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Characterizing subsurface properties in a young moraine area by combining invasive and non-invasive methods

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Groundwater and lake levels have been decreasing at many locations in northeastern Germany for the last 30 years. However, the reasons for this decline are still unclear. Our investigation aims at a better understanding of this hydrogeological system: its structures, dynamics and control mechanisms. Focus area is the domain of Lake Fürstensee (one of the TERENO field sites of the Helmholtz Association), which is located in a young moraine area in Mecklenburg-Vorpommern. The investigation area consists of the Pommeranian main terminal moraine in the north and the outwash plain in the south.

Currently, no detailed knowledge about subsurface structures, groundwater flow directions and dynamics is available for the lake Fürstensee region. However, as we are looking at a purely groundwater controlled lake system (no surface inflows or outflows), this information is essential for a better understanding of the ongoing processes. First field campaigns were carried out in 2012. The establishment of observation wells, a monitoring system and the investigation of subsurface characteristics with standard methods such as grain size analyses, permeameter tests on disturbed and undisturbed samples as well as pumping tests supplied important first insights. Due to the heterogeneity of the subsurface combined with limited possibilities to identify subsurface structures and boundaries through outcrop characterization, the application of different geophysical approaches seems to be most promising for larger scale surveys. First electric resistivity tomography (ERT) and ground penetrating radar (GPR) surveys along different transects of up to 800 m length have been performed to detect the boundary between aquifer and aquiclude or the lateral extent of both terminal moraine and outwash plain. In order to obtain extensive information on subsurface characteristics by geophysical methods, the creation of site-specific parameter relationships is necessary. Certain geophysical characteristics such as the specific electrical resistance and the electromagnetic wave propagation velocity are controlled by porosity and water content. Hydraulic conductivity on the other hand, does not only depend on overall porosity but also on pore size distributions and is thus a difficult parameter to infer directly from geophysical measurements. However, it might be possible to deduce hydraulic conductivities by combining GPR, ERT and soil physical data sets for the project area. First results of the determined subsurface structures as well as an attempt for a geophysical interpolation of hydraulic conductivities are presented.