Geophysical Research Abstracts
Vol. 21, EGU2019-13905, 2019
EGU General Assembly 2019
© Author(s) 2019. CC Attribution 4.0 license.

On the astronomical forcing of the Mid-Pleistocene transition

Didier Paillard
CEA-CNRS-UVSQ-IPSL, LSCE, Gif-sur-Yvette, France (didier.paillard@lsce.ipsl.fr)

Glacial–interglacial cycles have been shown to be paced by the astronomy with a dominant periodicity of 100 ka over the last million years, and a periodicity of 41 ka between roughly 1 and 3 million years before present (Myr BP). This last periodicity corresponds well to the expectations of Milankovitch, while the 100 ka one is still difficult to explain. If a full understanding of this Mid-Pleistocene transition (MPT) transition is therefore linked to the comprehension of the 100 ka problem, it is also important to appreciate the longer-term climatic context of general cooling during this period. This cooling is often attributed to a long-term decrease in atmospheric CO_2. Though pCO_2 data are still very sparse and uncertain over this time scale, it can be useful to look at other carbon records, in particular the 13C ones. Marine 13C data exhibits a very obvious 400-ka cyclicity over many millions of years. Understanding these oscillations appears therefore as a fundamental piece of the puzzle. These cycles are linked “in some way” to eccentricity (… just as the 100-ka ones). Interestingly, the amplitude of these 400-ka eccentricity cycles reaches a minimum just before the MPT about 1 million years ago, and a previous one just before the Plio-Pleistocene transition about 3 million years ago. This kind of association is in fact rather generic when looking at older time periods like the Oligocene or Miocene. The fact that the long-term carbon cycle is astronomically forced is too often overlooked and deserves closer attention. These cycles have some peculiar features during the last million years in terms of phasing that are likely to be linked with the large ice-sheet oscillations : the long-term 400-ka carbon cycle is reversed at the MPT. Such an observation puts interesting constraints on the possible mechanisms and I therefore have build a simple conceptual model in order to account both for these 400-ka cycles and for their evolution during the Plio-Pleistocene (Paillard, 2017). This model suggests a drop in atmospheric pCO_2 both at the MPT and another one at the Plio-Pleistocene transition, both being caused by the astronomical forcing.

Paillard D. (2017) The Plio-Pleistocene climatic evolution as a consequence of orbital forcing on the carbon cycle. Clim. Past, vol. 13 pp. 1259-1267.