-Rev1: b) Regarding the landslide inventory and the training and validation groups. How were selected the two groups? Randomly? Selected according to any specific criteria? Please state in the methods.

- Authors Reply: -The landslide inventory partition in training and validation groups were selected randomly. This partition criteria will be properly described in the methods section.

c) -Rev1: Why did you use 70% of the inventory and 30% for the validation? Why not 50% for each? You should state in the methods section why did you use these percentages?

- Authors Reply: -We acknowledge the reviewer doubt. The 70/30 partition was chosen because is in agreement with the commonly used partitions used for landslide susceptibility models training and validation (as an example please see: https://www.mdpi.com/2220-9964/9/12/696). Time dependent validation was not possible with the available dataset.

-Rev1: Minor comment: in line 43 you refer to "pressure". What kind of pressure? Urban pressure?

- Authors Reply: with "pressure", we intend to refer to the pressure applied by human activities on coastal systems. In the revised version of the manuscript "pressure" will be replaced for "to Anthropic activities pressure"

-Rev1: L. 125-129: Big paragraph, with several sentences separated by semi-colon. Consider rephrasing in shorter and clear sentences.

- Authors Reply: Done. The paragraph was rephrased as: "The landscape is however varied, crossed by cuestas and vigorous crests, turned towards the SE, and ~related with the frequent alternations of sandstone, dolomitic, limestone, or marl, clay and gypsum layers. The landscape is interrupted by sudden isolated anticlinal folds, as the Jbel Hadid (725 m), quite to the N, or the Jbel Ouamsitten (900 m) to the S. Towards to west, gain relevance the abundance of consolidated dunes and sandstones with oblique stratification and conglomeratic levels (Weisrock 1980)."

-Rev1: L. 130-135: you have two sentences starting after a comma, instead a full stop:

- Authors Reply: Done. The text was rephrased as "To the south, a coastal basin with original sedimentary material known as "Haha Basin" (Dufaud et al. 1966), is related to the opening of the North Atlantic, which is generally consistent with the end of the Triassic (Choubert et al, 1971; Hallam, 1971; Le Pichón, 1971, Weisrock 1980). It consists mainly by sandstones, pelites, conglomerates, and red salt clays, with essentially continental facies.From the Lower Liassic to Upper Cretaceous succeed more or less deep marine sedimentations."

-Rev1: - L. 131: " (…) Dufaud et al. 1966, Its existence…"

- Authors Reply: We thank the reviewer observation. We change it to “Dufaud et al. (1966), is related…”

-Rev1: - L. 132: “(…) Weisrock 1980), It consists (...)” - substitute "," by "."

- Authors Reply: - Done

-Rev1: L. 148: you could delete "of the replay"

- Authors Reply: Done. We change the phrase to “a W-E direction appears as a result of the ancient Hercynian direction (Saadi, 1972).”

-Rev1: L. 195-199: “According to the rainfall data, which were made available…”. You stopped this sentence without finishing your idea. Then in L. 196 you end a sentence with a comma and then start a new sentence. Be very careful with this. You have many examples like this. This becomes confusing.

- Authors Reply: Thanks for the observation. We rewrite the text as “Using the rainfall data from stations of Adamna, Chichaoua, Talmest, Abadla and Igrounzar, which were provided to us by the Tensift Water Basin Agency, we analyzed the average monthly variability of rainfall for the period 1965-2015, and main results shows the existence of a rainy season between October and April with a maximum in March for the two stations Abadla and Chichaoua and a maximum in December and November for the stations Talmest, Igrounzar and Adamna.”

-Rev1: L. 202-203: Please, show the maximum and minimum values (mm) of precipitation

- Authors Reply: - Done. The description in the revised version of the manuscript will be “The values observed in the months of October to April exceed the average rainfall for each of these two stations with a maximum in March (27 mm) and a minimum in July (0.5 mm) and August (1 mm). Thus, the evolution of monthly precipitation is the same for these two stations.”

-Rev1: L. 223: In the end of the line “… (Mennani, 2001), It…” – again you end a sentence with a comma.

- Authors Reply: Thanks for the observation. We change it to “conditioned by the straightening of its bedrock to the east following the uplift of the Tidzi diapir (Mennani, 2001).”

-Rev1: L. 225-231: A big sentence that could be divided in two, starting in line 228 “For this reason…”.

