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Primary productivity control of the simulated climate carbon cycle feedback

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Coupled climate-carbon cycle model simulations have identified an important postive feedback between the terrestrial carbon cycle and climate, whereby future carbon uptake declines under anthropogenic climate warming. However, the magnitude of this feedback has varied widely between models – at the year 2100, the increase in atmospheric CO_2 attributable to the climate-carbon cycle feedback has ranged by almost 200 ppmv. Attempts to explain this large uncertainty have pointed largely to the behaviour of soil respiration under future climate change, but to date it has not been possible to reconcile this range of results. In this study we show that it is in fact the response of primary productivity to climate change that primarily determines the magnitude of the simulated climate-carbon cycle feedback. By varying model parameters used to determine the photosynthetic rate, we are able to reproduce the range of results simulated by other climate models. We demonstrate further that the simulated feedback is highly sensitive to the temperature limits on photosynthesis, parameters that are currently very poorly constrained in global carbon cycle models.