Interactive comment on:

"Autumn-winter minimum temperature changes in the southern Sikhote-Alin mountain range of northeast Asia since 1509 AD".

By: O. N. Ukhvatkina, A. M. Omelko, A. A. Zhmerenetsky, and T. Y. Petrenko

This study presents a new climate reconstruction based on tree rings from Korean pine trees located in the Russian Far East. The new annually-resolved record, which spans more than five centuries, derives from an area wherefrom such centennial-scale climate reconstructions are sparse. The new record is therefore really exciting and important, as it may help improve our understanding of climate change in this area. Consequently, this study clearly deserves to be published, although after some major revisions.

The authors argue that the main limiting factor for tree-ring growth is the August-December temperature of the year prior to the growth year, implying that the new record documents changes in the August-December temperature in the period 1509-2014 AD. However, establishing the August-December-temperature as the dominant control on tree-ring growth is not straightforward and this aspect is not discussed in sufficiently detail to make it appear robust. Only in the Conclusion section do we learn that the August-December temperature only explains 25% of the variance of the data. Similarly, other important aspects are not discussed in sufficient detail and important information is lacking - these aspects should be addressed in the review process. In general, the paper is reasonably well written, but some aspects/sentences are unclear and the paper would benefit from a thorough check of the language. Below, I list my main concerns and some minor comments to the paper.

Main concerns

Establishing the dominant control on tree-ring growth

The paper initially discusses potential climatic parameters as the dominant mechanism controlling tree-ring growth, then – in one sentence – concludes that "the most stable correlation appears between the growth and the minimum monthly temperature of August-December of the previous year at MP7, on which we base our subsequent reconstructions". This aspect is critical, because this is where the meaning of the climate reconstruction is defined, and the treatment of this aspect is too superficial and not sufficiently robust. It is unclear what "stable correlations" refer to, and it should be discussed how much of the variance is actually explained by this parameter – that turns out (in the Conclusion section) to be quite a small fraction. Based on Fig. 4, it seems that several of the other climatic parameters correlate with the tree-ring growth almost as well as the August-December temperature. This should be explored – and discussed - in more detail. Also, would it make sense to use principal component analysis and combine some of the climatic parameters to see if it is possible to explain more of the variance in the data – although this will not make it possible to reconstruct more climate parameters back in time, it may still prove helpful for our understanding of the climate parameters driving tree-ring growth.

It is also unclear how the bootstrapping method was used for the verification – vital details are missing as this is not explained in the text. It just states that: "The idea that this method is based on indicates that the available data already include all the necessary information for describing the empirical probability for all statistics of interest". It is unclear what this actually means, and it should be explained in more detail how the verification is done.

Defining warm and cold periods

The occurrence of warm and cold periods in the new record is defined as when the temperature deviates more than half the standard deviation from the mean. However, it is unclear if this refers to the 21-yr smoothed record, or the annual data – my guess is the annual

data, but the text seems to suggests the 21-yr averaged data, and it is impossible to tell from the figure. The problem with the definition and the figure (Fig. 5) is that it is hard to make them match, i.e. the 21-yr smoothed record rarely increase/decrease above/below the dashed lines (or is that because it is the standard deviation on Fig. 5 and not half the standard devation?), whereas the annual data show more variability, briefly extending beyond the standard deviation on many occasions – but in this case the defined periods seem very arbitrary and could as well have been longer or shorter. Also, looking at Fig. 5b, the four warmest years do not occur during the years cited in the text (although it is unclear if this is based on the annual or the 21-yr smoothed data, but neither seem to fit the description in the text).

