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Comparison of Different Machine Learning Algorithms for Lithological Mapping Using Remote Sensing Data and Morphological Features: A Case Study in Kurdistan Region, NE Iraq

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Topographic effects and complex vegetation cover hinder lithology classification in mountain regions based not only in field, but also in reflectance remote sensing data. The area of interest "Bardi-Zard" is located in the NE of Iraq. It is part of the Zagros orogenic belt, where seven lithological units outcrop and is known for its chromite deposit. The aim of this study is to compare three machine learning algorithms (MLAs): Maximum Likelihood (ML), Support Vector Machines (SVM), and Random Forest (RF) in the context of a supervised lithology classification task using Advanced Space-borne Thermal Emission and Reflection radiometer (ASTER) satellite, its derived, spatial information (spatial coordinates) and geomorphic data. We emphasize the enhancement in remote sensing lithological mapping accuracy that arises from the integration of geomorphic features and spatial information (spatial coordinates) in classifications. This study identifies that RF is better than ML and SVM algorithms in almost the sixteen combination datasets, which were tested. The overall accuracy of the best dataset combination with the RF map for the all seven classes reach $\sim$80% and the producer and user's accuracies are $\sim$73.91% and 76.09% respectively while the kappa coefficient is $\sim$0.76. TPI is more effective with SVM algorithm than an RF algorithm. This paper demonstrates that adding geomorphic indices such as TPI and spatial information in the dataset increases the lithological classification accuracy.