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Carbon budgets under multiple climate targets

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A central goal of climate science and policy is to establish and follow carbon emissions pathways towards a single metric of changes in the Earth system. Currently, this most often means restricting global mean surface warming to 1.5 and 2 °C, in line with the Paris Climate Agreement. However, anthropogenic emissions do not lead solely to increases in global mean temperature, but also cause other changes to the Earth system. This study aims to quantify carbon emission pathways that are consistent with additional climate targets, and explore the impact of applying these additional climate targets on the future carbon budget. Here, we consider ocean acidification, although eventually multiple additional climate targets could be considered.

Emission of carbon dioxide leads to ocean acidification, since the ocean is a significant carbon sink in the climate system, absorbing an estimated 16 to 30% of yearly anthropogenic carbon emissions (Friedlingstein et al., 2020). Increased ocean acidification threatens ocean biodiversity, specifically coral reef systems and calcifying organisms, with impacts up the food web. The effects of acidification extend towards human systems, in part due to the impact on fisheries: Narita et al. (2012) estimate that the loss of mollusk production alone due to acidification could cost 100 billion USD globally following a business-as-usual trajectory towards 2100.

Despite the far-reaching damage caused by ocean acidification, there has been little successful effort to explicitly address ocean acidification in climate policy apart from the Paris Agreement warming targets of 1.5 and 2°C (Harrould-Kolieb and Herr, 2012). Although these targets mitigate many elements of dangerous climate change, Schleussner et al. (2016) project that carbon emission pathways consistent with 1.5°C cause 90% of coral reef areas between 66°N and 66°S to be at risk of long-term degradation in all but a single model run.

Calculating a future carbon budget based on a temperature goal alone is subject to significant uncertainty, largely due to uncertainties in response of the climate system to forcing and natural carbon sequestration. Here, results from a large observation-constrained model ensemble are presented for pathways that achieve multiple climate targets. The uncertainty in the resulting future carbon budget, compared to the budget for temperature-only targets, is discussed. A secondary aim is to establish a pair of mean ocean pH targets that are analogous with the Paris Agreement targets for global mean warming.

References

Friedlingstein P. et al., 2020, Earth System Science Data, DOI: 10.5194/essd-12-3269-2020

Narita, D. et al., 2012, Climate Change, DOI: 10.1007/s10584-011-0383-3

Harrould-Kolieb E.R. et al., 2012, Climate Policy, DOI: 10.1080/14693062.2012.620788

Schleussner C-F. et al., 2016, Earth System Dynamics, DOI: 10.1080/14693062.2012.620788