Managing Carbon Emissions to Avoid the Next Ice Age

Felix Pretis\textsuperscript{1} and Robert Kaufmann\textsuperscript{2}

\textsuperscript{1}University of Victoria, Victoria, British Columbia, Canada
\textsuperscript{2}Boston University, Boston, USA, (kaufmann@bu.edu)

There is considerable uncertainty about how the rapid, recent rise in greenhouse gas concentrations driven by anthropogenic emissions will interact with on-going changes in orbital position to affect climate in the very long run – the next several thousand years. Here we study the evolution of climate over the next hundred thousand years using a statistical climate model estimated on the paleo record that represents physically consistent relations between orbital position and climate. This climate model is able to use orbital position alone to simulate the timing, magnitude, and saw-toothed pattern of ice volume, CO\textsubscript{2} concentrations, and other climate time series both in- and out-of-sample. The model is used to run experiments that simulate climate with- and without human intervention in the global carbon cycle. Without human intervention, the next glacial maximum is forecast to occur in about 20,000 years. This result is relatively unaffected by the current anthropogenic spike in CO\textsubscript{2} concentrations. Conversely, the glacial maximum can be avoided - and the current climate maintained - by geo-engineering carbon concentrations to stabilize at around 325 ppm. The emissions needed to sustain these concentrations can be generated from known resources of fossil fuels. This suggests that CO\textsubscript{2} is a cost effective control variable that - if managed carefully - can be used to sustain a hospitable climate in the short-run (by reducing emissions) and the long-run (by stabilizing concentrations).