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Please fill in your manuscript title.	Sensitivity Analysis of Multiphase Parameters on CO2 Storage in Deep Saline Aquifers

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Abstract

Geological CO2 sequestration is one of the main enablers for reducing carbon emissions. Prediction of CO2 behavior in uncertain subterranean formations requires more robust descriptions of the most critical geological and multiphase parameters. The objective of this work is to present a sensitivity analysis of multiphase parameters on the amount of CO2 stored/leaked in a sequestration project and to identify the most critical parameters that we need to focus on to ensure successful project implementation.

A vertical equilibrium model is used to simulate the sequestration process for over 1000 years in the Johansen formation, which is a candidate site for large-scale CO2 storage offshore the southwest coast of Norway. The multiphase parameters of the capillary pressure and the relative permeability curves are altered randomly (Monte Carlo experiment). A distance-based generalized sensitivity analysis (DGSA) is used to interpret the responses and quantify the most influential parameters on five different masses of CO2 (free plume, leaked, residual after water reimbibition, residual CO2, trapped residually in structural traps).

Amongst the five different masses of CO2 investigated in this work, the most influencing parameters were the residual CO2 saturation and the relative permeability exponent. The residual water saturation, capillary pressure curve exponent, and the entry pressure had much lesser effect on the computed masses of CO2. The mass of CO2 in the free plume as well as the mass of residual CO2 in the plume after water reimbibition were most sensitive to the residual CO2 saturation. On the other hand, the mass of CO2 leaked from the aquifer, the mass of residual CO2, and the mass of CO2 that is trapped residually in the structural traps were most sensitive to the relative permeability exponent.

The results of our work indicate that initial experimental investigation in a sequestration project should be directed towards limiting the uncertainty of the relative permeability parameters such as the residual CO2 saturation and the relative permeability exponent.