The authors thank Anonymous Referee #2 for his/her detailed comments.

Reviewer's comments are provided in italics.

The Introduction is quite variable. The description of the North Atlantic jet is great, and gives a reader unfamiliar with the topic a good start. I don't understand why there's an extensive description of the mechanisms for abrupt change in the climate during the deglaciation, because much does not appear to be relevant for the subsequent analysis. For example, it's only in the Introduction that changes in the AMOC are mentioned - why include this? I suggest focussing the Intro only on information that is pertinent for the paper itself. P12 - I don't see a figure which shows the temperature over Greenland. Why are you showing the temperature over Greenland, anyway. What does it represent in this study looking at jet shifts.

The larger context of the paper is whether jet shifts over the last deglaciation may have contributed to the abrupt climate changes of that period. As we state in the introduction, "deglacial, winter wind conditions over the North Atlantic may have played important roles in the detected abrupt climate changes through their effects on sea ice and/or the surface ocean circulations." This is plausible, because "... altered winter sea ice extent is sufficient to reproduce the amplitude of deglacial climate changes in northwestern Europe and explain their seasonality (Renssen and Isarin, 2001). " This question is of potential importance to anyone who studies this period, whether they collect and analyse data or perform simulations. However, analyses of atmospheric phenomena under paleo timescales, and the behaviour of the jet in particular, tend to not get a lot of attention from this broader audience. Thus, we included information about the abrupt deglacial changes in the introduction and later in the results section in order to make this connection clearer and hopefully draw attention to this idea in the broader paleo community. As changes in AMOC play a central role in most hypotheses for explaining abrupt changes, we judge it necessary to include this.

Since the reviewer found these comments out of place, we have made some changes to the text to make this motivation stronger. Revised text in the introduction is "Proposed hypotheses explaining the presence of such variability during the deglaciation commonly centre around deep- water formation changes in response to freshwater anomalies in the regions where deepwater is formed (e.g. Rooth (1982); Broecker et al. (1985, 1989); Tarasov and Peltier (2005); Bradley and England (2008); Hu et al. (2010); Keigwin et al. (2018)). In simulations, abrupt reductions of the AMOC induced by hosing are successful at explaining the abruptness of cooling in the extratropical North Atlantic (NAtl), Nordic Seas, Arctic and Eurasia, the reduced precipitation in the NAtl and Europe, and the southward shift of the ITCZ (Kageyama et al., 2010, 2013). They are less successful at explaining the amplitude of tempera- ture changes over Greenland and Europe during the last deglaciation (Clark et al., 2012), particularly when hosing amounts are constrained to realistic values (Kageyama et al., 2010).

Freshwater forcing may not be the only driver of the abrupt climate changes of the last deglaciation. Modern Earth System Models (ESMs) are now exhibiting abrupt climate changes of similar magnitude under slowly-varying or constant boundary conditions (Knorr and Lohmann, 2007; Peltier and Vettoretti, 2014; Zhang et al., 2014; Brown and Galbraith, 2016; Zhang et al., 2017; Klockmann et al., 2018), due to the bistability of the AMOC (Stommel, 1961; Broecker et al., 1985; Knorr and Lohmann, 2007; Zhang et al., 2014, 2017) and/or thermohaline instabilities involving the interactions of the ocean, sea ice and potentially atmosphere (Knorr and Lohmann, 2007; Dokken et al., 2013; Peltier and Vettoretti, 2014; Brown and Galbraith, 2016; Vettoretti and Peltier, 2016; Klockmann et al., 2018; Vettoretti and Peltier, 2018). Winter sea ice extent changes alone are sufficient to reproduce the amplitude of deglacial climate changes in northwestern Europe and explain their seasonality (Renssen and Isarin, 2001), and changes to the surface ocean heat transports can affect the

rates of deepwater formation (Lozier et al., 2010; Häkkinen et al., 2011; Muglia and Schmittner, 2015). Since low-level wind patterns over the Arctic, Greenland and NAtl help constrain winter sea ice extent in this region (Venegas and Mysak, 2000) and affect surface ocean heat transports there through the application of surface wind stresses (Lozier et al., 2010; Häkkinen et al., 2011; Li and Born, 2019), these winds may play an important role in setting the conditions required for abrupt deglacial changes or be involved in the abrupt transitions themselves. However, in order to assess this potential, deglacial changes to lower-tropospheric winds must be first identified.

