**Comment to the Reviewer 2**

First thanks to the reviewer 2 for the detailed comments which provide a lot of points to enhance the quality of the paper. About the release of the dataset, it will be available after publication in the SNO H+ database (http://hplus.ore.fr/en/) or upon demand by email.

The main concern of the reviewer 2 is that such micro-gravity experiment is “no longer novel and that some unique aspect are lacking”. As finally noticed by the reviewer, only a few studies (thanks for the additional review of reports from USGS especially) focus on the micro-gravity applied to karst hydro-systems. Among them, only two deals with surface and subsurface measurements. The idea of the paper is to provide a relative gravity dataset as accurate as possible, taken advantage of natural caves (stable environment and common mode rejection as detailed below) to quantify seasonal transient water storage in the epikarst in different geological context. Such a study of the variability of the vadose zone water storage is not common, even in non-karstic hydro-systems

The reviewer 2 (as the reviewer 1) suggest also than the comparison of the two strategies of measurement is minimal. It is a choice of the authors to present the added values gravity measurements to quantify vadose zone water storage and not to focus on the methodological issue. Nevertheless, as suggested by the reviewer, a side by side comparison in a site with an easy access tunnel of the two strategies have been done. The main difference is that the transportation of the CG5 was done by bike. It could be added as a supplement material. Only a small loop of three points was used. It was published in french in the S. Deville phd (in french: *https://tel.archives-ouvertes.fr/tel-00829346/document*). I paste below a figure with the histograms of the residuals.

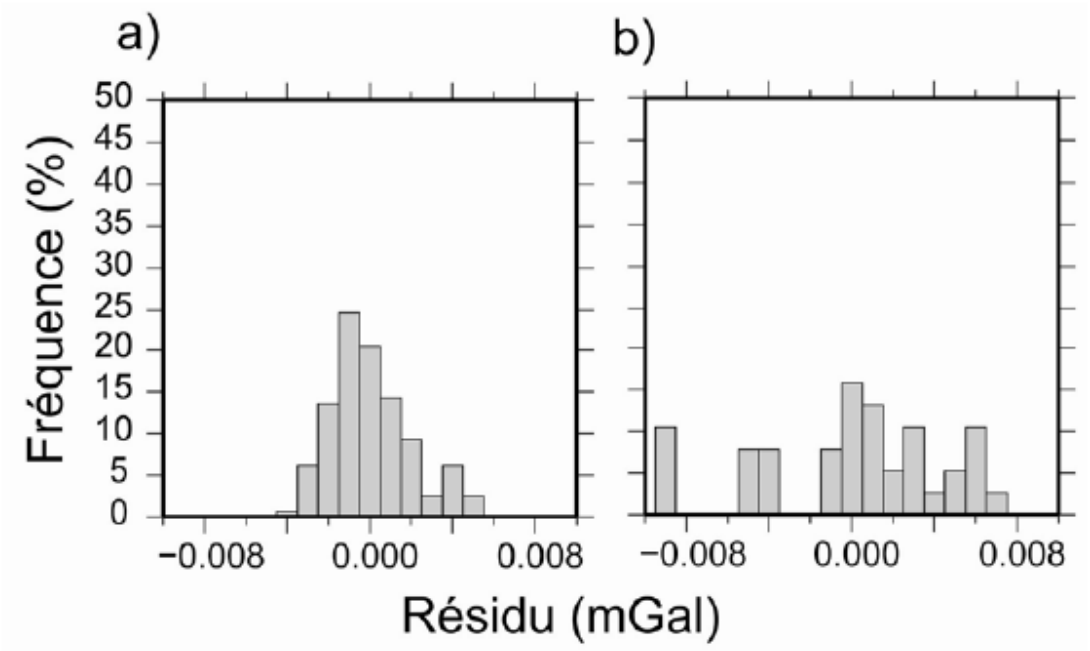


*Figure 1: a) long time strategy b) short time classical strategy*

The figure 1 is interpreted as a clear example of the impact transportation on the gravity readings. Transportation by bike induced tilting and vibrations. After transportation, a relaxation of the CG5 can be seen. The main problem is that no model of the relaxation is available currently. The only way not to be influenced by the relaxation is to wait until the end of the relaxation (around 30 minutes with the CG5 #167). That is the main idea of the so called in the paper long time strategy.

