

## ***Interactive comment on “Winter temperature variations over middle and lower reaches of the Yangtze River during the past three centuries” by Z.-X. Hao et al.***

**Z.-X. Hao et al.**

haozx@igsnrr.ac.cn

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The paper is an interesting work on temperature reconstruction using documentary data on frequency of snowfall days in a large region in China. I think that the manuscript would improve if the authors take into account the following comments: 1) Is the ML-RYR a climatically homogenous region? Is possible to construct a regional index using 5 stations (1906-1950), 8 stations (1853-1905), or 24 stations (1736-1852)? How do you construct the regional index? Averaging? Yes, this is homogenous region climatically, which has been detected by Empirical Orthogonal Function (EOF) method, and the first three EOF components showing the consistent spatial pattern in the whole of

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region explain 96% variance of the total.

The Partial Least Square (PLS) statistical method was applied here to construct the regional temperature. The model used to predict the regional temperature was built as below: the predicted parameter is regional temperature from 1951 to 2007, and predictors are winter temperatures at those stations from 1951 to 2007. If the model was used to reconstruct the temperature from 1906 to 1950, we selected snow days at those 5 stations as our predictors; if it was used to reconstruct the temperature from 1853 to 1905, then we selected number of snow days at those 8 stations as our predictors.

2) You must include (and discuss) statistics of the calibration/verification procedure (period 1951-2007).

We added statistical table about verification procedure in the supplementary material. Please see the end of this manuscript.

3) More detail in the description of documentary data (and treatment of information collected) is desirable. Do you have more data sources corresponding to the more antique period? There is a loss of variance due to the regression model in the calibration period. But, in addition, when you work with documentary data, you have a loss of variance due to the fragmentary character of this type of data. Although the interpretation of historical documents is correct, it always possible to find new data sources, and therefore, new data, which allow refine the reconstruction. In other words, the 'absence of evidence' is not equal to the 'evidence of absence'. How have the authors faced this problem?

In order to better understand the historical document, we move the appendix A for the example of Yu-Xue-Fen-Cun record to the section of data sources. And added the treatment of information like "Then we count the number of snow days (3-days in this example) from each record, and calculate the total number during the whole winter time. Since the different governmental officers could report same snowfall information

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at same location, the repeated snow procedure should be deleted” on page107, line 13.

During ancient time, we have local gazettes and memos to emperor archives, which both contain abundant weather information, however, local gazettes usually recorded extreme events and most of phenophase dates, and time resolution is very low. Several scientists have reconstructed the winter warm/cold index at decadal time resolution using the information from local gazettes. Yu-Xue-Fen-Cun recorded every precipitation event which occurred within a county, although occasionally, some events could be missed, it still has good completeness. The time resolution can reach up to day-month at least. From this point, the local gazettes are not helpful to improve variance of regression model. But we compared the temperature reconstructions from local gazettes in our discussion section. We hope in the next few years, our reconstruction can be refined when a few of tree-rings-based annual temperature reconstructions over this region are developed.

4) How affect the number of stations to the reconstruction of the regional series? It is obvious that uncertainties change over time, depending on the number of stations. Have the authors tried to correct possible bias due to changes in the number of stations? How do you “combine” different subseries? In the Figure 2, it would be desirable to distinguish between different subperiods.

All calibration periods are same from 1951 to 2007 in the different subseries, however, due to the different numbers of stations, the uncertainties change over time. The less number of station we used, the lower predicted  $R^2$  the regression model has, for example, during 1853-1905, the predicted  $R^2$  is only 0.41, which is lower than 0.57 at the period of 1736-1852.

Since the reconstruction of regional series came from different subperiods, the mean value of 1853-1905 from 8 stations has to be adjusted to the level of reconstruction from 24 stations. For example, we use 8 stations and reconstruct regional temperature of

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1853-1905. In order to combine the different subperiods, we also use these 8 stations to reconstruct the temperature of 1736-1852, and calculate the mean value of this reconstruction series. After that, the difference for the period of 1736-1852 between the results from 8 stations and 24 stations is compared. If the latter is higher (lower) than the former, then we subtract (add) this difference value from (to) our reconstruction during the period of 1853-1905. This paragraph has been added in the text of P108.

Yes, in figure 2, the interval lines are plotted in order to distinguish the between different subperiods, please see new figure 2.

5) Please, improve the quality of Figure 2, I cannot see error bands. Please, explain the legend in the caption.

The figure 2 has been replotted based on the comments from referees 1 and 2. Error bands are clear and the legend has been added in the caption.

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