

## ***Interactive comment on “Gully geometry: what are we measuring?” by J. Casalí et al.***

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In order to make our answer clearer, the original comments from Referee1 are maintained (quotation marks).

“General Comments. The aim of this paper is to propose a measurement protocol for ephemeral Gullies for comparing the results obtained by different researchers. This topic is very interesting, because the lack of a standardized measurement protocol makes the results of volume of eroded soil, cannot be compared easily. The paper would improve if authors include analysis of proposed methodology with different gully geometry datasets”.

We agree with Referee #2: it is highly convenient to include an analysis of the proposed methodology using data bases from gullies of different geometry. In fact, we think that

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this objective has been properly achieved in this paper. In effect, the method is applied to six ephemeral gullies of different lengths, widths and depths. These gullies were recently assessed using a very accurate methodology. Other data sets from gullies with varied morphology could have been used, but their assessment was not so accurate. In our opinion, it is preferable to use the more recent and accurate information. Besides, in our opinion, they provide enough information and in accordance with the length of the paper. On the other hand, I must be taken into account that the main objective of this paper is to present a first introduction of the protocol and of the methodology, and not to show an in depth analysis of that, which can be done in further studies.

“Specific comments

\* Page 325 Lines 20-23, the authors say “it is usually assumed that the width is defined by the imaginary line whose ends are located at both points of the two banks, where an abrupt change in slope is manifested.” The authors say the problem of presence of more than one points of slope inflection in one or both banks, it can use the concept used in stream geomorphology to determine the bankfull stage with the minimum width to depth ratio, bankfull represents in stream the breakpoints between in-channel and floodplain processes (see: NRCS 2007 Stream restoration design, Part 654. National Engineering Handbook. Department of Agriculture, Natural Resources Conservation Service; Pickup, G., and R.F. Warner. 1976. Effects of hydrologic regime on magnitude and frequency of dominant discharge. J. of Hydrol. 29:51–75.)”.

In this paragraph, and for defining gully width, Referee #2 alludes to a methodology previously used in rivers. However, in our opinion, such methodology is not a contribution in gully research, because using it the uncertainty about where the gully limit must be located persists.

“\* Page 327 Lines 12-18, what criteria is used to determine the gully width in the figures3b and 3c?”.

No particular criteria have been followed. It is just one example to illustrate: i) the great

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differences in volumes that can be obtained fixing the gully widths arbitrarily; ii) the error that can be generated and; iii) the necessity of establishing rigorous and objective criteria and protocols.

“\* Page 328 Lines 6-9, “This same operation could be repeated in a multitude of other points  $x_i$  along the channel, thus obtaining the two width values of each new section ( $W_i$ ).”, I don't know how the authors obtain the two width values at each section, it could be the two width values of the reach”.

There is one mistake in this sentence, which is modified as follows: “This same operation could be repeated in a multitude of other points  $x_i$  along the channel, thus obtaining the width value of each new section ( $W_i$ )”. This sentence will be included in the final text.

“\* Page 328 Lines 9-10. “Finally, the average of the values  $W_i$  would define the effective width of the whole gully,  $W_e$ .” I think it's better to use weighted average using distance between the adjacent gully cross-sections”.

Considering the nature of this paper, it does not seem necessary to include such modification. In the text, it is explained that the operations to obtain the gully width “could be repeated in a multitude of other points  $x_i$  along the channel”. Therefore, it is assumed that lots of measurements will be available, and that their average is representative of all the cross section morphologies. In case that there were less information available (cross section widths), the use of weighted average could be considered.

“\* It's not clear for me the proposed methodology to calculate the gully width value when I haven't the DEM prior to the appearance of the gully (DEM year  $n$ )”.

We realize that our proposal presented in this paper can be considered as peculiar because, in order to define the gully cross section width and to describe the protocol, it is assumed that the DEM year  $n$  is known, which is very difficult. However, we believe that, despite this difficulty, our proposal is still a remarkable contribution, because it

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provides an approximation to the true definition of the gully cross section width, a key variable that also determines other gully properties. In relation with the above mentioned difficulty, it is the challenge of reconstructing or knowing the DEM year  $n$ , which can be considered as a new line of research. This, and depending on the gully type, can be addressed for example from unaltered areas not affected by erosion. In this way, and for ephemeral gullies, it can be assumed that tilled areas close to the channel without erosion evidences can show or identify singular points of the original topography before erosion. In this way, and for ephemeral gullies, after tillage operations, one DEM can be obtained (DEM year  $n$ ), and the DEM year  $n+1$  can be obtained after erosion occurred. From this information, patterns for obtaining DEM year  $n$  from DEM year  $n+1$  can be explored. In any case, even when DEM year  $n$  cannot be obtained, the proposed protocol can still be developed, so that the effective width and depth and the equivalent prismatic gully, can be calculated. We think that this is a contribution in the way to standardize measurements, characteristics and properties in gully science.

These sentences above, slightly modified, will be included in the final text.

“\* The text of conclusions is very similar to abstract”.

We agree with Referee #2, and the conclusions have been modified as follows:

In order to progress in gully erosion research, clear criteria to define and determine the key morphological characteristics of gullies and their related properties (such as volumes) are needed. It would allow to make adequate comparisons under homogeneous conditions. In this paper, a new proposal to advance towards such goal is shown. In this way, starting from a precise definition of the width of each gully cross section, the mean equivalent gully width and depth are defined, and also the equivalent prismatic gully (EPG). By using the EPG it is possible, in a simple but rigorous way, to represent a gully, making easier the comparison among different gullies. The definition of the width of each gully cross section assumes that the topography of the area before the gully appearance is known. It is, in fact, really infrequent, so that a new line of research

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arises. Anyway, we believe that the proposal is a considerable advance in the applied research on gullies, because it allows to standardize the definition and determination of the most important characteristics of these erosion forms.

“Technical corrections “\* Page 324 lines 16-20, Change the sentence order “Rill erosion is produced in the form of numerous channels of a few centimeters in depth, distributed uniformly and randomly over sloping lands (Soil Science Society of America, 2015) and which can easily be obliterated by conventional tillage (Hutchinson and Pritchard, 1976). Also, permanent gullies are distinguished from ephemeral ones (Foster, 1986; Thorne et al., 1986; Casalí et al., 1999).””

The suggestion made is accepted. The text will be modified accordingly.

“\* Page 325, lines 2-3 “Rills, however, occur entirely on one single slope (Casalí et al., 1999); their formation is, therefore...”

The suggestion made is accepted. The text will be modified accordingly.

“\* Page 325, line 11 “ratio” instead of “quotient””. The suggestion made is accepted. The text will be modified accordingly.

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Interactive comment on SOIL Discuss., 2, 323, 2015.