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Hydrology and Earth System Sciences Discussions

Interactive comment on "Sediment yield model implementation based on check dam infill stratigraphy in a semiarid Mediterranean catchment" *by* G. Bussi et al.

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We would like to thank the reviewer #2 for its critical comments, and we would like to provide our particular view and position regarding the general ones and otherwise to address the more specific in the revise version of the paper.

The reviewer is critical with the contribution of the paper and states that "there is no obvious advance in the knowledge, as all the relevant information was obtained without the need of the model and there is no feedback for rejection or improvement of model structure or parameterisation".

As stated in the paper, the aim of this study was the development of a new methodology for sediment model calibration and its validation in case of no availability of gauged sediment data, by using a quantitative stratigraphical reconstruction as proxy data, and not the model conceptualization, already tested in previous studies (under review). As stated in the title ("Sediment yield model implementation based on check dam infill stratigraphy…"), in the abstract (page 2, line 5: "…a modelling approach is proposed to reproduce and evaluate erosion and sediment yield…"), in the introduction (page 3431, line 8: "The detailed analysis of their alluvial stratigraphy may provide quantitative information for specific events", page 3431, line 15: "the sedimentation of a small reservoir, draining a 12.9 km2 subcatchment, is used to calibrate the sediment submodel"), and again in the conclusion section (page 3445, line 15: "This paper shows that a distributed sediment model can be implemented using the proxy information obtained from check dam deposits").

At the authors' knowledge, this approach has never been implemented, and represents a very innovative technique for applying distributed deterministic (or mechanicistic) models in sediment ungauged catchments (the great majority of semi-arid catchments). The advance in the knowledge is represented by the possibility of applying sediment models at ungauged catchments by reproducing the proposed strategy. The Rambla del Poyo catchment was used as a case study, in order to show the proposed methodology. We will enhance the aim of our work in the revised version of the paper. For those reasons, the authors consider that the model structure used is valid.

The reviewer states that "this rate could be obtained, as stated by the authors, in a much easier way by a mass balance calculation with the help of a simple sediment trapping efficiency equation". As showed by this paper, the Brune curves provided a value of average trap efficiency of 57%, very close to the 51% provided by the model. Nevertheless, the Brown equation provided a much lower value of average trap efficiency, proving that the use of a simple sediment trapping efficiency equation could lead to incorrect results. Furthermore, trap efficiency strongly varies depending on the

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reservoir storage capacity (which is variable through time), the influent water and sediment discharge and the settling velocity of the particles. The STEP model was able to reproduce this variability, providing a time-variable trap efficiency which could not be computed with simpler sediment trapping efficiency equations.

The reviewer states that “A much simpler (lumped) model might provide similar results without the need for such a complex distributed model”. This affirmation may be correct for studies focusing a single catchment. Nevertheless, the aim of this paper was not only to estimate the sediment yield at the check-dam catchment, which, as stated by the reviewer, can be done by using a simpler approach. The additional advantages of a distributed model versus the difficulties of its implementation should be known by the reader. Distributed model results can be extrapolated to the whole domain of study, downstream and upstream the calibration point. In the presented case (Rambla del Poyo catchment). The calibrated and validated model can be used to determine the sediment yield to the floodplain. Furthermore, distributed models can provide state variable values at every cell of the domain of the study. In this case, a map of soil erosion may be produced of the whole Rambla del Poyo catchment, as shown in the attached map for the Rambla del Poyo stream gauge station after the October 2000 (the largest event of the series).

This kind of erosion map cannot be produced using a simple lumped model calibrated at one check-dam.

The reviewer also states that “a more interesting exercise would be a real predictive one”, and suggests to analyse the results of an uncalibrated model. As has been frequently reported in literature both for hydrological and sediment models[Jetten et al., 1999; Beven, 2001; Aksoy and Kavvas, 2005], calibration and validation are required in order to obtain reliable model results. A satisfactory result obtained with an uncalibrated model would not mean more than a “lucky guess”. Models need calibration in order to take into account model errors, input data errors and parameter estimation uncertainty[Beven, 1993]. Nevertheless, this is an old and long discussion, and is out of the scope of the present study.

The reviewer states that “The value of the work does not depend on the success of the model implementation”. As explained in the Result section, the first model validation was not completely satisfactory, and for this reason, after identifying the reason for the failure, we corrected the model implementation and obtained better results (from page 3441, line 16 to page 3443, line 20). Anyway, in this case we think that a successful model implementation is required in order to prove the usefulness of the presented methodology.

Detailed comments:

Comment: English style: There are a few scattered grammatical errors in the text. The past tense is not always used for verbs when the results are described. In some phrases there is no sufficient distinction between facts and assumptions.

Answer: We have revised the grammar and corrected the errors highlighted by the reviewer. Abstract: It is unclear that distributed models may facilitate the ‘comprehension’ of the soil loss and sediment transport phenomena. The ephemeral behaviour of the basin does not need any ‘confirmation’ by the modelling results.

Distributed sediment model help to understand the soil loss and sediment transport phenomena, because they can reproduce the spatial variability of the processes. For example by identifying the most erosion-prone areas [Jetten et al., 1999; Aksoy and Kavvas, 2005]. To clarify this point, this explanation will be included in the revised version of the paper.

