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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A conceptual model of check dam hydraulics for gully control" *by* C. Castillo et al.

C. Castillo et al.

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We would like to thank Referee 2 for the helpful comments. We have tried to address the questions in the following answers.

Comment 1: General comments: This paper presents an interesting work conducted on the modelling of check dam hydraulics for gully control. The paper is clearly written and the figures are all useful. Authors should improve their bibliography, they should add the book "Check dams, morphological adjustments and erosion control in torrential streams" edited by C. Conesa- Garcia and M.-A. Lenzi (2010). Several chapters are dealing with their main topic (flow modeling, gullying, etc.) and could improve their paper.

Author's answer:

We thank the reviewer for the suggestion. We have revised this useful and comprehensive work and we will include some interesting references from it in the introduction and discussion sections.

Comment 2: In the discussion and in the conclusion, authors should discuss the possibility to compare their results with field measurements and observations and how they could proceed to improve their knowledge about the processes and the model.

Author's answer:

We agree with the reviewer that further experimental studies are necessary to test the conclusions obtained using our theoretical approach, preferably at a suitable laboratory-flume scale to allow a range of conditions (slopes, drop heights, unitary discharges, spacings) to be tested. We mentioned in the manuscript that additional field observations were needed (page 24, lines 12-15). We will include a comment on this aspect in the conclusions as well. In addition, we have revised flume studies on step-pools configurations (e.g. Curran and Wilcock, 2005; Comiti et al., 2009) that will help to improve the discussion on the model results and their relationship with flume and field data.

Comment 3: Specific comments: Line 23-24: "A check dam is a small dam designed to reduce flow velocity and to enhance sediment deposition in order to control soil erosion within a stream, such as a gully." They although contribute to maintain the stability of the adjacent slopes by limiting the undercutting processes.

Author's answer:

Our apologies. We will mention other purposes check dams serve, providing a more comprehensive definition.

Comment 4: Page 11903 Lines 15-20. The spacing between dams is also depending on the dam height, the angle of deposition of the material behind (or trapped if you

prefer) the check dam, the length of potential downhill scour and the original channel gradient (see VanDine, 1996, Debris Flow control structures for forest engineering).

Author′s answer:

We agree with the reviewer that several factors must be taken into consideration for check dam design such as original gradient, final slope or check dam height. In those lines, we tried to refer to the main criteria employed in technical and scientific literature for defining check dam spacing. Those factors are included in the deposition slope equation (Eq. 7, page 10). The different criteria differ mainly in the definition of the deposition slope: zero for the head-to-toe criterion, or an ultimate or equilibrium slope either estimated by incipient-motion considerations or field observations. We will also include a reference to the Van Dine′s criterion in the discussion.

Comment 5: Page 11906 Lines 14-21. Authors should justify the ranges of their parameters. Why did they choose these values? For example, the gully gradient is usually higher than the bed slopes (0.02-0.1) used by the authors.

Author′s answer:

Our apologies. We will provide a better justification of the input parameters, especially regarding the slope interval. There was no obstacle to apply the model in higher gradients. Following the reviewer suggestion, we have extended the range of slope values in the efficiency analysis to consider higher slope values (up to 20%), the common upper limit found in check dams interventions (e.g. Nameghi et al., 2008) as well as in step-pools systems (e.g. Zimmerman and Church, 2001; Chartrand et al., 2011). We appreciate your suggestion since it encouraged us to improve our study. From this extended analysis, several relationships between check dam efficiency and step-pools observations were found, previously unnoticed due to the limited span of the input parameters. They will be fully analysed in the revised version of the manuscript. As a result, we have considered modifying the work title to "A conceptual model of check dam hydraulics for gully control: efficiency, optimal spacing and relationships

with step-pools units". In our opinion, this title is more specific and illustrates better the key issues examined in the manuscript.

Comment 6: Page 11909 Lines 22-24. "In the model, the HJ characteristics were estimated by comparing graphically the FSP calculated in both directions in order to find the point of correspondence between the downstream subcritical and upstream supercritical regimes." Authors should add a figure to illustrate their methodology; this would significantly help the reader.

Author′s answer:

Our apologies. To facilitate the understanding of this particular aspect (backwater calculations in both directions): i) we will provide a clearer wording of the procedure in the methodology section; ii) we will include the equation of sequent Froude numbers at the hydraulic jump; iii) we will illustrate the procedure graphically in Figure 2, removing the Equation (already present as Eq. 11) and adding a plot of Froude number evolution and the determination of the point of correspondence above the sketch of the restored gully.

Comment 7: Page 11915 Lines 12-17. Authors should add (if they exist) some references regarding the use of the IBER model in scientific papers.

Author′s answer:

Our apologies. We will include two references on the application of the Iber model from the scientific literature: González-Aguirre et al. (2012), Bladé et al. (2014).

Following the reviewer's suggestions, we will include a clarification of all these aspects in the revised version of the manuscript.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 11901, 2013.