How should the IPCC communicate uncertainty?

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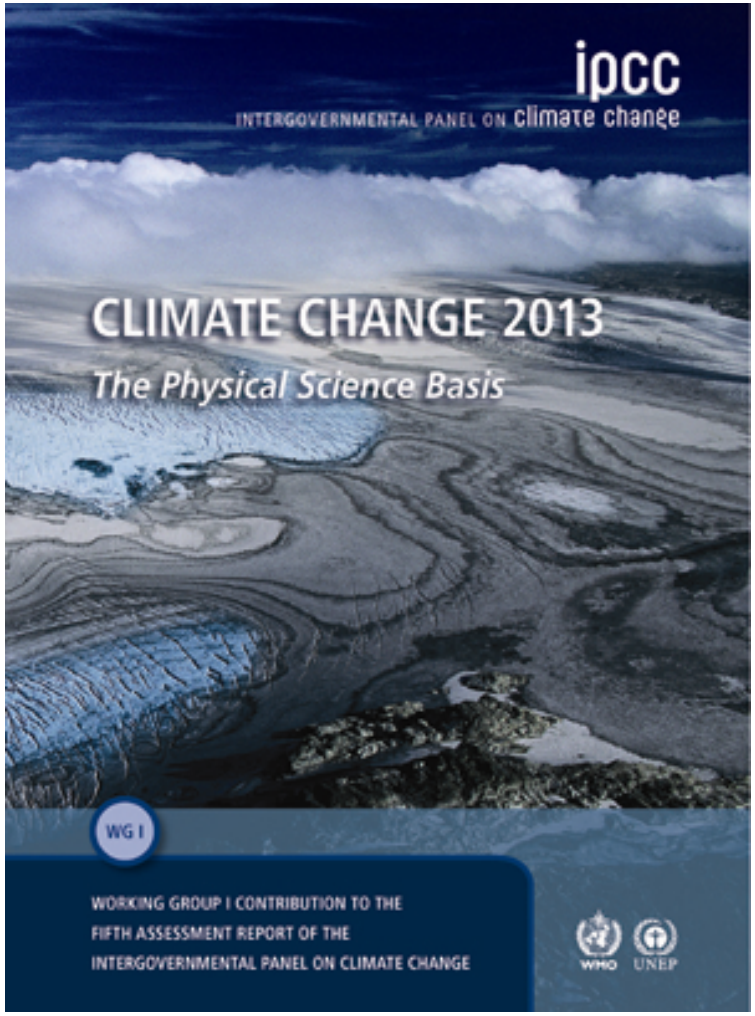
Oct. 31, 2022

The IPCC's presentation of uncertainty

"Equilibrium climate sensitivity is likely in the range 1.5°C to 4.5°C (high confidence)."

– IPCC (2013, 16)



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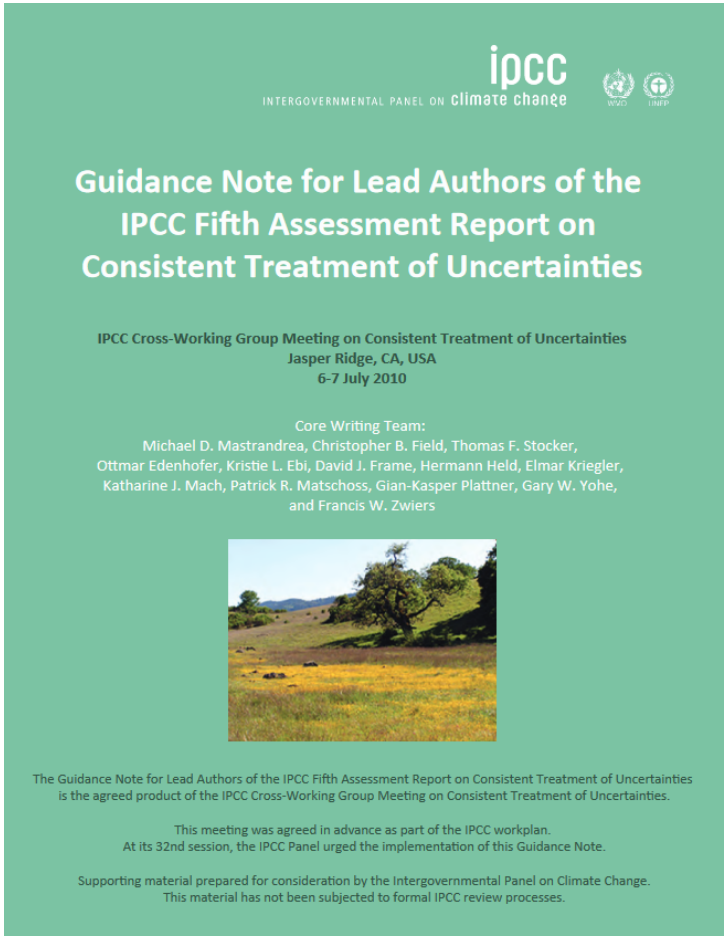

ipcc
INTERGOVERNMENTAL PANEL ON climate change

Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties

IPCC Cross-Working Group Meeting on Consistent Treatment of Uncertainties
Jasper Ridge, CA, USA
6-7 July 2010

Core Writing Team:
Michael D. Mastrandrea, Christopher B. Field, Thomas F. Stocker, Ottmar Edenhofer, Kristie L. Ebi, David J. Frame, Hermann Held, Elmar Kriegler, Katharine J. Mach, Patrick R. Matschoss, Gian-Kasper Plattner, Gary W. Yohe, and Francis W. Zwiers

The Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties is the agreed product of the IPCC Cross-Working Group Meeting on Consistent Treatment of Uncertainties.

This meeting was agreed in advance as part of the IPCC workplan.
At its 32nd session, the IPCC Panel urged the implementation of this Guidance Note.

Supporting material prepared for consideration by the Intergovernmental Panel on Climate Change.
This material has not been subjected to formal IPCC review processes.

Mastrandrea et al. (2010):

1. "Likelihoods": the quantified uncertainty captured by statistical results.
2. "Confidence": how much the experts / authors trust the results.

What does this mean?

Some lessons:

1. "Likelihoods" aren't anyone's credences.
2. Essentially: nested imprecise probabilities.
3. Requisite decision theory is complex.

Bradley, Helgeson, and Hill (2017), Dethier (forthcoming), and Helgeson, Bradley, and Hill (2018)

Ergo AN OPEN ACCESS JOURNAL OF PHILOSOPHY

INTERPRETING THE PROBABILISTIC LANGUAGE IN IPCC REPORTS

COREY DETHIER
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Climatic Change (2018) 149:517–525
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Combining probability with qualitative degree-of-certainty metrics in assessment

Casey Helgeson[1] · Richard Bradley[2] · Brian Hill[3]

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Abstract Reports of the Intergovernmental Panel on Clima
evolving framework of calibrated language for assessing a
certainty in findings. A persistent challenge for this framew
relationship between multiple degree-of-certainty metrics. We
between the *likelihood* and *confidence* metrics used in the Fi
with benefits for mathematical consistency among multiple
downstream modeling and decision analysis. We discuss h
current and proposed practice in IPCC uncertainty assessme

1 Introduction

Beginning with its Third Assessment Report (2001), characte
uncertainties by the Intergovernmental Panel on Climate Cha

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Springer

Climate Change Assessments: Confidence, Probability, and Decision

Richard Bradley, Casey Helgeson, and Brian Hill*†

The Intergovernmental Panel on Climate Change has developed a novel framework for assessing and communicating uncertainty in the findings published in its periodic assessment reports. But how should these uncertainty assessments inform decisions? We take a formal decision-making perspective to investigate how scientific input formulated in the IPCC's novel framework might inform decisions in a principled way through a normative decision model.

