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Determining Mercury's tidal Love number h with laser altimetry

U.R. Christensen, C. Koch and M. Hilchenbach
Max-Planck-Institute for Solar System Research, Germany (christensen@mps.mpg.de)

Solar tides generate elevation changes of Mercury's surface of the order 1 m within one Hermean year. Knowledge of the precise reaction of the planet to tidal forcing, expressed by the Love numbers h_2 and k_2, puts constraints on the internal structure, for example the state and the size of the core. The MESSENGER and BEPI COLOMBO missions to Mercury carry laser altimeters, whose primary goal is to accurately map the topography. Here we investigate if the Love number h can be determined from a global altimetry record. We do this by creating synthetic altimeter data for the nominal orbit of BEPI COLOMBO. The synthetic data comprise large- and intermediate-scale static topography, the tidal contribution, and noise with a 1σ amplitude of 65 m. The latter represents the influence of unresolved small-scale topography, measurement errors, and positional errors of the spacecraft. We then invert simultaneously for the spherical harmonic coefficients of the large-scale topography and the Love number. We find that despite the small signal-to-noise ratio the Love number can be recovered within a few percent error assuming ideal data with (i) global and uniform coverage of the planetary surface for two Mercury years without gaps, and with (ii) all sources of noise being purely Gaussian. Under these conditions also the amplitude of the planets forced libration can be obtained with a small error from the altimeter data. We currently study how the accuracy is affected by data gaps.