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The holocene carbon cycle as represented by an intermediate complexity model from 8000 BP to the present.

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The early anthopogenic hypothesis suggests that part of the 20 ppm rise in atmospheric CO2 concentration between 8 ka and the present can be explained by early human land-use change. In this study, the University of Victoria Earth System Climate Model (UVic ESCM) v. 2.9, containing a fully-coupled atmosphere-ocean-terrestrial-sediment carbon cycle, is employed to investigate whether an external forcing mechanism is necessary to reproduce the mid- and late-Holocene trend in the atmospheric CO2 concentrations observed in ice cores. The UVic model was equilibriated for 5000 years with solar forcing, CO2 concentrations, and land ice for 8 ka and subsequently used in transient simulations covering the full period from 8 ka to the present. These experiments were performed with natural vegetation only under both prescribed CO2 and for an unconstrained, freely-evolving carbon cycle. The model results in the free carbon run demonstrate an initial increase in atmospheric CO2 by 5-10 ppm in the first 2000 years of the run, closely reflecting observations, but then declined below their original mid-Holocene level rather than following the observed CO2 trend. Furthermore, in the prescribed CO2 simulations the global carbon reservoir grows significantly (carbon is thus not conserved), suggesting that a source outside of the model's natural carbon cycle is contributing to the observed increase in atmospheric CO2. Therefore, the results from the UVic ESCM suggest that terrestrial carbon changes (of which human land-use change may be part) and ocean feedbacks not represented in the model experiments have contributed significantly to the observed Holocene rise in atmospheric CO2.