Authors:
We thank the ***Anonymous Referee #3*** for his comments and suggestions. We are grateful for interesting suggestions allowing for manuscript improvement.

Anonymous Referee #3
General comments:
This paper presents a modeling study on postfire erosion rates and mitigation strategies for the Rio Mannu river basin in Sardinia, Italy. The RUSLE model was used to model 6 scenarios including natural and post fire conditions as well as different erosion mitigation measures. This is an interesting study which is well placed in HESS. However it should be revised regarding the following general comments:
The abstract is very brief. It should at least be mentioned that the modeling results were validated using measured data on erosion rates from the literature. In addition the main simulation results should be summarized.
Authors:
The authors thank for the suggestions. In the following, the abstract where the validation data have been reported as well as the main results have been summarized

ABSTRACT
Severe wildfires are often followed by significant increase in runoff and erosion, due to vegetation damages and changes in physical and chemical soil properties. Peak flows and sediment yields can increase up to two orders of magnitude becoming dangerous for human lives and ecosystem, especially in the wildland-urban interface. Watershed post fire rehabilitation measures are usually used to mitigate the effects of fire on runoff and erosion, by protecting soil from splash and shear stress detachment and enhancing its infiltration capacity. Modeling post fire erosion and erosion mitigation strategies can be useful in selecting the effectiveness of a rehabilitation method. In this paper a distributed model based on Revised Universal Soil Loss Equation (RUSLE), properly parameterized for a Mediterranean basin located in Sardinia , is used to determine soil losses for six different scenarios describing both natural and post-fire basin condition, the last accounting also for the single and combined effect of different erosion mitigation measures. Fire effect on vegetation and soil properties have been mimed by changing soil drainage capacity and organic matter content, and RUSLE factors related to soil cover and protection measures.
Model results, validated using measured data on erosion rates from the literature and in situ field campaigns, show the effect of the analyzed rehabilitation treatments in reducing the amount of soil losses with the peculiar characteristics of the spatial distribution of such changes. In particular, the mulching treatment substantially decrease erosion both in its mean value (-75%) and in the spatially distribution of the erosion levels over the burned area. On the contrary, the breaking up of the hydrophobic layer decreases post fire mean soil losses of about the 14%, although it strongly influences the spatially distribution of the erosion levels.
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Anonymous Referee #3
The introduction is rather long. It should be shortened a bit and focused on the scope of the paper.
Authors:
The introduction has been shortened.

Anonymous Referee #3
Chapter 2 (study area) and 4 (study scenarios) should be sub-chapters of “Material and Methods”. Chapter 3 which is currently named “material and methods” should be a sub-chapter of a superordinate “material and methods”-chapter and the title should be adapted to the content of the sub-chapter dealing with the model description. In addition the approach to validate the modeling results should be explained in “material and methods”.
The discussion chapter 6 currently contains the validation of the modeling results. I suggest moving the paragraphs related to model validation to the results section and focus the discussion

on the evaluation of the results In addition, information on the uncertainty range of the modeling results would be very helpful.

Authors:
Following the suggestion of the reviewer3 the authors reorganized the chapters (2 and 3) and subchapters of the manuscript, as well as they moved the "validation procedure" in scenario 1 results ad they also discussed the choice of the values of the parameters, as reported below:

