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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A coupled distributed hydrological-stability analysis on a terraced slope of Valtellina (northern Italy)" *by* C. Camera et al.

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Responses to Referee number 1 (HESSD, 10, C1537-C1539)

MODELING

We can surely give all of the fundamental equation for both the hydrological and the stability analyses. We avoided doing that giving the references of the methods; anyway we agree that it is better for the reader to have more information directly in the manuscript.

We also agree that we can improve the description of the coupling between the two models giving more details on its type (soft coupling), common variables, and duration

of the time-steps (it is the same).

As suggested in the comment left as a note in the manuscript (p. 2300, line 11) a table with a complete description of the parameters used will be added in the method section.

Regarding the absence of calibration, the idea was to use the parameters values defined in the previous step of the work (field and lab work and modelling at the single terrace scale) as presented in previous papers (Camera et al. 2012a, 2012b). The shear resistance parameters of soil (c and ÏŢ), as well as its bulk density, were defined with tests in the lab. Then they were used in the models at the single terrace scale and the results of these models testify that their values can be retained very plausible. We do not believe that there is a complete lack of uncertainty around these parameters but we can assess with a certain degree of confidence that uncertainty around them is relatively small. The same line of reasoning can be applied also to the parameters of the walls. It is true that uncertainty around these parameters is higher, above all around cohesion as in the two models presented in Camera et al., 2012b two different values were found at calibration. On the other hand the single scale models were set up to understand the processes and mechanisms that can lead to the failure of a dry retaining wall, but also to find a reliable geotechnical parameterization for it. In conclusion, also regarding walls, the idea is that the values given to the parameters are very plausible and they cannot differ so much from the one proposed. The feeling is that the most sensible parameters are soil depth and elevation, which are influencing also the slope of bedrock. It is true that is not clearly demonstrated and so, as suggested by the Referee 3, our proposal is to include a sensitivity analysis, maybe conducted on few terraces and not over the entire study area, to evaluate the influence of very small variations in the mechanical properties of soil and walls, but also in soil depth. Then, it is pointed out that we did not compare our results with occurred events, that there is not a validation. This is only partially true. We compare our results for a dry day and a wet day in which no landslides were observed. Therefore, the occurred events are zero,

we are validating our model against no occurrences; but we are observing something. The model has problems, and we are trying to recognize and fix these problems. We can add a comparison, a validation respect to the events occurred in the past to see if the initiation areas would be recognized as critical, but in this moment we believe that it is more important to understand why in a dry state we obtain FS < 1.

DEM AND SOIL DEPTH MAP

The description of DEM development is more detailed than the one of other parameters because it represents a very strategic task in the study together with soil depth map. The DEM development was particularly hard to complete because of the peculiar morphology of the terraced slope, where a series of very high changes in slope dip angle occur over a short spatial scale. The purpose of the detailed description was to highlight the complexity of the task, and proposing a possible path that can be followed to determine DEMs in this specific environment In detail, to answer to the comment left as a note in the manuscript (p. 2297 line 15), the DEM used was a merging of the one obtained from the photogrammetric analysis on one side, with the DB2000 where available, interpolated to have a 1-m resolution. The comparison with the contour line interpolated DEM, with a lower resolution, was a strategy to remove vegetation effects that were not possible to be seen in the 3D-CAD environment. The paragraph will be rewritten in some passages to make it clearer.

Note in the manuscript (p. 2298, line 15): the kriging part will be removed

Note in the manuscript (p. 2299, line 19): we agree that the calculated R2 value is very low but in this environment also geophysics suffers from the abrupt changes of slope dip angle. In addition, as pointed out by the Referee 2, R2 is not the best measure to evaluate the fitting and so other fitting measures will be added. In general, the purpose was to check if geostatistical methods could give trend of soil depth similar, even if not exactly reproducing, to the one obtained with other methods (geophysical), not to quantitatively compare soil depth values. We will introduce this explanation in the

text as well as we will modify Fig.4 adding also the map obtained with geostatistical techniques. Regarding the difference between the two different values of R2 (modelled values VS test points and modelled values VS geophysical measures), this is due in part to the different techniques used to take the measures. The direct measured test points are affected by the same type of error of the direct measured training points (and it is explained in the text at p. 2299, line 15-19). On the other hand with geophysics we are exploring a small area in a very high detail, so that interpolated sparse measures (even if we are talking about 830 values taken in the field) cannot reproduce the 1 m x 1 m variability

RESULTS AND DISCUSSION

We agree to separate results from discussion so that we can also better describe limits and drawbacks of the methods and of the results. Even if this version of the manuscript already contains critical analyses that cover both the parts of input parameters and of the results, a new organization of this section can improve the readability of the text. It answers also to the comment left in the manuscript as a note (p. 2300, line 23).

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 2287, 2013.