Supplement of Clim. Past, 13, 411–420, 2017
http://www.clim-past.net/13/411/2017/
doi:10.5194/cp-13-411-2017-supplement

Supplement of

Influence of North Pacific decadal variability on the western Canadian Arctic over the past 700 years

François Lapointe et al.

Correspondence to: François Lapointe (francois.lapointe@ete.inrs.ca, frankvarve8@gmail.com)

Text 1

Period before 1300 CE

We note a weaker correlation between our record and the PDO-reconstruction (Macdonald et al., 2005) prior to ~1300 CE during a period that corresponds broadly with a thick erosive layer dated ~1300 CE in the varve chronology (Lapointe et al., 2012) (Fig. S6). This layer has been suggested to be the consequence of a mass movement deposit in a recent study (Normandeau et al., 2016a). However, this event is also relatively synchronous with an unprecedented negative anomaly in the reconstructed PDO occurring around 1296 CE (Macdonald et al., 2005). Cross-correlation between these two proxy records shows a significant correlation between 993-1299 CE when VT is shifted by 45 years (CBEL lags PDO by 45 years, $r = -0.20$, $p < 0.001$; Fig. S7), suggesting that the large debris flow at ~1300 CE likely eroded 45 varves. It is worth noting that the tree-ring based PDO reconstruction values prior to 1300 CE are almost constantly negative. Moreover, the period encompassing 1000-1300 CE is characterized by periods of massive droughts in the southwestern USA, causing a deficit of soil-water recharge and possibly widespread tree mortality in this region (Williams et al., 2013). In any case, the low distribution of tree-rings prior to 1300 CE impedes a good understanding of the climate in the Northern latitudes (Wilson et al., 2015).

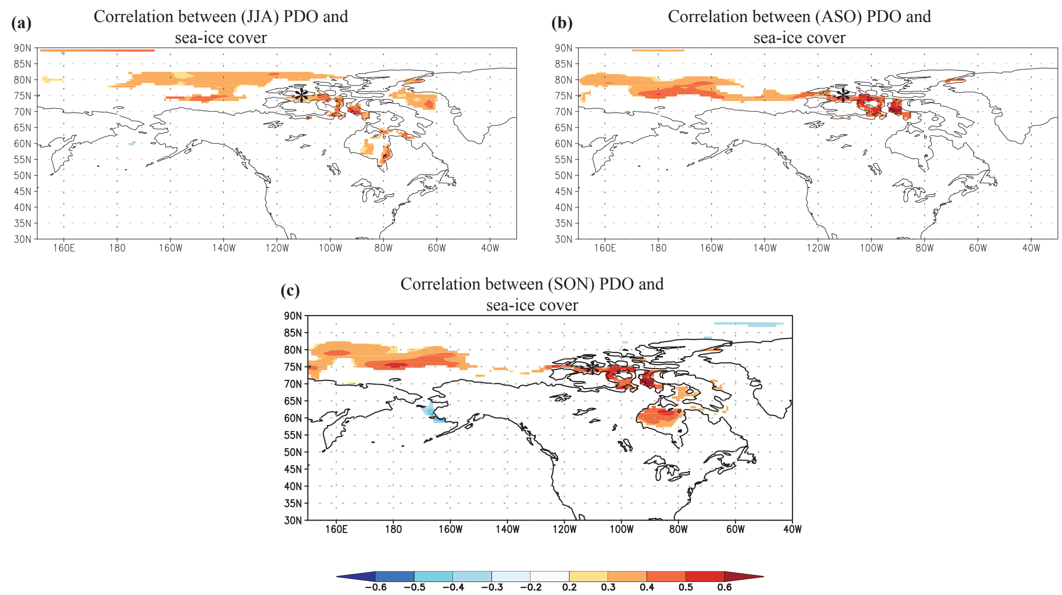

Figure S1. Sea-ice cover anomalies in relation to PDO phases during summer and autumn. Correlation between PDO (Huang et al., 2015) and sea-ice anomalies from ERA-Interim (Dee et al., 2011) for June-August (a), August-October (b), and September-November (c) during 1979-2016. Black asterisk denotes Cape Bounty.

