

Interactive comment on “Recent warming inconsistent with natural association between temperature and atmospheric circulation over the last 2000 years” by P. A. Mayewski and K. A. Maasch

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This paper presents an overview of Holocene changes in atmospheric circulation as archived in the chemical composition of ice cores from Greenland and Antarctica, with a focus on the past 2000 years. For this period, the authors compare the chemical records with hemispheric scale temperature reconstructions and discuss their phase lags, with implications on the current warming.

In general, I think that the paper is too long and sometimes speculative, without enough

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caution on the reliability of the hemispheric temperature reconstructions and the temporal persistence of teleconnections.

I recommend to make it shorter but add clear statements about the uncertainties. The authors must introduce what they call as "natural variability", "forced variability" and "abrupt changes" regarding their proxy records.

There should be a discussion on the expected relationships between hemispheric temperature and changes in circulation. I would not expect, for instance, changes in patterns of the NAO to induce large temperature fluctuations at the hemispheric scale, because the NAO results in a redistribution of heat rather than a consistent hemispheric increase in atmospheric heat transport. Only if large scale amplifiers are at play (cloudiness, sea-ice extent etc) should there be a dominant temperature signature.

* Abstract : The abstract should be reorganised by giving first the results obtained by the Holocene records (bipolar aspects and north/south lead/lags), then describe the method used for the past 2000 years to determine the range of "natural" variability and the detection method, and the results for the late 20th century.

* Introduction : - Luterbacher and colleagues have published several papers on the use of historical records to reconstruct European atmospheric circulation indices and temperature, and discuss their relationships; this could be cited. - The word "naturally forced" suggests a good understanding of the forcings and response. To my knowledge, this is not the case for any rapid change of the Holocene apart from the 8.2 event. I would recommend that the authors clarify their working and use the term "natural variability" rather than "naturally forced abrupt changes". It would be worth to state the timing of the "abrupt" changes because the first paragraph of the introduction is a bit elliptic. - The US Academy of Science report on the climate of the past millennium could be cited together with the Mann and Jones paper, since it provides detailed analyses on the reliability of the proxy records and the statistical methods used to in-

tegrate them. - There is a general ambiguity in the text because there is a potential to discuss polar temperature changes as indicated by stable isotopes of water from ice cores, which is never used. I think that there would be an interest in discussing atmospheric circulation versus local temperature changes, and then hemispheric estimates. - It would be nice to mention the spatial representativity of the GISP and SD records compared to other Greenland and Antarctic sites spanning the Holocene.

* Section 2 - Sources of uncertainties in the relationship between stable isotopes and temperature in polar ice cores could be mentioned, such as changes in moisture origin and deposition seasonality, with appropriate references. - The statement "unlike ice core stable isotope proxies for temperature" is misleading. Works conducted on GRIP and other Greenland records suggest that the winter d18O signal is related to the NAO for the past centuries (e.g. Vinther et al, 2003 for the most recent reference). - There should be a discussion of source, transport and deposition impacts on glaciochemical records. Is it expected that changes in land use over the past centuries could influence sources of continental dust?

2.1 - Please discuss the impact of the resolution of the records on the detection of the natural variability for the Holocene versus the high resolution records of the past millennia.

2.2 - Discuss the coherency between chemical and water isotopic records - This section should be shortened, separated in different paragraphs, and most of the text should be summarized either in a table or a figure showing the regressions observed over the past decades with circulation indices. - The validity of NCEP reanalyses prior to ~1975 in terms of polar circulation should be discussed. - What is the coherency of the various glaciochemical records in terms of origin of dust (and calcium) to Greenland? - Separate the SD paragraph - Remove the end of the section (wind speeds). - mention the hypothesis of persistent teleconnections

Section 3 - the introduction paragraph is very unprecise, and mixes different time

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ranges. It could be removed or made more precise.

3.1 - Discuss the detection of the events in local temperature (stable isotope records) - Discuss the regional representativity of the selected sites (wrt other Antarctic and Greenland records) - Give the timing of the rapid changes. - Is there an explanation for the recent trends? Can an decrease in SD accumulation rate account for the calcium and sodium trends? What about anthropogenic effects related to NH land use changes? - Place clearly the fluctuations of the past 2000 yrs in a Holocene perspective

3.2 should be termed "atmospheric circulation and hemispheric temperature change over the past 2000 yrs". - Sections 3.2.1, 3.2.2, 3.2.3 should be combined. The methodology to obtain figures 5 to 8 should be described and the common results discussed in terms of unusual temperature change. Basically, the result is that the hemispheric temperature increases over the past decades is not accompanied by an unusual signature in terms of circulation indicators. This should be said clearly and concisely. - The discussion on the leads and lags suggests that events in the chemistry of the cores, hemispheric temperature are related and bipolar; the hypothesis that these indicators can be totally decorrelated could be mentioned. The leads obtained are in contrast with those suggested by Goosse et al 2004. - In fact, there is no clear association between SH temperature and chemistry records, which deserved to be said clearly, whereas there is a trend for more concentration of chemicals during cold NH temperatures in Greenland. This could also be said shortly. - The validity of the SH temperature record must be discussed. - The second paragraph page 338 is not relevant for the discussion here but could be added in the introduction (Section 1). - The last paragraph page 338 should be deleted unless there are solid arguments about the analogy between cold phases of DO at the millennial scale and centennial scale fluctuations of the past millennium. By the way, gas fractionation data (e.g. Landais et al, GRL, 2004) suggest that despite stable d18 records during stadials, temperature fluctuations may have exhibited a small centennial minimum. - This paragraph could

be replaced by a discussion of mechanisms at play.

Section 4 - Same remarks as previously on the leads and lags discussion. - Past fluctuations may occur without any forcing, just due to abrupt processes within interactions in the climate system components => the term “naturally forced” is questionable. - The end of the conclusion is very speculative (esp. about forecasts on storminess in the high southern latitudes) and could be shortened.

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2, S396–S400, 2006

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