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Quantifying uncertainty on chronologies for palaeoclimate reconstruction from ice cores: glaciological models in focus

K Klauenberg (1), PG Blackwell (1), CE Buck (1), and R Röthlisberger (2)

(1) University of Sheffield, Department of Probability and Statistics, Sheffield, United Kingdom (k.klauenberg@sheffield.ac.uk), (2) British Antarctic Survey, Cambridge, United Kingdom

Like all palaeoclimate reconstructions, those based on properties of ice cores rely on the construction of good chronologies. An obvious method for constructing such chronologies involves identifying and counting annual layers in the core; however this is only applicable where suitable high-resolution data exist. Chronologies based on glaciological models provide a powerful alternative and conventionally match depth to time via a deterministic accumulation and ice flow model. As a result, they offer an apparently precise chronology once certain crucial parameters, such as the modern accumulation rate of ice, have been fixed.

In this presentation, we explore the information available with regard to these crucial parameters and how to learn about potential errors in the glaciological model itself. Having established the nature and scale of these uncertainties, we combine the glaciological model with a new Bayesian statistical modelling approach which allows us to propagate these uncertainties through to uncertainties in the chronology. One conclusion of this research is that even fairly small uncertainty on model parameters can lead to substantial uncertainties on the resulting chronologies.

The approach we demonstrate will eventually lead to a fully probabilistic framework for chronology construction in which information from a range of dating methods and a range of different locations can coherently be combined.