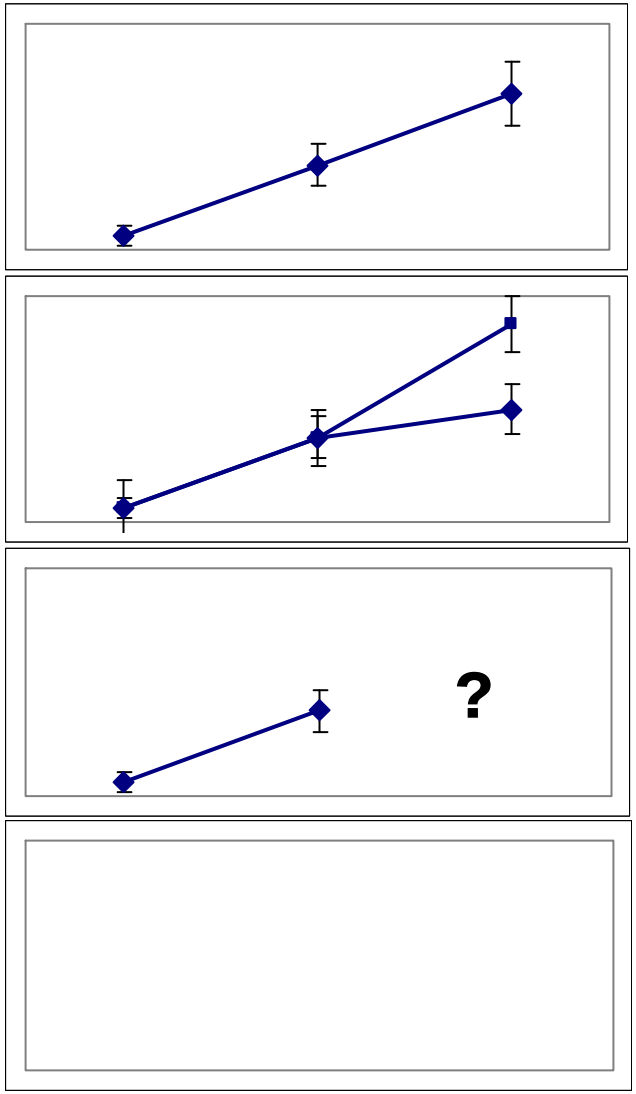
Piling Up Uncertainties



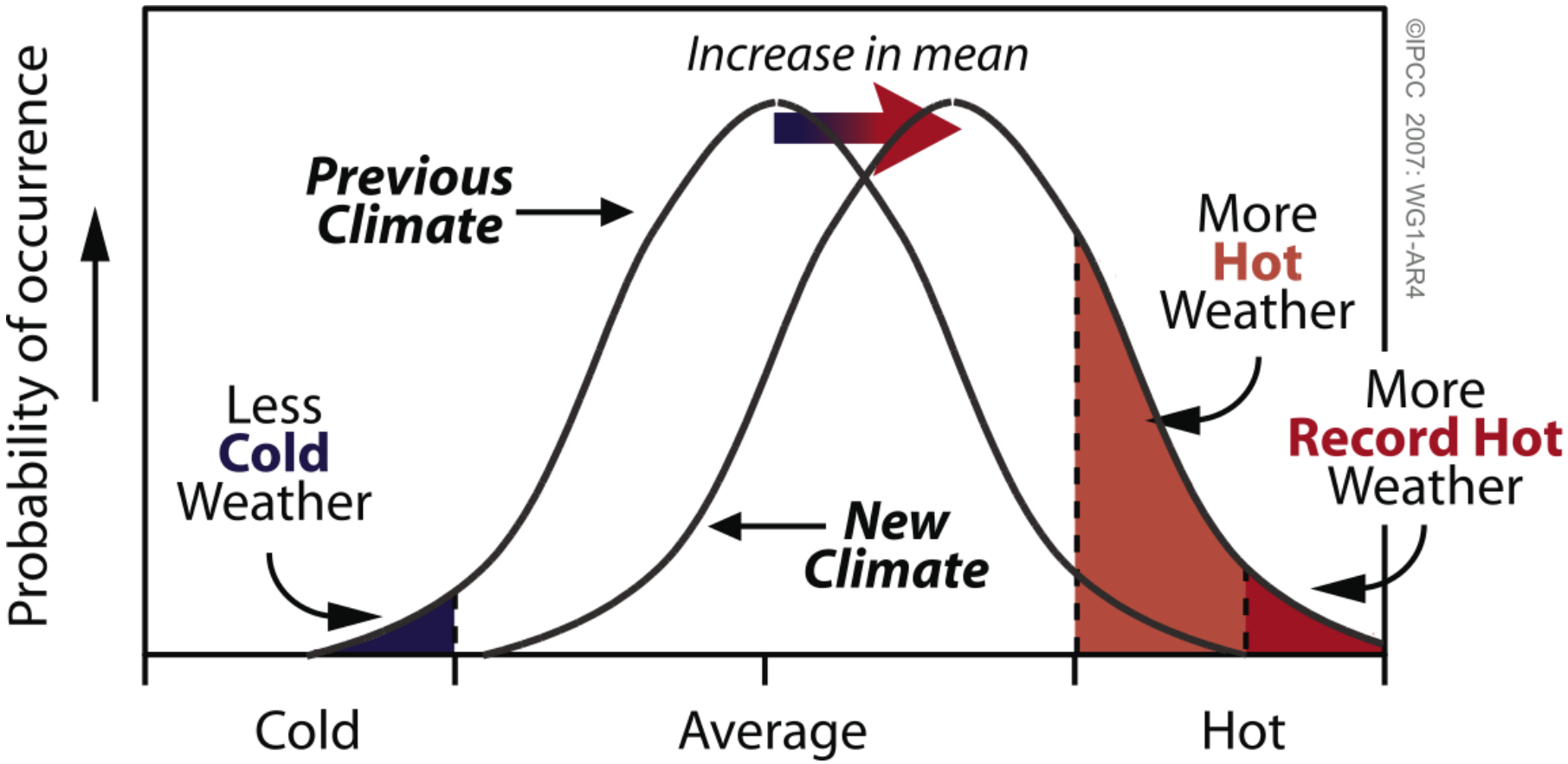
Sailing into terra incognita?



Adaptation under what uncertainty?