- Authors Reply: - Done. The text in the revised version of the manuscript will be “These are related to precipitation which thus controls the regime of the phreatic aquifer. Several problems related to water scarcity and long recurrent periods of drought, have been noticed in the Essaouira region during the last decades (Bahir et al., 2002; Chkir et al., 2008; Chamchati and Bahir, 2013; Bahir et al, 2017). For this reason, the piezometric level in the study area tends to a generalized decline and even the inability of some other wells to recover their initial water level, under the combined effect of the year 1995, the driest year that Morocco has experienced during the 20th century (Bahir et al., 2002), and overexploitation (Chkir et al., 2008, Bahir et al., 2017).”

-Rev1: L. 284: You start again a sentence after a comma. “… (Epifânio, et al. 2013), Slope angle…”.

- Authors Reply: Thank you for the observation. We change the text in the revised version of the manuscript to “because it enables the quantification of the weight of trivial qualitative quadrant (Epifânio, et al. 2013). Slope angle…”

-Rev1: e) L. 284-286: You state that slope angle does not have the same importance for all types of landslides in your study area. (This would be better stated and discussed in results and discussion section).

- Can you state why? Is it only because different types of landslides require different factors and different weight of each factor? Or is it because in your study area, are there other important factors also contributing for slope instability?

- Authors Reply: Thanks for the comment. In fact, slope is an important predisposing factor for landslide occurrence, and different landslide types, as described in literature, could be conditioned by different slope angle classes. Even so, lithology, structure and deposits also play an important role for the occurrence of the different types of landslides. These aspects will better be addressed and discussed in the results and discussion sections as suggested.

-Rev1: L. 292: “… nouthern part…”. Do you mean “northern section”, “northern area”?

You often use in the text the terms northern and southern part. Consider using “section” or “area”…instead of “part”. It is more correct from a geographical point of view.

- Authors Reply: We check the manuscript and we substituted part by section as suggested. In this context we change it to “southern section, and Marrakech 1/500000-scale for the northern section, completed with the field survey.”

-Rev1:L. 342: Consider substituting "than" by "then".

- Authors Reply: - Done. The phrase will be “Each landslide type inventory dataset was then sub-divided into a training and a validation group (Remondo et al. 2003).”

-Rev1: Figure 3: You jumped from C to E and forgot D.

- Authors Reply: We corrected the figures letters. The new version of figure is placed bellow.

