Negotiating to Avoid "Dangerous" Climate Change

Scott Barrett

Columbia University

Politics of "dangerous" climate change

- Framework Convention says that atmospheric concentrations of greenhouse gases should be stabilized "at a level that would prevent *dangerous* [my emphasis] anthropogenic interference with the climate system."
- Copenhagen Accord recognizes "*the scientific view* [my emphasis] that the increase in global temperature should be below 2 degrees Celsius."

Science of “dangerous” climate change

What is “the scientific view”?

Scientific thresholds for "dangerous" climate change

Study	Threshold	Rationale
IPCC TAR (2001)	"Reasons for concern," with red embers beginning at 1-2˚C, 2-3˚C, and 4-5˚C for different categories.	Risks to unique and threatened systems; extreme events; distribution of impact; aggregate impacts; large-scale discontinuities.
Smith et al. (2009)	Updating above, values from 0-1˚C, 1-2˚C, and 2.5˚C.	"…smaller increases in GMT are now estimated to lead to significant or substantial consequences" for the "reasons for concern."
Rockstrom et al. (2009)	350 ppmv CO_2 and radiative forcing of 1 Wm^{-2} above pre-industrial levels.	Climate sensitivity ignores slow feedbacks; stability of large polar ice sheets; instability of Earth's sub-systems.
Hansen et al. (2007)	1˚C relative to 2000 (or about 450 ppm CO_2)	Ice sheets
Hansen et al. (2008)	350 ppm CO_2	Taking into account slow feedbacks, ignored by "climate sensitivity."

Scientific thresholds for "dangerous" climate change

Study	Threshold	Rationale
O'Neill and Oppenheimer (2002)	450 ppm CO_2	"…would likely preserve the option of avoiding shutdown of the THC and may also forestall the disintegration of WAIS, although it appears to be inadequate for preventing severe damage to [coral reef ecosystems]…."
Oppenheimer and Alley (2005)	2-4˚C	WAIS.
Oppenheimer (2005)	2˚C relative to 2005	More conservative value in above range.
Mastrandrea and Schneider (2004)	"…optimal climate policy… can reduce the probability of dangerous anthropogenic interference from ~45% under minimal controls to near zero."	Cumulative density function of the threshold for dangerous climate change, applied to DICE.

