

A landscape photograph of a volcanic area. In the foreground, a rocky, dark path leads up a hillside covered in sparse green moss. A person in a red and black plaid shirt is walking away from the camera. In the middle ground, a wide, light-colored river flows through a valley between dark, rocky hills. Other people are visible in the distance. The sky is overcast with grey clouds.

Complexity and Uncertainty of Human Feedbacks to Climate Change

Brian Beckage

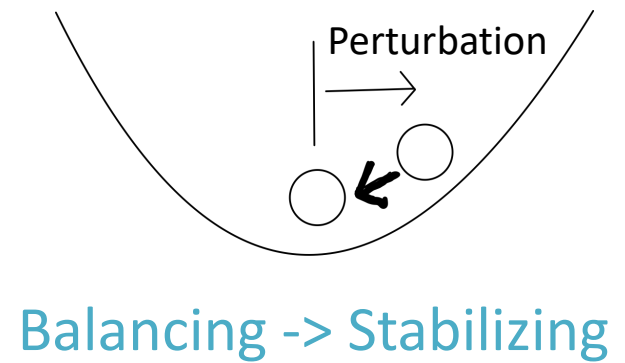
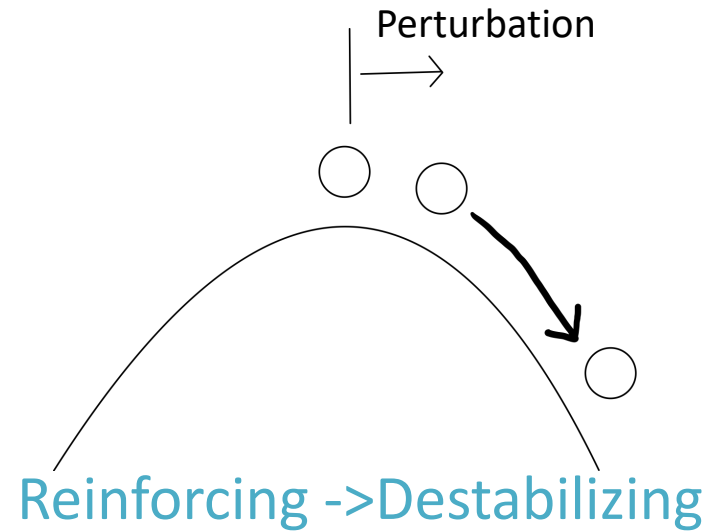
Plant Biology & Computer Science University of Vermont



Feedbacks

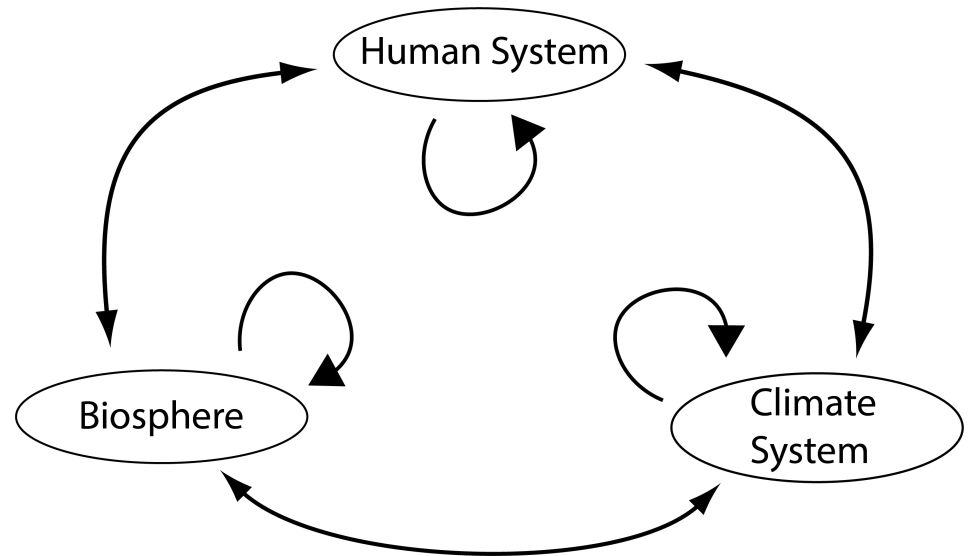
- Reinforcing
 - Positive feedback:
Change leads to more change
- Balancing
 - Negative feedback:
Change leads to pushback against change

