Authors' response to reviewers 3 and 4

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15/01/2021

Authors' response to review # 3

Dear Hans-Georg Scherneck,

we thank you for your valuable comments and suggestions on how to improve the manuscript. We included all comments, adjusted the figures and corrected the mentioned technical aspects. The corrections are marked in the pdf showing the differences.

Concerning these remarks hereafter we respond in the following way:

- Page 6, line 15ff: If possible, specify the uncertainty of the observed gradient values.

p.7 , l. 22
"In the Larzac observatory estimated vertical gravity gradient on measurement point p1 (FG5) is -3.226 kE with a standard deviation of 0.022 kE and -3.220 kE with a standard deviation of 0.017 kE for measurement point p2 (AQG), respectively, averaged over one year of monthly measurements (Cooke et al., in preparation)."

- Page 14, line 5: The bias due to tilt ζ goes with g (1-cos ζ). Say " and---at small angles---increases in a quadratic way…"

p. 15, l. 7
"A tilt bias of 50 µrad leads to an error of 12.3 nm s^{-2} and at small angles increases in a quadratic way which leads to 49 nm s^{-2} for 100 µrad."

- Page 14, line 18: No effect from precipitation on iGrav? Related to its location in the lab? Any obvious/plausible reason? Perhaps insert "for no obvious reason".
- Page 17, lines 18-20: Depends on how you respond to the previous point. I wonder how the effect escaped capture in the iGrav. The conclusive character of the remark on line 20 appears scantly underpinned to me. Yet, acknowledging the problems with drift in SG's, the expected (or proven) long-term stability of an AQG will be is primary asset.

Our excuses that these lines have been unclear. In fact, there was not much precipitation. There was no effect that the iGrav would have missed.
p.15, l.22
"Precipitation was negligible during these measurements and no significant effect of precipitation was observed in the iGrav#002 monitoring. "

- Page 18, cautioning against an overreach, the performance of the AQG in comparison with an OSG as concerns noise and resolution of sub-daily to weekly phenomena on multi-year time scales (e.g. Scherneck et al., 2020; papers by van Camp and many others) still needs evidence. For the applications mentioned, this is not crucial, however.

p. 20, l. 11
"On multi-year time scales the performance of the AQG in comparison with superconducting gravimeters still requires evidence with respect to noise and resolution of sub-daily to weekly phenomena (Scherneck et al., 2020)."

We would like to thank Hans-Georg Scherneck for his advice and suggestions on important aspects and the suggested references.

Authors' response to review # 4

Dear anonymous referee,

we thank you for your corrections and suggestions on how to improve the manuscript. We agree with your comments and included them as well as restructured the abstract.

- The changes in the title of the manuscript are partially satisfactory with respect to some concerns raised by previous reviewers. The work now right presents itself as a "first evaluation" of an experiment whose validity must be deeply verified. However, the Abstract should be rewritten in a clearer, more concise way and without repetition.

The abstract has been modified and rewritten in a more structured way.

- The various additions made partially fill the gaps in the initial version of the manuscript. However, some steps are treated rather roughly. I am referring in particular to the experimentation done in a semi-terrain environment (garage) and to the problems relating to the various physical variables (wind, humidity, temperatures, vibrations, ...) that may critically affect the experiment itself. I believe that the work made by the authors deserves to be published but after further revisions and technical corrections, and as a "Technical Report". However, the authors are advised to define the next steps for the full validation of the experiment.

From a metrological point of view, it is not possible to achieve a field measurement with an exhaustive error budget as all the environment parameters and their variability can not be

measured in a practical field experiment. The referee is certainly right about this statement. From the point of view of a field geophysicist, measurements have to be obtained and the various physical variables are indeed “roughly” treated. However, first order effects of the physical variables can be obtained from literature to get a first estimate of their importance. During the garage experiment, the gravity value should not change as no rainfall was recorded. If the AQG provides a 7-days gravity dataset with almost no gravity readings changes greater than 20 nms^{-2}, one can estimate that the various physical parameters (wind, humidity, vibrations etc.) at the first order are not affecting the measurements. This is a first important step and indeed one has to go further.

- I point out that the additional sentence "without significant variations in the measured gravity by the AGQ" (as response to a comment of the reviewer 1) does not appear in the revised text (cf. p. 19, line 2), and this is not the only case. In the amended text, I did not find even the sentence: "In future experiments, the potential influence of strong winds needs to be assessed. Due to the very recent delivery of the instrument, displacements between observatory locations and system mounting and unmounting cycles have not been as frequent and need to be repeated". Note that the last sentence is part of the response to a comment from the first reviewer and should fill some serious experimental gaps.

The missing sentences from the reply letter have been inserted into the manuscript.