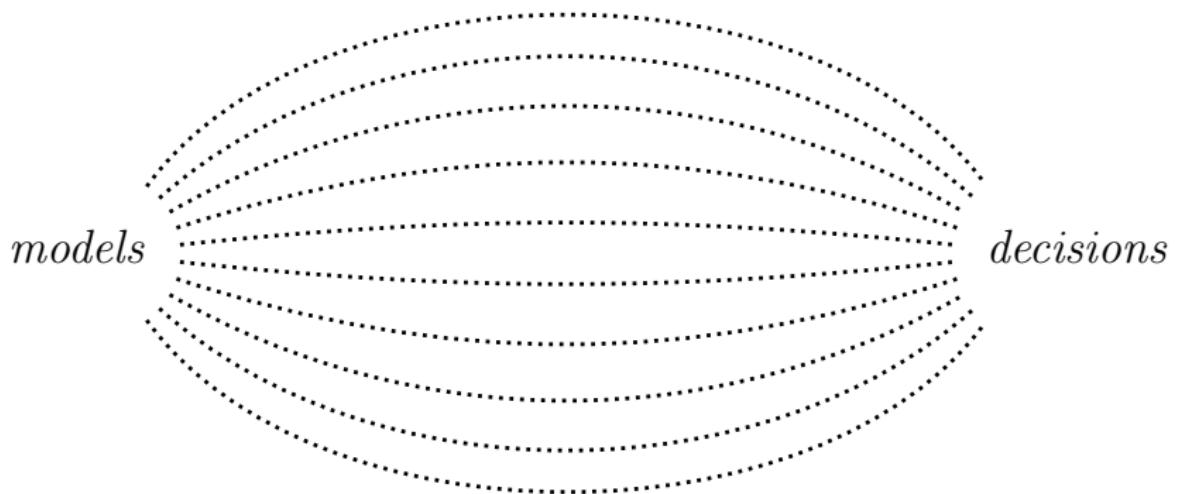


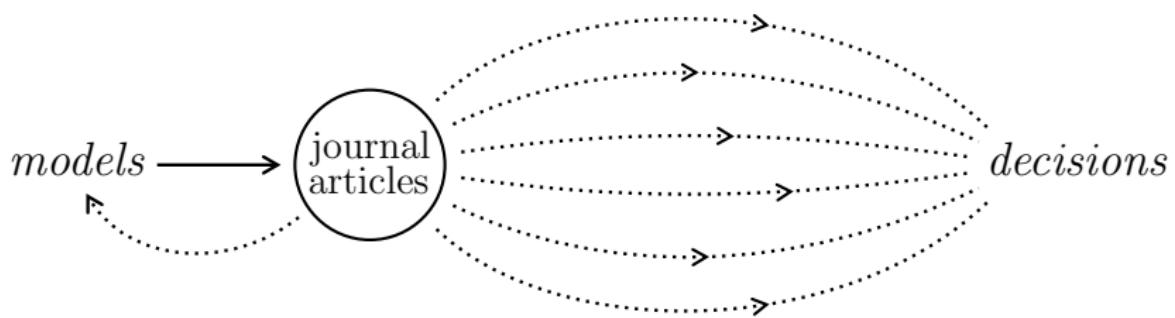
Informing Decisions with Models.
Contributions from:
PHILOSOPHY

Casey Helgeson, casey.helgeson@gmail.com
French National Centre for Scientific Research (CNRS),
HEC Paris, Laboratory GREGHEC

