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Lacustrine groundwater discharge (LGD) to a closed- basin lake – a concept for estimating the effects of a changing catchment on the lake water balance

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In the water balance of closed-basin lakes, which are common in young glacial landscapes of the North German Plains, groundwater is an important term beside precipitation and evaporation. A quantification of groundwater impacts on the lake water balance is still a challenge although there is a broad spectrum of methods from point measurements over integrative methods to numerical modelling approaches. All modelling approaches rely on a fixed lake catchment. This might be an adequate assumption for steady state estimations and catchments in hilly and mountainous landscapes but it is not for the long run in flat terrain such as the North German Plains. Of course, the calculation of the temporal development of a water balance requires the availability of time series of groundwater levels and lake water stages. Such hydraulic data set covering more than 50 years with a monthly resolution is available for the Lake Stechlin area. A former study already pointed out that the lake catchment differs between wet an dry years, but in that study no estimation of the water balance was conducted. We present a three dimensional conceptual model, which is based on the time series of the hydraulic data, additional geological and geomorphological information as well as estimations of spatial and temporal groundwater recharge rates within the area. At first, a geological model is established on the basis of about 50 drill logs. Based on hydraulic head data the temporal development of the catchment size is determined and the maximum and minimum area for groundwater exfiltration into the lake and surface water infiltration into the aquifer are derived. In the end, the annual varying catchment size is combined to the annual varying groundwater recharge to get an annual “steady state” estimation of the lake water balance. This model is the basis for further numerical modelling.