2. Materials and Methods

2.1 *Study area*

The study area is the Rio Mannu river basin, located in north Sardinia, Italy (Figure 1).
Basin area is about 650 km^2, mean elevation 252 m a.s.l. (minimum and maximum elevation respectively 0 m a.s.l. and 755 m a.s.l.), mean slope 8.5° (minimum and maximum slope respectively 0° and 63°). Rio Mannu is located in the so-called Fossa Sarda, an area repeatedly interested in the past by marine transgressions, regressions and volcanic activity, when the territory has been invaded by the sea and covered with thick sediment layers forming a big tableland. Geology consists of limestone, granites, volcanic substrates and carbonate deposits. Climate is typically Mediterranean, with hot and dry summers and mild and rainy winters. Precipitation occurs mostly in November and December. Sudden floods may happen in winter, while the summer is usually droughty.
Crops cover 60% of the basin area with main cultivation represented by olive groves and vineyards, which are 77% and 10% of total area, while 10% are cork tree plantations (Regione Autonoma della Sardegna, 2006). Shrub and herbaceous vegetation cover 28.4% of the basin, with 11% natural pasture, 10% typical Mediterranean sclerophyllous vegetation. Urban area is about 4.4%, with Sassari and Porto Torres representing the main urban sites.
Sardinia region is one of the most fire prone area in the Mediterranean basin experiencing on average 850 fires per year burning about 19000ha. During the year 2009, 684 fires occurred in the island burning 37104 ha, most of them (17000 ha) in the same province of the study area, the Rio Mannu basin itself was burned for about 4700 ha suffering both damages to vegetation (crops and forest) and considerable increase in soil loss (Regione Autunoma della Sardegna, 2006) (Figure 1).

2.2. Soil loss measurements in the study area

*Measured mean erosion in Mediterranean Europe amounts to 1.3 t/ha*year (Cerdan et al., 2010). In Italy forty reservoirs sediment deposition dataset, acquired by direct sonar sub-bottom profiler measurements or derived from estimates and measures carried by Italian Electricity Power Company during reservoirs dredging (Van Rompaey et al., 2005), reports mean erosion of about 2.3 t/ha*year. Concerning the Sardinian region, these measurements show mean erosion of about 4.0 t/ha*year. Measurements in Mulargia and Flumendosa basins, located south of island, show a mean erosion of 5.56 t/ha*year (respectively 10.3 t/ha*year and 0.9 t/ha*year) (Van Rompaey et al., 2003). Lower values are also recorded in Bonassai (SS), south-west of the studied area, where mean erosion rates lie around 0.025 t/ha*year (Acutis et al., 1996), and a field study carried out in Pattada (SS) reports a mean soil loss of 0.034 t/ha*year (0.049 t/ha*year on ploughed land, 0.048 t/ha*year on grassland, 0.033 t/ha*year on natural pasture, 0.014 t/ha*year on burned pasture, 0.025 t/ha*year on slashed bushland) (Rivoira et al., 1989); the authors themselves, though, note that these values have to be considered quite low for Sardinian conditions. Two field campaigns were carried out in Ottava (SS), a field site in the northern part of the Rio Mannu basin (Porqueddu and Roggero, 1994; Porqueddu et al., 2001). During first experiment, lasted from 1989 to 1991, soil loss on several soil uses (permanent pasture, annual forage crop, and continuously ploughed soil) were measured. The second experiment took place from 1994 to 1997, assessing soil loss data for four common crops of the Sardinian hi1ly areas which are natural pasture, improved pasture, annual forage crop and winter cereal. During the two experimental campaigns mean soil* *loss of respectively 2.55 and 0.86 t/ha*year were measured. Table 3 reports soil losses for each soil use and for each experiment.*

2.3. Soil loss modeling in the study area

Soil loss in the six different scenarios, that is natural, burned and after application of single and combined mitigation practices are analyzed, by using a spatially distributed model based on the Revised Universal Loss Equation (RUSLE) (Renard et al., 1997, McCool et al., 1995), parameterized for a Sardinian river basin. RUSLE is commonly adopted in erosion analysis for the simplicity of its structure and inputs and it is recognized to be appropriate for studies as the present one, where different erosion scenarios are analyzed and compared one with each other (e.g. Terranova et al., 2009; Ranzi et al, 2012), despite its application can produce an overprediction of low sediment fluxes, and underprediction of very high erosion rates (e.g. Terranova et al., 2009; Benavides-Solorio and Mac Donald, 2005; Larsen and Mac Donald, 2007).
The Digitial Elevation Model (DEM) of the basin, at 25m resolution, is accurately pre-processed since the RUSLE model is sensitive to the geomorphologic attributes. Pits and artificial flat areas are corrected applying the PEM4PIT method (Grimaldi et al. 2004; Grimaldi et al. 2007; Petroselli and Alvarez ,2012) that allows to enforce a slope on the erroneous flat cells using a simplified physically-based landscape evolution model. Soil loss is then evaluated for each cell through RUSLE equation.

