In the third group (Figure 15c), low-permeable rocks in the injection layer cause a high pressure buildup around the injection point. If the injector zone is isolated by sealing heterogeneities, the pressure rises in a limited region. However, if the well is connected throughout the medium, and the heterogeneities in the aquifer scale contain relatively low permeability rocks, the pressure build up spreads wider in the aquifer. In Figure 15c, the injection point is located close to a low transmissibility rock. This rises the pressure level in the injector. Other parts of the aquifer are connected with poor quality rocks, resulting in a wide buildup region.

The farthest pulse distance ranges from 8 km to approximately 10 km in the extreme cases. By controlling the injection pressure, the maximum shrinks to slightly above 4 km (Figure 14d).

# 5 Discussion

So far, we reported the model responses that measure the pressure rise and pressure disturbance propagation in the domain. The pressurized volume fraction indicates the actual high pressures that may occur in an injection operation. The buildup volume fraction and the farthest pulse are indicators of how the pressure disturbance is spread in the system. We are interested in limiting both the pressure increase and the distance the elevated pressure propagates into the aquifer.

In most of the results, aggradation angle, progradation direction, and faults play a major role in the pressure behavior. For low aggradation angles, geological layers are made of rock types piled in a parallel stratigraphy. Thus, efficient vertical permeability is the harmonic average of these layers. If any of these layers contain a low-permeability rock, the vertical transmissibility will be low, and injecting into a limited space that is vertically sealed increases the pressure at the injection point.

The progradation direction can dominate the pressure behavior. It is very important to locate the injector in a high permeability zone that is connected to other parts of the domain via permeable channels. Injecting into the riverside of a shallow marine depositional system may result in locating the injection point in low-quality rocks between river branches joining the sea. This fact increases the pressure significantly near the injection point and can result in a high well-bore and aquifer pressure.

Structural deformations due to faulting process can increase the connectivity in the medium. If the overall transmissibility of the aquifer scale is high, the injection pressure releases through the open boundaries. However, if the injection area is surrounded by low-quality medium, the pressure increases in the aquifer and the connectivity enhanced by the fault geometries spreads the buildup region in the domain. On the other hand, sealing faults result in high pressures within closed zones around the injection point, but may also limit the propagation of the pressure disturbance in the domain.

From an operational perspective, pressure limits must be set to keep the operations within safe margins. One approach to study the safety of an operation could be setting critical limits on the pressure responses measured here. These limits should be inferred from realistic operational requirements and can then be used to filter out cases with undesirable/unacceptable pressure behavior. Herein, we assume that the limits are set to be 53 years for the injection