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Identification of groundwater potential zones using remote sensing, GIS, machine learning and electrical resistivity tomography techniques in Guelma basin, northeastern Algeria

Massinissa Braham[a,b], Abdelmadjid Boufekane[a], Hamid Bourenane[b], Baya Nait Amara[b], Rabah Bensalem[b], El Hadi Oubaiche[b] and Youcef Bouhadad[b]

[a]Geo-Environment Laboratory, Department of Geology, Faculty of Earth Sciences and Country Planning (FSTGAT), University of Sciences and Technology Houari Boumediene (USTHB), Bab Ezzouar, Algiers, Algeria; [b]National Center of Applied Research in Earthquake Engineering (CGS), Algiers, Algeria

ABSTRACT

In this research we assess and map groundwater potential in the Guelma Basin (northeastern Algeria) using an approach combining remote sensing, GIS, statistical and machine learning models. Four models were used including the frequency ratio model with both conventional (CFR) and modified (MFR) versions, the decision tree (DT), and the random forest (RF). For this purpose, firstly, thirteen hydro-geo-morphological variables influencing groundwater potential have been mapped using GIS and remote sensing techniques including elevation, slope, aspect, topographic wetness index, slope Length and Steepness factor, profile curvature, plan curvature, drainage density, distance to river, lineament and fault density, distance to faults and lineaments, lithology, and land use/land cover. Secondly, the groundwater potential was assessed and mapped based on the four models using the training data. Finally, the obtained groundwater potential maps of the four models have been validated using two approaches: (i) a statistical approach based on the receiver operating characteristics curves (ROC); (ii) a geophysical approach by interpreting the electrical resistivity tomography (ERT) results. The validation process gives the Random Forest method as the most accurate. The obtained map by this model is the main finding of this research, where the very high groundwater potential class occupies 8.25%. It is located mostly in the Guelma plain centre and in the northern part of the study area. The used approach and the obtained results may serve for water resource managers to improve groundwater resource planning and to resolve regional scale issues in this area or elsewhere.

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CONTACT Massinissa Braham braham_massi@yahoo.fr