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Next Generation Gravity Missions are expected to enhance our knowledge of mass transport processes in the Earth system, establishing their products applicable to new scientific fields and serving societal needs. Compared to the current situation (GRACE Follow-On), a significant step forward to increase spatial and temporal resolution can only be achieved by new mission concepts, complemented by improved instrumentation and tailored processing strategies.

In extensive numerical closed-loop mission simulations studies, different mission concepts have been studied in detail, with emphasis on orbit design and resulting spatial-temporal ground track pattern, enhances processing and parameterization strategies, and improved post-processing/filtering strategies. Promising candidates for a next-generation gravity mission are double-pair and multi-pair constellations of GRACE/GRACE-FO-type satellites, as they are currently jointly studied by ESA and NASA. An alternative concept is high-precision ranging between high- and low-flying satellites. Since such a constellation observes mainly the radial component of gravity-induced orbit perturbations, the error structure is close to isotropic, which significantly reduces artefacts of along-track ranging formations. This high-low concept was proposed as ESA Earth Explorer 10 mission MOBILE and is currently further studies under the name MARVEL by the French space agency. Additionally, we evaluate the potential of a hybridization of electro-static and cold-atom accelerometers in order to improve the accelerometer performance in the low-frequency range.

In this contribution, based on full-fledged numerical closed-loop simulations with realistic error assumptions regarding their key payload, different mission constellations (in-line single-pair, Bender double-pair, multi-pairs, precise high-low tracking) are assessed and compared. Their overall performance, dealiasing potential, and recovery performance of short-periodic gravity signals are analyzed, in view of their capabilities to retrieve gravity field information with short latencies to be used for societally relevant service applications, such as water management, groundwater monitoring, and forecasting of droughts and floods.