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Bootstrap-Bayesian OSL approach for poorly-bleached sediment sequences tested with dendrochronological age constraints

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Optically stimulated luminescence (OSL) dating is widely accepted as a cornerstone dating method for sediments. The method is particularly suitable for aeolian sediments formed between 10 and 100 ka, but is also widely applied to non-ideal deposits.

Where light exposure prior to burial is insufficient for complete resetting of the OSL signal in all grains, additional processing is needed to determine accurate burial ages. The Minimum Age Model (MAM; Galbraith et al., 1999) has proven to be very powerful for such analysis, but results on sequences of poorly-bleached samples indicate that MAM uncertainty estimates are too optimistic.

We have recently proposed a method to improve MAM uncertainty estimates (Cunningham & Wallinga, 2012). This method involves repeated calculation of the MAM result, with slightly changing input data and model parameters. Resulting uncertainty ranges are wider and more realistic than those of the standard MAM. Moreover, the approach allows construction of probability density distributions of age which can be used for Bayesian modelling (e.g. Oxcal) to combine data of different samples and/or data obtained using other methods.

Here we explore the possibilities of the bootstrapped MAM approach combined with Bayesian analysis by detailed investigation of a 2-m thick sequence of aeolian deposits formed during the past 150 years. Processed OSL results on ten samples taken in a vertical sequence compare favourably with dendrochronological age constraints on stem discs taken from buried sections of the tree.

References:
Galbraith et al., 1999. Optical dating of single and multiple grains of quartz from Jinmium rock shelter, northern Australia, part 1, Experimental design and statistical models. Archaeometry 41, 339-364.
Cunningham & Wallinga, 2012. Realizing the potential of fluvial archives using robust OSL chronologies. Quaternary Geochronology, provisionally accepted.

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