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Improvement of GRACE solutions and of inferred mass variations after mitigating the effect of Level-1B (Release-1) K-band alignment biases

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The geometric correction of the GRACE K-band ranging data converts the original ranging observation (between the two K-band antenna phase centers) into an observation between the two satellites' centers of mass. The geometric correction operationally used so far (e.g. for the Release-4 monthly solutions by CSR and GFZ) are dominated by systematic errors. These errors are now among the major issues that are being addressed in the Level-1 reprocessing by the GRACE Science Data System.

We traced the systematic errors back to biases in the Level-1B data that determine the intersatellite K-Band alignment. In a re-calibration approach, we adjusted those biases in terms of pitch and yaw angles in the Science Reference Frame. The biases are as large as 1-2 mrad. We generated two series of 10-day solutions over about 2.4 years according to the CNES/GRGS processing approach: One series based on the original (Level-1B) alignment geometry and one based on a re-calibrated geometry. While technical details are presented elsewhere (Horwath et al., 2010, J. Geod., doi:10.1007/s00190-010-0414-2), here we concentrate on an assessment how the re-calibration effects time-variable gravity field solutions and inferred geophysical mass variations. Our results tentative anticipate effects of the alignment-related improvements in the Level-1 reprocessing.

According to our assessment, the alignment biases have previously induced gravity field errors on the level of 6-11 times the GRACE baseline error level. Their mitigation is therefore an important step towards the GRACE baseline accuracy goal. The zonal coefficients are affected in a particular way. Our re-calibration reduces their rms errors (from degree 14) by 50%. The zonal artifacts that have been induced by the alignment biases evolve coherently in time, thus aggravating the risk of geophysical misinterpration. As an example for geophysical inferences, we show that the improvement reduces disagreement between GRACE-based oceanic mass variations and in-situ ocean bottom pressure data.