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Topic of Master's Thesis

Investigation and development of criteria for the applicability of Vertical Equilibrium models

Energy storage is an essential component of future energy systems that use large amounts of variable renewable resources. Apart from pumped-storage hydropower, large scale energy storage is mainly provided by underground energy storage systems. The focus of this work lies on underground aquifer storage of gases (e.g. synthetic natural gas, so called wind gas). Simulating underground gas storage requires simulations over relatively large time scales on a large domain, including local fine scale features such as displacement fronts (see Figure).

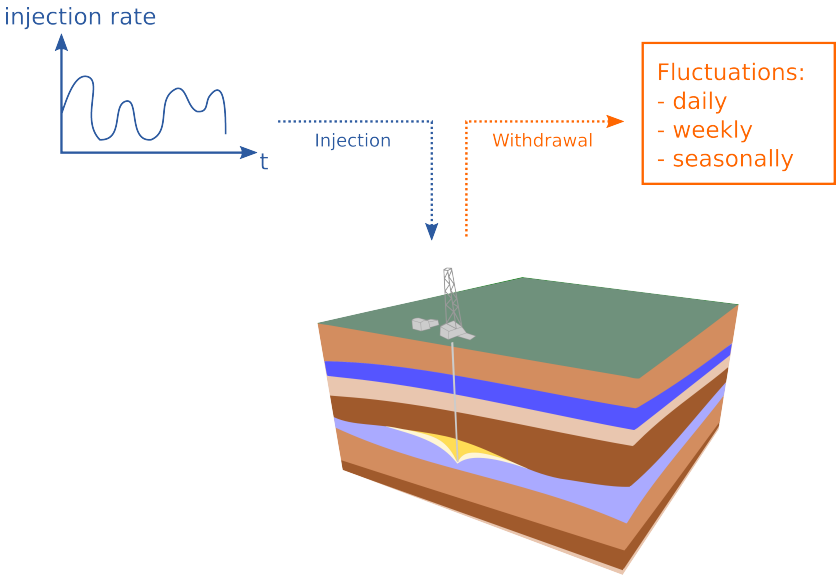

Figure 1: Geological storage of gas: injection and extraction cycles

Within acceptable computational time this cannot be achieved by the usual full three-dimensional multiphase multicomponent models due to limited computational resources. Instead, reduced models like Vertical Equilibrium (VE) models are applied. VE models are much more computationally efficient but are based on assumptions that only hold after a certain timescale

in the entire domain. Currently, no practical criterion is available to quantify locally if the Vertical Equilibrium assumption is valid. The scope of this work is to develop and implement such a criterion in an already existing VE model.

The work can be split into the following parts:

- Literature on existing global and local criteria for applicability of VE models has to be reviewed.
- A parameter study has to be conducted on how model parameters influence applicability of the VE model locally.
- A local criterion for applicability of VE models has to be developed based on the results and implemented in DuMux.

The text shall be summarized in a report and presented in an oral presentation.

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