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Comparison of empirical noise models for GRACE Follow-On derived with the Celestial Mechanics Approach

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A key component of any model is the accurate specification of its quality. In gravity field modelling from satellite data, as it is done with the observation collected by GRACE Follow-On, usually least-squares adjustments are performed to obtain a monthly solution of the Earth's gravity field. However,
the jointly estimated formal errors usually do not reflect the error level that could be expected but provides much lower error estimates. We take the Celestial Mechanics Approach (CMA), developed at the Astronomical Institute, University of Bern (AIUB), and extend it by an empirical modelling of the noise based on the post-fit residuals between the final GRACE Follow-On orbits, that are co-estimated together with the gravity field, and the observations, expressed in position residuals to the kinematic positions and in K-band range-rate residuals. We compare and validate the solutions that employ empirical modelling with solutions that do not contain sophisticated noise modelling by examining the stochastic behaviour of the respective post-fit residuals, by investigating areas where a low noise is expected and by inspecting the mass trend estimates in certain areas of global interest. Finally, we investigate the influence of the empirically weighted solutions in a combination of monthly gravity fields based on other approaches as it is done in the COST-G framework.