1. Introduction. Assessment reports produced by the Intergovernmental Panel on Climate Change (IPCC) periodically summarize the present state of knowledge about climate change, its impacts, and the prospects for mitigation and adaptation. More than 800 lead authors and review editors (and an even greater number of subsidiary authors and reviewers) contributed to the fifth and most recent report, which comprises a tome from each of three working groups, plus the condensed technical summaries, approachable summaries for policy makers, and a synthesis report. There is no new research in an IPCC report; the aim is rather to comprehensively assess exist-

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† We would like to thank participants at the Centre for Philosophy of Natural and Social Science, the Grantham Research Institute on Climate Change and the Environment, the Centre for Analysis of Time Series, and at conferences in Helsinki (CLMPS), London (London School of Economics), and Paris (Paris IV) for stimulating discussion and helpful feedback. Bradley and Helgeson gratefully acknowledge support from the Arts and Humanities Research Council grant Managing Severe Uncertainty (AH/J006033/1). Hill gratefully acknowledges support from the French National Research Agency (ANR) DUSUCA (ANR-14-CE29-0003-01).

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Is it a good system?

What's wrong with it?

1. Hard to understand / communicate.
2. Cultural discrepancies in probabilistic language.
3. Not clear what distinguishes the two scales in practice.
4. Discrepancies between author groups.
5. Not (easily) actionable.
6. Overly conservative.

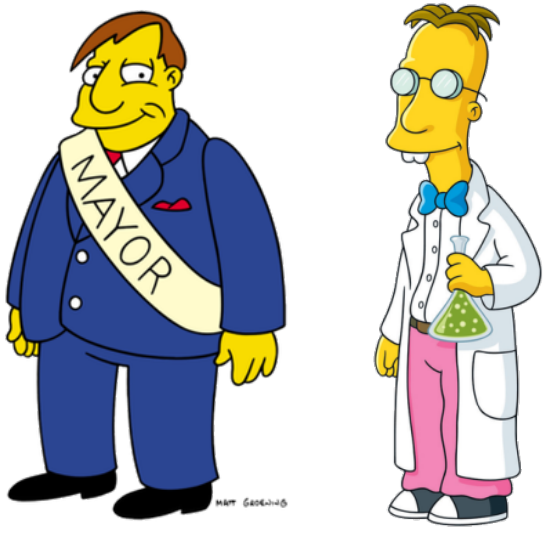
Adler and Hadorn (2014), Aven (2019), Aven and Renn (2015), Budescu et al. (2014), Harris et al. (2013), Herrando-Pérez et al. (2019), Janzwood (2020), Mach et al. (2017), and Teigen (2014)

What would be better?

1. Characterizing the problem.
2. Features of the current system.
3. A (tentative) positive proposal and some takeaways.

Characterizing the problem

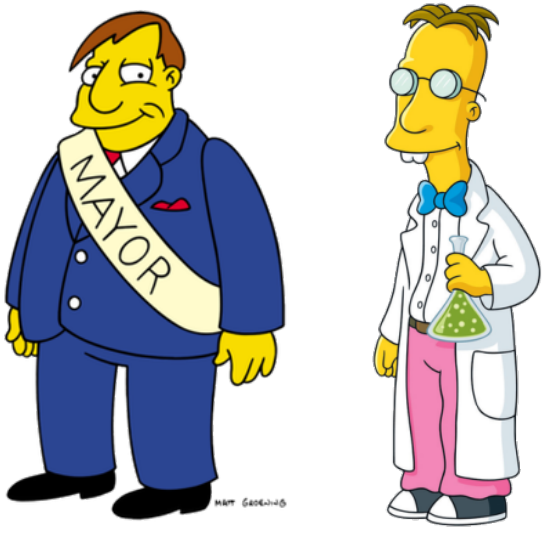
Science advice: a naïve picture



In three steps:

1. Public asks a question.
2. Scientist finds out the answer.
3. Scientist tells public the answer.

Science advice: a naïve picture



In three steps:

1. Public asks a question.
2. Scientist finds out the answer.
3. Scientist tells public the answer.

One problem: often scientists don't *know* the answer.

Keohane, Lane, and Oppenheimer (2014) and Lane (2014)

A second problem with the naïve picture

Often scientists know much more than can reasonably be communicated.

→ Information must be "filtered."

Often the information is not in a form that can reasonably be communicated.

→ Information must be "translated."

On filtration, see Grasswick (2010); I'm borrowing "translation" from Marina Baldissera Pacchetti.

Synthese (2010) 177:387–409
DOI 10.1007/s11229-010-9789-0

Scientific and lay communities: earning epistemic trust through knowledge sharing

Heidi E. Grasswick

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Abstract Feminist philosophers of science have been prominent amongst social epistemologists who draw attention to communal aspects of knowing. As part of this work, I focus on the need to examine the relations between scientific communities and lay communities, particularly marginalized communities, for understanding the epistemic merit of scientific practices. I draw on Naomi Scheman's argument (2001) that science earns epistemic merit by *rationally grounding trust* across social locations. Following this view, more turns out to be relevant to epistemic assessment than simply following the standards of "normal science". On such an account, philosophers of science need to attend to the relations between scientific communities and various lay communities, especially marginalized communities, to understand how scientific practices can rationally ground trust and thus earn their status as "good ways of knowing". Trust turns out to involve a wide set of expectations on behalf of lay communities. In this paper I focus on expectations of knowledge sharing, using examples of "knowledge-sharing whistleblowers" to illustrate how failures in knowledge sharing with lay communities can erode epistemic trust in scientific communities, particularly in the case of marginalized communities.

1 Communal accounts of science in feminist philosophy of science

Feminist philosophers of science have been important players in the development of communal accounts of scientific knowledge and its objectivity. In many cases, their

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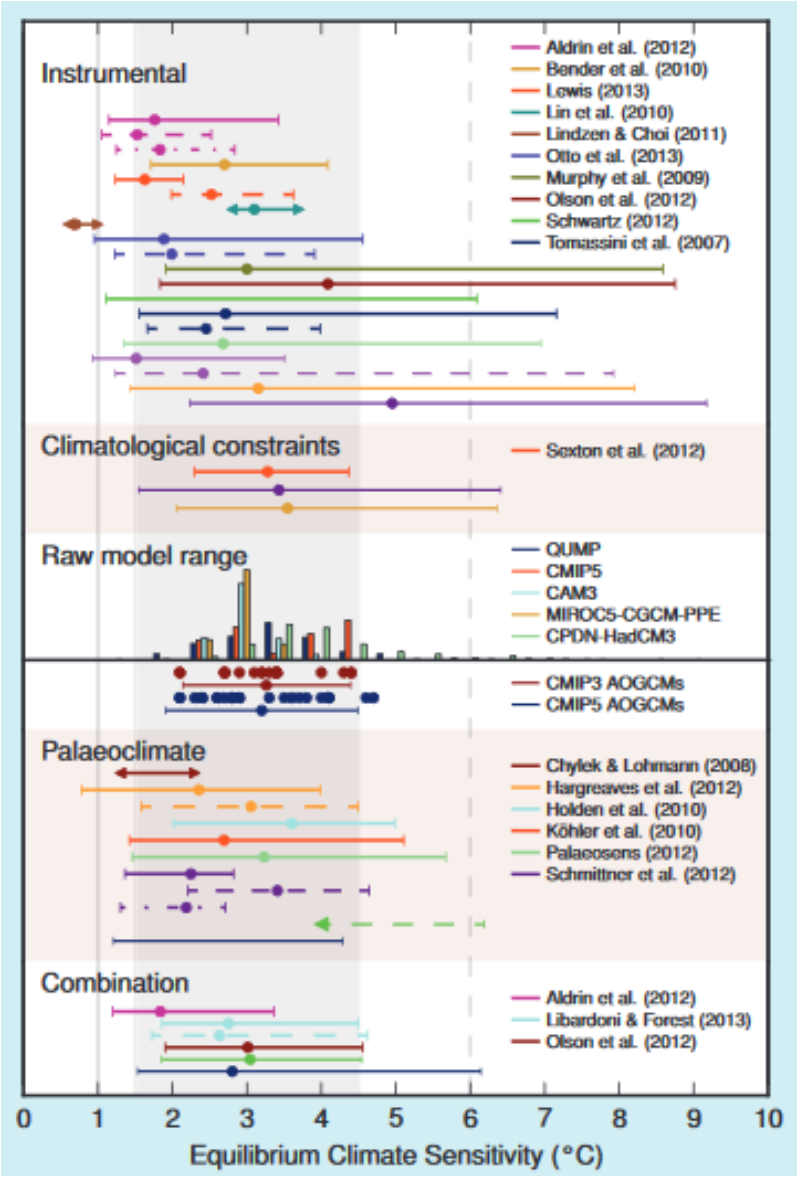
How ECS is determined, chart form

Equilibrium climate sensitivity is likely in the range 1.5°C to 4.5°C (high confidence).

