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Impact of orbit design choices on the gravity field retrieval of Next Generation Gravity Missions - Insights on the ESA-ADDCON project

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Next Generation Gravity Missions (NGGMs) expected to be launched in the mid-term future have set high anticipations for an enhanced monitoring of mass transport in the Earth system, establishing their products applicable to new scientific fields and serving societal needs. The European Space Agency (ESA) has issued several studies on concepts of NGGMs. Following this tradition, the project “Additional Constellations & Scientific Analysis Studies of the Next Generation Gravity Mission” picks up where the previous study ESA-SC4MGV left off.

One of the ESA-ADDCON project objectives is to investigate the impact of different orbit configurations and parameters on the gravity field retrieval. Given a two-pair Bender-type constellation, consisting of a polar and an inclined pair, choices for orbit design such as the altitude profile during mission lifetime, the length of retrieval period, the value of sub-cycles and the choice of a prograde over a retrograde orbit are investigated. Moreover, the problem of aliasing due to ocean tide model inaccuracies, as well as methods for mitigating their effect on gravity field solutions are investigated in the context of NGGMs.

The performed simulations make use of the gravity field processing approach where low-resolution gravity field solutions are co-parameterized in short-term periods (e.g. daily) together with the long-term solutions (e.g. 11-day solution). This method proved to be beneficial for NGGMs (ESA-SC4MGV project) since the enhanced spatio-temporal sampling enables a self-de-aliasing of high-frequency atmospheric and oceanic signals, which may now be a part of the retrieved signal. The potential added value of having such signals for the first time in near real-time is assessed within the project.

This paper demonstrates the preliminary results of the ESA-ADDCON project focusing on aspects of orbit design choices for NGGMs.