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Density-driven transport process following the seawater indundation of the freshwater lens of the island of Baltrum, Germany

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Due to the growing vulnerability of low-lying coastal zones to flooding by seawater, there is a need for more studies of the impact of inundations on fresh groundwater resources. We present previously unpublished data collected on the island of Baltrum following a devastating storm in 1962, which uniquely show the impact of seawater inundation on a freshwater lens in a siliciclastic aquifer. The field data show that elevated salinities persisted for at least 4 years at the measurement depths of 4 and 6 m, and at least for 6 years at greater depths. Numerical models confirm the importance of density-driven salt fingering. Models that did not consider density effects failed to simulate the observed breakthrough curves. Transient recharge, model dimension and lateral flow modify the details of the simulation results, but in all models density-driven flow dominates the overall system behaviour. The sequestration of intruded seawater into the deeper parts of the flow system, prolongs recovery and enhances the risk of upconing when pumping is resumed too early.