Dear reviewer 2,

thanks for the comments. These are very relevant and well prepared and most of them were considered in the reviewing process. We believe that your contribution helped to improve the manuscript.

This paper analyses landslide susceptibility for an area in Portugal using standard input data and also conventional bivariate statistical analysis. From a methodological point of view, the paper doesn't provide new approaches or insights. The aim was to see what would be the effect of different land use/land cover maps on the overall prediction of landslides. For that two land use maps were used with a different level of detail. Although the authors acknowledge the importance of land use/land cover changes for the occurrence of landslides, they do not make an attempt to use a map of land cover changes as input for their analysis. While this could have been done with the use of multi-temporal satellite images, and also correlate this with the changes in landslides that occurred after these changes.

Now the relationship between land use/land cover remains vague throughout the paper. It is also not clear when the two land cover maps were made and how these relate to the landslides mapped from images of 2005. Parts of this study area have been affected seriously by forest fires in the past years, and this must have also resulted in higher landslide activity. Nothing of that is mentioned in the paper, and a multi-temporal analysis is also lacking.

Authors: the relationship between land use/land cover (LUC) is referred in introduction, and this case study, is evaluated its importance in landslide susceptibility zonation (now table 4). The LUCC was not evaluated in the present research, because the main goal of this work is the comparison between the landslide susceptibility results obtained with different LUC datasets (same predisposing factor, but with different properties). The guidelines of drawing up LUC maps are presented in the text, but we consider important to resume the properties of this LUC geoinformation to the reader in a Table.

The wildfires were evaluated by us in other research's (e.g. see Meneses *et al*., 2018a), but the LUC maps (COS or CLC) do not represent the total burned areas, because if there is a potential to vegetation regeneration, the technical guidelines refer that the LUC type with this potential correspond to forest or scrubs, not the burned area observed in photointerpretation. By other side, this wildfires information does not interfere in the research goal, because burned areas were indirectly represented in the classes "Open spaces with little or no vegetation" and "Scrub and/or herbaceous vegetation associations". However, we also observed that burned areas do not match the principal location of the landslide inventory.

The landslide inventory was obtained by photointerpretation (orthophotos of the year 2005 and Google Earth images - 2004, 2005 and 2006), so these dates of information support the inventorying process selected according to LUC dates available (2006 and 2007). If these landslides were old slope movements, it would be more difficult to be identified through this information because of the regeneration of the vegetation.

The relation between the two land use maps should also be presented more in detail: how do the classes overlap? And are differences caused by errors or by temporal changes? Are landslide more frequent in zones where the classification do not match?

Authors: The relation between two land use maps was made and results are presented in Table 2. The main discrepancies were observed in forest areas and scrub and/or herbaceous vegetation associations, especially in central sector of watershed (surround of Cabril dam). By the landslides inventoried GIS analysis, we do not observed landslides in the areas with main discrepancies between COS and CLC (for the LUC types before mentioned). Some explanations will be made in the text.

Table 2. LUC data agreement (area ha) between CLC and COS classes.

Data	COS												
CLC	Urban fabric (UF)	Industrial, commercial and transport units (ICT)	Mine, dump and construction sites (MDC)	Artificial, non-agricultural vegetated areas (ANA)	Arable land (AL)	Permanent crops (PC)	Pastures (P)	Heterogeneous agricultural areas (HAA)	Forests (F)	Scrub and/or herbaceous vegetation associations (SHV)	Open spaces with little or no vegetation (OSV)	Inland waters (IW)	Total
UF	3160.2	439.8	77.3	100.8	207.7	502.0	15.7	929.2	337.7	251.5	0.1	18.7	6040.7
ICT	134.1	650.4	83.0	9.5	33.4	27.4	9.0	62.5	130.8	207.7	0.3	8.1	1356.1
MDC	6.1	58.3	283.0	0	3.6	3.6	6.8	6.5	48.2	53.5	0.2	5.4	475.0
ANA	29.3	2.9	0	22.5	0	0	0	0	1.7	9.1	0	0	65.6
AL	245.3	171.7	25.0	12.2	9166.1	1304.4	2225.0	1317.1	1133.2	1435.9	51.0	190.7	17277.5
PC	1271.4	93.3	37.3	21.2	1357.9	7948.5	315.4	2930.0	2004.5	2300.2	7.9	38.1	18325.7
P	4.4	2.4	0	0	61.3	0.9	36.1	58.4	41.2	188.6	0	0	393.2
HAA	7791.6	736.5	271.4	73.7	11773.1	15553.2	2341.0	23762.4	16514.4	12935.5	143.3	243.9	92140.0
F	745.3	392.9	173.1	29.3	741.9	1715.5	238.1	4058.7	100486.5	26805.7	42.0	735.8	136164.8
SHV	826.5	510.0	259.3	38.0	1353.1	2543.2	958.3	5832.8	50509.8	149644.0	4052.8	846.7	217374.5
OSV	29.4	13.8	5.3	1.4	18.3	10.3	10.7	140.4	860.0	6367.1	4206.6	30.3	11693.7
IW	5.6	12.0	0	0.2	1.3	7.5	0	15.2	278.5	180.7	2.4	4589.5	5093.0
Total	14249.1	3084.1	1214.7	308.8	24717.7	29616.3	6156.0	39113.2	172346.6	200379.5	8506.6	6707.1	506399.7