IPCC (2013, 1110, Box 12.2)



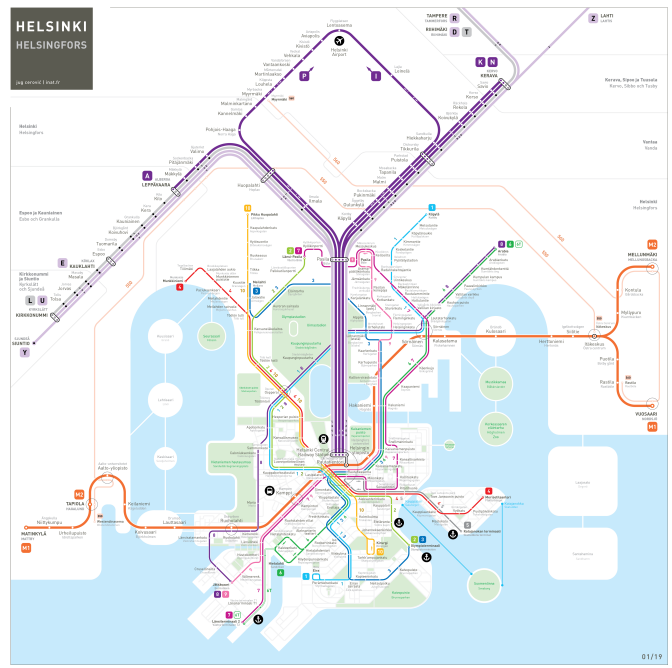
Why does this matter?

Implicitly working with a framework in which science communication is a matter of (in)accurate and (un)justified statements.

Better: science communication is a matter of appropriate representation.

Betz (2007, 2015), Katzav et al. (2021), Parker (2010a,b), Parker and Risbey (2015), and Stainforth et al. (2007)

Communication as cartography



The upshot

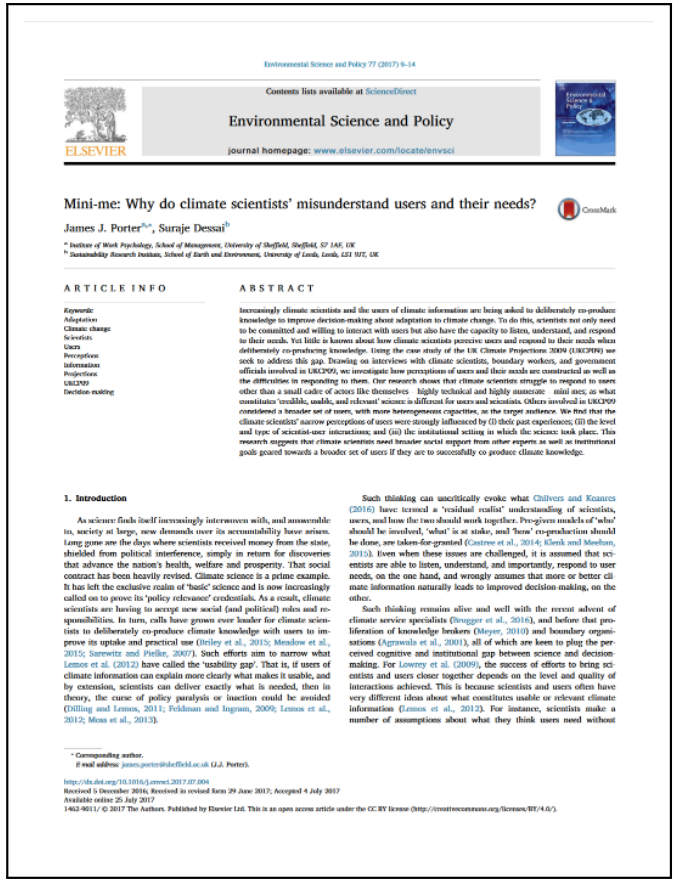
Inaccuracy and/or lack of justification are *not* themselves reasons to criticize an instance of science communication.

What matters is accuracy / justification with respect to the important features.

On models, compare Dethier (2021), Frigg and Nguyen (2020), Parker (2020), and Teller (2004), etc.

An ideal procedure: co-production

Ask the users what they want, and then work with them to translate scientific knowledge into a useful form.



Environmental Science and Policy 77 (2017) 9–14

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Environmental Science and Policy

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Mini-me: Why do climate scientists' misunderstand users and their needs?

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ARTICLE INFO

Keywords:
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Climate change
Scientists
Users
Perceptions
Information
Projections
UKCP09
Decision-making

ABSTRACT

Increasingly climatic scientists and the users of climatic information are being asked to deliberately co-produce knowledge to improve decision-making about adaptation to climate change. To do this, scientists not only need to be committed and willing to interact with users but also have the capacity to listen, understand, and respond to their needs. Yet little is known about how climatic scientists perceive users and respond to their needs when deliberately co-producing knowledge. Using the case study of the UK Climate Projections 2009 (UKCP09) we seek to address this gap. Drawing on interviews with climate scientists, boundary workers, and government officials involved in UKCP09, we investigate how perceptions of users and their needs are constructed as well as the difficulties in responding to them. Our research shows that climate scientists struggle to respond to users other than a small cadre of actors like themselves – highly technical and highly numerate – mini me's; as what constitutes 'credible, usable, and relevant' science is different for users and scientists. Others involved in UKCP09 considered a broader set of users, with more heterogeneous capacities, as the target audience. We find that the climate scientists' narrow perceptions of users were strongly influenced by (i) their past experiences; (ii) the level and type of scientist-user interactions; and (iii) the institutional setting in which the science took place. This research suggests that climate scientists need broader social support from other experts as well as institutional goals geared towards a broader set of users if they are to successfully co-produce climate knowledge.

1. Introduction

As science finds itself increasingly interwoven with, and answerable to, society at large, new demands over its accountability have arisen. Long gone are the days where scientists received money from the state, shielded from political interference, simply in return for discoveries that advance the nation's health, welfare and prosperity. That social contract has been heavily revised. Climate science is a prime example. It has left the exclusive realm of 'basic' science and is now increasingly called on to prove its 'policy relevance' credentials. As a result, climate scientists are having to accept new social (and political) roles and responsibilities. In turn, calls have grown ever louder for climate scientists to deliberately co-produce climate knowledge with users to improve its uptake and practical use (Briley et al., 2015; Meadow et al., 2015; Sarewitz and Pielke, 2007). Such efforts aim to narrow what Lemos et al. (2012) have called the 'usability gap'. That is, if users of climate information can explain more clearly what makes it usable, and by extension, scientists can deliver exactly what is needed, then in theory, the curse of policy paralysis or inaction could be avoided (Dilling and Lemos, 2011; Feldman and Ingram, 2009; Lemos et al., 2012; Moss et al., 2013).

Such thinking can uncritically evoke what Chilvers and Kearnes (2016) have termed a 'residual realist' understanding of scientists, users, and how the two should work together. Pre-given models of 'who' should be involved, 'what' is at stake, and 'how' co-production should be done, are taken-for-granted (Castree et al., 2014; Klenk and Meehan, 2015). Even when these issues are challenged, it is assumed that scientists are able to listen, understand, and importantly, respond to user needs, on the one hand, and wrongly assumes that more or better climate information naturally leads to improved decision-making, on the other.

