The AstroGeo project. The interplay between space missions, celestial mechanics and the analysis of stratigraphic series

Jacques Laskar*†[1]

[1]IMCCE/Observatoire de Paris – www.astrogeo.eu – France

Abstract

According to Milankovitch's theory of climate, the great climatic variations of the past result from variations in the orbit and orientation of the Earth, themselves modified by gravitational interactions with the other planets and the Moon. Within the AstroGeo project, we propose to recover the past orbits of the planets and the Moon over geological times through the joint use of space missions data analysis, analytical and numerical methods in celestial mechanics and geophysics, and the analysis of sedimentary cyclostratigraphic data. What probably caracterise the AstroGeo approach, is that in the chain of necessary steps to perform this task, we are often using tools that we have developed. This is the case for the adjustment of the orbital solutions to the terrestrial observations and space missions data. This is also true for the celestial mechanics methods. We have developed a dedicated computer algebra system, TRIP, that allows to computed the averaged equations that have been essential to derive the first high accurate orbital and rotational solutions for the Earth (Laskar, 1988, 1990, Laskar et al, 1993), and to discover the chaotic motion of the solar system (Laskar, 1988, 1990). When relying on direct numerical integrations, in order to read the highest accuracy and stability, we had to devise some new high order integrators for the planetary motions (Laskar & Robutel, 2001, Laskar et al, 2004). Finally, in order to obtain, the first coherent scenario for the Earth-Moon evolution (Farhat et al, 2022), we needed the analytical understanding of the atmospheric and oceanic tides previously developed within the team (Desrotour et al, 2017, 2018, 2019). I will briefly describe some of these steps, focussing on the essential results that are of interest for the stratigraphic community.

Keywords: AstroGeo project, stratigraphic series

*Speaker

†Corresponding author: laskar@astrogeo.eu