

Interactive comment on “Is Annual Recharge Coefficient a Valid Concept in Arid and Semi-Arid Region?” by Yiben Cheng et al.

Yiben Cheng et al.

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Received and published: 9 July 2017

I have not up load the revised paper, because the English is checking by a native English speaker right now. I think it will be finished in a few days. But I want to response the comments first.

General comments This work proposes an extensive review on the evaluation of Deep Soil Recharge (DSR) in arid and semi-arid regions. The validity of Annual Recharge Coefficient is questioned based on the test data of DSR measured by the improved lysimeter. The issue raised by authors is of great significance, but the section of data analysis (part 3.2) is not well structured. There is a lack of explanations on the new apparatus and details on the field test are not clear enough as well. Experiment data

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presented by the authors is limited to support the conclusions. Thus, the manuscript requires significant improvement before it is accepted for publication.

Response: Thank you for the positive comment. We give a detail explain of the new lysimeter at part 2.2, page 9, and descript field testing of the new apparatus at part 3.1, page 11. And we have reorganized the section of data analysis (part 3.2) by improving the explanations on the new apparatus and details on the field test (line 259-269). Experimental data presented are as complete as possible. The conclusions drawn are based on a careful analysis of the complete set of data.

Specific comments: 1. Some of the conclusions are not supported by the test data. For example, the authors claim that “The temperature influences the DSR rate” (in line 343). The evaporation intensity varies with temperature and affects the quantity of DSR indeed. However, if temperature influence is considered, the delay time is an issue remains to be discussed.

Response: Thank you for your careful observation, we compare two precipitation events which are similar in strength (17.2 mm for April 4 and 16.8 mm for October 5) but different in the DSR delay time (36 days for April 4 and 16 days for October 5) in line 354. Temperature is the most likely factor for such a delay time. This is the primary reason for above sentences. So we draw a conclusion that temperature affects the DSR rate. However, finding out exactly how the temperature affects the DSR rate will require additional field experiments that should be pursued in the future.

2. Authors claim that “recharge is somewhat positively correlated with a few strong precipitation events (greater than 10mm), and very closely correlated with the strongest precipitation event” (line 426-428). However, the data in table 3 seems do not support this conclusion.

Response: In Table 3 as showed, we showed inter-annual statistics of strong precipitation and its percentage in total annual precipitation amount. Comparing the maximum precipitation events in 2013 to 2015, we can conclude that recharge is somewhat pos-

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itively correlated with a few strong precipitation events, such as the 32mm, 15mm, and 17.2mm maximum precipitation events in 2013, 2014, and 2015, respectively. Such a positive correlation is particularly strong for 2013 which has the largest maximum precipitation event of 32mm. This positive correlation is weaker for 2014 and 2015 which have moderate and somewhat similar maximum precipitation events (15mm and 17.2mm, respectively). For these two years, other factors such as rainfall temporal distribution may also be a concern. Because of this, we stated on page 23, line 390-392 that “but the determination of the threshold for strong precipitation events that directly contribute to DSR is still unclear and requires further investigation.”

3. The quantity of DSR is actually given by the mass balance of surface layer. Surface runoff, evaporation and transpiration are critical components of water balance besides precipitation. It is necessary to present more monitored data, especially about evaporation and surface runoff, to support the conclusions in the paper.

Response: This is a nice comment. Firstly, there is no runoff at the studied area which is essential desert and easy to penetrate. Secondly, as stated correctly by this reviewer, the basic idea of lysimeter is water balance. So if the point of measurement is relatively shallow, one must consider evaporation and transpiration process. However, the DSR measurement reported in this study is NOT at relatively shallow depth, instead, it is specifically at a sufficiently deep location (2 m) is to make sure that evaporation and transpiration are both negligible. In another word, the downward DSR measured at such a deep depth is regarded as completely recharging the underneath groundwater aquifer.

4. Previous studies have shown that Annual Recharge Coefficient varies with the water table depth. To avoid the influence of water table depth, the dynamic of phreatic water table from 2013 to 2015 in the study area is suggested to be presented in the paper.

Response: A nice suggestion. We have added the dynamic phreatic water table position in 2013-2015 in the revised paper (see page 7line 153). It is found that the water

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table depth is greater than 4m in 2013-2015, so its influence to DSR is negligible.

5. In Figure 1(B), how to measure the flux at depth A? More details about the new lysimeter are required.

Response: Thank you for your careful observation, there is a rain gauge at depth B and the column between depth A and depth B is at a balance stage so flux at depth B is the same as at depth A. We have revised the caption for this figure.

6. Precipitation events are suggested to be presented by using columns (or vertical lines) in Figures 3, 4 and 5. 7. English should be improved because the text is somewhat difficult to follow.

Response: The English is checking by a native English speaker right now.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2017-160>, 2017.

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