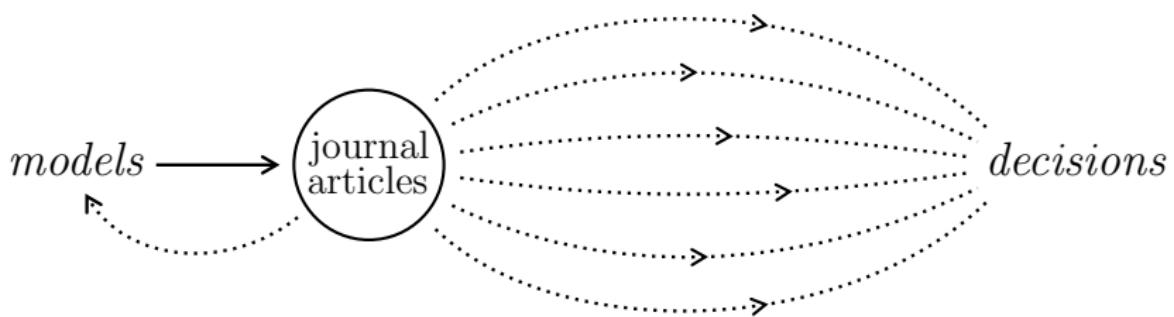
M2D 1st Annual Conference on Decision Making Under Uncertainty
University of Exeter, UK, July 2017



EXAMPLE 1/2



EXAMPLE 1/2



- ▶ “Towards Best Practice Framing of Uncertainty in Scientific Publications: A Review of Water Resources Research Abstracts” Joseph H. A. Guillaume, Casey Helgeson, Sondoss Elsawah, Anthony J. Jakeman, and Matti Kummu

Build-the-foundations: Many uncertainties have not been addressed, but that's OK, because we've produced a result/method that others will build on, and these uncertainties can be addressed later.

Restrict-scope-of-applicability specifies circumstances in which a statement applies, or points to exceptions: “x when a” or “x unless a”. Includes hedges like “typically” and “generally”, that suggest there are exceptions without naming them.

Validate-and-Defend involves a judgement about what is *good enough* or *sufficient/adequate*. “Adequately captured”, “good results”, “successfully modelled” or “can be reproduced”

“When heterogeneity is low to moderate, the simpler method adequately captures expected solute transport behavior despite the existence of heterogeneity at smaller scales.”

- ▶
- ▶
- ▶

“When heterogeneity is low to moderate, the simpler method **adequately captures expected solute transport behavior** despite the existence of heterogeneity at smaller scales.”

- ▶ Validate-and-Defend
- ▶
- ▶

“When heterogeneity is low to moderate, the simpler method adequately captures expected solute transport behavior despite the existence of heterogeneity at smaller scales.”

- ▶ Validate-and-Defend
- ▶ Restrict-scope-of-applicability
- ▶

“When heterogeneity is low to moderate, the simpler method adequately captures expected solute transport behavior despite the existence of heterogeneity at smaller scales.”

- ▶ Validate-and-Defend
- ▶ Restrict-scope-of-applicability
- ▶ Demonstrate-robustness

a) Maturity and utility

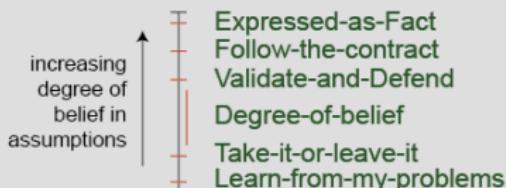
To what extent is the conclusion ready to be used?



Uncertainty can be reduced in the long term by delaying a definitive conclusion and investing in future work

c) Level of belief in a conclusion

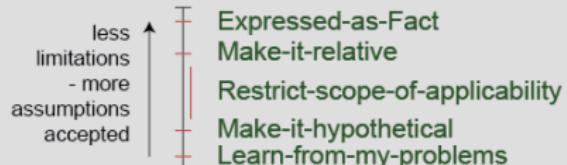
How certain is the author that the conclusion is true?



Uncertainty can be described in terms that allow reasoning about uncertain information

b) Scope of a claim

What limitations are there on how the conclusion can be used?