Of the two dominant features of mid-latitude atmospheric circulation patterns in the NAtl, the subtropical and eddy-driven 5 jets, the eddy-driven jet has the largest presence in the lower troposphere, and thus the most potential to change wind stress and thereby ocean circulation. “

Revised text in section 3.2 is “The motivation of this study is to assess the potential impact of atmospheric changes in the NAtl over the last deglaciation on the abrupt changes detected in Greenland ice cores, so we start by discussing climate changes over Greenland.”

Revised text in the Discussion and Conclusions is “ This paper explores the question of whether winter eddy-driven jet changes over the North Atlantic could have contributed to the abrupt climate changes detected in Greenland ice cores over the last deglaciation.”

The Intro, as written, just stops. It lacks a clear statement of the problem that this paper addresses. It conveys much information but doesn't link it together: how does jet variability have the potential to impact the climate during the deglaciation, especially abrupt changes? How is the paper going to answer this question?

Done. Revised text is “In summary, previous work has shown that lower-tropospheric winds over the North Atlantic have the ability to alter sea ice extent and surface ocean circulations in a manner that can reproduce abrupt climate changes detected over Greenland. Simulations have shown that these winds do change characteristics from the start to the end of the last deglaciation, although only a single study has examined how these changes may have progressed in time. Due to the manner in which boundary conditions were updated in the simulation that single study was based on and due to revised understanding of those boundary conditions, it is difficult to assess whether the timing of the wind changes that occurred are actually representative of past changes. Therefore, this study diagnoses the changes undergone by the NAtl eddy-driven jet from the LGM to the preindustrial period in multiple transient deglacial experiments using boundary conditions that are updated every simulation year following the specifications of the PMIP4 (Ivanovic et al., 2016). These simulations are performed using a modified version of the Planet Simulator (PlaSim) version 16, an Earth System Model with a primitive equation atmosphere and simplified parametrizations (Fraedrich, 2012; Lunkeit et al., 2012). As such, these simulations can help elucidate whether atmospheric dynamical changes have the potential to play important roles in the abrupt climate changes of the last deglaciation and provide an important comparison against PMIP4 deglacial studies performed using more complex models.”

Section 3.2 *What is the point in this section? At the end of this section I don't know what I am supposed to have learned. It would help to have a clear finishing paragraph to summarise this section.*

Done. Revised text is “Thus, the NAtl jet exhibits changes in position and distribution that occur independently of each other in both PlaSim and TraCE-21ka simulations. Some of these changes coincide with historical climate changes. However, since these jet characteristics and the timings of their changes differ on the eastern and western sides of the NAtl jet, we attribute them separately in the next section. “

At present it [Sec 3.2] is a selection of disparate facts. If you focus on the observations which support you summary, noting any discrepancies it may help add a narrative structure.

We have revised this section substantially, adding many more connecting sentences to improve the flow of ideas. Since other reviewer comments led us to move any discussions to a Discussion and Conclusions section, we chose not to add extra discussion in this section as the reviewer suggested.

e.g. "As discussed in Section 3.1, the low-level, NAtl jet is situated further south and exhibits a narrower range of latitudinal variability in the FullyTrans runs at the start of the deglaciation compared to its end. "

"The TraCE-21ka experiment reproduces both types of jet changes detected in the PlaSim simulations, although the timings of jet shifts are not the same. "

It would help if you were to link the discussion here [Sec 3.2] with the discussion comparing the jet in the east and west to the discussion of tilt - how do the changes at either end affect tilt? ***Tilt v east/west changes*** *Reading the manuscript one gets a sense that the tilt of the jet and the changes in the jet in the east and west are two separate entities, which they evidently aren't. Historically, the focus has been on tilt, so it makes sense to at least look at this. However, I really like the description of how the east and west vary as this adds nuance to the very simplistic view of tilt. What's lacking the manuscript though is much of a bridge between the two. How can we interpret the previous discussions about tilt in the context of your results?*

We added explicit comparisons of jet tilt changes extracted from this study with those from previous studies. We also made more explicit interpretation of how western and eastern jet latitude changes correspond to tilt changes.

Revised text is "A shift of similar size is observed on both the western and eastern regions of the eddy-driven jet (Figure 7), so there is little change in mean tilt values between these two periods (Figure 8)."