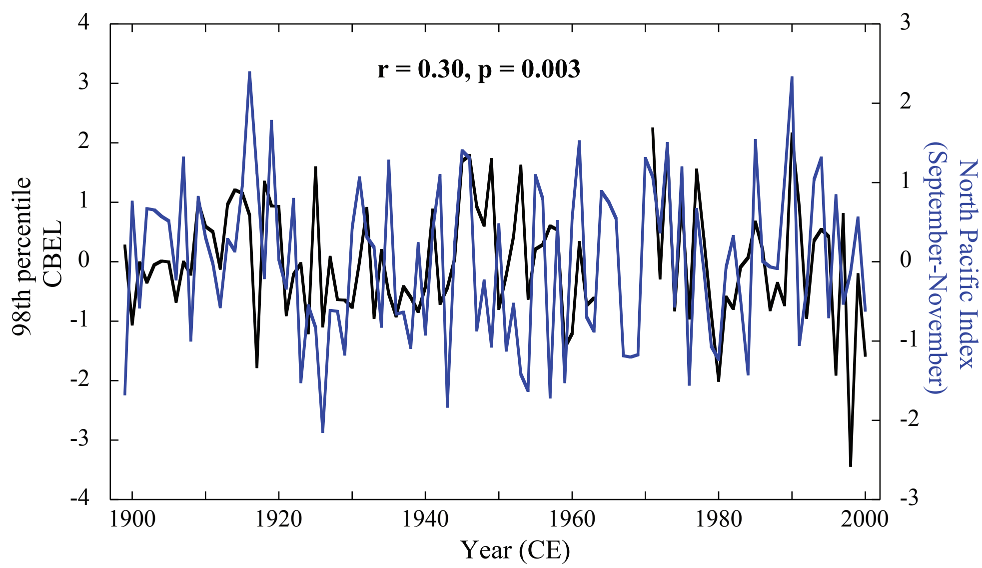

Figure S2. Correlation between the 98th percentile at CBEL (Lapointe et al. 2012) and the NPI during September-November (Trenberth and Hurrell 1994) for the past 100 years.

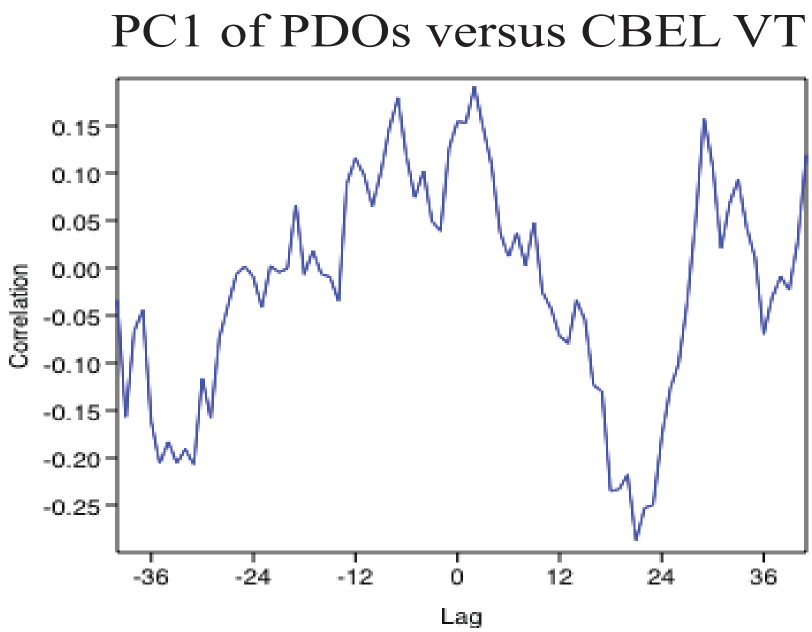

Figure S3. Cross-correlation between annual PC1 of reconstructed PDOs (MacDonald and Case 2005, D'Arrigo et al. 2001, Gedalof and Smith 2001) versus annual CBEL varve thickness from 1700-1900. Maximum correlation is reached at 18 year lag, that is CBEL leads the PDO reconstructions.

