

Interactive comment on “Dendroclimatology in Fennoscandia – from past accomplishments to future potentials” by H. W. Linderholm et al.

Anonymous Referee #1

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GENERAL COMMENTS

This manuscript provides a comprehensive review of dendroclimatology in the Fennoscandia region, and the authors have assembled a great deal of interesting material. My main suggestion is that the authors re-organize their paper to streamline the text and show more clearly the specific accomplishments of dendroclimatologists working in this region. I'd like to see the addition of a short section that provides (1) a general overview of the physiography and climate of Fennoscandia and (2) a summary of the composition of the region's forests with an emphasis on tree species that are used commonly in dendrochronology. Some of this information is already included in the manuscript, but it would be helpful to bring it together in a brief section near the beginning of the paper.

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suggested re-organization 1. Introduction 2. Fennoscandia: physiography, climate and regional forests 3. Early dendroclimatology 4. Reconstructing past climates 4.a Temperature 4.a.i Long reconstructions 4.a.ii Divergence 4.b Precipitation 4.c NAO 5. Isotope dendroclimatology 6. Future prospects

The current manuscript is a bit too long, and I suggest that the authors remove the references to work that is only beginning or planned, and shorten sections of the text that describe the field of dendrochronology in general. I suggest removing the repeated references to reconstruction statistics in the text and instead, present this information using a summary table or figure.

The text's grammar is generally quite good but phrasing is awkward in places, so an additional review of the revised manuscript by a colleague whose first language is English could be helpful. The text also includes many uses of abbreviations (especially i.e. and e.g.) and the writing would be better if most of them were removed.

SPECIFIC COMMENTS

Abstract The Abstract is too general and needs to provide more detail on the issues raised in the main body of the article. Not all trees in Fennoscandia are sensitive to climate. Some of the longest chronologies in the world - how long are they? Sentences like "Here we review..." are not really informative. In this case, it would be better to note the main applications (or limitations) of each tree-ring parameter.

Page 1416, line 4. The use of the semi-colon is not correct: "trees are sensitive to climate, particularly summer temperature" would be better.

Page 1416, line 4. A strong gradient in what?

1. Introduction The Introduction would be stronger if it began with a brief synopsis of the field of dendroclimatology, rather than a discussion of past climate change and a list of different proxies.

Page 1416, line 18. "...climate change caused by natural and anthropogenic factors..."

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would be better.

Page 1415, line 20. Be careful with cause-and-effect here. The observing sites did not attain sufficient geographic coverage. Also, the writing implies that estimates of the global mean temperature were made as soon as there were sufficient sites, but the data were not used for that purpose until much later in the 20th century.

Why specifically is dendrochronology the most suitable method to obtain proxy climate records with annual resolution? Tree rings are not the only proxy that have annual resolution after all. Also, I don't think the Gouriand paper is the correct citation to support this point.

Dendroclimatology I think this section is unnecessary. In a review of the regional application of a particular proxy, it would be preferable to have a brief description of that method with references to a few key papers that describe the proxy and field in general. There is very little in this section that is specific to dendrochronology or dendroclimatology in Fennoscandia.

Early Fennoscandian dendroclimatology studies The section title is awkward - Early studies of dendroclimatology in Fennoscandia' would be better. And can you add information to constrain what is meant by 'early'. Prior to 1950?

Page 1422, line 2. To be specific, you are discussing tree-climate linkages in Fennoscandia here.

The point about Douglass' contribution to the study of tree rings in Fennoscandia needs to be refined. On Page 1422, line 9, the sentence needs a stronger connection: how is the early application of dendroclimatology in Nordic countries related to Douglass' work in the US? Is it that the use of the technique in Nordic countries became more commonplace after Douglass demonstrated that the method could work in Arizona? And be careful with the reference to Douglass' work linking tree-ring data (or is it climate data?) in Fennoscandia to sunspots. The association reported by Douglass is

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no longer viewed as evidence of a relation between these phenomenon, so your text needs to note that limitation.

