

## ***Interactive comment on “Causes of Greenland temperature variability over the past 4000 yr: implications for northern hemispheric temperature change” by T. Kobashi et al.***

### **Anonymous Referee #1**

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In this study, the authors are exploring the origins of the Greenland temperature variability over the late Holocene using a decadal to centennial temperature record (argon and nitrogen isotopes) obtained by the same authors (published in 2011) at Summit from the GISP2 ice core and 1d Energy Balance Model constrained by climate forcings. The authors are looking at the implications for Northern Hemisphere temperature reconstruction, investigating the temperature relations between different Greenland sites and the Northern High Latitudes, as well as other parts of the world. A comparison with other Greenland temperature records derived from oxygen isotopes as well as the solar influence on Greenland temperature is thoroughly discussed. This paper takes advantage from another companion paper published on CPD by Kobashi et al and

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dealing with the more recent (800 years) part of their temperature record. The paper is noteworthy and the authors are doing a good job of explaining, considering all the climate forcings, some of which (volcanic forcing) are here reconstructed, as well as the internal climate variability (NAO/AO) and AMOC changes. The manuscript is well structured perhaps a little too long but the reading is good. The paper is appropriate for *Climate of the Past* and I recommend its publication after some corrections (see below).

P 4818, lines 3-4: the authors should explain what do they intend for “annual” since the record has a resolution of 20 years. This should be added not here, in the abstract, but in the main text. P 4819, lines 16-17: I would say spring to summer rather than the contrary. P 4819, line 25: add “is” after this. P 4820, line 5: “annual”, see above comment. P 4827, line 26: add “are” before “located”. Moreover, I would not say that GISP2 is located on the SW slope of the ice sheet. P 4828, line 4: why the correlation is negative? See table 2, it should be positive and the same below (line 6). P 4828, lines 16-20: Why the assumption by Vinther et al (2009) are not valid? Specify better. P 4828, line 25: add “s” to fluctuation. P 4829, line 5: change “though” into through. P 4830, line 13: the word “significant” is perhaps too much considering that the correlation between GTA and solar activity were quite low in the companion paper. P 4834, lines 1-3: I would delete this sentence; it seems a repetition of the first sentence of chapter 5. P 4834, line 6: event? P 4834, line 26: the words wide spread should be one, widespread. P 4835, line 27: add respectively before indicating. P 4836, lines 22-25. The sentence starting with “More recently,” should be rephrased. P 4838: I would exchange the order of the figures 13 and 14 putting before the figure of the reconstructed volcanic forcing over the last 1500 yr. P 4840, lines 22-23: It should be the opposite: during stronger solar activity Greenland temperatures should exhibit negative deviation. Please, correct. P 4841, line 4: it should be figure 16 and not 15. P 4841, lines 16-19: it is not clear how the calculation has been done, by using the eq. 1. P 4842, lines 8-9: which is the latitude interval for NHL? I found this part of the text not easy to follow. P 4844, line 28: add respectively after C.E. P 4845, line 28: the correct

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word is speleothem. Change also in the caption of Figure 21. P 4846, line 2: the correct word should be curve, instead of curb. P 4852, lines 26-28: the reference Kobashi et al 2012 is not correct. P 4859 Table 1: correct the headings: Mean air should stay over temperature. P 4861 Table 3: the caption is not clear at all. Why the PC1 had a negative sign? This comment is related to comment on P 4828 (see above). P 4863 Figure 1: add the label on the y-axis of the figure. The same comment for figures 6 (P 4868), 11 (P4873), 12 (P4874), 20 (P 4882), 21 (P4883). P 4864, Figure 2: add in the caption the resolution of the ice core based Summit temperatures. P 4869, Figure 7: again the same comment as above, why the PC1 is inverted? P 4870, Figure 8: add in the caption an explanation for the grey vertical bars and specify TSI. P 4871, Figure 9: the y-axis on the right has a delta. P 4875 and 4876: I would exchange the order of these two figures. P 4898, Figure 16: in this figure all the temperatures should be modelled and not ice core derived. Moreover, add that GTA is on a reversed y-axis.

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