

# Humanity, the Earth system, and the long-term future

12.090/12.S597 Spring 2022 U/G (2-0-4)  
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## Overview

Human actions are drastically and irreversibly modifying the Earth system, yet this is the very system upon which our survival as a species depends. Could such actions lead to our own destruction? If so, how? And what should we do about it? This seminar aims to address these questions, integrating perspectives spanning the Earth sciences, social sciences, and philosophy. Topics include nuclear winter, global warming, how to reason about future human welfare and present-day costs, how to do so while considering uncertainty and low-probability catastrophic outcomes, pandemics and Earth system change, and technology as an increasingly autonomous or perhaps even geological phenomenon. We end by discussing physical, social, and dynamical aspects of achieving long-term sustainability on a planetary scale.

## Organization

We will meet on Fridays from 2:30–4:00 in Rm. 56-169. The initial meeting on Friday February 4 will be organizational. Interested students with scheduling conflicts should email their schedule to the instructor; we'll make accommodations if we can.

## Participation, format, and expectations

Each week we will discuss the assigned readings. Rather than designating discussion leaders, we will each participate in discussions on an equal basis. No one is expected to have any special expertise in any of the subjects; instead, we will all come prepared to learn from each other. Participation is open to all, including undergraduates. Interested students should register (in advance, if possible) for [12.S597](#) (graduate) or [12.090](#) (undergraduate). Grading is P/D/F; continual attendance and active participation is required for P. Postdocs, faculty, and research staff are also welcome. All participants will contribute to discussions.

## Syllabus

All material will be available on [Canvas](#) or obtainable electronically from the MIT Library.

1. The stakes

Ord, T. (2020). *The Precipice: Existential Risk and the Future of Humanity*. Introduction and Chapters 1-2. Hachette Books, pp. 1–64.

## 2. Natural existential risks and nuclear winter

Ord, T. (2020). *The Precipice: Existential Risk and the Future of Humanity*. Chap. 3 and “Nuclear weapons”. Hachette Books, pp. 67–102.

Robock, A. (2010). “Nuclear winter”. *WIREs Climate Change* 1, pp. 418–427.

## 3. Anthropogenic climate change and its impacts

Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, E. F. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. J. Schellnhuber, et al. (2009). “A safe operating space for humanity”. *Nature* 461, pp. 472–475.

Sherwood, S. C. and M. Huber (2010). “An adaptability limit to climate change due to heat stress”. *Proceedings of the National Academy of Sciences* 107, pp. 9552–9555.

Ord, T. (2020). *The Precipice: Existential Risk and the Future of Humanity*. “Climate change”. Hachette Books, pp. 102–113.

## 4. Long-term social welfare: future value and present cost

Gollier, C. (2013). *Pricing the Planet’s Future: The Economics of Discounting in an Uncertain World*. Introduction. Princeton and Oxford: Princeton University Press, pp. 1–13.

Nordhaus, W. D. (1992). “An optimal transition path for controlling greenhouse gases”. *Science* 258, pp. 1315–1319.

Ord, T. (2020). *The Precipice: Existential Risk and the Future of Humanity*. Appendix A: “Discounting the long-term future”. Hachette Books, pp. 253–258.

## 5. Uncertainty and declining discount rates

Arrow, K., M. Cropper, C. Gollier, B. Groom, G. Heal, R. Newell, W. Nordhaus, R. Pindyck, W. Pizer, P. Portney, T. Sterner, R. Tol, and M. Weitzman (2013). “Determining benefits and costs for future generations”. *Science* 341, pp. 349–350.

Weitzman, M. L. (2001). “Gamma discounting”. *American Economic Review* 91, pp. 260–271.

## 6. Heavy tails, long-term welfare, and infinite costs: the *dismal theorem*

Wagner, G. and M. L. Weitzman (2016). *Climate Shock*. Princeton University Press, pp. 48–55.

Weitzman, M. L. (2009). “On modeling and interpreting the economics of catastrophic climate change”. *The Review of Economics and Statistics* 91, pp. 1–19.

Weitzman, M. L. (2014). “Fat tails and the social cost of carbon”. *American Economic Review* 104, pp. 544–46.

## 7. Heavy tails, long-term welfare, and infinite costs (2)

Pindyck, R. S. (2011). “Fat tails, thin tails, and climate change policy”. *Review of Environmental Economics and Policy* 5, pp. 258–274.

Millner, A. (2013). “On welfare frameworks and catastrophic climate risks”. *Journal of Environmental Economics and Management* 65, pp. 310–325.

## 8. Humanity and Earth's biosphere

Ord, T. (2020). *The Precipice: Existential Risk and the Future of Humanity*. “Environmental damage”. Hachette Books, pp. 113–119.

Williams, M., J. Zalasiewicz, P. Haff, C. Schwägerl, A. D. Barnosky, and E. C. Ellis (2015). “The Anthropocene Biosphere”. *The Anthropocene Review* 2, pp. 196–219.

## 9. Pandemics, and interactions with other Earth system change

Ord, T. (2020). *The Precipice: Existential Risk and the Future of Humanity*. “Pandemics”. Hachette Books, pp. 121–138.

McMichael, A. J. (2012). “Insights from past millennia into climatic impacts on human health and survival”. *Proceedings of the National Academy of Sciences* 109, pp. 4730–4737.

## 10. Technology and its potential autonomy

Haff, P. K. (2014). “Technology as a geological phenomenon: Implications for human well-being”. *Geological Society, London, Special Publications* 395, pp. 301–309.

Ord, T. (2020). *The Precipice: Existential Risk and the Future of Humanity*. “Unaligned Artificial Intelligence”. Hachette Books, pp. 138–153.

## 11. Long-term global sustainability

Frank, A., J. Carroll-Nellenback, M. Alberti, and A. Kleidon (2018). “The Anthropocene generalized: evolution of exo-civilizations and their planetary feedback”. *Astrobiology* 18, pp. 503–518.

Kleidon, A. (2022). “Empowering the Earth system by technology: Using thermodynamics of the Earth system to illustrate a possible sustainable future of the planet”. *Strategies for Sustainability of the Earth System*. Ed. by P. A. Wilderer, M. Grambow, and M. M. K. Oexle. Springer, pp. 433–444.

## 12. Dynamics of the collective human system

Farmer, J. D., C. Hepburn, M. C. Ives, T. Hale, T. Wetzler, P. Mealy, R. Rafaty, S. Srivastav, and R. Way (2019). “Sensitive intervention points in the post-carbon transition”. *Science* 364, pp. 132–134.

Centola, D., J. Becker, D. Brackbill, and A. Baronchelli (2018). “Experimental evidence for tipping points in social convention”. *Science* 360, pp. 1116–1119.

Bak-Coleman, J. B., M. Alfano, W. Barfuss, C. T. Bergstrom, M. A. Centeno, I. D. Couzin, J. F. Donges, M. Galesic, A. S. Gersick, J. Jacquet, et al. (2021). “Stewardship of global collective behavior”. *Proceedings of the National Academy of Sciences* 118, e2025764118.