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A mechanism for the pacing of Eocene hyperthermals

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A series of transient global warming events occurred during the late Paleocene and Early Eocene (∼59-50 Ma ago), of varying magnitude but apparently paced by orbital cycles. It is generally accepted that these 'hyperthermals' represent massive perturbations of the global carbon cycle, but a causal relationship between Earth's orbit and carbon injection has yet to be established.

Here we present a series of fully coupled climate model simulations that provide a mechanistic link between orbital variations and methane hydrates stored in marine sediments, through changes in global ocean circulation and the temperature of intermediate waters. Furthermore, using a simple threshold model, we account for the decreasing magnitude and increasing frequency of the hyperthermal events through the Early Eocene, as a consequence of progressive climate warming over millions of years and increasing tendency of the ocean to remain in a more stagnant state.