Feedbacks

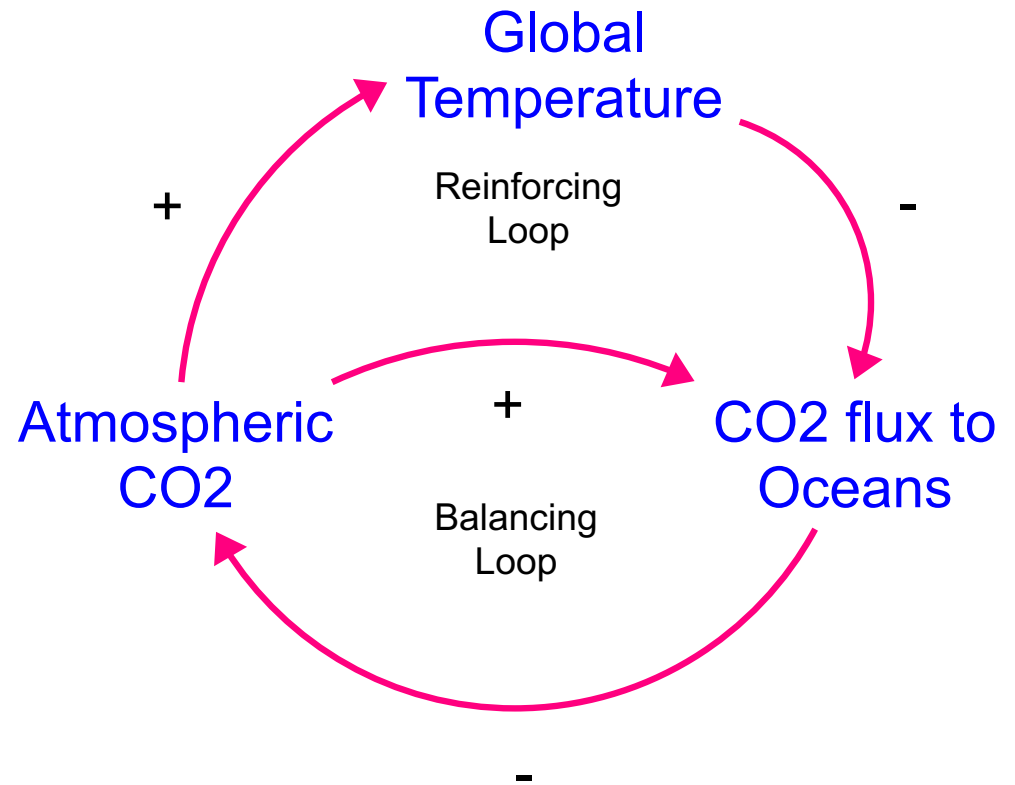


Feedbacks to climate change

