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Inference and comparison of inverse models for glacial climate from Greenland ice core data

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The most pronounced variability in the climate during the last glacial period are the so-called Dansgaard-Oeschger (DO) events. These abrupt climate changes are largely elusive in simulations of state-of-the-art coupled climate models. Furthermore, the underlying dynamical mechanism remains unknown.
We address this issue by employing statistical model comparison on different classes of stochastic dynamical systems with respect to the NGRIP ice core record from Greenland. The dynamical systems represent different dynamical paradigms, such as bi-stability, relaxation oscillations and excitability.
Specifically, we investigate whether the climate system is exhibiting self-sustained oscillations of vastly varying periods or rather noise-induced jumps in between two quasi-stable regimes.
We avoid calibrating the models by time series fitting, but rather focus on the most important qualitative features of the data, such as distributions of waiting times in between successive events.
These features are quantified as summary statistics and are used to perform inference and comparison of the models via Approximate Bayesian Computation. Based on our choice of summary statistics, we find evidence that simple stochastic motion in a double well potential is better supported by the data than noisy relaxation oscillations or excitable oscillators. With our model comparison approach we furthermore investigate to which extent the dynamical process underlying the observed climate record can be regarded as stationary.