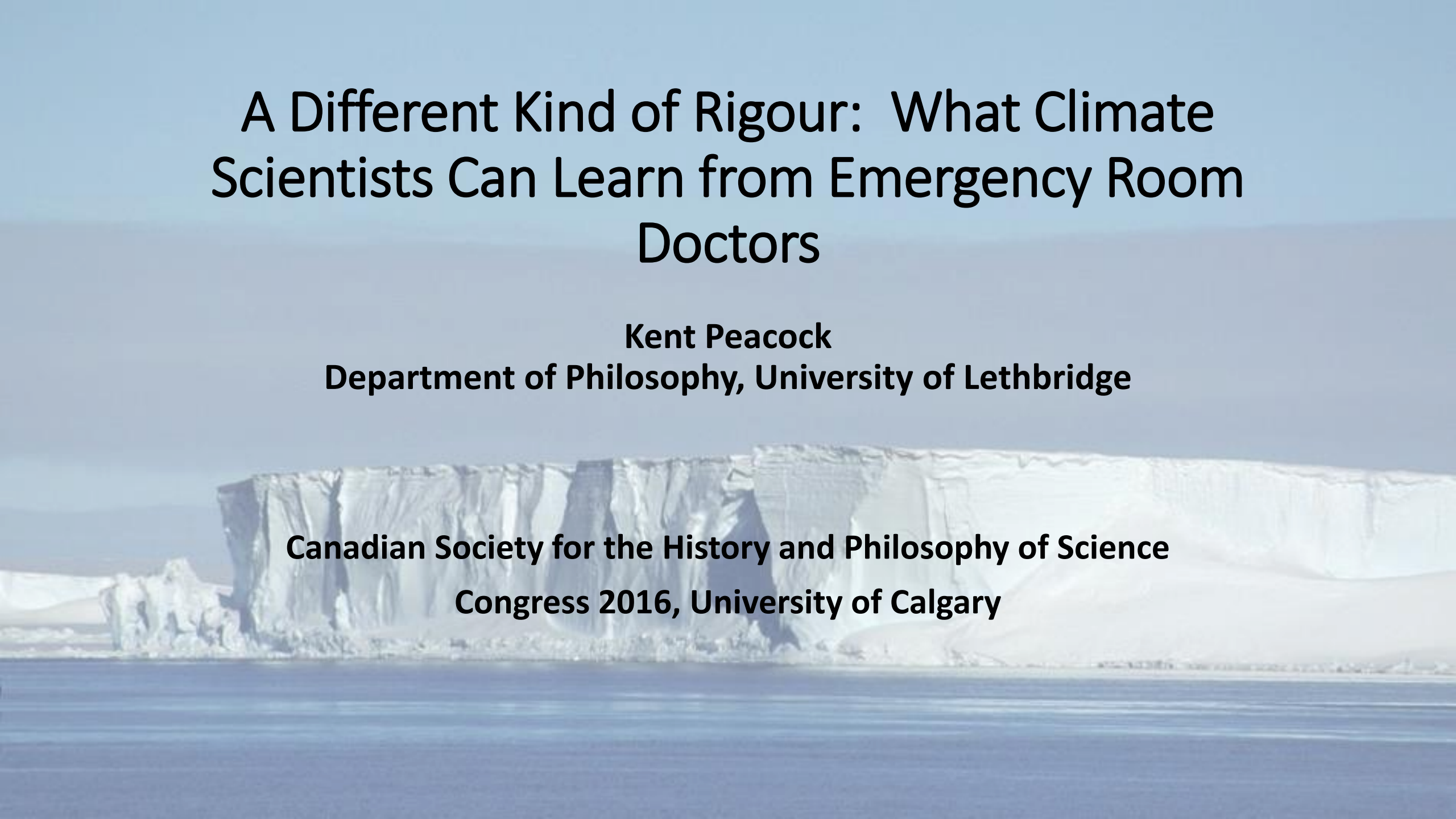
# A Different Kind of Rigour: What Climate Scientists Can Learn from Emergency Room Doctors

