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Hydrogeology of a young moraine area in NE Germany: Testing hypotheses on subsurface structures with an iterative groundwater modeling approach

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Investigating subsurface structures and properties of young moraine areas is a challenging task due to the heterogeneity of the subsurface combined with limited possibilities of outcrop characterization. To overcome this challenge we suggest a multi-method approach that merges a variety of geophysical, hydrochemical and hydrogeological monitoring data with iterative hypothesis-based modeling of groundwater dynamics.
The focus area of this study is the region of Lake Fürstenseer See, which is located in a young moraine area in the terminal moraine and outwash plain area of the last glacial maximum (Pomeranian) in Mecklenburg-Vorpommern, north-eastern Germany.

The assumed main control on groundwater flow paths of the uppermost aquifer in this region is the depth and the "topography" of the first aquiclude. The groundwater flow model Visual MODFLOW Pro was parameterized based on average hydraulic properties determined from core samples taken during observation well drilling. In a first hypothesis the depth of the aquiclude was assumed to be uniform over the entire region. Data from a nearby climate station was used as input, while well water level dynamics in 23 observation wells and lake water level dynamics were used for validation. In a second iteration, the depth of the aquiclude which was identified at 20 of the wells was interpolated over the area. The resulting groundwater flow paths and dynamics were re-evaluated. In a final step, data from ERT investigations along several transects throughout the area was also included in the interpolation of the depth of the aquiclude. While groundwater dynamics can be evaluated directly by comparison with the observed dynamics at the observation wells, groundwater flow paths are evaluated a) based on the observed differences in water chemistry including isotopic composition at the observation wells and b) based on the observed spatial patterns of groundwater inflow into the lake, which were identified both by lake sediment temperature profiles and an extensive network of piezometers along the shore.