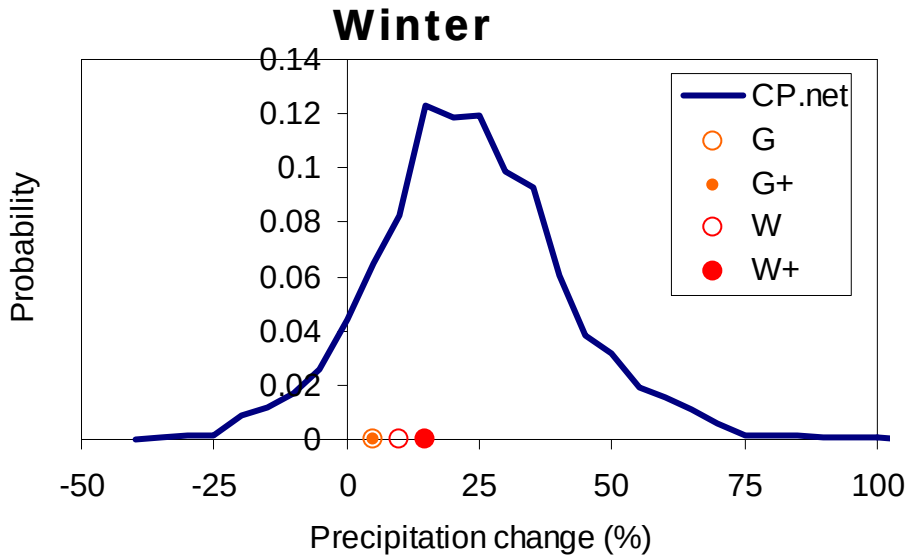
- Statistical
- Scenario
- Surprise/ignorance
  - Recognized ignorance ('known unknowns')
  - Total ignorance ('unknown unknowns')

