

REFeree #1

GENERAL COMMENTS

I found this manuscript very interesting and direct, however, personally I think that there are important points to improve. My main concern is related with the influence of C-factor in your analysis. I consider that your objectives should be only focused on the relationships with erodibility. It seems nice to me that with simple analysis of aggregation you can determine TOC and at the same time erodibility. The TOC-erodibility-aggregation analysis is valuable because you might be optimizing effort and investment to predict soil susceptibility to the erosion. In addition, as you mentioned in the lines 87-92, you can continue the lines of those works.

Nevertheless, I think it does not make sense to relate soil resistance factors such as the aggregation with the potential erosion provided by RUSLE. Please consider that in the triangle energy-soil resistance-protection determining the erosion rates, K is the only one component directly related with the soil resistance. Please, consider that if you have a very high erodibility but all the energy is dissipated by the vegetation (mulch, rock, etc), "the aggregation must not mirror soil erosion rates" (line 17). Thus, if you work in natural areas, the protection provided by the vegetation should be very fine described. In fact, the dissipation of energy associated to C factor must be quite different for shrubs, trees and grass. You used tabular annual values for C without considering the cover degree which must also have an important role. Remember that in C (fall height, residues, cover, soil moisture and previous land use) are their subfactors. They are implied in your hypothesis to discuss your results. In this line, the description of the vegetation type and the cover degree in each LUT is crucial if you want to quantify/relate the erosion. You mentioned this in the lines 64-67, but you do not consider these aspects. Therefore, I think you should modify the objectives and I recommend a Major Revision.

In line with the suggestions of referee #2, too, we tried to emphasise that soil aggregation seems to mirror the actual soil vulnerability to topsoil degradation (i.e. erosion + aggregate loss) better than soil erodibility, however we did not intend to use aggregate stability as an alternative to erodibility. Therefore we inserted a part on this issue in the revised abstract and conclusions sections. Although aggregate stability determination is a simple lab test, in terms of time effort and availability of databases, it can not substitute the computation of erodibility and the routine chemical analyses such as organic C determination. In the conclusion we emphasised the need of understanding the protecting role of forest floor in terms of richness and diversity, and not only of cover, in the RUSLE C factor definition, as discussed in the discussion section.

New abstract sentences: *"The aim of the research was to evaluate the agreement between aggregate stability and erosion-related variables and to discuss the possible reasons for discrepancies in the two kinds of land use.*

Topsoil horizons were sampled in a mountain catchment under two vegetation covers (pasture vs. forest) and analyzed for total organic carbon, total extractable carbon, pH, texture. Soil erodibility was computed, RUSLE erosion rate was estimated, and aggregate stability was determined by wet sieving. Aggregation and RUSLE-related parameters for the two vegetation covers were investigated through statistical tests such as ANOVA, correlation, and regression.

Soil erodibility was in agreement with the aggregate stability parameters, i.e. the most erodible soils in terms of K values also displayed weaker aggregation. Despite this general observation, when estimating K from aggregate losses, the ANOVA conducted on the regression residuals showed land use dependent trends (negative average residuals for forest soils, positive for pastures). Therefore, soil aggregation seemed to mirror the actual topsoil conditions better than soil erodibility. Several hypotheses for this behavior were discussed. A relevant effect of the physical protection of the organic matter by the aggregates that cannot be considered in K computation was finally hypothesized in the case of pastures, while in forests soil erodibility seemed to keep trace of past erosion and depletion of finer particles. A good relationship between RUSLE soil erosion rates and aggregate stability occurred in pastures, while no relationship was visible in forests. Therefore, soil aggregation seemed to capture aspects of actual vulnerability that are not visible through the erodibility estimate."

