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The carbon cycle during the Mid Pleistocene Transition

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It was recently hypothesised that the glacial variability as seen in sediment cores during the last 2 Myr can be explained solely by the obliquity cycle given by a 40-kyr periodicity (Huybers, 2007). This hypothesis suggests that the glacial cycles were and are continuously governed by obliquity pacing but that late Pleistocene glaciations repeatedly skip one or two obliquity cycling, thus resulting in 80 or 120 kyr (on average 100-kyr) periodicity. This would solve both the questions what drove the 100-kyr variability of the late Pleistocene and how the climate system shifted from the 40-kyr towards the 100-kyr variability during the Pleistocene Transition (MPT). One possible explanation for the observed trend towards longer cycles between glacial terminations is a gradual long-term decrease in greenhouse gases causing global cooling and the ability to sustain larger ice-sheets. This impact on the carbon cycle, however, is difficult to assess, because atmospheric CO_2 reconstructions from ice cores are until today restricted to the last 800 kyr. We extend informations on the global carbon cycle by running the global carbon cycle box model BICYCLE (Köhler et al., 2005; Köhler and Fischer, 2006) over the last 2 Myr and compare its results with benthic δ13C records and atmospheric pCO_2 calculated from pH reconstructions based on boron isotopes (Hönisch and Hemming, 2005). In both model- and data-based approaches atmospheric pCO_2 is indeed higher during glacial periods of the early Pleistocene, thus supporting the hypothesis of Huybers. However, the amplitudes in benthic δ13C increases by a factor of two over the MPT in the simulations, while it stays constant in the sediment cores. This suggests that the gradual changes in the carbon cycle are not only driven by increasing glacial/interglacial amplitudes in most climate variables

(such as temperature, sea level, etc). The main candidate to alternatively explain this long-term trend in the carbon cycle is an increase of the riverine input of terrestrial weathering as also suggested by Clark et al. (2006).

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