Earth System

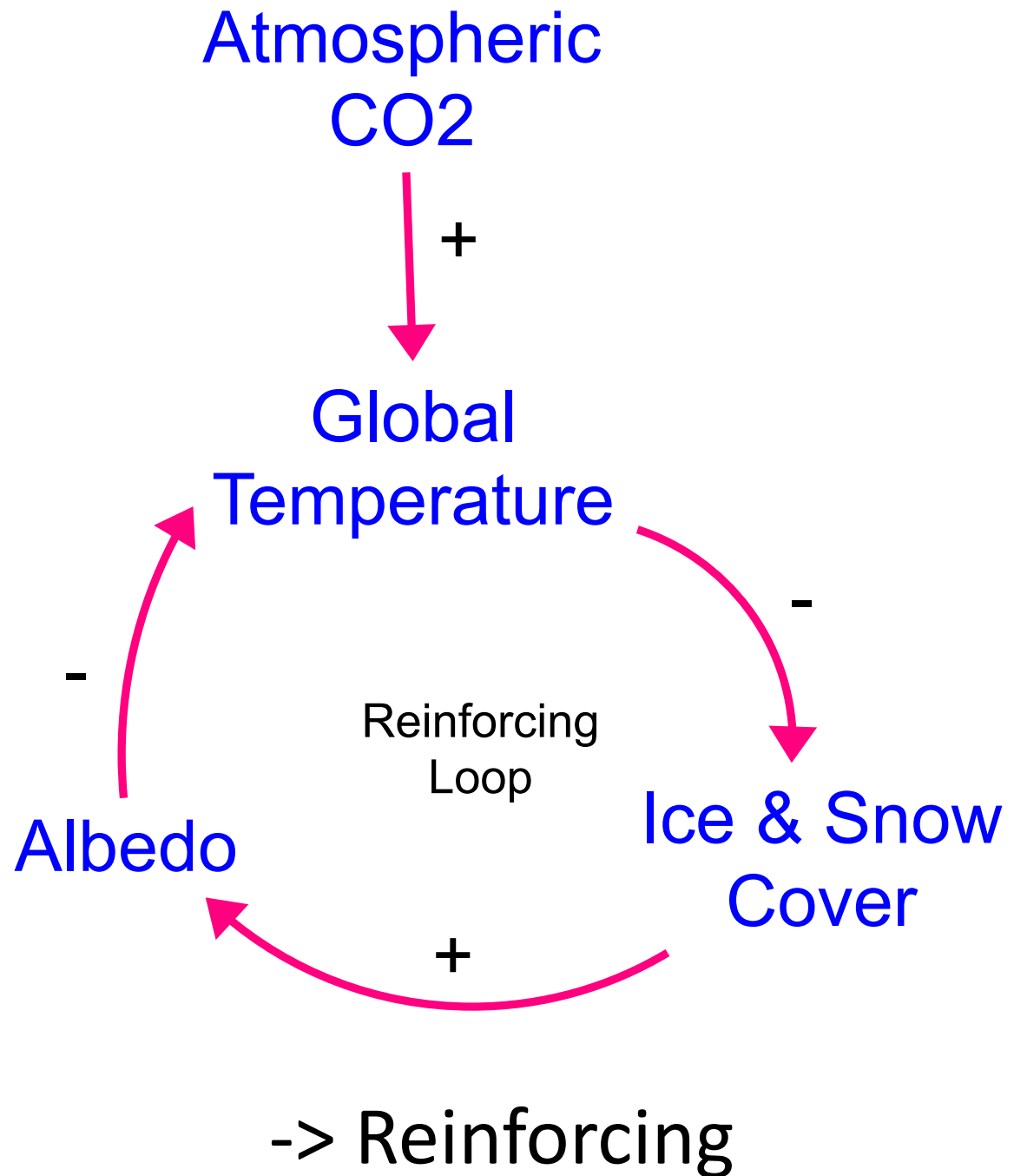


Ocean Feedback

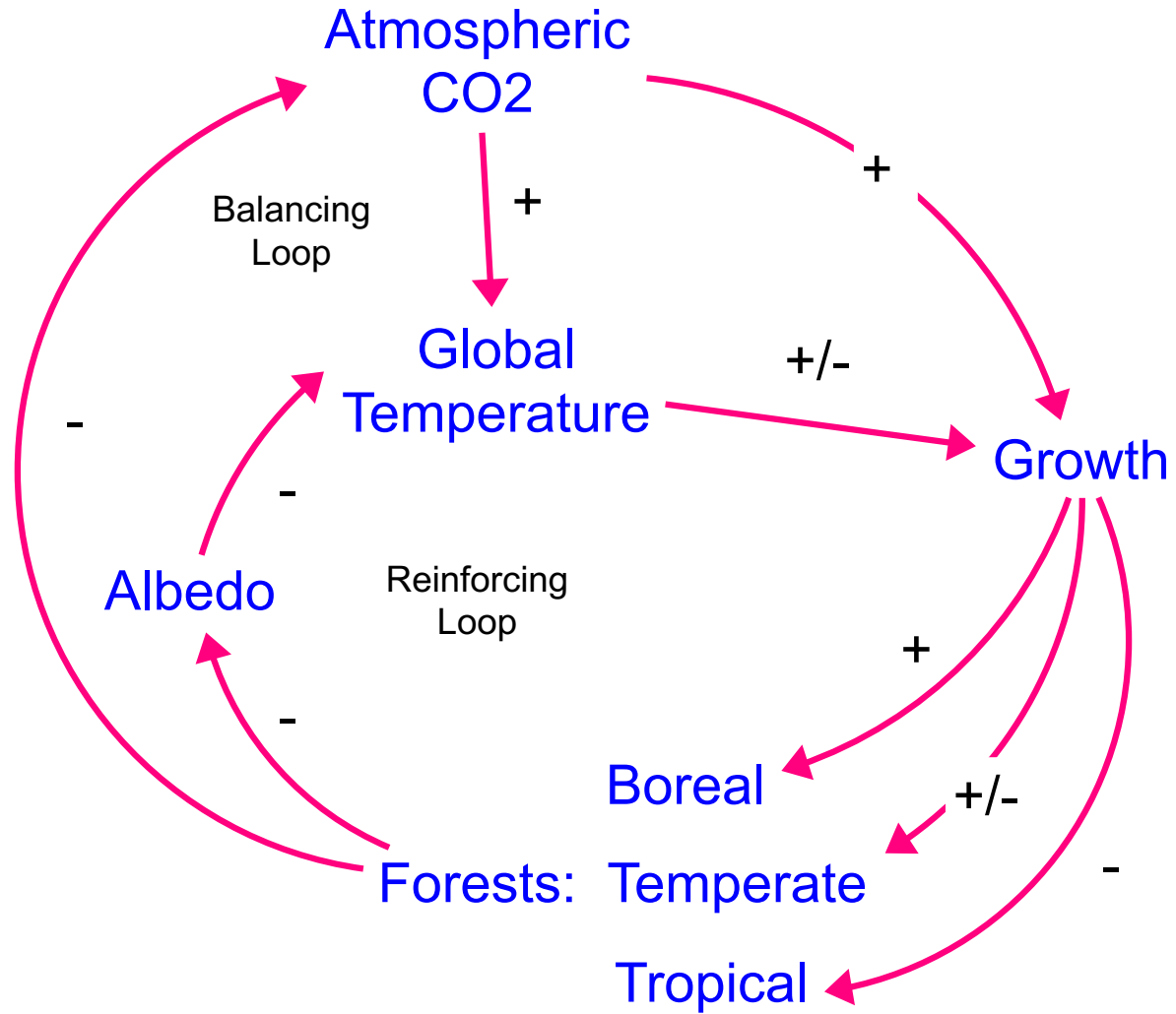


