

Quantify allowable warmings for 2 °C and 1.5 °C climate targets

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The allowable warming is defined as the temperature that can be allowed to increase during achieving the climate targets, set in Paris Agreement, that is, to limit the global average temperature to well below 2 °C and to pursue efforts to avoid 1.5 °C above pre-industrial level. The allowable warming considers the committed warming from the historical forcing till 2016, indicating the remaining maximum warming level that can occur from the future forcing, while achieving the Paris Agreement temperature targets. In this study, we applied the SCM4OPT v2.0, with a normalized marginal method, to quantify the allowable warmings for regions in the 2 °C and 1.5 °C climate targets. Using the most up-to-date emission datasets, we first calculated the emission-related marginal effects for each emission for years of 2017-2100. Then the individual marginal temperature can be obtained by comparing the temperature difference between a full emission input scenario and the scenario with a marginal scaling. Thus, the percentage for the individual emission-related temperature in total temperature was found. We used Monte Carlo summation (n=100,000) to estimate the regional allowable warming by summing the temperature increase which belonged to the specific region.

The results show that, the global allowable warmings are 0.72 ± 0.18 °C and 0.37 ± 0.17 °C for 2 °C and 1.5 °C climate targets, respectively. Among them, 0.17 ± 0.04 °C for 2 °C and 0.12 ± 0.03 °C for 1.5 °C will be contributed by China, followed by Middle East and North Africa, with 0.12 ± 0.02 °C for 2 °C and 0.08 ± 0.03 °C for 1.5 °C. The allowable warmings for the USA are 0.11 ± 0.02 °C and 0.05 ± 0.02 °C for 2 °C and 1.5 °C, respectively. Our findings here can provide a simple, but synthetical metric for policy-makers to evaluate the remaining allowable warmings within regional levels.

Keywords: Climate change, Allowable warming, Simple climate model