Virtual Learning to Support Class VI Permitting

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Science-informed Machine Learning to Accelerate Real Time (SMART) Decisions in Subsurface Applications

Motivation

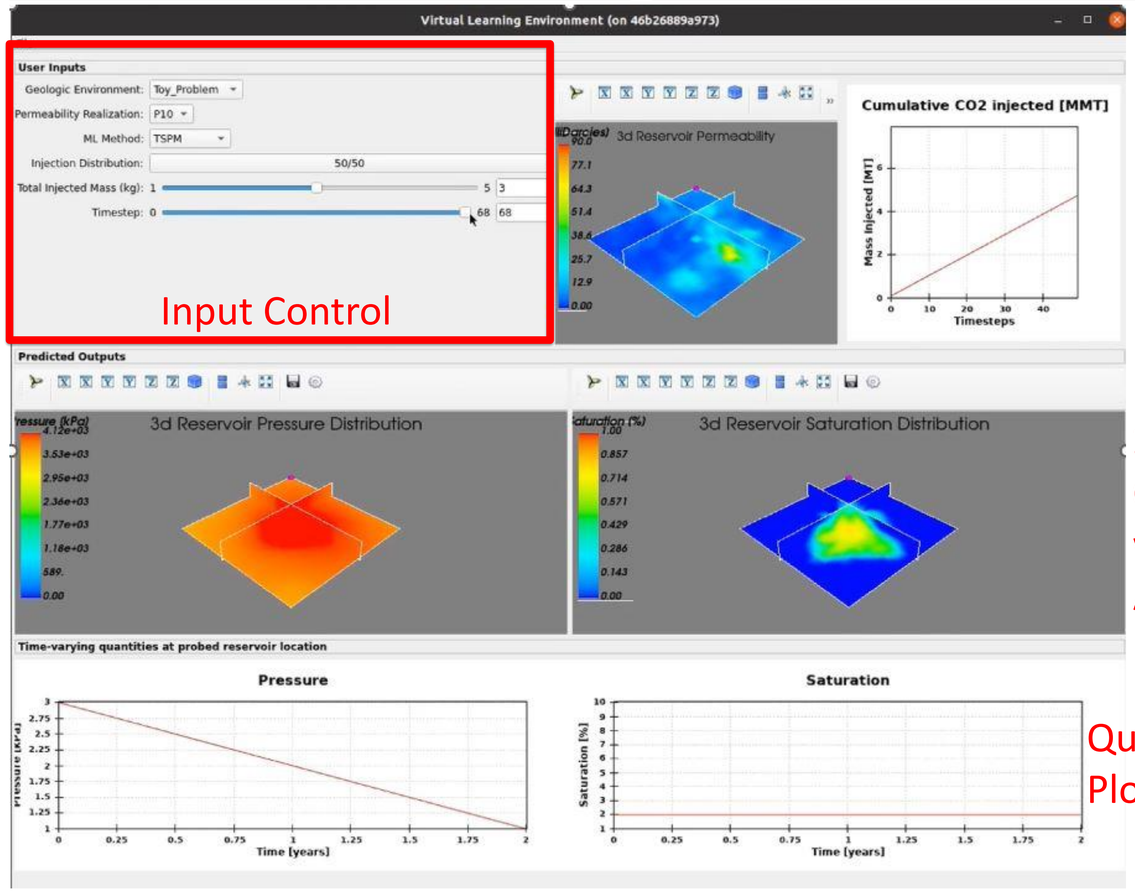
- ❑ Demonstrate how advanced machine learning based approaches can be used by regulators as well as site developers during the permitting stages of projects.

Research Objectives

- ❑ Sub-task 2.1: Stakeholder Interaction
  - ❑ Element 2.1.1: Identify pre-injection needs
  - ❑ Element 2.1.2: Identify ML-based tools
  - ❑ Communicate with regulators/site developers on progress/outcomes and receive feedback
- ❑ Sub-task 2.2: Improved Site Characterization
  - ❑ ML-based tools for faults/fracture and state of stress identification
  - ❑ Element 2.2.2: ML-based tools for PFO (pressure fall-off) Analysis
  - ❑ Element 2.2.3: ML-based enhancements of geophysical images
  - ❑ Element 2.2.4: ML-based tools for geologic variability and uncertainty
- ❑ Sub-task 2.3: Rapid Forecasting and Uncertainty Evaluation
  - ❑ Element 2.3.1: Run reservoir models for CarbonSAFE site
  - ❑ Element 2.3.2: ML based fast predictive modeling of reservoir performance using GAN
  - ❑ Element 2.3.3: ML based fast predictive modeling of reservoir performance using MLP/CNN
  - ❑ Element 2.3.4: ML based fast predictive modeling of reservoir performance using FNO
  - ❑ Element 2.3.5: Test ML based tools for fast predictive modeling of reservoir performance
- ❑ Sub-task 2.4: Model Explorer for Visualization of Uncertainty
  - ❑ Element 2.4.1: Develop model explorer software for VLE- dashboard
  - ❑ Element 2.4.2: Develop model explorer software for VLE-visualization platform
  - ❑ Element 2.4.3: Application of model explorer software

- ❑ Inputs
  - ❑ Geologic heterogeneity and uncertainty
  - ❑ CO_2 injection rate(s)
  - ❑ CO_2 injector location(s)
  - ❑ Time steps
  - ❑ Critical pressure (for AoR)
  - ❑ Selected simulation parameters

- ❑ Outputs
  - ❑ 3D pressure, saturation distributions
  - ❑ Time-dependent pressure, saturation plots at user-desired reservoir locations
  - ❑ Cumulative CO_2 injection amounts
  - ❑ AoR visualization
  - ❑ Export options (GIS, etc)



3D and 2D Outputs to visualize AOR

Quantitative Plots

Virtual Learning Environment (VLE) demo is available at demo sessions during the 2023 FECM meeting.

This work is part of the sub-task of the Science-informed Machine Learning to Accelerate Real-Time (SMART) Decisions in Subsurface Applications (edx.netl.doe.gov/SMART). seyyed.hosseini@beg.utexas.edu; viswana@lanl.gov