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Improved GRACE science results after adjustment of geometric biases in the Level-1B K-band ranging data

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The GRACE (Gravity Recovery and Climate Experiment) satellite mission relies on the inter-satellite K-band microwave ranging (KBR) observations. We detect systematic errors in the Level-1B KBR data, namely in the antenna offset correction. This correction converts the original ranging observation (between the two KBR antennas) into an observation between the two satellites' centers of mass. It needs data on the precise alignment between the two satellites' centers of mass and antenna phase centers. The used alignment data turn out to have large constant biases which, in turn, induce non-constant errors in the antenna offset correction. While the precise origin of the biases remains to be identified, we are able to parametrize and correct them. This significantly improves time-variable gravity field solutions. Empirical assessments indicate that the systematic KBR data errors have previously induced gravity field errors on the level of 6-11 times the so-called GRACE baseline error level. The zonal coefficients (from degree 14) have been particularly affected. Their rms errors now drop down to about 50%. As an example for geophysical inferences we show that the improvement may importantly affect estimates of interannual mass variations of the Antarctic ice sheet.