THE PROBLEM OF CALIBRATION
A possible way to overcome the drawbacks of age models

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The "calibration" curve relates 14C ages to true ages but results in irregular, multimodal age distributions.

From Calibrated Ages to Proxy Values
A Simple How-To-Get-There

Pick an age of your choice...
... and follow the dashed line clockwise.
E.g., from the two calibrated ages: 1474 yrs calBP (cyan) and 2211 yrs calBP (yellow), go up to their 14C ages. Turn right. Go straight to the respective weight functions (near their highest peaks).

Go down to the proxy measurements to a value equaling the weighted mean of the proxy observations using the weight function. Turn 90° clockwise and go straight till you are at the age you started with. The height you are at is the expected proxy value for that age (marked with a circle and suitable error bar).

Radiocarbon (14C) age measurements are few and erroneous.

Using an artificially simulated active growth, we replicated noisy 14C age measurements with a random error proportional to the age (marked in red).

We apply a nonparametric Bayesian regression [1] on the age-depth observations to get posterior probabilities of ages at those depths where the proxy is measured.

The regression estimate is shown in green.

Using Bayes' Theorem, we construct "weight" functions which tell us: Given any calibrated age, which depths are more likely to correspond to that age?

In summary, we present a new, analytical method for proxy estimation that circumvents the intermediate step of a proper age model. This overcomes limitations of existing age modelling procedures such as the assumption of Gaussianity of calibrated age distributions. The resulting confidence bounds represent the true amount of uncertainty in the data.

References:

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