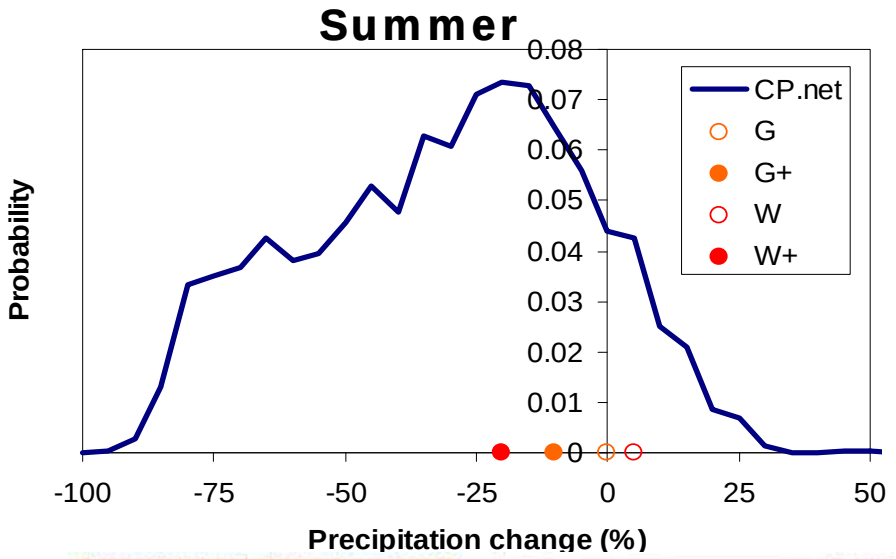


Variability in a changing climate:
Small shift in mean = big change in frequency of extremes

