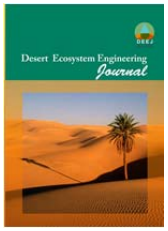
DEEJ (2024) 12 (4)

University of Kashan

Desert Ecosystem Engineering Journal

Journal homepage: http://deej.kashanu.ac.ir



Modeling Wind Erosion Via Google Earth Engine: A Case Study of Sabzevar City

Abdolhossein Boali,[1] Narges Kariminejad,[2*] Mohsen Hosseinalizadeh[3]

Received: 27/03/2024 Accepted: 11/09/2024

Extended Abstract

Introduction: Characterized by fragile ecosystems, dry regions are prone to frequent damage and wind erosion, making it crucial to develop effective strategies for accurately assessing wind erosion. Therefore, this study sought to model and prepare a wind erosion risk map using remote sensing and machine learning approaches in Sabzevar City. Throughout the past decades, this region has continuously suffered from land degradation, water and wind erosion, land use conversion, and groundwater depletion. Thus, this study identified the most important parameters contributing to wind erosion in the study area after reviewing the sources of wind erosion and its evaluation models. Moreover, a distance measurement index was considered for each individual parameter. Also, machine learning methods were used to model and prepare the wind erosion map of Sabzevar city using the remote sensing indicators prepared and auxiliary points obtained by reviewing previous studies. Finally, to reduce the uncertainty of the results, the combined modeling method was used to prepare the wind erosion map.

Material and methods: fifty ground data points were collected through performing field visits and reviewing the previous studies conducted in the study area. Accordingly, eight factors, including wind speed, land use, soil salinity, soil moisture, soil texture, vegetation density, precipitation, and digital elevation model (DEM) were selected based on the review of the related literature review. Then, to model wind erosion in the study area, the values found for each of the aforementioned factors were correlated with the field data. Moreover, four machine learning techniques, including SVM, GBM, GLM, and RF were used to predict wind erosion risk in the study area. In addition, the kappa coefficient, ROC curve, and True Skill Statistics (TSS) were used to assess model performance. Finally, a combined model was employed in the SDM statistical package to minimize the uncertainty of regional modeling.

Results: The SVM model demonstrated the best performance with AUC = 0.95, TSS = 0.97, and kappa = 0.87. The results indicated that the eastern regions of the study area were affected the most by severe wind erosion. Moreover, the combined model revealed that 44% of the area fell within the low wind erosion class (5340 square kilometers), 16% in the medium class (2007 square kilometers), 15% in the severe class (1916 square kilometers), and 25% in the very severe class (3122 square kilometers). The results of the significance of the variables showed that wind speed, precipitation, vegetation density, and surface moisture (NDMI) were the most important factors that contributed to the region's wind erosion, respectively. Furthermore, land use change, soil salinity, and soil surface texture were found to have the least contribution to wind erosion in the study area, respectively. These findings can help the relevant decision-makers to set managerial policies and practical plans to avoid the risks of wind erosion.

1. Department of Arid Zone Management, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran
2. Department of Natural Resources and Environmental Engineering, College of Agriculture, Shiraz University, Shiraz, Iran; Email: narges.karimi991@gmail.com
3. Department of Arid Zone Management, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

Doi: 10.22052/deej.2024.254641.1049

Discussion and Conclusion: effective planning, optimal management, and corrective measures can be made and implemented to prevent land degradation and wind erosion in the affected areas by using the combined model with the least uncertainty. Generally, modeling wind erosion and preparing its map play a fundamental role in environmental studies. In this study, four models were applied in the form of an SDM statistical package, where the accuracy of the evaluation results clearly identified the best model. The difference in the results obtained from the performance of the models confirmed the uncertainty between them. Therefore, it appears that using a combined approach can be a suitable solution to reduce the uncertainty of modeling. The results of the study also suggested that the western areas of Sabzevar City were the most important centers of wind erosion production, where the surface of the hills was loamy and sandy. Thus, to avoid wind erosion in the study area, some corrective and biological measures are suggested, including the cultivation and development of salinity-resistant plant community cover, the cultivation of sand-loving plants, and the construction of windbreaks for sand dunes. While the measures performed so far in combating dust storms and wind erosion in Sabzevar city have proved to be ineffective, the intensified occurrence of dust in the region throughout the recent years and the irreparable consequences it has brought about make it necessary to devise and implement a comprehensive plan to deal with those phenomena. In this regard, the wind erosion risk intensity maps prepared in this study can be an efficient and appropriate tool for managing and reducing the effects of wind erosion and land destruction.

Keywords: Wind Erosion, Land Degradation, Google Earth Engine, Spatial Modeling.