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A proposed framework for avoiding dangerous climate impacts from cumulative carbon emissions

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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 not the most appropriate 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; consequently, cumulative emissions may be a more appropriate framework within which to assess emission targets aimed at avoiding dangerous climate change. Here, we present a new cumulative emissions framework for climate impact assessment. We show first that both carbon dioxide concentration targets at a given year and the associated temperature changes are uniquely associated with a cumulative carbon emissions budget, regardless of the emissions pathway. We show further that it is generally possible to overshoot concentration targets without overshooting the temperature target, but that temperature overshoots may not be possible without technological intervention to achieve negative emissions. It follows also from this analysis that the rate of temperature change can be related to the rate of increase of cumulative carbon emissions. As a consequence, climate impacts that are sensitive to a given level of global temperature change can be avoided by restricting total cumulative emissions, whereas the rate of emissions cuts over the next century will determine the severity of climate impacts which are sensitive to the rate of global temperature change.