The relationship between the factor maps is considered as a bivariate relation only, whereas it is a multivariate problem. It matters to know what the slope steepness is in order to assess the importance of different land cover classes for landslide susceptibility.

Authors: The importance of each class of explanatory variables to landslides occurrence was evaluated by conditional probabilities that integrated the Eq. 1. We also present new information about the slopes and LUC relation (supplementary data - tables) and more information about this point was introduced in the text.

"In general terms, slope angle increasing promotes the landslide occurrence and is a very good proxy of the shear stress (Zêzere et al., 2017). Slope instability is more frequent in higher slope angles of the Estrela Mountain and throughout Zêzere valley. Also, in these areas, convex slope curvature is predominantly related with slope instability. The slope aspect is important in the spatial distribution of the different LUC types of the study area (Fig. 2) and on slope instability, especially in northwest-facing slopes (more exposed to the rain and with higher humidity levels)."

Extract of supplementary data - Conditional and priori probabilities (CP and PP, respectively) of landslides occurrence in Zêzere watershed.

PFM	Classe	Area watershed (%)	Landslides test area (%)	CP	PP	IV
Slope angle	0 - 5	28,17	1,69	0,000098	0,001652844	-2,824
	06-10	18,22	2,07	0,000206	0,001652844	-2,083
	11v-15	17,93	5,73	0,000617	0,001652844	-0,986
	16 - 20	15,30	12,97	0,001433	0,001652844	-0,143
	21 - 25	10,94	17,48	0,002798	0,001652844	0,526
	26 - 30	6,03	17,95	0,005499	0,001652844	1,202
	31 - 35	2,47	17,76	0,01118	0,001652844	1,912
	36- 40	0,73	10,71	0,020153	0,001652844	2,501
	41- 45	0,16	10,90	0,090941	0,001652844	4,008
	46 - 50	0,03	2,54	0,159236	0,001652844	4,568
	51 -55	0,01	0,19	0,042391	0,001652844	3,244
	> 55	0,01	0	0	0,001652844	-2,824

Landslide susceptibility maps are not validated using independent data sets that were not used for making the model. This is not how it should be done.

Authors: we acknowledge the reviewer comment. The research was reformulated, and independent dataset were used in order to perform an independent validation of the landslide susceptibility. The landslide inventory was randomly divided in two subsets (Fig. 1): the landslide training group and the landslide test group. The first group integrated the modelling an the second the validation process. More explanations about this procedure was introduced in the text.

"*The landslide inventory was obtained by photointerpretation (orthophotos of the year 2005 and Google Earth images), a process supported by ancillary topographic data and further field work validation only performed in the sample areas (Fig. 1) due to the extension of the study area. A total of 128 landslides (predominantly shallow translational slides), with a total area of 74042 m2, was validated during field work in sample areas (49.4% of the total inventoried landslide cases). Among the landslides initially inventoried by photointerpretation in sample areas more than 90% of cases were confirmed. In these sample areas roads disruptions were also validated.*

For complete Zêzere watershed 259 landslides have been identified, predominantly of shallow type. On the total, 32 landslides affected directly the road network (total or partial blockages by the material and 7 cases with partial loss of infrastructure). The landslide inventory was randomly divided in two subsets (Fig. 1) (Chung and Fabbri, 2003): the landslide training group and the landslide test group (81.5% and 18.5% of the total landslide affected area, respectively). The statistical description of each landslide group is presented in Table 3."

