1- 1st Reviewer comments:

-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.

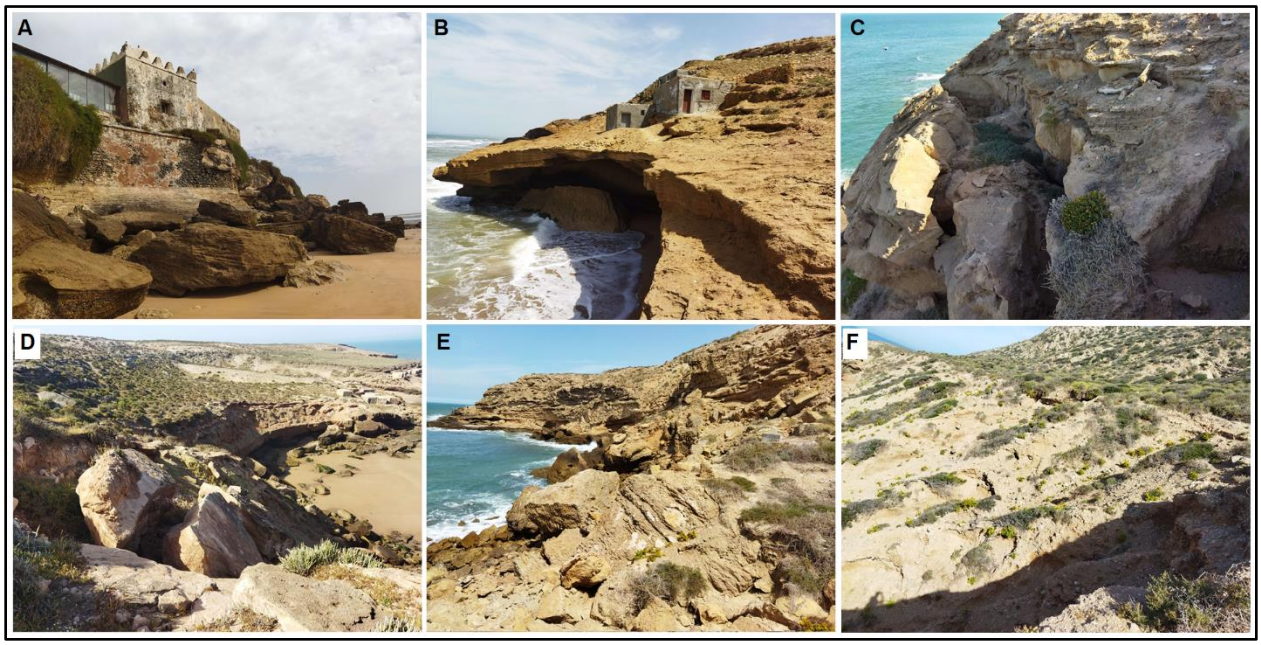


Figure 3: Some landslide types examples from study area; A, B Rock falls, C Rock topple, D Translational slide, E Rotational slide with back tilting, F Debris flow.

-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.”

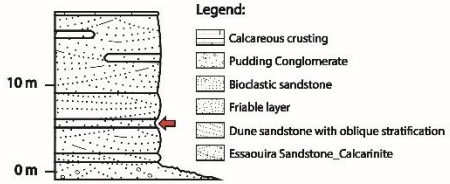
-Rev1: L. 435: That is – please, avoid word contractions.

