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Optimization of multi-element geochemical anomaly recognition in the Takht-e Soleyman area of northwestern Iran using swarm-intelligence support vector machine

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Mineral exploration is becoming increasingly challenging because the depths at which undiscovered mineral deposits can be found are progressively increasing under barren cover. Therefore, detecting metal resources under barren cover is a significant step for industrial progress. The application of optimized machine learning algorithms is critical for detecting undiscovered deposits under barren cover. One of the most significant issues in mineral exploration is the detection of multi-element geochemical anomalies that could indicate the presence of undiscovered mineral deposits under barren cover. Recently, many machine learning approaches have been developed and employed to model and map multi-element geochemical anomalies, where the important hyperparameters are generally regulated through trial-and-error processes. However, employing swarm-intelligence optimization techniques can reduce the training time and assists with obtaining more precise results. In the present study, a known swarm-intelligence procedure called grasshopper optimization algorithm was implemented to optimize the known hyperparameters of support vector machine (SVM) for identifying multi-element geochemical anomalies in the Takht-e Soleyman district of northwest Iran. The grasshopper-optimized support vector machine was proven to be a rigorous approach for detecting multi-element geochemical anomalies and can also be extended to other geoscientific applications. An optimized SVM algorithm was developed herein using polynomial and radial basis kernel functions that resulted in multi-element geochemical anomaly models with accuracies exceeding 95% in the shortest possible time without trial-and-error approaches.

KEYWORDS

advanced machine learning, support vector machine, grasshopper optimization algorithm, swarm-intelligence procedure, multi-element geochemical anomaly, Pb–Zn mineralization