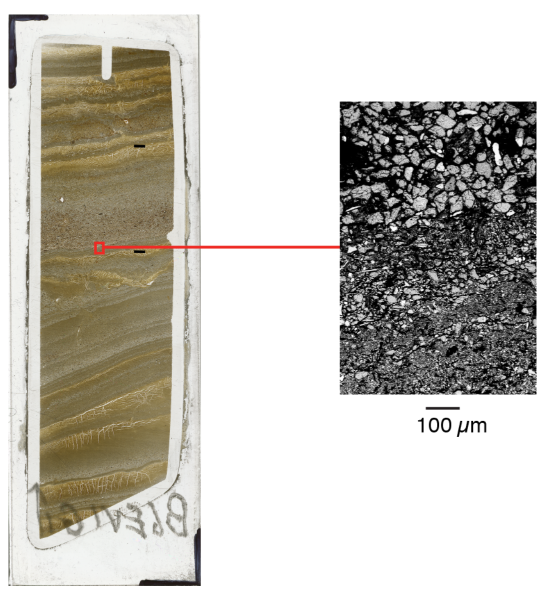

Figure S4. Large turbidite showing erosive features. The black lines indicate the thickness of the layer (1.34 cm) dated to 1446 CE. The backscattered electron image acquired at the scanning electron microscope shows the base of the turbidite (red square). Core # CBEV1, depth from top: 101.88 cm.

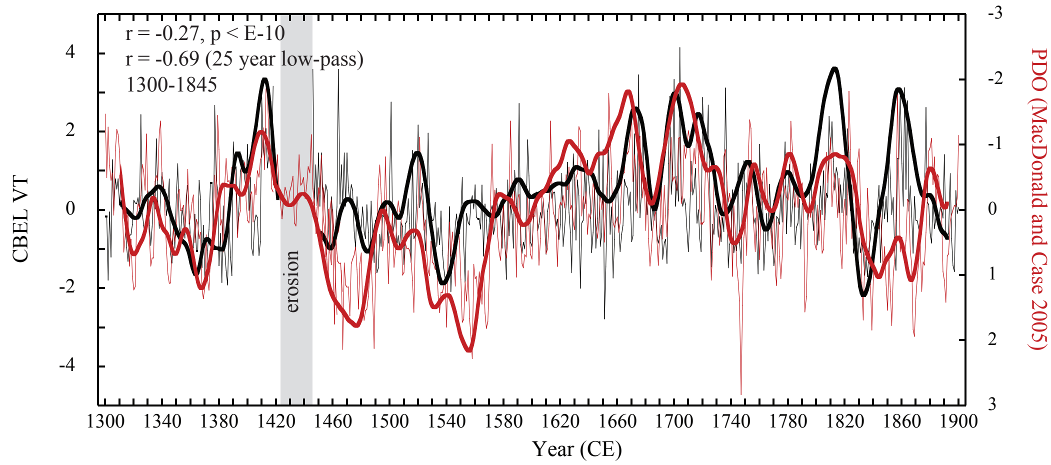

Figure S5. Comparison between CBEL varve thickness and the Pacific Decadal Oscillation (Macdonald et al., 2005) over the last ~700 years. Bold lines are 25-year low-pass filter. Grey shading (b) indicates the 28 years eroded varves at CBEL.

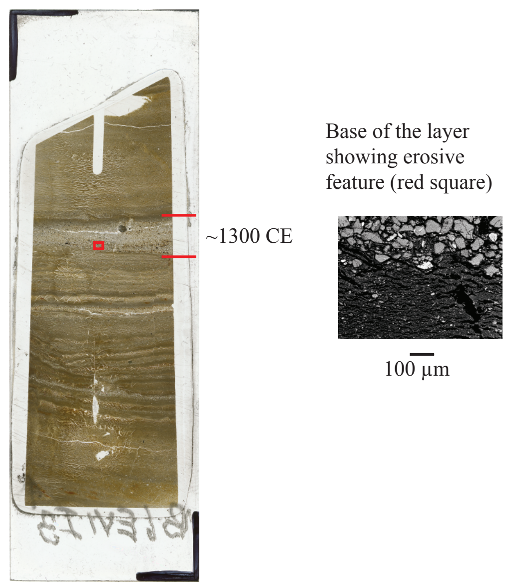

Figure S6. Largest debris flow deposit dated to ~1300 CE. The backscattered electron image acquired at the scanning electron microscope shows the base of the debris flow (red square). Core # CBEV1, depth from top: 130.14 cm.

