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Towards an open-source tool dedicated to the representation of gravitational interaction with neighbouring celestial bodies in planetary sciences

Antony Trinh and Veronique Dehant
Royal Observatory of Belgium, Brussels, Belgium (a.trinh@oma.be)

The presence of celestial bodies in the neighbourhood of a planet (in the loose sense of the word) generates gravity field variations which drive rotation perturbations and tides and affect the trajectory of orbiting artificial satellites. The computation of the induced torque, tide-generating potential and other related quantities is well known in celestial mechanics, and frequently needed in planetary sciences. For a limited number of planets, tide-generating potentials have been built numerically from accurate ephemerides using Poisson series manipulators, and published as tables of Poisson series involving the astronomical frequencies. However, since in the general case no such developments are available, and besides full accuracy is not always required in a range of applications, we felt the need to provide the planetary science community with a flexible tool to compute (in numeric or symbolic form) the approximate spectral expansion of the induced torque, tide-generating potential and related quantities. We show, in the full generality of the problem (i.e. taking into account the multipolarity of the gravitational fields, and without assuming that the neighbouring celestial bodies orbit - or seem to orbit - around the planet), how this can be done by direct analytical calculation, summarising the approaches proposed by various authors. We also wish to seize the opportunity of this session to evaluate the interest of the planetary science community for this project and judge how such a tool could best match its needs.