*RUSLE quantifies soil losses (t/ha*year) as*

$$A = R * K * LS * C * P$$

Where:

R factor
*R is the rainfall-runoff erosivity factor (MJ*mm/ha*h*year), calculated on the basis of average monthly cumulated rainfall; the R factor has been determined using the Fournier index, from mean cumulated yearly precipitation P_{year} and monthly precipitations P_i.*
Given the Fournier index

$$F = \frac{\sum_{i=1}^{12} P_i^2}{P_{year}}$$

the R factor is calculated as

$$R = 4.17*F - 152$$

In the present study R is obtained for seven raingauge stations based on monthly rainfall dataset over a period of 15 years (1982-2007) (Regione Autonoma della Sardegna, 2009). Spatially distributed R factor has been obtained by applying Thiessen's polygon method.
*R factor ranges from 161 MJ*mm/ha *h*year in Porto Torres to 293 MJ*mm/ha*h*year in Thiesi (Figure 2a).*

K factor
*K is the soil erodibility factor (t*h/MJ*mm) (Figure 2e), determined after Renard et al. (1997), i.e. calculated as*

$$K = (k_0*k_t + k_s + k_d) / 759.4$$

where k_0, k_t, k_s and k_d are subfactors depending on different soil characteristics, such as texture, drainage capacity, structure (soil percentage of silt, sand and clay), and organic matter content (Figure 2b-d):

$k_0=12 - co * 1.7$		*(co = soil organic carbon class)*
$k_d=2.5 * (cd - 3)$		*(cd = soil drainage class)*
$k_s=(2 - cs) * 3.25$		*(cs = soil structure class)*
if $v_{fs} + \%_{silt} \leq 68$	$k_t=ct$	*(ct = soil texture class)*
if $v_{fs} + \%_{silt} > 68$	$k_t=ct - 0.67 * (ct - 2.1*(6800(1-\%_{clay})^{1.14}) / 10000)^{0.82}$	
$v_{fs} = 0.74 * \%_{sand} - 0.62 * \%_{sand}^2$		v_{fs} *= percentage of very fine sand*

The pedological map of Sardinia has been used for K factor determination. Table 1 reports RUSLE input value classification after the pedological map of Sardinia.

LS factor
LS is the unitless slope length and steepness factor (Figure 2g), which is mainly based on the cell's slope and contributing area; LS factor has been calculated using data from basin DEM. The calibration of model parameters has led to the use of the equation proposed by Moore and Burch (1986), where A_S is the area of plot cell per unit width (25m), m and n are calibration coefficients, and β is the cell slope, computed from the basin DEM:

$$LS = (m+1)\left[\frac{A_S}{22{,}13}\right]^m \left[\frac{\sin(\beta)}{\sin(5{,}143°)}\right]^n$$

C factor
C is the unitless cover and management factor. In this study C (Figure 2f) has been determined on the base of CORINE Land Cover 2006 (Table 2), as described by Cebecauer et al., 2004. C factor has been properly determined in each one scenario.

P factor
P is the support practice factor, accounting for the effect of rehabilitation treatments as well as for other features, like roads, streams or railways, or also changes in soil use hampering natural runoff and erosion path. The P factor is unitless and ranges from 0 to 1, depending on the type of erosion soil protection strategy. P factor has been properly determined in each one scenario.

2.4 Study scenarios

The influence of soil condition (natural and burned) and three rehabilitation practices and their combination on soil losses have been analyzed referring to six scenarios which are described in the following.

The first scenario assesses soil loss at basin scale in natural (unburned) conditions. In this scenario the conservation practices factor P was set equal to 1 all over the basin, except for paved roads, railways and bare surface where P factor is set to 0. Due to the lack of information on particular conservation practices for the study basin, the other RUSLE parameters have been evaluated as described in soil loss modeling section.

The second scenario analyzes fire effect on soil losses. During the summer 2009 a forest fire burned about 47 km^2 of the study area, as Figure 1 reports .

