



## **Prospects and pitfalls of using the TCRE to estimate the remaining carbon budget**

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The Transient Climate Response to cumulative CO<sub>2</sub> Emissions (TCRE) is an appealing metric to represent the global temperature change caused by anthropogenic CO<sub>2</sub> emissions, and to infer the quantity of remaining emissions associated with a given global temperature target. In principle, this quantity of emissions — the remaining carbon budget — can be estimated as a function of the desired amount of future warming divided by the TCRE, and then adjusted downwards to account for the portion of warming that is expected to be caused by other non-CO<sub>2</sub> emissions. In practice however, even this very simple method can lead to widely varying estimates of the remaining carbon budget, especially for low-temperature targets such as 1.5°C. Here, I propose a new and potentially more tractable method to estimate the remaining carbon budget, incorporating parameters that explicitly represent the most relevant uncertainties: (1) observed historical human-induced warming; (2) total historical CO<sub>2</sub> emissions; (3) the amount of unrealized warming from past CO<sub>2</sub> emissions; (4) the current fraction of warming caused by non-CO<sub>2</sub> emissions; and (5) the fraction of warming caused by non-CO<sub>2</sub> emissions at the time a future temperature target is reached. I show how each of these uncertain parameters affects estimates of the remaining carbon budget, and suggest a new best estimate of the remaining budget given current known uncertainties.