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Validation of varve-based chronology for uppermost sediments using Cs-137: case study of Lake Żabińskie, northeastern Poland

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Lake Żabińskie is a study site of the CLIMPOL project, a joint Polish-Swiss initiative aiming at quantitative reconstruction of climate change in northern Poland during the last millennium. The lake is located in the Masurian Lakeland (54°07'54."N; 21°59'01.1"E) and presents features typical for kettle-hole lakes, i.e. small surface area (41.6 ha) and considerable depth (44.4 m). The catchment is dominated by glacial and fluvioglacial sediments deposited during the Vistulian glaciation. A set of gravity and piston cores was collected from the deepest part of the lake during field works carried out in 2011 and 2012. Undisturbed sediment cores were collected from a coring platform using 90 mm diameter UWITEC gravity and piston corers.

The sediment record shows laminated structure which was recognized as biogenic (calcite) varves. Varve identification was based on microscopic analysis of thin sections. Three independent counting enabled estimation of the number of varves and counting uncertainty for the last 120 years. However, complex structure of varves including multiple calcite laminae within one-year-deposition caused problems with defining varve boundaries in some sections. To verify the varve counting we used Cs-137 as an independent and unambiguous chronostratigraphic marker. Samples for Cs-137 measurements were taken in 3-years resolution according to estimated varve boundaries. The activity of Cs-137 was determined by gamma-ray spectrometry using HPGe well-type detector (Canberra). The obtained Cs-137 profile shows clearly two maxima: the first peak at the depth ca. 32 cm can be interpreted as deposition of radionuclides in the Northern Hemisphere after nuclear weapon tests in 1963 and the second peak at the depth ca. 13 cm is related to fallout after Chernobyl reactor accident in 1986. These two validation points were used to verify the varve time scale and support substantially our varve counting strategy.