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# Construction and validation of calendar-year time scale for annually laminated sediments – an example from Lake Szurpiły (NE Poland)

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## Abstract

The composite sediment profile (12.39 m) from Lake Szurpiły (NE Poland) represents an annually laminated organic-carbonaceous gyttja occasionally interrupted by turbidites and massive sand layers. This study focuses on the 7.58-m long and almost continuously varved top section of the profile, which produced a 8410-year long varve chronology with a cumulative counting error of  $\pm 1.24\%$ . The age-depth model was established by multiple microscopic varve counts and improved by the application of independent radiometric dating methods ( $^{210}\text{Pb}$ ,  $^{137}\text{Cs}$ ). Ten additional AMS  $^{14}\text{C}$  dates are consistent with varve counts. In some sections, missing varves were identified as a result of erosional processes related to turbidite deposition. Varve thickness ranges

from less than 0.1 to 13.7 mm (mean: 0.83 mm; std: 0.75 mm) with highest variability during the last 1500 years. The accuracy of the varve chronology depends mostly on the regularity of the varve thickness and the distinctness of varve boundaries, and was not influenced by the varve thickness itself. Even though manual and semiautomated varve counting show similar results of the total amount of varves, with the difference of only 0.56%, the comparison between those two methods in intervals of 200 years indicates potential problems, especially for sections with complex lamination and turbidites. We found that semiautomatic varve counting overestimated the varve boundaries in sections with erosive turbidites. Our results confirm the importance of validation of varve chronologies by independent dating methods and caution in relying on automated methods.

Keywords::

- lacustrine sediments
- biogenic varves
- varve chronology
- automatic varve counting
- radiometric dating
- age-depth model
- north-eastern Poland

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