

# **“We’ll Always Have Paris”: Climate, COP21, and Why It Matters**

**Kent Peacock**

**Department of Philosophy  
University of Lethbridge**

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“We’ll always have Paris...”

# Where I'm Going With This

- COP21: what is it?
- Is COP21 going to save the world?
- The current (grim) scientific picture (including some aspects that are not well enough known...).
- Some philosophical take-aways.
  - (I haven't forgotten that this is a philosophy talk...)

# Autumn in Paris

- COP 21, the 2015 Paris Climate Conference (to be held Nov. 30 to Dec. 12 of this year in le Bourget).
  - COP = “Conference of the Parties to the United Nations Framework Convention on Climate Change” (UNFCCC).
    - Signed at Rio Earth Summit, 1992.
    - Now 195 member nations (including Canada!).
    - Aim of UNFCCC: "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system“.
    - Non-binding, no quantitative targets.
    - Kyoto Protocol of 1997 tried to set targets, but failed due to non-compliance.
  - Aim of COP21: attempt to arrive at a binding international agreement to limit global warming to no more than 2°C above pre-industrial levels.
    - (We are currently around 0.8°C.)

# INDCs

- Most member nations (147 in total) have submitted their “Intended Nationally Determined Contributions” (INDC).
  - Pledge to reduce emissions by a certain target.
- Canada’s is behind the EU and also possibly dishonest, or at least murky.
  - (See <http://www.carbonbrief.org/mismatched-graph-creates-confusion-in-canadas-un-climate-pledge/> ).
  - Perhaps we’ll have a revised INDC after Oct. 19...

# Will INDCs Do the Job?

- A recent study (<http://www.theguardian.com/environment/2015/oct/10/climate-2c-global-warming-target-fail>) has done the math.
- Current world carbon emissions:  $\approx 50$  Gigatonnes/year
- Even if all pledges are met, we will hit 55 to 60 GT/year by 2030.
- This implies temperature increase around  $2.7^{\circ}\text{C}$ , probably by 2100 or sooner.
- Therefore, current INDCs are *not* sufficient to make the  $2^{\circ}\text{C}$  limit!

# The 2°C Guardrail

- But is the 2°C “guardrail” itself enough to prevent catastrophe?
  - *Probably NOT.*
- The 2°C limit is supposed to be the increase up to which we would still be able to avoid run-away effects of global carbonization (such as massive methane releases, ice-sheet collapse, oceanic die-off).
  - Tipping point: when positive feedbacks take over and temperature and other parameters increase rapidly and uncontrollably to a regime incompatible with the continued existence of human civilization.
- The 2°C limit was an *educated guess* based on 1990s climate science.
- Most scientists now fear that it is *way too high!*

# What the IPCC Says

- IPCC: Intergovernmental Panel on Climate Change.
- In October 2013 the latest IPCC Assessment Report (AR5) was released.
- Earlier predictions of warming have stood up very well.
- 95% certainty that observed warming is human-caused.
  - Up from 90% in 2007.
- Bottom line:
  - “Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.”
    - Summary for Policymakers, IPCC AR5, SPM-13



# What IPCC AR5 Did *Not* Tell Us

- Critics of the IPCC accuse it of wild-eyed alarmism; in fact, it is *extremely* conservative; represents cautious consensus of 100s of scientists, with governments looking over their shoulders.
- One major concern was under-emphasized because of scientific uncertainties involved:
  - Possible sea level rise (SLR) due to “ice sheet dynamics.”

# Sea Level Rise

- AR5 remains *conservative* in its prediction of sea level rise.
- This is *very important*, and still not well enough understood, so let's talk about this a bit...
- Sea level can and does rise by several means:
  - Thermal expansion
  - Melting of mountain glaciers and icefields
  - Melting of continental glaciers (Greenland & Antarctica)
  - Collapse of grounded marine ice sheets (such as WAIS, the Western Antarctic Ice Sheet)
    - The latter is not well known outside the circle of professional glaciologists—although it is finally receiving attention because of some recent studies.

