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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).

"This paper aims to propose a measurement protocol of the geometry of (ephemeral) gullies (width and depth) with the goal of pooling criteria in future works. The uncertainty of these measurements, especially in the case of complex cross section shapes, is a real problem felt by the researchers involved in studies on this kind of erosion, especially considering the general lack of information in the literature. Therefore, the subject is both interesting and challenging. The authors define "an equivalent prismatic gully (EPG)" obtained subtracting the "detailed digital elevation model (DEM) of a gully whose geometry we wish to determine" from the DEM of the same area before the gully in question would have been formed. Some points, however, need to be

addressed before this paper can be considered for publication. My major concerns are:

1. The technique suggested is not new among users of the GIS, but it is necessary to find the answers to some questions before it can be proposed as a standardized method for future research. The main questions are:

- what does it mean "detailed" DEM (P. 327, l. 20)? I suppose the authors refer to the detail of the field survey to build the DEM. But, what is the level of details required to reduce the error with respect to the simplified techniques? Do we have to survey a mesh of 1 mm, 10 mm, 100 mm? Clearly, the answer depends also on the size of the channel to detect and involves the choice of suitable instruments for the survey; -what is the error reduction with respect to the usual? -what is the error reduction respect to the usual technique improved measuring more than one width and depth for each section? -what is the difference in terms of economic engagement and hours of labor invested? -what is the advantage of minimizing the type of error described, compared to that due to other uncertainties, e.g. the choice of the distance between the cross sections to be surveyed? (P. 328, L. 8 “a multitude of other points xi along the channel”)”.

Firstly, it must be stated that in this paper the authors do not expect to address the type of details that the Referee #1 indicates, although they are, obviously, very interesting and relevant. We think that they should be considered in a subsequent development of the methodology. In fact, this is rather a conceptual paper.

The main purpose is to propose an objective, repeatable and of general validity definition of “width of a gully cross section”, which is a key magnitude that conditions the assessment of the gully volume and depth. This definition is based on gully genesis criteria instead of gully geometry, the latter with even arbitrary limits. “Equivalent prismatic gully”, “effective width” and “effective depth” are concepts that ultimately derive from the definition of “width of a gully cross section”, and try to standardize the assessments of gully characteristics.

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Obviously, the width of a gully cross section, as defined in this paper, depends on the DEMs pixel size and, in agreement with Referee #1, it depends on the type and size of the studied channel. Hengl (2006) concluded that, to avoid the loss of relevant information, the maximum pixel size must be the average of the minimum distances between sampling points. In the same way, Garbrecht and Martz (1994) fixed the pixel size to the size of the minimum distinguishable object. On the other hand, the new available methodologies (terrestrial or aerial LIDAR, 3D photo-reconstruction, etc.), provide a very detailed information, which are more than enough, in our opinion, for the purposes of these studies. The assessment methodology itself, as pointed out by Referee #1, it not new for GIS users and it is clear that the highest the DEMs' resolution, the closer to reality the assessments will be. However, these thresholds should be explored in future researches.

Another point is what happens in terms of the application of the proposed protocol when the DEMs are not available; or when field assessments made in the past must be evaluated; or when in present time it is only possible to use traditional techniques such as profilometers, tapes, etc. We think that even in this case the proposed protocol provides orientation for identifying the gully cross section width. We believe that this is an advance itself, both for guiding the direct assessment in the field and for defining the gully cross section width in the office from other data bases collected in the field. In this way, "equivalent prismatic gully", "effective width" and "effective depth" are concepts which are applicable whatever the assessment methodology or protocol was used. Different issue is the accuracy of this properties or variables, which depend on the detail and resolution of the baseline information. Anyway, we believe that, despite this limitation, the mentioned concepts are also a quite remarkable contribution when standardizing the assessment and characterization criteria.

It is difficult to quantify the assessment error reduction when implementing this definition. For that purpose, series of assessment experiments with different scientific teams should be carried out. From these experiments, it would be possible to compare the

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results achieved using conventional techniques with those achieved after using the proposed definition and protocol. We feel that it is appropriate to insist in the necessity of high density and detailed assessments, as Casalí et al. (2006) stated.

"2. The use of an equivalent prismatic gully defined by a single value of width (We) and depth (De) involves the loss of valuable information (e.g. the maximum depth of the different segments of the channel, etc.). This may be acceptable or not depending on the purpose of the measurements".

It is not our intention to eliminate from the analyses any relevant information for gully research. Moreover, as a consequence of using very detailed DEMs, as we propose, very detailed information of gully characteristics and of its spatial variation will be available. Our proposal is oriented towards providing an important additional information, aiming at the unity of criteria when characterizing the gully morphology and its most important properties, emphasizing its width, depth and volume.

"3. The authors affirm that the problem of reducing the type of error discussed is not even usually recognized by the researcher. I think it should be obvious that the researcher analyzes the shape of the section and choose what measures to take, in order to reduce errors in the estimation of the surface area of the cross section. These operations are not usually described in literature just because they are obvious for a researcher. In my opinion, the real explanation is, rather, that until recently the researchers who dealt with (ephemeral) gullies aimed to reduce errors, but only in order to compare measurements made by the same research team. Of course, the transition to a phase of comparison between the experimental results obtained by various research teams imposes a shared definition of standardized measurement protocols and techniques, as proposed by the authors in the manuscript".

There is no doubt that scientists do their best to get the most accurate assessments. However, in many cases, it is very difficult to be objective, consistent, even for experts. Then, in our opinion, the obviousness that Referee #1 points out is not enough, and

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we think that it is necessary go in depth. Anyway, there is great subjectivity that must be delimited. In effect, and in agreement with Referee #1, it is necessary to make the results general and universally comparable, and not only valid for one specific research group.

“In conclusion, in order to define a standardized measurement protocol of the (ephemeral) gully geometry, the authors should: - compare different measurement techniques for different sizes of the channel and, for the reconstruction of the DEM, for different survey meshes; - evaluate the related errors; - suggest the type of equipment necessary for create a detailed DEM”.

In our opinion, and in agreement with previous discussions, we think that it is not necessary to make the suggested operations, because they are not required to achieve the objectives considered in this paper.

“Other specific comments for the authors: P. 328, l. 9. and P. 329, l. 9. The authors define the width (We) and the depth (De) of the equivalent prismatic gully (EPG) as “effective”. I think it should be better to use a different term, e.g. “mean equivalent””.

We accept the suggestion made by Referee #1. The texts will be modified accordingly.

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