In burned area fire effects on soil characteristics have been mimed by changing the C factor, soil drainage capacity, and soil organic matter content. Fire, in fact, induces both a increase in soil aggregation leading to an increase in bulk density and soil compaction and a decrease of soil cohesiveness (Andreu et al., 2001). Moreover, the combustion of the organic matter can lead to the formation of a soil hydrophobic layer affecting soil hydrologic properties (De Bano, 2000).
Changing of conservation factor C in burned areas has been suggested by several authors. Terranova et al., (2009) assumed C equal to 0.2, 0.05, 0.01 corresponding to high, medium or low burn severity for burned area in Calabria region (Italy) having Mediterranean characteristics like the Rio Mannu basin. Another usually adopted hypothesis is to set C equal to 1 for areas with a percentage cover lower than 15%. In Slovakia, a study on soil erosion assessment set C factor ranging 0.35-0.55 to areas classified as "burnt areas" in Corine Land Cover map (Cebecauer et al., 2004). Larsen et al. (2007) assigned to C factor on burned areas having maximum of 0.33 and mean of 0.2.
By considering the ecosystem of the Rio Mannu basin and the fire severity, the C factor for the burned area was set equal to 0.2.
Post fire organic matter decrease has been simulated by considering burned areas having fertility class one level lower than in natural condition and soil water repellency layer formation has been accounted by reducing soil drainage capacity which was set to drainage class "very slow".

The third scenario analyses the effects of rehabilitation treatments like ploughing or tilling on crop burned areas. It mimics the breaking up of the hydrophobic layer by acting on the soil's drainage capacity. The partial restoration of soils drainage capacity due to ploughing or tilling has been reproduced by assigning to under treatment burned area a one level lower drainage class then natural condition drainage class.

The fourth scenario studies the mulching rehabilitation practice. Straw mulch is considered one of the more cost-effective stabilization treatments in reducing post-fire erosion. Besides, wood mulches provide greater resistance to wind erosion than straw mulch and also they are more decay resistant than hydromulch (Robichaud et al., 2010).
In this study, both straw and wood mulching on burned forested areas have been considered. In particular gentle slopes (slope < 30°) have been treated with straw mulching and steeper slopes (30 – 50%) with wood chip mulching. The treatment has been applied on about 45% of the burned slopes. Mulching effect on soil has been mimed by changing RUSLE parameters P and C. According to Fernàndez et al. (2010), P = 0.343 has been used for straw mulching on slopes < 30% and P = 0.943 for wood chip mulch on slopes up to 50% (Figure 3a) . In addition, the effect of seeding and regrowth of vegetation on soil erosion have been described through C factor. It was set equal to 0.13 corresponding to the mean value of C on the burned area prior the fire occurrence (Figure 3b).

The fifth scenario analyses the effectiveness in capturing soil losses by erosion barriers or trenches on arable land. Barriers at the distance of 50 meters along the contour lines were placed on crop land. This treatment is applied to a share of 35% of the burned area. Barriers application as rehabilitation treatments is usually modeled by modifying RUSLE P factor. Wischmeier and Smith (1978) and later Terranova et al., (2009) propose a P factor of 0.2 for reverse bench barriers. Myronidis et al., (2010) distinguished P factor for treatments and slope. They set P=0.85 for branch piles and woodboards on gentle slopes (< 30%), P= 0.75 for branch piles and woodboards or log barriers on steeper slopes (30% to 50%), and P=1 for slopes greater than 50%.

In this study, for taking in account the slope influence in the capturing effect of the erosion barriers, the P factor values introduced by Myronidis et al., (2010) were used (Figure 3c).

The sixth scenario considers the combination of all rehabilitation practices described in the previous scenarios 3, 4 and 5. In particular the effectiveness of the treatments combination is tested by assuming the following pattern: tilling all over the burned area, mulching on woodland and erosion barriers or trenches on arable land. The P factor has been set accordingly as showed in figure 3d, and the C factor is the same as in scenario 4 (Figure 2f).

