Novel Bayesian models for past climate reconstruction from pollen records

L. Ilvonen[1]*, L. Holmström[1], H. Seppä[2] and s. Veski[3]

[1]*Department of Mathematical Sciences, University of Oulu, P.O. Box 3000, FIN-90014 University of Oulu, FINLAND*
(*correspondence: liisa.ilvonen@oulu.fi)
[2]*Department of Geosciences and Geography, University of Helsinki, P.O. Box 64, FIN-00014 University of Helsinki, FINLAND*

[3]*Institute of Geology, Tallinn University of Technology, Ehitajate tee 5, 19086 Tallinn, ESTONIA*

Understanding and predicting future environmental changes is partly based on what is believed to have happened in the past. We use Bayesian hierarchical multinomial regression models to reconstruct past climate from fossil pollen records since these records provide continuous and long-term information on climate variation from the times which are not covered by instrumental records.

The simplest model describes a single core reconstruction with a fixed chronology. We propose to extend such a basic approach in two important ways. First, we introduce a single core model with time uncertainty. The handling of time uncertainty in the sediment sample dates is integrated as a separate module in to the hierarchical model. Second, a multi-core model is introduced. This multi-core model takes into account correlations in the environmental variable both within each core (temporal dependence) and between the cores (spatial dependence). All three models are applied to reconstruct the Holocene annual mean temperature from pollen records from Finland, Sweden and Estonia.

References:

Holmström, L., Ilvonen, L., Seppä, H. and Veski, S., 2015. A Bayesian spatiotemporal model for reconstructing climate from multiple pollen records. To appear in the Annals of Applied Statistics.
Ilvonen, L., Holmström, L., Seppä, H. and Veski, S., 2015. A Bayesian multinomial regression model for paleoclimate reconstruction with time uncertainty. Submitted for publication.