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Quantifying uncertainty on layer-counted chronologies for palaeoclimate reconstruction based on ice cores

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One method for providing chronologies for palaeoclimate reconstructions based on ice cores is that of layer counting. The approach used assumes that physical and chemical properties in the core vary on an annual cycle and that, if we can count the number of cycles reliably, we will know how many years have elapsed. Such counting is currently done by hand by several people and the uncertainty is quantified using heuristic methods which simply summarise the number of layers that were hard to count or that two counters could not agree upon. As a result, we do not have probabilistic statements about the uncertainties involved.

Without such knowledge of chronological uncertainty, it is very difficult to compare or combine information from ice cores with information from other climate archives. For example, there are now several fully probabilistic methods for obtaining radiocarbon-based chronologies for palaeoclimate records based on lake sediments which cannot formally be compared with those from ice cores because there is insufficient information about the structure and scale of the chronological uncertainty on the ice cores.

In this presentation, we report on the development of a Bayesian statistical method giving a probabilistic assessment of the number of layers in an ice core, using an approach known as 'reversible jump Markov chain Monte Carlo'. This is a key step towards automated ice core layer counting, and towards the coherent combination of layer counting with other forms of data.