“Climate scenarios and projections: the known, unknown, and unknowable – applied to California”

INITIAL REFLECTIONS
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1. What can be known about climate futures and their impacts?

- emission scenarios
- carbon cycle response
- global climate sensitivity
- regional climate change scenarios
- range of possible impacts
“Known, Unknown, and Unknowable”

- These are not absolute categories, but relative ones—“known” or “unknown” with what degree of confidence?
- What does it mean for something to be “unknowable?”
  - Ignorance?
  - Imaginable surprise?
  - While the carrying capacity of Earth is “unknowable,” we can say something useful about things that will affect it
- **Time frame** within which something is unknowable is useful in decision contexts
Qualitative Uncertainty Terms

<table>
<thead>
<tr>
<th>HIGH</th>
<th>LOW</th>
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<tbody>
<tr>
<td>Established but Incomplete</td>
<td>Amount of Evidence (Observations, model output, theory, etc)</td>
</tr>
<tr>
<td>Well Established</td>
<td>HIGH</td>
</tr>
<tr>
<td>Established</td>
<td>Speculative</td>
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</tbody>
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Legend:
- HIGH: Amount of Evidence (Observations, model output, theory, etc)
- LOW: Level of Agreement/Consensus
Knowledge about Outcomes

Outcomes Poorly Defined

Set of Discrete Outcomes

Continuum of Outcomes

Firm Basis for Probabilities

Shaky Basis for Probabilities

No Basis for Probabilities

Frequentist Probabilities

Subjective Probabilities

Scenario Analysis

Fuzzy Logic

Ignorance

Uncertainty

Risk

Source: Dessai and Hulme (2003)
2. User perspectives: how much certainty is needed?

CALVIN AND HOBBES by Bill Watterson

THE MORE YOU KNOW, THE HARDER IT IS TO TAKE DECISIVE ACTION.

ONCE YOU BECOME INFORMED, YOU START SEEING COMPLEXITIES AND SHADES OF GRAY.

YOU REALIZE THAT NOTHING IS AS CLEAR AND SIMPLE AS IT FIRST APPEARS. ULTIMATELY, KNOWLEDGE IS PARALYZING.

BEING A MAN OF ACTION, I CAN'T AFFORD TO TAKE THAT RISK.

YOU'RE IGNORANT, BUT AT LEAST YOU ACT ON IT.
Organizers’ Assumptions

• The use of probabilities to represent uncertainties in climate change projections will help users make more informed decisions
• It is better for experts to make these subjective judgments than non-experts
• Subjective evaluation and communication of uncertainty must employ a systematic approach to be done responsibly
• There are practical limitations for emissions, climate, and impacts projections that must be respected
3. What can be achieved?
Examples of evolving research...

- Probability-based projections of impacts?
In thinking about what’s doable, recall sources of uncertainty…

- Model structure: functional form, omitted variables, parameterizations, …
- Scaling/aggregation issues
- Measurement error: bias or random errors
- Miscellaneous sources: ambiguously defined concepts/terms, human behavior

Source: Dessai and Hulme (2003)
5. Broader issue of guidelines for assessments and syntheses

- IPCC TAR uncertainty guidance: What worked, what didn’t?
- US National Assessment: Results and lessons?
- RIVM Guidance for Uncertainty Assessment and Communication (NUSAP)
- CCSP Synthesis and Assessment Products—scenario-based reports and need for general guidelines
Minimum Goals for Evaluation and Communication in Assessments (IPCC TAR)

✓ Specify the problem/issue clearly and iteratively
✓ Identify all significant assumptions
✓ Choose appropriate level of precision given state of knowledge
✓ Characterize distributions systematically
✓ Use terminology consistently to describe state of science
✓ Provide a “traceable account”
Consistent terminology: How well do we know ...?
Graphics from WG II TAR (Settlements)
Damage/Abatement Cost Categories from NAS 1992

- Impacts/Damage Categories:
  - low sensitivity
  - sensitive, but adaptation at some cost
  - sensitive, adaptation problematic

- Abatement Cost Categories
  - net benefit (cost $0)
  - low cost (cost $1 - $9 per ton CO₂ equivalent)
  - moderate cost (cost $10 - $99 per ton CO₂ equivalent)
  - high cost (cost $100 per ton of CO₂ equivalent)
To recap, five different themes are addressed in the workshop

1. Develop better understanding of user perspectives for climate information
2. Clarify approaches to estimate the likelihood of climate change for different users
3. Discuss state of the art methods for uncertainty evaluation in different areas of climate research
4. Touch on vulnerability/adaptation assessment, a complementary approach to using estimates of future climate change from top-down scenario exercises
5. Reflect on how to improve evaluation and communication of uncertainty in large-scale assessment processes as inputs to IPCC, CCSP, etc.
Outcomes

• Workshop report
• Article for general audience
• Proposals for future research?
• Others to emerge during the workshop?
To close, some inspiration!

- “Probabilities direct the conduct of the wise man.” Cicero, 106-43 BC
- “The only certainty is uncertainty”. Pliny the Elder, AD 23-79
- “If a man will begin with certainties he shall end in doubts; but if he will be content to begin with doubts he shall end in certainties.” Francis Bacon, AD 1561-1626

Source: Richard Katz, 2001