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Error Characteristics of Satellite-only Global Gravity Models after Solid Earth Data Reductions

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The spatial homogeneity provided by satellite-only gravity models has been successfully exploited to probe the lithosphere density structure and its related quantities (e.g. composition and temperature). Compared with other observables, these models provide an unparalleled spatial coverage, which comes with the price of lower resolution.

Geophysical applications of gravity products start with data reduction, stripping the gravity effect of "known masses" to isolate an anomalous field. Uncertainties in the reductions, which rely on a-priori data, accumulate in the anomaly and are non-trivially propagated to the inversion results. The static spatial distribution of mass in the lithosphere is responsible for a large part of the observed signal, well above the sensitivity of the products. At the same time, the uncertainties in reductions can reach the same magnitude as the enquired source.

We aimed at providing an error estimate for solid Earth applications, in the form of error curves "after reduction", in the spectral domain, and maps of the spatial distribution of uncertainty. We computed a set of reductions for crustal and mantle inhomogeneities. Uncertainties in the input quantities were propagated trough Monte Carlo methods. Depth uncertainties, if not provided with the input data, were assigned according to method-specific assumptions. Estimates of density and its variance come from distributions fitted to literature data, from petrophysics, and from worst-case assumptions where no data is available. We report the results of these tests globally. Simulated improvements in the input data show how slight improvements in quality would pay off in terms of error reduction.