"Ensemble statistics for the NAtl jet tilt in the FullyTrans runs in Figure 9 show oscillations between the preferred jet tilt of LGM and a more zonal configuration. These changes in jet tilt reflect the very different behaviours with time of the western (270°E to 300°E) and eastern (330°E to 360°E) sides of the NAtl eddy-driven jet, which are shown in Figures 10 and 11. The timing of these transitions match the first two (more gradual) shifts in the jet as a whole and are consistent with the historical timings of the OD and B-A. They also correspond to reductions in the jet tilt ." "There is a single, gradual, northward shift in the eastern region, occurring between 16 and 15ka BP. This change is a little later than the time of increasing jet tilt. " "Without the ice sheet barrier effect, the preferred tilt in the PDTopo experiment is much smaller than in FullyTrans and does not change over the deglaciation (Supplemental Figure S7), asthe western and eastern sides of the jet appear to shift together. " "All of the fully-transient deglacial simulations presented here show that the NAtl eddy-driven jet shifted northward from the Last Glacial Maximum to the preindustrial period, and its latitudinal variability increased. These characteristics match those derived from other studies (Li and Battisti, 2008; Lofverstrom et al., 2014; Merz et al., 2015). However, unlike those studies, neither the PlaSim simulations nor TraCE-21 show much change in jet tilt between these two periods. "

I'm not sure "oscillation" is a useful term to describe periods like the Younger Dryas. Oscillation implies some set of physics that gives a distinct cycle, and it's not clear to me that any changes which occur over the last deglaciation can be described as cycles. A better term would be "variability",

which encapsulates the fact that there are changes without implying any cyclical physics. You even make this point on page 2 line 28. The presence or absence of cycles is not important for the interpretation in the paper so I'd suggest the less loaded term "variability"|.

We acknowledge the reviewer's point. Revised text is Mid-latitudinal atmospheric dynamics may have played an important role in these climate variations ..." "Thus, we suggest that changes to the NAtl jet may play a critical role in abrupt glacial climate changes.""The last deglaciation encompassed a period of large-scale global warming of the Earth's surface climate, with regional patterns of millennial-timescale variability ..." "Signatures of these climate variations are present in the mid- to high-latitudes of both hemispheres..."“Such variability is also present in proxy indicators..."“ "Proposed hypotheses explaining the presence of such variability commonly centre around deep-ocean..." "For example, altered winter sea ice extent is sufficient to reproduce the amplitude of deglacial climate changes ..." "Thus, deglacial, winter wind conditions over the North Atlantic may have played important roles in the detected abrupt climate changes..." "None of the transient simulations presented here produce abrupt transitions between stadial and interstadial conditions at the historical time of the OD, B-A, or YD."

p3 l5 - "During the deglaciation, changes to the variability of low-level winds can alter gyre transports (and to a lesser degree, wind position and strength" Not sure I understand this, surely variability of the low level wind ***is*** *changes in the wind position and strength?*

The sentence was rearranged to clarify our meaning. "Since low-level wind patterns over the Arctic, Greenland and NAtl help constrain winter sea ice extent in this region (Venegas and Mysak, 2000) and affect surface ocean heat transports there through the application of surface wind stresses (Lozier et al., 2010; Häkkinen et al., 2011; Li and Born, 2019), these winds may play an important role in setting the conditions required for abrupt deglacial changes or be involved in the abrupt transitions themselves.
"

p3 l27 - jet not yet.

Done. Revised text is "However, the eddy-driven jet is ..."

p5 l29 - how many ensemble members are there?

Since this section is a description of the model rather than the experiments run for this study, it doesn't seem fitting to discuss how many ensemble members were generated here. That information is provided in the introduction to this section. "The experiments discussed in this paper consist of four transient simulations of the last deglaciation generated using a modified version of PlaSim and a suite of sensitivity studies (FixedOrbGHG, FixedGlac, PDTopo and DarkGlac)." Instead, we reworded the identified sentence to focus the reader's attention on the attributes of the model. "Herein we use a spectral resolution of T42 (approximately 2.8°x2.8°), which has been previously shown to be sufficiently high to resolve phenomena of interest to the eddy-driven jet (Barnes and Hartmann, 2011; Lofverstrom and Liakka, 2018) while enabling fast enough model run times to make multiple deglacial experiments feasible."

p5 l30 - "Gaussian grid that is then used for diabatic calculations" not sure what diabatic calculations are.