- 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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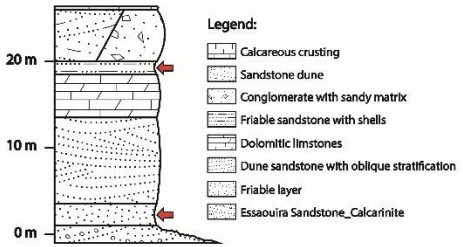

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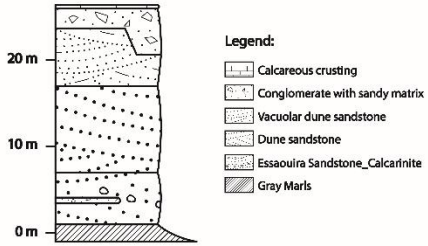

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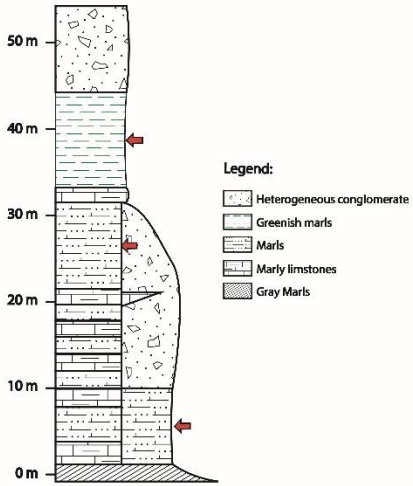
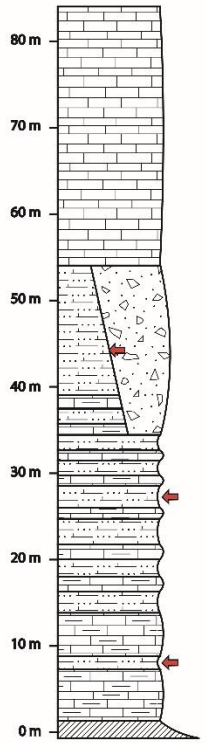


Log 5



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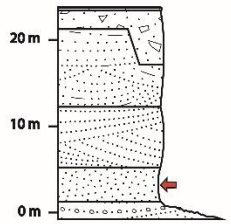

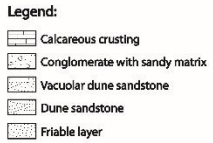

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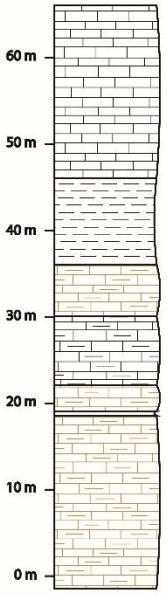

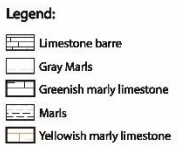

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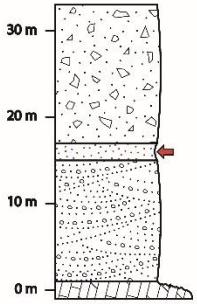

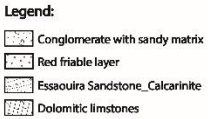

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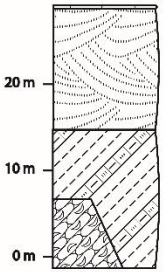

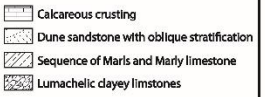

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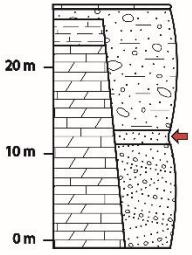

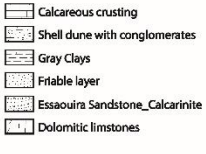

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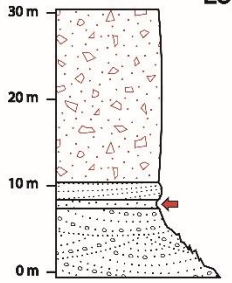
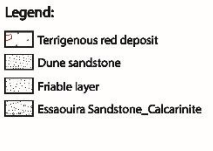
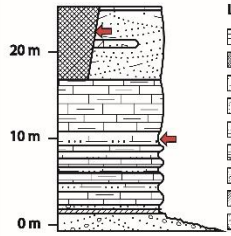




