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Climate of the Past Discussions

Interactive comment on "Two modes of glacial climate during the late stage 5 identified in Greenland ice core records" *by* M.-L. Siggaard-Andersen et al.

Anonymous Referee #2

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This manuscript presents new data of Na+ and Ca2+ in the NorthGRIP ice core over the last 110 kyrs. Based on the temporal variability of the correlation between these two ionic species, the authors propose an associated variation in the atmospheric circulation. Particularly, they identify the transition between MIS 5 and MIS 4 as a major shift between two modes of atmospheric circulation.

The approach is original. However I think that the interpretation of the authors needs to be strengthened because it can be easily challenged. Indeed it appears that the authors present only one possible interpretation for the combined record of Na+ and Ca2+. This paper strongly misses from a calibration or method section to explain on

what bases the interpretation in term of atmospheric circulation patterns relies. Thus the paper in its present form is not convincing at all because the argumentation is almost inexistent.

As a consequence, I would recommend not accepting this manuscript in its present form. However, if the authors can be more precise in their description and interpretation and provide a detailed argumentation for their interpretation, I would be happy to revise it again. I elaborate below and try to suggest possible ways of improvement.

General suggestion: Would it be possible to argument your interpretation using Na+ and Ca2+ data in recent snow and compare it with the different flow patterns (Mode I and Mode II) that you identified in your discussion? I imagine that the two flow patterns that you identify were not only present the 30 December 1978 and in January 1964. Or would it be possible to look at some AGCM output for MIS 5 and compare it with present-day flow patterns? It is really not clear how you identified mode I and mode II?

Specific and general comments along the text (I could not make the difference between both) Abstract: - elaborate on what are the “two distinct flow patterns”

Introduction - I don’t think that we can limit the huge amount of studies performed on the subject of MIS 5e to information on “temperature, oceanic flow and ice volume”. - It should be explained with great details why “changing correlations with time between these aerosol species identify reorganizations of the atmospheric flow patterns”. For example, I could imagine that a change in the aridity of the desertic regions will lead to an increase in Ca2+ while the Na+ remains unchanged. - Is it the first time that the Na+ and Ca2+ are submitted for publication? The [Siggaard Andersen et al., 2006] is simply an abstract ? - The last sentence of the introduction is not clear at all: what do you mean by “two different modes of glacial climate during the late MIS 5” ??

Part 2 - l.17 : “record” of what ? temperature ? - Is it possible to compare the North-GRIP d18O record with polar fauna record? The fact that the polar fauna counting is equal to 0 over a large time period does not imply that the temperature remains very

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high over this period but simply that the temperature remains above a certain threshold, thus preventing the apparition of this fauna. The same can be said for the comparison with pollen: there are possible saturation or threshold effects. - How can you say that the coolings were larger at high latitudes than at low latitudes during MIS 5? What are the associated references?

Section 2-1 - Argument when you say “the match, reflecting the dominating atmospheric flow pattern”. It is really not clear why combination of Na+ and Ca2+ should be a proxy for a certain atmospheric flow pattern. - What do you mean by “a geographical asynchrony in the onset of full glacial conditions”?? By doing this, you imply that the concentration of Na+ and the concentration of Ca2+ are direct indications of climate at a certain location and that this location is different for Ca2+ and Na+ ? But you said previously that the “deposition of aerosol in Greenland depends on the local North Atlantic conditions” because Na+ and Ca2+ were both correlated with 18O. Could you clarify and argument this point? Which information do you obtain from Na+, which information do you obtain from Ca2+? Is it related to Greenland temperature or is it driven by the climate of remote regions? - L26: Precise what you mean by "changes in the hydrological cycle": do you mean a more efficient transportation of the water mass? A change in the evaporative conditions of the water mass? - Would it be possible to do the same exercise with the Ca2+ and Na+ records of the GRIP ice core? Do you find the same results? - I don’t see that the change in dust size around 75 kyrs BP is significantly larger than other changes along the 100 kyrs record. - In the Jouzel et al. [1982] paper, d is interpreted as a change of humidity of the source, not temperature. - The variations of d over the last 100 kyrs have been related to change of obliquity with a 40 kyrs period better than a two mode system with a different hydrologic cycle before and after 75 kyrs BP.

Section 2.2 - This section should be detailed. It is impossible to understand why the slope of the relationship between Na+ and Ca2+ should indicate different flow patterns. Develop the argumentation through calibration, modelingĚ I think that nobody will be

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convinced by your interpretation in its present form.

Section 221 - I do not understand the comparison with IRD. Moreover, are you sure that the IRD come from the Laurentide during MIS 5? Are you sure that IRD indicate period of strong melting? Especially during MIS 5? - Again, I don't understand why you state that the transport route of aerosol into Greenland during the warm part of MIS 5 is similar to the present-day one? Do you have data / modeling experiment to support it?

Discussion and Conclusion:

I do not enter in the details because I always have the same comment: the argumentation is not convincing. There is not clear relationship for me between the Na+/Ca2+ correlation and the pattern of atmospheric circulation. Similarly I do not see clear relationship between IRD, deuterium excess, dust size and Na+/Ca2+ correlation. Then, I do not understand why the two modes of atmospheric circulation of MIS 5 should correspond precisely to the 30 December 1978 and January 1964? Then it sounds very strange that you state to have identify a "new regional atmospheric mode" by using Na+/Ca2+ correlation and two (randomly chosen ?) maps of atmospheric circulation.

I am convinced that very interesting information can be obtained from combination of different atmospheric tracers and that your approach is interesting but it definitely lacks of a solid argumentation.

Interactive comment on Clim. Past Discuss., 3, 285, 2007.