Scenarios can be wrong

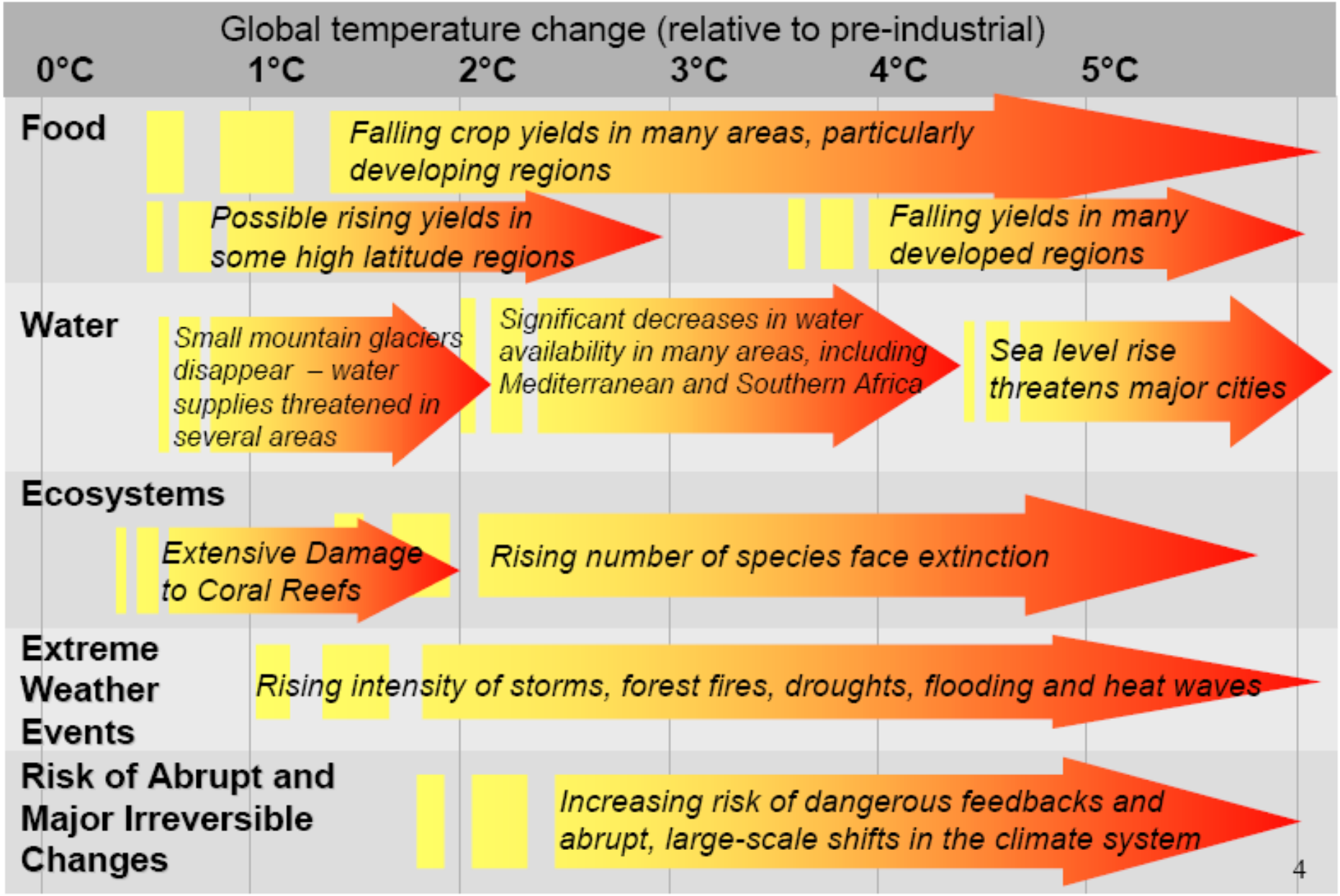
Statististical uncertainty precipitation
According to climateprediction.net
versus range KNMI scenarios





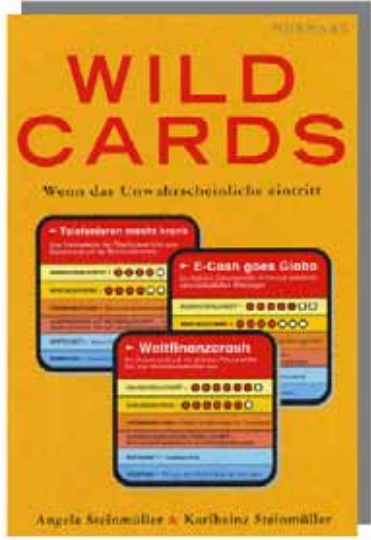
(Dessai & Van der Sluijs, 2007)

Projected Impacts of Climate Change



Bron: Stern Review

Types of wild cards



(1) extreme forms of expected trends,

(2) opposites of expected trends

(3) completely new issues (prepared for the wrong impact!)

Most options remain beneficial under type-1 wildcards.

Under type-2 wildcards, options that enhance flexibility and responsiveness remain beneficial

Few options protect against type-3 wildcards

www.steinmuller.de/media/pdf/WC_GFF.pdf

<table>
<tr><td rowspan="3">Top-down (Predict & quantify changes in stressors)