Log 12



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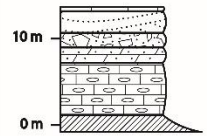
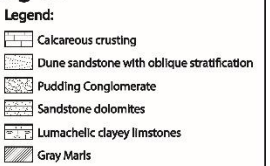
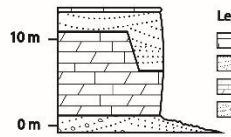
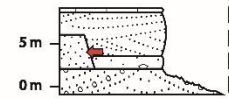


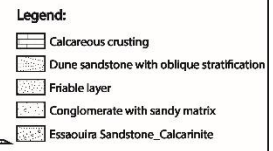


Log 14

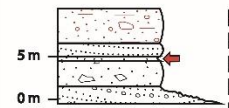


Log 15





Log 16



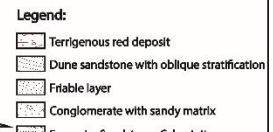


Figure 6: Stratigraphic columns for Essaouira coastal area

-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 we 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.

2- 2nd Reviewer comments:

-Rev2: In the modeling, 70% of the inventory were used as training set and the other 30% as validation set – explain why those values were used.

- 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)

-Rev2: L 42 – Classical references as Sunamura (1992) and Trenhaile (1987) are much more meaningful in this context. Other suggestion: Hampton & Griggs (2004).

- Authors Reply: - Done. In the revised version of the manuscript this text section will be rewritten as "These processes result essentially from the interaction of sub-aerial, marine and anthropogenic processes (Trenhaile 1987, Sunamura 1992, Hampton & Griggs 2004, Greenwood & Orford, 2007),"

-Rev2: L 44 – In the reference it is suggested to ad "e.g. Marques, 2009" but also other relevant references as Teixeira (2006, 2014), Moore and Davis (2015), Gilham et al., (2018) among others.

- Authors Reply: - We agree and thank the reviewer suggestion. In the revised version of the manuscript this text section will be rewritten as "the fast dynamic evolution imposes restrictions on the way the human occupy coastal areas (Teixeira 2006; Marques 2009; Teixeira 2014; Moore and Davis 2015; Gilham et al. 2018)"

-Rev2: L 60-62 – The landslide predisposing factors which have been used in published studies are listed along specific cliff factors as the cliff toe protections. This requires some separation, due to the specific context of sea cliffs and also because it was found that the factor is relevant in these studies (Marques et al,. 2011, 2013; Marques, 2018, Guilham et al., 2018, Letortu et al., 2019, Queiroz and Marques, 2019).

- Authors Reply: - We agree and thank the reviewer suggestion. In the revised version of the manuscript this text section will be rewritten as "These factors, although they depend on the scale of analysis and type of landslides, include generally: elevation, slope angle, slope aspect, slope perpendicular and profile curvature, topographic wetness factor index (TWI), topographic position factor index (TPI), slope over area ratio (SOAR), solar radiation, faulting, lithology, lithological layers tilt, precipitation, streams, land-use patterns, NDVI or vegetation density factor, grain size, and spring presence. (e.g. Van Westen et al. 2008,

Reichenbach et al. 2018, Pereira et al. 2020) and when specifically related with sea cliffs susceptibility assessment include also the cliff edge height, coastal slope toe protection (e.g. Marques et al,. 2011, 2013; Marques 2018; Guilham et al. 2018; ; Letortu et al. 2019; Queiroz and Marques 2019)."

-Rev2: L 71 – For sea cliff susceptibility, the terrain unit discussion and one solution were presented in Marques et al. (2011, 2013), which were published before Epifâneo et al. (2014).

- Authors Reply: - Done. In the revised version of the manuscript the references will be listed as "(Van Den Eeckhaut *et al.* 2009, Marques *et al*,. 2011, 2013, Epifânio 2014, Corominas *et al.* 2014, Zêzere *et al.* 2017)."

-Rev2: L 95 – The phrase seems out of context.

- Authors Reply: Done. The phrase "The field observations are useful for every type of landslide studies except for small area or single landslide studies (Shano et al 2020)." was removed from the revised version of the manuscript.

