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Dear Prof. Dr. Lorena Grabowski
Editor-in-Chief
SOIL

Greetings;

Attached please find the revised version of our manuscript entitled "**Mapping land degradation risk due to wind and water erosion**". Full revision has been carried out by responding to the comments and considering suggestions made by the reviewers. The implementation of those valuable comments and suggestions has significantly improved the quality of the paper for which we are grateful to the editor and the reviewers. I am also attaching a note in which major changes carried out in the paper have been explained. All revised parts have been highlighted in brown color.

I hope the emendations caused to consent the respected editor and make my paper well qualified for further processing leading to final acceptance and publication. The acknowledge receipt of the same and informing me about the final status of the paper is appreciated.
Sincerely,

Dr. M. Boroghani
Enclosure

Comment on egusphere-2022-1511
Anonymous **Referee #2**
Referee comment on "Mapping land degradation risk due to wind and water erosion" by Mahdi Boroughani et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-1511-RC2, 2023
The manuscript “Mapping land degradation risk due to win and water erosion” presents an interesting research, with significant data and results. However, I consider that in its present form the manuscript cannot be published and major revisions are needed before a new submission.
Ans: Thanks for reading this manuscript and your comments. I hope the revised version would have fulfilled your scientific expectations.

I do not agree with the sentence that land degradation receives little attention. I think that this topic has been widely and worldwide study with different studies, methods

Ans: We agree with you that land degradation has received much attention in the whole world, but we mean the simultaneous investigation of water and wind erosion. We revised in the manuscript line 16

Lines 32-34. The last sentences of the abstract should be also improved. Why larger area? Is it necessary for land management? These ideas should be better developed.

Ans: Due to the fact that dust affects large areas and the place of the source to transportation and sedimentation is very wide, therefore, the larger the area, the better the investigation is done. And in the continue, land management and better ideas will be developed.

In general, I consider that the introduction section should be improved. My suggestion is to present first the topic of land degradation (better developed), second dust-wind erosion, water erosion and finally all the ideas related to the methodology (machine learning…). In addition, the objectives should be improved and I consider that a research hypothesis should be included.

Ans: The introduction section was revised as suggestion. Objectives and hypotheses were revised and added in line 86-95.

Line 86-95: This research is conducted to test some hypotheses including (1) the central and western parts of the watershed are the highest susceptible areas to water erosion and aerosol emission, respectively (2) NDVI and land use are the most important factors for water erosion and aolian emission and (3) Central areas are the most prone parts of the watershed to these phonemona. Correspondigly, the aims of the current study are (1) to assess the spatially resolved contribution of soil erosion by water and wind using three machine learning algorithms, (2) determine the most important factor influencing water and dust emission susceptibility and (3) to combine the findings into spatially resolved information on risks for land degradation and recognize the hotspot area in terms of water erosion and dust emission.

Likewise, the novelty of the manuscript and the international impact of the methods and results should be highlighted thought the text.

Ans: It was revised.

Line 81: However land susceptibility to soil erosion and dust emsission has been assessed in different and separate studies, it has attracted less attention to investigate both of them in the same study. So, the novelty of this study lies in constructing an integrated framework based on field survey, different environmental factors, and machine learning algorithms to assess both of water erosion and dust emission.

Line 408-411: As mentioned before, the watershed is one of the key regions with dust concentration in southwest Asia. Spatial distribution of dust sources in this region is a key roadmap for preventive and adaptive measurement. This would reduce dust emission across the watershed, region, and even other near countries.

Line 464-466: Mutually, intensified soil erosion might lead to migration of resident people to other places and even other countries.

I consider that lines 88-93 should be moved to the introduction section, as it presents a research problem.
Ans: It was revised. A part of that was moved to introduction.

You should also improve the study area description (altitude, slopes, climate, soils…) a brief presentation of the study area.
Ans: It was revised.
Line 100-107: This watershed include a great diversity of topographic characteristics, with an elevation ranging from 124 to 4269m, and slope ranging from 0 to 28.04 degree. In this region, southwest and northeast aspects have the most frequencies (34% of the area). This watershed covers some parts of the South Khorasan, Yazd, Kerman, and Sistan-Baluchestan Provinces of Iran. In addition, several important cities and towns such as Birjand, Tabas, Bam located in the watershed. Aridisols is the dominant soil order of the watershed in which it constitutes 40.1% of this region.

Line 117-127. This information should be better presented. I understand that you indicate a reference where the methods are explained, but the reader of this manuscript should know more about it. More information is needed.
Ans: It was revised.
Line 138-140: In the previous research, a combination of consulting with provincial experts, satellite images, recent aerial photos, and field survey were applied to identify soil erosion.