Such thinking remains alive and well with the recent advent of climate service specialists (Brugger et al., 2016), and before that proliferation of knowledge brokers (Meyer, 2010) and boundary organisations (Agrawala et al., 2001), all of which are keen to plug the perceived cognitive and institutional gap between science and decision-making. For Lowrey et al. (2009), the success of efforts to bring scientists and users closer together depends on the level and quality of interactions achieved. This is because scientists and users often have very different ideas about what constitutes usable or relevant climate information (Lemos et al., 2012). For instance, scientists make a number of assumptions about what they think users need without

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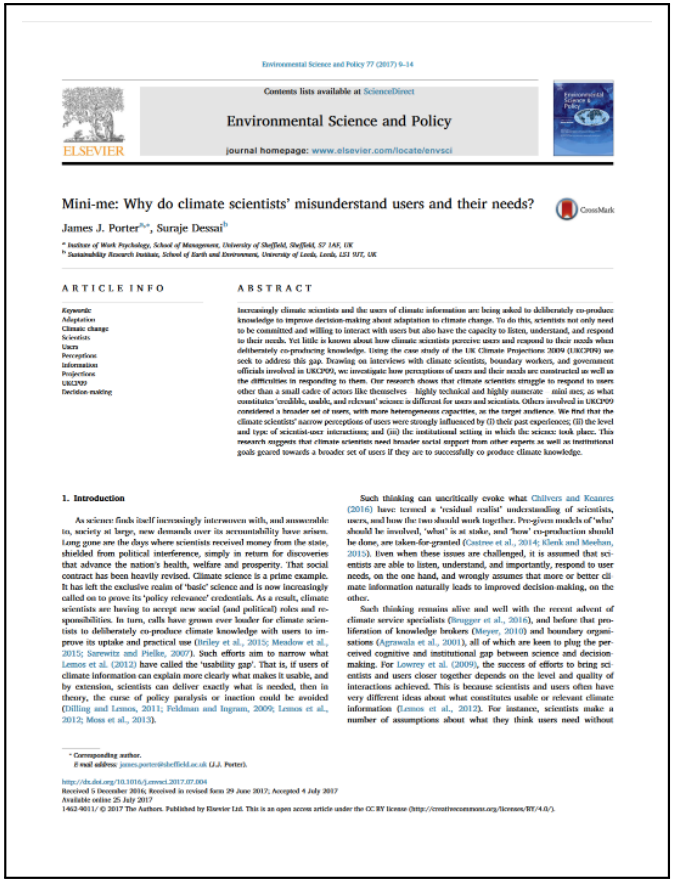
An ideal procedure: co-production

Ask the users what they want, and then work with them to translate scientific knowledge into a useful form.

Some difficulties:

1. Time-consuming and expensive.
2. Many users with different desires.
3. Frequent miscommunication.
4. Users may not know what they want.



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A role for philosophy of science

Analyzing different modes of communication to identify what they highlight / distort.

Questions:

1. Which features does a (mode of) presentation highlight?
2. How might those features line up with user desires?
3. Are there reasons beyond user desires to highlight those features?

Analyzing the IPCC's current approach

What's emphasized by the IPCC's current presentation?

It's likely that ECS is between 1.5°C and 4.5°C (high confidence).

What's emphasized by the IPCC's current presentation?

It's likely that ECS is between 1.5°C and 4.5°C (high confidence).

Hypothesis

What's emphasized by the IPCC's current presentation?

Quantifiable uncertainty

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Hypothesis

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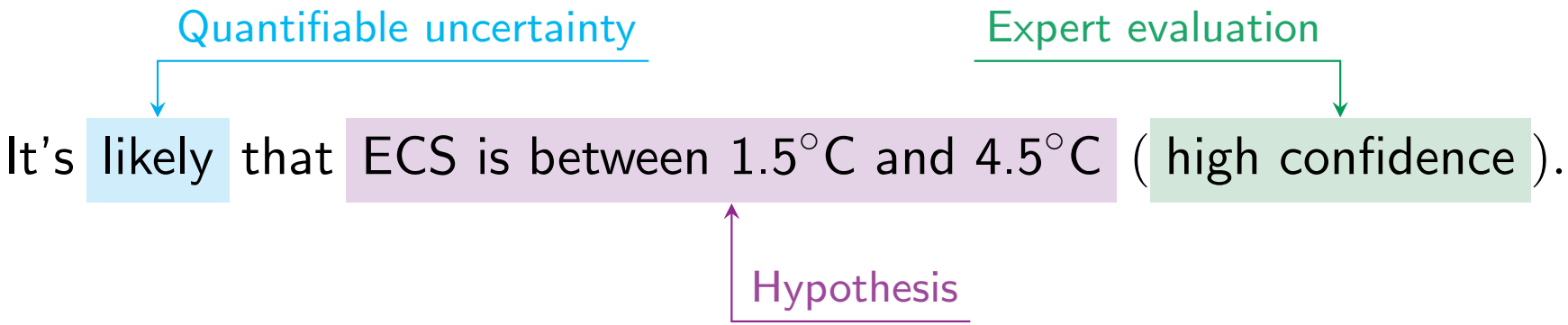

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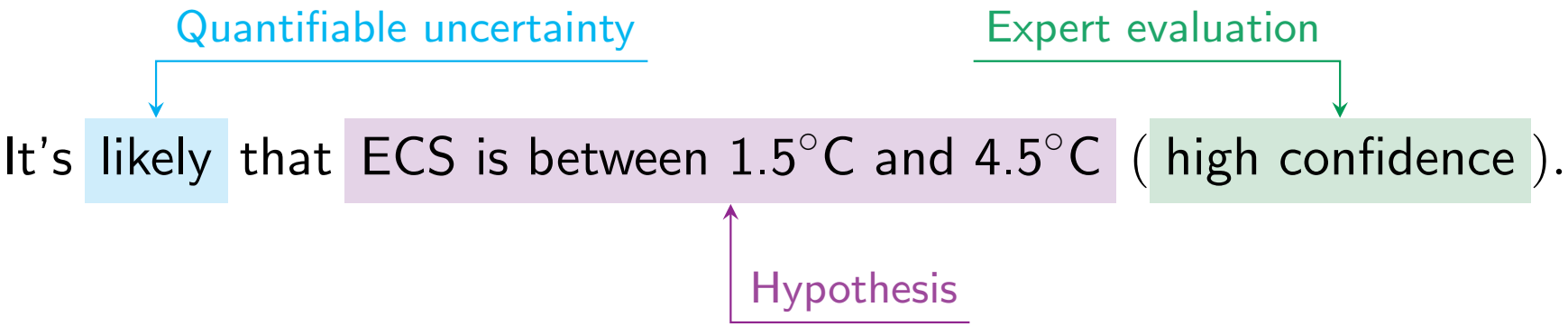
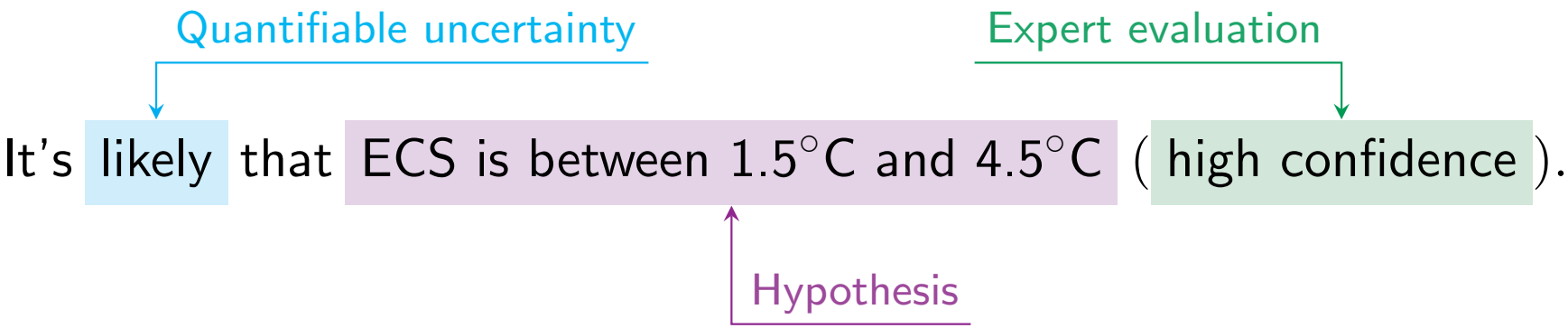


Why present uncertainty in this way? Or: what problem is this presentation solving?

