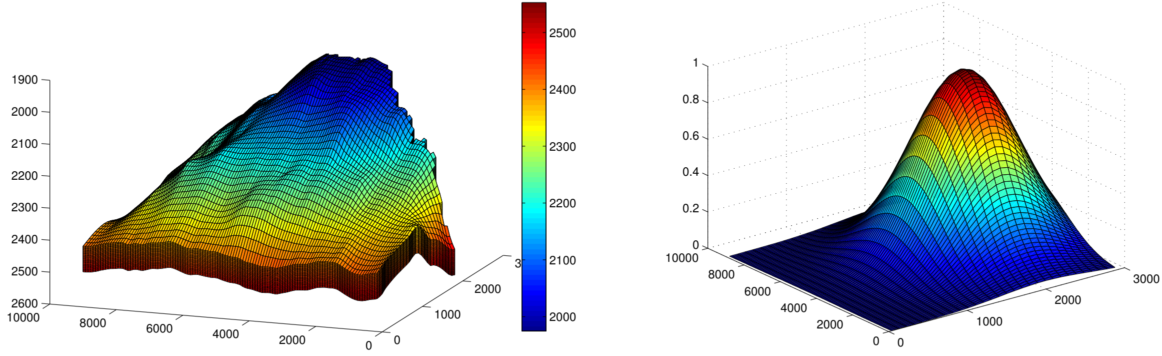

Figure 8: The left plot shows a sample grid geometry with depth values shown in meters. The right plot shows the Gaussian probability distribution for point leakage through the caprock. The distribution is centered at a point on the crest which is in the same slice as the injection point.

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 towards the crest.

The second row in Figure 7 shows the sensitivity in the number of CO_2 plumes. During injection, the barriers coverage is the most influential parameter, because mud-draped surfaces enhance the lateral flow and force the plume to split rather than migrating towards 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 7 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.

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 gradient 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.

5 Leakage Risk

The SAIGUP study does not supply any information about the caprock and its geomechanical properties. We are therefore only able to conduct a conceptual study of the risk associated with point leakage through imperfections in the caprock. To this end, we assume that each point on the top surface has a prescribed probability for being a leakage point. As a simple example, we will assume that the probability for point leakage follows a standard 2D Gaussian distribution centered at a given point on the crest, see Figure 8. Moreover, we will assume that all mobile CO_2 (except for the residual portion) will escape through the caprock if a plume comes in contact with a leakage point. We have seen above that the heterogeneity and tilt of the medium will cause the injected CO_2 to be distributed