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## A Noisy Excitable Model of Millennial Scale Glacial Climate Variability

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The Dansgaard-Oeschger (D-O) oscillation recorded in isotopic analyses of Greenland ice cores is a climate oscillation with millennial scale variability alternating very rapidly between cold climate and warm climate states. In contrast to theories invoking Heinrich event forced oscillations or stochastic noise induced transitions between on or off states of the Atlantic Meridional Overturning Circulation, theories are emerging that propose that the D-O oscillation is an intrinsic stable glacial limit cycle relaxation oscillation that can be perturbed by internal and external forcing. Here we use the Community Earth System Model (CESM), run with glacial boundary conditions, which accurately simulates internal unforced D-O oscillations that can be modulated by radiative forcing, freshwater forcing, and changes in ocean mixing. Based on our set of CESM climate simulations, we propose a clear process-based framework that explains the natural intrinsic timescale for the millennial scale climate transitions. We build a reduced dimensional planar dynamical system model in which the parameters of the simple model are informed by the fully coupled glacial climate model. This simple system can produce self-sustained millennial scale abrupt climate transitions, which can be modulated by forcing and display a behaviour like that observed in the complex model. We conclude that the physics underlying the glacial climate system is characterized by an excitable system susceptible to coherence resonance with similar analogues in biological systems that operate on vastly different spatial and time scales.