Table 3. *Statistics description of the training group and test group landslide inventories.*

	Training group		**Test group**		**Total inventory**
	Non affected roads	Affected roads	Non affected roads	Affected roads	
Total landslides	185	26	42	6	259
Total area (m^2)	44604	369404	10444	12089	104077
Minimum (m^2)	134	7	18	82	7
Maximum (m^2)	27364	12507	1911	5881	12507
Mean (m^2)	2414	1421	249	2015	402
Std. deviation (m^2)	3284	2647	304	2627	1069

The authors do not develop a specific method for landslide susceptibility along the road, but basically, overlay the susceptibility maps of the two landcover maps with the road network.

The assessment of landslide susceptibility along road requires a different approach where engineered slopes and natural slopes are evaluated separately, and where homogeneous road section is outlined with the upslope areas that could influence it. The method presented here is too simple for practical use along roads.

Authors: We don't simply overlay the susceptibility maps of the two landcover maps! The LUC maps integrated only the susceptibility modeling and the results was integrated in the road network (different datasets), allowing these results the representation of the landslide susceptibility obtained in context more widely, not point by point and assessed in isolation by each segment of roads.

The paper does not address the issue of landslide runout, which in the case of roads might be one of the most important hazards: debris (flows) or rock falls from the upslope areas are likely to affect the road. Only addressing land- slide initiation is not considered appropriate in such a case.

Authors: We present some examples of landslides validated in study area (Fig. 1). In the landslide susceptibility model only landslides were considered (predominantly shallow translational slides of small area and length).

The level of English is problematic, and the text needs to be thoroughly reviewed by an English editor.

Authors: The text will be reviewed by an English editor.

The paper also uses too many abbreviations which makes it very difficult to read. For ex- ample GI, MMU, LUC, COS, CLC, PFM, IV, Ai, Ri, LSM, LSRN. . .

Authors: Some abbreviations were decoded and eliminated (e.g. MMU, AUR, SRC, PFM). Other were defined in the text when used for the first time.

The paper refers to other publications of the authors which seem to have a substantial overlap with this manuscript.

Authors: The manuscript is an original research and the other publications do not focus on the same goals of this work. The study area is very important in Portugal, because have important supply water bodies and this fact justify the many publications of authors in this watershed, although not overlapping in the goals and results of the presented work. None of the published work addresses the issue of landslides or uses the presented methodology.

Some detailed comments:

- 1/23: locals should be locations Authors: OK
- 2/1: The landslides.. should be Landslides. The entire sentence should be rewritten Authors: OK
- 2/9: same Authors: ok
- 2/10: landslide occurrence Authors: OK
- 2/16-19: The entire sentence is not clear should be rewritten. I would not use the abbreviation GI throughout the paper. Just mention factor maps. Authors: OK
- 2/23: of landslides Authors: ok
- 2/23- : you indicate the importance of land use dynamics but do not analyse it yourselves in this paper. Authors: Yes, this is an introduction, and the main goal isn't the dynamics of LUC assessment.
- 3/8-9: avoid GI. Improve the sentence Authors: OK
- 3/10-13: is this not the same topic as this paper?
  Authors: The references present two different researches: 1 – LUCC in Portugal: multi-scale and multi-temporal differences obtained by LUC of different years; 2 – The paper assess the effects LUC geoinformation raster generalization in the analysis of LUCC in Portugal using different LUC datasets. None of the published work addresses the issue of landslides or uses the presented methodology.
- 3/16: improve description between brackets. Authors: OK
- 3/21-22: I don't think you achieved this goal
  Authors: This goal was achieved, because we present different results about the landslide susceptibility zonation of road network derived of integration LUC GI with different properties in the models, and we explain why in manuscript.
- 3/24: what does MMU mean? It is another abbreviation one has to remember.
  Authors: This abbreviation was decodified in the text.
- 4/6: high slope: steep slopes Authors: OK
- 4/10: rankers? Authors: OK
- 4/15: artificial land? Authors: OK
- 4/17-18: Improve the sentence Authors: OK