Scientific thresholds for "dangerous" climate change

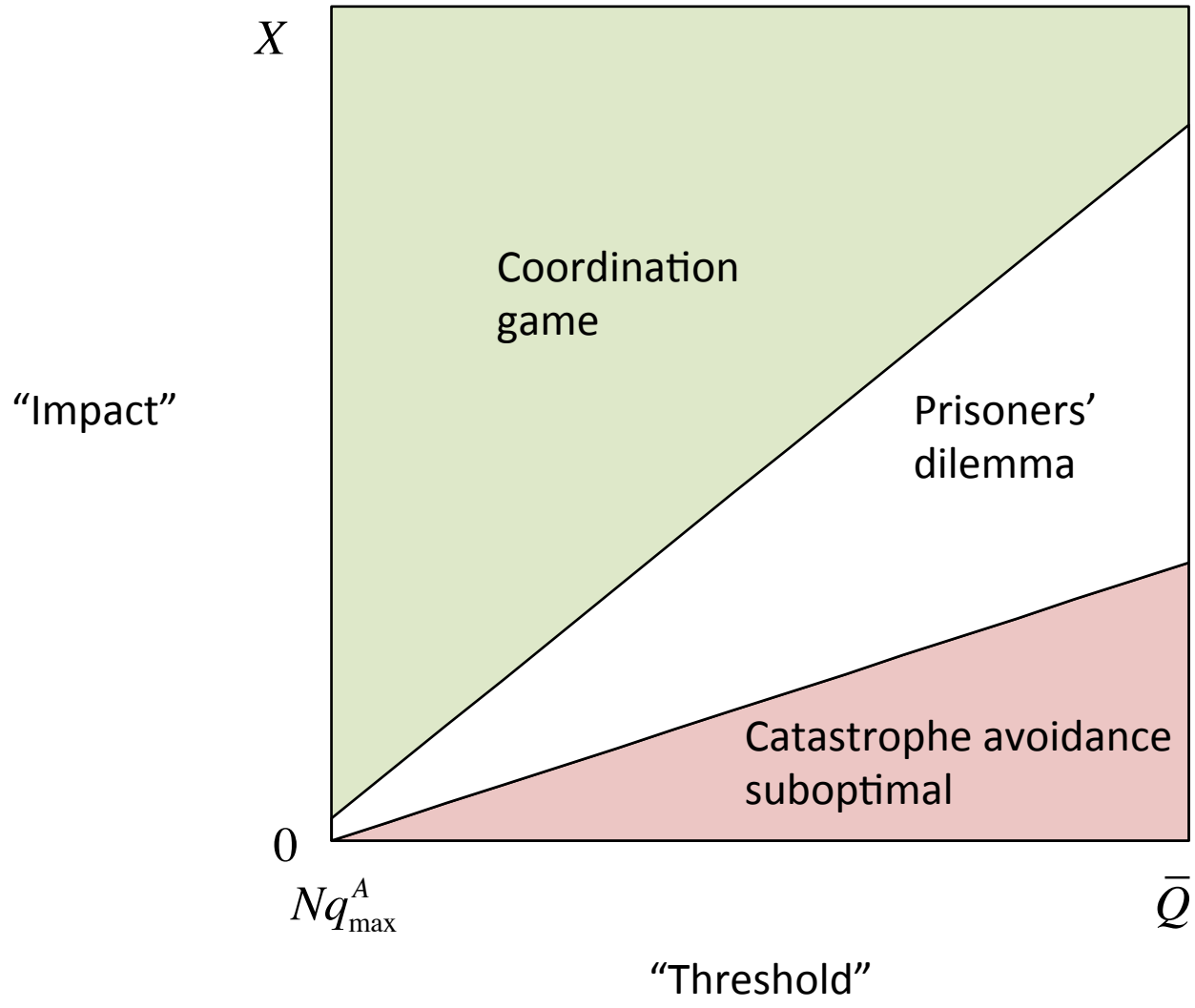
Study	Threshold	Rationale
Lenton et al. (2008)	Clusters of tipping points at 0.5-2˚C and 3-6˚C relative to 1980-1999.	Instabilities in geophysical sub-systems.
Lenton (2011)	Favours multidimensional approach, to include radiative forcing, rate of climate change, local temperature change, and non-GHG forcing agents.	Critical of "global warming" temperature targets, because physical systems respond to different metrics.