Certainly, the model does not confirm the reality, the reality validates the model. It will be corrected (or eliminated) in the final version.

Comment: Introduction: The review of the use of reservoir deposits for sediment yield studies is somewhat wordy, but the citations for the early works since the 1950s are lacking (the Brune and Brown equations provide a proof of these activities).

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Answer: The literature regarding sediment yield studies using reservoir deposits is quite extended and cannot be entirely included into a single paper. We wanted to focus our literature revision on sediment modelling studies which used reservoir sedimentation for model calibration and validation, especially the ones which used check-dam reservoir sedimentation. We will include more literature studies in the revised version of the paper (e.g. Geiger, 1957; Ackermann and Corinth, 1962; Rohel, 1962; Farnham et al., 1966; Callander and Duder, 1979).

Comment: Hydrological calibration and validation :The text is confusing respect to the calibration, as it is stated first that this was made using a single event in October 2000 and then between October 2000 and October 2003. This part should be improved and preferably moved to the methods section.

Answer: Two models were implemented within this study: a first model with 5-minutes time step, calibrated with data from the October 2000 event, and a second model with a daily time step, calibrated with data between 2000 and 2003. The first one was the main model, and it was used for reproducing flood events. The second one is used for reproducing no-flood periods, with the aim of estimating the initial conditions of soil moisture for each flood event. We employed this strategy in order to save computational time.

This is stated at page 3438, line 10 (“The model was calibrated at a 5 min time resolution on a single event in October 2000”), page 3438 line 13 (“the simulation of 20 yr of rainfall at 5 min time resolution is highly time-costing”) and page 3438 line 19 (“ a daily model had to be calibrated and validated”).

In any case, we will enhance this explanation in the revised version of the paper. This part deals with the hydrological sub-model calibration and validation. Given that the aim of the paper is the presentation of a new methodology for model implementation, we believe that this part should remain within the Results section; otherwise the reader will not have a comprehensive picture of the whole model implementation. Therefore, we would be willing to move this part to the Methods section if the editor felt it necessary, and we would be grateful for his advice on the matter.

Comment: Sediment sub-model calibration and validation: Pag 3433, lin10: STEP is suspect not reproducing.

Answer: This correction will be included in the final version.

Comment: Sediment yield: the annual flow of 2.05 Mm3 seems to be actually 2.05 Hm3.

Answer: We will replace Mh3 with Hm3.

Comment: Acknowledgments:The origin of the data, if it is not from the authors institutions,should be preferably stated.

Answer: Hydrometeorological data was provided by the Automatic Hydrological Information System of the Júcar River Authority (SAIH – Confederación Hidrográfica del Júcar). Wildfires information was provided by the Regional Government, as stated in the main text. We will include these institutions in the acknowledgements section.

References

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 3427, 2013.

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Interactive Comment

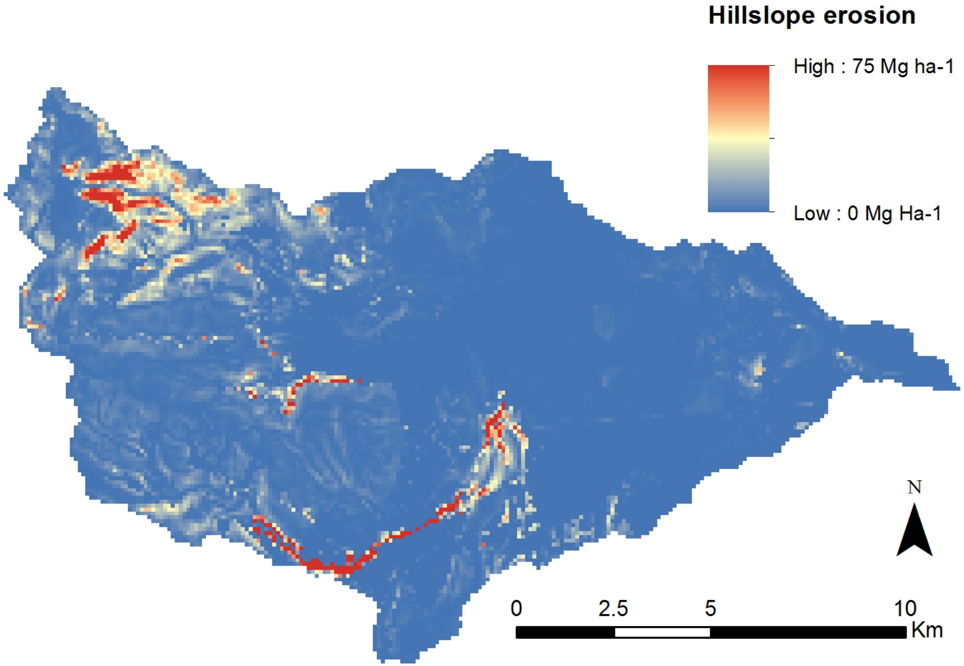

Fig. 1. Soil erosion map of the October 2000 event.