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The Mediterranean Plio-Pleistocene: A reference frame for astronomically paced low and high latitude climate changes (Jean Baptiste Lamarck Medal Lecture)

Lucas Lourens
Faculty of Geosciences, Utrecht University, Netherlands

The astronomical theory of climate has revolutionized our understanding of past climate change and the development of highly accurate geologic time scales for the entire Cenozoic. Most of this understanding has started with the construction of high-resolution stable oxygen isotope ([U+F064]18O) records from planktonic and benthic foraminifera of open ocean deep marine sediments explored by the international drilling operations of DSDP, ODP and IODP. These efforts culminated into global ocean isotopic stacked records, which give a clear picture of the evolution of the climate state through time. Fundamental for these reconstructions are the assumptions made between the astronomical forcing and the tuned time series and the accuracy of the astronomical solution.

In the past decades, an astronomically calibrated time scale for the Pliocene and Pleistocene of the Mediterranean has been developed, which has become the reference for the standard Geologic Time Scale. Characteristic of the studied marine sediments are the cyclic lithological alternations, reflecting the interference between obliquity and precession-paced low latitude climate variability. These interference patterns allowed to evaluate the accuracy of astronomical solutions and to constrain the dynamical ellipticity of the Earth and tidal dissipation by the Sun and the Moon, which in turn provided the backbone for the widely applied LR04 open ocean benthic isotope stack of the past 5 Myr.

So far, the assumed time lags between orbital forcing and the global climate response as reflected in LR04 have not been tested, while these assumptions hark back to SPECMAP, using simple ice sheet models and a limited number of radiometric dates. In addition, LR04 adopted a shorter response time for the smaller ice caps during the Pliocene. Here I present the first benthic [U+F064]18O record of the Mediterranean reference scale, which strikingly mirrors the LR04. I will use this record to discuss the assumed phase relations and its potential to constrain global sea level changes and their cause over the past 5.3 million years.