Complex Interfaces Under Change: Sea – River – Groundwater – Lake
Proceedings of HP2/HP3, IAHS-IAPSO-IASPEI Assembly, Gothenburg, Sweden, July 2013 (IAHS Publ. 365, 85-90, 2014).

Empirical quantification of lacustrine groundwater discharge – different methods and their limitations

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Abstract Groundwater discharge into lakes (lacustrine groundwater discharge, LGD) can be an important driver of lake eutrophication. Its quantification is difficult for several reasons, and thus often neglected in water and nutrient budgets of lakes. In the present case several methods were applied to determine the expansion of the subsurface catchment, to reveal areas of main LGD and to identify the variability of LGD intensity. Size and shape of the subsurface catchment served as a prerequisite in order to calculate long-term groundwater recharge and thus the overall amount of LGD. Isotopic composition of near-shore groundwater was investigated to validate the quality of catchment delineation in near-shore areas. Heat as a natural tracer for groundwater–surface water interactions was used to find spatial variations of LGD intensity. Via an analytical solution of the heat transport equation, LGD rates were calculated from temperature profiles of the lake bed. The method has some uncertainties, as can be found from the results of two measurement campaigns in different years. The present study reveals that a combination of several different methods is required for a reliable identification and quantification of LGD and groundwater-borne nutrient loads.

Key words lake; lacustrine groundwater discharge; water balance; heat as a tracer; stable isotopes; groundwater surface water interaction