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Transdimensional Inference of Archeomagnetic Intensity Change

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One of the main goals of archeomagnetism is to document the secular changes of Earth's magnetic field by laboratory analysis of the magnetization carried by archeological artefacts. Typical techniques for creating a model of temporal change include assuming a prescribed temporal discretisation which, when coupled with sparse data coverage, requires strong damping in order to ensure smoothness.
Because such damping is often chosen arbitrarily, and applied to the entire time series, interpretation and detection of rapid changes and frequency content may be difficult. Key to proper modelling (and physical understanding) is a method that places a minimum level of regularisation on any fit to the data.

Here we apply the transdimensional Bayesian technique to sparse archeointensity datasets, in which the temporal complexity of the model is not set a priori, but is self-selected by the data. The method produces the posterior distribution of intensity as a function of time, which is a useful tool for archeomagnetic dating. By extending the model to include the sample ages within a hierarchical Bayesian framework, we are also able to calculate the posterior distribution of the age of any individual contributing sample. We demonstrate the power of this technique within archeomagnetism by showing the results of its application to a variety of datasets.