Direct inputs of nutrients via groundwater to near-shore zones of large water bodies: Regional scale approaches and impact

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Dissolved nutrients such as nitrogen (N) and phosphorus (P) associated with direct groundwater discharge may influence near-shore zones of large water bodies (oceans and large lakes such as the Laurentian Great Lakes, part of the U.S. National Ocean Policy implemented by the Obama administration), and contribute to eutrophication, hypoxia or harmful algal blooms. There is, however, a lack of quantitative approaches, especially at regional to continental scales. While local field methods or models are available, targeted research at larger scales is scarce. Here, we review available assessments of direct groundwater discharge and nutrient transport, using examples from large inland water bodies (here, the Laurentian Great Lakes), as well as coastal areas surrounding tropical islands. We demonstrate example approaches, reaching from the use of the ratio of coastline length to hinterland area as first-order approach to estimate the importance of direct groundwater discharge compared to rivers [1]. We compare this to large-scale hydrological and hydrogeological models, coupled to geochemical information. Knowledge of near-shore groundwater quantity and/or baseflow (e.g., [2]), combined with assessments of nutrient concentrations in groundwater bodies (e.g., [3]), can set an upper boundary for the potential contribution, and identify likely hot spots of nutrient delivery via this discharge pathway.

[1] Moosdorf N., et al. (2015). *Grundwasser* **20**(**1**), 53-67. [2] Kornelsen K.C. and Coulibaly P. (2014). *J. Great Lakes Res.* **40**, 247–256. [3] Ontario Provincial Groundwater Monitoring Network (PGMN) Program (2013). Groundwater Level Data, Groundwater Chemistry Data, and Precipitation Data.