# Sea Level Rise

- IPCC: depending on how much emissions occur over next few decades, highest model range is 0.52 to 0.98 m SLR by 2100.
- Very bad; represents disaster for hundreds of millions of people.
- But this estimate *does not include collapse of the West Antarctic Ice Sheet* (WAIS).
- Why should we worry about WAIS?



# Warning from a Glaciologist

- “West Antarctic ice sheet and CO<sub>2</sub> 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 also correctly predicted that the centre of WAIS would begin to thin and flow faster.



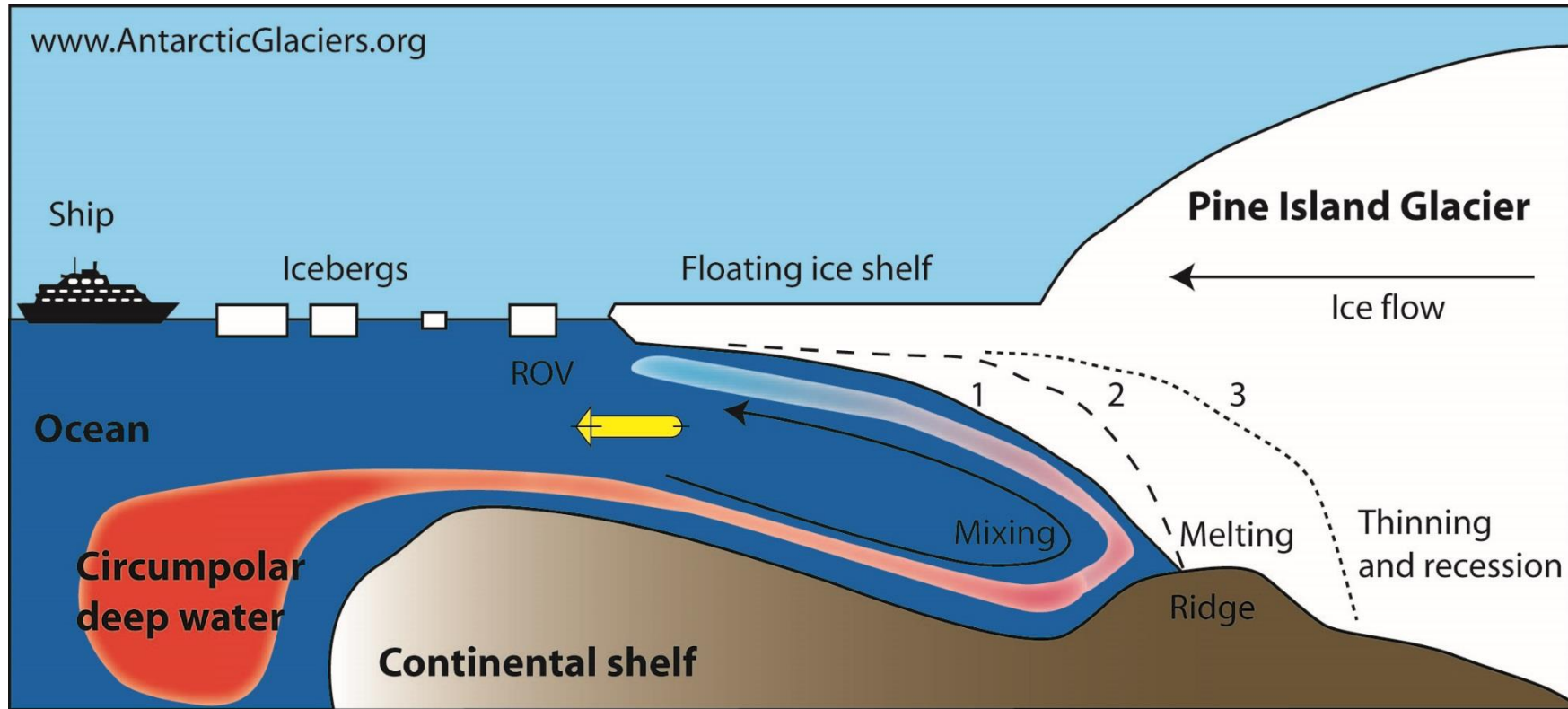
John H. Mercer  
1922—1987

# WAIS: The Restlessly Slumbering Giant

- WAIS (Western Antarctic Ice Sheet) is a grounded marine ice sheet:
  - Mountain of ice filling up a large basin (Bentley Trench) that is up to 2500 m below sea level.
- 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 sheets, they can collapse *catastrophically*, possibly even within a few years or *months* (though this remains uncertain).
  - “Marine Ice Sheet Instability”
- Collapse of Bentley Trench would cause sea level to rise by about 3.3 m.
  - There are two other major grounded ice sheets in East Antarctica that are also each good for at least 3 m.