-> Reinforcing

Albedo Feedback

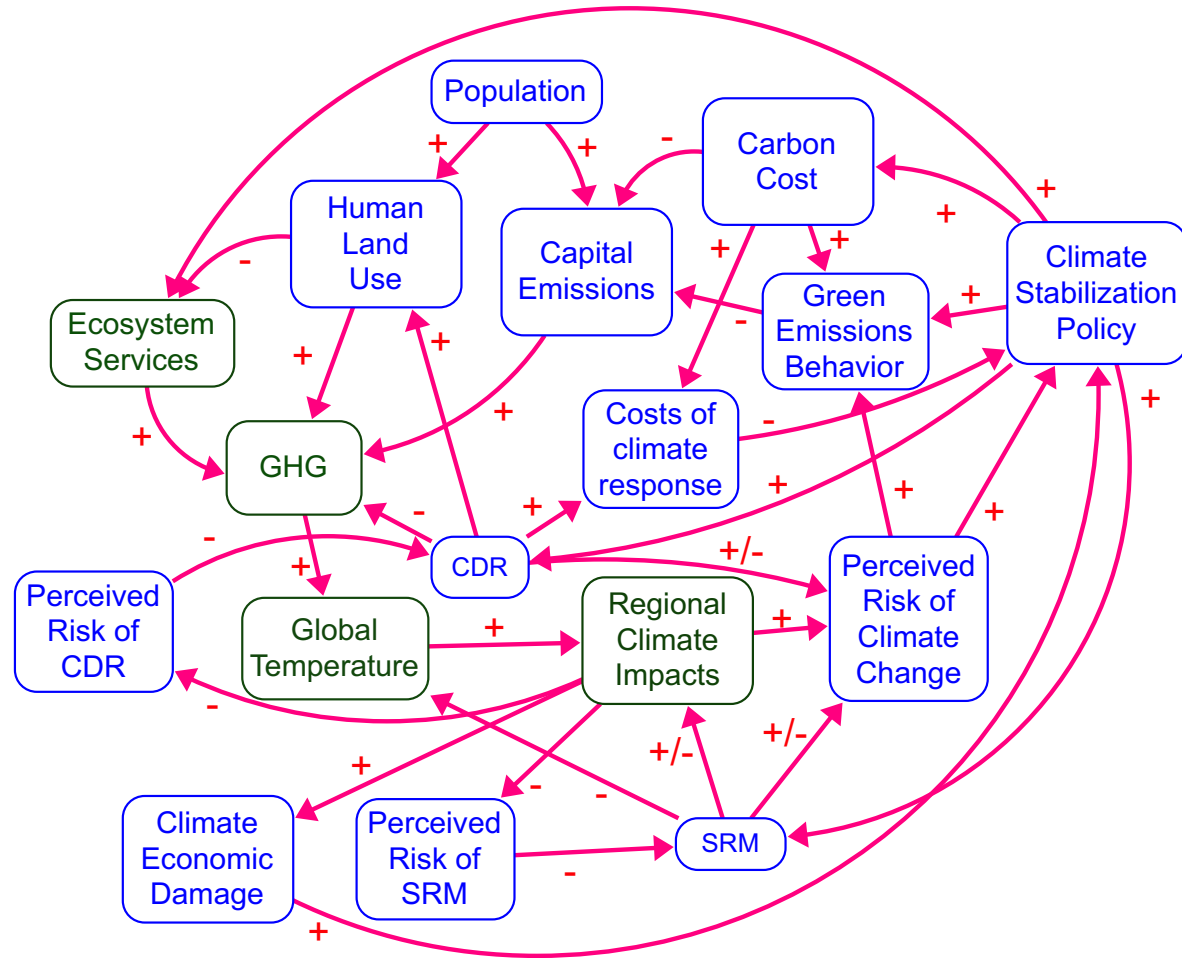