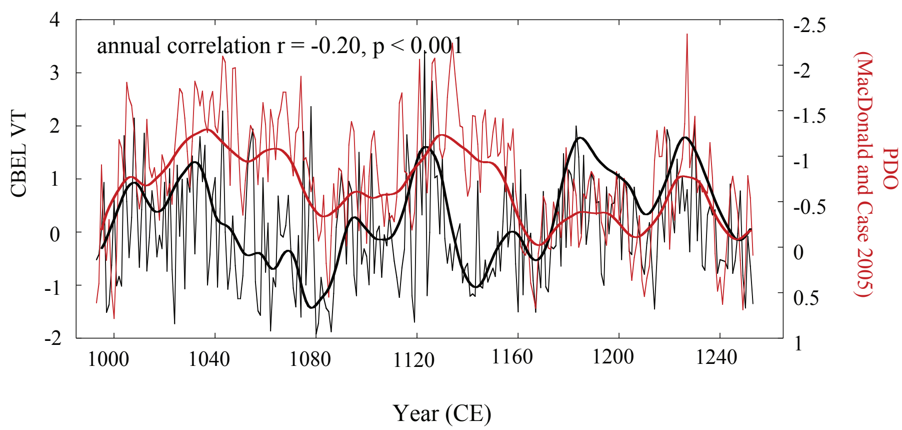

Figure S7. Varve thickness versus reconstructed PDO(Macdonald et al., 2005) during the Medieval Climate Anomaly. Bold lines are 25-year low-pass filter. Varve thickness is shifted 45 years earlier.

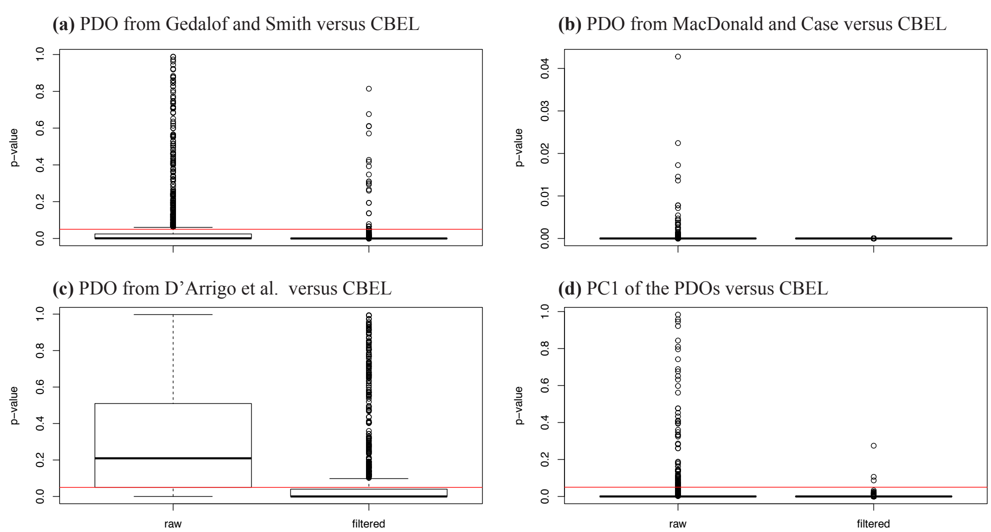

Figure S8. p-values for the correlations between (raw and filtered) reconstructed PDOs and CBEL VT using a nonparametric stationary bootstrap (1000 iterations). Red line is the 95% confidence levels.