“The scientific view” of “dangerous” climate change

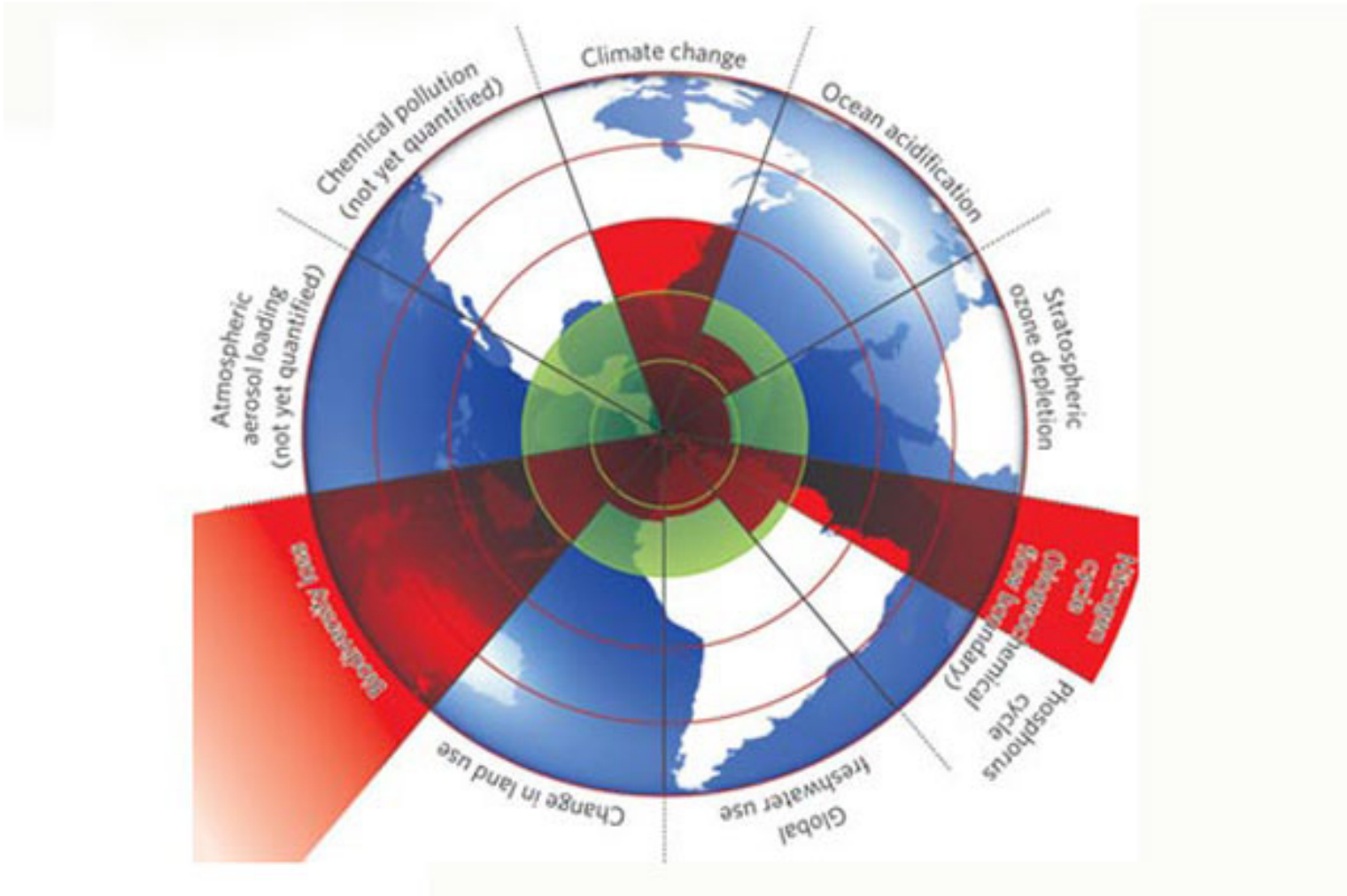
“The literature confirms that climate policy can substantially reduce the risk of crossing thresholds deemed dangerous.”

IPCC AR4 (Metz et al. 2007: 100)

