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Climate of the Past Discussions

Interactive comment on "Climate reconstruction from pollen and δ^{13}C using inverse vegetation modeling. Implication for past and future climates" *by* C. Hatté et al.

Anonymous Referee #2

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This manuscript presents a novel method to reconstruct climate variables using multiple proxies from terrestrial sediment archives. The method - employing both inferred biome and d13C of bulk sediment to identify a climatic niche - is remarkably successful in reducing the uncertainty in reconstructed paleoclimate at the authors' study site, particularly in annual precipitation. The manuscript is succinct and generally well written, and the figures are illustrative. The scientific results, which amount to an interpretation of the Eemian record at Grande Pile, are not particularly interesting, novel, or well developed in the discussion. But as the study generally presents the development and application of a method, this is not a major detraction to this manuscript. What this manuscript does lack is a thorough discussion of potential errors, limitations to the

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approach, and suggestions for further improvement. However, these may be easily addressed in one or two additional paragraphs. With minor modifications, I recommend publication of this manuscript in Climates of the Past.

What this manuscript generally lacks is an evaluation of the limitations of the approach, and suggestions for further improvement. For example, it is well established that the biomisation technique is relatively sensitive to small changes in constituent taxa - e.g., presence or absence of a single pollen grain of a single taxon can cause a change in the biome that is identified by the biomisiation technique. This effect may be amplified by using the variable taxa weighting factors employed to identify boreal and Arctic biomes by, e.g., Bigelow et al., 2003. The use of d13C as an additional constraint on reconstructed climate may reduce the likelihood of completely unrealistic climate reconstruction based on spurious identification of the biome, however the authors do not explain why they haven't attempted an approach based on using the abundance of plant functional types identified in the pollen spectra (PFT-scores) instead of biomes. The PFT-score approach has been used even without d13C to reconstruct late Glacial and Holocene climate in Europe on large spatial scale (e.g., Davis et al., 2003). As BIOME4 provides information on PFT performance (presence or absence and NPP of individual PFTs) it would, in principle, be possible to use this technique. For the current manuscript I do not suggest that it is absolutely necessary that the authors change their methods; what would be sufficient for now is a discussion of the merits and limitations of their approach, and suggestions for future work.

Another interesting point that is passed over by the authors is the opportunity to reconstruct seasonal changes in climate. As far as I understand, both winter and summer temperature and precipitation are input to the inverse modeling technique. Yet the reconstructed climate is limited to annual values for these variables. Why? We might expect significant changes in the biome-d13C relationship to develop because of misidentified changes in climate seasonality. Even at the latitude and altitude of Grande Pile, temperate grasslands, for example, would be expected to exhibit rather differ-

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ent carbon isotope ratios in winter-rain climates, where they would be dominated by C3 species and have very depleted d13C, as opposed to summer-wet climates where they could have a significant C4 component and therefore much more enriched d13C compared to either forests or C3-dominated grasslands. We would expect these differences to be exacerbated by low CO2 concentrations, which would tend to favor C4 species. This idea does not appear to be borne out by the results of the inverse modeling study, and I am surprised to see the generally low sensitivity of the inferred climate anomalies to CO2 concentrations in Figure 2. In general, a discussion of the potential to reconstruct seasonal changes in climate with the combined biome-d13C inverse modeling method would be very interesting, and it would be helpful to comment on the potential for these type of reconstructions in the future.

Interactive comment on Clim. Past Discuss., 5, 73, 2009.