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Orbital interpolation methods for coupling GCMs to ice sheet models and potential impact on ice sheet hysteresis

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The computational expense of running GCMs and the long response times of ice sheets presents a problem when modeling large ice sheet changes. Although a fully synchronous coupling between GCMs and ice sheet models is desirable, when performing long duration (10^5 – 10^7 year) transient simulations of paleoclimates this is currently not feasible. This has led to the use of reduced or intermediate complexity climate models, climate parameterizations, asynchronously coupled GCMs and GCM lookup tables to provide climate forcing to ice sheet models.

The coupling of GCMs to ice sheet models using an asynchronous method or a GCM lookup table requires interpolation of orbital variability from only a few GCM runs, reducing the computational expense of running the GCM. There are various methods for performing this interpolation. Orbital variability can be based on a synthetic orbit, which reproduces the essence of orbital cycles, or on reconstructions of the past orbit. If a reconstruction of the past orbit is used as a target, then a number of GCM runs with different insolation can be optimized to reproduce this past orbit.

We evaluate different methods for performing interpolation and optimization of orbital variability for asynchronously coupled GCM and GCM lookup table approaches by modeling the onset of continental sized Antarctic glaciation at the Eocene-Oligocene climate transition. We suggest that these different methods for including orbital variability in long duration transient simulations of ice sheets may have an impact on ice sheet hysteresis.