The Simple Game Theory of "Dangerous" Climate Change Certainty



Planetary boundary

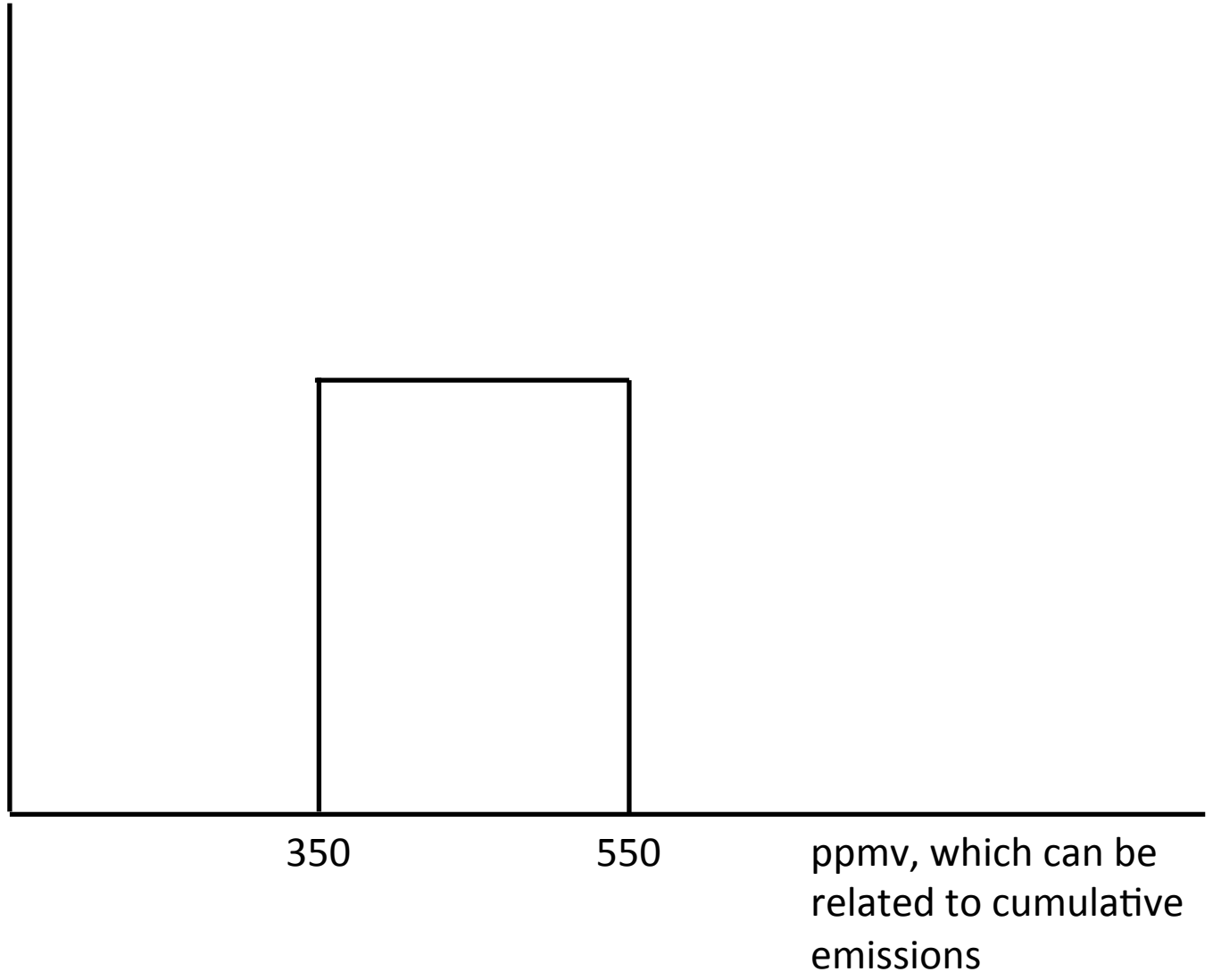


350 ppm CO_2

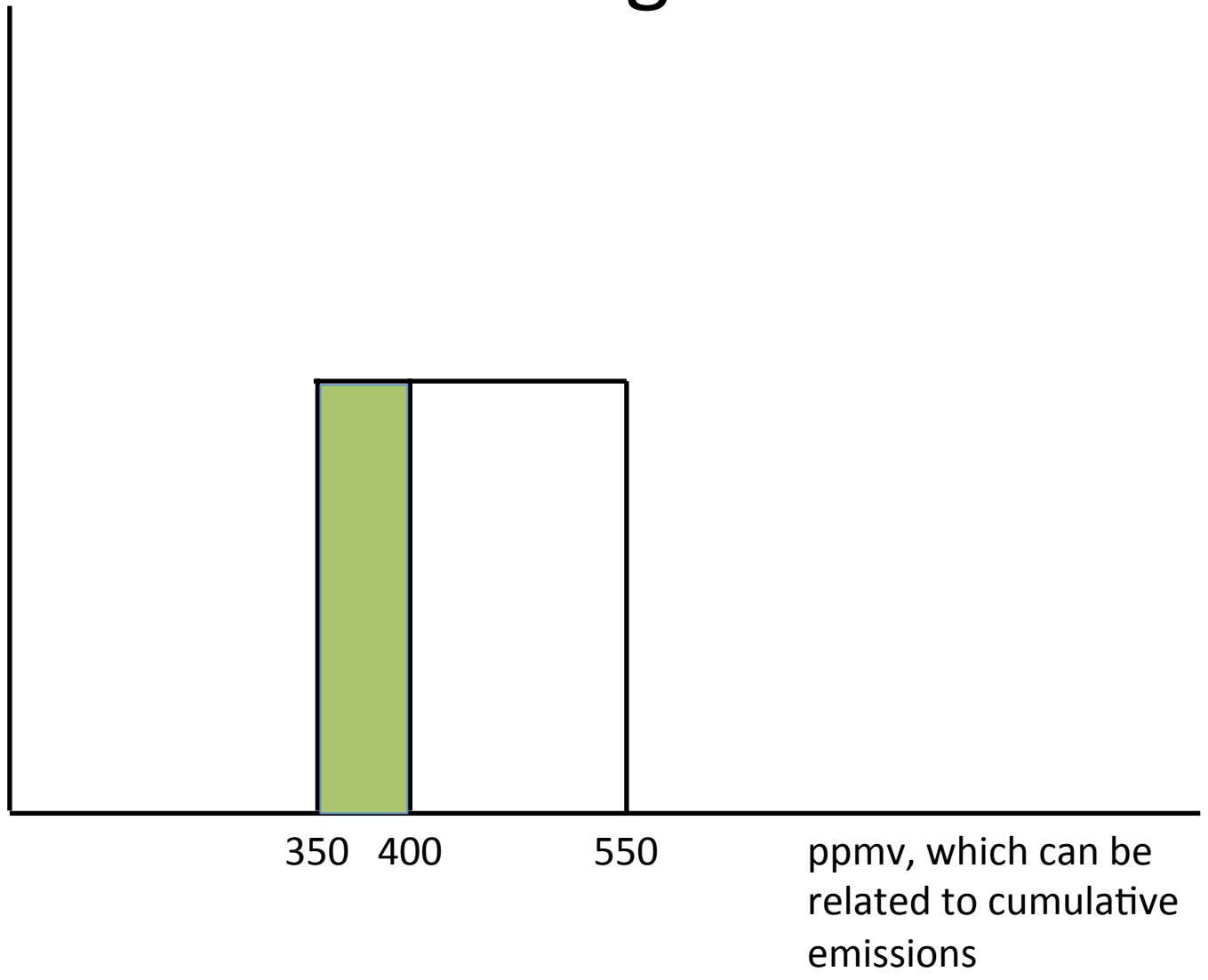
Planetary boundary

- One reason for picking this threshold is stability of the large polar ice sheets.
- "…the planet was largely ice-free until CO_2 concentrations fell below 450 ppmv (± 100 ppmv), suggesting that there is a critical threshold between 350 and 550 ppmv.
- "Our boundary of 350 ppmv aims *to ensure* [emphasis added] the continued existence of the large polar ice sheets."

