Motivation
Due to the decommissioning of GRACE before the launch of GRACE-Follow On a data gap of at least 12 month occurs. The data gap should be bridged in order to:
• have a consistent long term time series,
• allow the connection of GRACE and GRACE-Follow On time series and
• cross-validate GRACE and GRACE-Follow On.
We propose a combination of high-low satellite-to-satellite tracking and satellite laser ranging.

HL-SST - Processing
• Kinematic orbits provided by AIUB and IFG for 27 satellites:
• Acceleration approach with accelerometer data used if available
• Empirical stochastic error modelling based on residuals
• No regularization and no a priori model / information

SLR – Processing
• SLR observations to 9 satellites:
  Lageos 1/2, LARES, Starlette, Stella, Larets, AIJII, Beacon-C, Blits
• Estimation of gravity parameters together with station coordinates, ERP, geocenter and range biases
• Combination of SLR solutions at the normal equation level

Combination of HL-SST and SLR
• Combination of combined HL-SST and combined SLR solutions at the normal equation level
• Relative weighting found by calibrating the degree RMS of the estimated standard deviations with the difference degree RMS w.r.t. a static field for degrees > 40 (noise-dominated section)
• Exemplary contribution analysis for March 2003 till degree 6

Low-degree coefficient time series
Degree 2:
Excellent agreement with ITSG-GRACE 2016 solution due to SLR contribution
Degree 3 + 4:
• predominately derived from HL-SST
• coefficient-wise very good agreement
• at times spurious oscillations, e.g. C20

Spatial analysis
• Excellent agreement of the trend and the mean annual signal
• HL-SST+SLR solution with a higher noise level (cf. ocean)

Time series analysis
• Improvement of a factor 4 w.r.t. a single satellite solution visible in the wRMS over ocean areas
• Elevated noise level in the HL-SST+SLR solution in the RMS of the residual
• Subtle inter-annual variations and high-frequency variations unrecoverable due to noise

Correlation with Hydrology
• Excellent correlation due to fit of the annual signal (phase information)

Glacial Isostatic Adjustment
North America: good agreement with GRACE but underestimation of the amplitude and artefact in the south-western area
Scandinavia: origin well centered but again reduced amplitude

Conclusions
HL-SST is able (and probably the best chance) to bridge the gap between GRACE and GRACE-Follow On but:
• It is limited in spatial resolution to about 750 km,
• It is limited to strong signals due to a higher noise level,
• It is restricted to long-term signals, i.e. primarily the annual and trend signals.
Time series of spherical harmonic coefficients from 2003 to November 2017 is submitted to ICGEM and will be publicly available.

Acknowledgement
The authors would like to thank the DFG Sonderforschungsbereich (SFB) 1128 Relativistic Geodesy and Gravimetry with Quantum Sensors (geo-Q) for financial support.