THE EFFECT OF 100KA ATMOSPHERIC CO_2 VARIABILITY ON THE GLACIAL-INTERGLACIAL CYCLE OF THE LATE PLEISTOCENE

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Abstract

The timing of glacial cycles in response to two climatic forcing parameters, insolation and atmospheric CO_2 concentration, is examined. The influence of each forcing parameter on the glacial-interglacial cycle of the Pleistocene is evaluated through two ice sheet models of differing complexity; a zero-dimensional ice sheet coupled to a simplistic ocean temperature and atmospheric CO_2 model, and a more sophisticated 1-D ice sheet model coupled to a three layer atmospheric energy balance model. These ice sheet-climate models are forced with varying CO_2 concentrations in an attempt to determine if low values of atmospheric CO_2 are able to cool the climate enough to prevent the termination of high frequency (~41ka), insolation driven ice-age cycles. CO_2 concentrations varied between the full time dependent Pleistocene signal and constant values of 180, 200, 220, 280 and 350ppm. In both models the constant CO_2 forcing acts as an amplification for the glacial ice volume, and both models suggest that the time dependent Pleistocene CO_2 signal is capable of influencing 41ka insolation driven glacial cycles.

Future constant CO_2 concentration scenarios were designed in an attempt to show a 'best case' scenario for future glaciation, should future CO_2 concentrations remain high into the next 100ka. Model solutions differ substantially when examining possible future glaciation. The zero-dimensional model shows no glaciation for CO_2 concentrations above 350ppm, while the one-dimensional model predicts an ice volume loss of approximately 4,500 cubic kilometers per ppm increase over atmospheric CO_2 concentrations of 275ppm.