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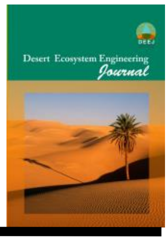

Identifying Sources of Dust Using Maximum Entropy Model in Eastern Iran

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Extended Abstract

Introduction: As a major type of atmospheric and environmental pollutant, dust bears terribly harmful consequences for agriculture, industry, and human health. In this regard, identifying the potential sources of dust is the main required step in managing and controlling the dust phenomenon and reducing its risks, especially in arid and semi-arid environments. Therefore, this study used the modern maximum entropy algorithm to predict the potential sources of dust in eastern Iran by considering the effective environmental factors.

Materials and Methods: As for the modeling process, eight effective factors in dust generation, including land slope, landform, vegetation, precipitation, wind speed, lithology, land use, and maximum air temperature were analyzed as independent variables involved in the occurrence of dust storms. Moreover, petrologic, land use, pedologic, precipitation, vegetation, and slope maps were prepared.

On the other hand, the locations identified by Iran’s Geological Survey as the sources of dust were used as dependent variables. Furthermore, the distribution of sand dunes, bare lands, dried beds of lakes, dried wetlands, and other places along the region’s dominant wind route was determined using the remote sensing technique and the MODIS sensor images extracted from Aqua and Terra satellites. Moreover, 70% and 30% of the identified sources of dust were randomly assigned to training and validation datasets, respectively. Then, the potential areas for generating dust were investigated using the maximum entropy algorithm and the MAXENT software.

Finally, a model was developed for identifying the potential areas of dust generation with the highest accuracy. After developing a complete model comprising of all relevant variables, the modeling was replicated to the number of variables, whereby each individual variable was removed from the modeling process in each replication of the process. Therefore, the influence of each variable in predicting the desired areas was evaluated and the forecast map of dust generation centers was improved. Then, the results of the forecast map were validated using the method under the ROC curve.

Results and Discussion: This study found that sensitive areas such as the Helmand River bed, Hamoon Lake, Darmian, Nehbandan, eastern parts of South Khorasan Province, Sarakhs, Tabas, Iranshahr, etc. had a high potential for dust generation. According to the input maps extracted from the maximum entropy model, the dust-

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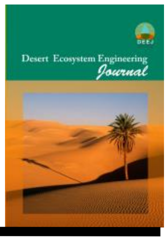

prone areas fell within the range of sand dunes, whose lands lacked any vegetation. Located in the direction of winds with more than 10 meters per second velocity, the areas are mostly spread in saline lands, barren lands, and dried water bodies, possessing less than 100 mm precipitation rate, low slope, and maximum temperature rate. It was also found that the AUC values were 0.78 and 0.75 in the calibration and validation stages, respectively.

On the other hand, according to the validation of spatial forecasting models and the current literature in the field of ROC curve method analysis, it can be argued that due to its over 70% accuracy, the maximum entropy model can perform well in predicting dust-prone areas. Also, the results of the Jackknife test indicated that wind speed, precipitation, pedology, vegetation, and land use were the most important variables involved in the prediction of dust generation centers, with the model being highly sensitive to such variables.

However, factors such as maximum air temperature, slope, and lithology were found to have exerted a minimal effect on the occurrence of the dust storm in the study area. Moreover, according to the results of analyzing the correlation between the studied factors and the occurrence of the dust storm, the highest density of dust generation was observed in lowland areas where barren lands, salt marshes, sand dunes, and dried beds of water bodies existed. Possessing no vegetation, the areas are also located in the region’s local wind direction with high velocity.

Conclusion: Based on the study’s results, it can be argued that the maximum entropy model performs highly efficiently in identifying the potential dust-generation areas, considering the old dust-generating centers as dependent variables to prepare and produce a forecast map of dust-prone areas. Moreover, the model identifies the correlation between independent and dependent variables based on the extent of entropy to minimize the possibility of prediction error. Therefore, the model’s predictions are made with the lowest degree of uncertainty, whose results could be used and relied on for managing and controlling watershed erosion.

On the other hand, the results suggested that the density and probability of dust storm occurrence varied in different parts of the region and that identifying dust-generation-prone areas was the first step in protecting the soil, controlling erosion, and managing sediment production. Moreover, the maximum entropy model showed an increase in wind speed and surface temperature throughout the study area, with a decrease in precipitation rate exerting a direct influence on the vegetation of the lowlands and plains where sand dunes, barren lands, and dried beds of wetlands are located. Finally, the maximum entropy model and other data mining models are recommended to be used for identifying potential areas of sediment production involved in the occurrence of dust storms to help improve the concentration of relevant executive projects in areas sensitive to wind erosion.

Keywords: Storm Control, Potential Dust Sources, Environmental Pollution.

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