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Interactive comment on "Reconstructing climatic modes of variability from proxy records: sensitivity to the methodological approach" *by* Simon Michel et al.

Anonymous Referee #1

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Review of "Reconstructing climatic modes of variability from proxy records: sensitivity to the methodological approach"

This paper presents new reconstructions methods and applies them to reconstruct the NAO using data primarily from the PAGES2k database. I think this is a good study that introduces some potentially useful new paleoclimate reconstruction methodologies.

I have a number of comments, corrections, and requests for clarification below:

p.1 l.7-9, p.4 l.18, p.20 l.10 These statements are too strongly worded. Not every mode of variability is reconstructable, some occur on too short of time scales to be captured in the paleoclimate record (e.g., monthly time scales) and some modes are

in locations where there are poor covariances with available proxy records (e.g., the Southern Ocean).

p.2 l.9-11 This sentence is unclearly worded, for example, "non-stationary variability" doesn't "ask" questions, people ask questions.

Introduction: In general, the introduction takes a long time to get to the main points of the study. The authors might consider revising the introduction to cut down the length.

p.5 l.4-5 Linear interpolation of low resolution proxies artificially increases the influence of these records and introduces spectral artifacts in the proxy time series (e.g., Hanhijarvi, Tingley, Korhola 2013, doi: 10.1007/s00382-013-1701-4). This process also ignores dating uncertainty in such low-resolution proxies, which can be a significant source of reconstruction error. Have you accounted for these factors, particularly the dating uncertainty? What is the influence of using only annually resolved data?

Section 2.2 Do the methods estimate uncertainty in the reconstruction or just provide a single reconstruction? Are the ensembles of reconstructions discussed elsewhere a kind of uncertainty estimate of the mean reconstruction? These, or something like them, would be essential to use and display because without reliable uncertainty estimates, paleoclimate reconstructions are not useful.

p.7 l.16-19 Using correlation as the only validation metric is problematic, especially when it comes to comparing reconstruction methodologies. You really must include additional metrics that account not just for the correlation, but the variance and bias as well. If the approaches provide uncertainty estimates, then the skill metrics need to also account for those (using, for example, the continuous ranked probability score).

p.16 l.19-20 This statement is incorrect. Previous reconstructions almost never overlook this issue, but rather proxy network selection is integral to the reconstruction process. It is very rare to have a reconstruction approach, especially one that is regression-based, that does not remove proxies because of insufficient correlation with

the target climate variable.

p.18 l.1-2 Or the "significant" correlation with the NAO could be spurious. Also note that non-stationarity violates one of the fundamental assumptions of these (and nearly all) reconstruction approaches.

p.19 l.12-15 I think this statement is too strongly worded given that you've only validated the reconstructions using correlation and haven't validated reconstruction uncertainties. How do the reconstructions compare given the uncertainties?