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Could undermining biosphere integrity trigger catastrophic climate change?

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The carbon stored in the terrestrial biosphere, were it all released into the atmosphere instantaneously as carbon dioxide, would catastrophically change the Earth's climate. Human actions that, both directly and indirectly, damage the integrity of the biosphere risk undermining's the biosphere capacity to maintain this store of carbon. Here, we investigate the risk that degradation of the biosphere will trigger catastrophic climate change, even if future fossil emissions are kept to low levels. Whether terrestrial carbon stores can be maintained depends critically on the speed and strength of feedbacks involving the global carbon cycle, climate change, and dynamics of the biosphere. Many of the interactions that comprise these feedbacks are highly uncertain, such as the vulnerability of the biosphere to the magnitude and rate of temperature changes and how changes to the biosphere affect its ability to store carbon, and therefore are rarely implemented in climate models. We extend a previous stylised dynamical model of the global carbon cycle to include interactions with biosphere integrity. We use this model to integrate the range of current knowledge on climate-biosphere interactions and study its possible consequences. Our model constitutes a study of the interactions between the two core planetary boundaries: climate change and biosphere integrity.