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## Synchronization of layer-counted archives using a statistical age-depth model

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Layer-counted paleoclimatic proxy records have non-negligible uncertainty arising from the dating process. Knowledge of this uncertainty is important for a rigorous propagation to further analyses; for example for identification and dating of abrupt transitions in climate or to provide a complete uncertainty quantification of early warning signals. This dating uncertainty can be quantified by assuming a probabilistic model for the age-depth relationship. We assume that the number of counted layers per unit of depth can be described using a Bayesian regression model with residuals following an autoregressive process. By synchronizing the chronologies with other archives one can constrain the uncertainties and correct potential biases in the dating process. This is done by matching the chronologies to tie-points obtained by analyzing different archives covering the same period in time. In practice, tie-points can be associated with a significant amount of uncertainty which also needs to be accounted for. We present a theoretically consistent approach which, under certain assumptions, allows for efficient sampling from synchronized age-depth models that match the tie-points under known uncertainty distributions. The model and associated methodology has been implemented into an R-package.