EGU2020-9422
https://doi.org/10.5194/egusphere-egu2020-9422
EGU General Assembly 2020

New approaches to radiocarbon calibration arising from statistical developments in IntCal20

Christopher Bronk Ramsey[1], Timothy Heaton[2], Maarten Blaauw[3], Paul Blackwell[2], Paula Reimer[3], and Marian Scott[4]

[1]University of Oxford, School of Archaeology, Oxford, UK (christopher.ramsey@rlaha.ox.ac.uk)
[2]University of Sheffield, School of Mathematics and Statistics, Sheffield, UK
[3]Queen's University Belfast, School of Natural and Built Environment, Belfast, UK
[4]University of Glasgow, School of Mathematics and Statistics, Glasgow, UK

Calibration is a key element of the radiocarbon dating methodology and the underlying Bayesian statistical approach taken, and algorithms used, are well established and used in calibration software and associated analysis packages. These calibration methods are based on a calibration curve which provides a mean estimate for the radiocarbon isotope ratio (fractionation corrected) expected in samples, and the associated standard uncertainty, both as a function of time (or calendar age). The measured samples also have their radiocarbon isotope ratio reported in the same form and so the calibration process involves comparison of the sample radiocarbon measurements with the calibration curve at different points on the calendar age scale. This then yields a probability distribution function, with associated highest probability density ranges, for the sample calendar age. We discuss here how improvements in the construction of the IntCal20 curve offer new opportunities, enabling users to obtain more from the calibration curve than previously possible and address some of the limitations of previous calibration approaches.

Previous approaches to calibration assumed that the values of the calibration curves at any time were normally distributed around their estimated mean. However, there are time periods where the distribution of these curves are not well represented by such a normal distribution. This is potentially significant even for calibrations of single samples. The new IntCal20 curve generates multiple possible calibration curves, providing us with the opportunity to identify and adapt to such non-normality. A second limitation of previous approaches to calibration arises when multiple determinations are used within a broader chronological model. In such cases the usual assumption is that the calibrated uncertainties are independent. This is certainly not the case if all the samples are the same age (which is currently addressed by combination before calibration) but also is potentially wrong if the samples are close enough in age for there to be correlated uncertainty in the calibration curve. Again, using the collection of possible curves provided in the construction of IntCal20, rather than just the summary curve, we look at possible solutions to this challenge. The implications for high-precision chronologies are also discussed.