**Detailed comments :** the main details comments to be corrected or discuss are sum up below.

Introduction: The introduction must be partially rewritten to present more clearly the difference between absolute and relative gravity measurements. The main characteristics of gravity measurements should be also added in the introduction. Indeed gravity is a unique method to directly monitor the groundwater budget with some advantage (integration of the small scale heterogeneities, accuracy, sensibility to the vadose zone, potential of both time lapse and spatial variations) and drawback (mainly the absence of vertical resolution and the non sensibility to water fluxes) : it will added in the revised version of the paper.

S2D field experiments in natural caves:
As suggested by the reviewer, a paragraph will be added to present the advantages and disadvantages of S2D experiments in natural caves : stable environment (low noise, stable temperature) versus accessibility (ropes are needed in BESS and SEOU) and moreover the common mode rejection (below and upper the gravity measurements). Its is an important point of the paper and should more discussed as suggest by reviewer 2

Figure 4, table 1 and annex 1:
Recharge and discharges period will be more clearly described in the text and seen on the figures and tables. In the all the figures and tables, the short and long time strategy will be also more clearly indicated (see the suggestion of the new table 1 below).

L164 : variability of the rainfall:
From the work of Jacob or of Fores, it is known that the rainfall are spatially heterogeneous at the event scale but quite homogeneous at the seasonal scale.

L227 : calibration
More details and one additional figure are presented in the answer to the comments of the reviewer 1. The calibration factor is linearly increasing during the period but slower than in Jacob et al.

L258 : The reviewer is right. The figure caption will be corrected. All gravity data after the relaxation exhibiting only a linear drift are kept.

L289 and 297 : The reviewer is right again: an offset during the transportation between two stations could be seen as a drift. But from my personal experience with the CG5, (but I do not have a reference for that only the figure below from Deville PhD *https://tel.archives-ouvertes.fr/tel-00829346/document*) after an offset or a jump, there a relaxation allowing the CG5 readings to keep a global linear drift (at the first order during a few hours). It is for our experience another benefit of the long time strategy.

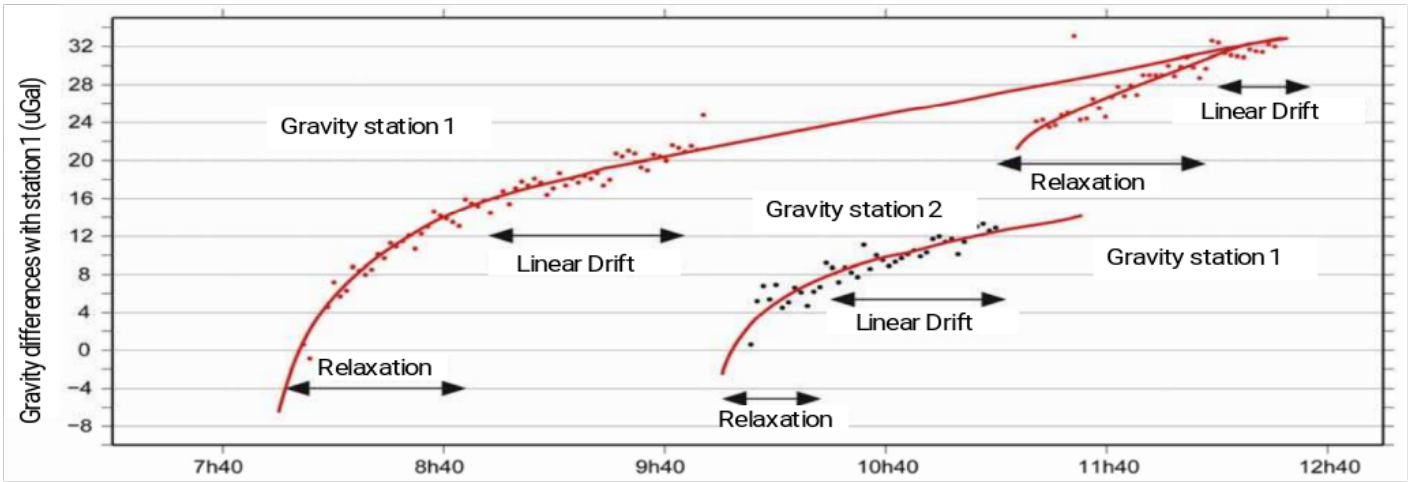


*Figure 2: Example of relaxation during gravity S2D measurements (CG5 #167) in a small cave 10 m depth modify (translation only) from Deville 2013. Only two stations are measured (station 1 and 2). The initial relaxation due to car transportation is well seen. At the begin of each gravity station, a small relaxation can be seen but the global linear drift is preserved at the reference station 1.*