Forest Feedback



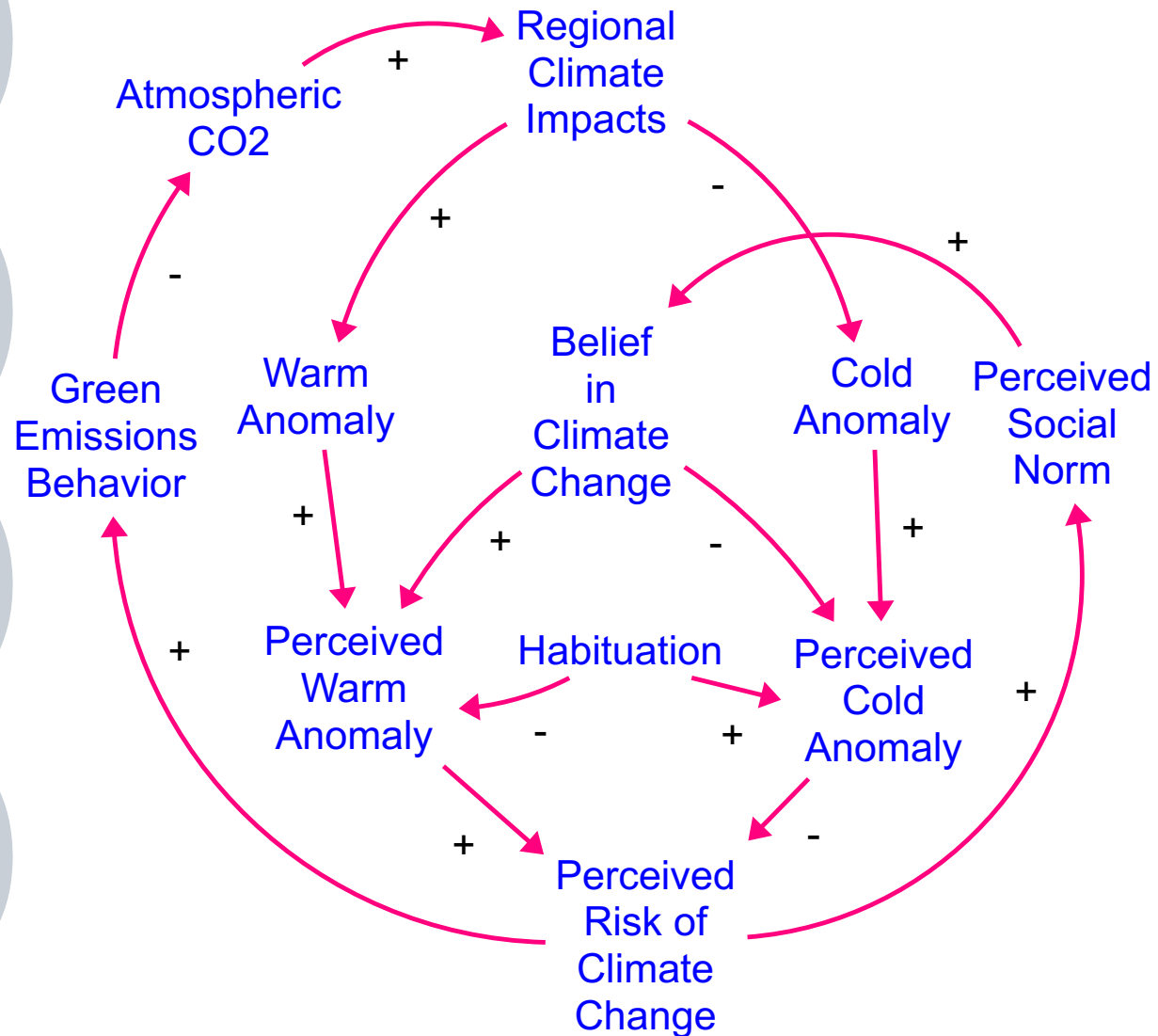
-> Weakly Balancing?