-Rev2: There is a lack of clarity on the study area: it is referred in several parts of the paper that study focus on the coastal area, but in Line 107 is stated that the focus is on landslides at the sea cliffs. Later, in lines 113 and 114 and Fig. 1, the coastal subsystems include sandy coast, rocky coast, and anthropic coast. The rocky coast corresponds to sea cliffs or includes sections of low height rocky coast, with no well-defined cliff. It is important to clarify and to use uniform designations along the paper.

- Authors Reply: We acknowledge the reviewer comment. The study area is defined by the sea cliff sectors located along the rocky coast subsystems of the Essaouira coastal area. As recommended, we will clarify and use uniform designations along the revised version of the manuscript.

-Rev2: L 121-129 – Rewrite and clarify the setting of the study area and be more specific on the geological structure et relations with geomorphology.

- Authors Reply: In the revised version of the manuscript this text section will be rewritten as "Geologically, the study area is located in the Atlantic Atlas which is considered the westernmost part of the High Atlas mountains (Weisrock 1980), whose northern part, the largest (Haha and Chiadma) plateau, drop gently from SE to NW, in accordance with the overall structural framework…"

-Rev2: L 130- 166 – The text chaotic and requires clarification, a deep reformulation, and the use of shorter periods.

- Authors Reply: In the revised version of the manuscript this text section will be rewritten 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.”

-Rev2: L 143 – extensional instead of distensional; NNE-SW ??? correct.

- Authors Reply: - We thank the reviewer observation. We change it to “, includes the extensional faults fundamentally oriented NNE-SSW”

-Rev2: L 144 – What is the second direction – only one was indicated above.

- Authors Reply: The other one is linked to the opening of Atlantic. The text was modified to turn clear this question. We change it to “the second direction, WNW-ESE, related to the opening of the Atlantic, is more and more evident…”

-Rev2: The rainfall data would be better expressed with the inclusion of graphs instead of descriptive and incomplete data.

- Authors Reply: We think there is no need to add graphs. We tried to improve the description and we consider that in this revised version is clear enough taking into consideration the contribution of this factor in this study.

-Rev2: L 216 – 231 – The hydrogeological information is relevant for the sea cliffs evolution?

- Authors Reply: We think it is relevant especially in the southern part, we explained some links between hydrogeological description and the lithological information collected on springs as a possible driver: “… the presence of springs, we localized 9 springs, 4 of them concentrated around Timzeguida Oufettas village which has locally a visible impact on landslides occurrence especially considering the presence of marls, which are becoming more sliding in contact with the water. Other springs are located in the southern part except one in the north between Bhaybeh beach and Sidi Ishak village. There are considerably affect the mechanical processes that lead to slope failure and the subsequent movements of landslide in the post-failure phase, especially where we have marls or clays.”

-Rev2: L 246 - 247 – What was the threshold percentage of unstable area in each terrain unit to be considered unstable.

- Authors Reply: We considered the presence or absence of landslides, each terrain unit contain a polygon of a landslide is considered unstable.

-Rev2: The aerial photographs and satellite images area coverage for the landslides inventory construction should be included in table 1. This is important because any inventory is incomplete by its own nature and depends heavily on the database available. It is also important to clarify that the inventory is of the historical type, with no past date of occurrence limits, and it is also useful to point out its limitations.

- Authors Reply: The aerial photographs and satellite images area cover all the study area and data sources used will be included in Table 1 as suggested. Regarding the question if the inventory is of the historical type, is not. We used mostly recent images to map the landslides. Nevertheless, we consider that for larger deep-seated landslides the inventory is quite complete, since landslide features associated to these landslides tend to remain for long time in the landscape. For shallow and smaller landslides, we assume some uncertainty on the number of landslides mapped, even so, the fact that cliffs are not explored for agriculture and the driest climate could also allow the maintenance of these landslides features on the landscape for a significant time from occurrence, given that way more consistency to the landslide inventory.

Table 1 will be reformulated as exemplified bellow.

