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Study of the accuracy of monthly time-variable satellites gravity field estimates

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The GRACE and GRACE Follow-On (GRACE-FO) missions have been providing monthly time-variable gravity field estimates since 2002 with a one-year gap between 2017 and 2018. The Level 2 data products are available through several processing centers with independent computation strategies. The Center of Space Research (CSR), the German Research Centre for Geosciences (GFZ) and the Jet Propulsion Laboratory (JPL) as part of the GRACE/GRACE-FO Science Data System (SDS) process gravity data with RL06 standards. The French National Centre for Space Studies (CNES) and the Graz University of Technology delivered GRACE gravity fields models respectively named *CNES/GRGS RL05* and *ITSG-GRACE2018*. Besides GRACE data, the European Space Agency (ESA) delivers Level 2 data products for the Swarm mission. Swarm data enables the evaluation of gap-filling methods between the GRACE and GRACE-FO missions. These datasets are very valuable inputs in studying the Earth's deep interior and could open new windows into the study of core-mantle boundary processes and core dynamics.

Earth's core dynamical processes inferred from geomagnetic field measurements are characterized by large-scale patterns. Studying them via gravity field observations involves the use of spherical harmonic coefficients up to degree and order 10. Particular attention needs to be dedicated to Stokes coefficients that are affected by problematic reconstruction effects such as $C_{2,0}$ or $C_{3,0}$. The comparison of time-series from various processing centers with Satellite-Laser Ranging (SLR) gravity products and hydrological loading models provides information on the consistency between different solutions and the accuracy of space gravity field measurements. The correction of hydrological and glacial isostatic adjustment (GIA) effects is an additional source of error in the determination of the gravity field. For example, the actual uncertainty of the GIA model over North America might lead to an error of 10% for some Stokes coefficients. Mismodelling in the seasonal loading could also affect the retrieved Stokes coefficients.

This study firstly provides a comparison of existing gravity field solutions and their accuracy. Secondly, a detailed analysis of different error sources provides us with better estimates of the current limits in the determination of elusive signals coming from the deep Earth's interior. It also

offers the possibility to better describe the external sources and then to minimize their contribution to the signal we are interested in.