Geosci. Model Dev. Discuss.,
doi:10.5194/gmd-2016-227-RC2, 2016

Geoscientific Model Development Discussions
Open Access
EGU

Interactive comment on "BUMPER v1.0: A Bayesian User-friendly Model for Palaeo-Environmental Reconstruction" *by* Philip B. Holden et al.

A. Parnell (Referee)

andrew.parnell@ucd.ie

Received and published: 16 November 2016

This paper introduces a Bayesian model (nicely acronymed 'BUMPER') to reconstruct palaeo-environmental variables from various proxies given modern training data and fossil samples. The model contains two neat ideas which I haven't seen before, namely that of using a mixture likelihood to model both abundance and presence/absence, and the idea of scoring training sets according to their richness and diversity.

I do have concerns about the mathematical model and the way it is described. As somebody who lives and breathes these types of models I found the mathematics confusing and my guess is that they will go straight over the head of the average reader of this journal.

Printer-friendly version

Discussion paper

- Starting with Equation 1, it seems to be missing a product term, which I think should appear after the proportionality constant. Either that or each SRC is being calculated for each taxa, species and site combination. This seems unlikely.

- Equation 2 seems to suggest that this is the normalising constant, but that can't be the case as the Bayes equation is p(SRC|y) = p(y|SRC)p(SRC)/p(y). It's p(y) that needs to be in the normalising constant.

- Equations 3 and 4 suggest that the likelihoods are all only known up to proportionality and the proportionality component isn't mentioned. I think these should all be equals signs.

- Equation 6 suggests that there is another Bayesian model being fitted. It's thus not clear whether there is one model being fitted (which is all that is required) or whether multiple Bayesian models are being stitched together.

All this points to a more fundamental problem, namely that of the lack of a statistical collaborator. These authors are world-renowned experts in the field of collecting and understanding the nuances of proxy data and how it links with climate. There are statisticians and groups out there (for example the Past Earth Network) who can help.

Models like these are now being studied by statisticians in collaboration with proxy experts. One that is not yet in the palaeoclimate literature (which is perhaps why the authors might have missed it) is that of Ilvonen et al which seems very similar to what the authors are trying to achieve here. A more flexible version can be found in Cahill et al which is in the palaeoclimate literature and uses multiple proxies (forams and d13C) in a Bayesian model for sea level reconstruction. A more recent model is my own Bclim (Parnell et al) which allows for joint inference (i.e. all fossil slices, all taxa, multiple climate variables) to be estimated together, with the aim of reducing uncertainty.

Lastly a note on the figures. Again I found these hard to follow. Figure 1 has three lines on three panels with two different y-axes. The x-axis runs from different values for

each of the three panels. My guess is that this is each SRC above the 1% threshold but it's not clear. I found matching this to the text very hard. Figure 2 contains lines, candlesticks, points, crosses, and three different colours. I've read the caption multiple times, and the text associated with it (which covers 3 different sections), and still cannot work out what's being learnt from this picture. Figure 3 is much more useful, but seems to be hardly mentioned aside from the end of the last paragraph of Section 4. It was a shame not to see any actual reconstructions of climate over time for any of the sites.

References used:

Ilvonen, L., Holmström, L., Seppä, H., and Veski, S. (2016) A Bayesian multinomial regression model for palaeoclimate reconstruction with time uncertainty. Environmetrics, 27: 409–422. doi: 10.1002/env.2393.

Cahill, N., Kemp, A. C., Horton, B. P., & Parnell, A. C. (2016). A Bayesian hierarchical model for reconstructing relative sea level: from raw data to rates of change. Climate of the Past, 12(2), 525-542.

Parnell, A. C., Haslett, J., Sweeney, J., Doan, T. K., Allen, J. R., & Huntley, B. (2016). Joint palaeoclimate reconstruction from pollen data via forward models and climate histories. Quaternary Science Reviews, 151, 111-126.

Interactive comment on Geosci. Model Dev. Discuss., doi:10.5194/gmd-2016-227, 2016.

Printer-friendly version

Discussion paper