An (in-principle) answer



We need to account for uncertainty that cannot be quantified or built into our formal models.

Incorporating unquantified uncertainty

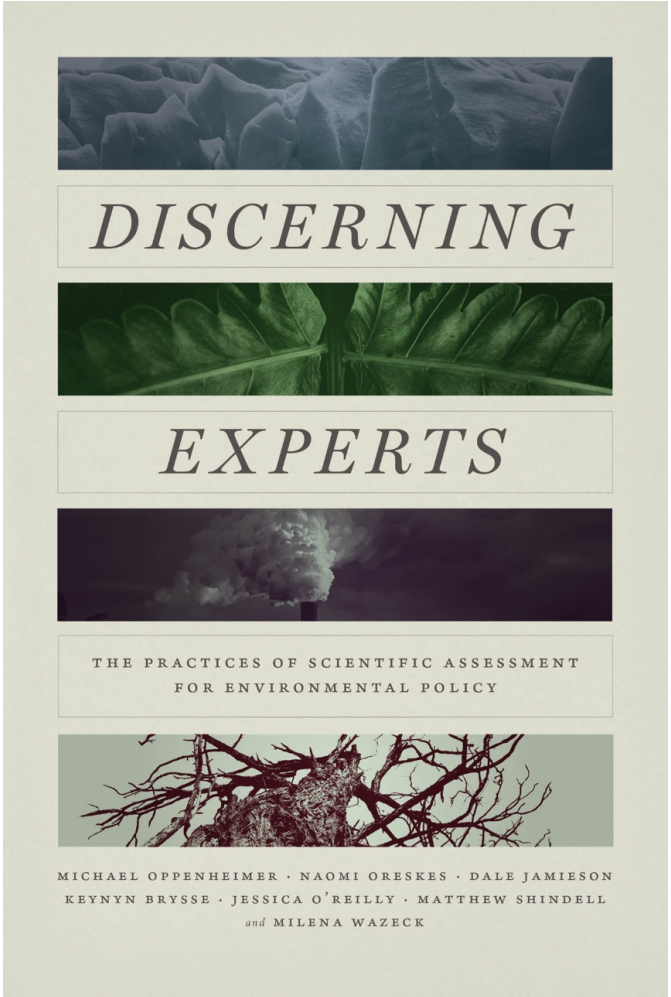
Two ways that ice sheets can contribute to sea level rise:

1. Melting
2. "Sliding" off the land into the sea.

As of AR4, the first was well understood; the second, not.

AR4 chose to issue an estimate for the former with a disclaimer.

Keohane, Lane, and Oppenheimer (2014) and Oppenheimer et al. (2019)



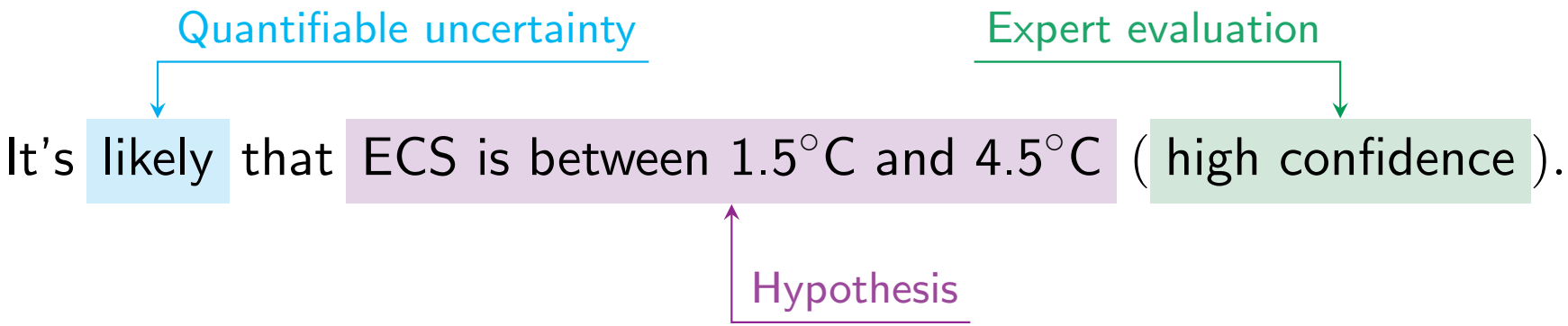
Incorporating unquantified uncertainty

It's (clearly) good for the IPCC to incorporate unquantified uncertainty when communicating with decision-makers.

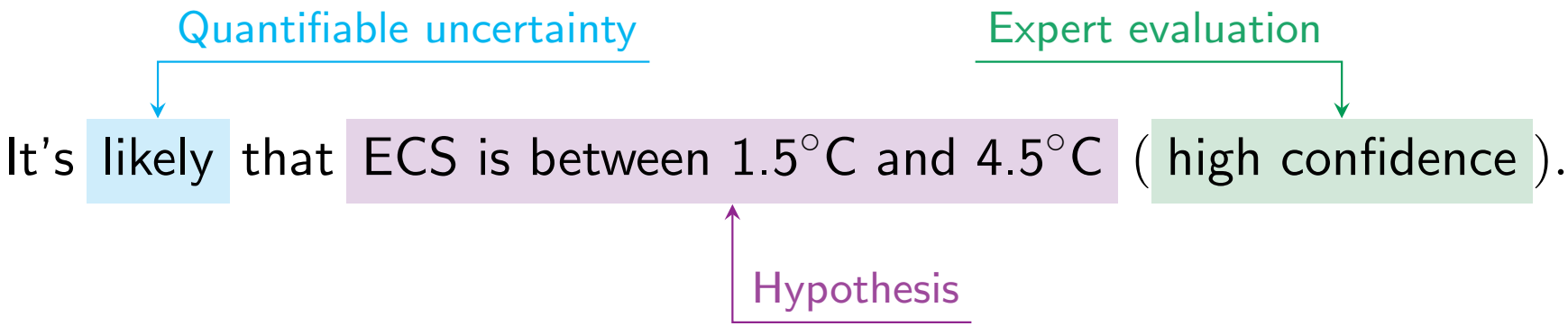
Quantified uncertainties are based on assumptions that hold approximately *at best*.

These results are useful and informative, but aren't "expert functions": they don't capture exactly what the decision-maker should believe.

Incorporating unquantified uncertainty



Incorporating unquantified uncertainty



Why separate quantifiable and unquantifiable uncertainty?

Some potential answers

1. **Transparency:** the two different judgments are generated in different ways.
2. **Action-relevance:** quantified and unquantified uncertainty *should* be treated differently by actors.
3. **Objectivity:** the numbers provided by the statistical tests are "objective"; expert opinion isn't.
4. **Desired**: it's what the users want.

Transparency

The FASEB Journal • Life Sciences Forum

How do disclosure policies fail? Let us count the ways

Inmaculada de Melo-Martín,*,1 and Kristen Intemann†

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Epistemic trust and the ethics of science communication: against transparency, openness, sincerity and honesty

Stephen John

Department of Histor

ABSTRACT

Canadian Journal of Philosophy (2020), 1–14
doi:10.1017/can.2020.21

ARTICLE

A Taxonomy of Transparency in Science

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Abstract

Both scientists and philosophers of science have recently emphasized the importance of promoting transparency in science. For scientists, transparency is a way to promote reproducibility, progress, and trust in research. For philosophers of science, transparency can help address the value-ladenness of scientific research in a responsible way. Nevertheless, the concept of transparency is a complex one. Scientists can be transparent about many different things, for many different reasons, on behalf of many different stakeholders. This paper proposes a taxonomy that clarifies the major dimensions along which approaches to transparency can vary. By doing so, it provides several insights that philosophers and other science studies scholars can pursue. In particular, it helps address common objections to pursuing transparency in science, it clarifies major forms of transparency, and it suggests avenues for further research on this topic.

