**Climate
of the Past
Discussions**

Interactive
Comment

Interactive comment on "The effect of precipitation seasonality on Eemian ice core isotope records from Greenland" *by* W. J. van de Berg et al.

Anonymous Referee #1

Received and published: 11 March 2013

Van de Berg et al. explore the Eemian anomalies in condensation temperature (Tc) using a high resolution regional climate model run forced at the boundaries by a global coupled atmosphere-ocean model. From Tc they infer how changes in seasonality during the Eemian might have affected the part of the climate signal in d18O of ice cores that originates in the condensation (or vapor-ice deposition) process. The authors conclude that "The induced uncertainty due to possible changes in precipitation seasonality in Eemian temperature estimates based on ice core data is up to 2 K".

General comments. In my opinion this study could be suitable for publication with some revisions. The study raises highly relevant questions and offers a well executed analy-

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

sis of state-of-the-art regional climate model simulations. The manuscript is well structured and predominately well written, but I think some effort could be made to make the text more concise. Examples are given in the detailed comments below. I have given suggestions for a number of corrections for poor language, but the manuscript could also benefit from being read through by a native English speaker.

Furthermore, I think the following points should be addressed more thoroughly.

1) How is the relation between Tc and d18O? You cannot answer this for your own simulations, but other people have compared Tc and d18O (Werner and Heimann 2002 http://onlinelibrary.wiley.com/doi/10.1029/2001JD900253/abstract; Sodemann et al. 2008 http://onlinelibrary.wiley.com/doi/10.1029/2007JD009416/full; Masson-Delmotte et al. 2011). Since the title of the paper mentions both ice cores and isotopes you should elaborate on what you are leaving out by using Tc and not d18O.

2) Does the ECHO-G model really match Eemian proxy data, and which climate feedback processes are left out of the simulations? See also comment to P271, L19.

3) Why use the ERA-40 model run?

4) In extension of the conclusions of this paper some speculations would be in order: what perspectives does the results of this study offer? How do we benefit from knowing the uncertainty in ice core reconstructions that Tc induces? And what is the next step?

Detailed comments. P270, L18-20 It is the isotopologues of water that have different vapor pressures not the isotopes them selves. Write the full molecular formula. Of course you can follow the widely used convention of using the term "stable water isotopes" even though it is technically incorrect.

P270, L26 Include references for Eemian ice core data Dahl-Jensen et al. 2013 http://www.nature.com/nature/journal/v493/n7433/full/nature11789.html and Johnsen and Vinther 2007 http://www.sciencedirect.com/science/article/pii/B0444527478003458

P271, L5-6 "The precipitation that ends up in an ice core ..." reformulate to "The mois-

ture that eventually precipitates over an ice core site ..."

P271, L10 Cite original publications concerning diffusion:

Johnsen, S. J. (1977), Stable isotope profiles compared with temperature profiles in firn and with historical temperature records, in Proceedings of Symposium on Isotopes and Impurities in Snow and Ice, I.U.G.G. XVI, General Assembly, Grenoble Aug. Sept., 1975, Int. Assoc. of Hydrol. Sci. Publ. 118, pp. 388–392, Int. Assoc. of Hydrol. Sci., Washington, D. C.

Johnsen, S. J., et al. (2000), Diffusion of stable isotopes in polar firn and ice: The isotope effect in firn diffusion, in Physics of Ice Core Records, edited by T. Hondoh, pp. 121–140, Hokkaido Univ. Press, Sapporo, Japan.

P271, L15 Dahl-Jensen et al. (Nature 2013) reported Eemian anomalies of +8 deg C at the NEEM site.

P271, L19 Does the ECHO-G simulation really compare well to proxy data? The ECHO-G simulation leaves of interactive vegetation and does not include any changes in ice sheet mass balance (run-off). Most Eemian simulations underestimate Southern Hemisphere annual mean warming and Northern Hemisphere winter warming. See proxy data compilations Turney and Jones 2010 http://onlinelibrary.wiley.com/doi/10.1002/jqs.1423/abstract and McKay et al. 2011 http://onlinelibrary.wiley.com/doi/10.1029/2011GL048280/abstract

P271, L27 See also Sturm et al. 2010 for a discussion of seasonality effects during mid Holocene http://www.clim-past.net/6/115/2010/cp-6-115-2010.html

P271, L29 Is that 1 permil in annual mean?

