

Referee comment to:

Journal: HESS

Title: Reducing the hydrological connectivity of gully systems through vegetation restoration: Combined field experiment and numerical modelling approach.

Author(s): A. Molina et al.

MS No.: hess-2009-77

General comments:

This paper presents novel data that is relevant to understand the influence of vegetation cover on the connectivity of gully systems and on their capacity to retain runoff (and sediments). The paper is therefore well placed in HESS. Substantial conclusions are reached regarding the most sensitive parameters on runoff transmission and outflow volume of gully systems. However some general comments should be addressed:

The results of the experiments are clearly described and evaluated. The main influencing factors of vegetation on runoff transmission and outflow volume are identified. The modeling part is also a very interesting approach but it should be overworked regarding the following comments:

1. I think it would be helpful to specify for what reason the experiments were modeled and what should be learned from the modeling part (i.e. at the end of the introduction).
2. I suggest being more precise when using the term "prediction". Since the model is calibrated in the beginning, it would be better to use the term "simulation" for all model results related to the calibrated parameter sets.
3. Since the model is not really "physically based" it would be better to characterize it as "process based"
4. A more detailed discussion of the results of the sensitivity analysis (chapter 4.2) would be helpful.
5. For the experiments the main influencing factors on infiltration are given in chapter 3.1 which are vegetation cover, runoff width and antecedent moisture content. Was it tested, if the model responds to changes within these parameters in the same range as observed by the experiments?
6. Some concluding remarks merging the experimental and modeling results would be helpful.

Specific comments:

- Page 2538, line 21: the relation of vegetation cover to sediment storage is not investigated in the paper. Maybe a citation could be added, where this is shown?
- Page 2538, line 25: "the model is able to predict the transfer of runoff water generally well..." → "The calibrated model is able to simulate the transfer of runoff water generally well..."

- Page 2538, line 26: “predicted total outflow” → “simulated total outflow”
- Page 2539, line 4 to 6: this conclusion could be only drawn from the results of the field experiments.
- Page 2541, line 5 to 8: it would be helpful to specify the aims of the model application.
- Page 2543, line 16 to line 21: in Table 4 roughness coefficients for each gully are shown. It would be helpful to mention, that the results of the roughness coefficient estimation are displayed in Table 4.
- Page 2543, line 24: why is equation (3) given here? It is not used again.
- Page 2550, line 25: “predicted” → “simulated”
- Page 2551, line 2: “predict” → “simulate”
- Page 2551, line 1 to 3 and Figure 5(a): why is there a slight tendency of the model to under predict the outflow volumes for some experiments, since each model run was calibrated? Can this be explained?
- Page 2551, line 25: “predictions” → “simulations”
- Page 2551, line 7 to 17: it should be mentioned within this paragraph, that the model results of the San Miguel 2 experiments are displayed in Figure 4. It is shown in Figure 4 that the recessing limb of the hydrograph is poorly predicted. I suggest a more detailed explanation why the rock outcrops in the gully bed are poorly represented by the model and why this results in an under prediction of the outflow volume.
- Page 2550 to 2551, chapter 4.1: I suggest giving the spectrum of the variation of K and S in the text. What is the difference between wet and dry conditions?
- Page 2552, line 2: it is unclear why Fiener and Auerswald (2005) are referenced here. Are the authors’ observations in agreement with theirs?
- Page 2551 to 2553, chapter 4.2: I suggest a discussion of the results of the sensitivity analysis at the end of chapter 4.2.
- Page 2553, line 11: it would be helpful to give a short explanation how the correlation analysis was carried out (for what parameters) before explaining the results.
- Page 2553, line 11 to 12: I suggest giving a band width of the weak correlation of S in comparison to K in the text.
- Page 2553, line 17: give a number (i.e. model efficiency) for decreasing model performance.
- Page 2553, line 18 to 19: it would be again helpful to give a band width of the correlation of K^* in comparison to K in the text and to mention how it has changed.
- Page 2554, line 9 to 13: give some references here.
- Page 2554, line 17 to 18 and page 2555, line 1 and 14: I suggest to use the term “process based model” than “physically based model”
- Page 2554, line 23: give a number for the poor model efficiency
- Page 2555, line 26/27: “predicts” → “simulates”

- Page 2556, line 3: “predict” → “simulate”
- Page 2556, line 2 to 3: S and K were calibrated
- Page 2556, line 5 to 8: I suggest some concluding remarks, why these model parameters are difficult to predict.
- Page 2556, line 8 to 11: the influencing gully characteristics mentioned here are derived from the experimental results (chapter 3.1). The results of the correlation analysis of the optimized parameter values and gully characteristics are given in chapter 4.3. Some concluding remarks merging the experimental and modeling results would be helpful.
- Page 2570, Figure 5:
I suggest “simulated outflow” than “predicted outflow” in the description of (a). It would be helpful to add the results of the goodness of fit parameters to the Figures (a), (b) and (c).
The measured outflow volume should be put to the x-axis and the simulated volume to the y-axis in (a), (b) and (c). Then the under or over prediction of the simulation is clearly shown.

Technical corrections:

- Page 2538, line 27: “the most sensitivity parameters” → “the most sensitive parameters”
- Page 2540, line 21 and line 23: writing of “stabilization” varies between “z” and “s”
- Page 2540, line 23: delete “most likely”
- Page 2540, line 25: “quantitative measures” → “quantitative observations” or “quantitative measurements”
- Page 2540, line 29: delete “,”
- Page 2541, line 15: “southern” → “Southern”
- Page 2541, line 18 to line 21: “The region is characterized by a tropical mountain climate (Dercon et al., 1998), and mean annual rainfall measured at the station of Cochapamba-Quingeo is about 810mm, but it is known be significantly higher at higher altitudes.”
→ “The region is characterized by a tropical mountain climate (Dercon et al., 1998). Mean annual rainfall measured at the station of Cochapamba-Quingeo is about 810mm, but it is known to be significantly increasing at higher altitudes.”
- Page 2541, line 26: delete “,”
- Page 2542, line 6: “has accelerated” → “have accelerated”
- Page 2542, line 9: delete “...and vegetation restoration” because this is again mentioned and explained in the following sentence
- Page 2543, line 14: “Manning’s resistance coefficient” → “Manning’s roughness coefficient”
- Page 2544, line 17: “The model describes...” → “The model processes...”

- Page 2545, line 11: delete “,”
- Page 2546, line 14: “Delectic” → “Deletic” (see References)
- Page 2547, line 13: delete “,” after “obtained”
- Page 2548, line 1: α , β are already defined in line 3, page 2547
- Page 2548, line 3: give a Reference here
- Page 2549, line 8: “tranmission” → “transmission”
- Page 2549, line 25: “when dry” → “when they are dry”
- Page 2550, line 1: “adds roughness” → “increases roughness”
- Page 2551, line 7: “shows error” → “shows an error”
- Page 2552, line 22: add “When“ at the beginning of the sentence
- Page 2552, line 28: “sensitivity“ → “sensitive”
- Page 2553, line 22 to 23: explain abbreviations of equation 12
- Page 2555, line 20: delete “,”
- Page 2558, line 3 to 4: delete Le Bissonnais et al. This Reference is not cited in the paper.
- Page 2560, Table 1: delete “component”
- Page 2561, Table 2: add, that the other experiments (without asterisk) are wet run experiments
- Page 2569, Figure 4: the Figures as well as the font size are small and therefore difficult to read
- Page 2570, Figure 5: the font size of the Figures is small and therefore difficult to read
- Page 2571, Figure 6: add abbreviations of the varied parameters (S, W, K, n) to the Figure description