The Use of Climate Change Scenarios for Supporting Decision-Making

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Why do we need scenarios in decision-making?

Predicting the future accurately (and convincingly) is hard

Why do we need scenarios in decision-making?

Decision-making is also hard

Elements of Decision-Making

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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

NRC (2009)

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Choice Task:

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

NRC (2009)

Elements of Decision-Making

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

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

NRC (2009)

Challenges to Decision-Making

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Human decision-making has well-understood biases - both individual cognitive and group dynamical:

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

These factors inhibit full consideration of the consequences of alternative actions

Lempert (2013)

Use of Scenarios Can Help

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Scenarios-based approaches employ various cognitive mechanisms to overcome these barriers:

- 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

Lempert (2013)

Scenarios have a role as both products and processes:

- View of scenarios as productive: emphasizes their tangibility, with value unrelated to processes of creation
- View of scenarios as procedural: emphasizes modes of formation, with benefits independent of products' value

Constructive tension among the two framings
Relate to different elements of the decision task

Hulme and Dessai (2008)

These framings yield different expectations about how one might evaluate the “success” or “failure” of scenarios - for example:

- Predictive success: Has the future turned out as envisioned?
- Decision success: Have good decisions been made?
- Learning success: Have the scenarios proved engaging and enabled communication and learning?

Hulme and Dessai (2008)

Scenarios and Real Decisions

When considering scenario use in real decisions, it's clear that at least two aspects of any given decision process matter a lot for how we might wish to view, develop, and apply scenarios:

- The rich contextual details of an individual decision
- The choice of decision analytic framework

Challenges and Limitations

Scenarios have problems too:

- Ambiguity and bias
- Illusion of communication
- Failure to account for the possibility of surprise
- Insufficient relevance and context
- Tradeoffs among credibility, salience, and legitimacy
- Lack of compelling detail vs. lack of sufficient breadth and scope
- Probabilities vs. plausibilities vs. possibilities

Most of these have to do with tradeoffs ...

Challenges and Limitations

- Ex: “Global change scenarios may also fail to provide effective decision support because they are only weakly connected to potential users’ concerns and worldviews. For instance, climate scenarios may focus on long-term trends with little apparent relevance to users’ near term decisions. They may lack the spatial and temporal details needed by decision makers who are concerned with local impacts and adaptation” (Lempert, 2013)
- But: “The more detail that one adds to the storyline of a scenario, the more probable it will appear to most people, and the greater the difficulty they likely will have in imagining other, equally or more likely, ways in which the same outcome could be reached.” (Morgan and Keith, 2008)

Now let’s talk about climate change

Climate change is a uniquely tricky problem

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)

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Sussman et al. (2014)

Deep Uncertainty

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

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?”

And this includes guarding against the high downside risks of underrepresenting the full range of possible future outcomes.

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 Decision-Making"

- 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?

Weaver et al. (2013)

Paradigm 1: "Predict Then Act"

- Top-down
- Start with scenarios/futures
- Use within choice task
- Attach probabilities to future states

Paradigm 2: "Robust Decision-Making"

- Bottom-up
- Start with decision context - “discover” scenarios later
- Use within decision-structuring task
- Scenarios as special/bounding cases to understand which uncertainties are actually most important

Weaver et al. (2013)

‘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
- Are inherently iterative

Include approaches such as Robust Decision Making, Decision Scaling, Scenario Planning, Real Options, risk-based framing, etc.

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

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Practical Implications for Scenario Selection

Choose initial scenarios that most clearly bound the decision-relevant climate changes, in the face of multiple uncertainties, rather than produce a contingent probability distribution around a ‘most likely’ future value

- A natural consequence of focusing on societal risk, where a disproportionate fraction of total risk will often be associated with low-probability outcomes

Choose initial scenarios that most clearly distinguish between futures in which your policies succeed and those in which they fail

- Will most often be composed of variables with (a) highest impact on management endpoints and (b) highest levels of uncertainty

Summary

Use of scenarios (as either products or processes) helps us overcome twin challenges of future uncertainty and intrinsic cognitive and behavioral barriers to good decision-making

Value for the decision-structuring task, the choice task, and/or the achievement of desirable social outcomes within decision-making settings - distinguish between these

Tradeoffs and dynamic tensions among the different uses of and lenses for scenarios - selection of scenario products, framings, and uses is itself often a key part of the overall decision to be informed

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

Use of scenarios within ‘alternative’ (bottom-up) decision frameworks can help overcome twin challenges of deep uncertainty and intrinsic barriers (cognitive, behavioral, institutional) to good decision making

Choice of initial set of scenarios will need to reflect the shift in decision framework

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