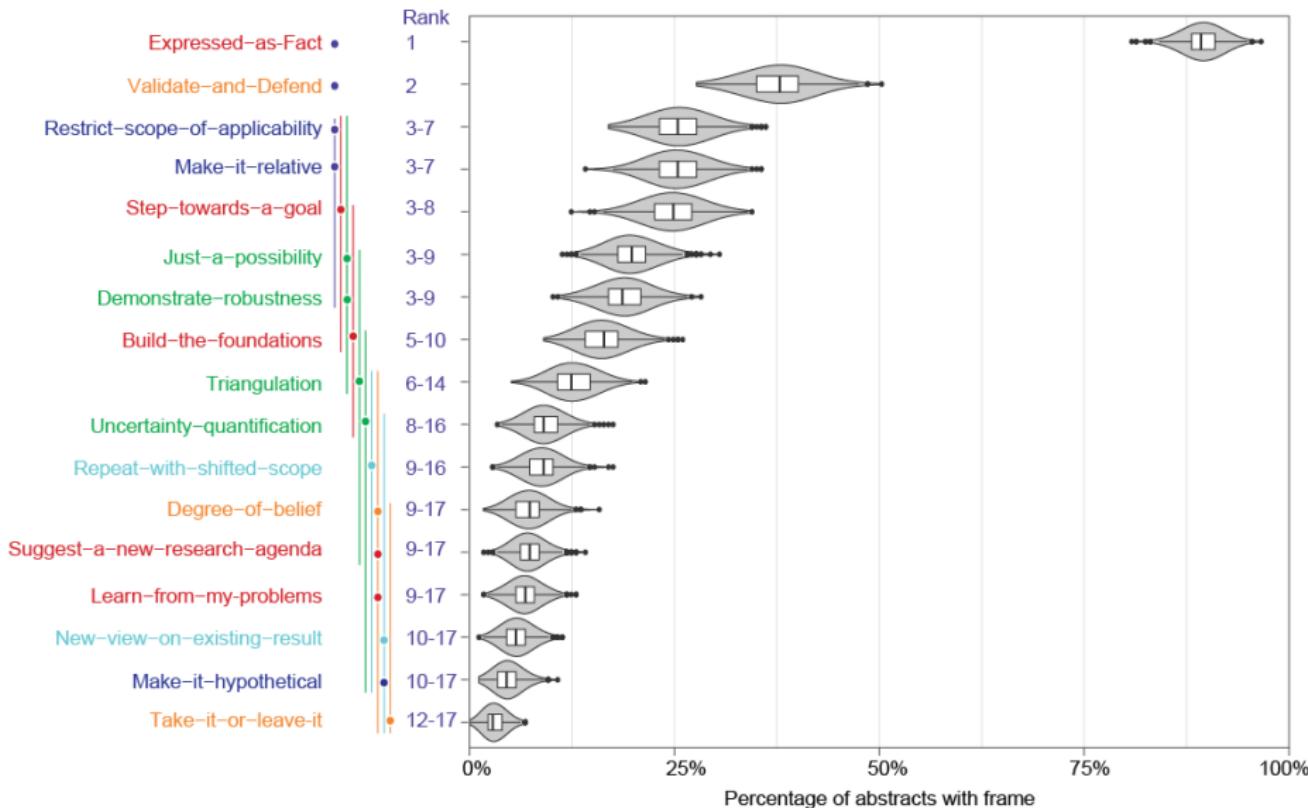
Uncertainty can be reduced in the short term by making assumptions that limit scope of applicability

d) Depth of analysis

How thoroughly has the issue been examined?



