Geophysical Research Abstracts
Vol. 16, EGU2014-861, 2014
EGU General Assembly 2014

Disentangling Holocene lake level changes with a transect of lake sediment cores – a case study from Lake Fürstenseer See, northeastern Germany

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Deciphering the main processes contributing to lake and landscape evolution in the northern central European lowlands on different temporal scales is one of the main targets of the Virtual Institute of Integrated Climate and Landscape Evolution Analysis (ICLEA) of the Helmholtz Association. In the context of future climatic changes especially the hydrological system is a vulnerable landscape component that showed considerably large changes in the recent past. The analysis of lake sediment archives can help to infer long-term dynamics of regional lake and groundwater levels, although available proxy information needs to be studied carefully, as water level changes are only one trigger.

Lake Fürstenseer See (53°19'N, 13°12'E, lake level in 2009: 63.3 m a.s.l.) formed after the retreat of the Weichselian ice sheet in a subglacial channel in the direct forefront of the Pommerian ice margin. The ∼2 km2 large lake (zmax = 24.5 m) has a (sub-) surficial catchment area of ∼(20) 40 km2 including other smaller lakes and peatlands. In the past, the lake system was artificially dammed for the operation of water mills. Located within the well-drained sandur substrate, the lake levels vary with groundwater levels in response to hydrological and catchment-related groundwater recharge. Detrital matter input from fluvial activity can be excluded.

Lake sediment cores at four sites along a transect down to 23 m water depth show distinct sediment facies patterns. Stratigraphic descriptions and non-destructive continuous micro-XRF scanning allowed the differentiation of the main sediment facies, which were microscopically described using thin sections. Quantification of total organic and inorganic matter (TOC, TIC, C/N-composition) and discontinuous macrorest, diatom and Cladocera analysis helped to approach the sedimentation history. Stable isotopes of (delta-180, delta-13C) were used for characterization of carbonates. A high amount of non-reworked terrestrial plant remains from prominent facies shifts were dated with AMS-14C and allowed to link the different cores, assess individual sedimentation rates and to evaluate sediment focusing in the lake.

Carbonatic and organic gyttjas are the main sedimentary components related mainly to authigenic production. Sometimes, carbonates show detrital mineral structures and correlations with allochthonous components (K, Ti, Si) that can only be provided by reworking of shore and slope material or in times of intense aeolian transport. Sandy facies dominate only at near-shore, steep sites and form distinct layers at the current sediment limit. A robust statistical analysis considering compositional data constraints allows an objective compilation of indications for lake level change from water depth-related habitat changes and shore erosion. They oppose detrital matter input from aeolian processes in times of anthropogenically-cleared forests. A first lake level reconstruction from the Early Holocene to recent times will be presented and linked to climatic and/or anthropogenic drivers of regional hydrological changes.