

# **Climate-Related Decision Making Under Uncertainty**

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February 2016

# **Why is climate change decision making hard?**

Climate change is a uniquely tricky problem

But effective, science-based decision support is also just inherently hard!

# Challenges to Human Decision Making

To this latter point, human decision-making has well-understood biases; these are both individual (cognitive) and group dynamical:

- Overconfidence
- Focus on easy-to-quantify risks
- Neglect of risks you believe you can't control
- Strategic use of uncertainty to sway opinion

These biases inhibit full consideration of future consequences (including the consequences of alternative actions)

**Combined with the challenges associated with the climate problem, the overall outlook can be daunting!**

# Climate change poses big challenges to planning and decision making

Five key characteristics of the climate system, impacts of climate change on human and natural systems, and our ability to understand and anticipate potential future changes:

1. global phenomenon, potentially affecting everything, everywhere; its impacts are **ubiquitous** with respect to factors such as geographic region, type of system, population group, socioeconomic sector
2. many impacts are **intangible**: i.e., impacts such as loss of cultural heritage, that do not have physical substance, and can be difficult to define, measure, and quantify
3. many impacts of climate change are (individually or aggregate), potentially large: i.e., **non-marginal**
4. a great deal of lag is built into the climate system: impacts of both climatic changes and policy choices made today span **decades to generations**
5. the challenges related to all of the above compounded by deep **uncertainty** about the future trajectory of climate over long timescales

*Sussman et al. (2014)*

# Deep Uncertainty

Large and poorly characterized uncertainties associated with impacts of large-scale, long-term climate change; in an economic context, often referred to as 'Knightian' uncertainty; results from lack of predictability of future climate change due to:

- Inherent characteristics of the physical climate system (e.g., chaotic dynamics and natural internal variability of the ocean-atmosphere system)
- Potentially large and poorly understood feedbacks (e.g., biogeochemical) with the distinct possibility of surprise
- Uncertain trajectory of key anthropogenic drivers: e.g., GHG emissions
- Uncertainty about how human systems will respond and adapt

Greatest for just the types of things we're interested in: smaller scales, extreme events, impacts on human/ecosystems

Precludes creating well-characterized probability distributions for key climate changes and impacts, challenging traditional approaches: e.g., Monte Carlo methods, BCA, and others that assume them

Any approaches to climate change assessment must deal credibly with this kind of uncertainty. We must be able to adequately address the following question: “How do we ensure that we continue to meet our mission even when we can’t predict everything about the future we think we’d like to know?”

One key to addressing this challenge is to tackle it within the context of a specific management or policy decision to be informed.

To support decision making with scientific information (e.g., output from a model), it is first useful to understand which part(s) of the decision making process you are influencing.

# Elements of Decision Making

## Decision-Structuring Task:

1. Defining the problem in a way that opens it up to thoughtful consideration
2. Defining the objectives to be achieved
3. Laying out the alternative actions that might be taken in an attempt to achieve the objectives

## Choice Task:

4. Estimating the consequences of each alternative
5. Evaluating the tradeoffs among the options in terms of their ability to meet the objectives

# Elements of Decision Making

Within these elements, effective, science-based decision support should seek to achieve certain **social values** in the decision environment - i.e., to improve:

- Credibility, salience, legitimacy of the information used
- Usability: making information actionable
- Mutual understanding, respect, and trust among parties
- Quality of the decision

When considering real decisions, it is critical to ensure that the rich contextual details are front and center ... context really matters!

# It might rain tomorrow, but ... what do you have planned?



The analytic framework within which you choose to structure a given decision support problem matters a lot for creating effective decision support: e.g., how to handle deep uncertainty while still achieving good decision outcomes in a transparent and accepted process.

The decision sciences recognize multiple paradigms: we can contrast two such here.



## Paradigm 1: "Predict Then Act"

- Figure out your best-guess future and design the best policy you can for that future
- Conceptual framework: Maximize expected utility
- Question: "What is most likely to happen?"

## Paradigm 2: "Robust Decisions"

- Identify greatest vulnerabilities across full range of futures and identify the suite of policies that perform reasonably well across this range
- Conceptual framework: Minimize regret
- Question: "When might my policies fail?"

## Paradigm 1: "Predict Then Act"

- Top-down
- Start with scenarios or futures (e.g, climate model output)
- Use within choice task
- Attach probabilities to future states

## Paradigm 2: "Robust Decisions"

- Bottom-up
- Start with decision context: "discover" future scenarios later
- Use within decision-structuring task
- Look at special and bounding cases (e.g., 'worst case', tipping points) to understand which uncertainties are actually most important for your problem

'Paradigm 2' approaches can be extremely helpful for managing deep uncertainty because they:

- Systematize consideration of key factors in a decision
- Force reorganization of mental models by challenging assumptions
- Present set of plausible and contrasting futures without likelihood claims; less psychologically threatening
- Facilitate communication and collaboration among those with different worldviews
- Focus uncertainty analysis on the most consequential uncertainties, not the ones easiest to quantify/agree on

Include approaches such as Robust Decision Making, Decision Scaling, Scenario Planning, Real Options, etc.

# Summary

Climate change presents numerous unique challenges to effective, science-based decision support; one major challenge is the presence of deep uncertainty about future climate changes, impacts, outcomes

In climate-related decision support, 'alternative' (bottom-up) decision frameworks help overcome twin challenges of deep uncertainty and intrinsic barriers (e.g., cognitive, behavioral) to good decision making:

- They focus first on the decision context and how the decision/policy might fail, rather than on defining presumed future conditions
- They use that decision focus as a filter for assessing which potential futures are most important for the success of the decision/policy and assess vulnerability across those futures
- They have value for the decision-structuring task, the choice task, and the achievement of desirable social outcomes w/in the decision setting

# References

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