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A Global Sensitivity Methodology to Guide Risk Assessment for CO2 Geological Storage in Deep Saline Aquifers

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SUMMARY

Various sources of uncertainties are associated with the risk assessment models. In this context, the recent European Commission directive on CO2 storage operations (Annex I Step 3.2 Sensitivity characterization) has outlined the need for measuring the influence of these sources of uncertainties for an appropriate decision for risk management. Nevertheless, numerical models can be complex and associated with high non-linearities and high computer time cost. Therefore, appropriate tools to carry out sensitivity analysis should be developed to measure parameter importance. In this view, the present paper describes a stepwise selection approach based on non parametric regression techniques is proposed to provide the measures of the parameter importance at a moderate computational cost taking into account all model non linearities. Unlike the commonly used one factor at a time approach, the analysis is global so that the potential co-operative effect between input parameters are investigated. A multiphase fluid flow transport model of the Dogger deep saline aquifer in the French Paris basin context is used as an application case. Four key factors for co2 risk assessment are then considered, namely the maximal overpressure, the maximal lateral distance of respectably the CO2 plume, the elevated pressure zone and the drying out zone. The influence of each of them to eight sources of uncertainties is studied, namely the intrinsic permeability, the porosity, the pore compressibility, the capillary model parameters, the residual fluid and gas saturation and the salinity. The analysis shows in particular that the residual gas saturation has an important effect when considering risk associated with pressure perturbation. The effect of salinity appears to be negligible, whereas the pore compressibility presents a moderate influence only for the maximal lateral distance of the elevated pressure zone. Both porosity and intrinsic permeability represent 80 % of the effect on all considered risk outputs.