



Long-range spatial correlations in GRACE products: a matter of S2-tidal aliasing?

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Unlike hydrological and hydro-meteorological mass change residuals (monthly minus mean monthly mass changes), those from GRACE contain a long-range spatial correlation pattern mainly w.r.t. latitude. A principal component (PC) analysis on residuals of GRACE products identifies a responsible mode with maximum sigma. The empirical orthogonal function (EOF) map of this mode shows a long-range spatially correlated pattern and the PC shows periodic behaviour. Spectral investigation on the PC reveals a periodicity around 158–161 days for different products. Both the EOF map and PC are interpreted as the result of mismodelling or non-modelling of the S2-tidal aliasing in GRACE.

We determine the aliasing period of S2 over the time using the observed orbital elements. It shows a distinct, though small, variation due to change on inclination, semimajor axis and eccentricity. The dominant frequency of GRACE residuals, determined from spectral analysis of the PC, agrees well with the aliasing frequency of S2 tide. Filtering of the respective frequency from the GRACE products leads to a new GRACE data set with the following properties:

- 1- The long range spatial correlation of the residuals has vanished
- 2- GRACE signals as well as their residuals show higher correlations with hydrological and hydro-meteorological data
- 3- Residual amplitudes are reduced over the oceans and landmasses at equatorial and polar latitudes.

As a consequence, the corrected GRACE signals provide more reliable data, particularly for hydrological, glaciological and oceanographic studies.