Diabatic calculations are those that involve the exchange of heat between fluid parcels and their

environment or phase changes. The text has been changed to clarify this. Revised text is "The dynamical atmospheric solutions are generated in spectral space, while the remaining calculations (e.g. phase changes, heat exchange with the land, sea ice or slab ocean, and any changes in those sub-components) occur in real space on a Gaussian grid with 64 latitude points and 128 longitude points."

p8 l22 - You don't mention anything about model spin up? How is the model initialized?

Done. Revised text is "All deglacial simulations are initialized from the same initial conditions, which are derived from year 2567 of an equilibrated LGM spin-up started from present-day."

p9 l7 - I'm not sure what "peak zonal winds" means. Perhaps just say strongest winds?

Done. Revised text is "For the LGM, northern midlatitude zonal winds from the PlaSim simulations are stronger than those from the CMIP5 multi-model ensemble. Also, the strongest winds of both the NAtl and the NPac jets are shifted further east toward the the eastern margins of their respective ocean basins."

p9 l16 "the pattern of wind changes from the LGM to the past1000 are similar in both CMIP5 and PlaSim runs (including during JJA, not shown) even though the differences are stronger in the PlaSim transient simulations." Saying transient simluations at the end of this sentence makes it sound like there's an extra set of simulations - "the transient simulations" - as well as the normal "runs". This is not the case?

There is only one set of FullyTrans deglacial simulations performed with PlaSim. Revised text is "In spite of these specific differences, the pattern of wind changes from the LGM to the past1000 are similar (but differ in magnitude) between the CMIP5 and PlaSim runs (including during JJA, not shown). "

p10 l9 - I'm not sure how you get from "10 consecutive DJF periods" to the histogram on figure 6. 10 DJF periods surely gives 30 months, yet the frequencies on Fig 6. show 100s of months. Is this due to all the ensemble members?

The reason the numbers of months presented in Figure 6 are much larger than expected based on 10 consecutive DJF periods is that the statistics in this Figure are based on 100 simulation years for all four ensemble members. Revised text is "Unlike Woollings et al. (2010), however, these latitudes are defined from monthly data (without low- pass filtering) over longitudes of 90°W to 0°W. Unless otherwise indicated, the monthly jet latitudes are aggregated over consecutive DJF periods to generate jet latitude frequencies." in Figure 6 caption: "Histograms of latitudes corresponding to peak NAtl zonal winds for all PlaSim ensemble members (left column) and the TraCE- 21ka data (right column) during indicated periods. Monthly jet latitude statistics are aggregated over 100 simulation years and four ensemble members for PlaSim and 1000 simulation years for the TraCE-21ka simulation."

p12 l6 - "tilt .. shifts slightly higher" - better as tilt becomes steeper. p12 l7 - It would be interesting to compare the spread in histograms between Trace21ka and PlaSim. You discuss spread for PlaSim on p11, why not Trace21ka too?

Done. Revised text is "Differences between the PlaSim ensemble and the TraCE-21ka simulation primarily arise with respect to the jet tilt. The mean jet tilt increases by approximately 2°. ... However, either value of jet tilt change in the TraCE-21ka simulation is larger than that detected in the PlaSim simulations, and asymmetries in the increase in the range of jet tilt are opposite for these two datasets. Examining the eastern and western sides of the jet separately, the distributions in both regions change

more similarly from LGM to past1000 in TraCE-21ka than in the PlaSim simulations (see Supplemental Figure S2). ”

p12 l14 - There needs to be a discussion of “abrupt”. What constitutes abrupt: changes over what timescale? When looking at jet shifts in a coarse resolution model, a movement from on one grid box to the next come across as abrupt, tipping point like, but is actually just a smooth rapid change. To be abrupt suggests some set of non-linear feedbacks giving a larger response than the input would suggest. A linear response to a large change to me is not abrupt, just rapid. This is totally personal, but to avoid anyone misinterpreting what ***you*** *mean by abrupt you need to define it.*

We agree and added the following paragraph to the Discussion and Conclusions section.
“Assessing the abruptness of NAtl jet changes is problematic, because the abruptness of a phenomenon depends on its context. During the deglaciation, changes are generally considered abrupt if they occur within a couple of decades and are of sufficient amplitude to appear unusual compared to background climate variability. In this study, additional complication arises from the fact that the wind data is gridded; a latitudinal change in the position of the NAtl jet will involve a discrete step from one latitude grid to another. Thus, we consider a jet change to be abrupt (given the decadal resolution of our jet diagnostics) when thejet shifts its median latitudinal position from one grid cell to the next without an intermediate period when the jet splits its time roughly equally between the two. “

p13 l5 - What exactly are you saying in this paragraph? I don't see what the point is.