Uncertainty can be described by considering the effect of alternative assumptions



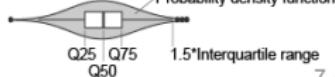
Category of frames:

- Maturity and utility
- Scope of a claim
- Level of belief
- Depth of analysis
- Relatability

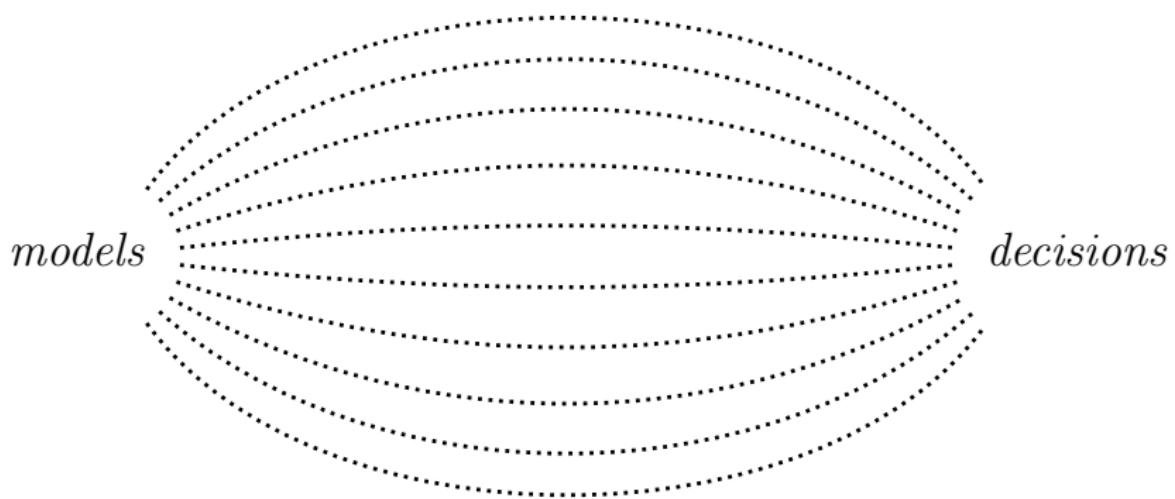
Vertical lines indicate frames
that are statistically equally frequent:

• 12-17
Range of possible ranks
given uncertainty

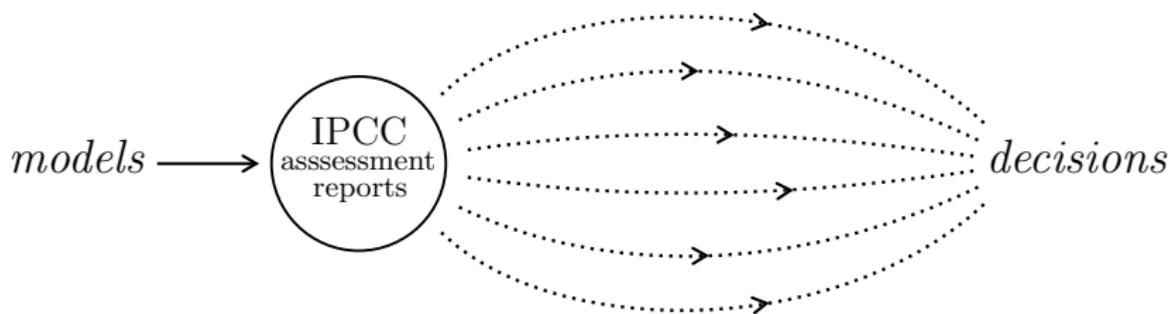
Bootstrapped uncertainty in
frequency of occurrence of frames:
Probability density function



