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Climate of the Past Discussions



# *Interactive comment on* "Multiproxy records of climate variability for Kamchatka for the past400 years" *by* O. Solomina et al.

**O. Solomina et al.**

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We took into account almost everything that was suggested and sincerely thank Brian Luckman for the improvement of the manuscript. According to his suggestions we also added two additional figures and we substantially re-organized the text concerning glacier variations and extended the discussion. Below I combined the suggestions of the reviewer with my responses. There are two parts here: 1 - general suggestions, and 2 - suggestions extracted from the text.

1. General suggestions - The English needs a fair amount of work - revised by a native speaker

- More information is needed about the climate records - provided

- and signal strength of the tree-ring records - some clarification is provided and table



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1 improved

-There are a number of places where additional or revised diagrams comparisons are made with solar forcing or the PDO; a summary histogram or other figure for the glacier record would be useful.- a diagram showing the number of moraines, the smoothed regional chronology and periods of low solar activity, as well as Alaska moraine chronology is added. The PDO is now shown in the figure 3 in a comparison of instrumental summer temperature.

- The BY chronology (Gostev et al.) was, I suspect an early collaborative project with the Lamont group and this should perhaps be more clearly specified. The comparisons with the new data indicate that it was a reasonably good regional estimate and it should possibly be included in the analysis in Table 1. - included

- The authors should be careful throughout to identify that they are discussing relationships between glacier records and temperature and precipitation proxies- rather than directly measured variables or quantitative reconstructions. This is important as they do not actually present conventional reconstructions of these parameters which is surprising given that Gostev et al. did so with a much smaller data set. - the correlations with May-June and June-August temperature are significant, but not strong enough, therefore we do not present the reconstructions, though formally it is possible. The discussion of the glacier record and discussion section could be more clearly organized (see comments on text) to identify the major inferred periods of positive balances and compare them with the known glacier history. Perhaps the authors could split the discussion clearly into the two periods based on the two diagrams with appropriate subheadings. It is difficult to read this discussion when it starts with Figure 5 and then goes back to figure 4. - the discussion is reorganized as suggested

- A moraine histogram might be useful here.- the histogram is included

- The discussion about solar forcing of the glacier record is based mainly on the interrelation of the tree-ring record and correlation with other glacier records. It would



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be better to introduce this when discussing the tree-ring record (e.g. indicate the solar minima on the diagram) so that readers may better judge this synchroniety - done

- The description and attribution of the change in relationship between the TR record and ice melt prior to the 1860s is somewhat overplayed. Firstly the combined record prior to 1860 is short and secondly it is the earliest and most poorly dated period of the ice core. - The ice core dating up to the mid 18th century seems to be accurate - it is checked by the known volcanic eruptions as well as by the comparison with tree rings shown in this paper. The 1820s is not the end of the ice core itself which is about 300 years longer but the end of processed samples. The discussion of this point is shortened as suggested by the reviewer.

- I have extensive comments on the WORD version of the manuscript that are both technical corrections and comments indicating that I think some additional material merits consideration before this article is posted for formal discussion. - many thanks, we took all of them into account and corrected the text accordingly.

B. H. Luckman October 12, 2006

2. Suggestions extracted from the text - Ěand in the highest belt, larch tree line rises to 1000 m. - clarify - clarified

- Have these records been screened for homogeneity???? - yes, they are screened, the reference is given

- Only mainly spring and summer? Not a sharp shift but really a change in pattern of change? But also shows considerable decadal trends which do not cleanly fit PDO Changes In fact, they show considerable variability within PDO phases. Show PDO on figure - re-worded. A figure showing PDO together with met.records is now included.

- these sites should be clearly identified on Figure 1 - done

- The spruce chronology (SHE) (SHI in table? ) also correlates well with the larch, but with a weaker correlation (Table 1). - SHE is spruce chronology, now included in the



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table 1

- Quality of met records?- mentioned above, quality controlled, reference is given

- But table shows correlations with individual months not for the combined May-June record and some sites are better correlated than KAML . Using KAML is fine but you have to justify it better as the % explanation is better with some other individual chronologies - the table is re-organized as suggested. Explanation for the priority of the use of KAML chronology is given

- Explain more clearly - did you combine the chronologies or create a chronology from all of the cores? - it is constructed from all individual samples - done

- What is the EPS cutoff? - indicated at the figure (EPS$>$0.85)

- Surely the point here is that the new records confirm the regionally representativeness of the earlier record for most of the reconstruction and would support your inference of a strong temperature signal in KAML. - included in the text

- Individual temperature minima inferred from the tree rings are, in part, related to climatically significant volcanic eruptions (e.g. in 1641, 1695, 1810, 1816, 1831), The multi-decadal variations of the KAML and the BY chronologies (Fig. 6) correlate strongly for 1770-1985 (r=0.63, 99% significance level); Meaning?? is this correlation between the annual chronologies or filtered versions of the chronologies. However the relationship deteriorates prior to 1769. Again what is the replication in each of these chronologies- this could reflect weak signal strength in either. Why is it important to compare these two chronologies except for historical reasons? Presumably each of the other (new) chronologies is as well or better replicated than BY. It would make more sense to include BY in the analysis shown in Fig 1 as just another chronology and possibly include the raw data in your regional chronology if it is available from Lamont. This might strengthen the signal in the early part of the record. - the text is rewritten and advantages of the use of the new chronology are more clearly demonstrated.



