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Long-term solution for the insolation quantities of the Earth

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Abstract. We discuss a long-term solution for the insolation quantities of the Earth.

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A precise solution for the motion of the Earth axis (precession and nutation) is required for the reduction of astronomical observations over a few centuries. On the other hand, over long time scales, the short term variations of the Earth axis can be neglected and only the long term variations of the obliquity and precession angle become dominant. These solutions are used for the analysis of the paleoclimate signal present in the sedimentary records over several millions of years, according to Milankovitch theory of paleoclimates.

The agreement between the computed insolation signal (that depends on the secular evolution of the Earth's orbit and spin axis) and the sedimentary records is now so well established that in the recently published geological timescale GTS2004 (Gradstein, Ogg & Smith, eds., 2004), the whole Neogene period (0 - 23 Ma) has been calibrated using the astronomical solution of Laskar *et al.* (2004). In the continuation of this work, there is now an international effort for the astronomical calibration of the full Paleogene period (65 Ma). This goal is a difficult challenge for the computation of the Earth parameter evolution. Indeed, due to the chaotic evolution of its orbit (Laskar 1989, 1990), the uncertainty on the solution diverges exponentially by a factor of 10 every 10 Myr. The present orbital solution of Laskar *et al.* (2004) is estimated to be valid over about 40 Myr. To extend this solution over 65 Myr will require to improve the accuracy of the model by more than 2 orders of magnitude. The situation of the solution for the evolution of the Earth's axis is even worse, due to the uncertainty of the past evolution of the tidal dissipation in the Earth-Moon system. A first step towards the construction of a new generation of long term insolation solutions that will attempt to meet this challenge has been achieve recently in our group with the development of a new high accurate planetary ephemeris (INPOP06) fitted over all available planetary observations (see the presentation of A. Fienga in this volume).

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