Response to comments on the article *"Brief communication: What do we need to know? Ten questions about climate and water challenges in Berlin-Brandenburg"*

We would like to thank the editors and referees for their time and effort in improving our manuscript. Below, we address each of your comments point by point.

RC1

The presented `Brief communication` manuscript documents a collaborative effort by a large group of multidisciplinary researchers. The aim of the project was to identify key topics in the fields of climate change and water resources, relevant to the Berlin-Brandenburg region (NE Germany). The paper briefly describes the study area, articulates the need for in-depth research and an actionable mitigation plan, outlines the methodology of the questionnaire, and presents the outcome – a list of proposed scientific questions to be addressed in the coming decade.

I have an overall positive impression of the manuscript. I would like to offer two general suggestions.

1. *The title of the paper suggests a focus on "climate and water challenges", yet among the identified 10 questions, there seems to be a bias towards water availability problems. For example, the selected questions in Category 1 and Category 2 are quite specific with respect to water balance of the Spree and Lausitz, while climate-related questions are quite high-level and are applicable almost universally. The same is seen in the Appendix TableS1, where the Water Management category clearly dominates. This, in my opinion, warrants some reflection. Does it have to do with the expertise of the survey participants and their Berlin residence?*
2. *It would be valuable to highlight the transferability of this collaborative and inclusive approach to a broader scientific network and other regions. There must be a reason why the authors present these pressing issues for BBR in the international journal, rather than simply passing them to the local authorities or publishing a white paper. Was there anything original about the methodology worth highlighting? What pitfalls did you identify during the survey? The authors touched on this in the final paragraph of the conclusions, but the message could have been delivered in a more structured way.*

Thanks for the positive feedback on our work.

Regarding point 1, we agree with the referee's remarks about a bias that has not been fully explored in the text. The Region of Berlin and Brandenburg is perhaps the driest in Germany and struggles frequently with water management and water supply. Therefore, a bias is formed. Additionally, the land use change was promoted by the end of mining operations in the Lausitz is foreseen as a major threat to sustainable water management in the region, leading to an over-representation of the topic. It is our hypothesis that the close proximity (both geographic and temporal) of this challenge and its impacts on water management led to the bias, although we don't have the means to test the hypothesis, nor was it the intention of the manuscript to explore them.

On point 2, as you mentioned, we tried to convey the benefits of replicating our experiment/methodology in other regions. We highlighted this point in the introduction, as we believe one of the main contributions of our manuscript is the methodology implemented to obtain relevant questions from a small group of specialists in a specific region, dealing with local problems rather than overarching questions.

My minor suggestions (line-by-line):

- Line 13: please add a reference to the D.Hilbert paper.
    - The reference was added.
- Line 17-18: use 'mean annual' instead of just mean
    - Corrected in the new manuscript version
- Line 27: please be more specific, e.g., "carbon dioxide emission reduction"
    - Corrected in the new manuscript version
- Line 29: the reference to "the Spree" lacks context. Please clarify that it refers to a river that a densely-populated urban center relies on for water supply, navigation etc. (i.e., what is written later in Lines 32-33)
    - Corrected in the new manuscript version. Now reads "River Spree catchment"
- Line 44: please be more specific, e.g., groundwater storage or quality decline.
    - Corrected in the new manuscript version. Now reads "groundwater storage decline"
- Line 48: consider re-phrasing this sentence for clarity.
    - Rewritten in the new manuscript version. Now reads "For example, up to 70% of drinking water for Berlin's 3.4 million inhabitants is sourced from groundwater and bank filtration from surface waters"
- Line 55: I believe, the referenced paper is from 2011, not 2019. Please also check and cite more recent summaries (like GERICS). Some modelled scenarios project steady or increasing precipitation in Eastern Germany, including summer precipitation.
    - Indeed. There was a mistake in the .bib file.
    - We thank the reviewer for the recommendation. It was included in the restructured paragraph.
- Line 82: please rephrase for clarity - the top 10 questions selected based on the questionnaire responses were compiled into a list, presented in Table 1
    - Corrected in the new manuscript version
- Line 83-84: this reads like a repetition of the information from the Introduction. Can be safely removed. There is no need for brackets in (BBR).
    - Corrected in the new manuscript version
- Line 118: Concluding remarks or Conclusions
    - Corrected in the new manuscript version
- Line 123 this sentence appears to be out of context: "Drought has been a topic on the research agenda at BBR for a long time". Or does it belong to the next paragraph?
    - Corrected in the new manuscript version
- Line 125 – it is not totally clear what recommendation the authors are referring to.
    - Clarified in the new manuscript version: "Drought has been a topic on the research agenda at BBR for a long time. Nevertheless, only a small fraction of the knowledge and recommendations produced by researchers have been put into practice, leaving many of the existing (and new) challenges unsolved"