- 5/15- : there is no need to explain why you use slope steepness as a factor in landslide susceptibility assessment
  Authors: this is a complementary information for the readers and explain part of landslides, for example in Estrela mountain.
- Table 1: include the date of production. Authors: OK
- 7/8: why such a coarse scale? 1:500000 for roads is too general.
  Authors: This is the data validated available to research (free data). Other information is available, but with considerable costs. However, at the scale of research, the GI used represent the main road network and serve the purposes of this research.
- Figure 2: Are all these maps needed? Where is the landslide inventory map?
  this is the predisposing factor maps used in many researches of landslide susceptibility in Portugal and we explain why in the introduction and, also, in characterization of study area. The landslide inventory is represented in Figure 1 and the characteristics in Table 3.
- 9/9 and table 2: round off values. Authors: OK
- What is the size frequency distribution?
  Authors: the frequency is represented in fig 3.
- 10: is it needed to describe this method again? Authors: recast text.
- 12/11-12: explain why this is done? Shouldn't this be based on the final score? Why 10 classes? What is the use of this for the end user of the susceptibility map?
  Authors: Landslide susceptibility maps were built and classified in 10 classes (deciles) because allow the visual comparison between results of different models. We performed some tests to represent IV by classes and the deciles method present good results allowing the comparison above mentioned.
- 13/15-16: if these are landslide scars then the landslides are not caused by it, but they result in bare areas.
  Authors: this is an assumption generalized, but the forest also includes landslides. Please, see the extract table with the landslide area by LUC type in supplementary data.

Extract of supplementary data.

PFM	Classe	Area watershed (%)	Landslides test area (%)
COS	Urban fabric	2,81	0,72
	Industrial, commercial and transport units	0,61	0
	Mine, dump and construction sites	0,24	0
	Artificial, non-agricultural vegetated areas	0,06	0
	Arable land	4,88	0
	Permanent crops	5,85	0,84
	Pastures	1,22	0
	Heterogeneous agricultural areas	7,72	0,96
	Forests	34,03	14,34
	Scrub and/or herbaceous vegetation associations	39,57	81,96
	Open spaces with little or no vegetation	1,68	1,19
	Inland waters	1,32	0
CLC	Urban fabric	1,19	0
	Industrial, commercial and transport units	0,27	0
	Mine, dump and construction sites	0,09	0
	Artificial, non-agricultural vegetated areas	0,01	0
	Arable land	3,41	0
	Permanent crops	3,62	0
	Pastures	0,08	0
	Heterogeneous agricultural areas	18,20	1,91
	Forests	26,89	22,10
	Scrub and/or herbaceous vegetation associations	42,93	71,57
	Open spaces with little or no vegetation	2,31	4,42
	Inland waters	1,01	0

- 14/15: success rate curves: validation should be done with independent data. What would be the result if you don't use any land-use map?
  Authors: the landslide susceptibility validation was made with landslide test group (1), and we also assessed the performance of models with a part of the landslide inventory (training group), and now

prediction and success rate curves will be presented. The partition inventory increases the performance of models (see AUC), comparatively to the results presented in first version.
By other side, the importance of each variable in model's is presented in table 4 and LUC is important in the analysis, i.e., the determined classes of this predisposition factor are relevant because they contain landslide area.

- 15/6-9: I don't understand what you are saying here. Explain it better. We will make an effort to clarify this idea in the text.
- 15/11-14: not clear. Authors: ok
- Figure 6: the land use classes should be combined with slope. It is difficult to find out what the codes mean. There is not much description of it in the text.
  Authors: we introduce the decoding after figure. 16-17: I got lost in reading these pages with so many abbreviations and English language issues.
  Authors: the abbreviations were reduced.
- Table 4: Not clear what the values indicate? Percentage of the area? Then the combinations are very strange: 86% in very high, and only 0.23 in very low?
  Authors: table 4 (now table 5) represent the area (%) of watershed area by each susceptibility class, and when tabulation is performed between LSRN1 and LSRN2 the coincident area between the same classes and the area distributed by other classes is obtained. In final, it is possible to represent the agreement value between two maps.
- Figure 10 could be skipped. Authors: Ok