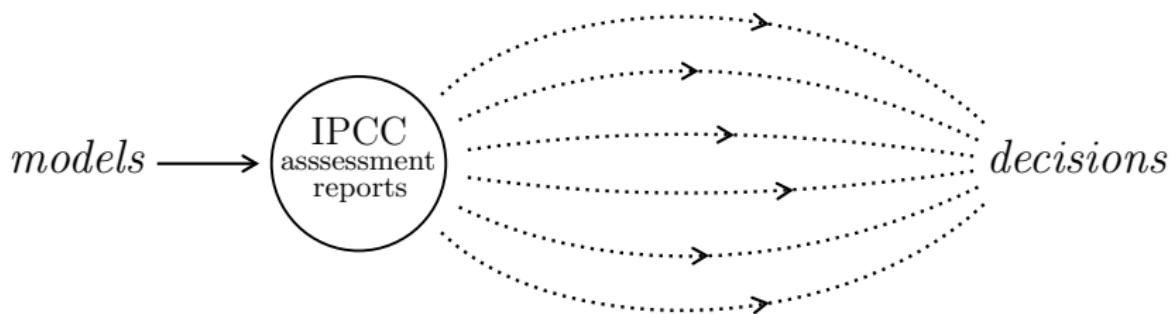
EXAMPLE 2/2



EXAMPLE 2/2



EXAMPLE 2/2



- ▶ “Climate Change Assessments: Confidence, Probability, and Decision” (2017) *Philosophy of Science* 84(3): 500-522.
Richard Bradley, Casey Helgeson, and Brian Hill

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:

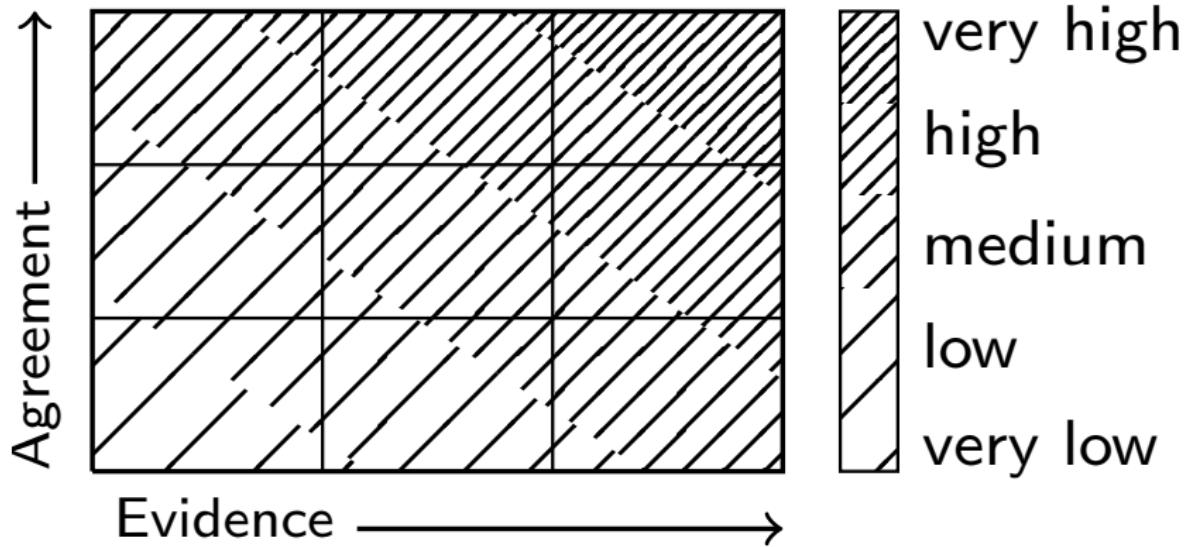
Michael D. Mastrandrea, Christopher B. Field, Thomas F. Stocker,
Ottmar Edenhofer, Kristie L. Ebi, David J. Frame, Hermann Held, Elmar Kriegler,
Katharine J. Mach, Patrick R. Matschoss, Gian-Kasper Plattner, Gary W. Yohe,
and Francis W. Zwiers