Bottom-up (analyse and reduce vulnerabilities of impacted system)</td><td>Act on the best prediction</td><td>Based on single scenario</td></tr>
<tr><td rowspan="2">Robustness-oriented adaptation</td><td>Based on range of scenarios</td></tr>
<tr><td>Exploratory / discursive</td></tr>
<tr><td>Resilience-oriented adaptation</td><td>Preparing for unknown changes</td></tr>
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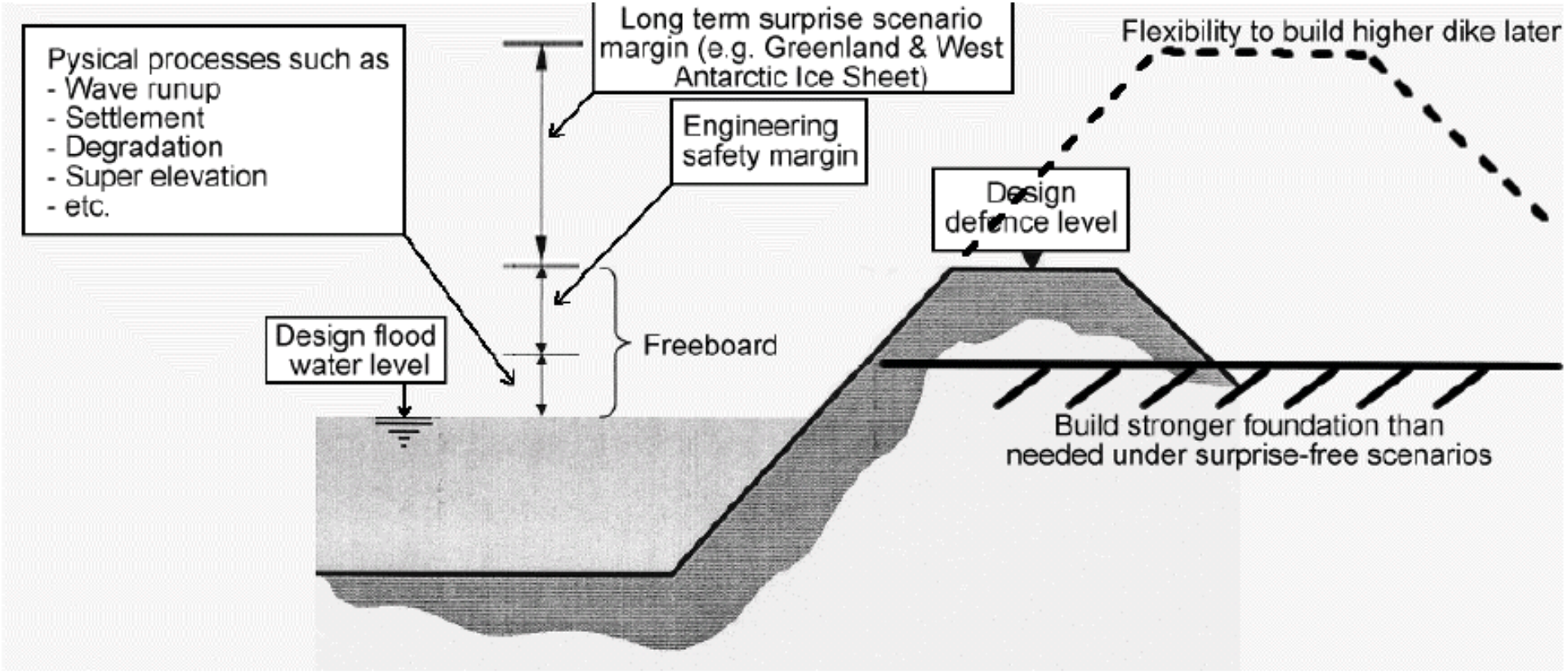
No regrets

