The main objectives of CO_2 storage studies are to maximize the injection volume/rate and to minimize the risk of leakage [1]. The problem of CO_2 storage differs from oil recovery prediction not only in the objectives of study, but also in the time scales considered for the process (thousands of years compared to tens of years for CO_2 migration). In addition, the characteristic length scale of the flow is much larger. Working with long temporal and spatial scales and huge amounts of uncertainties poses the question of how detailed the geological description should be. The motivation of this work is mainly to answer two questions related to CO_2 storage:

- How sensitive is the injection and early-stage migration to uncertainty and variability in the geological description?
- What simplifying assumptions are allowed in averaging the geological attributes over scales?

To this end, we use a subset of the synthetic models from the SAIGUP study to perform a preliminary sensitivity analysis for CO_2 sequestration in aquifers. Heterogeneity classes are defined based on different sequence-stratigraphy parameters and levels of shale barriers. We assume two-phase flow with slight compressibility for supercritical CO_2. The injection scenarios are defined based on the objectives outlined above, and important responses are discussed to evaluate the efficiency and risk of the process.

2 Geological descriptions

In this work we question the widespread use of simplified geological descriptions that ignore the detailed heterogeneity in modeling. Our hypothesis is that heterogeneity features like channels, barriers, sequence stratigraphy of facies, and fault intensity/geometry all have a particular effect on flow behavior, both locally and globally, and may significantly alter the injection and migration of CO_2 plumes.

Sound geological classifications and descriptions of key geological features are important to give a realistic description of the sensitivity of CO_2 storage performance. To this end, we have selected four parameter spaces of geological variations from the SAIGUP study [2, 3, 4]. The parameters span realistic intervals for progradational shallow-marine depositional systems with limited tidal influence. In the following, we give a brief description of each.

Lobosity: Lobosity is defined by the plan-view shape of the shore-line. As a varying parameter, lobosity indicates the level at which the shallow-marine system is dominated by each of the main depositional 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