



Cumulative carbon as a policy framework for avoiding dangerous climate impacts

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The primary objective of The United Nations Framework Convention on Climate Change is to stabilize greenhouse gas concentrations a level that will avoid dangerous climate impacts. However, greenhouse gas concentration stabilization is an awkward framework within which to assess dangerous climate change on account of the significant lag between a given concentration level, and the eventual equilibrium temperature change. By contrast, recent research has shown that global temperature change can be well described by a given cumulative carbon emissions budget. Here, we propose that cumulative carbon emissions represent an alternate framework that is applicable both as a tool for climate mitigation as well as for the assessment of potential climate impacts. We show first that both atmospheric CO₂ concentration at a given year and the associated temperature change are generally associated with a unique cumulative carbon emissions budget that is largely independent of the emissions scenario. The rate of global temperature change can therefore be related to first order to the rate of increase of cumulative carbon emissions. However, transient warming over the next century will also be strongly affected by emissions of shorter lived forcing agents such as aerosols and methane. Non-CO₂ emissions therefore contribute to uncertainty in the cumulative carbon budget associated with near-term temperature targets, and may suggest the need for a two-basket mitigation approach. By contrast, long-term temperature change remains primarily associated with total cumulative carbon emissions due to the much longer atmospheric lifetime of CO₂ relative to other major climate forcing agents.