Answers to anonymous referee #2 (referee's comments in black, answers in blue)

General Comments

This paper presents a study comparing precipitation estimates derived from weather radar observations and gravimeter data. This is an original contribution to the field dealing with a topic of scientific significance, the estimation of the precipitation, from a non-traditional approach. The comparison methods are relatively standard and the results and conclusions well justified. A few clarifications and suggestions that may enhance the quality of the manuscript are listed below, along with some minor formal corrections.

The authors thank the reviewer for the very positive feedback and the interesting suggestions.

Specific Comments

1. Page 2, line 10. Considering TRMM or GPM spaceborne weather radars I think this should be modified: radar-derived -> ground-based radar derived

Good remark. Will be adapted.

2. Pages 5 (line 30) - Page 6 (line 1). "The radar beam width is 1 degree ... the lowest radar beam at 0.3 degree elevation is used". If the radar half beam-width is 1 degree, then using a 0.3 degree antenna elevation does not imply substantial beam blockage? Unless the radar antenna is higher than the surrounding terrain. I think this should be briefly explained in the text.

The radar antenna is installed on top of a 50-m tower. The surroundings are lower than the antenna and the beam blockage is very limited. This especially true in the direction of Membach, the location of interest where the gravimeter is installed. This will be briefly explained in the text.

3. Page 6, line 16. "Intense precipitation is expected to produce a gravity decrease". This is a crucial point of the paper and, perhaps because it is very obvious for the authors, it is only mentioned very briefly. In my opinion this sentence deserves a longer explanation, perhaps one or two additional sentences.

Since the gravimeter is underground, the increase of water mass at ground level due to precipitation results in a decrease of the measured gravity. The fact that the gravimeter is underground is an essential characteristic, because (1) the sensitivity radius reaches a few hundreds of meters and (2) there is no building preventing rainwater from being measured ("umbrella effect"). However, in some cases, gravimeters installed at the surface have already been used to study soil moisture processes, as shown by Guntner et al 2017 in which their superconducting gravimeter is installed in a small field enclosure.

As recommended by reviewer 1, we will reformulate the manuscript and the title to make it more explicit since the very beginning. As a new title, we propose: "*Exploring the use of underground gravity monitoring to evaluate radar estimates of heavy rainfall*"

4. Page 6, line 29 (last sentence of section 2.3). Why a 4 minute shift in the timestamp is considered? Please explain briefly (or perhaps simply connect with the previous sentences).

When the 3D scanning of the atmosphere is performed starting from the highest elevation angle, 4 minutes are approximately necessary to reach the lowest elevation angle after 14 antenna rotations. This will be explained in the revised manuscript.

5. Pages 6-7, section Data Selection. The weather radar used operates at C-band so attenuation with heavy precipitation and/or hail is a potential problem. When selecting the events, did authors consider identifying and discarding attenuation cases by checking the radar sector (or specific radials) which extends from the radar site to the gravimeter site? I think this should be commented.

No selection has been performed based on attenuation effects between the radar and the location of interest. It means that rainfall underestimations are possible when heavy rain or hail is present in the corresponding radial. This will be commented in the revised version.

6. Page 9. I found interesting the analysis described where different radar reflectivity thresholds are applied for QPE conversion. The values reported are consistent with those used for QPE estimates in the US National Mosaic and Multi-Sensor QPE (NMQ) system - see Zhang et al (2011), p. 1329 - where different capping dBZ values are for pixels classified as convective, warm-rain and hail: 55, 50 and 49 dBZ respectively. I think this could be further commented.

This is a very interesting comment. We were not aware that the optimal threshold found in our study was consistent with the 49-dBZ threshold used for capping dBZ values in hail as described in Zhang et al. (2011). It is interesting to note that the capping value used for rain (55 dBZ) is substantially larger than the one used for hail. When capping all reflectivity values to 48 dBZ as we do, we certainly underestimate some very intense precipitation in the form of rain. This issue was raised by reviewer 1. We will extend the discussion of our results in the revised version.

Technical Comments

7. Page 1, line 17 (and elsewhere where amounts are considered). Suggest: larger than -> greater than.

Will be done.

8. Page 4, line 19. Please check meaning: change -> changes?

Will be done.

9. Page 4, line 19. Typo: check superindex in nm/s2 -> nm/s[super_index]2 OR nm s[super_index]-2

Will be checked and adapted throughout the text. This was also mentioned by reviewer 1.

10. Page 6, line 10. Please check meaning: is evaluating -> is evaluated

Will be adapted.

11. Page 8, line 12. Figure 8 is cited after Figure 4 and before Figure 5. Please consider reordering/renumbering the figures to cite them in order.

Will be adapted.

Reference

Guntner et al 2017 https://www.hydrol-earth-syst-sci.net/21/3167/2017/