Figure 3. I think Figure 3 should be separated into several figures.
Ans: All of maps in this figure are related to the same procedure, and are used for machine learning algorithms. These maps were presented in one figure, because of ease of following the factors and avoiding any confusion. This format of presenting of controlling factors was also applied in different studies such as "Gully erosion zonation mapping using integrated geographically weighted regression with certainty factor and random forest models in GIS", " Comparative assessment using boosted regression trees, binary logistic regression, frequency ratio and numerical risk factor for gully erosion susceptibility modelling", and " A New Approach for Smart Soil Erosion Modelling : Integration of Empirical and Machine Learning Models"

Figure 3. Water-induced soil erosion points for training and validation. You should justify the location of these points, as they are limited-spatially.
Ans: However it is mentioned in line 143 that the field survey was conducted in accessible parts of the watershed, it is explained more as below:

Line 142-144: This field survey was carried out in accessible parts of the watershed in April 2020. These accessible parts are mostly distributed around the cities (such as Bam, Ravar, Shahdad, Baravar, Birjand, Tabas, etc) with proper road access located in the watershed.

Figure 3. Better legends should be included in some cases (rainfall, is it annual rainfall?, lithology?). In addition, the maps distance from roads and rivers present strange information.
Ans: Rainfall and Lithology were revised. Since there too many lithology classes in the study watershed, dominant classes are presented in this figure. Other classes would be illustrated in the appendix. The figures were also revised. Distance from road was double-checked, but there is the same information in other available layers.

Results, discussion. This section should be also improved, including international studies, comparisons, discussing your main results, your methodology…
Ans: It was revised.

Line 357-363: Land use and NDVI as an index of vegetation cover proved to have a controlling impact on wind erosion and dust emission (Gholami et al., 2020). Elevation is an effective factor for DSSA in which lowlands have higher impacts than highlands. This was confirmed by other studies such as Darvand et al., 2021. Lithology is another important factor in this watershed since dust emission is mostly occur in the sensitive lithology rather than resistant ones (Sissakian et al., 2013).

Line 398-399: In all three maps, it can be seen that the biggest potential for dust emission is located in the central parts (Lut Desert) of the watershed.
Line 415-425: There are some differences in the contributions of influential factors among models. So that, RF indicates that rainfall, TWI, slope, elevation, land use, and geology are the most important conditioning factors. Considering this watershed located in arid region of Iran, rainfall and TWI play decisive and crucial role in soil erosion among them. TWI which indicate soil moisture and water-saturated area (Silva et al., 2023) has been also identified an effective factor for different kinds of soil erosion such as rill-interrill, gully, and piping erosions (Sholagberu et al., 2017; Hosseinalizadeh et al., 2019). Slope influences also soil erosion rate through effecting on runoff velocity, vegetation cover, and soil type (Avand et al., 2022). This conditioning factor has been also reported as one of the most influential factor in most studies (Sholagberu et al., 2017; Pournader et al., 2018; Lei et al., 2020).
Line 431-433: TWI has an important impact on SESA in all three models. This is because the study watershed predominates with low slopes and elevations. The opposite result of this finding was obtained by Silva et al., 2023.
Line 452-456: High performance of RF model in classification issues is related to its potential to handle bigh datasets and aplly large number of conditioning factors (Naghibi et al., 2018). In addition, Rahmati et al., 2020 states that high accuracy of RF is the results of several advantage of this model such as iterative nature and preventing problems by overfitting (Rahmati et al., 2020).

As I suggest in the introduction section, the conclusion section should be also rethought, and improved.

Ans: It was revised.

Line 510-527: Based on the land degradation map, almost the entire study region is at risk. A large fraction of 43% of the area is prone to both high wind-driven plus water-driven soil erosion. In addition to these areas, another 45% and 8% of the area have a risk for water-driven and wind-driven soil erosion, respectively. The methods tested in this study could be later transferred to similar assessments in other regions around the world. Choosing this region in Iran is further motivated by the impact of land degradation on the country's economy. The current study has some limitation including the small sample size and non-uniform distribution of water-induced soil erosion points because of lack of accessibility to a road network in some parts of the watershed. Despite these limitations, these results can potentially be useful for managers and policy makers to identify local hotspots for land degradation to implement mitigation and adaptation measures in this watershed. Future studies could work on improving the spatial resolution and coverage of the risk assessment for providing more information on risks for land degradation. In addition, it is suggested that future research should estimate the role of other climatic factors such as humidity, and air temperature on soil erosion and dust source susceptibility. Prediction of NDVI and rainfall as the most effective factors on soil erosion and dust sources and estimated of their impacts on future water induced-soil erosion and dust sources susceptibility is also suggested for the other studies. It requires more measurements for soil erosion by water and winds to train the machine learning models.