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Virtual constellations of Future Satellite Gravity Missions

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The most realistic scenario for future satellite gravity missions includes at least two missions in orbit at the same time. Both missions will most likely fly in a low-low Satellite-to-Satellite tracking (SST) constellation. The important question arises, how gravity field determination especially for time variable applications benefits from such parallel missions. Going more into detail let us assume on the one hand one low-low SST satellite pair on a near polar orbit. On the other hand there is one pair on an inclined orbit, e.g. sun-synchronous or as in a so-called Bender-constellation with 63 degrees inclination. It is clear that an additional satellite pair improves not only the formal quality of the estimated spherical harmonic (SH) coefficients but also the temporal aliasing behavior resulting from background model errors. Several combinations are compared analyzing the influences of different parameters, e.g. measurement performance, inclination, repeat cycle. In particular, the added value of a second satellite pair compared to a single-pair mission shall be analyzed, evaluated and assessed in detail.
A closed-loop simulation environment, by combining the missions on normal equation level will provide a realistic estimate of the achievable accuracy of gravity field determination. The reference world consists of a static and time variable gravity model and an ocean tide model. Starting from realistic orbit positions the key observations for one pair are computed in terms of acceleration differences between the two satellites in Line-of-Sight direction. Realistic noise time series are added and with auto-regressive moving average (ARMA) filters their colored behavior is overcome to get an appropriate weighting of the observations.
The rigorous estimation process leads to SH coefficients with formal errors from full normal equation matrices. Therefore the results can be expressed in both, the SH domain and the spatial domain. Several aspects are analyzed in detail by comparing the differences with respect to the mean reference field. One key problem to be addressed is the choice of the repeat cycles for the two satellite pairs.