Net Economic Impact of UN Global Warming Mitigation Targets

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Introduction

- Burke et al. (2015) & (2018) produced empirical estimates of economic damages from climate change that are significantly more-severe than widely-used prior estimates.
- These more-severe damage estimates suggest that limiting global warming to 1.5◦C above preindustrial levels relative to 2◦C would result in cumulative benefits from avoided damages of ~36 trillion US$ of gross world product through 2100 (3% discount rate).
- However, this assessment does not consider any costs associated with decarbonizing the global economy.
- To investigate the *net* economic impact (benefits-costs), we parameterize an estimate of Burke et al. (2018) damages into the Dynamic Integrated Climate-Economy model (Burke-DICE) so that these damage estimates can be weighed against the model's representation of mitigation costs in a unified framework.

Modelling Framework

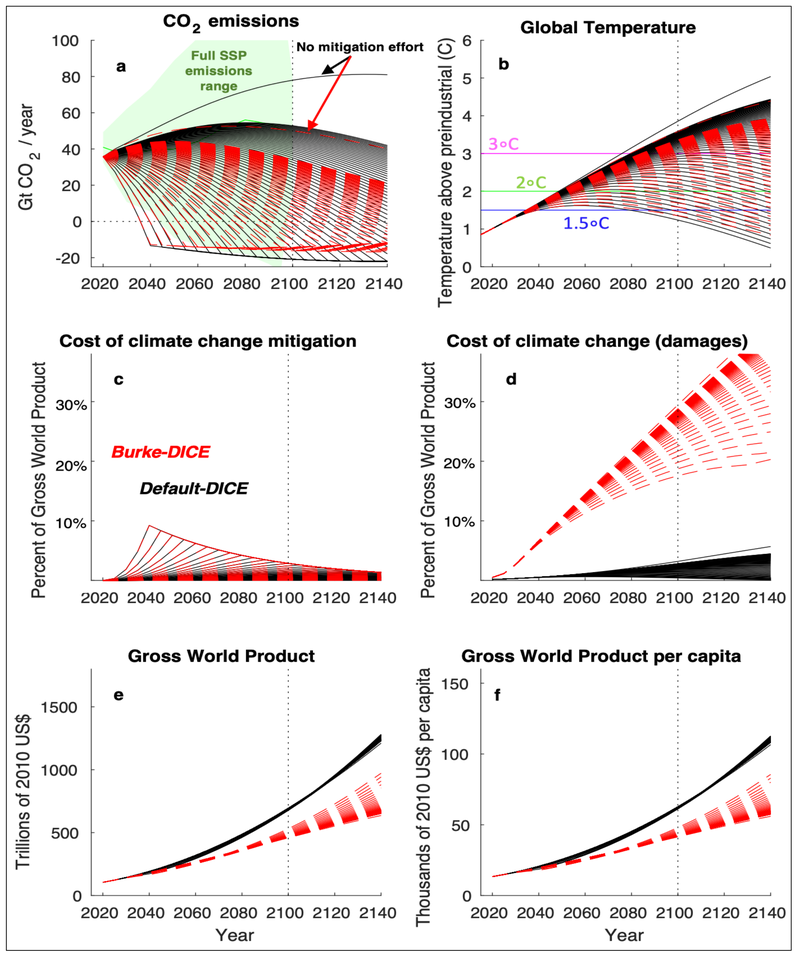

Fig. 1. All DICE model runs conducted, showing the effect of various levels of mitigation effort as well as the difference between default (black) and Burke-like (red) economic damages from climate change. Each line represents a different level of mitigation effort. UN global warming mitigation targets are indicated in panel b.

Benefits & Costs of Mitigation Through Time

- All levels of mitigation considered in this framework eventually confer a net economic benefit with the magnitude of the long-term benefit increasing with the level of mitigation effort.
- For the 1.5◦C and 2.0◦C mitigation targets:
  - Default-DICE damages suggest a 21st century entirely characterized by economic sacrifice for the benefit of future generations.
  - Burke-DICE damages imply that net economic benefits will begin to be realized in the 2070s-2080s, within the lifetimes of many people alive today.

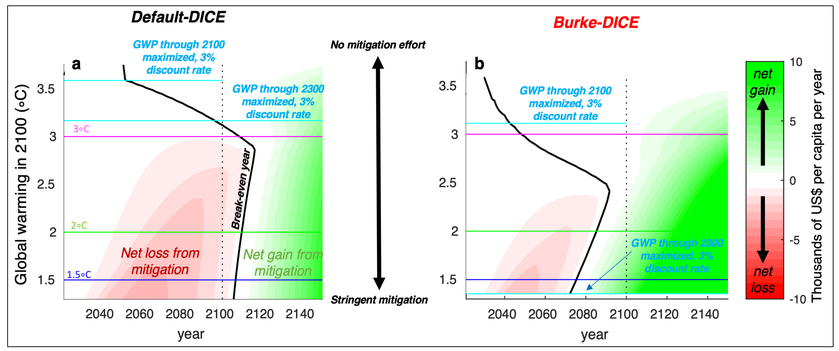

Fig. 2. Effect of the level of mitigation effort on global economic output through time for both default and Burke-like economic damages from climate change. Plots contour the difference in per-capita gross world product (GWP) between the no-mitigation scenario and the mitigation scenario which results in the global warming above preindustrial levels (in 2100) labelled on the y-axes.

