

## Past and future evolution of saltwater intrusion in Southern Denmark

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### ABSTRACT

The border region between Denmark and Germany, adjacent to the Wadden Sea, faces a massive saltwater intrusion reaching up to 20 km inland. It is still an open question where it came from and how it will develop in the future. The region is characterized by a very low topography and complex geology and has undergone dramatic changes in hydraulic conditions during the last millennia. Laying in the direct glacial foreland of the Scandinavian Ice Sheet (SIS) during the last ice age, it was impacted by extreme hydraulic conditions. With the post-glacial sea level rise, part of the area was inundated until a few hundred years ago where humans started to reclaim wide areas from the Wadden Sea. Today, dikes prevent these areas from flooding while drains and ditches keep the water table below ground surface.

In this study we investigate by means of a 3D SEAWAT model the main processes that formed the regional saltwater intrusion during the Holocene and in the future. A complex (hydro)geology paired with historical sea level variations reproduced the observed saltwater intrusion. Several scenarios were then simulated to analyze and quantify the effects of future sea level rise and non-stationarity on the salinization of the aquifers within the coming 200 years. With an expected sea level rise, the saltwater intrusion will likely progress further inland with severe consequences for the local water management. The results show that the deeper aquifers are more affected by non-stationarity while the salinization of the shallow aquifers is caused by sea level rise.

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