More than the sum of its parts: structural modelling interactions and the social cost of carbon

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The Social Cost of Carbon: “The most important number you’ve never heard of”

- The **SCC** quantifies marginal climate damages — relevant, but uncertain
- Much attention to **parametric** uncertainties (discounting, damages, ...)
- But: **structural modifications** matter just as much!
  - climate dynamics (Dietz et al. 2021a; Folini et al. 2024)
  - natural capital (Drupp & Hänsel 2021; Bastien-Olvera & Moore 2021; Bastien-Olvera et al. 2023)
  - persistent damages (Moore & Diaz 2015; Dietz et al. 2021b)
  - tipping points (Dietz et al. 2021b; Kessler 2017; Nordhaus 2019)

→ How do these modifications **interact**?

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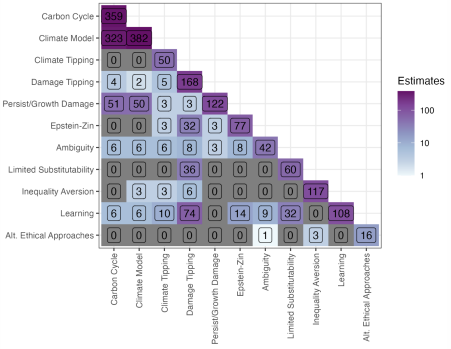
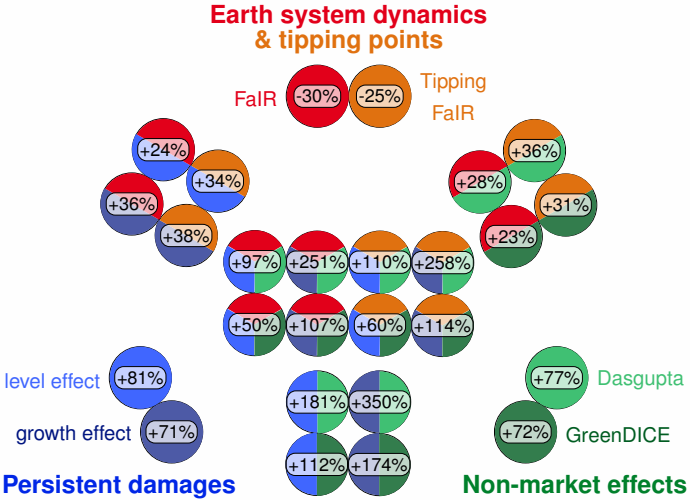


Most interactions are missing! (Moore et al. 2024)

Sneak peek: Structural interactions can be large and nonlinear

- New **SI-IAM** framework combining multiple modifications
- Strong nonlinear interaction effects
- Direction depends on changes to damage time profile

→ **The whole is more than the sum of its parts!**



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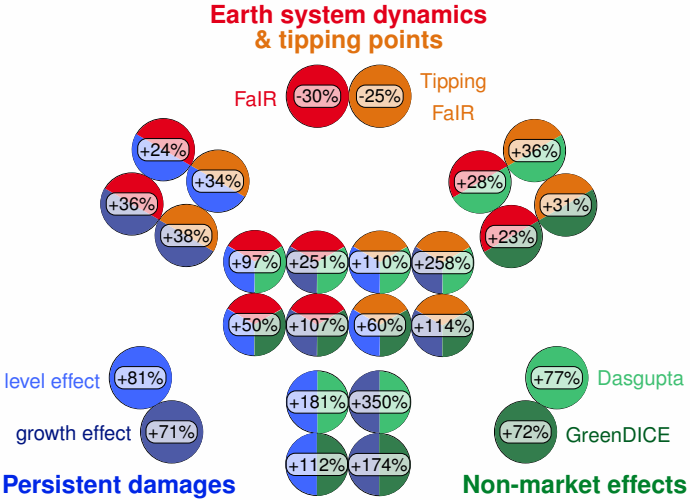

Come visit my poster!

Learn about combined SCC effects of:

- climate and tipping dynamics
- natural capital and limited substitutability
- damage persistence

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References I

Bastien-Olvera, B. A. et al. (Dec. 2023). “Unequal climate impacts on global values of natural capital”. en. In: *Nature*, pp. 1–6. ISSN: 1476-4687. DOI: 10.1038/s41586-023-06769-z. URL: https://www.nature.com/articles/s41586-023-06769-z (visited on 12/21/2023).

Bastien-Olvera, B. A. & F. C. Moore (Feb. 2021). “Use and non-use value of nature and the social cost of carbon”. en. In: *Nature Sustainability* 4.2, pp. 101–108. ISSN: 2398-9629. DOI: 10.1038/s41893-020-00615-0. URL: https://www.nature.com/articles/s41893-020-00615-0 (visited on 02/02/2022).

Dietz, S. et al. (Sept. 2021a). “Are Economists Getting Climate Dynamics Right and Does It Matter?” In: *Journal of the Association of Environmental and Resource Economists* 8.5, pp. 895–921. ISSN: 2333-5955. DOI: 10.1086/713977. URL: https://www.journals.uchicago.edu/doi/10.1086/713977 (visited on 10/27/2021).

Dietz, S. et al. (Aug. 2021b). “Economic impacts of tipping points in the climate system”. In: *Proceedings of the National Academy of Sciences* 118.34. DOI: 10.1073/pnas.2103081118. URL: https://www.pnas.org/doi/10.1073/pnas.2103081118 (visited on 08/18/2022).

References II

Drupp, M. A. & M. C. Hänsel (Feb. 2021). “Relative Prices and Climate Policy: How the Scarcity of Nonmarket Goods Drives Policy Evaluation”. In: *American Economic Journal: Economic Policy* 13.1, pp. 168–201. DOI: 10.1257/pol.20180760. URL: https://www.aeaweb.org/articles?id=10.1257/pol.20180760.

Folini, D. et al. (Jan. 2024). “The Climate in Climate Economics”. In: *The Review of Economic Studies*, rdae011. ISSN: 0034-6527. DOI: 10.1093/restud/rdae011. URL: https://doi.org/10.1093/restud/rdae011 (visited on 01/06/2025).

Kessler, L. (2017). “Estimating the economic impact of the Permafrost Carbon Feedback”. In: *Climate Change Economics* 08.02, p. 1750008. DOI: 10.1142/S2010007817500087. eprint: https://doi.org/10.1142/S2010007817500087. URL: https://doi.org/10.1142/S2010007817500087.

Moore, F. C. & D. B. Diaz (Feb. 2015). “Temperature impacts on economic growth warrant stringent mitigation policy”. English. In: *Nature Climate Change* 5.2, pp. 127–131. ISSN: 1758-678X. DOI: 10.1038/nclimate2481.

References III

Moore, F. C. et al. (Dec. 2024). “Synthesis of evidence yields high social cost of carbon due to structural model variation and uncertainties”. In: *Proceedings of the National Academy of Sciences* 121.52, e2410733121. DOI: 10.1073/pnas.2410733121. URL: https://www.pnas.org/doi/10.1073/pnas.2410733121 (visited on 01/05/2025).

Nordhaus, W. (June 2019). “Economics of the disintegration of the Greenland ice sheet”. In: *Proceedings of the National Academy of Sciences* 116.25, pp. 12261–12269. DOI: 10.1073/pnas.1814990116. URL: https://www.pnas.org/doi/abs/10.1073/pnas.1814990116 (visited on 02/26/2023).