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Lacustrine Groundwater Discharge at Lake Hinnensee – Spatial Patterns and their Temporal Stability

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Lacustrine groundwater discharge (LGD) can play an important role for the lake water balance and lake water quality of enclosed lakes. Measuring groundwater- lake interactions is generally challenging and spatial exchange patterns are seldom explored in detail. This study aims at a) identifying spatial patterns of lacustrine groundwater discharge along the shoreline of Lake Hinnensee, b) identifying spatial patterns of LGD along several cross-sections through the lake and c) investigating the temporal dynamics of these flow patterns for both the seasonal and event time scales.

The lake under investigation is located in the lowlands of northeast Germany. The lake has a surface area of 49 ha and the length of the shore line is about 4 km. To monitor LGD at Lake Hinnensee short piezometer transects (2-4 piezometers) were installed every 250 m around the lake. Additional piezometers were installed where major inflow was expected. Vertical hydraulic gradients indicating strength and direction of exchange are measured continuously with pressure sensors. To identify small scale spatial variability vertical temperature profiles were measured every 10 m along 2.35 km of the total shoreline. LGD rates can be determined by fitting the heat transport equation to these profiles. Measurements were repeated in summer 2011, 2012, 2013 and winter 2013 to investigate the temporal stability of the observed patterns.

It is generally assumed that the majority of groundwater inflow occurs in the immediate vicinity of the shore line (the focus area of the temperature surveys and piezometer transects). Strength of hydraulic gradients measured in the piezometers decrease considerably within the first few meters from shore und thus support the general assumption, but no information on groundwater discharge is available within the lake basin itself. To test the hypothesis of minimal off-shore groundwater inflows we installed a 500 m long distributed-temperature-sensing cable on the lake sediment resulting in several transects across the northern part of the lake. Measurements will be carried out in February when temperature differences between lake and groundwater are expected to be strongest.