Table 1: Data sources Table

Data type	Data denomination	Source	Scale / resolution / Duration
Topographic maps	Sidi Ishaq 2008	National Agency of Land Conservation, Cadastre and Cartography (ANCFCC)	1/25000
	Berrakat Erradi 2008		
	Sebt Akermoud 2008		
	Bir Kaouat 2008		
	Moulay Bouzarqtoune 2008		
	Jbel lahdid 2008		
	Essaouira 2008		
	Chicht 2008		
	Ras Sim 2008		
	Essaouira El Jadida 2008		
	Sidi Kaouki 2008		
	Tidzi 2008		

	Sidi Ahmed Essayeh 2009		
	Tafdna 2009		
Geological maps	Tamanar map	Ministry of Energy and Mines, Water and Sustainable Development	1/100000
	Taghazout map		1/100000
	Marrakech map		1/500000
Aerial photographs	Mission TAMANAR 07/2016	National Agency of Land Conservation, Cadastre and Cartography (ANCFCC)	1/7500
Meteorogical data	Adamna station	Hydraulic basin agency of Tensift (ABHT)	1977-2015
	Igrounzar station		1968-2015
	Talmest station		1984-2015
	Chichaoua station		1965-2014
	Abadla station		1969-2014
Satellite images	Sentinel	https://scihub.copernicus.eu/ (Copernicus 2021)	10 m
	High resolution Ortho-imagery	https://earthexplorer.usgs.gov/ (USGS-EROS 2018)	0.3 m
	Digital elevation model	https://search.asf.alaska.edu/ (JAXA/METI 2020)	12.5 m

-Rev2: L 295 – 296 – phrase seems incomplete.

- Authors Reply: Done; it's only because of comma instead of point. The phrase will be replaced by "obtained at the weather stations and projecting them using the Inverse Distance Weighting (IDW) interpolation. While field survey, topographic maps (1:10,000) and DEM were used for identify and map the stream networks."

-Rev2: Table 2 – Replace "limstone" by limestone.

- Authors Reply: - Done

-Rev2: L 312 – The references deserve improvement: Lee and Pradhan (2007), Shahabi et al. (2014), Wang et al. (2016) studied sea cliffs? Proper references include Marques et al, 2011, 2013; Epifâneo et al., 2013, 2014.

- Authors Reply: We thank the reviewer observation. The references list will be like this "This method was successfully applied to coastal areas worldwide (Marques et al, 2011, 2013; Epifâneo et al., 2013, 2014)."

-Rev2: Figure 5 – Replace the pie plots by bar or column plots.

- Authors Reply: We believe that, by a typo, the reviewer is referring to figure 4 and not figure 5. The pie plots are in figure 4 and not figure 5. Yes, we can replace them by bar or column plots.

