EGU2020-2959, updated on 01 Jul 2022
https://doi.org/10.5194/egusphere-egu2020-2959
EGU General Assembly 2020

Tipping Points in the Climate System and the Economics of Climate Change

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Tipping points in the climate system are a key determinant of future impacts from climate change. Current consensus estimates for the economic impact of greenhouse gas emissions, however, do not yet incorporate tipping points. The last decade has, at the same time, seen publication of over 50 individual research papers on how tipping points affect the economic impacts of climate change. These papers have typically incorporated an individual tipping point into an integrated climate-economy assessment model (IAM) such as DICE to study how the the tipping point affects economic impacts of climate change such as the social cost of carbon (SC-CO2). This literature, has, however, not yet been synthesized to study the joint effect of the large number of tipping points on the SC-CO2. SC-CO2 estimates currently used in climate policy are therefore too low, and they fail to reflect the latest research.

This paper brings together this large and active literature and proposes a way to jointly estimate the impact of tipping points. In doing so, we bridge an important gap between climate science and climate economics. To do so, we develop a new integrated assessment model with frontier characteristics: a tractable geophysical module for each tipping point, damage functions based on recent climate econometric advances, and disaggregated climate change impacts at the national level, including from sea-level rise. In this model, we consider the following tipping points: the permafrost carbon feedback, the dissociation of ocean methane hydrates, Amazon forest dieback, the disintegration of the Greenland ice sheet, the disintegration of the West Antarctic ice sheet, the slowdown of the Atlantic Meridional Overturning Circulation, changed patterns of the India summer monsoon, and changes in surface albedo feedback (also referred to as Arctic sea-ice loss).

Our preliminary findings show that the geophysical tipping points tend to increase the economic impact of climate change, with a combined effect of increasing the social cost of carbon (SC-CO2) by 14%-43%. The largest contributions to this increase come from methane-related tipping points.