3. Results and discussion

Table 3 shows the summary of results where simulated soil loss main statistics, corresponding to the six studied scenarios, are reported. In particular, the statistical analysis of erosion in natural condition (scenario 1) has been reported both for Rio Mannu basin and for the sub-area subjected to treatments (47 km^2). Soil losses corresponding to basin sub-area under treatments have been analyzed for scenarios 2-6.

Scenario1: pre-fire estimated erosion and model validation

*Mean soil loss calculated over the whole basin amounts to 1.9 t/ha*year (Table 5), that lies in the range of measured erosion data in Sardinia, South Italy and the Mediterranean Europe*

*Zonal statistic underlines significant differences in soil losses among areas having different soil condition. Mean soil loss ranges from 0.12 t/ha*year on land classified as pasture, to 4.5 ÷ 5.6 t/ha*year on areas cultivated with vines or olive trees, up to 20.5 t/ha*year in areas with little or no vegetation cover. The analysis shows values greater than 30 t/ha*year occurring in very few cells of the basin (0.24 %). In addition, the 99^{th} percentile of the whole area soil loss is 19.4 t/ha*year, and 90% is 5.05 t/ha*year (Figure 4).*

*In detail, peak simulated soil losses in Rio Mannu basin corresponds to areas with spare vegetation, olive groves or vineyards. For these land use classes, zonal statistics provide peak soil losses of 55.4 t/ha*year, 13.72 t/ha*year and 10.9 t/ha*year, respectively. Indeed, peak values of 55.4 t/ha*year occur in very few cells (0.2%) where the combination of steep slopes, high LS factor and C factor lead to such maxima. Cerdan et al., (2010), during their field experiments in Mediterranean environment, observed erosion on bare soil of 9.05 t/ha*year and on vineyards of 8.62 t/ha*year. Model performances in reproducing soil losses in selected soil uses as pasture, forage crops, cereals have been assessed by comparison with Ottava field campaigns measurements.*

Model results have been further compared with measurements of Ottava, the field site in the northern part of the Rio Mannu basin.

*Model simulations have been carried out both for a sub area located in the proximity of Ottava study site and for the whole Rio Mannu basin by using rainfall input being the measured rainfall in the same time period of when the experiment took place. Data coming from Sassari raingauge, the closest to Ottava, were used for sub area simulation, while for Rio Mannu 7 raingauges data properly spatialized formed the model input. Results, reported in detail in Table 6, show a good agreement with measurements especially among sub area simulations and second experiment results reporting mean erosion of 1.08 and 0.86 t/ha*year respectively. The model, despite its simplicity, adequately reproduces observed soil loss for the different land uses.*

Scenario 2: fire effect on erosion

*Soil losses in the burned areas are considerably higher than in not fire affected conditions, the mean soil loss being 7.18 t/ha*year, while maximum value is 45.1 t/ha*year. The 99^{th} percentile lies at 24.4 t/ha*year, and 90^{th} percentile at 16.4 t/ha*year. In the first scenario, soil loss within the same area reaches a mean rates of only 2.01 t/ha*year, and a maximum of 41.5 t/ha*year. These* *values show that fire affects erosion by increasing mean soil loss by more than 150% (Figure 5a). Again, only a very small percentage of cells (0.20 %) have extremely high erosion values, above 30 t/ha*year.*

Before commenting this increase, it should be kept in mind that the variability of measured data concerning post fire erosion is unavoidable, depending on several factors, such as, among others, site specific characteristics, fire severity, rainfall intensity and total.

*The few measured data on burned plots in Sardinia are those from Rio S.Lucia (Ollesch and Vacca , 2002), from Pattada (Rivoira et al., 1989) and from Ottava (Porqueddu and Roggero, 1994). Field experiments in S.Lucia basin report mean yearly soil loss on burned pasture lands of 0.06 t/ha, less than soil loss on slopes covered with shrub (0.11 t/ha) and with Eucalyptus (0.23 t/ha); in Pattada, the erosion on burned slope is 0.014 t/ha*year, less than on ploughed land (0.049 t/ha*year), grassland (0.048 t/ha*year), natural pasture (0.033 t/ha*year) and shrub (0.025 t/ha*year); in Ottava, soil losses of 0.23 t/ha*year have been observed on burned plot, as shown in Table 4. In all three cases, the erosion values on burned soil do not significantly differ from values on unburned slopes. The authors themselves underline that such low values are probably not representing of the not controlled wild fire impact on soil losses and they are probably due to the very low severity of fire.*