**Kent Peacock**
**Department of Philosophy, University of Lethbridge**



**Canadian Society for the History and Philosophy of Science**
**Congress 2016, University of Calgary**

# Scientific Reticence

- Science deniers present a picture of climate scientists as alarmist.
- In fact, there is evidence that (with some notable exceptions) many climate scientists tend to underplay the seriousness and risks of global warming, and are reluctant to make even the most obvious recommendations suggested by their own scientific findings.
- James Hansen ("Scientific Reticence and Sea Level Rise", 2007):
  - "…'scientific reticence'…hinders communication with the public about dangers of global warming… Caution, if not reticence, has its merits. However, in a case such as ice sheet instability and sea level rise, there is a danger in excessive caution. We may rue reticence, if it serves to lock in future disasters."

# Some Recent Literature on Reticence

- James Risbey (2008):
  - Also cited risk of ice sheet collapse; argued that it is reasonable for scientists to describe the current situation as “alarming” (a value judgement).
- Naomi Oreskes et al. (2013):
  - Scientists tend to “err on the side of least drama” (ESLD) when predicting possible consequences of global warming.
  - “Scientists’ fear of ‘crying wolf’ is more immediate than their fear of ‘fiddling while Rome burns’.”
  - Controversial example: last two IPCC reports (AR4 2007, AR5 2013) have downplayed risk of ice sheet collapse because the process is not well enough understood to allow highly confident predictions.
    - Result: IPCC predictions of possible sea level rise are *way* low in view of many glaciologists.

# Kevin Anderson

- “As scientists, we must now leverage the clarity gained by the [carbon] budget concept to combat the almost global-scale cognitive dissonance in acknowledging its quantitative implications. Yet, so far, we simply have not been prepared to accept the revolutionary implications of our own findings, and even when we do we are reluctant to voice such thoughts openly.” (Anderson, 2015)
  - His point: it is going to be much more difficult to meet the 2°C “guardrail” than most scientists admit.
  - Many current projections are based on “changing the past” or dependence upon negative emissions technologies that do not yet exist.
  - Many “ultimately choose to censor their own research”.
- Why?

# Possible Reasons for Reticence

- A good reason:  in science it is imperative to avoid error:
  - In science it is very hard to be right, very easy to be wrong.
    - Loss of respect of peers, trouble with career advancement…
  - Significant career penalties for anyone who has their name on an error.
    - (Cf. philosophers, who are allowed to make mistakes, so long as they are interesting!)
- Fear of losing funding.
- Gaussian pride:
  - *Pauca sed pura*.
- Pearls before swine?
  - Some may feel that it is a waste of time to attempt to communicate complex science to the public.

# Reticence:  Pros and Cons

- Fear of disapproval from colleagues, supervisors, or the scientific community.
- This factor cuts both ways.
  - Scientists find that appropriate caution increases their reputation for reliability.
  - However, there are cases where advances have been hindered when a scientist has bowed to the prejudices of his or her supervisor or other critics.
    - (E.g., Hans Kramers, who wrote the theory of the Compton Effect about two years before Compton, but did not publish because of Bohr's disapproval; Lindley, 2007.)

# Possible Reasons for Reticence

- “Seepage” from poisonous atmosphere of climate science denial:
  - Essentially a form of suggestibility.
    - S. Lewandowsky et al. (2015).
- A very understandable fear of personal attack:
  - A colleague of mine called out a notorious denier for demonstrably false claims and was sued by the denier and left on his own by my university.
  - Other scientists have been vilified publicly, threatened in many ways including death threats.