Discussion of regional climate variability

First of all, it is a bit difficult to follow the discussion of regional climate changes without a map, where the location of some of the other records are indicated (e.g. Fig. 7). Secondly, the discussion is somewhat unclear, because it is concluded that "…these results characterize regional climate variations and provide reliable data for large-scale reconstructions for the northeastern portion of Eurasia". At the same time, there are clearly differences between the record presented in this study and the nearby records shown in Fig. 8c and 8d. The differences between the new climate record presented in this study and those from nearby areas are briefly discussed in lines 308-316, and are attributed to differences in the reconstructed temperature parameters – and the asymmetry between medium, minimum, and maximum temperatures. This is a really important aspect, as the different records reconstruct the temperature during different parts of the year, as it is therefore a little like comparing apples and oranges. I think this aspect deserves much more attention, particularly if we are to understand the regional climate variability. It also raises the question as to how and the extent to which we should understand the new record as representing regional climate variability.

Spectral analysis and links to solar cycles

First of all, there is no description of the methods underlying the spectral analysis. The paper just states that "The MTM analysis over the full length…", which means that it is impossible to reproduce the spectral results presented in this paper. The Methods section should provide sufficient details of the method used to enable other people to reproduce the results.

Secondly, in the Results and Discussion sections a myriad of significant 2-3 year cycles (2.3, 2.5, 2.9, 3.0, 3.3, and 3.7) are reported and discussed. While these periodicities may be real – and potentially reflect the ENSO or quasi-biennial oscillation – they are very close to the Nyquist frequency. With a Nyquist period of 2 years, it is hard to interpret the 2-3 years as direct evidence for climatic oscillations on this time scale. It is thus likely that these high-frequency periods reflect year-to-year scatter, but this aspect is not discussed as all.

Thirdly, the Abstract and Conclusion mention an 11-year cycle, but the 11-yr cycle is not visible in the power spectrum (Fig. 6), and the Results section only mentions the 8.9-yr cycle, whereas the Discussion section mentions a 8.9-11.5-yr cycle. But where did the 11- or 11.5-yr cycle come from? There is no mention of this and this a confusing.

Finally, a more general criticism of this aspect concerns the discussion of the origin of the periodicities. The main problem is that the periodicities, in particular the 8.9- and 189-yr cycles, uncritically are taken as direct evidence for a strong solar influence on climate on these time scales. While the Sun may have driven climate change on these time scales in the study area, it is simply not enough to infer this based on periodicities that resemble those of the Sun (which on average are 11 and 210 yeas, respectively). In such a record, there will almost always be periodicities that resemble those of the Sun and it therefore takes more to infer causality. In the authors want to establish that the Sun influenced climate in the area, they should engage in much more detailed analysis of the new tree-ring climate record and

records of solar activity and calculate correlations, lads, and compare those to red-noise models. It would also be interesting to establish if the cold period indeed corresponds to solar minima – as stated in the abstract – but such an analysis is completely missing.

Minor comments

L. 19. Abstract: It is unclear what you mean by "de-Vier quasi-200 quazi-200 solar activity cycle." Presumably this refers to the de Vries (or Suess) 210-year solar cycle. The word "year" is also missing.

L. 47. "It is well known that warming of the climate is correlated with solar activity". This sentence and the following sentence suggest that solar activity is the only source of warming, including global warming. You need to be much more precise with respect to what you mean here. Also, solar activity is a driver of climate change, but it is not strong driver a temperature changes compared to changes in greenhouse gases.

L. 128-129. Maybe spell out what is meant by "...it matches a minimum sample depth of 3 trees in this segment".

L. 133. Where is the Chuguevka meteorological station relative to the sample site? This is really an import aspect.

L. 175. There is no "Y" in the equation – guess this refers to "VUSr"?

L. 297. "The period of landscape formation……during the transition". This is unclear, as the landscape formation occurred long before the Little Ice Age – do you refer to vegetation changes?

L. 326-327. This sentence makes no sense to me – how is this related to the sentences above (which it refers to)?

Figures

Figure 3
It is unclear what the sample depth refers to. Is it he number of tree records?

Figure 7
It is the correlation coefficient that is plotted here – this is not clear to me? It is also unclear if the signifance refers to all colours, so that for white areas there is no correlation at the 10% signifaince level? It would be very helpful if the geographical position of the record from this study (Fig. 8a) and the two nearby records in Figs. 8c and 8d could be indicated in this plot.