

EGU22-5997

<https://doi.org/10.5194/egusphere-egu22-5997>

EGU General Assembly 2022

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A fast-slow model for glacial cycles since the Mid-Pleistocene Transition

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A new simple approach inspired by MacAyeal (1979) to explain the time-asymmetric 'saw-toothed' shape and 100,000-year quasi-period of glacial-interglacial cycles since the Middle Pleistocene Transition, is presented. Using a simple model with fast-slow dynamics, the global ice volume is taken to be a function of two independently varying parameters, the solar insolation and 'alpha', a secondary control parameter, the study of which is the focus this research. The steady state of the model is a partially folded surface in three-dimensional space where insolation, 'alpha', and global ice volume are orthogonal axes. The pleated surface allows for the gradual increase and sudden decrease in ice volume that is observed in the paleoclimate record. To derive a time series of global ice volume, the Euler integration method is used, producing a time series which replicates the 'saw-toothed' pattern of glacial cycles in the late Pleistocene. The second control parameter, 'alpha', is proposed to be related to internal dynamics of the climate system, such as ice sheet dynamics.

Reference

D. R. MacAyeal, 'A Catastrophe Model of the Paleoclimate Record', *Journal of Glaciology*, Volume 24, Issue 90, 1979, pp. 245 – 257.