Contribution ID: **248** Type: **Oral Presentation**

Solving inverse problems with machine learning for real-time monitoring of subsurface plumes

Monday, 19 May 2025 12:10 (15 minutes)

There is an immediate need for carbon sequestration coupled with a need for low-cost, continuous monitoring, and real-time awareness of the saturation plume to prevent leakage. We seek to maximize plume prediction accuracy with economical and reliable monitoring strategies. Multilevel pressure monitoring is a monitoring scheme shown to be effective in determining the height and footprint of a plume. An approach directly inverting saturation maps is considered. A machine learning model is trained with an augmented U-Net architecture to history match a single deterministic full saturation map using input well data. A machine learning forward model with U-FNO architecture is used in conjunction with the direct inversion approach to generate a stochastic ensemble of full saturation maps. The direct inversion approach is shown to be effective, achieving close statistical agreement with the ground truth. For the direct inversion model, a base model is trained using permeability, porosity, and pressure buildup well data. The plume error over the 500 sample test set was 2.019%. The benefits of this approach over traditional history matching are computational efficiency, the ability to generalize out of sample, and not being dependent on priors. We produce ensembles of saturation maps that can learn the height and footprint of the plume and reasonably reconcile observed pressure data with predicted pressure data over time while incorporating uncertainty quantification from both measurement error and model error into predictions.

Country

United States

Acceptance of the Terms & Conditions

Click here to agree

Student Awards

I would like to submit this presentation into the student poster award.

Water & Porous Media Focused Abstracts

This abstract is related to Water

References

Primary authors: NUZ, Alice (Stanford); WEN, Gege (Imperial College London); BENSON, Sally (Stanford University)

Presenter: NUZ, Alice (Stanford)

Session Classification: MS14

Track Classification: (MS14) Uncertainty Quantification in Porous Media