



Bayesian inference of local geomagnetic secular variation curves: application to archaeomagnetism

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The errors that occur at different stages of the archaeomagnetic calibration process are combined using a Bayesian hierarchical modelling. The archaeomagnetic data obtained from archaeological structures such as hearths, kilns or sets of bricks and tiles, exhibit considerable experimental errors and are generally more or less well dated by archaeological context, history or chronometric methods (14C, TL, dendrochronology, etc.). They can also be associated with stratigraphic observations which provide prior relative chronological information. The modelling we propose allows all these observations and errors to be linked together thanks to appropriate prior probability densities. The model also includes penalized cubic splines for estimating the univariate, spherical or three-dimensional curves for the secular variation of the geomagnetic field (inclination, declination, intensity) over time at a local place. The mean smooth curve we obtain, with its posterior Bayesian envelop provides an adaptation to the effects of variability in the density of reference points over time. Moreover, the hierarchical modelling also allows an efficient way to penalize outliers automatically. With this new posterior estimate of the curve, the Bayesian statistical framework then allows to estimate the calendar dates of undated archaeological features (such as kilns) based on one, two or three geomagnetic parameters (inclination, declination and/or intensity). Date estimates are presented in the same way as those that arise from radiocarbon dating. In order to illustrate the model and the inference method used, we will present results based on French, Bulgarian and Austrian datasets recently published.