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Earth System Science Data Discussions

Interactive comment on "Multi-approach gravity field models from Swarm GPS data" *by* João Teixeira Encarnação et al.

Anonymous Referee #2

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The authors combine several instrument data sets and analysis methods to provide a series of gravity fields for the Swarm mission. Results of a multi-analysis combination solution are compared to individual ones and to GRACE results. The paper provides several methodological analyses, new approaches explored, and it describes intermediate data sets such as kinematic orbits and the accelerometry/non-conservative force modelling. The authors, apparently, also have set up standardized and officialized workflows which is encouraging.

The paper is well-written, very detailed and in-depth on a technical level. As they combine four individual solutions, naturally several analyses have been published already by the individual groups, so there is some overlap. The paper could be probably shortened with respect to the description of the background. But these are minor issues.

As a methodological paper, the paper somewhat lacks a hypothesis. It is clear that by combining many analysis we will have a smoother result. What is expected from the outset? That could have been described better. Which is a pity since they seem to have added interesting new methods. What message is conveyed in view of other LEO missions that could be used for gravity retrievals? Should one have different orbits, instruments, what did we learn now for the next LEO mission?

The big issue for this reviewer is whether the authors were well-advised to submit to ESSD. ESSD focuses on "original research data (sets), furthering the reuse of high-quality data of benefit to Earth system sciences". Here, the focus is clearly on the methodology of generating the data and neither its use nor reuse, and I guess other journals are more appropriate. While the authors motivate their study with the need of the community to rely on data sets for studying "glacial cycles and long-term trends", the GRACE-GRACE-FO gap is 10 months and this is the period where these data will be relevant, in addition to few monthly gaps. It seems like a huge effort and the groups are to be congratulated, but they don't show what Earth Science applications will be enabled now that were not possible. We don't learn from their results for the understanding of processes. In their words, the "consequences of the 10-month gap" are not outlined and it is not clear what we gain.

The other very major problem for this reviewer is that apparently no independent validation is provided, except comparisons to GRACE. We don't have GRACE them for the gap, but the authors could compare their low-degree results to satellite laser ranging (SLR) solutions, e.g. for single coefficients or for the ocean mass change. The authors mention only one SLR time series for C20 but that's just one data set and more exist. Others provided C02 timeseries and it is not clear to this reviewer why they rely on GRACE extrapolatons for this. Moreover, the authors, e.g. in Berne or Potsdam, could easily use their Swarm models in SLR range residual analysis as a validation but it is not done. And several other validation techniques and data sets were developed for GRACE but nothing is used here. This is somewhat disappointing.

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