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The carbon cycle during the Mid Pleistocene Transition: The Southern Ocean Decoupling Hypothesis

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We here use the global carbon cycle box model BICYCLE to investigate changes in the carbon cycle during the Mid Pleistocene Transition (MPT) covering the past 2,000,000 years (2 Myr). While there exist so far no ice core record of atmospheric CO_2 beyond 650,000 years our simulated atmospheric carbon dioxide partial pressure across the MPT can only be compared with pCO_2 calculated from new pH reconstructions based on boron isotopes measured in planktic foraminifer shells. We validate our results further by a comparison of simulated δ^{13}C with paleo reconstructions of benthic δ^{13}C in the deep Pacific Ocean. Our approach is based on regression analyses of various paleoclimatic proxies with the LR04 benthic δ^{18}O stack, which are then used to extrapolate changing climatic boundary conditions over the whole 2 Myr time window. The focus of our investigation is on the changes in the glacial/interglacial (G/IG) amplitudes in climate (represented by LR04) and the carbon cycle (represented by benthic δ^{13}C) across the MPT. We find that the G/IG amplitudes in LR04 increased by a factor of two across the MPT, those of benthic δ^{13}C in the deep Pacific only by $\sim$40%. According to our model this difference in the dynamic of the climate system and the carbon cycle can be explained if we assume a different response to the applied

forcings in the Southern Ocean prior and after the MPT. This behaviour is what we call the "*Southern Ocean Decoupling Hypothesis*" of the climate and carbon dynamics. We finally discuss how our findings are related to the various hypotheses on the causes of the MPT published within the last years. This study is a temporal extension of the "EPICA challenge", which tried to estimate variations in atmospheric CO_2 from published paleo reconstructions before new ice core measurements of CO_2 were made public. We finally hypothesise that as consequence of our analysis the close relationship between Antarctic temperature and atmospheric CO_2 found in ice cores breaks down prior to the MPT.