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The comparison with BY chronology is shortened - from Arctic Canada ( locality, data source?) - provided with reconstructed degree days above 10°C for June-July from a ring-width chronology from Central Alaska.( is this TTHH with Mt Logan, which are both in Canada? - details provided as requested - There is no Fig 4c identified - corrected - The maxima in both records (warm years), which are more prominent in the MFI curve, are not coherent with the ring-width chronology (Fig. 4). Would a table be useful here. There is insufficient detail in Fig 4 - we show the dates of minina at the figure. I am afraid we do not have anything else for the table - This may be due to the lower sensitivity of tree growth to unusual warmth, the more sensitive nature of the MFI to short melt intervals, and the potential of heating during the volcanic eruptions reflected in the ice cores, which may be unrelated to climatic warming (Shiraiwa et al., 2001). Is there any evidence of this? - this is just a speculation - the text is corrected accordingly

- all as 11 year means? How significant is r given these are means? - indicated, corrected as suggested

- Can you show the PDO on this diagram? It does not look very clear from Fig 4b. - the correlation of the accumulation with the PDO is not a finding of this paper, we provide reference to the original paper by Shiraiwa et al, 2001

- The 1860s-1880s were the coldest interval in the record, with an early summer cooling of about 1.5°C compared with the warmest during the mid 20th century (Gostev et al., 1996).

- Your discussion is based on ring-width data so how can you then estimate a 1.5 degree cooling. If Gostev et al could provide a temperature reconstruction from their data and the chronologies appear so similar why is it not possible to provide a temperature reconstruction from your data? You need to emphasize that this estimate is from their tree-ring reconstruction..- done

- Three periods favorable for glacier buildup occurred in the 20th century - during the 1910s-1920s, the 1940s-1950s and the 1960s-1970s (Fig. 5A?). What is this state-



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ment based on? If it is based on fig 5A it should come after the following discussion)The Evidence for glacier advances from Kamchatka between 1910-20 is poorly documented, however, comparison of photographs from 1908-1911 with the glacier margins in 2000 suggest that Zhelten'ky Glacier was much larger than in the mid 20th century and later (Vinogradov, 1975). However, by itself this is only evidence of recession since that time and not a previous or simultaneous glacier advance - taken into account, the discussion about this glacier is deleted

- Ushkovsky accumulation series correlate at R=-0.49, (99% significance level). Significance of N in these data? - provided

- The accumulation series from the ice core record ends in 1820s and therefore earlier comparisons are based on the KAML temperature record and the MFI (Fig. 4). Moraines older than the 19th century are rare in Kamchatka. According to tephrochronological dating, one of the moraines at Koryto Glacier predates the AD 1854 eruption of Avacha. This moraine can be tentatively attributed to the cooling of the 1810s-1830s. why rather than one of the earlier periods of inferred positive balance? - the reference is deleted

-These are not temperatures but inferred temperature as there is no formal reconstruction - edited - The preceding discussion could be better organized to identify the major inferred periods of positive balances and compare them with the known glacier history. Perhaps you could split the discussion clearly with subheadings into the two periods based on the two diagrams. It is difficult to read this discussion when you start with Fig 5 and then go back to figure 4. A moraine histogram might be useful here - done as suggested

-August temperatures where have you talked about August? - corrected, August added in the table and in the discussion

- More recent glacial activity in Kamchatka based on measured mass balance records show positive mass balance in the 1970s, which coincides with the PDO shift (no they



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are prior to the shift) - re-worded

- This could be better shown with a diagram - a diagram added

- but could also reflect changes in the PDO which is also common to these areas. . - PDO mentioned as suggested

- This discussion seems to be mainly about comparing the glacier records not comparing the “proxy” mass balance and glacier history - the discussion is extended

- (??? Are supported by mass balance reconstructions from instrumental data) - yes, re-worded

- Collectively the proxy records suggest that there was a change in character of circulation in the region about AD 1875. what you are really describing here is the difference in the records prior to 1875 - re-worded

List of Tables and Figures: Table 1. - What is KAML?? Identify abbreviations used here. Why are the KR site results not shown? Possibly BY should also be included in this analysis. - done, the abbreviations of the sites are shown at the fig.1

- Fig. 1. Study area showing the location of tree-ring, glacier, ice core sites and meteorological stations used in this study. The TR , met and glacier sites should be shown by different symbols. I could not find all of them .- done

- Fig. 3. Comparison of the KAML and BY ring-width standard chronologies. These records are considered to be proxies of summer or early temperature. These two figures should show sample depth and EPS limits (at least for the new composite chronology) - done, the sample depth and the EPS control $>$0.85 is shown for the KAML series.

- Fig. 4 A - Smoothed values (11 year running mean) of the Melt Feature Index (MFI) of the glacier of Ushkovsky Volcano and the KAML ring-width chronology. B - the unsmoothed values of the same parameters and dates of corresponding minima. The



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melt data in Figure b seem to have a lower resolution that the RW chronology data . Are they actually annual values? - they are averaged for 1 m and 5 m. Those averaged for 1 m seem to be close to annual, at least in the last two centuries (Shiraiwa et al., 1999, 2001)

- Fig. 5. A - Mass balance of Kamchatka glaciers reconstructed using meteorological records: Kozelsky glacier (Vinogradov, Muraviev, 1992) Grechisknia glacier (Vinogradov, Muraviev, 1985), Koryto glacier (Muraviev et al., 1999), These data are not clear redraft the figure to distinguish more clearly - done, the figure now represent the three glaciers separately.

- B - Precipitation of hydrological year and June-August temperature (Kliuchi met.station) C - KAML ring width chronology (proxy for summer temperature) and accumulation for Ushkovsky ice core. All series are 11-years averaged. Shaded stripes are periods favorable to glacier advances. What criteria are these based on? Interpretation from each record (i.e. they are all different) or the same limits in each figure ? - explained in the caption

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Interactive comment on Clim. Past Discuss., 2, 1051, 2006.