**Climate
of the Past**

Discussions

Interactive comment on "Reconstructing Late Holocene North Atlantic atmospheric circulation changes using functional paleoclimate networks" *by* Jasper G. Franke et al.

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In this paper, the authors use a network approach to investigate climate teleconnections across the North Atlantic region during the Common Era and relate climate in this region to the NAO. The authors take an interesting approach toward utilizing published paleoclimate records for reconstructing a regionally important climate index. I agree with the other Referees that this work should be published with some modifications outlined below. I am in agreement with Referee 1 who suggests that the authors take a more "pedagogical" approach toward describing their methodology. Whenever possible, relating the purpose of equations in words as well, providing definitions for all

variables, and including a table of variables that readers can refer back to would help to clarify the approach taken by the authors. This will make their work more accessible and thus their approach will more likely be followed by others in the future.

We will clarify the general approach and add the requested additional information in our revised manuscript.

I suggest that the authors include more discussion of the proxies they are including in their analysis, which archives they come from, and what the records are interpreted to show across the interval in question. If the authors are not space limited, I would suggest moving the table of proxies into the main text so that readers can clearly see what records are being used and so the original citations for the records can be included in the main text citations. As this is only 37 records, it does not seem unreasonable to include in the main text. I also suggest a more careful description of the clustering of sites with some information to validate this approach – to show that each proxy does reflect regional temperature to a reasonable degree and can be clustered with other sites in the region.

We think that the selection of records as well as providing the corresponding details in the Supplementary Material instead of the main manuscript is well justified by the inclusion of most records in the PAGES2k archive, which has reasonable high requirements on the data quality. Also spatial reconstructions from similar data sets justify grouping spatially close records together (see e.g. Werner et al in this special issue). We will clarify this in our revised manuscript.

Regarding the clustering of sites, we have drawn upon recent observation-based records instead the proxies themselves to ensure that the underlying variability of the baseline data reflects temperature directly instead of any site or archive-specific effect. In turn, the fact that the individual archives/proxies are temperature sensitive has been established in the original publications and further discussed in the cited publications of the PAGES 2k working group. Thus, we are confident that this aspect is sufficiently well

documented. This point will be emphasized more clearly in our revised manuscript.

Some discussion of the uncertainties involved in the proxy records, age uncertainty as well as uncertainty with what each proxy reflects, should also be included. I agree with Referee 1 that to generate space to accommodate clarifications, the section 5.4 could be reduced or removed as it seems overly speculative.

As discussed in the data section, we only chose annually, or close-to-annually resolved paleoclimate records. They all stem from tree rings, varved lakes and ice cores and can thus, for this time period, be dated very accurately (see also the corresponding discussions in the cited publications of the PAGES 2k working group). Unfortunately, there is no detailed information of proxy uncertainty consistently available for all records. Thus, it is not possible to include this absolutely useful information in our manuscript. See the proxy tables in Werner et al. (same special issue) for an estimate of the uncertainties of some of the varved lake sediment records

As for Section 5.4, we are aware of the fact that our corresponding considerations cannot be proven in the sense of establishing any particular causal linkage between predominant NAO phase and societal development. However, we are confident that it is still illustrative to discuss such observations to highlight the potential impacts of long-term changes in the NAO phase and thus provide potential complementary indications for the qualitative correctness (or at least reasonability) of our reconstruction..

I also suggest including a plot of the Ortega NAO reconstruction as well as a description of how this was constructed and what records went into it and any potential overlap with the records used in this analysis. Something along the lines of Figure S5 would be useful in the main text to show the comparison between the reconstructions generated here and the Ortega reconstruction.

We will include a plot of the Ortega NAO in a revised Fig. 6 (see below for a corresponding draft version) and clarify in Tab. S1 which records have been included there.

Need to explain symbology for site markers – changes from figure to figure, not sure that it means. This is true for both the main text and supplementary figures (e.g. Figure S2)

In general, we use three types of marker symbols. In Fig. 1, they indicate the type of archive at each location as indicated by the legend. In Fig. 3, we use the same markers for all records in general, but different markers if two clusters are shown in the same color to illustrate, that these clusters are actually distinct. We decided not to use too many colors because this would be even more unclear visually. In all other figures, a circle just marks the center of each group of records. We will explain the markers used in each figure in more detail in our revised manuscript.

Figure 4 caption needs more description – what do the line thicknesses represent? Why were these time intervals chosen? What controls when points are shown or not shown?

Here, the line thickness corresponds to the value of the CLD. The time intervals were chosen to illustrate qualitative differences in the large-scale spatio-temporal correlation patterns among our proxies. To find a more objective representation than just this visual representation is the main motivation to investigate the linear model. We will discuss this in more detail in our revised manuscript.

Elaborate on what is meant by most "informative" clusters and why this is the case (page 9, line 32 – page 10, line 2).

Most informative means those with the highest regression coefficients in the linear model. We will clarify this in our revised manuscript.

Are the Deininger et al., (2016) records (mentioned line 25 of page 16) included in the analysis? If not, why not? A diagram of the reconstruction presented here, the Deininger work, and the Ortega reconstruction may be informative.
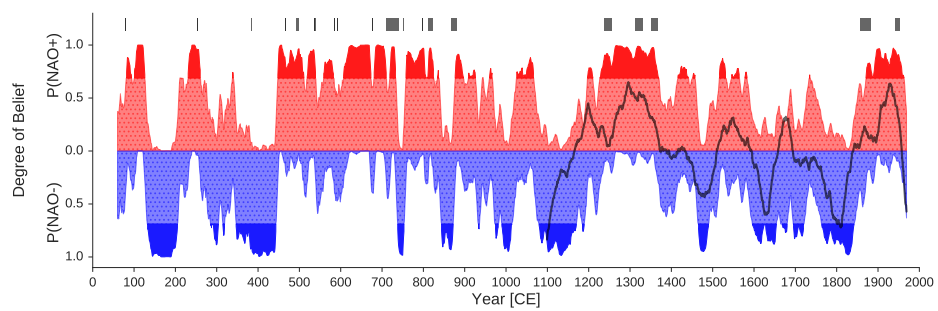
They are not included for two reasons. First, they are not temperature proxies and we

wanted to use a set of records which is comparably due to a shared influence of the same climate variable. Second, they do not have nearly-annual resolution, which was one of the main criteria for data selection. We will add a short note regarding the work by Deininger et al. in our revised manuscript.

C5

Fig. 1.

C6