slope of this line, which thus represents how the number of plumes increases if the barrier parameter increases one level. For other parameters like fault and lobosity, we follow the same procedure. We use three levels for each parameter and fit a trend through these three points. For example, the first level of fault criteria relates to unfaulted cases, the second relates to open faults, and the third represents cases with closed faults.

Figure 12 shows the sensitivity for three different flow responses. In the upper row, we see that during injection the average aquifer pressure is most influenced by aggradation, while at the end of simulation the most influential parameter is the fault specification. The lack of good vertical communication for low aggradation angles means that the CO_2 is confined to the lower (poor quality) layers and relatively high pressures must be imposed to inject the required amount of CO_2 into the aquifer. For higher angles, the CO_2 can flow more easily upward through channels with higher permeabilities and less pressure support is required. Hence, the negative sensitivity. After the injection ceases, the dominating force is gravity, the main flow direction is vertical, and the pressure is now mostly affected by faults. If the faults are closed, they will prevent the release of pressure through the open boundaries. We also observe that the effect of progradation switches from positive to negative after the injection is stopped: Injecting in the up-dip direction is easier than injecting down-dip, while a down-dip deposition opens up more conductive medium in front of the plume as it migrates toward the crest.

The second row in Figure 12 shows the sensitivity in the number of CO_2 plumes. During injection, the barrier coverage is the most influential parameter, because mud-draped surfaces enhance the lateral flow and force the plume to split rather than migrating toward and accumulating at the crest. Aggradation has a similar effect: the lower the angle is, the more the injected CO_2 spreads out laterally. At the end of simulation, progradation and aggradation are the dominant effects. In particular, higher aggradation angle improves the segregation across layers and thus increases the splitting of plumes through heterogeneities. The impact of the faults is more significant than the figure shows: open faults contribute to split plumes, while the unfaulted cases and the cases with closed faults introduce a small number of plumes. In average, the positive and negative contributions cancel out to almost zero. Finally, the bottom row in Figure 12 reports sensitivities for the total residual volume. Here, aggradation is the most influential parameter during injection and faults the most important parameter during the migration phase.

The discussion is based on the overall trend averaged over all realizations and one should therefore be careful to draw general conclusions. For example, pressure sensitivity values with respect to progradation dip direction are based on only two points: the average over all cases with up-dip progradation and the average over all cases with down-dip direction. In Figure 12, we see that the progradation sensitivity changes polarity from the end of injection to the end of simulation. Squeezing the information of about 80 cases in one point makes it more difficult to make a general conclusion from this result. Figure 13 shows that some cases do not follow the trend shown in Figure 12. While there is a slight increase in the average level of pressure values from Figure 13a to Figure 13b, the average pressure level is decreasing when we compare Figure 13c to Figure 13d.

Similar analyzes have been conducted for other flow responses as well. Altogether, our sensitivity study shows that aggradation is the parameter that has most impact on the flow responses we have studied. Aggradation has either the largest or the second largest sensitivity during both injection and migration for almost all responses. The faulting has the second highest impact. Mostly effected by closed fault, the fault parameter influences the storage capacity and the extent to which a CO_2 plume accumulates under the caprock. Barriers play a dominating role for the splitting of plumes during injection, whereas the progradation affects the gravity segregation through conductive channels during the migration phase and the volume available to flow in the dip direction. Finally, lobosity has small impact compared to the other parameters and can therefore likely be ignored for the fluid responses considered above. However, lobosity has a considerable effect on the lateral movement and splitting of plumes during the migration period and may therefore have a more significant impact on the estimates of point leakage.