Page 1422, line 26. Why mention Erlandsson first and give almost no attention to the earlier work by Eide?

This section would be more interesting if it described the background of these early tree-ring scientists? Were they foresters or geologists or did they have other training? Were they looking at these records as indicators of past climates? What was the motivation for their research?

Page 1423, line 12. 'Scots pine with July temperatures.' seems to be missing a few words.

Spatial variability of tree growth/climate relationships in Fennoscandia This section is also a candidate to be removed. The text touches on a couple of issues - the climate of Fennoscandia, the fingerprint of the NAO in regional tree-ring chronologies - that would be better included in another section of the manuscript. The remaining text deals with some interesting findings but I'm not sure how these ideas fit within the rest of the paper. Do these findings have implications for site selection criteria used by dendroclimatic studies that target a specific climate variable, for example?

5.1 Temperature The first few sentences jump around in time too much. The link between summer temperature and conifer growth was established in several studies between the 1930s and 1980s, but the first reconstruction (by whom?) was published in the 1980s, but a researcher in the 1960s claimed that his chronologies were effectively qualitative reconstructions of past temperatures?

Page 1425, line 18. Is the paper by Aniol and Eckstein a re-examination of the Bartholin and Karlen reconstruction?

Page 1425, line 24. 'Transparent' is not the correct word. I think the problem lies with the way the earlier paper was described. Why is it not clear if Bartholin and Karlen

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used Fritt’s reconstruction method? Could you say instead that the earlier paper did not include a description of the methods used to develop its reconstruction? Page 1426, line 10. The grammar in the phrase, ‘why the claim of a short Little Ice Age...’ needs improvement. In the following sentence, why does ‘new’ appear in quotation marks? I know that the Briffa method is similar to the approach outlined by Erlandsson, but “new” implies something of a negative attitude towards Briffa’s work that you probably don’t intend.

Page 1426, line 29. “between” 1500 and 1985

Page 1427, line 6. What is meant by ‘dramatic landscape’. Is this because some of the chronologies are developed from trees at higher or lower elevation?

Precipitation First sentence: There are relatively few reconstructions of precipitation from tree rings in Fennoscandia. In the next sentence, I presume that the lack of precipitation sensitivity in Fennoscandia trees is because the region is cold and wet, rather than being caused by its high latitude and proximity to the Atlantic Ocean.

Page 1428, line 6. Be specific - what are the characteristics of sites that might produce records that are more sensitive to precipitation?

Page 1428, line 18. This sentence repeats the main idea of the first sentence of the preceding paragraph.

Page 1429, line 3. What kind of evidence?

Page 1429, line 10. Prefer centennial to ‘centurial’.

Multi millennial temperature reconstructions Why is this section separate from Section 5 (Climate reconstructions)? It would fit better if this text was included in Section 5.1 (Temperature reconstructions). Why should these studies be considered separately from the others simply because they cover a longer interval?

Page 1430, line 15. Avoid the use of symbols in the text.

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Page 1430, line 23. What area? Why is the large-scale climate of northern Sweden relevant to the discussion of this specific tree-ring chronology? The structure of the sentence beginning “The Scots pine material...” seems to exhort that the reader is already familiar with this collection and site.

Page 1431, Line 16. The tense is incorrect (Grudd argued) and ‘predicted’ is not correct here. thought?

Page 1431, line 19. Again, the explanation in this section is inadequate. How could the Jamtland site be selected for study in the mid-1990s based, in part, on reports of old trees in lakes that were published in 2001 and 2002? Also, this site was selected for study because old-growth forests were known to exist in this area (not, as the text implies, that they simply exist).

Page 1432, line 5. These data could (in the future) be compared to precipitation or have the comparisons already been made?

Page 1432, line 14. Why is climate information from these records ‘ambiguous’? Explain.