P273, L5-7 Are the correlations spatial (which area?) or temporal (which time period?).

P274, L6 You use 125 kyr to represent the Eemian. How is this timing compared to the warmest part of the Eemian? The Eemian is

not a homogeneous warming neither temporal nor spatial (Zagwijn 1996 http://www.sciencedirect.com/science/article/pii/027737919600011X). This is analogue to the climate development during the Holocene (Rensen et al. 2012 http://www.sciencedirect.com/science/article/pii/S0277379112002168).

P274, L12 -1 to 3 K is not a "warming". Use "anomaly" instead.

P274, L18-22 How does this work with warmer lake temperature? I would expect the land to warm up faster due to smaller heat capacity. Leave out the explanation if it takes too much text to explain. According to Livingstone et al. 1999 (cited by Francis et al. 2006), land-lake temperature contrasts are also height dependent.

P274, L25 Replace "measure" with "proxy"?

P277, L8-9 Explain in first sentence of paragraph, that you have two inland profiles and one marine.

P277, L14 Replace "sea point" with "ocean point".

P277, L19 Replace "in which" with "where".

P278, L18 Replace "disappears" with "goes to zero".

P278, L19-20 What is the reason for the decreasing condensation altitude with latitude – can you explain this? Is it because of moisture content and air pressure?

P279, L11-12 Replace "As a result, it is situated relatively close to the surface over the higher parts of the ice sheet. " with "As a result, condensation occurs relatively close to the surface over the high elevation areas of the ice sheet. "

P280, L22-26 Perhaps replace these two sentences with something like "For a consistent analysis of Eemian anomalies we compare the Eemian RACMO2 simulation with a preindustrial RACMO2 control run, both with boundary conditions from the ECHO-G model. Before the analysis of the Eemian simulation we compare the preindustrial control run with the ERA-40 driven run analyzed in the previous sections".

P281, L3 Replace "human induced" with either "anthropocentric" or "CO2 driven".

P281, L3 Is the ECHO-G cold bias well known for other studies? How can you be sure it is not a genuine difference in climate between the recent and preindustrial period?

P281, L21-22 Here you are discussing the Eemian climate anomalies in general, and Greenland is be affected by changes outside of the model domain. The amplitude of the annual cycle is also affected by the decrease in winter insolation south of the Arctic circle.

P281, L22-24 What exactly do you want to say with the sentence "This additional insolation is efficiently absorbed by the earth and released to the atmosphere, since the Northern Hemisphere has a large fraction of land"? Maybe strike this sentence.

P282, L1-2 This lack of warming is at least partly contradicted by proxy data (Turney and Jones 2010; McKay et al. 2011).

P282, L18 Replace "ice cores" by "drill sites".

P283, L17 Replace "The changes in precipitation seasonality has two components" with "The impact of changes in seasonality on Tc has two components"?

P283, L22 Replace "does not look similar to" with "is different from".

P284, L11-27 I find this discussion of the impact of sea ice somewhat superficial and not up to the standards of the rest of the manuscript. If you want to assess local or regional effects of sea ice I suggest you look at some parameters like changes in wind and vapor advection. See also Sime et al. 2013 for questions of the influence on sea ice extent on Greenland d18O http://www.sciencedirect.com/science/article/pii/S0277379113000188

P284, L15-17 The effect of increased precipitation with increased temperature could be non-linear and vary a lot from model to model. I do not think it can be referred to as "logical" as I am convinced the regional scale climate-precipitaion relation is far more

complex than the Clausius-Clapeyron relation.

Comments to figures. Subplot indexing a), b) . . . should be made more clear in figures 3 and 4.

Interactive comment on Clim. Past Discuss., 9, 269, 2013.