



Multi-decadal lake-level dynamics in north-eastern Germany as derived by a combination of gauging, proxy-data and modelling

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In the glacially formed landscape of north-eastern Germany pronounced hydrological changes have been detected in recent decades, leading to the general question how lake levels and related groundwater levels perform in a long-term perspective, i.e. during the last c. 100 years. But long-term lake-level records are rare; most observations do not start before the late 20th century. Therefore, the potential of historic hydrological data, comprising drowned trees (as a geo-/bioarchive) and aerial as well as map imagery (as a document archive) was tested in order to derive discrete-time lake-level stands. These data are contrasted with lake-level simulations, obtaining a continuous-time series. Two small glacial lakes without connection to the stream network (i.e. closed lakes) were investigated in the Schorfheide area, c. 70 km north of Berlin. Both are dominantly fed by groundwater and precipitation but differ in their hydrogeological and catchment characteristics. For one lake a c. 40 year-long gauging record is available, showing high lake levels in the 1980s followed by a lowering of c. 3 m till the mid-2000s. In both lakes submerged in situ tree remains were discovered and dated by dendrochronology, revealing low lake levels during the first half of the 20th century. One lake was almost completely dry until c. 1960. Aerial photos provided data on lake levels since the 1930s which are corroborated by evidence of topographic mapping. Combining the empiric data with retrograde lake-level modelling, a well-proven lake-level record can be established for one lake that covers the last c. 90 years. The same general lake-level dynamics could be reconstructed by means of proxy data for the other lake. In both cases climate has been the dominant driver of lake-level dynamics. Comparisons with other multi-decadal lake-level records from the region show that these differ, depending on the hydrological lake type which modifies water feeding and water level. The results clearly showed that lake levels exhibited substantial long-term changes that should be taken into account in future hydroclimatic and hydrological studies.