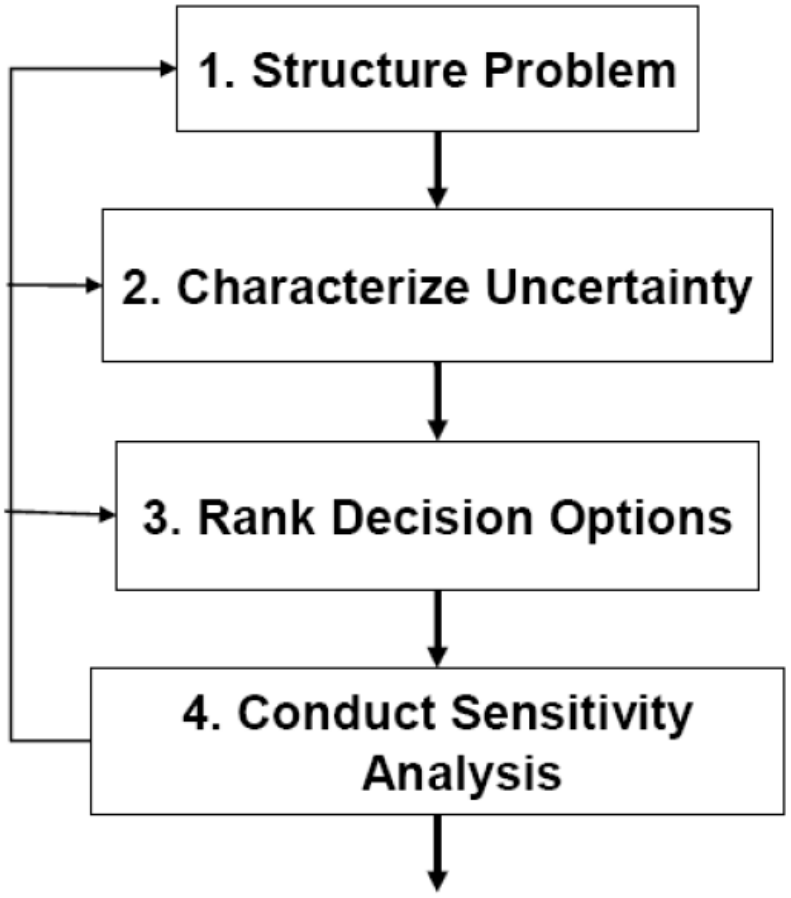
- Favour adaptation strategies which will yield benefits (for other, less uncertain, policy concerns) regardless of whether or not climate impacts will occur.

