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Allowable carbon emissions for a medium mitigation scenario

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The world climate research centres are currently running Earth System Models (ESMs) forced by Representative Concentration Pathways (RCP) scenarios. Based on these future pathways in atmospheric greenhouse gas concentrations, the emphasis has been mainly on estimating the associated levels of global warming that might be expected. There is also the important task of determining emission trajectories associated with the pathways, that may then be assessed by socio-economists for feasibility. Here we use an earth system model of intermediate complexity and a probabilistic framework to estimate the range of future temperature change and allowable emissions corresponding to a medium CO_2 concentration pathway (RCP4.5). Uncertainty is initially estimated by allowing the equilibrium climate sensitivity, aerosol forcing and intrinsic physical and biogeochemical processes to vary within the widely accepted ranges. The results are then further constrained by extensive use of contemporary measurements. The resulting range of temperatures corresponding to RCP4.5 remains large. By year 2300, the predicted global temperature increase from pre-industrial has $\pm$ 2 standard deviation range of 1.4K, either side of a mean of 3.0K with 91% probability for increase over 2K. This result has major implications for future planning, as the difference between the upper and lower levels of warming may be expected to be enormous in terms of impacts, and quite possibly could differentiate between what is deemed "dangerous change" or otherwise. After constraint using contemporary data, the ensemble mean of the experiment allows similar emissions to the standard RCP4.5 emission scenario. The allowable emission for the peak emission period is projected as 11.5$\pm$2.0 PgC yr-1. Our ensemble demonstrates that, with high probability, drastic cuts in emissions will be required and that there is a probability of around 2% that there will need to be an extended period of time with global negative emissions.