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Long-term projections of climate change commitment

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Eight earth system models of intermediate complexity (EMICs) are used to project climate change commitments for the upcoming IPCC Fourth Assessment Report. Simulations are run until year 3000 AD and extend substantially further into the future than conceptually similar simulations with global coupled climate - carbon cycle models. First, atmospheric CO_2 is projected from SRES emission scenarios until 2100 and kept constant afterwards to investigate climate change commitment in response to stabilized GHGs and radiative forcing. Sea level continues to rise due to thermal expansion for several centuries after CO_2 stabilization. In contrast, temperature changes level off after a century. The meridional overturning circulation is weakened in all EMICs, but recovers to nearly initial values in all but one of the models after centuries. Comparison with results from comprehensive AOGCMS up to year 2100 indicates that the suite of EMICs generally reproduces the AOGCM behaviour quite well. Second, the climate change commitment in response to earlier emissions is investigated. Anthropogenic carbon emissions are prescribed as inferred from a range of CO_2 stabilization profiles until 2100 and as zero from 2100 to 3000 in the EMICs with an interactive carbon cycle. The modelled slow decrease of atmospheric CO_2 after the emission reduction is due to the long timescales involved in the transfer of carbon from the atmosphere into the terrestrial and oceanic reservoirs. Emissions effected in the 21^{st} century continue to impact atmospheric CO_2 and climate even at year 3000. 21^{st} century emissions represent a minimum commitment of climate change for several centuries, irrespective of later emissions. A reduction of this minimum commitment is only possible if CO_2, in addition to cutting emissions after 2100, were actively removed from the atmosphere by measures such as capture and geological storage of CO_2.