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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Citizen science flow – an assessment of citizen science streamflow measurement methods" *by* Jeffrey C. Davids et al.

Anonymous Referee #1

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This manuscript aims at studying the potential for citizen science streamflow measurement methods. Citizen science is so far underused in hydrology and studies on this topic are, thus, much welcome. The manuscript starts with a well-written introduction, where several relevant studies are cited. After this promising start, however, I was rather disappointed by the study. I really like the aim of this study, and I appreciate the attempt to evaluate the suitability of different streamflow gauging methods, but in the end, I have three major concerns. These are related to 1) the study design and data collection, 2) the data analyses and 3) statements that are not supported by the data analyses presented in the manuscript.
A more detailed discussion of these issues and some minor comments are provided below.

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Discussion paper

I am afraid that the concerns related to the available data require additional data to be collected. Frankly, I would say the presented work is an interesting pre-study, but a better study design and data collection are needed to obtain useful results. Publishing the preliminary results as presented here could do more harm than good as people might use the conclusions without being aware that there actually was little data evidence. Given the importance of the topic, I hope the authors will be able to do this and will resubmit a study, which addresses the issues they raise in this manuscript.

1) There are several severe flaws in the study design and in the end I am afraid the authors did not collect the data that would be needed to address the questions they wanted to study.
a. It is highly unfortunate that there are no concurrent flow measurements for the 'true' flow available. Flow measurements taken a few weeks apart are just not the basis for a serious evaluation. It is also surprising the different 'citizen scientists' were asked to measure streamflow at different sites. It would have much more informative to let them measure the same stream and about the same conditions.
b. The authors mention that three salt dilution measurements were excluded as outliers. While they present some explanation (which I do not fully agree), they do not present anything that would help to detect such cases in an application where there is no comparison with any other gauging. In other words, in a real application, these values would pass undetected, and the potential error, thus, would be much larger than reported here. Note that almost half of the cases with comparison streamflow data were excluded! Again, it is unfortunate that the authors need to very speculative about what might have happened because of the study design.
c. Related to the above comment, one potential issue are mistakes that could be done by 'citizen scientists'. With a better study design (e.g., more groups at the same place, 'secret' observer, . . .), this could have been addressed.
d. Basically, there are two separate questions: 1) which of the 'simple' gauging methods provides best results (with 'perfect' persons) and 2) how re the methods used

by ‘citizen scientists’. By deciding the best methods already after the first step, the authors, unfortunately, do not fully explore which method is most suitable for citizen science approaches.
e. The accuracy of the salt dilution measurement depends largely on the selected site (mixing, flow volume, and velocity. . .), and depending on the site, thus, different methods might be most suiatble. Again, this is an important aspect that could have been adddressed with a better study design.
f. A minor point related to the study design: when the aim is to obtain relations of the calibrated k-factors with elevation or other variables, k should have been determined at as may places as possible and not just half of them. I am also not sure whether it is reasonable to use the mean k value was for the 10 locations without individual measurements, but the individual values for the others. I would rather have expected to use the mean or some regionalized values for ALL locations to ensure comparability.

2) The data analyses contain some questionable use of statistics:
a. Averaging of errors (tables 12): averaging positive and negative errors just does not make any sense, this makes the results look much better than they are. Instead, one should base the analyses on the absolute values so that positive and negative errors do not cancel out each other
b. The correlations shown in figures 3 or 4 (and reported in the abstract) are misleading. These are spurious correlations! Comparing streams of different size, of course, one gets high r2 values. Imagine two persons would measure the height of a group of people, even if the individual measurements would be off by 5 cm, the correlation of the heights would still be large simply because some people are much taller than others. Please be more careful when using statistics.

3) The statements in section 4.4 are not really supported by the data in this study. The number of persons needed in each group, for instance, has not been tested. Also, the inexpensive EC meter has not been tested (or has it? Comparison?).

As another example, the statement of enjoyability seems not to be supported, and actually, the other methods have not been tested with 'citizen scientists.
The authors also need to explain much better which type of citizen scientist they refer to. Form the title (where the term citizen science is used twice!), the abstract, the introduction and section 4.4 one gets the impression that this is about citizen science in a broad meaning. However, looking more closely at what has been done, it seems that the work does not address the participation of the general public in science but is based on selected individuals, which received a significant education. This is fine, but is a rather special case of citizen science.

4) Minor comments:
a. P4: which factor for c was used in the end? Variable or constant. This needs to be included in the steps.
b. P8: too little information is given about the 'citizen scientists': how old? Gender? Students, but which topic (how much hydrology or environmental engineering?), how large groups, ...
c. What is the purpose of showing figure 2?
d. P5L15: where does the value of 1667 g per m3/2 come from. Moore (2005) recommend a different value
e. Tables 1 and 2: providing runoff with four digits seems a bit too accurate, especially given that the observations actually were weeks apart.
f. Please check the author guidelines, especially with regard to the date format and equations

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