Nashville, TN – Tuesday, September 10th, 2024 3:30 PM – 5:00 PM, Cumberland North

Application of Machine Learning to Support CCS Deployment

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Overview of the SMART INITIATIVE

The objective of the US DOE funded SMART Initiative, i.e., Science-informed Machine Learning (ML) for Accelerating Real-Time Decisions in Subsurface Applications, is to showcase how the utilization of ML can significantly improve efficiency and effectiveness of field-scale commercial carbon storage operations in three main areas: real-time visualization, virtual learning, and real-time forecasting. This paper presents the status of SMART for demonstrating: (a) virtual learning during the pre-injection permitting phase, and (b) ML-assisted operational decision making and visualization.

The SMART tools and workflows will be available as open-source packages and contribute to the deployment of commercial-scale geologic carbon storage projects along multiple fronts: (a) enabling dramatic improvements in the visualization of key subsurface features and flows, (b) creating a computer-based experiential learning environment to improve field development and monitoring strategies, and (c) transforming storage reservoir management by rapid analysis of real-time data and rapid forward prediction under uncertainty to inform operational decisions.

Characterization of faults and fractures with machine learning for CCS Implementation

The effective implementation of Carbon Capture and Storage (CCS) relies on comprehensive understanding and characterization of subsurface structures, particularly faults and fractures. Traditional methods for fault and fracture characterization are time consuming, consequently prolonging CCS implementation process. To expedite the CCS implementation including well permitting, it is critical to characterize these geological features in an efficient way. Under DOE's Science-informed Machine Learning for Accelerating Real-Time Decisions in Subsurface Applications (SMART) initiative, we develop methods and tools to improve geological feature characterization for potential CCS sites. Leveraging machine learning, our methods can accurately and efficiently extract signals from seismic data to characterize faults and fractures. The tools developed under SMART tackle critical components of the CCS implementation, enabling an expedited process.

Assisting the CCS Class VI well permit process with SMART's model explorer

With over 200 Class VI wells awaiting EPA and states with primacy (ND, WY and LA) for CO2 sequestration permits in the U.S., there's a pressing need for efficient evaluation methods. Currently, the review process relies on time-consuming full physics simulations, demanding high level of expertise. However, models developed under the SMART initiative, leveraging machine learning, surpass the existing standards by accurately characterizing critical parameters like faults, fractures, injection zones and confining system. By integrating these advanced models into SMART's model explorer interface, real-time scenario analysis of the Area of Review becomes feasible. SMART's approach addresses key aspects of the Class VI well review process, including Site Characterization, Area of Review (AoR), Corrective Action, Testing and Monitoring, and Post-Injection Site Care (PISC) and Closure.

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