Orbital-scale variations in atmospheric CO_2 during the Paleocene and Eocene

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Multi-million-year proxy records (d13C, d18O, %CaCO3, Fe, etc.) show prominent variations on orbital time scale during the Paleocene and Eocene. The cycles have been identified at various sites across the globe and preferentially concentrate spectral power at eccentricity and precessional frequencies. It is almost certain that these cycles are an expression of changes in global climate and carbon cycling paced by orbital variations. However, little is currently known about (1) the driving mechanism linking orbital forcing to changes in climate and carbon cycling and (2) the amplitude of atmospheric CO2 variations associated with these cycles. We have used simple and complex carbon cycle models to explore the basic effect of different orbital forcing schemes and noise on the carbon cycle by forcing different carbon cycle parameters. For direct insolation forcing (opposed to eccentricity - tilt- precession), one major challenge is understanding how the system transfers spectral power from high to low frequencies.We will discuss feasible solutions to this problem, including insolation transformations analogous to electronic AC-DC conversion (DC'ing). Our results show that high-latitude mechanisms are unlikely drivers of orbitally paced changes in the Paleocene-Eocene Earth system. Based on a synthesis of modeling and proxy data analysis, we present the first estimates of orbital-scale variations in atmospheric CO2 during the Paleocene and Eocene.