Seismic-ML Fusion for Optimized CCUS Site Selection: A Case Study on Volve Dataset

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Abstract

Objectives/Scope:
ML-techniques have demonstrated effective results in advancing CCUS from seismic and well log data. These workflows significantly reduce the time required for the interpretation life cycle. The scope includes the development of an ML model employing boosting techniques to predict key well log attributes (density or gamma ray) based on seismic line attributes. The proposed methodology involves careful well selection, preprocessing, and model training with subsequent application to seismic areas lacking well log data. The incorporation of physics-based conditions facilitates the derivation of a carbon storage index, aiding in the identification of strategic CCUS positions along seismic lines.

Methods, Procedures, Process:
The study follows a systematic approach, beginning with the selection of wells and associated seismic lines from Volve dataset by Equinor Norway. Depth-specific preprocessing is conducted on well log data, facilitating the training of a boosting-based ML models. Cross-validation ensures model robustness. SME-defined conditions are then applied to derive a carbon storage index. This index is subsequently employed to predict CCUS viability in seismic areas lacking well log data. The process integrates well-defined steps, merging ML techniques with geophysical insights, to enhance the accuracy of carbon storage assessments within the broader framework of CCUS deployment.

Results, Observations, Conclusions:
The results demonstrate the efficacy of the ML model in predicting well log attributes (density and gamma ray) from seismic line data. Observations reveal nuanced spatial patterns of carbon storage potential along seismic lines. Physics-based conditions further refine the index, providing a reliable metric for CCUS feasibility. The study concludes that the ML-driven workflow, combining geophysical and machine learning insights, offers a robust approach to identifying optimal CCUS positions. This holistic methodology enhances decision-making processes related to carbon storage and contributes to sustainable energy practices.

Novel/Additive Information:
By incorporating SME-defined conditions, it provides a unique carbon storage index applicable to areas without well log information. This innovative approach not only enhances the accuracy of CCUS site selection but also contributes a valuable methodology for optimizing carbon storage strategies within the petroleum industry, bridging the gap between geophysical insights and machine learning techniques in the context of sustainable energy practices.