Keywords: open science; transparency; values and science; value judgments; science communication; research ethics

1. Introduction

The concept of transparency is currently receiving a great deal of attention from both scientists and philosophers of science. The scientific community has been championing transparency under the auspices of the "open science" movement. According to the US National Academy of Sciences, "Open science aims to ensure the free availability and usability of scholarly publications, the data that result from scholarly research, and the methodologies, including code or algorithms, that were used to generate those data" (NAS 2018, 1). The open science movement has been celebrated as a means for promoting scientific reproducibility, hastening innovation, and benefiting the public (NAS 2018; Nosek et al. 2015; Royal Society 2012). At the same time, philosophers of science have been championing transparency as a strategy for responding in a responsible fashion to the value-ladenness of science. As the value-free ideal for science has come under fire, philosophers have been proposing alternative ideals for maintaining the trustworthiness, objectivity, and legitimacy of scientific results. Transparency is an important element of many of these proposals (see e.g., Douglas 2009; Elliott 2017; Havstad 2020; Stanev 2017).

Nevertheless, the concept of transparency is highly complex (Biddle 2020). Scientists can be transparent about many different elements of their practice, including their data, methods, computer codes, analysis plans, conflicts of interest, and value judgments. Different kinds of information end up being more or less important to disclose depending on the reasons for pursuing transparency and the recipients of the information. While the scientific community has focused especially on developing initiatives for disclosing data and methods, philosophers of science have focused more of their attention on transparency about value judgments (Douglas 2009; Elliott 2018b). However, even when focusing on transparency about value judgments, one could focus on the judgments themselves, or the values underlying the judgments, or the consequences of making the judgments in one way rather than another. One might wonder whether the concept of

Recall: the information is too vast and too complicated for transparency about everything.

Upshot: we should be transparent about X only where communicating X is otherwise important.

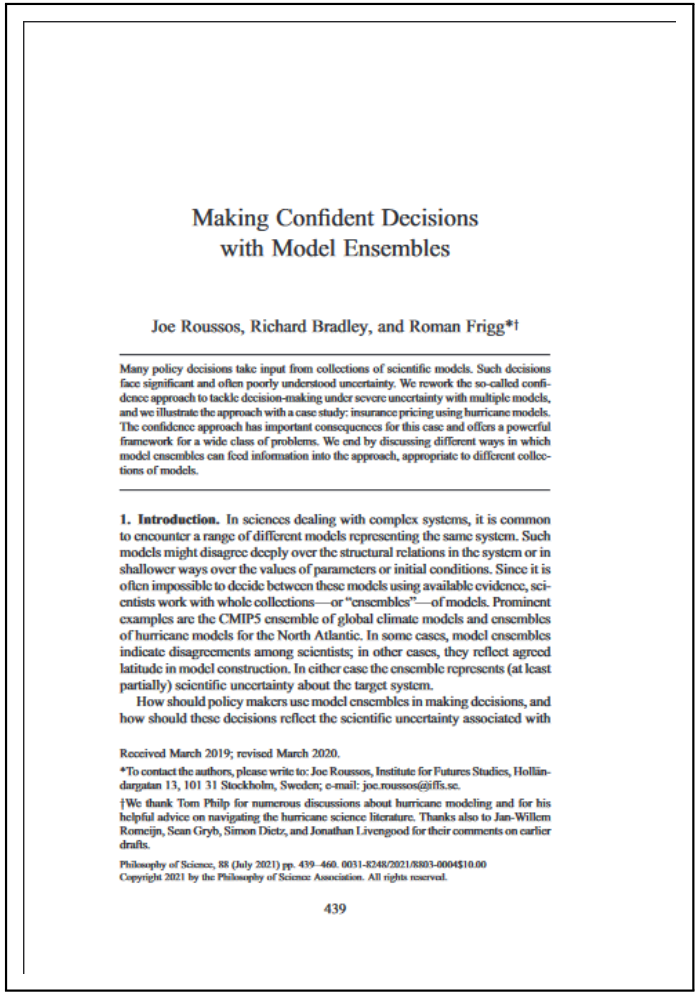
de Melo-Martín and Intemann (2009), Elliott (2020), and John (2018)

Action-relevance

Some decision theories recommend a distinction between quantified and unquantified uncertainty.

However: unlikely that IPCC report users are (typically) making use of this kind of decision theory.

Roussos, Bradley, and Frigg (2021)



Making Confident Decisions with Model Ensembles

Joe Roussos, Richard Bradley, and Roman Frigg*†

Many policy decisions take input from collections of scientific models. Such decisions face significant and often poorly understood uncertainty. We rework the so-called confidence approach to tackle decision-making under severe uncertainty with multiple models, and we illustrate the approach with a case study: insurance pricing using hurricane models. The confidence approach has important consequences for this case and offers a powerful framework for a wide class of problems. We end by discussing different ways in which model ensembles can feed information into the approach, appropriate to different collections of models.

1. Introduction. In sciences dealing with complex systems, it is common to encounter a range of different models representing the same system. Such models might disagree deeply over the structural relations in the system or in shallower ways over the values of parameters or initial conditions. Since it is often impossible to decide between these models using available evidence, scientists work with whole collections—or "ensembles"—of models. Prominent examples are the CMIP5 ensemble of global climate models and ensembles of hurricane models for the North Atlantic. In some cases, model ensembles indicate disagreements among scientists; in other cases, they reflect agreed latitude in model construction. In either case the ensemble represents (at least partially) scientific uncertainty about the target system.

How should policy makers use model ensembles in making decisions, and how should these decisions reflect the scientific uncertainty associated with

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Objectivity

Arguably just mistaken.

Quantified uncertainty isn't really more "objective" than expert judgments about unquantified uncertainty.

Though appearances might be more important...

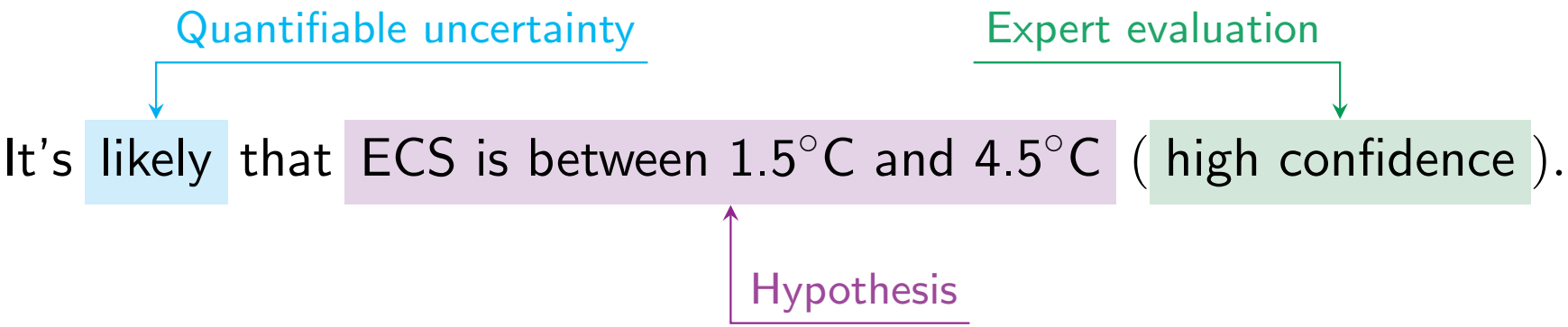
Dethier (2022a,b), Jebeile (2020), and Porter and Dessai (2017)

It's what the users want

If a user reports that they want only the quantified uncertainty (i.e. raw model outputs), at least one of three things is true:

1. They're wrong about what they want.
2. They have purposes other than making the best decision.
3. They think that the scientists' information about unquantified uncertainties is more likely than not to mislead.