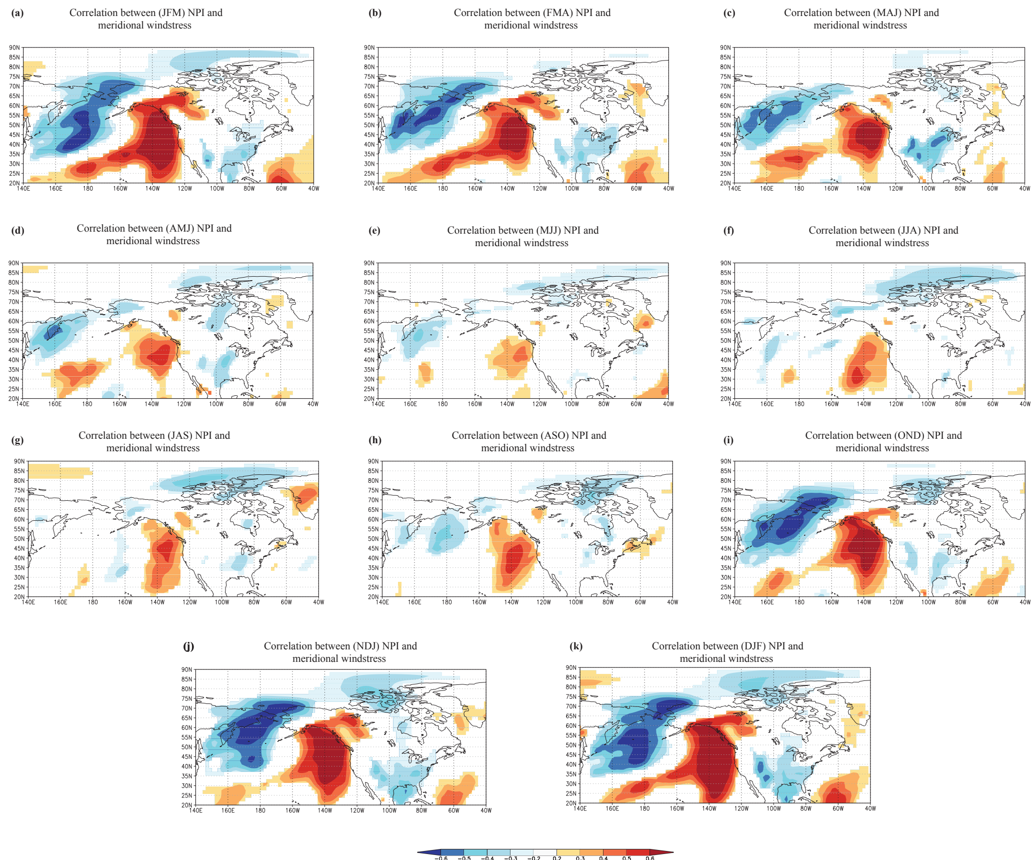

Figure S9. Same as Figure 6a, but for all year-round except SON (as it is in the main text). (a) averaged January-March, (b) February-April, (c) March-May, (d) April-June, (e) May-July, (f) June-August, (g) July-September, (h) August-October, (i) October-December, (j) November-January and (k) December-February.

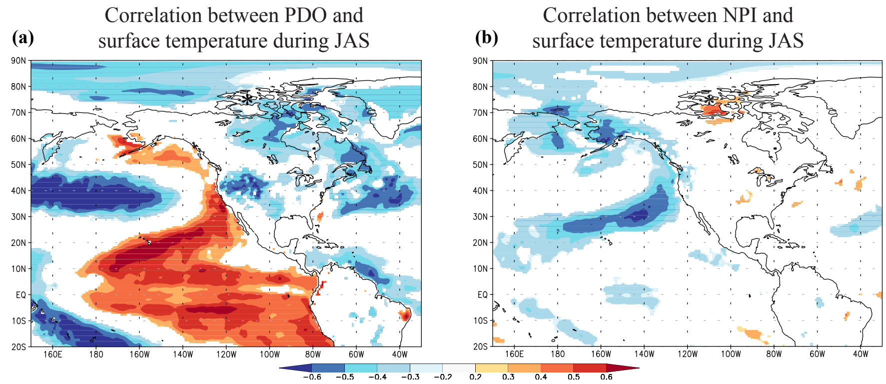

Figure S10. North Pacific influences on temperature anomalies in the western Canadian Arctic. (a), Spatial correlation between July-September PDO index and July-September surface temperature (Dee et al., 2011) for 1979-2016. (b), as in (a), but for the North Pacific Index (Trenberth et al., 1994).

