Simple stochastic models for glacial dynamics

Y. Ashkenazy (1), D.R. Baker (2), and H. Gildor (3)

(1) Department of Solar Energy and Environmental Physics, The J. Blaustein Institute for Desert Research, Ben Gurion University, Sede Boker Campus, 84990, Israel (2) Earth and Planetary Sciences, McGill University, Montréal, QC H3A2A7, Canada, (3) Environmental Sciences, Weizmann Institute, Rehovot, Israel

Glacial-Interglacial events have several nonlinear and stochastic characteristics. Recent studies suggested additional stochastic nonlinear features (not necessarily related to the large scale dynamics of the glacial cycle) in the time scale of 1-100 kyr including (i) strong long-range correlations in the magnitude of climate variable increments as well as (ii) a wide multifractal spectrum. Realistic climate models should reproduce these properties of the natural system. We first study several previously proposed stochastic models for glacial-interglacial dynamics and demonstrate that they do not reproduce some of the nonlinear properties of the paleoclimate proxy data. We then suggest two nonlinear stochastic models for glacial-interglacial dynamics that exhibit similar stochastic nonlinear properties to those seen in the natural data. We conjecture that interaction between fast random fluctuations (representing atmospheric variability) and slowly varying fluctuations (representing oceanic variability) may underlie the observed stochastic nonlinearity of time series for glacial-interglacial oscillations.