The atmospheric circulation This section only describes the impact of the NAO and attempts to link tree-growth in Fennoscandia to that mode, so the section should have a more specific title than ‘atmospheric circulation’.

Again, I would prefer to see the description of the NAO appear earlier in the paper as part of a discussion of the climate of Fennoscandia.

Page 1434, line 13. What is meant by ‘extend this large scale feature’. Proxy records can be used to extend our understanding of the behavior of the NAO back in time, but the NAO cannot itself be ‘extended’.never t

Page 1434, line 26. ...and the strong positive...” what?

8. Isotope dendroclimatology This section has a lot of overlap with Section 2.1.4, and

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the manuscript would be improved if it had one or the other rather than both.

The temporal strength of climate-signals in Fennoscandian trees

I think a more appropriate title would be ‘The ‘divergence’ phenomenon in Fennoscandian ring-width records”.

It would be helpful to include the definition of divergence, perhaps drawn from one of the recent papers on the subject by D’Arrigo and Wilson. I also think this section should focus less on divergence-related studies in other parts of the world and expand its discussion of the phenomenon in Fennoscandia. As written, the text does not make a strong distinction between local studies and studies from elsewhere.

Page 1439, line 11. I don’t understand the explanation of Bjorklund’s findings and the meaning of the associated Figure 6 is not clear.

9. Some future prospects I would prefer to see the ideas in this section integrated into a coherent argument, rather than appearing as separate topics under unrelated headings.

Page 1440, line 15. I’m not convinced that Figure 6 proves that spruce have a stronger connection to summer temperature than pine. In either panel, the spatial extent of strong correlations seems largely the same. Furthermore, the correlation map for the pine network seems to show higher values than the map derived from the single spruce record. A simple comparison between these maps also ignores the possible impact of uncertainty in the estimate of each correlation coefficient, which might make it impossible to state that the correlations on one map are higher or more extensive than those on the other.

Page 1440, line 22. The chance to improve climate reconstructions using tree-ring records developed from multiple tree species is certainly not unique and is not even that uncommon.

Page 1440, line 25. The conclusion is too late in the paper to present a definition

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of teleconnections. And more broadly, the section describing the potential study of the AMO seems quite speculative. How well constrained is the impact of the AMO on the climate of Fennoscandia? In North America, the relationship between regional climate and the AMO is still not well understood and further connecting this mode to proxy records is even more uncertain. I think the more important question is, Given the relatively high uncertainty of proxy climate records derived from Fennoscandian tree rings, is it reasonable to expect that these tree-ring records could contain reliable information about remote climate forcings?

Page 1442, line 3, How do tree rings provide ‘synthetic’ (artificial?) information. I am not aware of any studies that have used tree ring data to validate the ability of climate models to simulate multidecadal climate variability? Could you provide an example?

Page 1442, ‘Some final remarks’. In summary, what are the major insights gained from dendroclimatology in Fennoscandia. The final point, stating that some information has been excluded is a fairly non-descript idea and is not a strong point to end the paper.

Table 1. The column labeled ‘Species’ also includes the number of samples? And latin names should be used instead of common names. Why does McCarroll et al., (2003) lack an Age-range? What is meant by the use of the ‘greater than’ sign in the ‘Signal’ column?

Figure 2. Please mark the location of the chronologies on the map. Either report the correlation associated with a given significance level or add this information to the map.

Figure 3. Presumably these records have been filtered to emphasize centennial variability? What is meant by ‘interpreted synchronous periods’ and how were these periods identified?

Figure 4. This is a scatterplot rather than a relationship. The text on this figure (and Figure 5) is too small, the axis lines are too faint and the data circles should be a bit larger.

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Figure 5. I don't understand this figure. Running correlations - does each data point correspond to a correlation calculated over a different period? How can the x-axis represent both July temperature AND the correlation for the regional chronology? What is the uncertainty of each of the calculated correlation coefficients?

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