Spatial predictive modeling of land degradation in a semi-arid region: proposing a new conceptual framework

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Abstract

The present research aimed to develop a new conceptual framework to predict land degradation (LD) susceptibility based on net primary production and machine learning domains. The annual NPP maps related to 2001-2020 were obtained using MOD17A3 and the trend of NPP changes was taken into account to investigate the occurrence and non-occurrence sites of land degradation in a region under the semi-arid climate in Iran. An inventory map of LD was generated based on occurrence and non-occurrence locations of degradation. The locations were randomly separated as the training (70%) and testing (30%) dataset to evaluate the goodness-of-fit and predictive efficiency of models. Next, fifteen geo-environmental factors including temperature, precipitation, slope, aspect, altitude, land use, normalized difference vegetation index, normalized difference salinity index, vegetation soil salinity index, normalized difference moisture index, visible and shortwave infrared drought index, electrical conductivity and sodium adsorption ratio of groundwater, groundwater table, and annual depletion of groundwater resources were selected as LD predictive variables. Four advanced machine learning techniques were performed to model LD susceptibility. Finally, the predictive efficiency of the applied models was measured utilizing the area under the ROC curve and true skill statics. The results indicated that the random forest model, with AUC = 0.84 and TSS = 0.64, showed the highest efficiency for predicting LD in our area of study followed by BRT, CART, and SVM. This study successfully proposed a new LD modeling framework based on the trend of NPP changes and can be used in different parts of the world.

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