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BRIDGING THE GAP BETWEEN GRACE AND GRACE FOLLOW-ON USING CONVENTIONAL TRACKING DATA

Abstract

This study examines a method designed to bridge the likely six-to-eight-month gap between the GRACE and GRACE Follow-On (GFO) missions (from DLR and NASA) using a combination of existing GRACE data with an aggregate of independent time-variable gravity solutions. The GRACE mission is expected to re-enter the atmosphere in mid-2017, while GFO is slated to launch in early 2018. The bridging technique therefore entails filling in the missing months.

The independent solutions stem from ground-based tracking (SLR and DORIS) of a constellation of satellites. These tracking data are accumulated and turned into gravity fields that are ensured to continue over the GRACE – GFO gap. Three research centers (Goddard Space Flight Center in Greenbelt, MD, Astronomisches Institut Universitaet Bern in Bern, Switzerland, and Deutsches Geodaetisches Forschungsinstitut in Munich, Germany) have provided these solutions and their full covariances. The dominant GRACE spatial patterns, obtained from a Principal Component Analysis (PCA), are truncated and fit onto these SLR/DORIS fields to determine their temporal behavior. As such, the resulting reconstructed gravity fields are made of a linear combination of the full GRACE spatial patterns and the associated temporal behavior. The reconstructed fields cover the time span of the SLR/DORIS fields, which (1) started in 1993, (2) will continue well into the GFO time frame, and (3) are independent of GRACE. The error budget treats both the geophysical errors that are inherent to global gravity fields, as well as errors that arise from the reconstruction assumptions (e.g., the GRACE patterns can be truncated).

For the purpose of this gap-bridging effort, simulated six-to-twelve-month gaps in the GRACE data provide a perspective on the effectiveness of this technique. We show that short gaps do not significantly alter the first three modes recovered from a PCA on GRACE. Moreover, the timing of the simulated gaps (e.g., centered in 2007 or 2010) has little influence on the final reconstructions. As such, these reconstructions with simulated gaps remain similar to the "truth" reconstructions. This indicates that this technique is resilient to short interruptions in the data. We apply this technique to specific continental-wide cases such as Australia and the Greenland ice sheet. These case studies show that the errors from simulated gaps are much smaller than the errors from the technique itself. The use of independent gravity solutions as a complement to GRACE provides a resilient technique in bridging the upcoming GRACE – GFO gap.