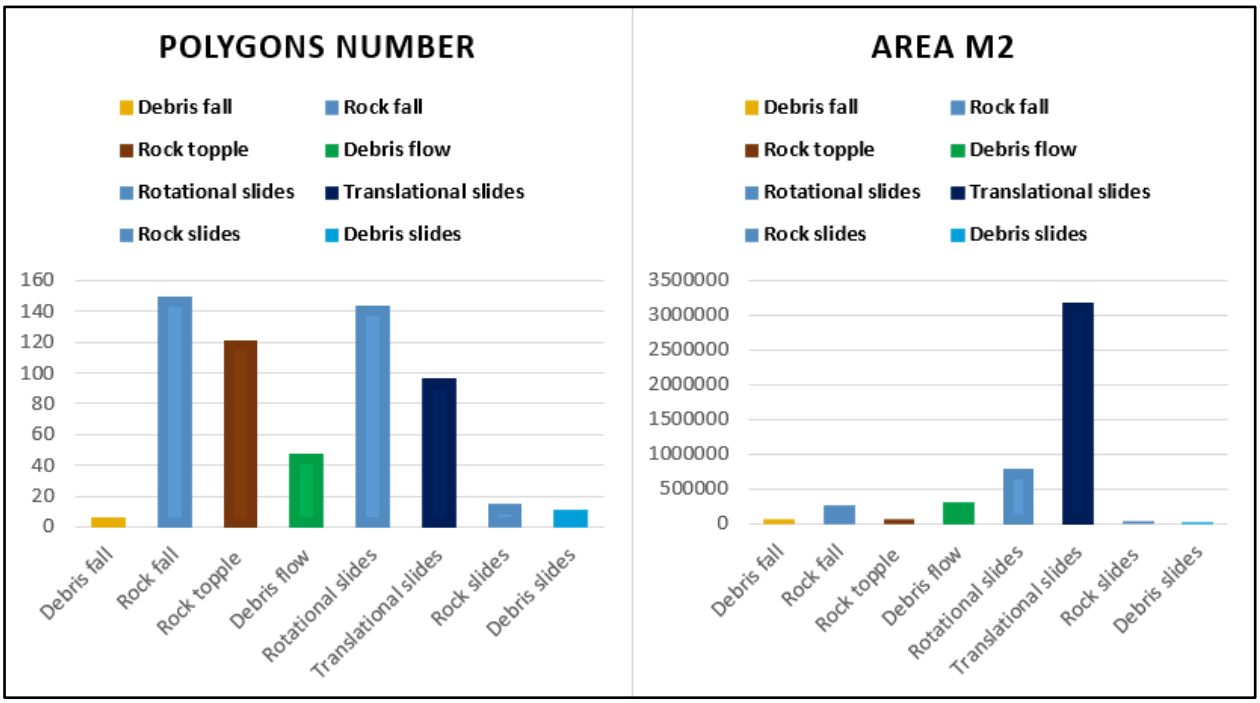


Figure 4: The relative distribution of landslides by type and area in the ETU of the study area

-Rev2: L 417 – What is "limestone barre"? Clarify.

- Authors Reply: It is a cretaceous formation with limestone, looks like a continuous barre (band or visible layer) in the cliff area.

-Rev2: L 528 – Clarify "the respective average of the unstable area, are located more to the souths of study area."

- Authors Reply: - Done. This phrase in the new version of the manuscript will be placed as "The approach was done individually for each type of landslide studied, and shows that, for all type of landslides, the unstable areas (classified as non-stabilized) are located more to the south units of study area."

-Rev2: Although involves some additional work, it would be useful to have the AUC of the ROC curve of each individual factor, at least for all types of movements, to enable the assessment of the more important susceptibility predisposing factors, which could be improved in further studies, in order to obtain better models.

- Authors Reply: We agree with the reviewer suggestion and in the revised version of the manuscript we could include the AUC of the ROC curve of each individual factor, at least for the model with all types of movements, in order to assess the more important susceptibility predisposing factors for instability.

-Rev2: One other aspect to address is the validation method: using one part of the inventory to build the model and the other part for validation is a statistically sound method of validation, but it only indicates that the landslide inventory is robust enough and that the inventory partitions are representative samples of the total inventory and have similar relations with the landslides predisposing factors. However, as showed in Queiroz and Marques (2019) a temporal partition of a cliff failure inventory (1947-1980 and 1980-2012) led to very high success ROC AUC values, but to poor prediction rates, which raises fundamental doubts for the true prediction of future evolution behavior of sea cliffs based on its past evolution (as in Guilham et al., 2018). It is the reviewer opinion that this matter should also be subject of discussion and a subject for future work.

- Authors Reply: We acknowledge the reviewer comment, and we totally agree. In fact, the temporal resolution of landslides in our coastal landslide inventory do not allow to apply a temporal partition of the inventory dataset. That is the reason for which we apply a random partition to generate training and validation landslide groups. This is a potential source of uncertainty and will be properly addressed and discussed on the results section. We will use the reviewer comment/description, which we thank, to better address/guide this potential source of uncertainty. this aspect,

-Rev2: The validation process is also a matter of debate in the discussion part of the paper.