RC2

General comments:

This article addresses the highly relevant subject of identifying key research questions on water and climate change in the Berlin-Brandenburg region. The format of a 'Brief Communication' is well suited to providing ideas and stimulating discussion, and aligns with the journal's requirements.

The article makes a valuable contribution by systematically identifying and prioritising research questions through a transparent, participatory process. The involvement of a broad spectrum of scientists demonstrates a clear commitment to transdisciplinary collaboration. The iterative co-design approach and multi-phase structure in particular indicate a thoughtful and inclusive methodology. It is especially commendable that the authors actively engage in public discourse and leave the confines of the academic "ivory tower" by formulating research questions that are meant to resonate beyond disciplinary boundaries. The publication also has the potential to raise awareness of regional water and climate challenges beyond the academic sphere. As such, it provides a solid basis for future research activities within the scientific community.

However, despite this potential, the article also reveals certain weaknesses. Most notably, it lacks sufficient reference to existing political strategies and to the ongoing research landscape in the region.

We thank Reviewer #2 for the positive feedback and constructive comments on our manuscript. Below, we present a point-by-point response to the comments.

Specific comments

> *Lack of political and administrative context The article fails to provide a context for the identified questions within the framework of existing political and administrative developments. Yet numerous strategic water management documents and ongoing processes already exist for the Berlin-Brandenburg region – just to name a few of them.*
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> *Positionspapier Wasser Brandenburg (2022): https://mleuv.brandenburg.de/sixcms/media.php/9/22-09-19_Positionspapier-Wasser.pdf Flussgebietsbewirtschaftung Obere Havel: https://mleuv.brandenburg.de/mleuv/de/aktuelles/presseinformationen/detail/~10-05-2022-flussgebietsbewirtschaftung-der-oberen-havel Nationale Wasserstrategie Wasserstrategie Hauptstadtregion 2050 This represents a major shortcoming, as water-related challenges in Berlin-Brandenburg are inherently linked to political decision-making and institutional frameworks. Furthermore, the article aims to serve as a 'roadmap for scientists and policymakers'. However, without integration into the relevant political framework, it is unclear to what extent the identified questions can actually be addressed in terms of administration, setting priorities, and allocating resources.*

We agree with the reviewer's concerns and have added three short paragraphs regarding the political and administrative context of the study area to the chapter 2 "Focus area: Berlin-Brandenburg region", including new references. It reads as follows:

"The political and administrative responses to climate-related water challenges in the BBR operate across multiple levels (Beveridge et al., 2017; Ibisch et al. 2014; Vogelpohl and Feindt,

2024). While key responsibilities lie with regional and municipal institutions, they are embedded in a dense framework of state federal, national and EU-level regulations (Beveridge et al., 2017; Vetter et al., 2017), showing a high degree of institutional fragmentation, with overlapping responsibilities among state agencies, municipal utilities, and, in some cases, private sector actors (Hüesker et al., 2011; Schaefer and Warm, 2014).

Recent political efforts to address climate-related water issues include federal state-level strategies such as Brandenburg's Low Water Concept (*Landesniedrigwasserkonzept*) (MLUK, 2021) and Berlin's Water Master Plan (*Masterplan Wasser*) (SenUMVK, 2022), as well as cross-federal state strategies like the forthcoming Water Strategy for the Capital Region 2050 (*Wasserstrategie Hauptstadtregion 2050*) (Land Berlin, 2024) and the Position Paper of the Water Management Administrations of Saxony, Brandenburg and Berlin (Günther et al., 2022). These initiatives aim to improve strategic alignment and governance coherence across administrative boundaries.

