Response to comments by Referee 1 (Don Chambers).

We are thankful to Dr. Chambers for his nice words about our study. We were delighted to read that he has particularly appreciated our idea to fitting the fingerprints to a single dataset: a choice that was indeed made to avoid possible biases introduced by the combination of different techniques.

Comment 1
"*One issue, which the authors do acknowledge, is the assumption that their basis functions (the fingerprints) are orthogonal. If they aren't, then the estimated scaling parameters will be correlated and they can't really be treated as independent. This isn't really a problem if they cluster regionally and are independent of other regional clusters. The problem in this solution may be that the GIA over Antarctica may be correlated with the mass loss over Antarctica, so they can't really be treated independently.*
The authors have all the information needed to test the level of correlation in their covariance matrix from the least squares estimation. I would like to see some analysis of the correlations between estimated parameters that can be computed from this matrix – in particular, the correlation between the GIA parameters and the Antarctica parameters. If these are NOT correlated significantly, then great – the authors have demonstrated that their GIA model can probably be treated independently from their mass loss over Antarctica. If the they ARE correlated significantly, then they need to make some cautionary statements acknowledging this."

As suggested, we have computed the correlation of the covariance matrix, which we show below (Figure R1) and which will be added to the paper. Since we make use of 158 fingerprints (from top to bottom and from right to left: 7 GIA, 64 TWS, 47 glaciers, 15 GIS, 25 AIS), the labels are somehow small. Antarctic GIA is represented by the fingerprint gia_001 (7^{th} line from the top) and it is only showing a correlation larger than 0.8 with ant_001, which represents that part of the WAIS draining into the Ronne Ice Shelf, and larger than 0.6 with ant_017, along Siple Coast (WAIS, draining into the Ross Ice Shelf). A lower positive correlation, between 0.4 and 0.6, is also shown with basins ant_002 and ant_003 (EAIS, draining into the Filchner Ice Shelf), ant_018 along Siple Coast (WAIS, draining into the Ross Ice Shelf), and ant_024 over Graham Land (tip of the Antarctic Peninsula).
Since the present-day mass change of Antarctica is represented by 25 drainage basins and 10 peripheral glacier regions, and the largest mass loss is not coming from those correlated regions, we think we can consider the inversion over Antarctica to be a well-posed problem. Concerning other regions, we only see some larger correlations over Greenland, mostly concerning high and low elevation sector of the same basins, and over a few adjacent glacier regions. Those likely reflect a limit in the capability of GRACE of resolving such concentrated signals, but they do not represent a problem for the estimation of large-scale mass loss.

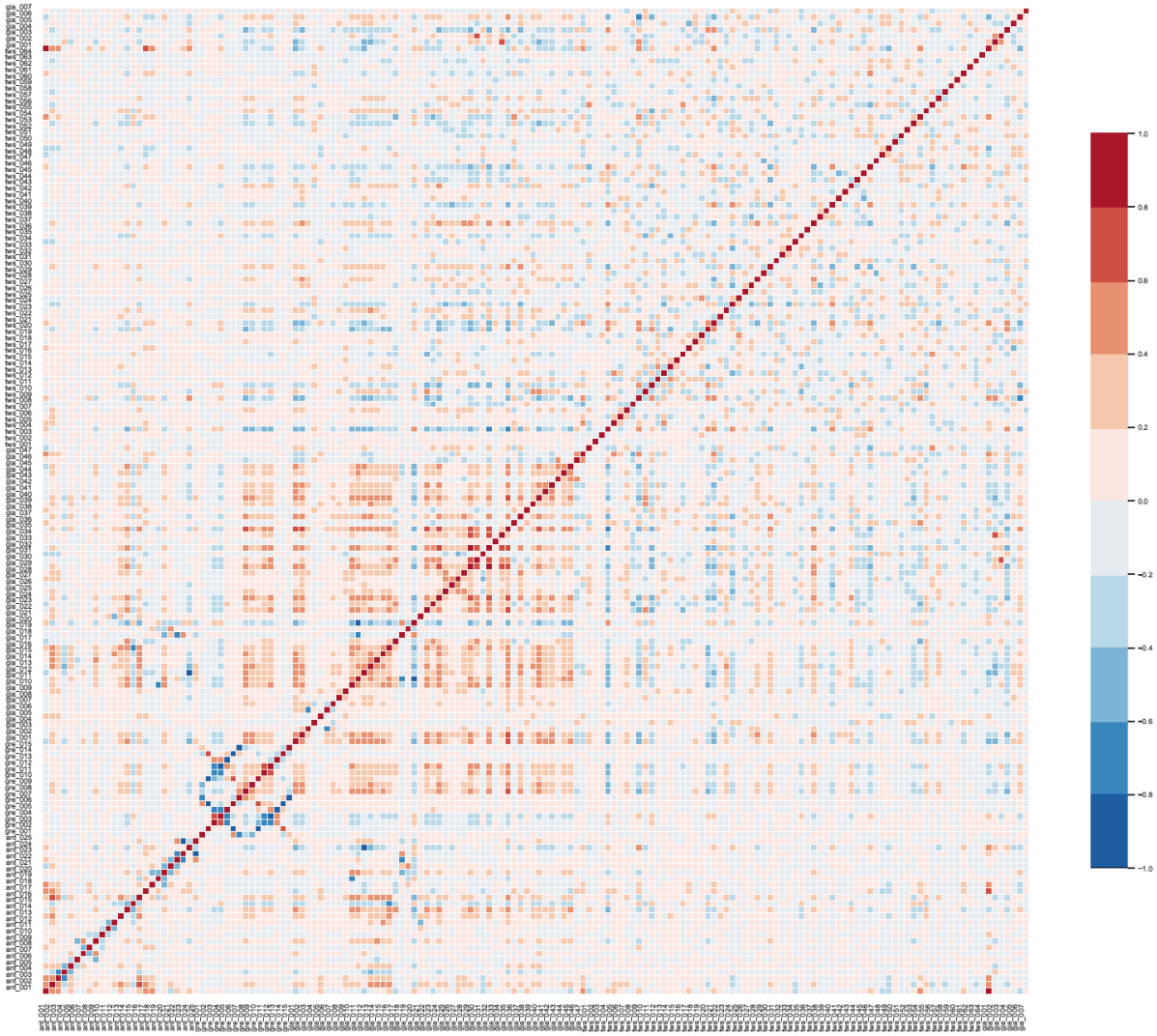

Figure R1: correlation of the covariance matrix.

Comment 2

"My only other comment would be a request for the authors to also include their GIA patterns and other patterns in terms of gravitational spherical harmonics (and not just geoid rates). This will allow easier combination for anyone using GRACE data to convert to water storage – this isn't the same as geoid height."

This seems to be a misunderstanding, since we had already published the GIA solution in terms of spherical harmonics, something that was possibly not very clear. While submitting a revised version of this manuscript, we will also submit spherical harmonics of the other trend solutions (total water layer, as well as four sub-components: Greenland, Antarctica, other glaciers and TWS).

Kind regards,
Riccardo Riva and Yu Sun