- Authors Reply: We acknowledge the reviewer comments. The landslide inventory partition in training and validation groups were selected randomly. 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). And the time dependent validation was not possible with the available dataset.

-Rev2: In the various model results classification why were used the IV values instead of a classification based on the ROC curve results, with limits of unstable areas of, for example 50%, 65%, 80%, 95% of the correctely predicted unstable terrain units.

- 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.

-Rev2: In the paper is missing a discussion of the results obtained and a comparison with other studies of the same type carried out in other coastal cliffs.

- Authors Reply: In the new version of the manuscript we will include a discussion section to properly discuss main source of uncertainties and comparison of results with other studies.

3- Editor's comments:

We thank and acknowledge the editor's observation:

L16-17: Change "which qualified as a wide applied statistical model in several coastal environments." to "which is a statistical model widely applied to various coastal environments."

-Reply: Changed

L17: Replace "The aim of this study was" by "This study aims to"

-Reply: Replaced

L18: "the bivariate …" instead of "this bivariate…"

-Reply: Replaced

L18-19: I´d suggest rephrasing as follow: "In this coastal area, 588 landslides of distinct types were identified, inventoried and mapped. They mostly result from ..."

-Reply: Changed

L22: add a space between the value and the unit, here (50 m) and thorough the text.

-Reply: Added

L23: 70% for training and 30% for validating.

-Reply: Changed

L27: Spell out the full term NDVI as this is its first mention. The same applies to the term ROC at L30.

-Reply: Changed to "…land-use patterns, the normalized difference vegetation index (NDVI), lithological…"

L31-32: Try: "Two methodologies, considering a pixel-based approach or using coastal terrain units, were adopted to evaluate the coastal landslide susceptibility."

-Reply: Changed

L34: Remove " being the majority of these high susceptible areas" that ca be replaced by "mostly".

-Reply: Replaced

L35: Replace "Those " by "These".

-Reply: Changed

L41: Is there any reference that can reinforce such a statement? If so, please add it at the end of the sentence.

-Reply: No sir, I didn't find it.

L41-43. Too long sentence with excess in using the term "processes", please rephrase.

-Reply: Rephrased to "…..Essaouira province. Resulted essentially from the interaction of sub-aerial, marine and anthropogenic processes (Trenhaile 1987, Sunamura 1992, Hampton & Griggs 2004, Greenwood & Orford, 2007), that is why this system have been exposed to Anthropic activities pressure and erosional processes more than any other natural systems…."

L46: Correct "involves" to "involve"

-Reply: Corrected

L49-50: Try: "For rocky coastal areas, landslide susceptibility/hazard assessment mainly addresses the evaluation …"

-Reply: Changed

L52: replace ",which control" by "controlling"

-Reply: Replaced

L56-57: replace ",which have" by "with"

-Reply: Replaced

L74-75: Unclear. Please try" … while there are other suitable approaches such as the bivariate, multivariate, and active learning statistical methods."

-Reply: Changed to the suggested phrase

L86-91: Too long sentence. Consider splitting it in two.

-Reply: Splitted

L100: remove "coastal"

-Reply: Removed

L100: is poorly studied or is less studied.

-Reply: Changed to “…..The dynamics of Essaouira coastal area is poorly studied….”.

FIGURES

Fig1: Both the figure and its legend need further improvements:

- Add an overview map showing where Morocco stands.
- The map in the right top corner is not informative at all: indicate that the yellow territory corresponds to Morocco and that the red rectangle marks the study area of Essaouira.
- Consider adding the coordinates (longitudes and latitudes) for the map depicting the study area.
- What is the source of the satellite image used in the map? This should be mentioned in the legend.

-Reply: Changed according to your instructions.

Fig3: Unclear where are the landslides in these photos. I would suggest identifying the landslide at each photo by drawing their scars for example.

-Reply: The landslides where identified by the red line.

Figs5, 9 and 10: Consider adding the coordinates (longitudes and latitudes) for all the maps.

-Reply: The coordinates were added for all the maps.