# More Possible Reasons for Reticence

- “Erring on the Side of Least Drama” (ESLD)
  - A systematic tendency to deliberately err on the conservative side of predictions.
  - Oreskes pointed out (AGU talk, December 2015) that ESLD is an obvious methodological (systematic) error; how could it be good science to usually be wrong in a certain direction? And yet, it is taken as a sign of good judgement!
- In part, ESLD suggests cultural and even methodological barriers to speaking out.
- Lack of clear guidelines: scientists often simply don’t know what to do if their research points to probable catastrophe.

# What Can be Learned from the Learned Professions

- Research scientists can take both *ethical* and *methodological* guidance from the learned professions such as engineering and medicine.
  - N.b.: I do not suggest that research science should become a licensed profession like engineering.
    - The codes of ethics for engineering, medicine are *legislated*; engineers and doctors are required *by law* to do things that for most people would be supererogatory.
  - But scientists who are concerned about the ethical dilemmas of their trade can voluntarily emulate the ethos and methods of the learned professions.

# Lessons from the Ethos of the Professions

- Professionals have a *duty to decide*: life and death decisions must be made in real time, often under conditions of uncertainty.
  - Scientists are expected to withhold assent until the evidence for a view becomes overwhelmingly high.
  - The point: professionals (e.g., emergency room doctors) usually do not have the luxury of an indefinite amount of time to make a call.
- Professional decisions are often required in cases where *there is no algorithm*. Such cases require *judgement* (Aristotle), an ability to weigh the pros and cons of a complex problem and act decisively and creatively.
  - Non-algorithmic decision making needs further study.

# Lessons from the Ethos of the Professions

- Professionals have a duty to avoid negligence.
  - There is a higher onus placed upon them than members of the general public to go out of their way in their areas of competency to do those things that would be right and necessary according to their professional judgement.
  - *Precedent*, *experience*, and *good judgement* are essential in determining what is right and necessary in a given case.
    - Definition of professional negligence in Ontario engineering code: "an act or an omission in the carrying out of the work of a practitioner that constitutes a failure to maintain the standards that a reasonable and prudent practitioner would maintain in the circumstances" (Ontario Engineering Act).

# And…Duty to Report!

- Members of the learned professions have a *duty to report* (whistle-blow) and a *duty to inform the public*.
  - Under certain circumstances, the duty to report, which is *legislated*, over-rides duties to self, the client, or any vested interests.
  - "Engineers must act out of a sense of duty, with full knowledge of the effect of their actions, and accept responsibility for their judgment [in a way that is] open, personal, [and] conducted with the interest of the public in mind… [This] obviously requires that engineers put their names on the action and sometimes their jobs on the line." (Professional Engineers of Ontario, n.d.)

# But Aren't You Merely Condoning Politically-Motivated Activism by Scientists?

- Possible criticism: all I am doing is demanding a lessening of epistemic rigour for the sake of "activism".
- No—I am arguing for the occasional exercise of a *different kind of rigour* than expected of a pure research scientist.
  - No one got a Nobel Prize for the discovery of the Higgs boson until the result was established to *seven sigma*! (Anthony, 2012)
    - Presumably the immediate future of the species did not turn on the confirmation of the Standard Model of particle physics.
  - But professionals must learn to make decisions in low finite time without what Hansen (2007) called "the comfort of waiting for incontrovertible confirmations".

# Why Doctors and Engineers Get Paid a Lot of Money…

- I do not recommending a lessening of the standards of scientific rigour any more than I recommend that scientists allow their advocacy for a position held for non-scientific reasons to bias their science.
- Rather, I am arguing for a different kind of rigour — one that recognizes that the need for the highest possible epistemic certainty must sometimes be counterbalanced by the need for the best possible decisions to be made in finite time, with less-than-perfect resources of information.
- This is the rigour that professionals in fields such as medicine and engineering have been required to aim at for centuries, and it can be very difficult to achieve.  It is far easier to withhold assent until one's result is confirmed to near-Cartesian certainty.

# Disaster Prevention vs. Advancement of Knowledge

- The aim of climate science with respect to the future of WAIS (West Antarctic Ice Sheet) is not to confirm that this ice sheet will definitely collapse under certain circumstances — we *do not* want to test that claim.
- Rather, we want to avoid the parameter regimes where that outcome is probable.

