



## **What is the true age uncertainty of radiocarbon dated Holocene records?**

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Radiocarbon-based age-depth models are the backbone of the chronology of Holocene sediment records. The uncertainty of such age-depth models is often estimated from the uncertainty of the calibrated radiocarbon samples. A necessary assumption hereby is that the age of the samples is representative for the proxies in the same sediment layer they originate from. Here we generate radiocarbon and multiple temperature proxy data in three Holocene sediment cores from the same multi-corer employed in the Southwest Pacific. Surprisingly, whilst radiocarbon ages at the same sediment depth strongly differ between the tubes, multiple independent proxy time-series measured in each of the sediment cores suggest stratified sediments at the site. This is based on the finding that proxy time-series correlate significantly better between sediment cores when analyzed over depth, rather than against core-specific age-depth models based on the radiocarbon dates. If our site is not a pathological special case – an argument which we have no evidence for – our finding has important implications for age-depth modeling and the interpretations of paleoclimate time-series. It suggests that the true age uncertainty of a sediment layer can be much higher than the uncertainty obtained from the radiocarbon dates. An alternative but less likely hypothesis is that the proxy values are modified post-deposition in the sediments, resulting in more consistent stratification than the original climate signal time-series. Our study demonstrates the usefulness of replication of the proxy time series and radiocarbon dates in the quest for chronologic precision and proxy reliability, which are crucial for a more quantitative understanding of Holocene climate evolution.