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Sensitivity of different variants of GENESIS orbit to global geodetic parameters

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The GENESIS mission plays a pivotal role in the FutureNAV program envisioned by the European Space Agency. This groundbreaking venture aims to co-locate four space geodetic techniques on a single platform in space. One of the primary mission objectives is accurately determining geodetic parameters, including geocenter motion, low-degree gravity field, Earth rotation parameters, and the positions of ground stations in tracking networks. Although preliminary satellite inclination and altitude were provided, there is untapped potential for studying ways to enhance the efficiency of incorporating GENESIS into geodetic products.

This research focuses on the preliminary optimization of GENESIS orbital parameters – semi-major axis, inclination, and eccentricity- to assess the benefits arising from diverse observation geometries on geodetic products. The analysis is based on simulations of different variants of GENESIS orbital parameters tracked by a network of 20 satellite laser ranging (SLR) stations. We provide GENESIS-only solutions as well as the combined solution with a selected subset of geodetic satellites that are used today or in the future for the realization of the terrestrial reference frames: LAGEOS-1, LAGEOS-2, LARES-1, and LARES-2. GENESIS will be equipped with two GNSS receivers contributing to high-accuracy orbit determination, serving as a priori parameters for SLR-based solutions. Therefore, we check the GENESIS sensitivity to global geodetic parameters, assuming that the precise orbits are not derived from SLR but can be well-defined from other techniques.

We study the impact of different GENESIS orbits on the gravity potential parameters, especially the zonal terms, Earth rotation parameters, and geocenter coordinates. Our findings underscore that, through meticulous processing, GENESIS has the potential to significantly contribute to achieving the goals of the Global Geodetic Observing System (GGOS), particularly in terms of refining the Z component of the geocenter coordinates.