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The MMCO-EOT conundrum: same benthic $\delta^{18}O$, different CO_2

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Knowledge on temporal variations of Earth's climate over the past 38 Myr largely stems from benthic $\delta^{18}O$ records. These records are difficult to interpret, however, since they document combined effects of deep-sea temperature and ice volume variations. Information on CO_2 is expanding, but remains highly uncertain and intermittent. Attempts to determine the long-term relations between $\delta^{18}O$, sea level and CO_2 from proxy data suffer from paucity of data and apparent inconsistency among different records. One outstanding issue is the difference recorded in proxy CO_2 data between the Eocene-Oligocene boundary (EOT) and the Middle-Miocene Climatic Optimum (MMCO), while similar levels of benthic $\delta^{18}O$ are shown during these time periods. Here, we take a model-based approach to deconvolute the benthic $\delta^{18}O$ signal, and reconcile knowledge on benthic $\delta^{18}O$, sea level, CO_2 and temperature. We obtain continuous and mutually consistent 38-Myr-long simulations of these variables, by forcing a coupled ice sheet-climate model inversely with benthic $\delta^{18}O$ observations. We investigate the factors influencing Arctic and Antarctic polar amplification, and the relation between sea level and CO_2. Furthermore, we show that different CO_2 between the EOT and MMCO, as indicated by proxy data, can only be obtained if we impose erosion or tectonic movement of the Antarctic continent over time.