# Living With Uncertainty

- This implies that it will not always be possible to recommend preventative measures with absolute confidence that they will be relevant or effective.
- Uncertainty is our constant companion in real-life decision-making, and as Lewandowsky et al. (2014) argue, it may be rational for uncertainty about high-risk outcomes to provide *increased* justification for pre-emptive action.

# The Methodological Problem in a Nutshell…

- Scientists warn of a “tipping point” (around 2°C or less above pre-industrial level) beyond which climate changes would probably be irreversible.
  - “Tipping point”:  when changes (such as ice sheet collapse) become dominated by positive feedback.
- Yes, there is a very small chance that the scientists are wrong, but (adapting a line from Dirty Harry):  “How lucky do we feel?”

# A Long Tradition

- It may seem that I threaten to impose impossibly severe expectations on climate scientists.
- There does exist a well-established model which can provide guidance for those research scientists who do feel a sense of responsibility about the implications of their work and who are troubled by the conflict between the imperative to remain objective and disinterested in the conduct of scientific research, and the imperative to speak out in those cases where it would be unconscionable not to do so.
- Such scientists may find it comforting and steadying, in these very uncertain times, to place themselves within the long and honourable tradition of professional practice.

# Appendix:  Why Scientists are so Worried about WAIS

- It is not widely enough understood why the risk of multi-metre sea level rise (SLR) is so high.
- Western Antarctic Ice Sheet (WAIS), Zacharaie Glacier (Greenland), and three major glaciers in East Antarctica are grounded marine ice sheets, which have the potential to collapse catastrophically.
  - Collectively, good for 15 – 25 m SLR.

# WAIS:  The Restlessly Slumbering Giant

- WAIS (Western Antarctic Ice Sheet) is a grounded marine ice dome:
  - Mountain of ice filling up a large basin (Bentley Trench) that is up to 2500 m below sea level.
  - Held in place by its “ice over flotation”.
- There is evidence (partly from paleoclimate, partly from physical analysis) that if relatively warm sea water can get access to the base of such ice domes, they can collapse *catastrophically*, possibly even within a few years (though this remains uncertain).
- Collapse of Bentley Trench would cause sea level to rise by about 3.3 m.  (Prof. Richard Alley, AGU, Dec. 2013.)

