Geophysical Research Abstracts
Vol. 16, EGU2014-2210, 2014
EGU General Assembly 2014

An "inverse" modelling approach to reconstruct CO_2 and climate change during the Pliocene-Pleistocene transition

Matteo Willeit, Andrey Ganopolski, and Reinhard Calov
Potsdam Institute for Climate Impact Research, Potsdam, Germany (willeit@pik-potsdam.de)

The Pliocene-Pleistocene Transition (PPT) happened at around 2.7 million years ago (Ma). This transition culminated a gradual cooling trend observed during the end of the Pliocene and was characterized by appearance of the large continental ice sheets over northern Eurasia and North America. There is evidence from reconstructions that the PPT was accompanied and possibly caused by a decrease in atmospheric CO_2 from values indicatively between 350 and 400 ppm during the late Pliocene, around 3 Ma, to values closer to the preindustrial value of 280 ppm, but uncertainties in CO_2 reconstructions for this period of time remain large. In this study, we present the best guess CO_2 scenario for the interval from 3.3 to 2.4 Ma, which is the most consistent with benthic $\delta^{18}O$, tropical surface ocean temperatures and other paleoclimate records. With the CLIMBER-2ice Earth system model of intermediate complexity, including interactive ice-sheets and driven by orbital forcing, we run a large ensemble of model simulations with different prescribed CO_2 pathways that are compatible with the broad range from reconstructions. We then define a metric to quantify the model-data agreement. Minimizing the data-model mismatch allows us to infer the CO_2 pathway which results in the best fit of the model to the data. Assuming that other external forcings, e.g. topography changes, played only a secondary role for the PPT and that the model performs reasonably well at simulating the response of climate and ice volume to orbital forcing and prescribed CO_2, we obtain an independent estimate of the CO_2 evolution during the Pliocene-Pleistocene transition. Our results confirm that CO_2 evolution alone can explain major changes in climate dynamics during PPT.