*Some more useful evidence of fire forcing on erosion can be inferred from other studies, most of them carried out in Mediterranean environment, pointing out how most of the fire effect on soil loss depends on fire severity. Soto and Diaz-Ferros (1998) measured, in the first year after fire in Monte Pedroso (Galicia, Spain), soil loss of 12.4 t/ha on high severity burned plot, and on average 4.9 t/ha on two low severity burned plots , whereas the control plot erosion in the same year was 1.96 t/ha. These values show an increase in erosion of 150% passing from unburned to low severity burned, and of 530% from unburned to high severity burned plots. Moreover, measurements after several wildfires in the Colorado Front Range showed soil losses of 0.05 t/ha*year, of 2 t/ha*year and of 2÷10 t/ha*year respectively in areas burnt by low, medium and high severity fire (Benavides-Solorio and Mac Donald, 2005), so representing an increase of more than two orders of magnitude from low severity to high severity fire. Further, mean post-fire erosion estimations in Greece report an increase of 570% (Vafeidis et al., 2007) in post fire erosion, and plot scale erosion rates after rainfall simulations in the Branega catchment in Liguria (Italy) show ratios of 143 to 162 between a recently burned plot and a long unburned one, depending on soil moisture conditions before rainfall (Rulli et al., 2006).*

According, simulation results in this study highlight the impact of fire in enhancing soil losses so showing the increase of maximum and mean erosion in the burned areas, as well as the increase of the percentage of basin area affected by large soil losses (high level of erosion) (Table3 and Table 7).

Scenario 3: soil loss after tilling / ploughing

Scenario 3 This treatment does not achieve significant reduction on soil erosion: mean soil loss on burned area is only 14% less than in the scenario with burned soils (Table 3).

*Amelioration of the burned soil drainage capacity by ploughing or tilling is modeled to achieve some mitigation of erosion. Nevertheless, after treatment on burned areas, maximum soil loss is around 47 t/ha*year, mean value decreases to 6.15 t/ha*year, while 99% of soil loss lies under 21.2 t/ha*year, and 90% under 14.1 t/ha*year (Figure 5b).*

Scenario 4: soil loss after mulching on woodland areas

*The mulching treatment reduces soil loss considerably more than the previous treatment: although maximum soil loss calculated is 60.1 t/ha*year, 99% of cells show soil loss less than 18.0 t/ha*year, and 90% less than 5.4 t/ha*year; mean value is 1.78 t/ha*year. (Figure 5c).*

In particular, mulching rehabilitation treatment on woodland shows a decreasing of 75% in mean soil loss calculated over the whole burned area. The decrease in erosion is such that estimated soil loss becomes slightly lower than in the first scenario (Table 3).
Robichaud (2006) measured effectiveness for mulching treatments ranging from 63% to 68% for wood and straw mulch, while for hydromulch it ranged from 19% to 27%. During the first year after a fire in Galicia Fernàndez et al. (2011) measured that straw mulch application with 80% soil cover produced a reduction of sediment production of 66% compared with the control plots, while chip mulch application with 45% soil cover produced almost no reduction of sediment yield (33 Mg/ha after treatment, 35 Mg/ha in the control plot). In our exercise rehabilitation treatment has been applied on about 45% of the burned slopes, so that our results agree with the literature measured data.

