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GRACE-FO accelerometer data: An alternative approach using Least Squares Spectral Analysis

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Technological advances in satellite geodesy have been demanding more and more accurate gravity field models but also precise measurements of the movement of water along the Earth system. GRACE-FO (GFO) mission is dedicated to monitor the Earth with a purpose of estimating the gravity field and the hydrological cycles. For the extraction of monthly gravity field models the non-gravitational accelerations are essential. The performance of GFO accelerometers (ACC) is not the optimal. The ACC measurements present immense spikes, spurious signals and bias jumps on all three axes affecting the validity of the measurements. The bias jumps are similar to those presented at GRACE measurements and they have been related to the satellites' entrance to and exit from the Earth's shadow. The dominant spikes, mainly appearing in the equatorial region, have been connected to the thermal sensitivity of the instrument or the orientation of the magnetic field lines. We propose an alternative dataset generated from Level 1A of GFO C with corresponding Gaussian weights and an optimal correction of the bias jumps, along with the estimation of linear and quadratic trends using the Least Squares methodology in the frequency domain and in all three axes. The method does not remove spikes, nor does it interpolate missing values. The new 1B dataset with estimated variances shows no spike effects in the frequency domain contrastingly to the existing ACT Level 1B data. Also, a preliminary analysis of the daily amplitudes of the orbital period and semi-period components of the ACT Level 1B data set spanning one year, reveals a strong periodic signal of ~ 153 days. This signal vanishes when the proposed weighted data set is used. This signal could be related to calibration deficiencies or a systematic error in the ACC data that requires further study. The same weighted filtering approach is proposed for the ACC measurements of Swarm C satellite, a LEO constellation that measures the magnetic field of the Earth. The ACC measurements of Swarm display low signal to noise ratio due to an increased thermal sensitivity of the instrument. A weighted Gaussian filter applied on the Swarm ACC measurements reduces the contribution of the dominant spikes in the frequency domain and displays the non-gravitational signals more clearly leading to a more extended use of Swarm non-gravitational accelerations measurements.