Séminaire

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salle L. Lliboutry, LGGE

On the nature of the Pliocene/Pleistocene glacial cycle lengthening

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Abstract

Although numerous endeavors have been undertaken to understand the nature of the 40-to-100 ka transition in the glacial cycle lengths that took place about 1,0-1,5 ma BP this phenomenon remains to be a mystery up to now. Here we use a specially designed wavelet-based technique to treat paleoclimatic records related to those times in concepts of the mathematical dynamical system theory. Just, we interpret the well known fact that the global climate system underwent a rhythmic behavior of the ~41 ka period (the main period of the Earth's axis obliquity) during the Pliocene as an evidence of the so-called limit cycle attractor in the climate system dynamics. Under stress of a gradual climate system cooling the magnitude of this limit cycle attractor increased from the Early to Late Pliocene. But this increase was not monotonous because of the ~1.2 ma-long beat of obliquity. Ones, when this magnitude exceeded a certain level, the climatic limit cycle attractor has lost its stability, and a new, more complex, attractor arose via the period doubling bifurcation well-known in the dynamical system theory. During the Pleistocene the magnitude of the new-arisen attractor essentially enhanced because of resonances with insolation variations which were induced by combinational tones of the Earth's orbit eccentricity, and so. the period of the new-arisen attractor trebled, doubled and trebled by turns depending on phase-locking to either of those tones. As a result, the climate dynamics during the Pleistocene, even if it looks to be very complex at the first glance, turned out to be mutually ordered and self-similar. Such kind of the dynamics is called STRANGE NONCHAOTIC in the mathematical theory of the nonlinear dynamical systems. It is actually predictable in some sense. In particular, a wavelet-based comparison of the Holocene climate variations with the MIS11 ones indicates that the end of the Holocene can be waited soon (in the timescale of a few thousands of years).