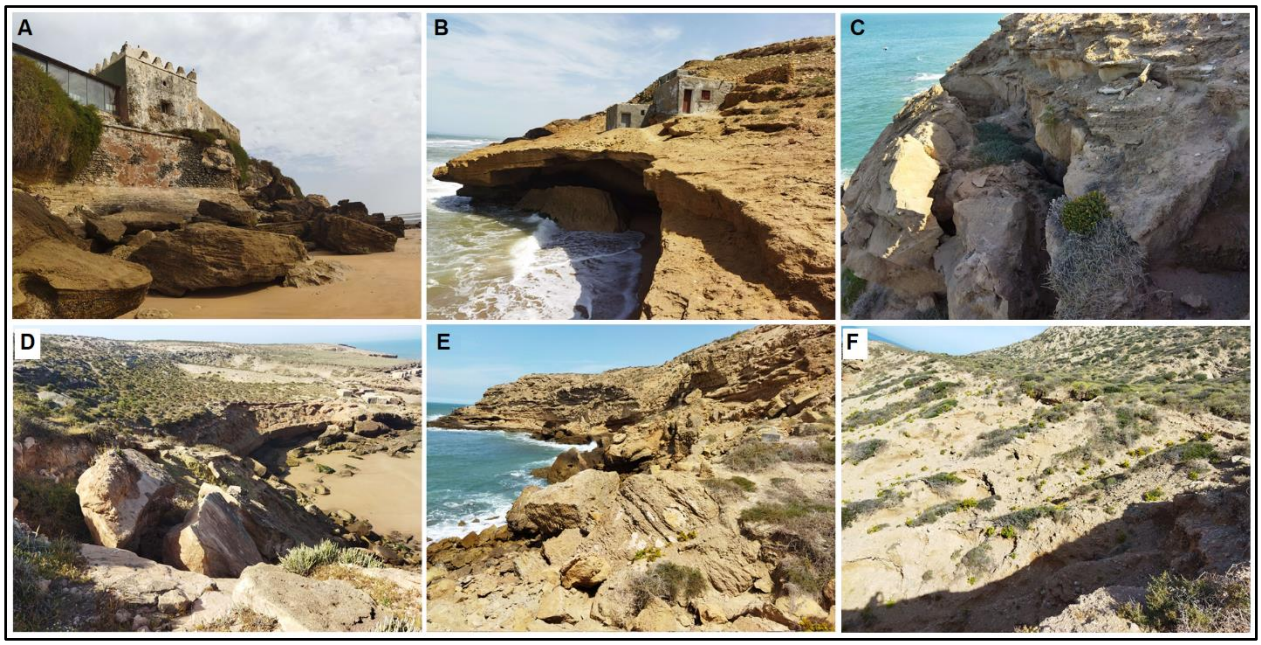


Figure 3: Some landslide types examples from study area; A, B Rock falls, C Rock topple, D Translational slide, E Rotational slide with back tilting, F Debris flow.

-Rev1: L. 412-413: Like it is written, it does not make much sense. Do you mean "... Calcareous crusting and Essaouira sandstone-calcarenite are the two lithological formations most found in the majority of ETU...”?

- Authors Reply: Yes. In the study area, we have 1534 ETU and in each ETU it could be found more than one lithology type. We rewrite the phrase to turn clear: “Regarding the number of ETU per lithology type, Calcareous crusting and Essaouira Sandstone-calcarenite are the two lithological formations most founded in the majority of ETU (total ETU = 1534), these lithologies are present in 1216 and 1270 ETU, respectively.”

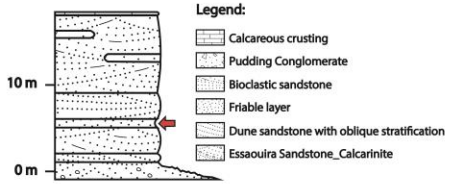
-Rev1: L. 435: That is – please, avoid word contractions.

- Authors Reply: - Done. The new phrase will be “that is why we consider them important, especially because some of them are in contact with springs,”

-Rev1: Figure 6: This figure is very low. Please make the fond size readable. The legend and the vertical scale are not readable.

- Authors Reply: We acknowledge your comment, the figure's resolution is good, it is because of the logs number that we couldn't rise the size, but we suggest splitting it in two pages or figuring it in one page landscape format, as illustrated bellow.

Log 1



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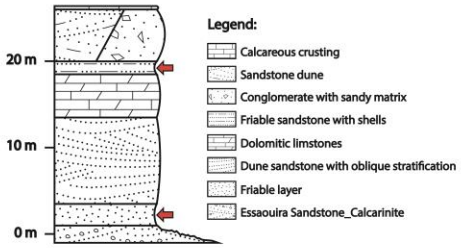

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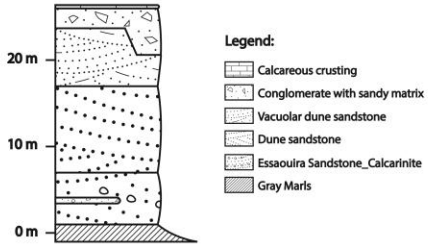

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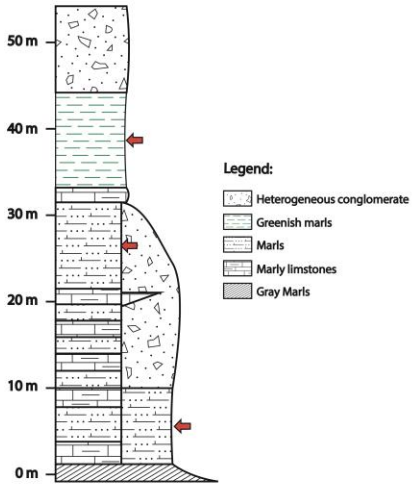

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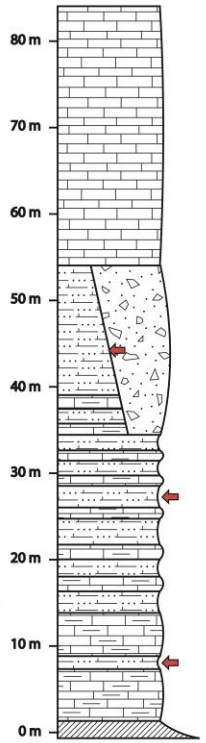
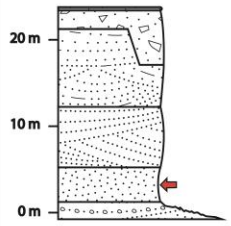