Scenario 5: soil loss with barriers on crops land
*Scenario 5, consisting on applying barriers on crop land, reduce soil loss less than mulching, but a little bit more than ploughing. In detail, this treatment leads to a decrease of only 6.5% in mean soil losses on the whole burned area, by applying the treatment to a share of 35%. Maximum soil loss on burned areas lies around 45.1 t/ha*year, and mean value is 6.71 t/ha*year, 99% lies under 24.1 t/ha*year, 90% under 15.9 t/ha*year. All these values are very close to those obtained in scenario 3 (Figure 5d).*
Robichaud (2006) found a reduction in soil losses due to the presence of barriers (contour felled logs) of about 20-50% for mid- to high-intensity rainfall events. Accordingly, Fernàndez et al. (2011) observed that the initial mean efficiency of cut-shrub barriers in retaining sediment (58%) decreased to 15% four months after treatment. Measurements in burned plots treated with different barrier types (Robichaud et al.,2007) showed better performance for contour-felled logs and straw wattle treatment while contour trench showed no significant erosion mitigation effect.

Scenario 6: soil loss with application of all rehabilitation treatments on burned areas
*Scenario 6, studying the effects of the combination of the three different rehabilitation treatments, shows mean soil loss lower than the post fire scenario (79%) and also the natural scenario (20%) (Table 3). Mean soil loss estimated over the Rio Mannu basin is 1.50 t/ha*year, maximum soil loss is 52.7 t/ha*year; 99% of cells have soil lesser than 15.1 t/ha*year, 90% lesser than 4.5 t/ha*year (Figure 5e).*

Analysis of the erosion levels distribution on the study area
*Besides mean and maximum estimated soil losses, an interesting feature to observe for the six scenarios is the erosion levels distribution on the study area. In the present study four erosion levels have been defined: low, medium, high, very high having respectively soil loss lesser than 0.5 t/ha*year; comprised between 0.5 and 2 t/ha*year; comprised between 2 and 8 t/ha*year; greater than 8 t/ha*year.*
In the first scenario, the area of the Rio Mannu basin classified at very high erosion level is 5% of total area, while 53% of the basin presents low erosion level. High and moderate erosion levels cover 20% and 22% of the area, respectively.
Regarding the sub-area, 63% shows low erosion level, 10.3% moderate, 16.6% high and 10.1% very high (Figure 6a).
In scenario 2, the area having very high level raises to 37%, while low erosion level decreases to 11% of the area. Also high level shows a considerable increase to 41 % of the total burned area, while moderate class remains around 12 % (Figure 6b).
In the third scenario, where no significant reduction in term of mean or maximum soil loss estimations have been observed compared with scenario 2, there is nevertheless a remarkable decrease in the percentage of area affected by very high soil loss, which is 30%, while high, moderate, and low are respectively the 41%, 12% and 11% (Figure 6c).

Scenario 4, already reporting a significant contribution for soil loss mitigation in term of mean or maximum soil loss at treated area scale, shows that the effect of treatment in reducing soil loss is made more evident by the distribution of erosion levels over the area: only 6% of the area presents very high erosion level, 15% high, 21% moderate and as much as 58% low (Figure 6d).
In the fifth scenario, very high erosion affects 39% of the area, and 16% of it is classified as low in erosion level. This means an increase in low erosion zones and a decrease in very high erosion zones, while high or moderate erosion affects the same percentage of area as in the second scenario. As noticed before, the erosion barriers performance would be more appreciable if studied with a model for sediment propagation (Figure 6e).
The last scenario shows that the area presenting low erosion is 62%, whereas very high erosion occurs on just 4% of it (Figure 6f).
A summary of the erosion levels corresponding to the analyzed treatments is reported in Table 7.

Anonymous Referee #3
The language of the paper reads well. However the present version contains many grammatical and typing errors. I thus recommend to let the paper proofread by a native speaker.

Specific comments:

