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Predictive modelling of Ketzin - CO2 arrival in the observation well

M Kühn (1), H Class (2), P Frykman (3), A Kopp (2), CM Nielsen (3), and P Probst (4)

(1) German Research Centre for Geosciences, Centre for CO2-Storage, Telegrafenberg, 14473 Potsdam, Germany, (2) University of Stuttgart, Hydromechanics and Modeling of Hydrosystems, Pfaffenwaldring 61, 70569 Stuttgart, Germany, (3) Geological Survey of Denmark and Greenland – GEUS, Øster Voldgade 10, 1350 Copenhagen, Denmark, (4) Schlumberger Carbon Services, 76 route de la Demi-Lune, Immeuble La Madeleine D, Les Collines de l'Arche, 92057 Paris La Défense Cedex

The design of the Ketzin CO2 storage site allows testing of different modelling approaches, ranging from analytical approaches to finite element modelling. As three wells are drilled in an L-shape configuration, 3D geophysical observations (electrical resistivity, seismic imaging – for details see further presentations at EGU2009) allow to determine the 4D evolvement of the CO2 plume within the reservoir. Further information is available through smart casing technologies (DTS, ERT), conventional fluid, and permanent gas sampling. As input parameters for the models, a high resolution 3D seismic as well as detailed analysed core samples from all three wells at Ketzin were available. Logging data and laboratory experiments on rock samples act as further boundary conditions for the geological model. Hydraulic testing of all three wells gave further information about the complex hydraulic situation of the highly heterogeneous reservoir.

Before CO2 injection started at the Ketzin site on the 30th of June 2008 any member of the CO2SINK project was asked to place a bet in a competition and predict when the CO2 arrival in the observation well - 50 m away from the injection site - is to be expected. This allows for a double blind study, the approval of different modelling strategies, and to improve modelling tools and strategies.

The discussed estimates are based on three different numerical models. Eclipse100, Eclipse300 (CO2STORE) and MUFTE-UG were applied for predictive modelling. The geological models are based on all available geophysical and geological information. We present the results of this modelling exercise and discuss the differences of all the models and assess the capability of numerical simulation to estimate processes occurring during CO2 storage.

The role of grid size on the precision of the modelled two phase fluid flow in a layered reservoir is demonstrated, as a high resolution model of the two phase flow explains the observed arrival of the CO2 very well. All used models are capable to predict the arrival of the CO2 quite well. However, history matching of the models and comparison to the derived evolution of the CO2 cloud over time and space will help to better understand and constrain the processes involved within the reservoir and to optimize the modelling tools.

Last but not least - within the described competition, the best forecast of all was achieved by a modeller.