Log 6



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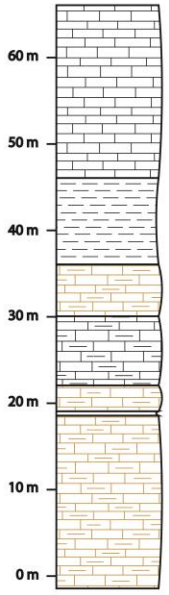

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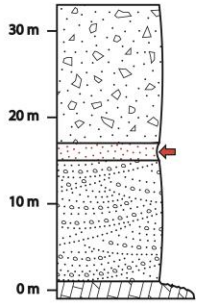

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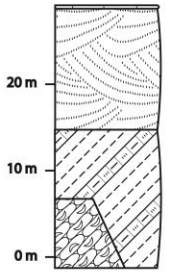

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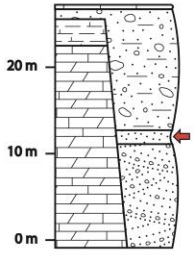

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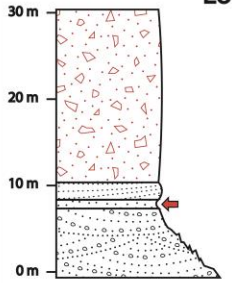

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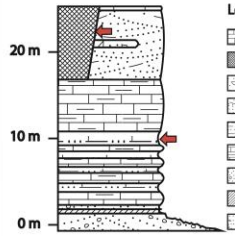
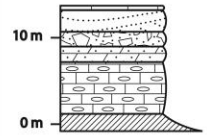


Log 13



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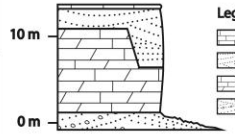

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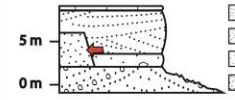

Log 16

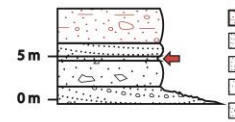

Figure 6: Stratigraphic columns for Essaouira coastal area

-Rev1: L. 452-453: Please revise the sentence. As it is does not make much sense.

Do you mean this? - "These considerably affect the mechanical processes that lead to slope failure and to the subsequent post-failure movements, especially where there are marls or clays."

- Authors Reply: Yes, thank you for the suggestion. We change it to "These considerably affects the mechanical processes that lead to slope failure and to the subsequent post-failure movements, especially where there are marls or clays."

-Rev1: f) You also mention that slope angle is one of the most influent factors (lines 481-482). However, table S1 shows that some types of landslides do not fit in this assumption.

What does contribute for the low IV score for the highest slope classes (> 35º) for models 10-13, and 15? In the case of rock topple, slopes >15º have negative scores. This should be discussed.

- Authors Reply: We understand the reviewer doubt, and it could be possible to rank susceptibility that way from lower to higher scores of IV using breaks in the ROC curves. Nevertheless, we adopt this criterion sustained on the IV values due to their simple meaning. According to Zêzere et al (2017), for example, the relevance of any independent variable to discriminate stable and unstable areas is as greater as its distance from the 0 value of IV. When the score is negative it means that the presence of the variable Xi is favorable to slope stability. Positive scores mean a positive relationship between the presence of the variable and the landslide occurrence, as high as the higher the score. Information values equal to zero means no clear relationship between the variable and the landslide occurrence. We will improve this aspect, according this description in the new version of the manuscript.

-Rev1: g) In table 5 you have the same percentage of landslide susceptibility for translational and shallow translational landslides. What is the explanation? Is it an error or are you assuming all translational landslides as shallow translational?

- Authors Reply: Thank you for the comment. No, it was just an error. We correct Table 5 as illustrated bellow.

