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Interactive comment on "Assessing performance and seasonal bias of pollen-based climate reconstructions in a perfect model world" *by* K. Rehfeld et al.

Anonymous Referee #2

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The paper by Rehfeld et al. deals with the pollen-based climate reconstructions. The authors use climate model data and modelled vegetation to explore the reliability of reconstructions of different climate parameters in pollen-based reconstructions. The advantage in such an experiment "in an ideal model world" is that the past climate and vegetation are known at all times (6 ka to present), allowing to assess the reliability of the reconstructions. The authors show that reconstructing multiple climate parameters can be misleading, as it is possible that in reality there is only one climate parameter which drives the spatial and temporal vegetation change, and the reconstructions of other climate parameters show temporal variability which is caused by the fact that these less important parameters are spatially correlated with the important parameter

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Discussion paper

in the modern spatial data used for constructing the transfer function. This is certainly nothing new, most of the palaeoecologists using pollen data have been aware of this problem, but it is useful to have a special study where this problem in explicitly explored using novel approaches.

I find it easy to agree with the authors that “the temporal changes of a dominant climate variable are imprinted on a less important variable, leading to reconstructions biased towards the dominant variable’s trend” and that the high r2 in the cross-validation is of limited use to identify which variables can be reconstructed, as r2 can be high not only for the variable which is really important for vegetation or pollen, but also to non-important variable which are spatially correlated with the important variable. The authors suggest assessing the amount of fossil vegetation variance explained the reconstruction output and expert knowledge as possible means to select the climate variables. The latter one has been used in pollen-based reconstructions, but unfortunately the expert knowledge almost invariably is limited to present ecological setting. It is possible, or even likely, that if we go back in time enough, the combination of climate parameters governing the vegetation composition have been fundamentally different from the present.

There is one striking problem with the paper. Given that the authors use model data only, they are restricted to use plant functional types (pft), not pollen types or plant species. In the real world, the WA-based climate reconstructions often comprise over 100 pollen types, not pfts. Modern analogue-based reconstructions use pfts, but even in them the number of pfts is generally 20-30. In a striking contrast, the number of pfts in the current study is eight - in other words extremely low. I am surprised that the palaoeclimate reconstructions with such a low number of variables make any sense in the first place, given that they are based on a few, extremely broad pft classes. I suspect that the reconstructions using modern analogue must have included some serious problems which are not reported in the paper. The problem of multiple analogues (where the many modern analogues for the fossil sample are present, often in very dif-

ferent climatic settings) would be unavoidable with eight pdfs only. The error estimates of the calibration sets and the fossil reconstructions are not presented or discussed in the paper, but they most likely are extremely high. I therefore wonder if the difference in the reconstructions (in Fig. 8 and 9, for example) are inside or outside the error estimates?

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