Comments by Referee #2

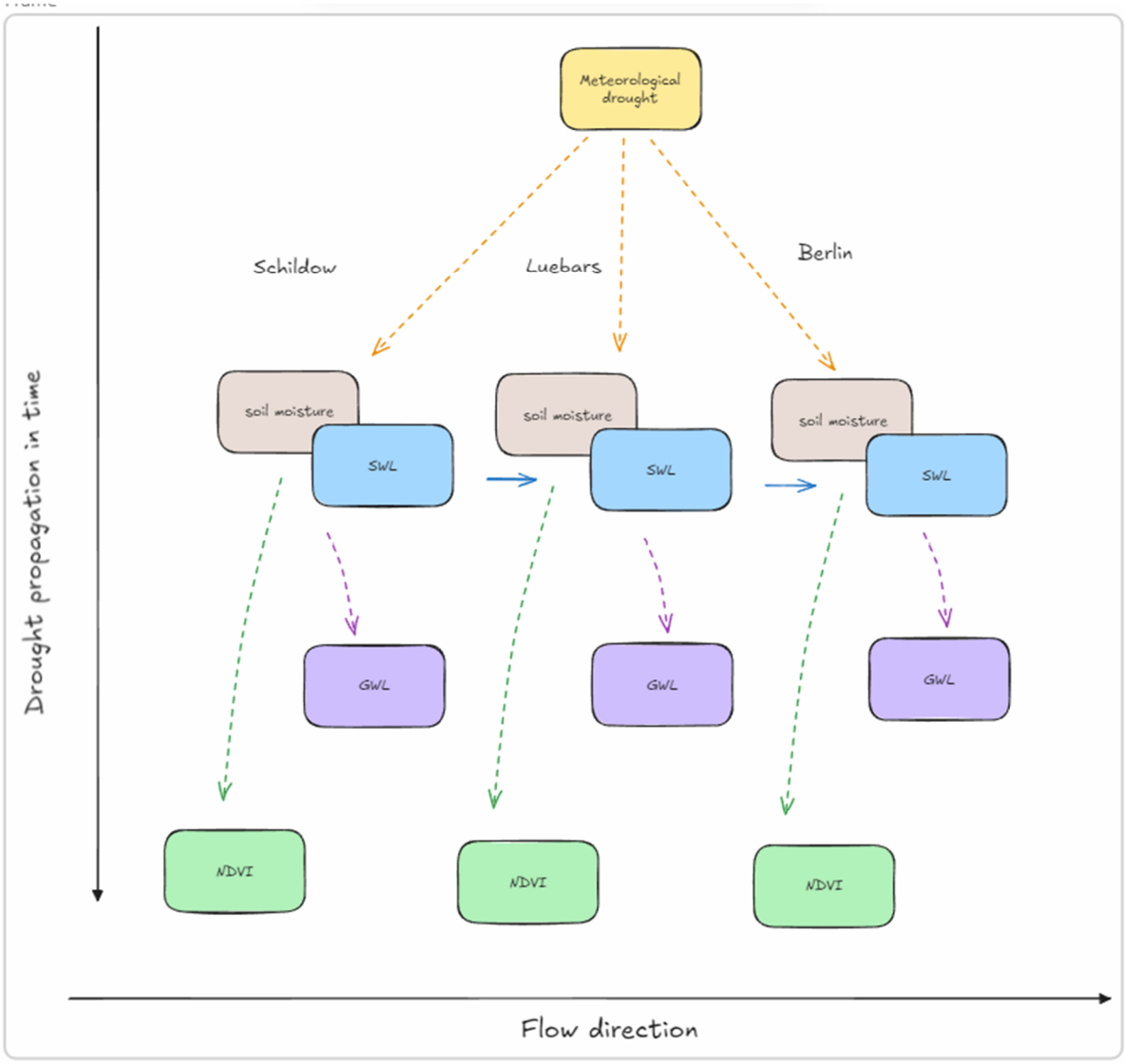
RC: While the research question is relevant, the study lacks a comprehensive conceptual framework for the field settings. This absence leaves the connection between groundwater and surface water droughts and vegetation responses vague, despite the application of various statistical methods. A more robust conceptual model is necessary to illustrate the relationships among the land surface, groundwater, and surface water at the study sites. Understanding these hydrological connections is critical to understand or verify how drought propagates through this system and affects vegetation.

AC: Thank you very much for your detailed comments. Please find our answers and proposed modifications below the specific comments.

