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Comment on article by Blackwell and Buck

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1 Introductory remarks

It is a pleasure to discuss not just an interesting paper but in fact an excellent project: the successful infiltration of a body of physical science by modern Bayesian methods. The story of that project is a classical mix of cutting edge statistical methodology combined with years of dogged ground work, carefully building credibility in the right places. It is a most suitable story for a Case Studies meeting.

From the point of view of Statistics per se, this project is an instance of a wider theme. From a theoretical point of view the theme is of an underlying stochastic process - here a Gaussian random walk - given which the likelihoods of the observations decompose multiplicatively reflecting conditional independence. MCMC provides an algorithm for the inversion. From the point of view of environmental statistics, the wider theme is of 'data synthesis' - scraps of data scattered through space and time, being of variable quality, and brought together *for inference* by the underlying latent process, taken to be 'smooth' in some sense, and modelling assumptions of conditional independence.

We believe that projects such as this add to the credibility of the wider Statistics community, and this Case Studies paper should assist in developing both wider themes. We expand below on some examples, necessarily reflecting some of our work, some of which is collaborative with Professor Buck. The applied theme, which we address first, is of course much wider than environmental statistics, but my pointers in other directions will be weaker.

2 Scraps

In the present paper the scraps are data on ^{14}C from objects that contain information on calendar age. The underlying space-time process is the varying amount of ^{14}C in the past atmosphere. In this specific context the spatial dimension plays no role, as the atmosphere is supposed to achieve perfect mixing of ^{14}C. Studies in which we have been involved include eg Haslett et al. (2006) where the focus is the climate of the past atmosphere of Ireland for the past ∼13,000 years for example, or more generally of regions such as Europe. Now the scraps are proxies: eg pollen in cores extracted from lake sediment, where changes in the relative frequencies of different types of pollen reflect vegetation response to climate change.

The objective of palaeoclimate reconstruction is more accurately described as using modelling to reduce the uncertainties about past climate. A key step is to regard past

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