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A comparative approach for modeling of CO_2 storage capacity and associated pressure response – analysis of data from South Scania site, Sweden

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Comprehensive modeling with models of varying level of accuracy can give valuable information for the appraisal of CO_2 storage potential and the assessment of risks for a given site. Here, we present a comparative modeling approach/workflow where a sequence of mathematical models of different levels of complexity are applied. These models span from semi-analytical solution to three-dimensional (3D) numerical simulator. The Scania Site, south-west Sweden where the geological model was developed within the MUSTANG project activities is selected for an example study. Initially, a semi-analytical approach is used to investigate pressure increase induced by CO_2 injection so as to determine a viable injection strategy (including injection rate and number of injection wells) and parameter sensitivity. The result is then used as a starting point in subsequent numerical simulations with TOUGH2/ECO$_2$N for 2D and 3D simulations. At the same time a simplified numerical model with the vertical equilibrium (VE) approach is also implemented. A systematic comparison is done between the different methods in terms of pressure response. CO_2 spreading during both the injection and post-injection phase is also carefully compared between the 2D, VE and 3D numerical simulations. Through these comparisons we can thus identify a model with the appropriate level of complexity according to the objectives of the modeling study. Given the data available, we show an effective modeling strategy in achieving order-of-magnitude estimates on the behavior of the identified CO_2 traps during and after the injection.