processes. Two depositional processes are considered in the SAIGUP study: fluvial and wave processes. The higher amount of sediment supply from rivers relative to the available accommodation space in the shallow sea, the more fluvial dominant the process will be. As the river enters the mouth of the sea, it can divide into different lobes and branches. Wave processes from the sea-side smear this effect and flatten the shoreline shape. Less wave effect produces more pronounced lobe shapes around the river mouths. Very high permeability and porosity can be found in the channelling branches, while dense rock with low permeability fills the space between them. Reservoir quality decreases with distance from the shore-face. We expect that the level of lobosity can have a considerable effect on the CO_2 injection and plume size in the aquifer. In this study, models of three levels of lobosity are used: flat shoreline, one lobe and two lobes, see Fig. 1.

Barriers: Periodic floods result in a sheet of sandstone that dips, thins, and fines in a seaward direction. In the lower front, thin sheets of sandstone are interbedded with the mudstones deposited from suspension. These mud-draped surfaces are potential significant barriers to both horizontal and vertical flow. In the SAIGUP domain used here, these barriers were modelled by transmissibility multipliers in three levels of coverage of barrier sheet: low (10%), medium (50%), and high (90%). We use the same variations in this study, see Fig. 1.

Aggradation: In shallow-marine systems, two main factors control the shape of the transition zone between the river and the basin: amount of deposition supplied by the river and the accommodation space that the sea provides for these depositional masses. One can imagine a constant situation in which the river is entering the sea and the flow slows down until stagnation. The deposition happens in a spectrum from larger grains depositing earlier in the land side to fine deposits in the deep basin. If the river flux or sea level fluctuates, the equilibrium changes into a new bedding shape based on the balance of these factors.

In the SAIGUP study those cases are considered in which, for example, the river flux increases and shifts the whole depositional system into the sea. The angle at which the transitional deposits are stacked on each-other because of this shifting, is called aggradation angle. Three levels of aggradation are modelled here: low, medium and high (Fig. 1). As we will observe later, aggradation can have a dramatic influence on the injection and migration process.

Progradation: The next factor varied is the progradation or the depositional-dip direction. Two types are considered here: up and down the dominant structural dip. Since the model is tilted a little, this corresponds to the lobe direction from flank to the crest or vice-versa (Fig. 1). This has a potential influence on the CO_2 flow from the injection point up to the crest.

Fault: There are three variational dimensions considered for faults in the SAIGUP study: fault type, intensity and transmissibility. However we did not include all of these variations in our work and confined this step to two transmissibilities of almost open and closed faults. Fig. 2 shows the effect of fault transmissibility on the flow pattern. Here we took the compartment type of faults of medium intensity ([3, 5]).

Simulation workflow

A fully automated workflow was designed for this study, starting from variational parameters in the SAIGUP models and ending into comprehensive result outputs based on the objective of the work. As a first step, 54 representative cases are studied using a commercial simulator. However, the parallel aim of future work is to develop fast simulation methods that are suitable for performing thousands of runs, using e.g., a vertically-averaged formulation [6].