# Battling Models

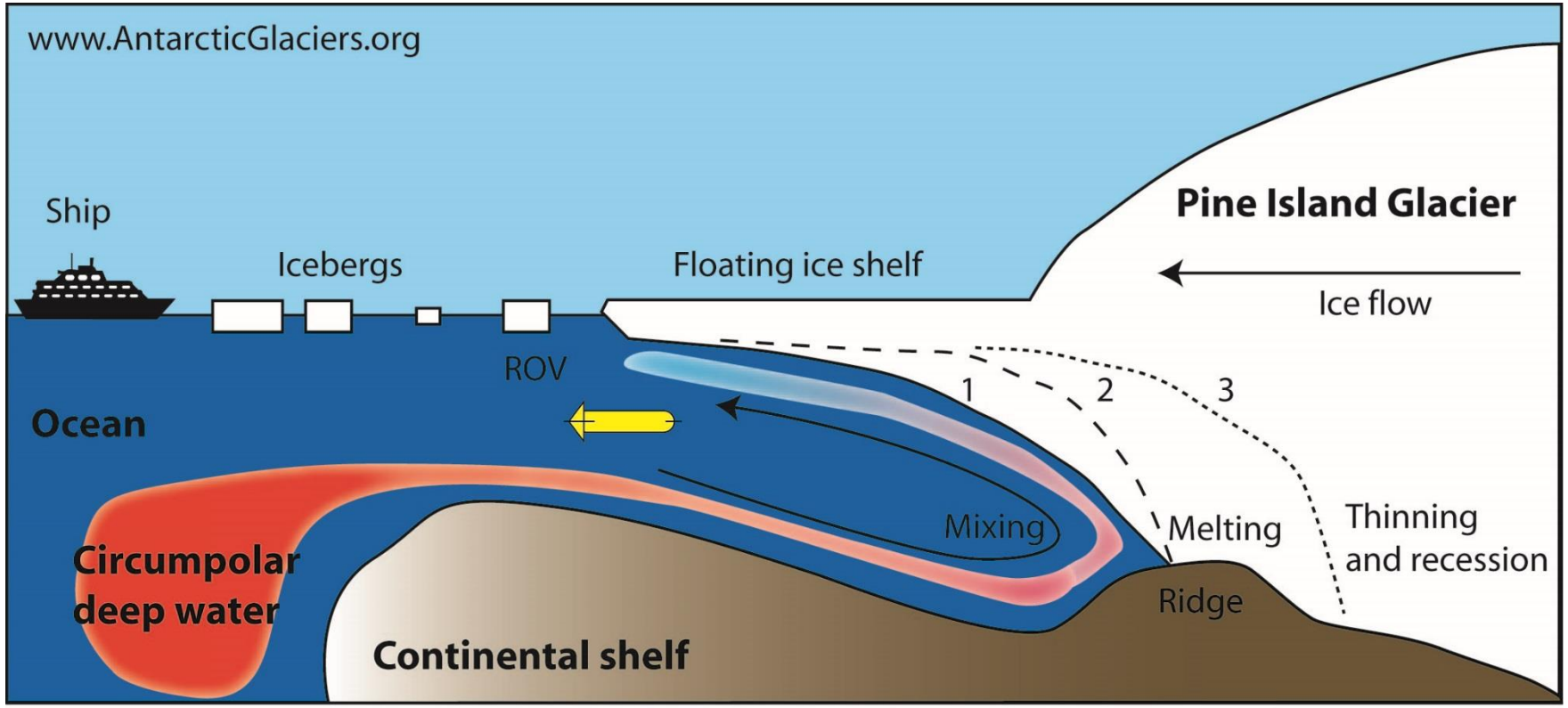
- Currently there is an intensely technical discussion among glaciologists & climatologists about how great is the risk of a catastrophic collapse of WAIS.
- It was decided to leave this *out* of the predictions of AR5, since it was felt the scientific uncertainties are still too great.
- What is uncertain is *how fast* WAIS and Greenland will melt; there is *no question* that if it gets only a degree or two warmer than it is now, enough of them will melt to eventually raise sea level by several m.
  - (When marine ice sheets in EAIS are affected, which would probably take a few centuries, we'd be looking at 15+ m.)

# Warning from a Glaciologist

- "West Antarctic ice sheet and $CO_2$ greenhouse effect:  A threat of disaster," J. H. Mercer, *Nature* 271, 26 January 1978, 321—5.
  - "One of the warning signs that a dangerous warming trend is under way in Antarctica will be the breakup of the ice shelves on both coasts of the Antarctic Peninsula, starting with the northernmost and extending gradually southward."
  - Larsen A (1995), Larsen B (2002), …
  - Mercer (*not* guilty of reticence!) also correctly predicted that the centre of WAIS would begin to thin.

John H. Mercer
1922—1987

# The Weak Underbelly of WAIS




1. Early 1970s. Pine Island Glacier is grounded at a bedrock ridge.
2. Warm, inflowing Circumpolar Deep Water melts the base of the glacier. The glacier steepens and accelerates.
3. Present day, observed by a remotely operated vehicle (ROV). Glacier is thinning and receding.