Human feedbacks to climate change



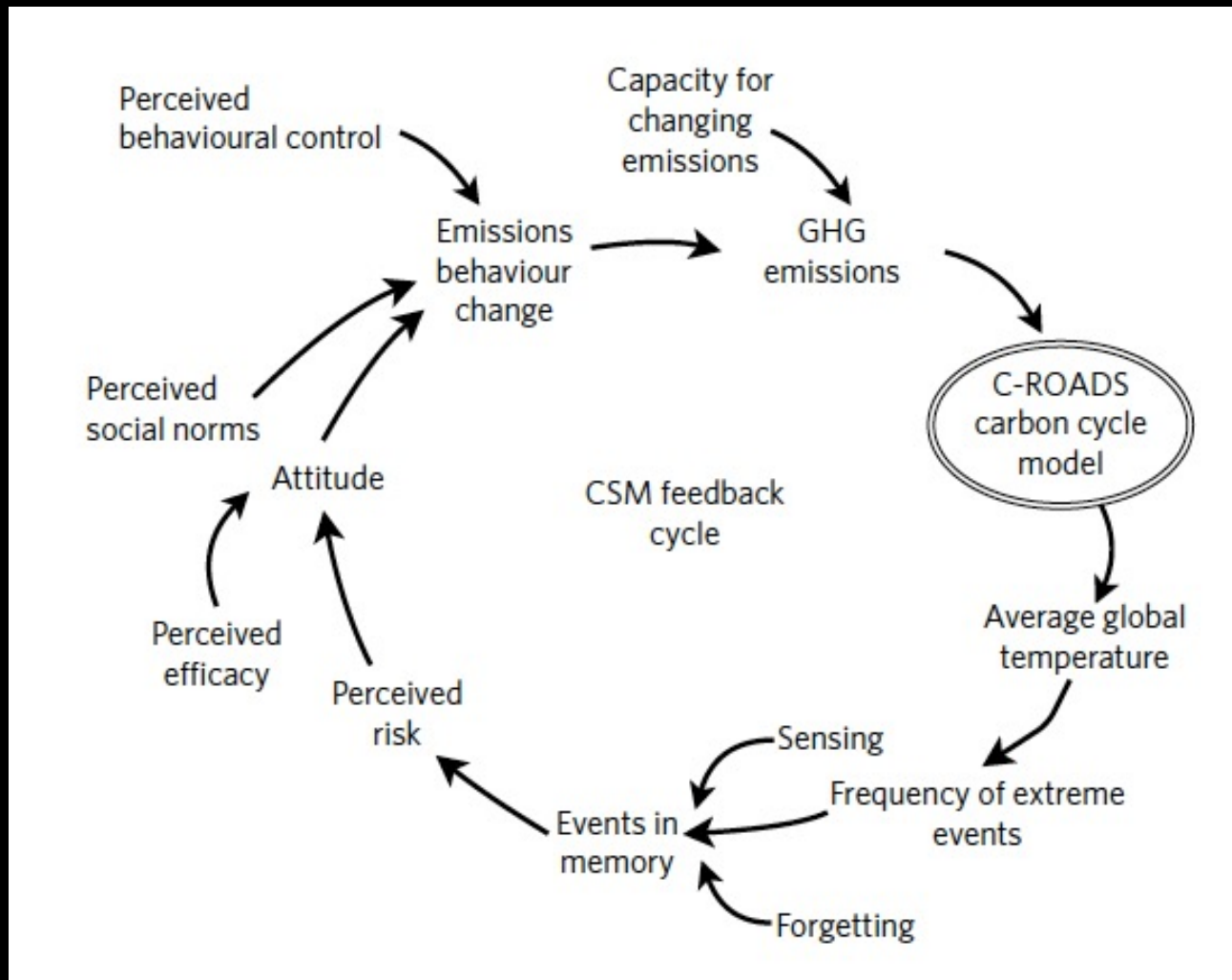
-> Complex set of potential
feedback loops