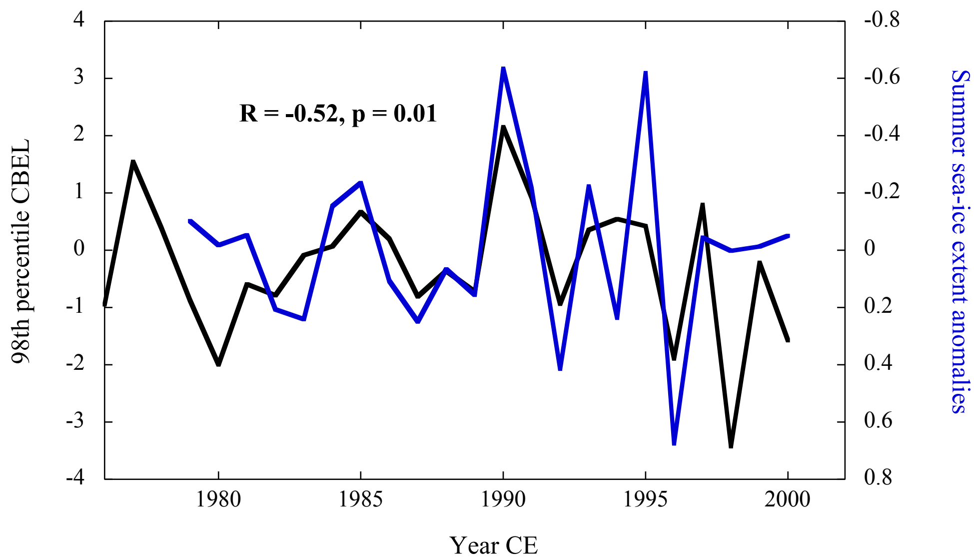

Figure S11. Summer sea ice extent covering 84°- 67°N / 100° W - 170° E compared to the 98th percentile at CBEL.

References

Cuven, S., Francus, P. and Lamoureux SF.: Mid to Late Holocene hydroclimatic and geochemical records from the varved sediments of East Lake, Cape Bounty, Canadian High Arctic, Quatern. Sci. Rev., 30 2651-2665, 2011.

Dee, D., S. Uppala, A., Simmons, P., Berrisford, P., Poli, S., Kobayashi, U., Andrae, M., Balmaseda, G., Balsamo and Bauer P.: The ERA-Interim reanalysis: Configuration and performance of the data assimilation system, Q. J. R. Meteorol. Soc., 137**,** 553-597, 10.1002/qj.828, 2011.

Huang, B., Banzon, V. F., Freeman, E., Lawrimore, J., Liu, W., Peterson, T.C., Smith, T.M., Thorne, P.W., Woodruff, S.D. and Zhang, H.-M.: Extended reconstructed sea surface temperature version 4 (ERSST. v4), Part I: upgrades and intercomparisons, J. Climate, 28**,** 911-930, 2015.

Lapointe, F., Francus, P., Lamoureux, SF., Saïd, M. and Cuven, S.: 1750 years of large rainfall events inferred from particle size at East Lake, Cape Bounty, Melville Island, Canada, J. Paleolimnol., 48, 159-173, doi: 10.1007/s10933-012-9611-8, 2012.

MacDonald, G. M. and Case, R.A.: Variations in the Pacific Decadal Oscillation over the past millennium, Geophys. Res. Lett., 32, 10.1029/2005GL022478, 2005.

Normandeau A., Joyal G., Lajeunesse P., Francus P., Lamoureux SF. and Lapointe F.: Late-Holocene Mass Movements in High Arctic East Lake, Melville Island (Western Canadian Arctic Archipelago). Submarine Mass Movements and their Consequences: Springer; 2016. p. 311-20.

Normandeau, A., Lamoureux, SF., Lajeunesse, P. and P. Francus.:, Sediment dynamics in paired High Arctic lakes revealed from high-resolution swath bathymetry and acoustic stratigraphy surveys, J. Geophys. Res.: Earth Surface., 2016b.

Ojala, A., Francus, P., Zolitschka, B., Besonen M., and Lamoureux, SF.: Characteristics of sedimentary varve chronologies–a review, Quatern. Sci. Rev., 43**,** 45-60, 2012.

Trenberth, K. E. and Hurrell, J.W.: Decadal atmosphere-ocean variations in the Pacific. Clim. Dynam.,9**,** 303-319, doi:10.1007/BF00204745, 1994.

Williams, A. P., Allen, C.D., Macalady, AK., Griffin, D., Woodhouse, C.A., Meko, D.M., Swetnam, T.W., Rauscher, S.A., Seager, R. and Grissino-Mayer , H.D.: Temperature as a potent driver of regional forest drought stress and tree mortality, Nature Clim. Change, 3(3), 292-297, 2013.

Wilson, R., K. Anchukaitis, K. Briffa, U. Büntgen, E. Cook, R. D'Arrigo, J. Esper, D. Frank, B. Gunnarson, and G. Hegerl (2015), Are tree-ring based estimates for Northern Hemisphere medieval temperatures fit for purpose?, paper presented at EGU General Assembly Conference Abstracts.