Since those abrupt climate changes were associated with changes to surface conditions over Greenland, based on $\delta^{18}O$ ratios in Greenland ice cores, we discuss whether we see evidence of such variability in Greenland temperatures in the PlaSim simulations. The answer is that during the historical periods of the Oldest Dryas, Bolling-Allerod and Younger Dryas, we detect changes to the jets , but they do not yield large-amplitude, abrupt climate changes over Greenland. Instead, we detect that type of variability over Greenland at other times in the simulations. Is this sufficient to rule out these jet changes as important to the OD, B-A or YD? This depends on whether PlaSim represents all of the (presently unknown) feedback processes important to these events effectively enough to capture any possible link between the jet changes and the rest of the climate system and the degree to which these historical events were stochastic.
Revised text is “Due to the absence of abrupt climate changes over Greenland, we conclude that the changes in the position, tilt and variability of the NAtl eddy-driven jet are not sufficient on their own to generate large-amplitude, abrupt climate changes in PlaSim. It may be that feedbacks between the atmosphere, ocean, land ice and sea ice that are not captured in the simulations here are important in abrupt changes. For example, one very plausible process that is missing from PlaSim is the effect of winds on sea ice. Furthermore, this absence of simulated abrupt climate change does not rule out the possibility that the discerned atmospheric dynamical changes were important to historical abrupt climate changes through their controls on the background climate state. Thus, we characterize the atmospheric changes present in the accelerated transient simulations and leave further assessments of their implications for future work. “

p14 - Transition seems to be used to describe two different things here. From line 8 there are the three events called transitions then on l10 transition is used to describe the way things change. It doesn’t help that on l10 it says “A second type of transition” without ever being clear what the first type of transition is. This whole paragraph l2 onwards is really difficult to understand. I’m struggling to be more helpful and think of suggestions to improve it, but a reader is really going to struggle with this.

The reviewer is correct in that we attempt to categorize two types of changes to the NAtl jet over the deglaciation (jet shifts and changes to the distribution of jet frequencies) and use the word "transition" to describe both of them. Revised text is "The two different types of deglacial changes (the latitudinal shift and the change in the shape of its distribution) occur separately over the deglaciation. In the first type of change, the median jet latitude shifts northward three times over the deglaciation in all ensemble members.""In the second type of jet change evident in Figure 9, the frequency of time that the NAtl eddy-driven jet spends at its median latitude decreases, and the range of jet latitudes increases. "

p15 l4 - This seems to contradict p11 l5 which says that the jet tilt doesn't change much from LGM to past 1000.

Both are true. Throughout the deglaciation, the jet tilt switches back and forth between its state at LGM and one grid cell more zonal configuration. Since the distribution of jet tilts broadens at the end of the deglaciation without introducing much overall tendency in the changes to this variable, there is little change in mean jet tilt between the start and the end of the simulation (LGM and the past1000). *"*A shift of similar size is observed on both the western and eastern regions of the eddy-driven jet (Figure 7), so there is little change in mean tilt values between these two periods (Figure 8)." "Ensemble statistics for the NAtl jet tilt in the FullyTrans runs in Figure 9 show oscillations between the preferred jet tilt of LGM and a more zonal configuration. These changes in jet tilt reflect the very different behaviours with time of the western (270°E to 300°E) and eastern (330°E to 360°E) sides of the NAtl eddy-driven jet, which are shown in Figures 10 and 11. Nevertheless, by the end of the deglaciation, the jet on both its western and eastern sides has shifted northward by a similar amount, leading to little net change in jet tilt. "

p15 l13 - "The preferred latitude shifts northward twice within a single decade of simulation, at 19.3ka BP and 14.6ka BP. The timing of these transitions match the more gradual shifts in the jet as a whole and two occasions when the tilt is reduced. They are also consistent with the historical timing of the start of the OD and B-A." I do not understand this pair of sentences.