“Flexible design”
Anticipating imaginable surprises



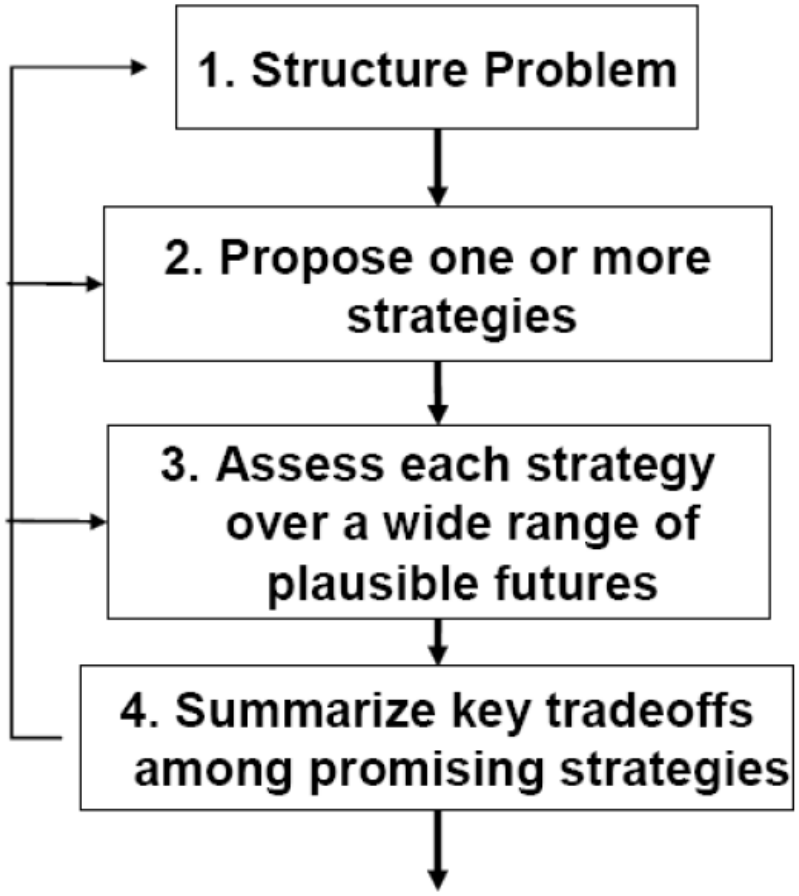
Robust decision-making

Predict-then-act approach



Suggests Optimum Alternative

Assess-risk-of-policy framework



Suggests Robust Alternative

Resilience

Figure 1 - Concept of resilience

- If uncertainties about climate change are large, one can still know how the resilience of social-ecological systems can be enhanced
- Resilience is the capacity of a system to tolerate disturbance without collapsing into a qualitatively different, usually undesired, state

Principles:

- **Homeostasis**
- **Omnivory**
- **High flux**
- **Flatness**
- **Buffering**
- **Redundancy**

www.resalliance.org
Wardekker e.a. 2010 doi:10.1016/j.techfore.2009.11.005

Performance of strategies

decision making under uncertainty frameworks	Statistical uncertainty	Scenario uncertainty	Recognized ignorance & surprises
IPCC approach	+	++	--
Risk approaches	++	+	--
Engineering safety margin	++	±	-
Anticipating design	++	+	+
Resilience	±	+	++
Adaptive management	++	-	--
Prevention Principle	++	±	--
Precautionary Principle	+	++	++
Human development approaches	±	+	+
Adaptation Policy Framework	+	+	+
Robust decision making	+	++	+

Uncertainty & adaptation options

Effects are of: *and known with*	Low relevance	High relevance
High level of precision (low level of uncertainty)	Tailored, prediction-based strategies (e.g. risk approach) feasible. Focus: low costs or co-benefits.	Tailored, prediction-based strategies (e.g. risk approach) feasible. Consider costly and extensive options.
Low level of precision (high level of uncertainty)	Enhance system's capability of dealing with changes, uncertainties, and surprises (e.g. resilience approach). Focus: low costs or co-benefits.	Enhance system's capability of dealing with changes, uncertainties, and surprises (e.g. resilience approach). Consider costly and extensive options.