Biased Assimilation and Habituation



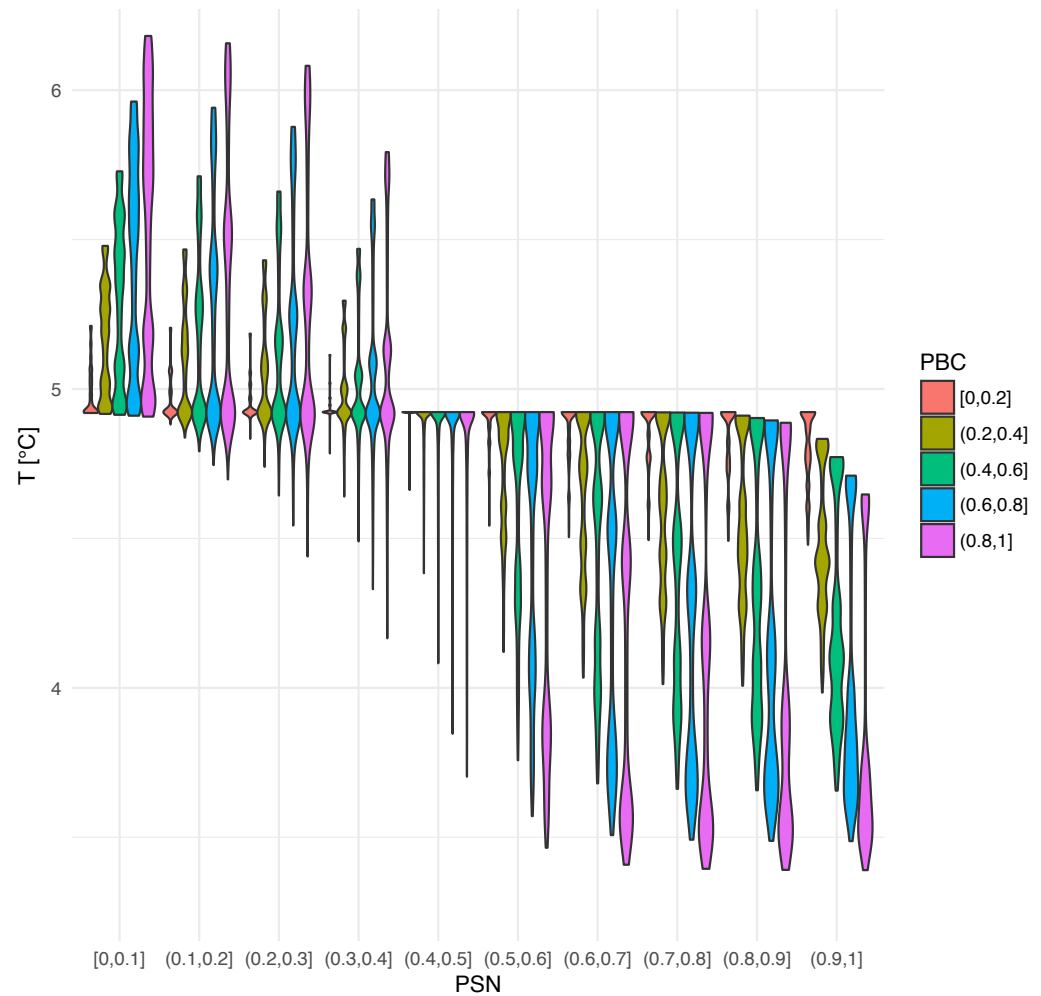
-> Reinforcing? Malleable?