- Page10878, line 17-19: Please add 1-2 sentences on the main results of the model study.
- Page 10882, line 22 and 26: In line 22 it is mentioned that the model developed by Rulli and Rosso was used for “disturbed conditions”. Please indicate if the model was used for postfire predictions and if it was already used in similar regions.
Is the model based on the RUSLE mentioned in line 26, which was used for this study, the same model mentioned in line 22? If yes please add the reference of Rulli and Rosso.
- Page 10883, chapter 2: should be moved to “material and methods”
- Page 10884, line 2: mention the soil loss measurements displayed in Figure 1
- Page 10884: the actual chapter 3 should be a sub-chapter of “material and methods” and should receive a new title related to the model, which is introduced in the chapter.
- Page 10884, line 4-5: I suggest moving the short description of the scenarios to the objectives on Page 10882, line 29. This information would be more useful in this earlier section.
- Page 10884, line 7: Please add a reference behind “Sardinian river basin”
- Page 10884, line 7-13: In my opinion the sentence on the applicability of the RUSLE for this study should be rather moved to the introduction or to the discussion section. It should not be part of “material and methods”.
- Page 10884, line 25: Please add a reference for the Fournier method.
- Page 10885, line 6-7: An hourly resolution of rainfall data seems very coarse to me, although I learned that it is the correct aggregation of precipitation data when the Fournier method is used. It would be interesting to discuss the influence of this method on the results in the discussion section.
- Page 10886, line 10-13: The mentioned parameters are meaningless since no equation is given.
- Page 10886, chapter 4: should be a sub-chapter of “material and methods”
- Page 10886, line 21: Is there a better term for “soil use”? It seems to be not an adequate

term to distinguish between “natural and burned”
→i.e. soil condition

- Page 10887, line 24: Please explain why this C factor was chosen. It is not clear from listing the highly variable literature values.
- Page 10888, line 11-13: Please explain why different mulching materials were assumed on gentle and steep slopes.
- Chapters 2-4 (material and methods): I miss a description of the validation approach in the “material and methods” chapter.
- Page 10889, line 19: Better term for “soil use”?
- Page 10891, chapter 6: The validation of the model results are presented in the discussion chapter. In my opinion the paragraphs of the discussion related to the validation of the model results should be moved to the results chapter. The discussion should only deal with the discussion of the results and the appropriateness of the model parameters. In addition it would be very interesting to discuss the uncertainty range of the modeling results.
- Page 10896, chapter 7: I suggest shortening and focusing the conclusions section.
- Page 10905, Table 2: The term “soil use” is unclear in the context of the table.

Technical corrections:

- Page 10878, line 9: add “a” before “rehabilitation method”
- Page 10879, line 1-4: check wording
- Page 10879, line 4: “results” →“result”
- Page 10879, line 13: “condition” →“conditions”
- Page 10880, line 28: add “as” before “one”
- Page 10881, line 25: add “the” before “road”
- Page 10882, line 22: “scales” →“scale”
- Page 10882, line 22: add “A” before “fully”
- Page 10882, line 23: “the both” →“both the”
- Page 10882, line 24: “dynamic” →“dynamics”
- Page 10882, line 24: “parameters” →“parameter”
- Page 10883, line 13: add “and” between “substrates” and “carbonate”
- Page 10883, line 13: add “the” before “year 2009”
- Page 10884, line 14: add “A” before “digital”
- Page 10884, line 12: add “rates” behind “erosion”

- Page 10884, line 17: add “the” before “RUSLE”
- Page 10885, line 17: add “such” before “as”
- Page 10886, line 2: add “the” before “pedological”
- Page 10886, line 19: “one scenario” →“of the scenarios”
- Page 10887, line 26: add “a” before “fertility class”
- Page 10888, line 27: “factor” → “factors”
- Page 10890, line 7: “reach” →“reaches”
- Page 10890, line 7: “values” →“rates”
- Page 10891, line 11: “tahn” →“than”
- Page 10894, line 16: “increasing” →“increase”
- Page 10895, line 28: “shows” →“show”
- Page 10896, line 12: add “the” before “area”
- Page 10897, line 8: “dynamic” →“dynamics”
- Page 10897, line 13: add “of” before “bare”
- Page 10911, Figure 1: Mention the soil loss measurements in the Figure caption. In addition please add a scale bar and a north point to the figure of the Rio Mannu watershed.
- Page 10912, Figure 2: Please provide a detailed figure caption. In particular, mention figures b to c, since these are no RUSLE factors.
- Page 10916, Figure 6: Please provide a more detailed figure caption.

Authors:
All the suggestions, comments and technical corrections have been acknowledged by the authors in the **Abstract,** in the **Materials and Methods** and in the **Results and Conclusions** previously reported in the reply to ***Anonymous Referee #3*** .

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