However, coordinated and effective action is hindered by a number of issues, including: increasing competition for landscape functions and natural resources, weak economic incentives for proactive adaptation, the privatisation and commercialisation of water services, unclear institutional responsibilities, and limited stakeholder participation — all of which are particularly pertinent given the region's growing vulnerability to climate extremes (Hüesker et al., 2011; Ibisch et al., 2014; Vetter et al., 2017)."

> *Lack of integration with the current research landscape: The article presents the formulated research questions in isolation from ongoing or recently completed research activities. However, there are numerous relevant projects that should discussed in the context of the questions, including Inno_MAUS, AMAREX, SpreeWasser:N, WadKlim, NITRO2, VITA-MIN,… and the CliWaC project itself. A sound contextualisation is essential to clarify:*
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> *Which (sub-)questions have already been researched, and where do actual knowledge gaps remain? How can synergies between research and practice be strategically promoted? Which findings have already been implemented in practice? For example, the NITRO2 project developed a decision support system for low water and drought conditions. Similarly, SpreeWasser:N produced a drought management plan and an early warning system. In this context, it is important to consider how far we have progressed in answering Q5 ('How feasible is the implementation of a multi-sector, impact-based drought monitoring and forecasting system?')?*

The reviewer raises a relevant point. There are indeed projects dealing with climate change adaptation in the BBR. In this context, we added some insights already available from some of these projects to the discussion. It reads as follows:

"The Federal Ministry of Education and Research (BMBF; now BMFTR) has also recognised the need to adapt to the increased occurrence of extreme water events and is/was funding 12 joint projects in the 'Water Extreme Events (WaX)' funding guideline. Some of these address the issues identified here as particularly relevant. For example, the Spreewasser:N project developed a drought forecasting system that provides irrigation recommendations for farmers. However, the quality of the recommendations depends on the reliability of the short-term and the seasonal weather forecast, the latter being associated with large uncertainties (Q5). Spreewasser:N also developed a statistical forecast model for drinking water demand and

identified maximum daily temperature as the most important climate variable (Q8), and evaluated the past impacts of climate change and lignite mining in the Spree catchment (Q2 - Koch et al., 2024). Project Inno_Maus dealt with the management of urban heavy rain risks, with a focus on real-time forecasting and risk mapping. One work package investigated the potential for water retention through green infrastructure with the aim of mitigating the effects of heavy rain (Q6 - Hans et al., 2023). Therefore, not all questions from the compiled list in Table 1 are new or original, but often point to a still critical research topic for the coming years. ”

Detailed Comments on the Article

- Line 20: Comment: The reference to Reyer et al., 2023 is missing in the list and should be added.
    - Corrected in the new manuscript version
- Lines 20–21: Comment: The paper explicitly names floods as a relevant challenge. This makes it even more surprising that none of the ten prioritized or 48 total questions explicitly address pluvial or fluvial flooding — the term "flood" is entirely absent. The article lacks a discussion of why this topic was not considered relevant or did not emerge from the process. This omission is particularly striking given that current projects, such as Inno_MAUS, are explicitly investigating the impacts of heavy rainfall and urban flooding. A brief reflection on this gap — whether due to methodological limitations, the composition of participants, or shifting priorities — would have added important context.
    - [response]
- Line 40ff: Comment: A clear geographical delimitation of the study area is missing. It remains unclear whether the focus is limited to Berlin and Brandenburg or also includes neighboring regions such as Saxony's Lusatia or the Upper Havel area.
    - A map of the study area was added
- Lines 54–55: Comment: At this point, it would be helpful to provide an initial contextualization using regional climate scenarios. Which climatic projections were considered—or deliberately not? Behind this lies a central question: Will the region become wetter or drier in the future, when (seasonally) will these changes occur, and how will groundwater recharge develop?
    - Better contextualization of climate projections was added
- Lines 56ff: Comment: The methodological description of the co-design process remains too vague. Quantitative information on key steps is missing: How many experts participated in phases S1 to S3? How many statements were generated in total—and by how many individuals?
    - In S1, there were 50 project members present and invited to provide statements on their view of current and future water and climate in BBR. A total of 82 statements were provided. These 82 statements were initially organised into nice categories (extreme events, water management, policy, hydrology, land use change, climate change, new technologies, and industry).
    - The 82 statements were translated into 48 questions by the core group (PHLA, SA, KN, MS) and grouped into five categories. These questions were sent as a questionnaire open to the 50 project members, of whom 28 replied.
    - The answers were analysed, and the ten selected questions were sent to the same group for their final comments. We received eight brief comments regarding language and style issues.
    - These numbers and detailed description will be added to the new version in section 3.