Upshot



Recommendation: collapse the distinction between the likelihood and confidence scales.

The positive proposal

A complex message

More complex

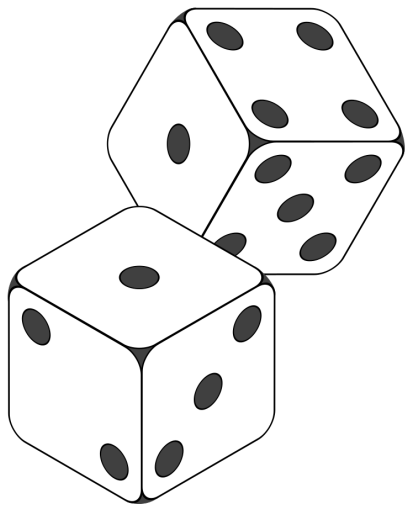
Current approach

2 imprecise scales

1 imprecise scale

1 precise scale

Less complex



A complex message

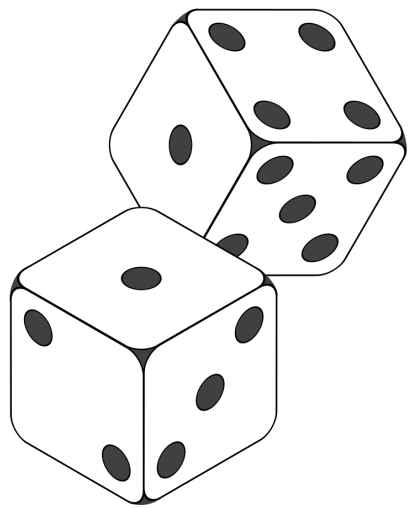
More complex

Current approach — 2 imprecise scales

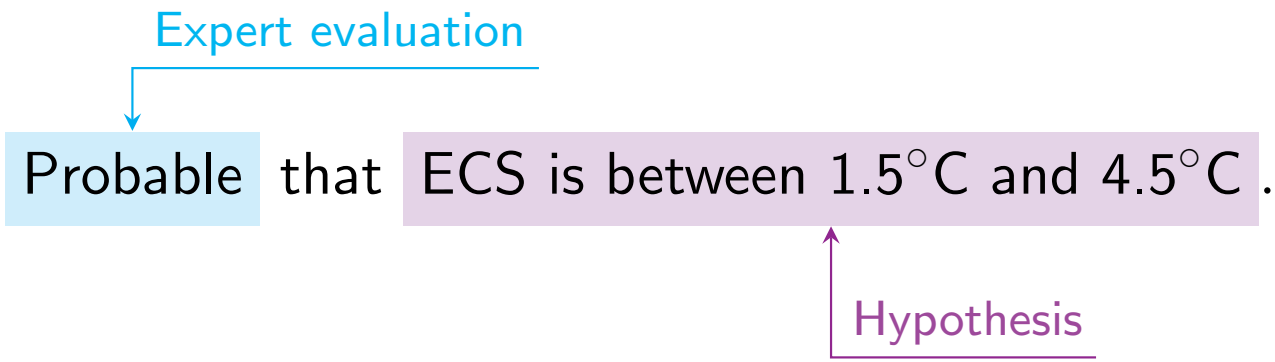
My suggestion — 1 imprecise scale

1 precise scale

Less complex



Positive proposal



Where the (new) "probability" scale = the imprecise confidence (/ credence) that experts believe is (best) justified by the totality of the evidence.

Costs and benefits

Benefits:

+ Retain flexibility for author groups while simplifying guidance.
+ Easier to understand and put into practice.
+ Avoids overly precise language.
+ Jettisons "likelihood" terminology.

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+ Retain flexibility for author groups while simplifying guidance.
+ Easier to understand and put into practice.
+ Avoids overly precise language.
+ Jettisons "likelihood" terminology.

Costs:

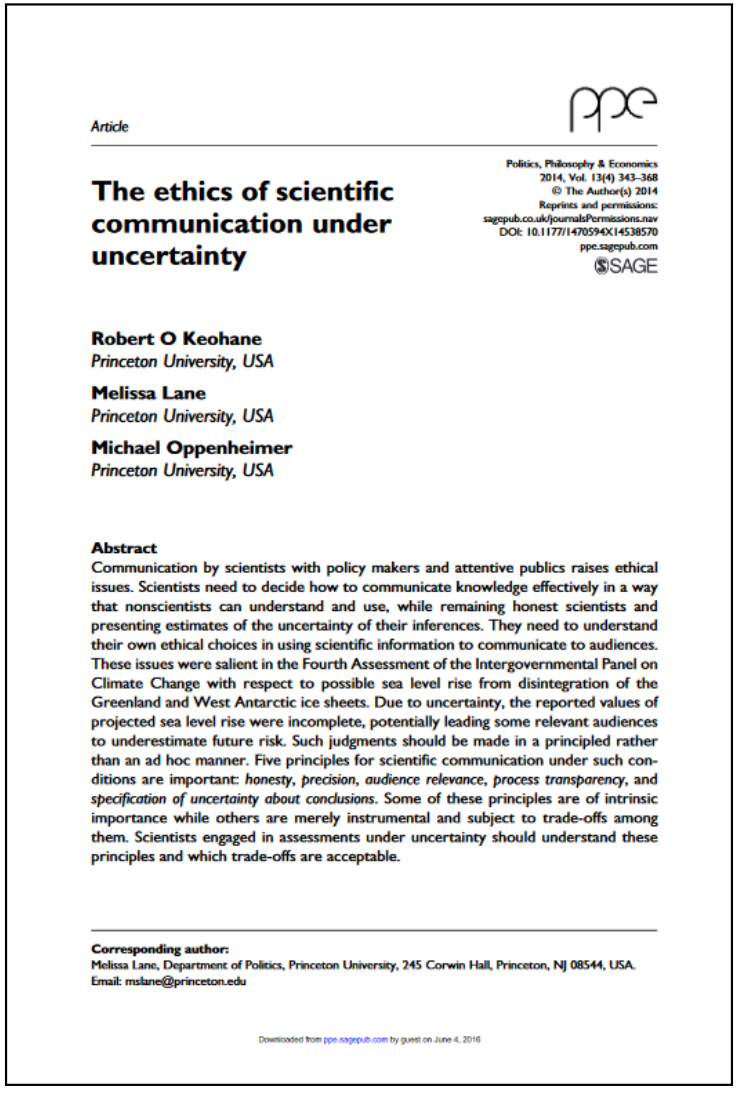
- IPCC must take a more active role in synthesizing information.
- Potentially counter-productive with some users.

On honesty

Is it "honest" to obscure the distinction between quantified and unquantified uncertainty?

Seems to depend on why you're doing so.

Certainly: equating "honesty" with "accuracy" or "transparency" is unhelpful; a presentation can be honest but simplified.



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The ethics of scientific communication under uncertainty

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Abstract
Communication by scientists with policy makers and attentive publics raises ethical issues. Scientists need to decide how to communicate knowledge effectively in a way that nonscientists can understand and use, while remaining honest scientists and presenting estimates of the uncertainty of their inferences. They need to understand their own ethical choices in using scientific information to communicate to audiences. These issues were salient in the Fourth Assessment of the Intergovernmental Panel on Climate Change with respect to possible sea level rise from disintegration of the Greenland and West Antarctic ice sheets. Due to uncertainty, the reported values of projected sea level rise were incomplete, potentially leading some relevant audiences to underestimate future risk. Such judgments should be made in a principled rather than an ad hoc manner. Five principles for scientific communication under such conditions are important: *honesty*, *precision*, *audience relevance*, *process transparency*, and *specification of uncertainty about conclusions*. Some of these principles are of intrinsic importance while others are merely instrumental and subject to trade-offs among them. Scientists engaged in assessments under uncertainty should understand these principles and which trade-offs are acceptable.