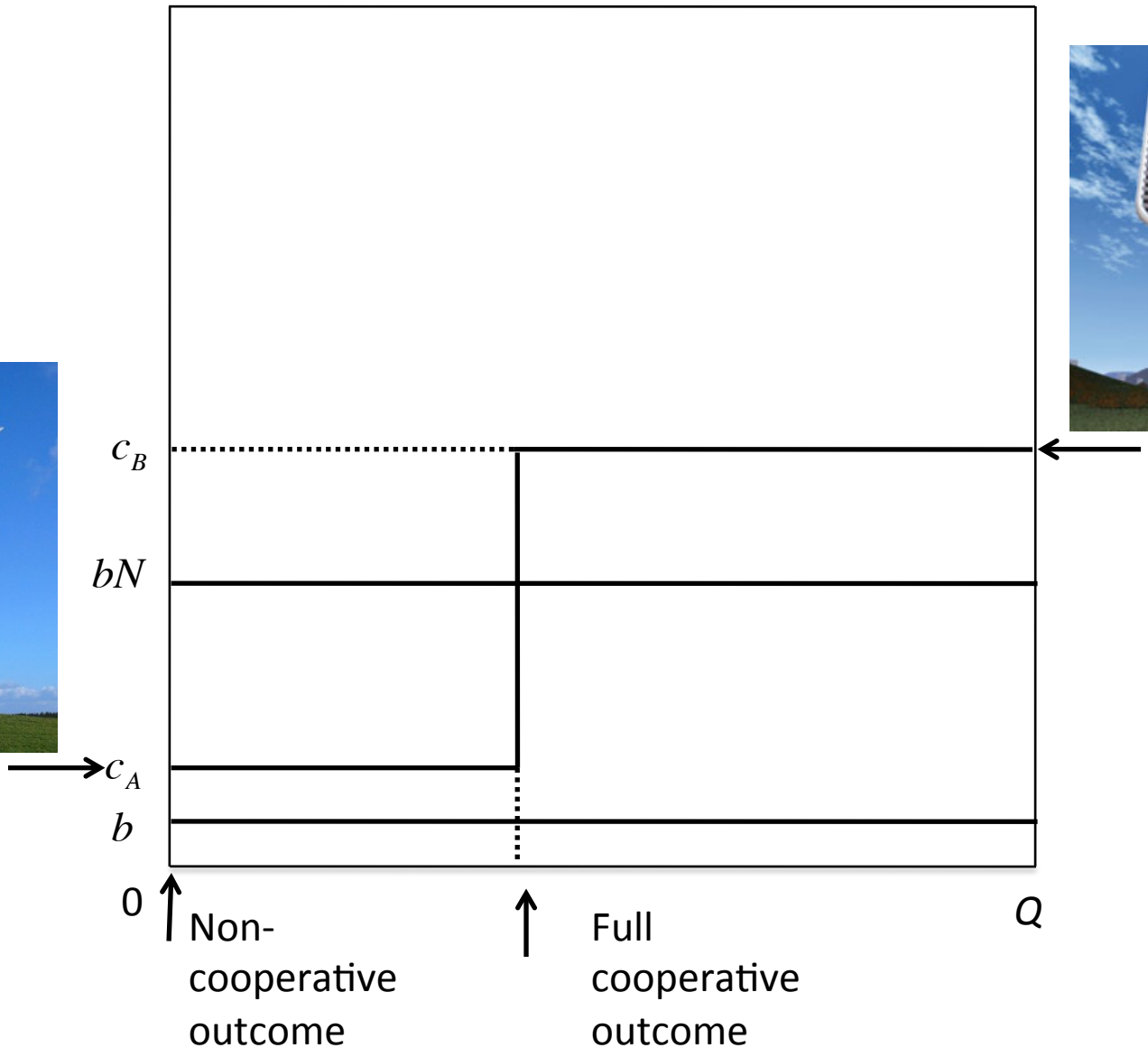
Threshold Uncertainty--pdf



