Potsdam Institute for Climate Impact Research e.V. · P.O. Box 60 12 03 · 14412 Potsdam

Potsdam Institute for
Climate Impact Research e.V.

Member of the Leibniz Association

Potsdam location:
Telegrafenberg

Berlin location:
EUREF-Campus

www.pik-potsdam.de

Board of Directors:
Prof. Dr. Ottmar Edenhofer
Prof. Dr. Johan Rockström
Dr. Bettina Hörstrup

Association registry:
Nummer VR 1038 P
District court Potsdam

Bank account:
Mittelbrandenburgische
Sparkasse Potsdam (MBS)
IBAN: DE69 1605 0000 3502 2355 29
BIC: WELADED1PMB

Authors' response letter: egusphere-2026-79

21 August 2026

Bastian Ott, ERSU

bastian.ott@pik-potsdam.de

Dear Gabriele Messori, dear anonymous reviewers,

We would like to sincerely thank you again for those highly constructive and helpful comments, which helped us improve critical areas of our study especially when it comes to the framing. In the revised manuscript, great care has been taken to avoid possible misinterpretations and unnecessary repetitions. Substantial parts of the abstract, the introduction, and Section 1 were rewritten in order to refine and focus the framing. Moreover, many figures were completely redesigned to ensure full clarity, comprehension, and publication quality. Lastly, not least thanks to a new part on "key concepts and definitions," great care has been taken to ensure that the paper is largely self-contained and accessible to a wide readership. Still, for reference, please also see the quoted unpublished paper, which is currently in the last stages of review with the Anthropocene Review (please respect confidentiality as the reviewers have already recommended publication).

A point-by-point response to your comments was already provided in the interactive discussion phase. All relevant changes to the manuscript are marked via track changes. Please also see a summary of all relevant changes made to the manuscript below. We are confident that the manuscript now fully meets the high standards of Earth System Dynamics and are looking forward to your feedback and guidance.

Sincere regards,
Bastian Ott, Jonathan Donges, and Johan Rockström

List of all relevant changes made to the manuscript

Abstract

- The abstract was substantially rewritten in order to
  - clarify that both adaptation to Holocene-like climate + anthropogenic climate change could affect the Planetary Boundaries and that both need to be assessed here.
  - clarify that this assessment is about "*current* Earth system pressures" of "*existing* adaptation" and not about future trajectories. Additionally, examples of adaptation to Holocene-like climate and adaptation to anthropogenic climate change were added. Moreover, examples of potential Earth system pressures resulting from this were added.
  - clarify that the majority of these Earth system pressures comes from adaptation to climate (would also have happened under Holocene-like climate) and not yet from adaptation to anthropogenic climate change.

Introduction

- Substantial parts of the introduction were rewritten in order to
  - make the distinction between adaptation to *climate* vs. adaptation to *anthropogenic climate change* clearer right at the beginning (avoiding potential misinterpretation).
  - clarify that our assessment is about the *current* impacts of *all* forms of adaptation and not about future trajectories of only adaptation to anthropogenic climate change (avoiding potential misinterpretation).
  - clarify that our study is about the *biogeophysical* dimension of adaptation and therefore different from the economic argument about mitigation vs. adaptation (avoiding potential misinterpretation).
  - provide a better understanding of the current literature on this issue and the research gap as also identified by other authors (additional important references added).
  - avoid unnecessary repetitions. For this purpose, parts of formerly Section 1 were integrated into the introduction and unnecessary repetitions were substantially reduced.
- Figure 1 was slightly simplified for better comprehension
- A new paragraph on "key concepts and definitions" was added so that the paper is more "self-contained" and the need to consult the quoted Ott et al., paper is reduced. Moreover, more/better examples were also added for improved conceptual comprehension.

Outline and methods

- One adaptation option (precipitation enhancement operations) was removed from the sample of adaptation options so that 69 instead of 70 adaptation options were considered. See also Section 2.

Section 1

- Large parts of the beginning of formerly Section 1 could be integrated into the introduction to avoid unnecessary repetitions (see above).
- The part of the paragraph on interactions across Planetary Boundaries was shortened and simplified as one reviewer remarked it was too complex before. This part is now substantially clearer.
- Figure 2 was slightly redesigned for better readability.

Section 2

- The first paragraph was slightly rewritten in order to clarify again that both adaptation to anthropogenic climate change and adaptation to Holocene-like climates were assessed in the attribution analysis. Furthermore, the sampling process was better explained and additional context for the database used was added.
- One adaptation option (precipitation enhancement operations) was removed from the sample of adaptation options because “novel interventions” are now excluded so that the focus is entirely on established, quantifiable forms of climate adaptation. This does not affect any key results or figures. Additionally, the discussion of artificial snow production was removed as the impact on freshwater withdrawals (although relevant at the local scale) is negligible at the global scale.
- Figure 3 was completely redesigned for improved clarity and readability. The need for this was highlighted in the review process. The numbers are unchanged.
- Figure 4 was completely redesigned. Specifically, as one reviewer made specific recommendations: the number of vertical and horizontal tick marks and lines were reduced to a necessary minimum and all font sizes were increased (especially for the legend). Further, the title above the diagram was removed and the title of the vertical axis was changed accordingly. Lastly, for further simplification, the percentages on the vertical axis are now displayed without decimal points and the caption was slightly amended.
- In the last sentence, an additional supporting reference was added.
- Figure 5 was completely redesigned for improved clarity and readability. The need for this was highlighted in the review process. The numbers are unchanged.

Discussion and conclusion

- Figure 6 was slightly redesigned for improved clarity and readability. The approximate contribution of adaptation to climate change is now also explicitly shown in numbers. This will help more clearly distinguish the contribution from adaptation to Holocene-like climate from adaptation to anthropogenic climate change.
- The argument around the Abajian et al. study was sharpened as questions about this study were asked in the review process. Additional, high-quality references about the contribution of HFCs and HCFCs to cooling-related GHG emissions were added to strengthen the argument.

Throughout the manuscript

- The term “refrigeration” was changed to “artificial cooling“ in order to avoid possible misinterpretations. This was an issue identified in the review process.
- Consistent rounding to one digit after the decimal point is applied.