

APPLICATION OF RANDOM FOREST MACHINE LEARNING FOR REGIONAL 3D HYDROSTRATIGRAPHIC MODELING

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3D hydrostratigraphic models are important for groundwater planning, management, and modeling. At regional scales, such models benefit from the inclusion of airborne electromagnetic (AEM) surveys because they provide dense resistivity-depth models that fill gaps between boreholes. But the resistivity-lithology relationship is nonunique and nonlinear, so transforming resistivity into hydrostratigraphy is not straightforward. We use random forest-based machine learning to learn the relationship between resistivity and hydrostratigraphy and then predict the 3D distribution of hydrostratigraphic units. The method uses numerous lithological terms from thousands of boreholes, which are grouped into 5 hydrostratigraphic units based on hydrologic characteristics, grain size, texture, and assumed resistivity characteristics. The input data are resampled into a 200x200x1m grid and then the hydrostratigraphic units are paired with co-located resistivity nodes. The data pairs are split into 70% training and 30% validation. Initial results show that hydrostratigraphic unit prediction had a training F1 score of 97% and 91% testing accuracy, improving to 100% and 95% after hyperparameter tuning. This method is fast and reproducible. It creates high-resolution 3D models of hydrostratigraphic units that can be used to build robust frameworks for a variety of hydrogeological applications.