

Replies to Short Comment #1

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I really enjoyed reading this manuscript and I hope the review process will be smooth. I have two small comments/requests though:

Answer: We want to thank the Colleague for his comments to our manuscript. We reply point-by-point to the Reviewer's comments. Our responses are shown in red color. Text from the manuscript is identified by quotation marks and italic font style, added or modified text can be identified by red colour.

(1) This manuscript was recently accepted for publication in EPSL. Among other things, it presents a new interpretation of the LGM jet zonalization in the N Atlantic and the precipitation distribution in SW Europe. I would greatly appreciate if the authors could cite this paper when you discuss these topics in the introduction. Link to accepted manuscript:

<https://authors.elsevier.com/a/1aRAS,lq4KpRO>

A: We thank the colleague for this suggestion. We now included a reference to this paper in the introduction (line 60, see text in next reply).

(2) The main result of the present study is at odds with a number of GCM studies that, contrary to findings here, show a reduced storminess in the N Atlantic at the LGM. It would be good to add a paragraph in the discussion section that puts these contrasting results in perspective with one another, and if possible, provide at least a speculative interpretation of possible sources of this discrepancy. For example, it could be model dependent (the top three studies used CCSM3 derivatives, and Riviere et al used IPSL), resolution could be a factor (this paper discussed this aspect in some detail in GCM simulations – see e.g. Fig 1: <https://www.the-cryosphere.net/12/1499/2018/tc-12-1499-2018.html>), parameterizations, boundary conditions (again, top three studies used PMIP2 boundary conds.), etc.

Li and Battisti, 2008 JCLim <https://journals.ametsoc.org/doi/full/10.1175/2007JCLI2166.1>

Donohoe and Battisti, 2009 JCLim

<https://journals.ametsoc.org/doi/full/10.1175/2009JCLI2776.1>

Lofverstrom et al. 2016 JAS <https://journals.ametsoc.org/doi/full/10.1175/JAS-D-15-0295.1>

Riviere et al, 2018, JCLim <https://journals.ametsoc.org/doi/full/10.1175/JCLI-D-17-0247.1>

A: We also thank the colleague for this suggestion. A similar comment had been posted by reviewer #1. We have enhanced our discussion on this issue and explicitly state that the changes in storminess in the PMIP3 models depends on the model choice, parameterizations and chosen boundary conditions.

“Under the influence of the continental ice sheets and extended sea ice, the PMIP3 GCMs show stronger meridional temperature gradients, leading to a southward displaced, more intense and less variable North Atlantic jet than under current climate conditions (Löfverström et al, 2014; 2016; Merz et al., 2015; Wang et al. 2018). These differences have been related e.g., to more dominant cyclonic Rossby wave breaking near Greenland (Rivière et al., 2010), stationary wave packets trapped in the mid-latitude wave guide (Löfverström, 2020) and to enhanced meridional eddy momentum flux convergence over the North Atlantic (Wang et al., 2018). In line with a southward displaced and stronger jet stream, several studies show a more intense and southward shifted North Atlantic storm track compared to today’s climate (e.g., Hofer et al., 2012; Luetscher et al., 2015; Ludwig et al., 2016). However, other studies display reduced storm track activity over the North Atlantic in spite of the enhanced baroclinicity (e.g. Donohoe and Battisti, 2009; Rivière et al., 2010; Löfverström et al., 2016). Rivière et al. (2018) discusses a reduced baroclinic conversion as a possible reason for this apparent discrepancy, arguing that the eddy heat fluxes are less well aligned with the mean temperature gradient for LGM than for PI. Other arguments for the reduced storminess include model resolution, parameterizations and boundary conditions (e.g. Donohoe and Battisti, 2009; Rivière et al., 2018). Thus, the intensity differences between LGM and PI North Atlantic storm track activity may be model dependent.” (lines 56ff).

In the discussion, we have added:

“Given that this study is based on a single GCM, a single tracking method and a single RCM, it should be regarded as a preliminary analysis as the uncertainties of the jet stream position and storm track activity (e.g., Merz et al, 2013, Riviere et al., 2018) may be considerable among different GCMs.” (lines 293ff)