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The role of accelerometer data calibration within the ITSG-Grace2016 release: impact on C20 coefficients

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Both GRACE (Gravity Recovery and Climate Experiment) satellites are equipped with a three-axis electrostatic accelerometer, measuring the non-gravitational forces acting on the spacecraft. In order to make use of the uncalibrated Level-1B accelerometer (ACC1B) data during gravity field recovery, bias and scale parameters have to be estimated. We present a two-step approach used for ACC1B data calibration within the ITSG-Grace2016 release and analyze its impact on the recovered gravity field solutions, especially on the C20 coefficients.

Within this approach, the accelerometer biases are estimated daily using uniform cubic basis splines (UCBS), and the scale factors are also estimated daily using a fully-populated scale factor matrix. Therefore, not only the scale factors in along-track, cross-track and radial direction are estimated, but also the non-orthogonality of the accelerometer axes (cross-talk) and the misalignment between the Accelerometer Frame (AF) and the Science Reference Frame (SRF) are taken into account.
Since our approach aims at improving the gravity field recovery, it does not guarantee a physically correct model. Hence, the setup of the calibration parameters is likely to also absorb mismodeled or non-accelerometer induced spurious signals that otherwise map into the gravity field coefficients.

For the ITSG-Grace2016 release, the improved calibration parametrization not only contributed to a noise reduction, but also significantly improved the estimates of the C20 coefficients. We show that the offset between SLR (Satellite Laser Ranging) and GRACE derived C20 time series can be reduced remarkably by the use of a fully-populated scale factor matrix, demonstrating the merit of this new approach. Based on our results, we suggest the presence of a clear temperature-dependent behavior (biases and scale factors) and the presence of off-diagonal elements within the accelerometer scale factor matrix.