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Submarine and lacustrine groundwater discharge and groundwater-mediated nutrient transport

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Submarine groundwater discharge (SGD) and its role in marine nutrient budgets are well known since the last decade. The freshwater equivalent, lacustrine groundwater discharge (LGD), is often still disregarded, although first reports of LGD are more than 50 years old. Based on a literature review we analyzed the broad range of water volumes discharging into lakes and oceans. Additionally, we summarized typical groundwater-borne nutrient loads. Both, nitrogen and phosphorus can be mobile in near-shore aquifers. We identified nine different reasons why groundwater has long been disregarded in both freshwater and marine environments. Although there are some fundamental hydrological differences between SGD and LGD, caused primarily by density-driven seawater recirculation that occurs only in marine settings, there are also a lot of similarities (e.g. focusing of discharge to near-shore areas). We found that nutrient concentrations in groundwater near the groundwater-surface water interface might be anthropogenically increased by several orders of magnitude resulting in severe nutrient loads for the receiving water bodies. Unfortunately, due to spatial heterogeneity of aquifer characteristics and biogeochemical processes at and near the sediment-water interface, the quantification of groundwater-borne nutrient loads is challenging.