

The social cost of carbon when accounting for biosphere integrity and land use change: An extension of the DICE model

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Abstract

The intensifying damages from increasing temperatures and unprecedented degradation of the biosphere highlight the critical need for integrated approaches to environmental policy that recognize the interdependent natural processes. Current integrated assessment models mostly focus on single aspects and, for example, address climate change and biosphere integrity loss independently, thereby missing key interactions between these processes. This paper extends the latest Dynamic Integrated Climate-Economy (DICE-2023) model to incorporate three Earth system processes highlighted by the Planetary Boundaries Framework: climate, biosphere integrity and land system change. We add a land use sector to explicitly link economy, climate and biosphere integrity capturing the key dependencies and reciprocities. To explore the intersection between climate change mitigation and biosphere integrity conservation policies, the extended model allows to conduct both classical DICE-style cost-benefit analysis and to investigate the additional welfare cost of remaining within specific targets. Our results show that accounting for biosphere integrity loss in the coupled climate-economy significantly increases the social cost of carbon and leads to more stringent climate policies. Further, we find that land conservation efforts can yield substantial co-benefits for climate mitigation, reducing the overall economic costs of achieving climate targets. The integrated framework presented here provides a valuable tool for policymakers to evaluate the trade-offs and synergies between climate and biosphere integrity policies in a comprehensive and accessible manner.

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