Table 1. Likelihood Scale

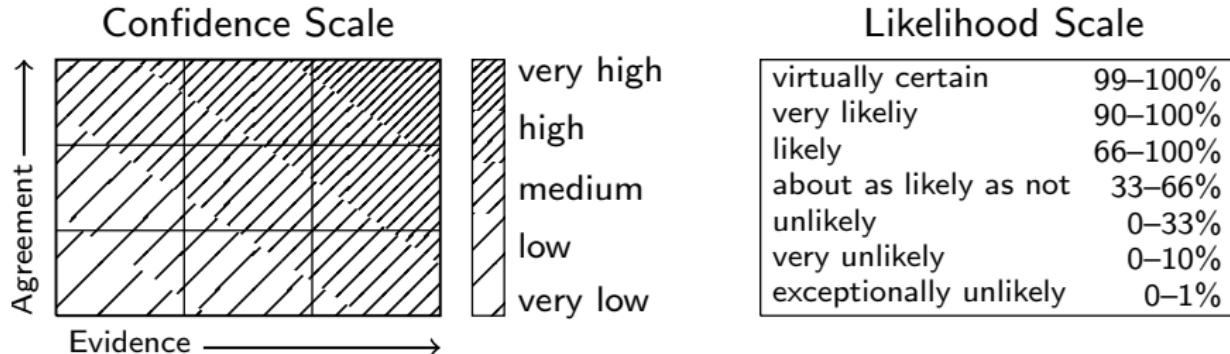
Term*	Likelihood of the Outcome
<i>Virtually certain</i>	99-100% probability
<i>Very likely</i>	90-100% probability
<i>Likely</i>	66-100% probability
<i>About as likely as not</i>	33 to 66% probability
<i>Unlikely</i>	0-33% probability
<i>Very unlikely</i>	0-10% probability
<i>Exceptionally unlikely</i>	0-1% probability

* Additional terms that were used in limited circumstances in the AR4 (*extremely likely* – 95-100% probability, *more likely than not* – >50-100% probability, and *extremely unlikely* – 0-5% probability) may also be used in the AR5 when appropriate.

Confidence Scale



Example statement



“Relative to the average from year 1850 to 1900, global surface temperature change by the end of the 21st century is . . . *likely* to exceed 2°C for RCP6.0 and RCP8.5 (*high confidence*)”

Chance of rain
= 0.3

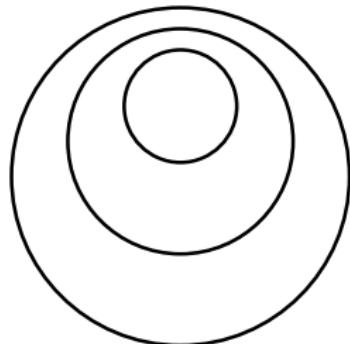


maximise
expected
utility

Chance of rain
= .66–1
(medium confidence)

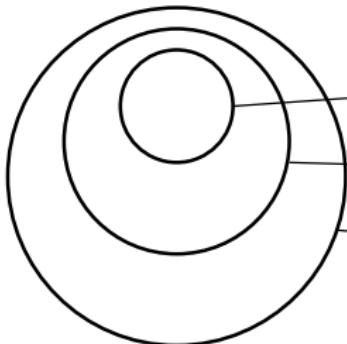


???



Hill, B. (2013). Confidence and decision. *Games and Economic Behavior* 82, 675–692.

Hill, B. (2016). Incomplete preferences and confidence. *Journal of Mathematical Economics* 65, 83–103.



.9–1 (*low confidence*)

.66–1 (*medium confidence*)

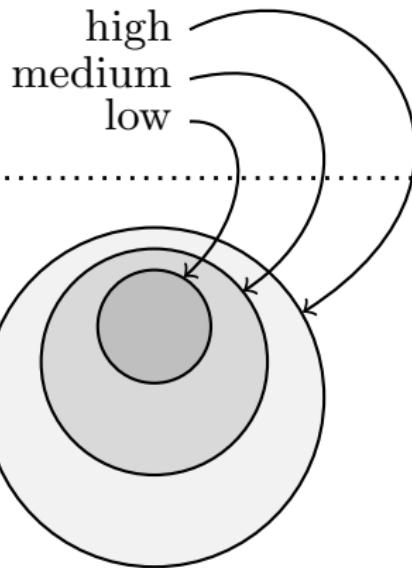
.5–1 (*high confidence*)