L404 : The reviewer is right: there a typo in the conversion between uGal and mm of water from the Bouguer slab approximation. From Bouguer, 1 uGal = 23 mm of water. Form S2D, 1 uGal = 11,93 mm of water. The table 1 and the annex 1 are not clear. In the annex, the S2D gravity differences have been reported. In the table 1, half of the S2D gravity differences between two measurements periods (equivalent to the simple Bouguer slab) have been reported! It will be clarify in the revised version with coherent S2D gravity values. Error of copy/paste in the error for the BEAU site has also be corrected thanks to reviewer 1. See the new table 1 below:

| *Site* | *Time period* | *Gravity difference (µGal)* | *Equiv. Water height (EqW) (mm)* | *Cumulative precipitation (mm)* | *Cumulative AET (mm)* | *Net water inflow (NWI) (mm)* |
|---|---|---|---|---|---|---|
| SEOU | Feb10-Aug10 | -17 ± 3.9 | -203 ± 48 | 281 ± 11 | 239 ± 48 | 41 ± 49 |
| | Aug10-May11 | 8 ± 3.9 | 95 ± 48 | 628 ± 25 | 254 ± 51 | 373 ± 56 |
| | May11-Sep11 | -3 ± 2.0 | -35 ± 25 | 256 ± 10 | 344 ± 69 | -88 ± 69 |
| BESS (0-12m) | Feb10-Aug10 | -15 ± 3.1 | -179 ± 37 | 315 ± 13 | 381 ± 76 | -66.6 ± 77 |
| | Aug10-May11 | 11 ± 3.5 | 131 ± 42 | 854 ± 34 | 266 ± 53 | 587 ± 63 |
| | May11-Sep11 | -11 ± 2.6 | -131 ± 31 | 162 ± 6 | 320 ± 64 | -158 ± 64 |
| BEAU | Sep06-Nov06 | 26 ± 2.5 | 310 ± 30 | 445 ± 18 | 69 ± 14 | 375 ± 22 |
| | Nov06-Sep07 | -20 ± 3.2 | -238 ± 38 | 482 ± 19 | 753 ± 150 | -271 ± 151 |
| | Sep07-Feb08 | 25.7 ± 3.0 | 307 ± 32 | 424 ± 17 | 208 ± 17 | 217 ± 44 |

*Table 1: Time-lapse S2D gravity difference, Equivalent water height, cumulative precipitation, cumulative evapotranspiration and total water inflow with the associated errors at SEOU, BESS and BEAU site for different recharge and discharge periods. Recharge periods are indicated by the gray color.*

Discussion (L500-700): The discussion will be rewritten following the helpful comments of the reviewer. I just add a few words here. The importance of the subsurface reservoir for pollution is evident as the subsurface reservoir will act as a buffer. On a karst, from classical measurements, the hydrogeologist have no quantification of the buffer and therefore of the amount of water flowing directly to the spring. With gravity data, such a quantification is possible as demonstrated in the study.

We would like also to enhanced the discussion with an additional data available from Mazzilli and published in Deville PhD. The gravity results are also in accordance with other geophysical dataset. A MRS sounding has been done twice in 2011 (in Deville PhD *https://tel.archives-ouvertes.fr/tel-00829346/document*). The results on the inversion clearly show water content only in the first meters of the soil (figure 3 below) but the MRS in not accurate enough to monitor the temporal variations of the groundwater content. The figure 3 below could be added in the discussion.

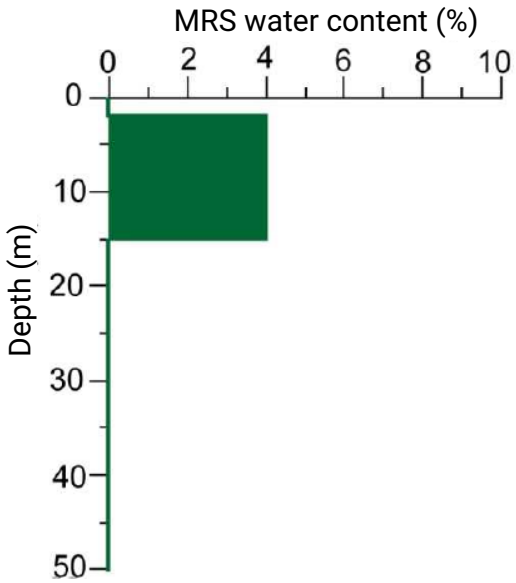


*Figure 3: Water content vertical profile from MRS inversion (modify from Deville, 2013)*