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On trust

Many (though not all) analyses of "trust" in science boil down to believing propositions.

That's not the whole story.

We're also trusting experts to (e.g.) translate their knowledge appropriately.

On philosophy

"There's often little to be gained in satisfying the theoretical desiderata of philosophers. ... Much more important is that the IPCC's practice is valuable to its target audience."

– Dethier (forthcoming)

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Interpreting the Probabilistic Language in IPCC Reports

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The Intergovernmental Panel on Climate Change (IPCC) often qualifies its statements by use of probabilistic "likelihood" language. In this paper, I show that this language is not properly interpreted in either frequentist or Bayesian terms—simply put, the IPCC uses both kinds of statistics to calculate these likelihoods. I then offer a deflationist interpretation: the probabilistic language expresses nothing more than how compatible the evidence is with the given hypothesis according to some method that generates normalized scores. I end by drawing some tentative normative conclusions.

1. Introduction

The Intergovernmental Panel on Climate Change (IPCC) systematically uses probabilistic language in two different ways: in qualitative "confidence" judgments and in quantitative, but usually imprecise, "likelihood" assignments. This two-fold use of probabilistic language has attracted substantial discussion from scientists (including the authors of various IPCC reports), who worry that the two categories are not clear enough for either the scientists who are asked to make such judgments or the policy-makers and public who are asked to interpret them.[1] To date, philosophical attention to this two-fold use of probabilistic language has (understandably) focused on the relationship between the two: since the confidence language is often applied not just to hypotheses but also to the likelihood assignments, it's an interesting question how this confidence language is to be

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1. For a sampling, see Herrando-Pérez et al. (2019), Janzwood (2020), and Mach et al. (2017) as well as the citations therein. Note also that the IPCC's approach has been influential throughout climate science; Crimmins (2020) documents that many of the same problems can be found in U.S. governmental reports on climate change.

https://doi.org/---

Thank you!


Adler, Carolina E. and Gertrude Hirsch Hadorn (2014). The IPCC and Treatment of Uncertainties: Topics and Sources of Dissensus. *Wiley Interdisciplinary Reviews: Climate Change* 5: 663–76.


Aven, Terje (2019). Climate Change Risk – What is it and how should it be Expressed? *Journal of Risk Management* 23.13: 1–18.


Aven, Terje and Ortven Renn (2015). An Evaluation of the Treatment of Risk and Uncertainties in the IPCC Reports on Climate Change. *Risk Analysis* 35.4: 701–12.


Betz, Gregor (2007). Probabilities in Climate Policy Advice: A Critical Comment. *Climatic Change* 85.1-2: 1–9.


— (2015). Are Climate Models Credible Worlds? Prospects and Limitations of Possibilistic Climate Prediction. *European Journal for Philosophy of Science* 5.2: 191–215.

- Bradley, Richard, Casey Helgeson, and Brian Hill (2017). Climate Change Assessments: Confidence, Probability and Decision. *Philosophy of Science* 84.3: 500–22.
- Budescu, David V. et al. (2014). The Interpretation of IPCC Probabilistic Statements Around the World. *Nature Climate Change* 4: 508–12.
- de Melo-Martín, Inmaculada and Kristen Intemann (2009). How Do Disclosure Policies Fail? Let us Count the Ways. *The FASEB Journal* 23.6: 1638–42.
- Dethier, Corey (2021). How to Do Things with Theory: The Instrumental Role of Auxiliary Hypotheses in Testing. *Erkenntnis* 86.6: 1453–68.
- — (2022a). Calibrating Statistical Tools: Improving the Measure of Humanity's Influence on the Climate. *Studies in the History and Philosophy of Science* 94: 158–66.


Dethier, Corey (2022b). When is an Ensemble Like a Sample? 'Model-Based' Inferences in Climate Modeling. *Synthese* 200.52: 1–20.


— (forthcoming). Interpreting the Probabilistic Language in IPCC Reports. *Ergo*.


Elliott, Kevin C. (2020). A Taxonomy of Transparency in Science. *Canadian Journal of Philosophy* (online first).


Frigg, Roman and James Nguyen (2020). *Modelling Nature: An Opinionated Introduction to Scientific Representation*. Cham: Springer.


Grasswick, Heidi E. (2010). Scientific and Lay Communities: Earning Epistemic Trust through Knowledge Sharing. *Synthese* 177.3: 387–409.


Harris, Adam J. L. et al. (2013). Lost in Translation? Interpretations of the probability phrases used by the Intergovernmental Panel on Climate Change in China and the UK. *Climatic Change* 121: 415–25.

- Helgeson, Casey, Richard Bradley, and Brian Hill (2018). Combining Probability with Qualitative Degree-of-Certainty Metrics in Assessment. *Climatic Change* 149.3: 517–25.
- Herrando-Pérez, Salvador et al. (2019). Statistical Language Backs Conservatism in Climate-Change Assessments. *BioSciences* 69.3: 209–19.
- IPCC (2013). *Climate Change 2013: The Physical Science Basis*. Ed. by Thomas F. Stocker et al. Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.
- Janzwood, Scott (2020). Confident, Likely, or Both? The Implementation of the Uncertainty Language Framework in IPCC Special Reports. *Climatic Change* 162: 1655–75.
- Jebeile, Julie (2020). Values and Objectivity in the Intergovernmental Panel on Climate Change. *Social Epistemology* 34.5: 453–68.

- John, Stephen (2018). Epistemic Trust and the Ethics of Science Communication: Against Transparency, Openness, Sincerity and Honesty. *Social Epistemology* 32.2: 75–87.
- Katzav, Joel et al. (2021). On the Appropriate and Inappropriate Uses of Probability Distributions in Climate Projections, and Some Alternatives. *Climatic Change* 169.15: 1–20.
- Keohane, Robert O., Melissa Lane, and Michael Oppenheimer (2014). The Ethics of Scientific Communication under Uncertainty. *Politics, Philosophy and Economics* 13.4: 343–68.
- Lane, Melissa (2014). When the Experts are Uncertain: Scientific Knowledge and the Ethics of Democratic Judgment. *Episteme* 11.1: 97–118.
- Mach, Katharine J. et al. (2017). Unleashing Expert Judgment in Assessment. *Global Environmental Change* 44: 1–14.


Mastrandrea, Michael D. et al. (2010). *Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties*. URL: https://www.ipcc.ch/site/assets/uploads/2017/08/AR5_Uncertainty_Guidance_Note.pdf.


Oppenheimer, Michael et al. (2019). *Discerning Experts: The Practices of Scientific Assessment for Environmental Policy*. Chicago: University of Chicago Press.


Parker, Wendy S. (2010a). Predicting Weather and Climate: Uncertainty, Ensembles and Probability. *Studies in the History and Philosophy of Modern Physics* 41: 263–72.


— (2010b). Whose Probabilities? Predicting Climate Change with Ensembles of Models. *Philosophy of Science* 77.5: 985–97.


— (2020). Model Evaluation: An Adequacy-for-Purpose View. *Philosophy of Science* 87.3: 457–77.


Parker, Wendy S. and James S. Risbey (2015). False Precision, Surprise and Improved Uncertainty Assessment. *Philosophical Transactions of the Royal Society Part A* 373.3055: 20140453.


Porter, James J. and Suraje Dessai (2017). Mini-me: Why do Climate Scientists' Misunderstand Users and Their Needs? *Environmental Science & Policy* 77: 9–14.


Roussos, Joe, Richard Bradley, and Roman Frigg (2021). Making Confident Decisions with Model Ensembles. *Philosophy of Science* 88.3: 439–60.


Stainforth, David A. et al. (2007). Confidence, Uncertainty and Decision-Support Relevance in Climate Predictions. *Philosophical Transactions of the Royal Society Series A* 365.1857: 2145–61.


Teigen, Karl Halvor (2014). When Very Likely is not so Likely. *Nature Climate Change* 4: 421–22.


Teller, Paul (2004). What is a Stance? *Philosophical Studies* 121.2: 159–70.