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A Realistically Perturbed Atmosphere and Ocean De-Aliasing Model for Future Gravity Mission Simulation Studies

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Recently completed performance studies of future gravity mission concepts arrived at sometimes contradicting conclusions about the importance of non-tidal aliasing errors that remain in the finally retrieved gravity field time-series. In those studies, typically a fraction of the differences between two different models of atmosphere and ocean mass variability determined the magnitude of the aliasing errors.

Since differences among arbitrary pairs of the numerical models available might lead to widely different aliasing errors and thus conclusions regarding limiting error contributors of a candidate mission, we present here for the first time a version of a realistically perturbed de-aliasing model that is consistent with the updated ESA Earth System Model for gravity mission simulation studies (Dobslaw et al., 2015). The error model is available over the whole 12-year period of the ESA ESM and consists of two parts: (i) a component containing signals from physical processes that are intentionally omitted from de-aliasing models, as for a example, variations in global eustatic sea-level; and (ii) a series of true errors that consist of in total five different components with realistically re-scaled variability at both small and large spatial scales for different frequency bands ranging from sub-daily to sub-monthly periods.

Based on a multi-model ensemble of atmosphere and ocean mass variability available to us for the year 2006, we will demonstrate that our re-scaled true errors have plausible magnitudes and correlation characteristics in all frequency bands considered. The realism of the selected scaling coefficients for periods between 1 and 30 days is tested further by means of a variance component estimation based on the constrained daily GRACE solution series ITSG-GRACE2014. Initial full-scale simulation experiments are used to re-assess the relative importance of non-tidal de-aliasing errors for the GRACE-FO mission, which might be subsequently expanded to further mission candidates currently under consideration for a potential Next Generation Gravity Mission.

Dobslaw, H. Bergmann-Wolf, I., Dill, R., Forootan, E., Klemann, V., Kusche, J., Sasgen, I. (2015), The updated ESA Earth System Model for future gravity mission simulation studies, J. Geodesy, doi:10.1007/s00190-014-0787-8.