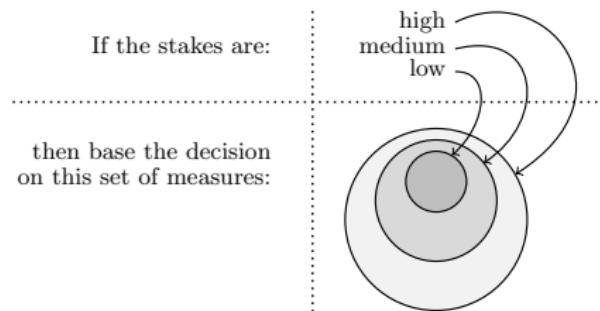
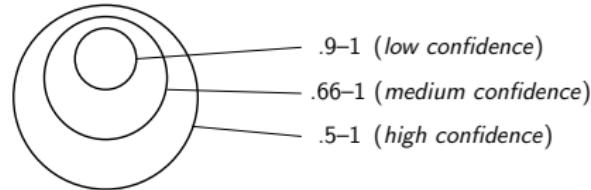
Hill, B. (2013). Confidence and decision. *Games and Economic Behavior* 82, 675–692.

Hill, B. (2016). Incomplete preferences and confidence. *Journal of Mathematical Economics* 65, 83–103.

If the stakes are:

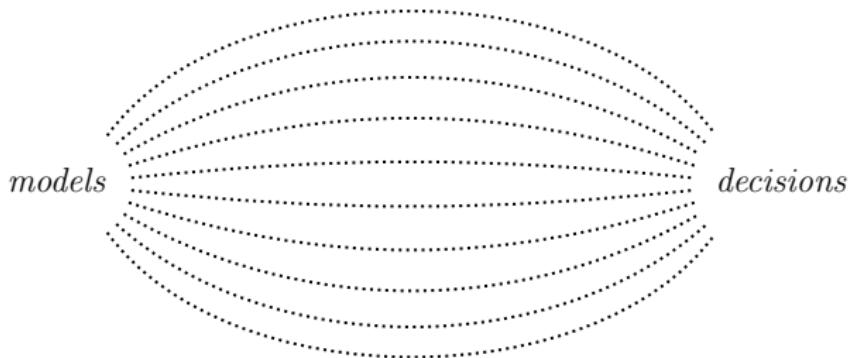
then base the decision
on this set of measures:





Consequences of interpreting the IPCC uncertainty language through the Hill (2013, 2016) decision model:

- ▶ Using IPCC framework requires making judgements about relative importance of confidence and precision to end users.
- ▶ Provides a way to check mathematical consistency among multiple probability-plus-confidence statements



- 1. How modellers “frame” uncertainties in their publications**
“Towards Best Practice Framing of Uncertainty in Scientific Publications: A Review of Water Resources Research Abstracts” Joseph H. A. Guillaume, Casey Helgeson, Sondoss Elsawah, Anthony J. Jakeman, and Matti Kummu
- 2. Bridging the gap from IPCC language to decision making**
“Climate Change Assessments: Confidence, Probability, and Decision” (2017) *Philosophy of Science* 84(3). Richard Bradley, Casey Helgeson, and Brian Hill

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- Hill, B. (2013). Confidence and decision. *Games and Economic Behavior* 82, 675–692.
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- IPCC (2013). Summary for policymakers. In T. F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P. M. Midgley (Eds.), *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Mastrandrea, M. D., C. B. Field, T. F. Stocker, O. Edenhofer, K. L. Ebi, D. J. Frame, H. Held, E. Kriegler, K. J. Mach, P. R. Matschoss, G.-K. Plattner, G. W. Yohe, and F. W. . . Zwiers (2010). Guidance note for lead authors of the IPCC fifth assessment report on consistent treatment of uncertainties. Technical report, Intergovernmental Panel on Climate Change (IPCC). Available at <<http://www.ipcc.ch>>.