# Death by Calving Bay

- A marine ice dome can remain stable for tens of thousands of years, but if protective ice shelves crumble and the grounding line retreats inside the sill, a calving bay eventually opens up inside the basin.
- It brings warm sea water into the basin, risking rapid collapse of the ice sheet:
  - "…a relatively minor climatic fluctuation along the ice shelf calving barrier can unleash glacial dynamic processes independent of climate that cause calving bays to remorselessly carve out the living heart of a marine ice sheet."
    - T. Hughes, "West Antarctic Ice Streams," *Reviews of Geophysics and Space Physics* 15(1), February 1977, 43.

# Marine Ice Sheet Instability

- If a calving bay forms in WAIS, several processes take over *that are largely irrespective of air temperature*:
  - WAIS stands up to 1000 m above sea level; however, no ice cliff can stand more than about 100 m high since ice simply is not strong enough; thus, the walls of the calving bay will tend to collapse *rapidly*.
  - Simultaneously, it will crumble from below:  ice will lose compressive strength as warm sea currents soften it.
  - Ice will tend to float away from the sea bed; buoyancy will cause it to lift, fragment, and overturn.
  - Channels in seabed underneath Bentley Trench will carry warm seawater far underneath the sheet.

# Marine Ice Sheet Instability

- Pressure inside calving face could literally lead it to explode, analogous to rock bursts in a quarry.
- These processes will *accelerate* as the calving face eats its way deeper into the basin.
  - It is not out of the question that the collapse of the ice dome in the Bentley Trench could take only a few months.
- No glaciologist doubts that what I've described here is essentially what would happen if the sea water impinging on WAIS stays warm enough for long enough.
- Crucial question: *how long will this take?* I.e., *how much time do we have*?

# Good Philosophy from a Glaciologist

- “Nature’s best thermometer, perhaps its most sensitive and unambiguous indicator of climate change, is ice. When ice gets sufficiently warm, it melts. Ice asks no questions, presents no arguments, reads no newspapers, listens to no debates. It is not burdened by ideology and carries no political baggage as it crosses the threshold from solid to liquid. It just melts.”

  — Henry Pollack (*A World Without Ice*, Penguin/Avery, 2009, 114)

## References


(Anon.), n.d. Definition of Professional Misconduct; Ontario Regulation 538/84, Sect. 86, (1990).

Anderson, Kevin (2015). "Duality in Climate Science," Nature Geoscience 8, December 2015, 898-900.

Anthony S. (2012). "CERN now 99.999999999% sure it has found the Higgs boson," *ExtremeTech*. http://www.extremetech.com/extreme/143497-cern-now-99-999999999-sure-it-has-found-the-higgs-boson2012.

Brysse, K., Oreskes, N., O'Reilly, J., and Oppenheimer, M. (2013). "Climate change prediction: Erring on the side of least drama?" *Global Environmental Change* 23 (2013) 327–337.

Hansen, James (2007). "Scientific Reticence and Sea Level Rise," *Environmental Research Letters* 2 (2007), 024002.

Hughes, T. (1977). "West Antarctic Ice Streams," *Reviews of Geophysics and Space Physics* 15(1), February 1977, 43.

Lewandowsky, S., Risbey, J.S., Smithson, M., Newell, B.R., Hunter, J. (2014). "Scientific uncertainty and climate change: Part I. Uncertainty and unabated emissions." *Climatic Change* 124, 21-37.

Lewandowsky, S., Oreskes, N., Risbey, J.S., Newell, B.R. (2015). "Seepage: Climate change denial and its effect on the scientific community." *Global Environmental Change* 33 (2015), 1-13.

Lindley D. (2007). *Uncertainty: Einstein, Heisenberg, Bohr, and the struggle for the soul of science*. New York: Doubleday.

Mercer, John H. (1978). "West Antarctic ice sheet and $CO_2$ greenhouse effect: A threat of disaster,", *Nature* 271, 26 January 1978, 321—5.

Professional Engineers of Ontario (n.d.), *A Professional Engineer's Duty to Report* (Pamphlet).

Risbey, James S. (2008). "The new climate discourse: Alarmist or alarming?" *Global Environmental Change* 18 (2008), 26–37.