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Simulation of long-term future climate changes with the green McGill Paleoclimate Model: the next glacial inception

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The ‘‘green” McGill Paleoclimate Model (MPM), which includes an interactive vegetation component, is used to simulate the next glacial inception, under orbital and prescribed atmospheric CO2 forcing. This intermediate complexity model is first run for short-term periods with an increasing atmospheric CO2 concentration. The MPM’s response to these changes of the CO2 level is in agreement with the results of GCMs. The MPM is then used to produce projections of the climate for the next 100 kyr. When forced by a constant CO2 level, the model predicts three possible evolutions for the ice volume: an imminent glacial inception (low CO2 levels), a glacial inception in 50 kyr (CO2 levels of 280 or 290 ppm) or no glacial inception during the next 100 kyr (CO2 levels of 300 ppm and higher). This high sensitivity to the CO2 level is due to the exceptionally weak future variations of the summer insolation at high northern latitudes. The changes in vegetation and thermohaline circulation re-inforce the buildup of ice sheets. Finally, if an initial global warming episode of finite duration is included, after which the atmospheric CO2 level is assumed to stabilize at 280, 290 or 300 ppm, the impact of this warming is seen only in the first 5 kyr of the run; after this time the long-term response is insensitive to the early warming perturbation.