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Ocean tide loading (OTL) displacements from global and local grids : comparisons to GPS estimates over the shelf of Brittany, France.

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The earth's crust undergoes periodic displacements due to temporally varying atmospheric oceanic and continental water mass surface loads. Crustal deformation caused by loading due to ocean tides are strongly dependent on the surface load closest to the observation site. The correct modeling of this effect in today's geodetic applications is of very high importance.

First, by validating ocean tide loading (OTL) models, we are directly validating for the tide models in a specific coastal region. The impact of tides mismodelling in the estimation of GRACE's geoïd (∼mm) and equivalent water height (EWH)(∼cm) has been recently shown (*R.D. Ray et S. B. Luthcke 2006, Panet I. et al, 2006*). Errors in tidal models can propagate globally as resonant errors through correlations with satellite state, accelerometer and range-rate parameters estimated during the orbit determination process. Even for the calculation of the tide models the introduction of loading and self-attraction (LSA) terms must be considered in the most consistent way as possible in order to avoid an erroneous non-zero global rate of work of the LSA forcing (*Lyard et al 2006*), especially in coastal regions . OTL has an impact on the vertical movements of stations like tide gauges, instruments that measure the variations of the sea level, but not only. Un-modelled effects of OTL in the time series of GPS permanent stations can introduce aliasing signals when solved for 24hrs, with periods from 2 weeks to 1-year (Penna and Steward, 2003 and Penna, 2006).

Our area of study is the continental shelf of French Brittany and Contentin. Brittany is one of the few places in the world were tides can reach up to an amplitude of 14m (during the equinox spring tide) causing loading displacements of $\sim$10cm in vertical and a few cm in horizontal components of geodetic stations. We are using a set of global ocean tide charts (FES2004 corrected for K2 + M4 , TPXO.7.0, GOT00.2, CSR4.0, NAO.99b) and the most recent grids of the North East Atlantic (NEA) atlas from F. Lyard and the LEGOS team. Theses gridded amplitudes and phases of the 11 main, or even more, constituents of the ocean tides, together with the Green's functions calculated from a particular set of Load Love Numbers (LLNs), are convolved in order to get the modeled displacements due to ocean loading. The global charts usually have a very good resolution of 0,125x0,125 to 0,5x0,5 degrees over the continental shelf as well as over the deep ocean. Though OTL effects over the near-field of the irregular coastal areas can easily be mismodelled due to the poor resolution of global tide atlases and the complexity of currents and friction phenomena especially in areas with low bathymetry as is in Brittany and in the English channel. Nevertheless, due to the high resolution of the regional NEA grids (1'x1') we are expecting more accurate OTL displacements. For that we are comparing modeled displacements to observations of a 12-station GPS campaign taken in a period of 120 days from March to June 2004. We are analyzing possible misfits between models (global vs regional) and we are trying to find the best correspondence to the real GPS OTL observations. We are estimating influences of the loading effect on Zenith Path Delays (ZPD) and we derive the necessary transfer functions. Finally, as in any other geodetic technique GPS suffers from errors in its final position estimates (perturbations at sidereal cycles, unfixed ambiguities, antenna phase center variations etc.) and a careful error budget analyses gives recommendations for future applications. For our GPS estimates we are using the CNES/GRGS scientific software package GINS 6.1.