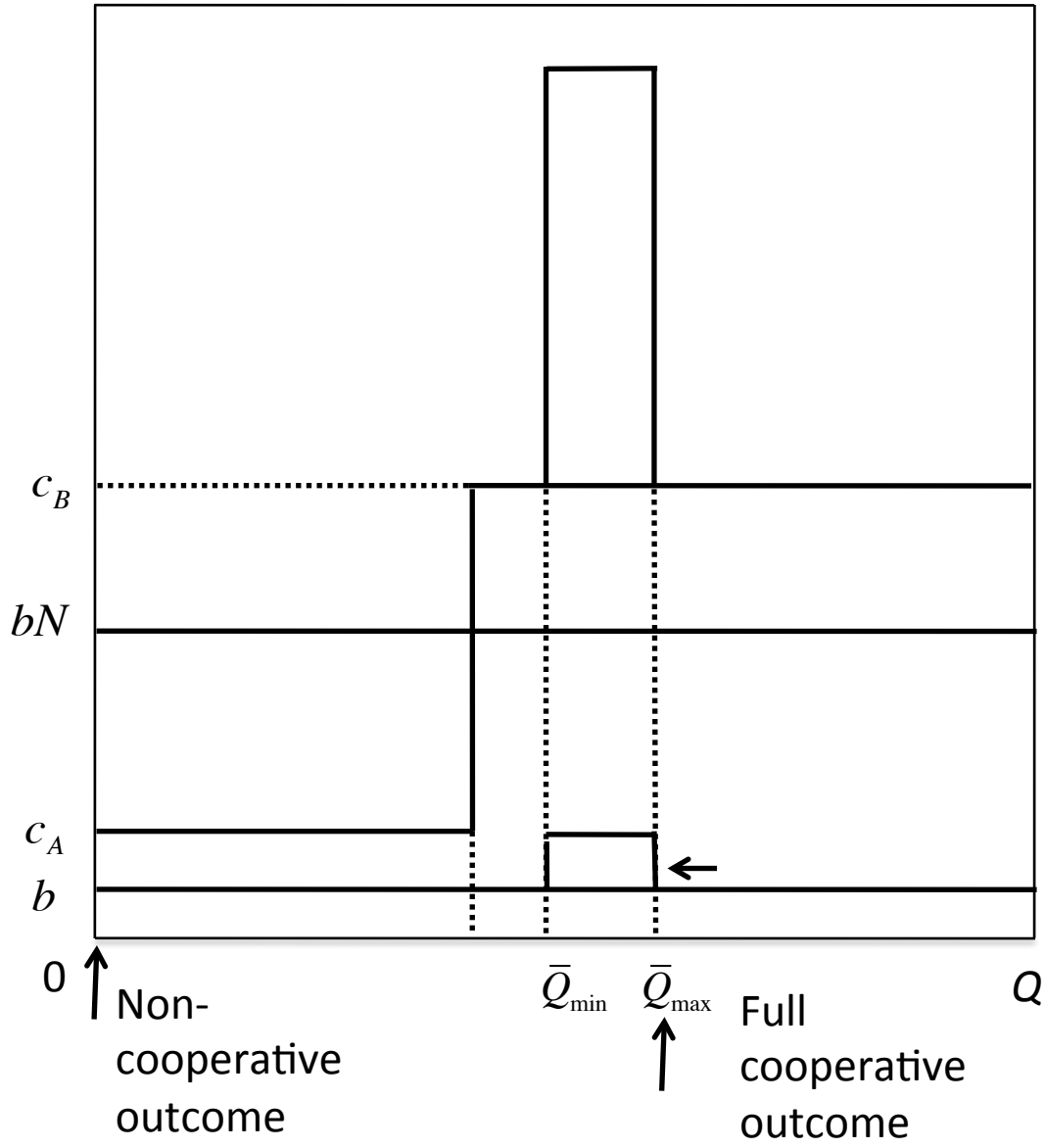
Probability of “Dangerous” Climate Change



