Climate of the Past
An Interactive Open Access Journal of the European Geosciences Union

Clim. Past, 2, 221-235, 2006
www.clim-past.net/2/221/2006/

Comparing transient, accelerated, and equilibrium simulations of the last 30 000 years with the GENIE-1 model

D. J. Lunt[1], M. S. Williamson[2,3,*], P. J. Valdes[1], T. M. Lenton[2,3], and R. Marsh[4]

[1]Bristol Research Initiative for the Dynamic Global Environment (BRIDGE), School of Geographical Sciences, University of Bristol, Bristol, UK
[2]School of Environmental Sciences, University of East Anglia, UK
[3]Tyndall Centre, UK
[4]National Oceanography Centre, University of Southampton, Southhampton, UK
[*]now at: Quantum Information Group, University of Leeds, Leeds, UK

Abstract. We examine several aspects of the ocean-atmosphere system over the last 30 000 years, by carrying out simulations with prescribed ice sheets, atmospheric CO_2 concentration, and orbital parameters. We use the GENIE-1 model with a frictional geostrophic ocean, dynamic sea ice, an energy balance atmosphere, and a land-surface scheme with fixed vegetation. A transient simulation, with boundary conditions derived from ice-core records and ice sheet reconstructions, is compared with equilibrium snapshot simulations, including the Last Glacial Maximum (21 000 years before present; 21 kyrBP), mid-Holocene (6 kyrBP) and pre-industrial. The equilibrium snapshot simulations are all very similar to their corresponding time period in the transient simulation, indicating that over the last 30 000 years, the model's ocean-atmosphere system is close to equilibrium with its boundary conditions. However, our simulations neglect the transfer of fresh water from and to the ocean, resulting from the growth and decay of ice sheets, which would, in reality, lead to greater disequilibrium. Additionally, the GENIE-1 model exhibits a rather limited response in terms of its Atlantic Meridional Overturning Circulation (AMOC) over the 30 000 years; a more sensitive AMOC would also be likely to lead to greater disequilibrium. We investigate the method of accelerating the boundary conditions of a transient simulation and find that the Southern Ocean is the region most affected by the acceleration. The Northern Hemisphere, even with a factor of 10 acceleration, is relatively unaffected. The results are robust to changes to several tunable parameters in the model. They also hold when a higher vertical resolution is used in the ocean.

Final Revised Paper (PDF, 1631 KB) Discussion Paper (CPD)

Citation: Lunt, D. J., Williamson, M. S., Valdes, P. J., Lenton, T. M., and Marsh, R.: Comparing transient, accelerated, and equilibrium simulations of the last 30 000 years with the GENIE-1 model, Clim. Past, 2, 221-235, 2006. Bibtex EndNote Reference Manager