



## **Bifurcation structure and noise-assisted transitions in the Pleistocene glacial cycles**

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The glacial cycles are attributed to the climatic response of the orbital changes in the irradiance to the Earth. These changes in the forcing are too small to explain the observed climate variations as simple linear responses. Nonlinear amplifications of the orbital forcing are necessary to account for the glacial cycles. Here an empirical model of the nonlinear response is presented. From the model it is possible to assess the role of stochastic noise in comparison to the deterministic orbital forcing of the ice ages. The model is based on the bifurcation structure derived from the climate history. It indicates the dynamical origin of the mid-Pleistocene transition from the “41 ka world” to the “100 ka world.” The dominant forcing in the latter is still the 41 ka obliquity cycle, but the bifurcation structure of the climate system is changed. The model suggests that transitions between glacial and interglacial climate are assisted by internal stochastic noise in the period prior to the last five glacial cycles, while the last five cycles are deterministic responses to the orbital forcing.