- Lines 70–71: Comment: It is unclear how many questions were originally submitted. Who was responsible for editing, organizing, and finalizing the list of questions? The composition of the reference group is also unclear. How many people were involved? Which disciplines were represented? Was there balanced representation in terms of gender, institutions, or sectors?
    - Forty-eight questions were prepared. The core group (PHLA, SA, KN, MS) was responsible for compiling the final list of questions, with input from the community. The members of the core group are four early-career researchers from Berlin-based universities from diverse genders (two male and two female), cultural (German, Eastern European, Asian, and South American) and academic (Political sciences, Environmental Planning, Geohydrology, Ecohydrology) backgrounds
- Line 75: Comment: Question Q6 received notably higher relevance scores (cf. Figure S1), whereas question Q2, for example, barely made it into the top 10. To improve the transparency and interpretability of the selection, it would be helpful to include information about the highest-scoring question as well as the spread of scores (e.g., mean, standard deviation).
    - Thank you for bringing this to our attention. We initially left this information to the supplements to reduce the article length (as per NHESS regulations, a maximum of 4 pages of edited material). However, the mean/sd data can easily be added as an additional column to Table 1.
- Lines 80ff: Comment: While a detailed discussion of the questions is formally not envisaged, some conceptual ambiguities arise when reading them. Two examples: Q1: Why are only ecosystems and agriculture addressed? Other important sectors such as drinking water supply, public health, tourism, or navigation are excluded. Furthermore, which extreme events (e.g. flood, wind) are meant that specifically affect agriculture and ecosystems (e.g. forest fires)? Q6: Why is the focus solely on “nature-based solutions”? Technological and infrastructural options, such as the (controversially discussed) Elbe water transfer into the Spree, are left out. An open-ended question on the combination of both approaches would be more practice-oriented. Such considerations should be more integrated into the discussion.
    - The reviewer raises excellent points. The phrasing of questions in the final list could be wider to include other relevant matters for the region. This point was also raised during internal discussion. There were, however, questions related to different sectors (Q1) and solutions (Q6) that did not receive good grades. We opted to keep the top-10 questions with the original scope, as they were evaluated. It is, nonetheless, an interesting discussion to include on *why* agriculture has received special attention in the process (internal biases, recent droughts and concerns about crop losses, recent farmer protests, etc.).
- Lines 83–84: Comment: Content is repeated from Section 2.
    - Corrected in the new manuscript version
- Line 94: Comment: Typographical error: a space is missing between two words.
    - Corrected in the new manuscript version
- Lines 100ff: Comment: A critical discussion of potential goal conflicts—e.g. between planning certainty, procedural acceleration, and participation—would be beneficial here
    - That is a very interesting point that could warrant a lengthy discussion and multiple scenarios of how the selected questions would interplay under different conditions. To underline these potential conflicts, we added to the text the following: “Furthermore, considering the listed biases and the compiled list of questions, conflicts between research and policy agendas may emerge. For instance, Q1, Q2, and Q4 emphasise the difficulties of allocating limited water

resources to preserve ecosystems and their ecosystem services, while ensuring agricultural production and a secure urban water supply in rural Brandenburg and meeting the urban demands of Berlin. Additionally, Q9 and Q10 pose the challenge of integrating diverse local perceptions and knowledge systems, which may diverge from scientific assessments or administrative priorities, potentially leading to friction between communities, experts, and decision-makers across the region."

- Lines 105ff: Comment: The prioritisation process is not considered in relation to current weather events (e.g. drought versus heavy rainfall). For example: If an extreme rainfall event such as those in Münster or Copenhagen had occurred shortly before the workshop, different topics might have been prioritised.
    - We thank the reviewer for the comment. We included a sentence on the manuscript to highlight this source of bias (" We can also observe some biases due to local conditions (e.g., regional economic and political characteristics that influence the participants), temporal conditions (the BBR has experienced multiple drought years in the past decade, making droughts a more sensitive topic than floods, for example), as well as particular converging interests of the group being assessed.")