Contribution ID: **687**

Type: **Oral Presentation**

A robust and efficient deep-learning-based surrogate model for CO2 storage in deep saline aquifers

Wednesday, 24 May 2023 12:45 (15 minutes)

CO_2 sequestration and storage in deep saline aquifers is a promising technology for mitigation of the excessive concentration of the greenhouse gas in the atmosphere. The assessment of the CO_2 plume migration depends on the complex multi-physics-based numerical simulation approaches which require prohibitively high computational costs due to the highly non-linear coupled governing equations and multiscale uncertainties of heterogeneous spatial parameter distributions. This study contributes to the development of an end-to-end deep learning workflow that accurately and efficiently predicts the temporal-spatial evolution of the solution CO_2-brine ratio R_S and gas saturation S_g which are two essential tasks for quantification of the amount of trapped CO_2, given input variable of the heterogeneous permeability fields. To this end, a general multitask learning (MTL) framework is developed and applied for learning the dynamic mappings of R_S and S_g simultaneously. The generalization ability of MTL model can be improved by leveraging the information of related tasks with fewer computational expensive labelled datasets. As a novel development, in this work, the predictions made for multiple tasks from the same permeability realization are not independent, yet they are expected to be consistent. This is due to the fact that the proposed method utilizes the data-driven cross-task consistency constraints which augments the learning of the related tasks. For several test cases, it is shown that MTL models with jointly learning yields more accurate predictions and leads to models with improved generalization for predicting the migration of CO_2 migration. At the same time, the MTL workflow is 10^3 times faster than a high-fidelity physics-based numerical simulator. Therefore, it can serve as a field-scale applicable alternative to conventional simulators for CO_2 storage management. The developments of the work are made on the basis of the publicly-available DARSim research simulator.

Participation

In-Person

References

MDPI Energies Student Poster Award

No, do not submit my presenation for the student posters award.

Country

Netherlands

Acceptance of the Terms & Conditions

Click here to agree

Energy Transition Focused Abstracts

This abstract is related to Energy Transition

Primary author: Ms ZHAO, Mengjie (TU Delft)

Co-authors: WANG, Yuhang (Delft University of Technology); Dr HAJIBEYGI, Hadi (TU Delft); Dr GERRITSMA, Marc (TU Delft)

Presenter: Ms ZHAO, Mengjie (TU Delft)

Session Classification: MS01

Track Classification: (MS01) Porous Media for a Green World: Energy & Climate