



Understanding the origins of the differences among 1.5°C carbon budgets

Carl-Friedrich Schleussner (1,2,3), Peter Pfleiderer (1,2,3), Martin Stolpe (4), Nathan P. Gillet (5), and Katarzyna Tokarska (6)

(1) Climate Analytics, Berlin, Germany, (2) Humboldt University, Berlin, Germany, (3) Potsdam Institute for Climate Impact Research, Potsdam, Germany, (4) Institute for Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland, (5) Canadian Centre for Climate Modelling and Analysis, Environment and Climate Change Canada, University of Victoria, Victoria, Canada, (6) School of Geosciences, University of Edinburgh, Edinburgh, United Kingdom

The amount of the remaining cumulative carbon emissions available to meet the Paris Agreement long term goal of stabilizing the global mean temperature at well below 2.0 °C, and pursuing efforts to limit warming to 1.5 °C, is of high policy relevance, yet the remaining carbon budget estimates differ widely among studies. The most recent estimates of the remaining carbon budget consistent with meeting the 1.5 °C warming limit as presented in the IPCC Special Report on 1.5 °C (SR15) are larger than the original carbon budgets presented in the IPCC Fifth Assessment Report (IPCC AR5). These differences are partly explained to arise due to a ‘rebasement effect,’ because SR15 carbon budgets are calculated from a more recent baseline, compared to the IPCC AR5 baseline. However, it is still unclear what factors contribute to the changes in budget estimates.

Here we address the origins of the differences among the recent carbon budget estimates consistent with meeting the 1.5 °C warming limit. We identify and quantify the following three sources of modelled and observed warming mismatches to reconcile global mean temperature model projections and observations: the CMIP5 blended-masking correction, non-anthropogenic forcing, and natural variability. We also separate the two factors contributing to the differences in carbon budgets: the effect of temperature corrections, and the effect of carbon cycle differences, and assess the approximate size each of these two effects has on the remaining carbon budget. Finally, we discuss the practicality of the concept of carbon budgets applied to low warming limits (such as the 1.5 °C limit), and the implications for countries’ emission reduction targets.