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What do recent advances in quantifying climate and carbon cycle uncertainties mean for climate policy?

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The temperature increase due to human activity since pre-industrial times has been in the order of 0.8K. The IPCC reports projections of an additional global warming of 1.1-6.4K for the 21st century based on greenhouse gas emissions scenarios (SRES) that intentionally exclude mitigation policy. The United Nations Framework Convention on Climate Change commits its signatories to achieve "...stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." What constitutes "dangerous" climate change is difficult to determine and highly subjective as regional impacts, rate of change and ability to cope with change are highly variable. The EU has adopted a target of limiting global warming to 2K above pre-industrial levels.

Whilst such global policy targets for greenhouse gas emissions reductions are still being negotiated it is important for scientists to be able to understand how they might be achieved. The amount of emitted carbon dioxide remaining in the atmosphere is controlled by carbon cycle processes in the ocean and on land. These processes are themselves affected by climate. The resulting climate-carbon cycle feedback and its uncertainty have recently been quantified, but the policy implications have not. Using a reduced form model to emulate the range of state-of-the-art model results for climate feedback strength, including the modelled range of climate sensitivity and other key uncertainties, we analyse recent global targets. The G8 target of a 50% cut in emissions by 2050 leaves CO2 concentrations rising rapidly, approaching 1000 ppm by 2300. The Stern Review's proposed 25% cut in emissions by 2050, continuing to an 80% cut, does in fact approach stabilization of CO2 concentration on a policy-relevant (century) timescale, with most models projecting concentrations between 500 and 600 ppm by 2100. However concentrations continue to rise gradually. Long-term stabilization at 550 ppm CO2 requires cuts in emissions of 81 to 90% by 2300, and more beyond as a portion of the CO2 emitted persists for centuries to millennia. Reductions of other greenhouse gases cannot compensate for the long-term effects of emitting CO2.

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