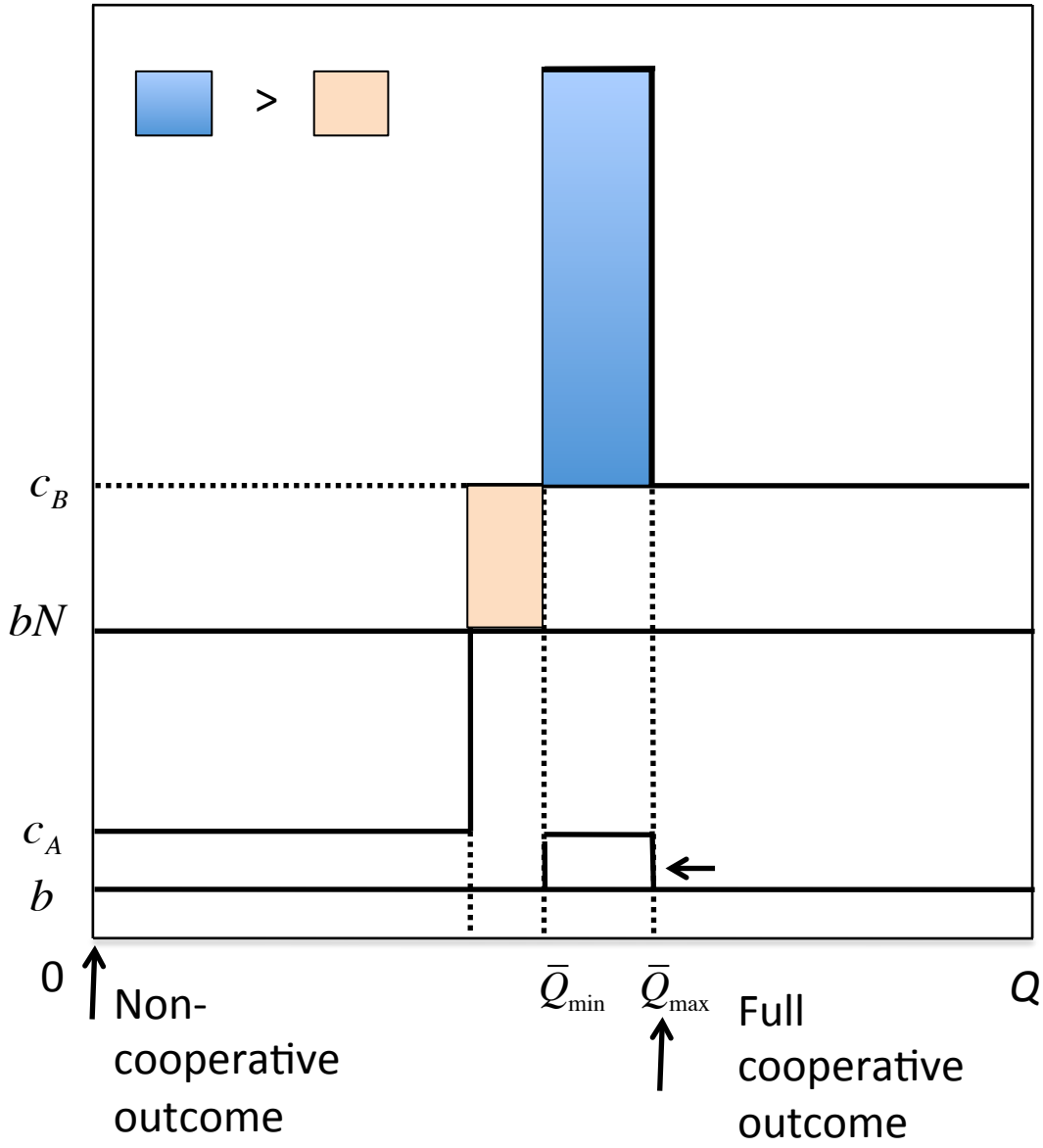
Game theory of “gradual” climate change



Game theory of “dangerous” climate change



Game theory of “dangerous” climate change



Threshold Uncertainty

Restores the Prisoners' Dilemma

Implications

- The central challenge remains enforcement.
- There are ways to increase cooperation.
    - New protocol on HFCs, etc.
- But there will remain a chance that we will cross a “dangerous” threshold.
- What then?
    - Geoengineering?
    - Air capture?