Revised text is "The preferred latitude shifts northward twice at 19.3ka BP and 14.6ka BP, and each shift is completed within a decade of simulation. The timing of these transitions match the first two (more gradual) shifts in the jet as a whole and are consistent with the historical timings of the OD and B-A. "

p16 l14 "This separation makes it much easier to identify what changes are occurring and attribute their causes than examinations of the mean jet position over the entire range or its tilt.. " This is an awkward sentence.

Revised text is "Since these jet characteristics and the timings of their changes differ on the eastern and western sides of the NAtl jet, we attribute them separately in the next section. "

p17 l4 - this is an interesting point, any conjecture as to why orbit and GHG matter?

Since the position of the jet over the eastern NAtl is determined based on where transient eddies (i.e. storm tracks) form and decay, moving the location of the polar front could affect the location of the jet in this region. Orbital and greenhouse gas forcings alter the background climate conditions in different characteristic ways. Orbital changes alter the distribution of heating around the globe, particularly on sub-annual timescales. Greenhouse gas changes are known to have a disproportionate effect in polar regions. Both of these processes could move the polar front.

Revised text is “In general, it appears that the characteristics of the jet on the eastern side of the North Atlantic are sensitive to changes in the background climate state, likely through changes to the positions of the polar front (and the growth of associated eddies) and sea ice margin.”

p18 l10 - “Yet, the jet does not always move to the latitude of the jet” Is an odd sentence.

Revised text is “Yet, the jet does not always move to the latitude of the ice sheet margin.”

p19 l3 - “The consequences of this restriction are that the western end of the jet is more focussed relative to the eastern side, particularly when the NAIS extends well into the midlatitudes, and that the northern range of the western side of the jet increases much more over the deglaciation than its southern range”

Perhaps rewrite as: “There are two consequences of this restriction. First the western end of the jet is more focussed relative to the eastern side, particularly when the NAIS extends well into the midlatitudes. Second, the northern range of the western side of the jet increases much more over the deglaciation than its southern range”

*“*The western side of the jet is more focussed to a single latitude than the eastern side, particularly when the NAIS extends well into the midlatitudes. This is because the barrier is being applied to the winds in the western region of the jet, but not the eastern region.” “The distribution of the western side of the jet during most of the deglaciation is strongly skewed with the jet spending the bulk of its time at the northern boundary of its range. In contrast, the jet distribution in the eastern region is more symmetrical. As long as the ice sheet continues to impinge on where the jet would preferentially be located in the absence of the ice sheet, the wind shear along the northern edge of the jet remains very strong. Thus, eddies tend to break along this boundary and accelerate the flow there. This keeps the jet preferentially in its northernmost position. Since there is no such constraint on the jet in the eastern region, it is free to vary equally in both directions around its mean position. “

p19 l10 - “The preferred tilt in the PDTopo experiment is near zero”. The tilt doesn't change much in this simulation and stays at its past1000 value, which you show and argue does have a tilt, 5 degrees in Fig. 8. I agree that the ***change*** *is near zero, but not that there is no tilt.*

Revised text is *“*Without the ice sheet barrier effect, the preferred tilt in the PDTopo experiment is much smaller than in FullyTrans and does not change over the deglaciation (Supplemental Figure S7), as the western and eastern sides of the jet appear to shift together.”

p19 l15 - “In contrast, the shift in latitudes occurs earlier on the eastern side of the jet, and no further change to the preferred range of jet latitudes occurs following this.” This sentence exemplifies why, I think, this paper is so confusing. What is important in this sentence is “the eastern side of the jet”: this is what is being compared to the preceding sentence. Yet the way that this sentence is structured puts this midway through the sentence, slightly buried. Thus it takes very careful reading to parse the sentence. If you wrote it as: ”In contrast, on the eastern side of the jet the shift in latitudes occurs earlier...” it would be much more obvious what's going. It may be that this reviewer is a bit stupid, but with the long sentences that you use any help that a reader can get would be good. I'd have a look through the paper for more instances of this inverting of sentences. Given the quality of the English in this review you may, however, choose to ignore the stylistic recommendations of this reviewer.

