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Evaluating the age-depth models based on coupled ^{14}C and ^{210}Pb data

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^{14}C and ^{210}Pb methods are regularly used to determine ages and accumulation rates of peat, fen and lake sediments. The overall aim is to estimate the age of discrete layers, which were analysed for environmental proxies. Ideally, the age-depth models should fit the investigated proxy in terms of resolution and give precise results. Nevertheless, the differences in the nature of dating methods and statistical treatment of data need to be considered.

Both ^{14}C and ^{210}Pb signals are integrated over a considerable period. Moreover, they originate from different sources. ^{210}Pb is bound to aerosols and trapped by peat while ^{14}C is bound from atmospheric CO_2 by photosynthesis. Hence, ^{210}Pb gives the time span during which the aerosol has been buried, whereas the ^{14}C date gives the time of death of a plant.

After the analysis, the results are usually combined into an age-depth model. This process involves statistical treatment of data during which specific assumptions and simplifications are made. Depending on the algorithm, they lead to alterations in modelled ages compared to unmodelled data. Principally it is a desired result–increasing the robustness and decreasing the uncertainty of the age-depth model. In worse cases models alter the modelled ages to an unacceptable extent, which may be overlooked if the results are treated automatically.

We test the performance of various age-depth modelling algorithms (OxCal P_Sequence, Bacon, clam, MOD-AGE) on a selected true dataset where ^{14}C and ^{210}Pb data overlap and are used simultaneously. Afterwards, a point estimate is selected and used for proxy analysis on a time scale and for calculation of the accumulation rates. We also check the influence of ^{210}Pb calculation method (CRS, ModAge, extrapolation technique) on derived age-depth models.

Together with the thickness of analysed samples the age model provides an information about the time resolution of proxy analysis. While the age-depth curves, except outstanding circumstances, give relatively similar answers within 95% uncertainty ranges, the differences are observed in point estimates and accumulation rate, and they may be relevant for the palaeoenvironmental studies. With this exercise we attempt to assess the uncertainty beyond simple age errors reported from the measurements and age-depth modelling.