

Interactive comment on “Can we reconstruct Arctic sea ice back to 1900 with a hybrid approach?” by S. Brönnimann et al.

Anonymous Referee #2

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I am not qualified to comment on the bulk of this paper, which concerns techniques for reconstructing sea ice fields using modeling and statistical techniques. I am qualified to remark on sea ice data and data sources, so where my comments extend beyond these bounds, the editor and authors are justified in weighting my comments accordingly.

The paper addresses the relevant and timely topic of finding practical ways of improving coupled climate model performance in polar regions. (For why this is necessary, see, e.g., Stroeve, et al 2007, Arctic sea ice decline: Faster than forecast, Geophys. Res. Lett., 34, L09501, doi:10.1029/2007GL029703.) The assumption that historical sea ice data can be used to improve models has been around a long time. The authors do a nice job of building on the work of Chapman and Walsh and Rayner et al. in terms of maximizing the value of historical sea ice data for modeling. While an improved

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product does not result, the technique is shown to be useful primarily because, if I understand correctly, variability in the reconstructed fields is realistic (or can be, with some additional work).

I believe that the description of the work is complete enough to allow reproduction of results (Figure S1 is surely a great addition in this regard). However, one limit to reproducing results may be ensuring that the all data used are bundled such that future researchers can retrieve the same data sets, preferably from a data center so that changes in the data set might be traced over time. A version of the Chapman and Walsh data are at the U.S. National Snow and Ice Data Center (http://nsidc.org/data/docs/noaa/g00799_arctic_southern_sea_ice/index.html) but this is apparently an earlier version than the data used in this study.

The authors will want to read Observed Sea Ice Extent in the Russian Arctic, 1933-2006 (Mahoney et al. 2008); currently in press and on line at <http://www.agu.org/journals/pip/jc/2008JC004830-pip.pdf>. This paper introduces a new data set that includes some of the Russian ice chart data used by Polykov et al. in gridded form. The data are available at <http://nsidc.org/data/g02176.html>. Mahoney et al address (though inconclusively) differences with the HadISST1.1 data, and estimates errors in the historical ice chart data.

Specific Comments

Section 1 p. 958 "These series suggest more variability prior to around 1950, including a marked decrease during the early 20th century in some areas." Mahoney et al (2008) is consistent with this finding.

Section 2 p. 958. If J&P give *extent*, and W&C give *concentration*, how are the two used together? I may have missed it, but didn't see extent and concentration mentioned again. Is J&P converted to concentration somehow?

Section 2 p. 959 "As our reference sea ice data set we used HadISST. This means that

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our 1900–1953 reconstructions should be consistent with post-1953 HadISST sea ice as well as with historical sea-surface temperatures (SSTs) from HadISST. In particular, we used the historical (1900–1953) sea ice climatology from HadISST." Unless I am very much mistaken, HadISST for 1900-1953 relies almost entirely on the Walsh and Chapman. Is this irrelevant? Even if so, please mention this and explain why it is irrelevant.

Section 3.3 p960. "We use a simple analogue approach, i.e., we select the 54-year period in the control run that fits best, based on low-pass filtered data, with all available historical information (highest average of correlation coefficients, giving equal weight to W&C and J&P)." Once again, if one is concentration, and the other is extent, how does this work?

Section 3.3 p961 "There is an even more fundamental assumption behind the analogue approach, namely that the climatologies from the model and from HadISST match. As this is clearly not the case (see also Wang et al., 2007) a regridding procedure is performed at a later step (see Sect. 4.1)." This regridding procedure is never adequately explained in 4.1. A diagram on the method, included in the online supplement, would be very helpful.

Section 3.4 p963 "Because historical sea-ice data are only available in summer, lagged predictor variables were used to reconstruct winter sea ice." Some reference for why these lags are the right ones would be helpful, though I may not be understanding the significance here ("Note that the exact choice of the weights is not crucial as the subsequent principal component (PC) extracts the relevant information")

Section 4.3

Technical Corrections

Section 3.3 p961 Typo: predictand

Section 3.3 p962 "Similar as in BL" should be "Similar to BL…"

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