When Mitigation Targets are Optimal

- Under Default-DICE damages:
  - The 1.5◦C target is economically optimal under time horizons beyond 2200 and discount rates below ~0.25%.
- Under Burke-DICE damages:
  - The 1.5◦C target is economically optimal under time horizons beyond ~2175 and discount rates below ~3.8%.
  - The 1.5◦C target is economically optimal under time horizons beyond ~2100 and discount rates below ~1%.

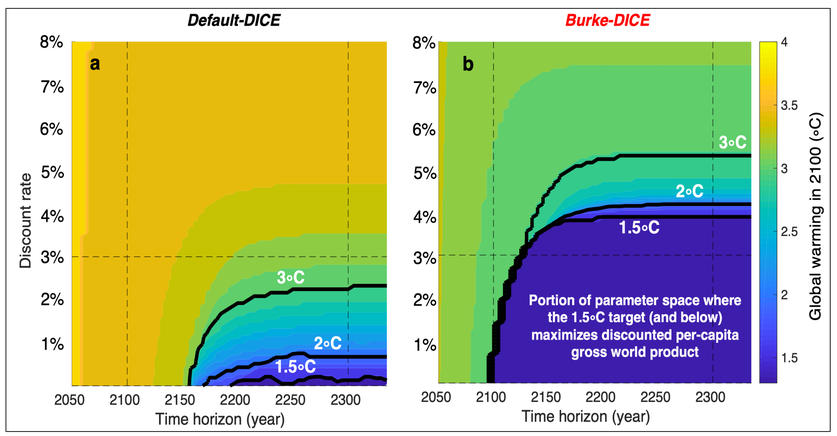

Fig. 3. Sensitivity of the optimal level of mitigation effort to the discount rate and time horizon for both default and Burke-like economic damages from climate change.

Net Economic Impact of Mitigation Targets

- For a time horizon of 2100, mitigation efforts tend to reduce cumulative gross world product and more stringent mitigation efforts are associated with further reduction in gross world product under both representations of damages (i.e., stabilizing at 1.5◦C results in more loss of gross world product than 2.0◦C).
- For a time horizon of 2300, mitigation efforts tend to enhance cumulative gross world product under both representations of damages.
- Of the four time-horizon/damage-representation combinations considered below, the 1.5◦C mitigation target only tends to be economically superior to the 2◦C target under a time horizon of 2300 and Burke-DICE damages (Fig. 4d).

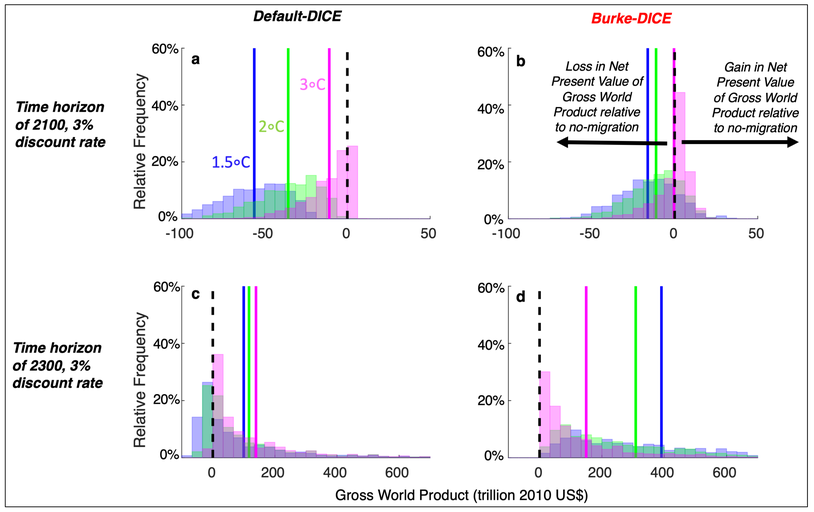

Fig. 4. Net cumulative economic impact (benefit - cost) of three mitigation targets (1.5◦C, 2◦C and 3◦C in 2100) for both default and Burke-like economic damages from climate change. Histograms plot the distribution, across Monte Carlo trials, of the difference in gross world product (in terms of net present value, time-discounted at 3%) between the scenario closest to achieving the given temperature target and the no-mitigation scenario. Two thousand Monte Carlo trials were performed in which eight geophysical/socioeconomic DICE parameter values were perturbed.

Conclusion

- Considering the benefits of avoided economic damages from climate change in conjunction with the costs of decarbonizing the global economy, we find:
  - Burke-like representations of damages from climate change justify more stringent mitigation effort than default DICE damages and they shift the break-even year from the 22nd century to well within the 21st century.
  - limiting global warming to 1.5◦C relative to 2.0◦C (and relative to a no-mitigation scenario) results in cumulative net *loss* of gross world product under both representations of damages, through 2100 (3% discount rate).
  - In order for the United Nations global warming mitigation targets to be economically optimal, lower discount rates, longer time horizons, or lower mitigation costs than are typically assumed must be considered.

References

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