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Extraction of time-dependent topography variations from BepiColombo laser altimeter data

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The Bela laser altimeter is one of the instruments on the BepiColombo mission to Mercury set up by ESA and JAXA. The main goal to be achieved with the BELA instrument is the determination of the global surface topography with an accuracy of the order one meter, expressed in terms of a spherical harmonic expansion. Here we investigate if it is possible to determine time-dependent variations such as the tidal interaction of Mercury with the Sun, i.e. the second-order tidal Love number h_2, and Mercury's forced libration amplitude $\Delta\lambda_{libr}$. Mercury has a 3:2 spin resonance between its rotational and orbital motion. A particular surface feature is revisited six times by the spacecraft during two Mercury years. This makes it principally difficult to extract the amplitude of the solar tides and the forced libration. We study this problem by using synthetic data and inverting simultaneously for the static topography and time-dependent variations. The problems in extracting the Love number for the sectorial tides that are arising from the operational constraints for the instrument and Mercury's 3/2 spin in combination with the analysis method are described in detail. Alternative solutions for the BELA data analysis are discussed. Because of Mercury's eccentric orbit around the Sun, the amplitude of the zonal tides in the polar regions of the planet is fairly large. It seems feasible to exctract this amplitude from BELA data.