

Interactive comment on “Defining the Little Ice Age” by Ø. Paasche and J. Bakke

Anonymous Referee #2

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The paper addresses a very important topic, namely the spatio-temporal pattern of the Little Ice Age, but does not, unfortunately, contribute to any new knowledge of this period. Therefore, I would not recommend the paper to be published in *Climate of the Past* in its present form. However, I do think a much revised and extended version could be considered for publication since the paper has a potential if properly reworked.

The authors try to gain a better understanding of the Little Ice Age by studying 6 proxy records reflecting atmospheric circulation and numerous glaciological records from the North Atlantic region. Temperature, precipitation or drought proxies are not considered. The aim of the paper is global but still the authors merely study data from the Northern Hemisphere and primarily from the North Atlantic region. The reader never gets any good explanation why not data from other regions are studied as well. Actually, it is quite surprising that data from China are not studied at all when China is one of the regions in the world with most and best temperature and precipitation proxies for

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the period of interest. All stalagmite records from southern Asia, reflecting changes in the monsoon pattern, and tree-ring records from the American southwest, reflecting changes in the drought pattern, are not studied either despite that such hydrological records are very important to gain a better understanding of large-scale reorganizations and dynamics of the climate system during the Little Ice Age. To summarize this criticism, too few of the presently potentially useful proxy records are considered in the paper.

The discussion about the geographical extent of the Little Ice Age feels out of date. Numerous studies have shown, in recent years, the global, or near global, extent of the Little Ice Age. To refer to a work from 1993, before modern quantitative late-Holocene palaeoclimatology hardly had begun, to support the notion of the unknown extent of the Little Ice Age is not proper. More modern references (from the last 5 years) are needed. In general, it would be preferable if more references are given for the different statements made concerning different views on the Little Ice Age.

Moreover, my feeling is that the authors are not very familiar with the huge amount of literature concerning the Little Ice Age and its spatio-temporal pattern. Many key studies are missing in the reference list. It is not my job as referee to survey the literature for the authors, but I have listed some studies, mainly concerning temperature changes, that they ought to consider:

Ammann, C.M., Joos, F., Schimel, D.S., Otto-Bliesner, B.L., and Tomas, R.A., 2007: Solar influence on climate during the past millennium: Results from transient simulations with the NCAR Climate System Model. *Proceedings of the National Academy of Sciences, USA*, 104, 3713–3718.

Crowley, T.J., 2000: Causes of climate change over the past 1000 years. *Science*, 289: 270–277.

D’Arrigo, R., Wilson, R. and Jacoby, G., 2006: On the long-term context for late 20th century warming. *Journal of Geophysical Research*, 111: D3, D03103.

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- Esper, J., Cook, E.R. and Schweingruber, F.H., 2002: Low-frequency signals in long tree-ring chronologies for reconstructing past temperature variability. *Science*, 295: 2250–2253.
- Ge, Q., Zheng, J., Fang, X., Man, Z., Zhang, X., Zhang, P., and Wang, W.-C., 2003: Winter half-year temperature reconstruction for the middle and lower reaches of the Yellow River and Yangtze River, China, during the past 2000 years. *The Holocene*, 13: 933–940.
- Ge, Q.S., Zheng, J.-Y., Hao, Z.-X., Shao, X.-M., Wang, W.-C., and Luterbacher, J., 2010: Temperature variation through 2000 years in China: An uncertainty analysis of reconstruction and regional difference. *Geophysical Research Letters*, 37: 10.1029/2009GL041281.
- Hegerl, G., Crowley, T., Allen, M., Hyde, W., Pollack, H., Smerdon, J. and Zorita, E., 2007: Detection of human influence on a new, validated, 1500 year temperature reconstruction. *Journal of Climate*, 20: 650–666.
- Jones, P.D., Briffa, K.R., Osborn, T.J., Lough, J.M., van Ommen, T.D., Vinther, B.M., Luterbacher, J., Wahl, E.R., Zwiars, F.W., Mann, M.E., Schmidt, G.A., Ammann, C.M., Buckley, B.M., Cobb, K.M., Esper, J., Goosse, H., Graham, N., Jansen, E., Kiefer, T., Kull, C., Küttel, M., Mosley-Thompson, E., Overpeck, J.T., Riedwyl, N., Schulz, M., Tudhope, A.W., Villalba, R., Wanner, H., Wolff, E. and Xoplaki, E., 2009: High-resolution palaeoclimatology of the last millennium: A review of current status and future prospects. *The Holocene*, 19: 3–49.
- Juckes, M.N., Allen, M.R., Briffa, K.R., Esper, J., Hegerl, G.C., Moberg, A., Osborn, T.J. and Weber, S.L., 2007: Millennial temperature reconstruction intercomparison and evaluation. *Climate of the Past*, 3: 591–609.
- Lamb, H.H., 1977: *Climate: Present, past and future 2. Climatic history and the future*. London, Methuen: 835 pp.

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- Ljungqvist, F.C., 2010: An improved reconstruction of temperature variability in the extra-tropical Northern Hemisphere during the last two millennia. *Geografiska Annaler*, 92A: 1–13.
- Moberg, A., Sonechkin, D.M., Holmgren, K., Datsenko, N.M., and Karlén, W., 2005: Highly variable Northern Hemisphere temperatures reconstructed from low- and high-resolution proxy data. *Nature*, 433: 613–617.
- Neukom, R., Luterbacher, J., Villalba, R., Küttel, M., Frank, D., Jones, P.D., Grosjean, M., Wanner, H., Aravena, J.-C., Black, D.E., Christie, D.A., D'Arrigo, R., Lara, A., Morales, M., Soliz-Gamboa, C., Srur, A., Urrutia, R., and von Gunten, L., 2010: Multiproxy summer and winter surface air temperature field reconstructions for southern South America covering the past centuries. *Climate Dynamics*: in press.
- NRC (National Research Council), 2006: *Surface temperature reconstructions for the last 2,000 years*. Washington, DC: National Academies Press: 196 pp.
- Solomina, O., and Alverson, K., 2004: High latitude Eurasian paleoenvironments: introduction and synthesis. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 209: 1–18.
- Yang, B., Braeuning, A., Johnson, K.R., and Yafeng, S., 2002: General characteristics of temperature variation in China during the last two millennia. *Geophysical Research Letters*, 29: 1324.

Minor remarks

Page 2, line 2: I have difficulties with the word “anomaly” here. The Little Ice Age is likely the latest of many Holocene “cold events” and neither warm or cold periods can be considered as “anomalies” since it is a state of climate no more abnormal than a warm state.

Page 2, line 2–5: The harsher living conditions are documented for China during the Little Ice Age as well as for Europe. If a global perspective on the Little Ice Age is the

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goal, a Eurocentric view must be avoided.

Page 4, line 25: Why are only Mann et al. 2008 and Mann et al. 2009 cited when numerous other similar studies exist that should also be cited?

Page 5, line 3–8: References to the literature are needed,

Page 7, line 15: Why are not other relevant studies cited here?

Page 7, line 24: A reference to such an old work as Bradley and Jones (1993) is not proper here.

Page 9, line 11–19: There are many important studies concerning the external forcings behind the Little Ice Age that should be considered here.

Page 11, line 6–8: The statement regarding the lack of Southern Hemisphere data seems out of place when the data that do exist are not considered.

Page 17, line 8: The reference should be to Kaufman et al. (2009) and not to Mann et al. (2008). It is the Kaufman et al. (2009) reconstruction that is shown in the figure.

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