Wardekker e.a. 2010

Uncertainty & adaptation options

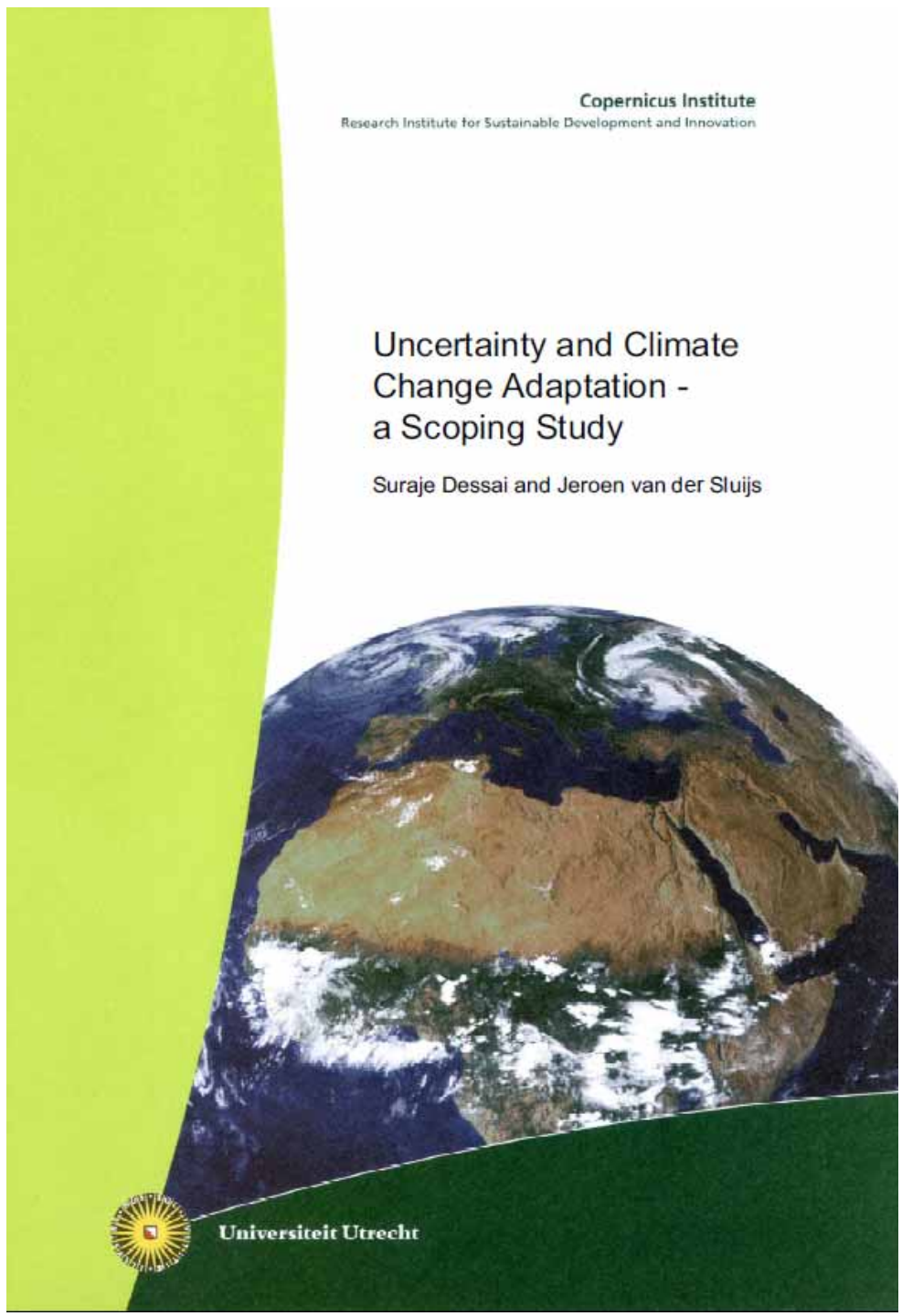
Effects are of:	Low relevance	High relevance
High level of precision (low level of uncertainty)	Options are preferably fairly generic, reducing a range of effects, rather than a specific one.	Options may be highly specific, for one particular effect.
Low level of precision (high level of uncertainty)		

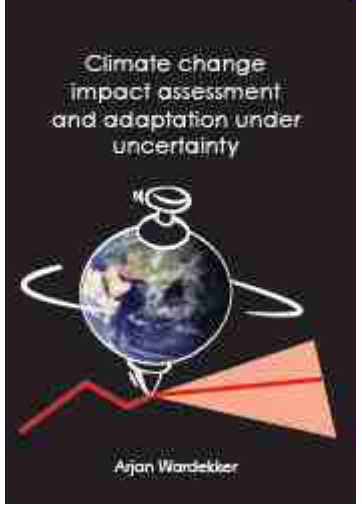
Wardekker e.a. 2010

Dynamic Adaptive strategy

No ‘silver bullet’ / very context dependent

- What **type of uncertainy** dominates?
- What **timehorizons** need be taken into account?
- **Robust** to what range of scenario’s?
- What kind of **flexibility and reversibility** should one create and how much is enough?
- What can be done to increase **adaptive capacity**, to improve **reaction-speed** (to changes, shocks and early warnings), how to increase **pro-active capacity** (acting on imperfect foresight)?
- How to anticipate **surprise**?
- How to organise anticipating and evaluation **capacity of reflective learning of the governance system**





http://www.nusap.net/downloads/Wardekker_PhDdissertation_2011.pdf

Download 2007 rapport:
www.nusap.net/adaptation

Case studies 2008-2010:
- Delta committee (water safety)
- Nature / Waddensea
- Health impacts

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