In conclusions: *"The soil aggregate stability in a mountain catchment was assessed with a laboratory wet sieving test and the results were compared with the erodibility factor K and the estimated erosion rate (RUSLE model). The K factor was positively correlated with the aggregate loss (wet sieving test), i.e. the most erodible soils (higher K) also displayed higher aggregate losses and quicker breakdown. Land use dependent trends were however observed in the estimate of K from aggregate loss. In fact, the residuals for forest soils were lower in absolute value and with average negative value, while the opposite behavior was found in pastures. Therefore, soil aggregate stability seemed to reflect better the actual vulnerability of topsoils to physical degradation. Several reasons for this behavior were discussed, and a relevant effect of the physical protection of organic matter by aggregates that cannot be considered in the traditional K formulation was hypothesized for pastures. In forests, soil erodibility seemed to keep trace of past erosion and depletion of fine particles. Moreover, while the RUSLE erosion rate could be satisfactorily predicted from aggregate loss for pastures, this was not possible for forests. In forests, erosion estimate seemed particularly problematic also because of a high spatial variability of litter properties. The protecting role of the forest floor in terms of richness and diversity, and not only of cover, in the RUSLE C factor definition, would need further investigation in*

order to better understand the mechanisms that determine the relationship between soil erosion and structure for the different land uses.”

SPECIFIC COMMENTS

The following points are thought to improve the readability. I hope they are useful. 1.

Abstract – line 17. Please, review the sentence.

2. Abstract – I think you should briefly describe Material and Methods: i) soil analysis; ii) statistical tests. Without ii) “residual negative” cannot be understood (line 25).

We almost completely rewrote the abstract according to the referees comments, rephrasing the sentences that were not clear. We are now giving more detail on soil analyses, and statistical tests (see paragraph reported above). At line 17 we changed “is expected” into “should be”, more hypothetical, in agreement with the changes made in the next paragraph (reported above) and with the general concerns of reviewer#1.

The residual analysis is therefore introduced after the general description of statistical methods. Parts of the abstract with relevant changes are already reported above in the general comments section.

3. Abstract – lines 28-35, be careful with these paragraph because you calculated C with a tabular factor (only two values to discriminate 15 LUTs?).

Thank you for the comment, this allowed us to rediscuss the study, and to direct our actual research, as we are aware that this might be an oversimplification. However, the categories available in Bazzoffi (2007) are quite wide in terms of canopy and understorey % cover. In particular, they refer to relatively wide ranges of canopy cover for forests. A set of 6 values (derived from Stone and Hillborn, 2000; Wishmeier and Smith, 1978) are reported by Bazzoffi (2007) for forest covers; a set of 3 values for pastures (derived from Stone and Hillborn, 2000).

The following table summarizes the classes, the grey-colored rows are the ones we chose as they fitted the study area situation.

Forests	C value	Source
Schrubs	0.05	Stone and Hillborn, 2000
Mixed forest, canopy cover 100-75%, litter cover 100-90%	0.002	Wishmeier and Smith, 1978
Mixed forest, canopy cover 70-45%, litter cover 85-75%%	0.003	Wishmeier and Smith, 1978
Mixed forest, canopy cover 40-20%, litter cover 70-40%	0.007	Wishmeier and Smith, 1978
Pasture		
Good conditions	0.02	Stone and Hillborn, 2000
Degraded	0.05	Stone and Hillborn, 2000
Severely degraded (herbaceous cover almost absent)	0.1-0.8	Stone and Hillborn, 2000

In order to clarify this point, we inserted more details in the methods section:

“As no specific survey was done, the C factor was derived from tabular data proposed by Bazzoffi (2007) for forest and pasture vegetation cover, i.e. 0.003 for the forests of the study area (i.e. mixed forest with canopy cover ranging from 45 to 70% and litter cover ranging from 75 to 85%) and 0.02 for pasture (non-degraded pasture). The attribution to the classes was made on the basis of observations made during survey.”

The reviewer’s comments allowed us to insert (end of conclusions) a deeper reflection on the issue of vegetation cover in forests, considering the limitations of the available coefficients and stressing the need for a more detailed approach.

“The protecting role of the forest floor in terms of richness and diversity, and not only of cover, in the RUSLE C factor definition, would need further investigation in order to better understand the mechanisms that determine the relationship between soil erosion and structure for the different land uses.”

Also the last sentence in the abstract is modified as follows, specifying which aspects would need deeper insight:

“Considering the relevance and extension of agrosilvopastoral ecosystems partly left to natural colonization, further studies on litter and humus protective action might improve the understanding of the relationship among erosion, erodibility and structure.”

4. Lines 116-117. Scientific names of the species are fundamental. Please, also consider include the main formation to complete the categories pasture/forest.

