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Extraction of tidal Love number and forced libration amplitude of Mercury from synthetic laser altimetry records

Ch. Koch, U.R. Christensen, R. Kallenbach
Max-Planck-Institut für Sonnensystemforschung, Katlenburg-Lindau (Germany)

Solar tidal forces generate elevation changes of Mercury's surface of the order 1 m within one Hermean year, and solar torques on the non-symmetric mass distribution of the planet cause an uneven rotation of Mercury's surface with a libration amplitude of order of 40 arcseconds. Knowledge of the precise reaction of the planet to tidal forcing, expressed by the Love numbers h_2 and k_2, as well as accurate knowledge of the amplitude of forced libration Φ_{lib}, puts constraints on the internal structure, for example the state and the size of the core. We investigate if the Love number h and the amplitude of forced libration can be simultaneously determined together with the static topography of the planet from a global synthetic altimetry record of the BepiColombo Laser Altimeter BELA over the nominal mission duration of approximately 4 Mercury years. We find that it should be possible to extract the parameters h_2 and Φ_{lib} with an accuracy of at least 4% and 7%, respectively, while the static topography coefficients of a spherical harmonic expansion up to order 64 can be determined simultaneously with an accuracy at the centimeter level. The simulation results demonstrate that it seems feasible to test current models on Mercury's interior with sufficient precision using BepiColombo Laser Altimeter data.