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Groundwater discharge to lakes (GDL) – the disregarded component of lake nutrient budgets

J. Lewandowski, K. Meinikmann, F. Pöschke, and G. Nützmann

Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Ecohydrology, Berlin, Germany (lewe@igb-berlin.de)

Eutrophication is a major threat to lakes in temperate climatic zones. It is necessary to determine the relevance of different nutrient sources to conduct effective management measures, to understand in-lake processes and to model future scenarios. A prerequisite for such nutrient budgets are water budgets. While most components of the water budget can be determined quite accurate the quantification of groundwater discharge to lakes (GDL) and surface water infiltration into the aquifer are much more difficult. For example, it is quite common to determine the groundwater component as residual in the water and nutrient budget which is extremely problematic since in that case all errors of the budget terms are summed up in the groundwater term. In total, we identified 10 different reasons for disregarding the groundwater path in nutrient budgets. We investigated the fate of the nutrients nitrogen and phosphorus on their pathway from the catchment through the reactive aquifer-lake interface into the lake. We reviewed the international literature and summarized numbers reported for GDL of nutrients. Since literature is quite sparse we also had a look at numbers reported for submarine groundwater discharge (SGD) of nutrients for which much more literature exists and which is despite some fundamental differences in principal comparable to GDL.