EGU General Assembly 2023

EGU23-17249, updated on 29 Mar 2024
https://doi.org/10.5194/egusphere-egu23-17249
EGU General Assembly 2023

Effects of surface water boundary condition scaling on modelled groundwater salinity and salt fluxes

Ignacio Farias[1], Gualbert H.P. Oude Essink[1,2], Perry de Louw[2,3], and Marc F.P. Bierkens[2,1]
[1]Department of Physical Geography, Utrecht University, The Netherlands
[2]Unit Subsurface and Groundwater Systems, Deltares, Utrecht, The Netherlands
[3]Soil Physics and Land Management Group, Wageningen University, the Netherlands

Calculating groundwater salinity requires the computation of variable density groundwater flow coupled with salt transport in a 3-D gridded space. This type of groundwater modelling requires large amounts of hydrogeological information, computational power, and thorough hydrogeological knowledge of the area being studied. To overcome limitations in knowledge, data availability and computer run times, these models are simplified which may lead to a lack of accuracy in the results. In this setting, enlarging the cell size and/or simplifying surface-groundwater interactions (boundary conditions, BC) are common solutions to achieve feasible runtimes at the expense of precision.

Over the last decades, however, computational power has grown exponentially, which, in combination with recent developments involving parallel computing for groundwater models and ever-increasing resolution and availability of datasets, allow for unexplored model resolutions. This immediately raises the question of what level of detail is required to estimate a sufficiently accurate groundwater salinity distribution for the relevant salinization processes in coastal zones for a given management or policy objective.

This research will explore how groundwater salinity distribution and salt fluxes are affected by varying grid sizes and the parameterization of the surface water boundary conditions. To achieve this, we start from the datasets of the Dutch national hydrological model (LHM fresh-salt). Models of a selected area are created with varying grid resolutions from 10 to 250-meter grid cell size. The surface water features are discretized at these same resolutions resulting in specific datasets with scaled conductance values for each resolution. The models are run in cluster environment using a parallelized version of SEAWAT developed by Deltares called iMOD-WQ. With the model results we aim to quantify the effect of grid size on the groundwater salinity distribution and salt loads to the surface and identify the right balance between required resolution and computational effort. Ultimately, we intend to contribute to the development of objective guidelines for model-enabled fresh groundwater management in coastal aquifers.