Climate Social Model (CSM)

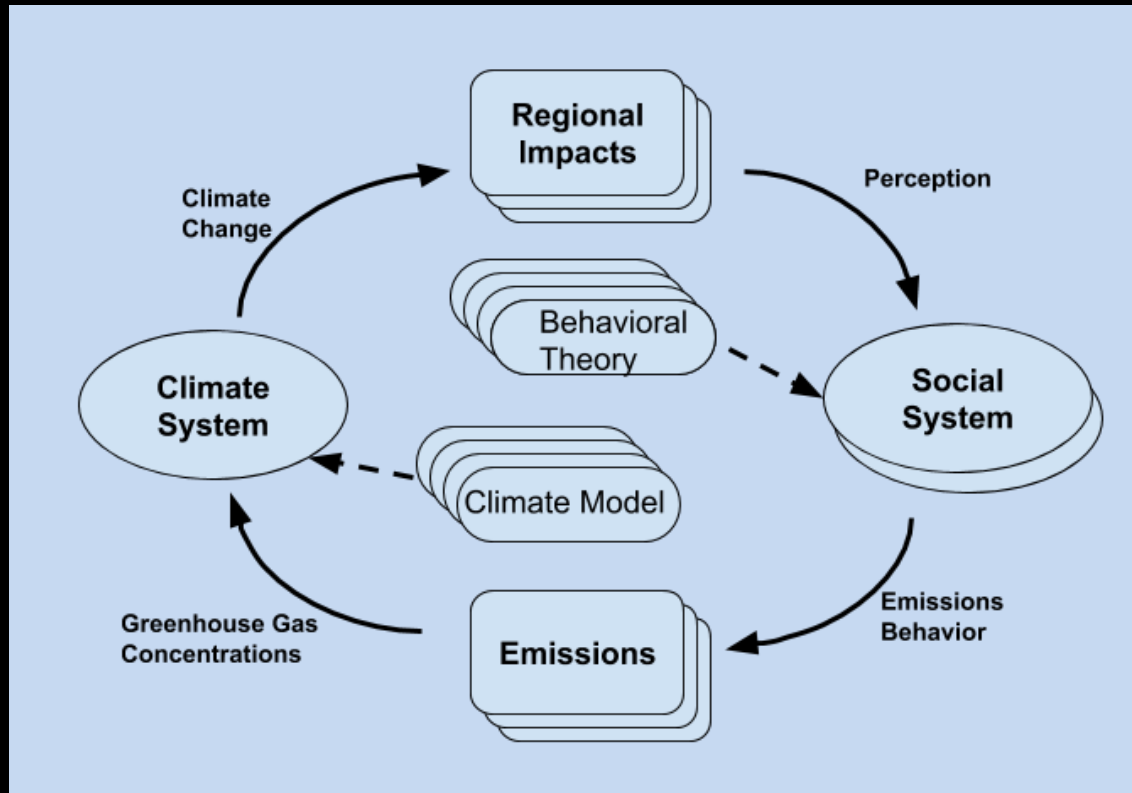


Beckage, B., L. J. Gross, K. Lacasse, E. Carr, S. S. Metcalf, J. M. Winter, P. D. Howe, N. Fefferman, T. Franck, A. Zia, A. Kinzig and F. M. Hoffman. 2018. Linking models of human behavior and climate alters projected climate change. *Nature Climate Change* 8, 79–85

Interaction of
perceived social
norm (PSN) and
perceived
behavioral
control (PBC)
on global
temperature
change



Further Steps



Beckage, B., K. Lacasse, J. M. Winter, L. J. Gross, N. Fefferman, F. M. Hoffman, S. S. Metcalf, T. Franck, E. Carr, A. Zia, and A. Kinzig. 2020. The Earth has humans, so why don't our climate models? *Climatic Change*: <https://doi.org/10.1007/s10584-020-02897-x>

Some Processes to consider in Human Feedback Loops

- Social conformity
- Cognition
- Political interest
- Credibility-enhancing display
- Expressive force of law
- Endogenous cost reduction

Feedbacks, Tipping-Points, and Future Emissions Pathways in the Coupled Climate-Social System. Frances C. Moore, Katherine Lacasse, Katharine J. Mach, Yoon Ah Shin, Louis J. Gross, Brian Beckage. *Science*. In review.

Conclusions

- Natural feedbacks to climate change are predominately reinforcing at human time scales
- Identify reinforcing and balancing feedbacks of human system to climate change
- Which feedbacks may be malleable? How to shift the feedbacks to be balancing?
- How does structure of the coupled human natural system constrain behaviors and feedbacks that can occur? Is it malleable?