# 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.

# Mercer Called It

- Two recent studies show that WAIS collapse is inevitable because major outflow glaciers (such as Pine Island, Thwaites) have thinned, accelerated, and their grounding lines are retreating back toward deep interior basins.
- Joughin et al. estimate collapse of Thwaites sector to occur within a “few centuries” but emphasize the uncertainties.
  - In particular, “our simulations also assume that there is no retreat of the ice-shelf front.”
    - (I. Joughin *et al.*, Science 344, 2014, 738; see also E. Rignot, Geophys Res Lett 41(10), 2014.)
  - Why does that matter?



# Death by Calving Bay

- A grounded marine ice sheet can remain stable for tens of thousands of years, but if the grounding line retreats inside the sill, a calving bay 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 inside the sill, 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 WAIS will carry warm seawater into the centre of the Trench.

# 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.
- Some glaciologists fear that the combination of these mechanisms (pressure, collapse of ice cliff, undermining by warm sea water, hydrofracturing) could clear out the Bentley Trench in literally a matter of *months*.
  - (See D. Pollard, R.M. DeConto, R. Alley, Earth and Planetary Science Lett 412, 2015.)
- (Bentley Trench  $\approx$  3.3 m of SLR)

# The Clock Is Ticking

- 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 much time do we have?*
  - Note that 80% to 90% of extra heat due to global warming has gone into the seas: even if we entirely stop CO<sub>2</sub> emissions almost immediately, it is going to take a long time for that excess heat in the oceans to dissipate.
  - It is almost certainly this excess heat that is driving the warming of the circumpolar currents that threaten WAIS.
- Meltwater pulses from end of last glaciation (ca 14 kya) show that sea level on rare occasions can rise several metres per *century*.

# One More Prediction from Mercer (1978)

- “If the CO<sub>2</sub> greenhouse effect is magnified at high latitudes, as now seems likely, deglaciation of West Antarctica would probably be the *first* [my emphasis] disastrous result of continued fossil fuel consumption.”
  - We now *know* that the GH effect is indeed “magnified at high latitudes.”
  - In fact, there is some evidence from paleoclimate that in past warm interglacials, WAIS tends to collapse *early* in the warming phase, precisely as Mercer predicted.
  - Collapse of WAIS in late Eemian (ca. 120 thousand years ago) occurred in temperature range only slightly higher than now, with CO<sub>2</sub> at 280 ppm!
    - (We are currently at 400 ppm; the last time the world had such CO<sub>2</sub> levels, in the Pliocene, sea levels were probably 15—25 m higher than now.)

# The Methodological Problem

- It is a mistake to suppose that we need not plan for an event such as collapse of WAIS because we cannot predict precisely when it will happen.
  - And yet, the difficulty of predicting possible ice sheet collapse has encouraged scientists to be “reticent” (Hansen, 2007) about this very significant risk.
- What we *can* predict with confidence is the range of key parameters (such as position of glacial grounding line, ocean current temperatures, or CO<sub>2</sub> concentration) within which collapse becomes highly probable.

# Getting Back to the 2°C Limit

- All of this is why many scientists (including James Hansen) fear that allowing temperatures to climb to 2°C puts us too close, if not inside, the parameter regime that would allow for *multimetre, rapid* collapse of WAIS and possibly even the major grounded ice sheets in East Antarctica.
  - (And let us not forget about Greenland!)
  - (And methane emissions from the high Arctic...)
  - (And... and... )

“Our analysis paints a different picture than IPCC (2013) ... if GHG emissions grow at a rate that continues to pump energy at a high rate into the ocean. We conclude that multi-meter sea level rise would become practically unavoidable. Social disruption and economic consequences of such large sea level rise could be devastating. It is not difficult to imagine that conflicts arising from forced migrations and economic collapse might make the planet ungovernable, threatening the fabric of civilization.”

