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Treatment of ocean tide aliasing in the context of a next generation gravity field mission

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Current temporal gravity field solutions from GRACE suffer from temporal aliasing errors due to undersampling of signal to be recovered (e.g., hydrology), uncertainties in the de-aliasing models (usually atmosphere and ocean), and imperfect ocean tide models. Especially the latter will be one of the most limiting factors in determining high resolution temporal gravity fields from future gravity missions such as GRACE Follow-on and Next-Generation Gravity Missions (NGGM) equipped with improved measurement technology, which cannot be fully exploited due to this dominant systematic error source. In several previous studies it has been shown that temporal aliasing, related to tidal and non-tidal sources, can be significantly reduced by double-pair formations, e.g., in a so-called Bender configuration, and its effects can be migrated to higher frequencies by an optimum orbit choice, especially the orbit altitude (Murböck et al. 2013). Improved processing strategies and extended parameter models should be able to further reduce the problem. Concerning non-tidal aliasing, it could be shown that the parameterization of short-period long-wavelength gravity field signals, the so-called Wiese approach, is a powerful method for aliasing reduction (Wiese et al. 2013), but it does not really work for the very short-period signals of ocean tides with mainly semi-diurnal and diurnal periods (Daras 2015).

In this contribution, several methods dealing with the reduction of ocean tide aliasing are investigated both from a methodological and a numerical point of view. One of the promising strategies is the co-estimation of the 8 main tidal constituents over time spans of several years, also considering the basic orbit frequencies of the satellites. These improved estimates for ocean tide signals can then be used in a second step as an enhanced de-aliasing product for the computation of short-period temporal gravity fields.

Numerical closed-loop simulations of low-low satellite-to-satellite-tracking missions for a single (near-) polar pair and a classical Bender configuration being composed of a (near-) polar and an inclined in-line satellite pair are performed, using time variable geophysical background models and noise assumptions for new generation instrument technology.
As a further aspect of this work, independent results from two different gravity field processing software packages are assessed. Finally, possible correlations between ocean tides and other co-estimated parameters (static, Wiese, etc.) as well as their impact on the gravity solution are analysed.