Table 5: Percentage of landslides susceptibility classes

		Very low susceptibility	**Low susceptibility**	**Moderate susceptibility**	**High susceptibility**
Model 1	All landslides	55.45	2.55	2.66	39.35
Model 2	Deep-seated landslides	60.22	2.32	2.22	35.25
Model 3	Shallow landslides	72.58	4.10	3.80	19.52
Model 4	Rotational slides	52.71	7.02	6.55	33.72

Model 5	Deep rotational slides	55.03	5.84	5.95	33.18
Model 6	Shallow rotational slides	71.29	3.75	4.55	20.40
Model 7	Translational slides	61.08	2.42	2.07	34.43
Model 8	Deep translational slides	63.99	1.42	1.44	33.15
Model 9	Shallow translational slides	74.35	3.41	3.02	19.21
Model 10	Rock topple	67.41	5.52	5.95	21.12
Model 11	Rock fall	71.39	3.21	3.65	21.75
Model 12	Rock slides	80.02	2.72	2.56	14.70
Model 13	Debris fall	59.75	5.82	5.32	29.10
Model 14	Debris flow	39.15	3.04	3.96	53.85
Model 15	Debris slide	89.76	1.67	1.50	7.07

-Rev1: i) In L. 549-550, you found that eliminating precipitation and TWI of your analysis you get better results (Fig. 11). This is statistically valid. However, considering that this is a dry climate, the effect of humidity and precipitation, when they occur, may be very important for slope instability, but your analysis cannot identify it. It would be important to discuss the limitations of this statistical analysis.

- Authors Reply: According to the spatial distribution of rainfall in this study area, the most rainy zone is the middle part near Essaouira city and around it (Sandy coast), and rainfall values decrease towards the two study area extremities, which is totally against the spatial distribution of the landslide inventory. With the statistical constrains that could overcome using a statistical method sustained on landslide density in each class of a predisposing factor, this particular factor will not be relevant even if we are in a dry area.

-Rev1: d) The most frequent phenomena are Rock fall (149 events). However, translational and rotational slides occupy 85% of the unstable area, mainly occurring in the southern section, where they have higher weight on landslide susceptibility. Is there a higher landslide susceptibility in the southern section because of a higher number of these landslide events or is it because of the area of each landslide, thus performing higher susceptibility?

- Authors Reply: It is uncertainty related with the age of these landslides and with the uncertainty related with the triggering factor (rainfall, earthquake). This is a purely space dependent modeling and we are not considering the time scale of the events.

-Rev1: j) Given your results and considering the two approaches (Pixel-based and ETU) used in this work, which is the most suitable one for representing the landslide susceptibility in the area?

Since ETU are defined based on the morphometry of the area, there is a more “guided” analysis in

this approach, comparing with pixel-based that is more “random”, some differences between both modelling should be expected.

- Authors Reply: -We acknowledge the reviewer comment. Since ETU are more close to the morphometry of the area, there is a more “guided” analysis in this approach, comparing with pixel-based that is no related with a particular morphology on the cliff area. Both approaches have advantages and inconvenients. It is true that ETU takes more into account the cliff morphometry and it’s more useful for territorial management interventions, but also leads to loss of susceptibility classification detail comparing with pixel approach, which is more relevant in term of resolution.

-Rev1: h) You state that the precipitation is not a “decisive conditioning factor” (L. 588). From a pure statistical point of view, it is true. The reason why you don’t see great differences may be because you are using annual average values of precipitation. However, in drier areas, rainfall intensity may be more important than the annual average amount. Since precipitation is an important triggering factor, it would be expected an increase of landslide events during the rainy season. Didn’t you find any variation? Considering precipitation is not a permanent factor as the others, is it proper to treat it as a conditioning factor based on its (low) annual average?

- Authors Reply: We agree with you, but I didn’t use the annual average, I used the monthly cumulative values, even though, to use the intensity it’s to have close stations to the cliffs, which is not the case for the study area, the stations are a little far from the cliff, we just opted the interpolation method to estimate it in the cliffs. We could also describe something about the relationship between the landslide dates and the critical rainfall thresholds that trigger them, which are unfortunately not known.

-Rev1: k) One limitation of this bivariate statistical method is that it does not consider possible correlations between variables. This limitation and its impact on possible high scores should be discussed.

l) Another, and very important, drawback of this method is that it uses a part of the landslide inventory to model the susceptibility. Considering this, the validation is not done with the whole inventory, and the landslide dimensions may bias the IV scores. It would be important to discuss this in the text. How do these drawbacks may influence the final results?

- Authors Reply: We thank the reviewer observation, Part of this topic were already discussed on the paper of Zêzere et al 2017 (http://dx.doi.org/10.1016/j.scitotenv.2017.02.188), In the new version of the manuscript we will include a discussion section to properly discuss this comment.