We inserted scientific names and put indications on understorey cover species. The vegetation cover description is now more detailed. *“Large parts of the catchment were planted with tree species between the 50s and the 70s of the XXth century, while the rest of the forest cover was characterized by natural colonization by pioneer trees. In all cases, the canopy cover ranges from 50 to 75%, with a litter cover ranging from 75 to 80%. The dominating species,*

depending on altitude, are larch (*Larix decidua* Mill.), Juniper (*Juniperus communis* L.), Scots pine (*Pinus sylvestris* L.), rhododendron (*Rhododendron ferrugineum* L.) and blackberry (*Vaccinium myrtillus* L.). The tree line is at around 2200 m, and the upper part of slopes is occupied by pastures, generally abandoned and with no relevant evidence of degradation. “

Moreover, as a further detail, the threshold values used for C classes are reported in the methods (see comment 3).

5. Line 136. The catchment was divided into 15 LUTs but in Tables 1 and 2, you have 25 and 33 samples/points. Can you clarify the approach?

Sorry the number of samples (16 in forest + 9 in pastures, for a total of 25) is correct. In table 2 we reported by mistake a lab id number. We uniformed the columns using the same ID in all tables.

Which was the standard deviation? Did you calculate the fortnightly values to weight K? It is not clear. See line 197, please correct “does not”.

This part was not clearly explained in the methods, therefore we better explained.

“Out of the total area, around 199 ha were represented by soils while the rest was covered by rock outcrops. Considering a medium to high detail according to Deckers et al. (2002) we hypothesized a minimum sampling density of ca 1 profile/10 ha, then distributed the sampling frequency according to LUTs abundance and accessibility. Twenty-five topsoils (i.e. always within A horizons, discarding the organic layers) were sampled at 0-10 cm (n=25, of which 9 were represented by pasture, 16 by forest). The number of samples per LUT class was proportional to the LUT type abundance and considered the internal homogeneity of the LUT types. “

Of course, reduced accessibility and steep morphology limited the use of a systematic sampling.

As required by other referees, we improved the figures and introduced the LUTs map.

6. Lines 193-198- You selected 1680 MJmm/ha.h or year? Why? Which was the standard deviation? Did you calculate the fortnightly values to weight K? It is not clear.

In Bazzoffi (2007) a set of 6 equations used to compute R for all Italian municipalities is presented.

We computed the R yearly value using all six equations on a time series of 30 y which was available for the closest meteo station, based on monthly data. Then we averaged the results obtaining a standard deviation of ca 576, which is quite high but takes into account the different performance of the available equations.

In the text we therefore added the st. dev. Value and we stated that we used monthly meteorological data.

See line 197, please correct “does not”.**done**

7. Lines 229-231. Please, see the overall comment.

8. Line 233. Please, include the statistical tests carried out. **We inserted paragraph 2.4 on statistics at the end of the methods section.**

“2.4 Statistical analyses

A one-way analysis of variance (ANOVA), using land use as factor variable, was carried out for all soil properties. The homogeneity of variance was checked by the Levene test, and all the variables showed homoscedasticity, therefore no variable transformation was needed. The correlation between variables was evaluated using the Pearson coefficient (two-tailed), after visual inspection of the data to verify that the dependence relationship was linear. Linear regression was also performed and the residuals saved for further data treatment.

All statistical analyses were performed using SPSS 19.”

9. Line 300, I do not agree with it, see overall comment.

We rephrased to avoid overinterpretation: “Soil organic matter content did not differ between land covers” but we keep the sentence as we were expecting different organic matter contents under forest and pasture as stated in the rest of the sentence (unchanged).

10. Please, review the conclusions according to the implications of C-factor. **Done, see also comment #3.**

11. Figure 1, it would be good to include the limit of the catchment and some pictures. 12. Figure 4, please see my comment

We are now showing the limit of the catchment in the RUSLE map and a general picture of the catchment in figure 1. The new caption of Figure 1 will be: “Fig.1 Digital elevation model of the study area (left-up); catchment location (right-up); Google Earth picture of the area (left-down); LUT map (right-down).”

As requested by reviewer #2, a LUT map has also been added.