James Hansen et al. (2015): Atmos. Chem. Phys. Discuss., 15



# My Personal Guesstimate...

- Bearing in mind that IANAG (I Am Not A Glaciologist), my own guess is that barring a technological miracle (Star Trek technology that will totally replace fossil fuels as an energy source overnight and also allow us to almost immediately reduce  $[CO_2]$  to 350 ppm or less) there is not much chance that we can avoid SLR of at least 1 m by 2100, and I also think there is significant risk of quite a bit more.
  - Even if we arrive at emissions agreements far stronger than what COP21 is likely to produce.

# A Policy Goal that Makes Scientific Sense

- Hansen et al. (2015) point out that the planetary heat imbalance is about  $0.6 \text{ Watts/m}^2$ , due to greenhouse warming.
  - (Adds up to about 400,000 Hiroshima bombs/day).
- The most sensible goal is to do what it takes to return the planet to heat balance—or even a negative heat balance for a few decades.
- This would be an enormous challenge, both technically and politically—but that's what makes *scientific* sense.

# What About COP21?

- Does this mean that the Paris Conference is a waste of time?
- No:
  - Calculations show that even the present INDCs give us a chance of keeping the 2°C target within reach (and thus of eventually doing better).
    - (See <http://thinkprogress.org/climate/2015/09/28/3706024/paris-co2-pledges/> ).
    - It could be 3.7°C without COP21.
  - Most important, it helps to create an international political and institutional framework that will allow us to keep talking and make it easier to take the next steps.
- Humanity has to learn how to “think globally and act globally.”
  - (Cf. the patronizing, “Think globally and act locally.”)

# A Philosophical Take-Away

- 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)

## By Contrast...

- Bad philosophy from an eminent pragmatist:
  - “[T]here are no constraints on inquiry save conversational ones... only those retail constraints provided by the remarks of our fellow-inquirers... [I]t is useless to hope that objects will constrain us to believe the truth about them...”
    - Richard Rorty, “Pragmatism, Relativism, and Irrationalism.” Proc APA, 53, 1980.
- The last hundred and fifty years have been a period of unusual abundance, which made it possible for philosophers to make fatuous remarks such as this.

# Non-Conversational Constraints

- We could get into an intriguing philosophical analysis of exactly what it could mean to talk about the “truth” about WAIS.
- However, it is clear that whatever WAIS may do will constrain our conversations in important ways.
- Most important: WAIS is not something or someone with which we can *negotiate*—we cannot “cut a deal” with a grounded marine ice sheet.
  - It simply has requirements which we must understand and respect, if we wish to continue *our* conversations for much longer.

# Reality Knocks at the Door

- The glaciers are sending us a reminder that there is a level of reality (pardon me for using a rude word) that is non-negotiable, non-political, non-linguistic, non-social—non-human.
- The 2°C “guardrail” had some basis in 1990s science, but it has now taken the role of a negotiating point, a “deal” we can live with.
- The “other side” (i.e., the realm of the ice-sheets and oceans) is not listening...

# Hazards of Abundance

- Philosophy has not done a good job of acknowledging this level of reality:
  - We have endless talk about the social construction of reality, the Quinian web of concepts, the theory-ladenness of observation, the importation of many kinds of biases (based on class, gender, economic, interests) into science, conversational constraints on inquiry, the magical power of the 'free market' to overcome any form of scarcity if it wants to, etc.
- That which is non-negotiable has receded into the background.
- This is a product of ecological abundance: with a full belly and a roof over his or her head, the social constructivist philosopher can enjoy the luxury of quibbling disputation over the various ways in which human beings define their “realities.”
  - When sea-water comes in the front door, this is over!



# A Hope for the Future

- Perhaps one of the few salutary consequences of impending global ecological collapse will be a rapid improvement in the quality of philosophizing.
- We can hope!