Dear Editor,

Many Thanks for the confirmation of manuscript acceptance. In the second review of our manuscript, the two referees have made several minor comments, which were all considered in the final manuscript revision. The referees have pointed out a few typographic errors and suggested to rewrite some imprecise formulations.

It was further recommended to use the term 'geologic carbon storage' instead of 'geological underground utilization' in the title of the manuscript. However, our study results are of general character related to subsurface fluid storage, so that we decided to maintain our findings of injection-related brine displacement transferable to various other types of subsurface storage. Thus, we decided to use the following title 'Fault damage zone volume and initial salinity distribution determine intensity of shallow aquifer salinization in subsurface storage'.

It was recommended to delete Table 1 or, if not, to explain in more detail on which basis the different studies in the table were chosen. We clarified in the text that all studies listed in Table 1 investigate large-scale displacement of resident formation brines resulting from fluid injection (which is actually the topic of our study), for both, real and synthetic locations. Further, one referee suggests to delete the discussion about why Person et al. and Zhou et al. come to slightly different pressure responses as it does not add any benefit to the topic of the paper. However, it was recommended by another referee to add this information to the manuscript in the first cycle of the review process. The disparity between the simulation results is, among other things, related to the fact that different lateral flow boundaries were applied in both studies. That these have a crucial impact on the simulation outcome is also demonstrated in our paper. For this reason, we decided not to delete this part.

Further, it has been pointed out by one referee that both, the 'Summary and discussion' and the 'Conclusion', sections start with a more-or-less long summary and that one summary should be deleted. We deleted the summary in the 'Conclusion' section to avoid a duplication of content.

One referee would like us to omit the discussion on fault displacements in Section 2. We have added this information to the manuscript as a result of the first review cycle, also upon the strong recommendation of another referee. From our point of view, the reader needs to know the fault displacements, since these are directly linked to the width of the fault damage zone, and thus the chosen lateral discretization of our model grid. This is described on page 5, line 29.

One referee noted that it is not sufficiently precise and clear why we used a single-phase flow model. As recommended, we have added the following two arguments to Section 3.3: 1) Potential CO_2 leakage via the faults is not focus of our study. 2) Initial testing has shown

that the difference in pressure response at the faults from using a two-phase model instead of single-phase model is small, compared to other effects studied in the present study.

As recommended, we now use simple descriptors for the three formations. We chose ‘storage reservoir’ for the Detfurth Formation, ‘secondary reservoir’ for the Muschelkalk formation and ‘shallow aquifer’ for the Rupelian basal sand. It was proposed to use also descriptors for the three different fault lengths, such as ‘short fault’ for the 2km fault, ‘main adjacent fault’ for the full fault close to the injection, ‘surrounding faults’ for the three faults that are farther away. However, we believe that our scenario abbreviations clearly identify the different fault zone lengths with, e.g., F1_2kmBc, F1_60kmBc and F1-4_193kmBc and no further descriptors are needed. During manuscript revision, we found that additional abbreviations or descriptors for the faults did not improve understanding and would be rather confusing. For this reason, we only introduced descriptors for the different formations.

Table 3: As suggested, we set the area where salinity in the shallow aquifer is above the drinking water standard in km^2. In Table 3 it was further remarked that the salinization area of Scenario F1_2kmBc* should not be that large and that there might be a typographic error in the table. However, the area affected by a salt concentration exceeding 0.5 g kg^{-1} solution has almost the same size, when applying a salinity gradient or a sharp freshwater-saltwater boundary below the shallow aquifer. But salt concentrations in total are significantly lower in case of a salinity gradient, which we made clear during the first review process by introducing a column in Table 3 showing the average salt mass in kg/m3 in the salinization area. This is emphasized in the text more clearly now.

Figure 3: We believe that it is better to use global coordinates for display instead of local coordinates, since the location should be traceable for the interested reader, so we did not change that. However, the referee also pointed out that in Figure 1 the first reference number of the coordinate system (UTM zone) is missing. This has been corrected.

Figure 4a): As recommended, the order of magnitude difference between the two scales is now mentioned in the figure caption.

It was noted that there are too many figures in the manuscript. We therefore combined several figures and deleted three (old figures 8, 10 and 13) to show only the most important features of the results.

We would like to thank again everyone involved for the very careful and comprehensive review.

On behalf of all co-authors, kind regards
Elena Tillner