Thank-you to the reviewer for pointing out sentences that (s)he finds difficult to parse. We tried to shorten the sentences and make the language clearer as we edited the manuscript. For the example provided, the revised text is “In the eastern region, the shift in latitudes occurs earlier than in

FullyTrans, but the jet never reaches as northern a position as it does in FullyTrans."

p22 l1 - This section of the conclusions relates to the weakest part of the main text, much of what is in this part of the conclusions was not clear from the preceding sections.

We have substantially revised the results section and hope that it is much clearer now.

p22 l10 colon inappropriate here.

Revised text is "These shifts are each accomplished within a decade of simulation (century of forcing), and their timings are consistent between the accelerated simulations, an unaccelerated run, and an accelerated transient simulation starting from a warmer initial state. "

p22 l21 - it would be clearer to say "through two phenomena: first, ... second ...." the two descriptions are so long you need to make it clear where one stops and the other starts.

This sentence was removed in more recent edits of the manuscript.

p23 l7 - "Conversely, the sensitivity of the jet position on the eastern side of the North Atlantic to the background climate state implies that it would be difficult to estimate historical changes to the jet in this region from model simulations, since estimates would vary between models and between simulations with different boundary conditions." Need to explain this more. Surely, because the orbit and GHG are better constrained than ice sheets, this response will be better simulated?

While the reviewer is correct in that our knowledge of deglacial changes in orbital forcing and greenhouse gases is less uncertain than our knowledge of past ice sheet configuration, his/her conclusion is mistaken. Climate responses to orbital and greenhouse gas forcings are complex and involve a multitude of feedbacks between different climate components and depend on subgrid parametrizations for phenomena like clouds. The combined effect of all of these processes makes predicting climate responses challenging and model-dependent. In contrast, ice sheet margins acting as a physical barrier to the winds is a very simple process that does not depend as strongly on the most uncertain components of climate models.
Revised text is "As such, it would be difficult to estimate historical changes to the jet in this region from model simulations, since the pattern of thermal responses to changes in boundary conditions is sensitive to model parametrizations for processes like cloud physics, and feedbacks between the atmosphere, ocean and sea ice. Thus, the effect of changing boundary conditions likely varies between models and even between simulations using the same model but different initial boundary condition states."

p23 l12 - I disagree. The assumption here is that the surface temperature response is linear with respect to the jet latitude: as jet latitude increases so will temperature in direct proportion. But, if there are non-linear feedbacks it could be that when the jet reaches a certain latitude abrupt changes in temperature are possible. For example, imagine the jet is well south of the sea ice margin but gradually moves north due to a slow retreat of the ice sheet. At some point the jet will be over the sea ice margin and a different set of feedbacks become possible. Thus you can get abrupt changes in temperature from a smoothly varying jet/ice sheet.

The reviewer raises a good point. Revised text is "It is unlikely that relevant changes in the ice sheet margin occur on timescales of decades, so it appears that changes to the upstream end of the North Atlantic jet are more likely to play an enabling role than a causal role for abrupt climate changes. Yet, we can not entirely rule out the possibility that gradual jet changes can trigger abrupt climate changes.

The non-linearity of the coupled climate system implies that gradual changes do not necessarily lead to gradual responses, particularly if there are thresholds (e.g. sea ice edge) beyond which feedbacks change. “

Figure 1(a) - There's an enormous remnant ice sheet over NAm: 1.7km at 0ka. What is this?

Figure 1 plots the peak elevation of ice sheet-covered areas in North America and Fennoscandia. There is no 1.5km thick ice sheet over North America during the Holocene, but there are regions that have an elevation in excess of 1.5km that are covered by ice: glaciers in the Rockies, for example.

Revised caption is “a) Peak elevation in ice sheet-covered areas (bedrock elevation plus ice sheet thickness) and b) ice sheet area for North America (NAIS) and Eurasia (FIS). ” Revised text is “In Figure 1a, there appears to be an elevated remnant of the NAIS that continues to present day, which corresponds to small glaciers located in the Rocky Mountains.”

Figure 5 - Its hard to judge in this figure how the amplitude of the jet changes. If you highlight one isotach, 20m/s, in both the contours and colours it would make it simpler to see how the structure of the jet differs.

From our perspective, highlighting a colour and adding a highlighted line isotach for LGM would likely both reduce and add confusion.