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Introduction

GRACE K-Band is highly sensitive to gravity field variations at low to medium spherical harmonic degrees. But for very low degrees the results are affected by aliasing from slowly varying geophysical signals or tides (Seo et al, 2008). Especially C₂₀ shows a spurious signal at a 160 day period. These aliasing effects can be mitigated by the combination of GRACE data with other satellite data sensitive to the gravity field variations, e.g., from Satellite Laser Ranging (SLR).

GRACE + SLR

It has been common practice to replace C_{20} in GRACE gravity fields by SLR-derived values (Cheng and Ries, 2007). Combined GRACE / SLR solutions including SLR observations to LAGEOS were generated by GRGS (Bruinsma et al, 2010). Lately Sośnica (2014) and Sośnica et al. (2015a, b) showed that a gravity field solution from up to nine dedicated SLR satellites (LAGEOS 1 and 2, Starlette, Stella, AJISAI, LARES, Larets, BLITS and Beacon-C) shows sensitivity to temporal gravity field variations at least up to degree 6. At AIUB these SLR solutions were combined with GRACE GPS and K-Band at the level of normal equations with a relative weight of 1e-10.

GRACE GPS + SLR

Since 2011 data gaps are occuring in the GRACE K-Band data due to the aging of the batteries and consequently a shutdown of the onboard accelerometers and K-Band instrument during phases of extended shadow passes (occurring every 160 days). During these times only GPS and attitude observations are available. Lately the sensitivity of monthly gravity fields derived from LEO GPS observations to temporal variations has been studied widely (e.g., Weigelt et al, 2014). GPS-derived gravity fields may also be used to bridge the short K-Band gaps of GRACE. We therefore also derived monthly GRACE GPS-solutions and GPS / SLR combinations to show, if the GPS solutions may benefit from the combination with SLR data. The relative weight of SLR in this combination is 1e-2.



Fig. 4: Significance of secular and annual variations per coefficient. GPS is sensitive mainly at low order and sectorial coefficients. SLR does not only contribute to the low degree coefficients, but also increases sensitivity beyond degree 6 due to the different inclination of the SLR satellite orbits that help to de-correlate the coefficients.



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Combined GRACE / SLR monthly gravity field solutions



-12.6 -12.4 -12.2 -12 -11.8 -11.6 -11.4 -11.2 -11 -10.8 Fig 1: Impact of SLR on monthly GRACE GPS / K-Band solutions 2003-2013 (in terms of the RMS of the differences GRACE only - SLR only per coefficient).







Fig. 5: Amplitude of annual variations that were fitted to the time series of monthly gravity fields (left) and trends derived from the period 2004 to 2013 (right), both in geoid heights. The combination of GPS and SLR leads to a slight damping of the observed signals, but also to an improved localization and a reduction of noise.

Disclaimer: All views expressed are those of the authors and not of the Agency.

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Fig. 3: Example time-series of coefficients from monthly GRACE GPS / K-Band gravity fields (black), SLR (blue) and GRACE / SLR while all other coefficients are dominated by GRACE K-Band. In case of C₂₀ the combined solution shows a small bias compared to SLR only, as yet unexplained. A small impact of SLR on other coefficients is only visible at degree 2. Spectral analyses reveal that the spurious signal at 160 day frequency inherent to GRACE solutions may be slightly dampened by the combination with SLR. The plots also visualize that SLR is well capable to capture secular or seasonal



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Bruinsma S., J.M. Lemoine, R. Biancale, N. Valès (2010): CNES/GRGS 10-day gravity field models (release 2) and their evaluation. Advances in Space Research, Seo K.W., C.R. Wilson, J. Chen, D.E. Waliser (2008): GRACE's spatial aliasing error. Geophysical Journal International, 172: 41-48, doi: 10.1111/j.1365-Sośnica K., A. Jäggi, U. Meyer, D. Thaller, G. Beutler, D. Arnold, R. Dach (2015): Time variable Earth's gravity field from SLR satellites. Journal of Geodesy, under Sośnica K. (2014): Determination of precise satellite orbits and geodetic parameters using satellite laser ranging. PhD thesis of the Faculty of Science of the hISST and SLR replace GRACE? A discussion from the point of view of applications. GRACE Science Team Meeting 2014, 29th September to 1st October, 2014,



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