Lessons learned from a regional variable density groundwater flow model and implemented climate change scenarios: a Dutch case

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ABSTRACT

The fresh groundwater resources of the Province of Zeeland, The Netherlands, are jeopardized by various causes. Floods, droughts and salinisation of the ground and surface waters are some pressing topics. Sea level rise and climate change threaten the fresh groundwater resources even more. For Zeeland, a 3D-model for density-dependent groundwater flow and coupled solute transport was developed to assess the impact of sea level rise and changing precipitation and evapotranspiration patterns on the freshening and salinisation processes of shallow groundwater systems. SWIM21, the building of the 3D numerical model was presented with the focus on the determination of the complex initial chloride distribution, using different types of (geophysical) techniques (Van Baaren et al). SWIM22, the use of the model as an interpolator to improve the 3D fresh-brackish-saline distribution was presented (Oude Essink et al). For SWIM23, the focus will be on the steps we have taken to improve the quality of this regional model (15 million model cells), and subsequently, on the results of the climate change scenario's. The first problem we had to tackle was the model size. We used a 64-bits computer, converted the MOCDENS3D software to 64-bits, and made sub-models to speed up the simulation time. The next step would be to use the beta version of a parallel computing version of SEAWAT. On top of these ICT-technological changes, we had a close hydrogeological look at the top of the groundwater system in order to decrease the largest fluxes which –through stability criteria- largely determine the length of the transport time steps. In order to improve the accuracy of the modelling results to monitoring values, we did tests with the number of particles and transient versus steady state groundwater flow. By building this model, we think we found a balance between simulation time and accuracy for regional variable-density groundwater flow models that use the particle tracking method for advective transport (like SEAWAT). At the end of this learning process, we implemented climate scenarios in order to predict the effects on the groundwater system. With this model we can offer two results for other low-lying saline deltaic areas: 1. the lessons learned and research questions for the balance between calculation time and accuracy for regional variable-density groundwater flow models and 2. the effects of climate change on the groundwater system.

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