RC: **Conceptual Model:** The paper lacks a conceptual model for each of the study sites, detailing how drought propagates through the system. It's crucial to establish the distances between land surface, groundwater, and surface water. How does the groundwater well relate to stream measurements? Are groundwater flow directions understood? Moreover, soil water storage and its direct impact on vegetation should be discussed early on—a critical missing link in the observations of the system, more directly affecting drought propagation to vegetation than surface water or groundwater levels alone.

AC:

Thank you for this comment. We have created a conceptual model for the catchment which we summarize on the new figure below:



"2.3 Conceptual model of drought propagation

Fig. # presents the conceptual model of drought propagation within the catchment: across different domains and along the river as well. A meteorological drought could trigger droughts at the surface level, via the reduction of soil moisture content and streamflow (hydrological drought). Hydrological drought also propagates downstream along the river. Later in time, reduction in recharge can lead to drought in the groundwater, and the reduced available soil moisture (and in the case of deep rooted plants reduced groundwater table) can also lead to a drought in vegetation.

In the following, we will present how we analyze the drought propagation over the different domains based on the available datasets. We use the conceptual model as a roadmap to try to infer the relations of the different drought types at the different sites."

In the catchment of the Tegeler Fliess unfortunately no soil moisture measurements were available, hence to characterize the drought conditions near the surface we had to rely on the hydrological drought indices. We will acknowledge this limitation in the conclusions of the revised manuscript.

Regarding the groundwater drought, we have to note two additional details: first, not all of the available wells are filtering the same groundwater body. The area near Luebars is defined as a separate groundwater body, due to the special geological conditions near this site. While this groundwater unit is not completely isolated

from the aquifers at the other two sites (which is the same aquifer unit GWL 1.3 and GWL 2 citation) we cannot assume a direct groundwater connection between the 3 sites. We will emphasize this in the revised manuscript and put more focus on the cross-domain drought propagation (related to the recharge processes).

Second, there is an overall decreasing trend in groundwater levels. This is a regional phenomenon observed across multiple wells that can be related to long term climate change impacts (Somogyvari et al., 2024).

RC: **Drought Index and Data Trends:** The data itself, as seen in Figure S2, already depicts long-term trends that should be discussed more thoroughly. While indices offer clearer comparisons, understanding the data and its trend provides a lot of discussion material. Moving Figure S2 to the manuscript's main section would enhance this discussion, please consider this suggestion. Relate the findings to other regional studies. The indices primarily reflect the underlying data trends, not necessarily drought propagation effects in the system. The interpretation and discussion of the drought indices time series seems to be mainly based on visual inspection, including mainly qualitative and somewhat subjective descriptions. Thus the findings remain rather vague.

AC: Thank you for your thoughtful comment. After careful consideration, we have decided to move Figure S2 into the main manuscript, as you suggested. In the revised version, we will also provide a more thorough discussion of the long-term trends to enhance the context of the figure and interpretation of our results. However, we believe it is important to retain the drought indices as central elements of our analysis, as they provide essential high-level information for understanding drought dynamics across the different domains studied.

We appreciate your observation regarding the interpretation of drought indices time series being mainly based on visual inspection. Our intent was to provide an initial exploration of drought propagation dynamics across compartments, but we acknowledge and agree that a stronger quantitative basis is needed to support and clarify the findings. We will address this oversight in the revised manuscript by including a quantitative assessment of drought occurrence and propagation. Specifically, we propose to

- *count the number of drought events detected per index and site, disaggregated by drought severity class,*
- *quantify the frequency of drought propagation by tracking whether a drought identified in one compartment (e.g., meteorological) is followed by drought conditions in downstream compartments (e.g. surface or groundwater),*
- *calculate drought transition rates (e.g., how often an SPI drought is followed by an SDI or GDI drought in subsequent months),*
- *where feasible, evaluate how often certain types of drought propagate and to what extent this varies across sites.*

We believe this addition will make the discussion more robust and transparent.

Another referee comment also addressed the importance of relating our findings to other studies. Please refer to our response to that comment for a detailed answer.

RC: **Groundwater Drought and Vegetation (NDVI):** The study posits that groundwater drought impacts NDVI but does not convincingly explain this relationship. If NDVI shows minimal effects, why emphasize the need for improved vegetation monitoring over groundwater or water management strategies?

AC:

In the city of Berlin there is a very active discord on water management to mitigate the impact of drought periods, with a special dedicated focus on green areas. Multiple studies are focusing on the sponge city concept, to retain water after rainfall and not to lead it straight out from the city. This is an integrated water

management concept that needs to consider both the available groundwater, surface water and also rainwater resources - and also the water demand by the vegetation.

The minimal effects seen in the NDVI values show that there is still enough buffer in the system to not develop serious stress responses in the vegetation itself. Groundwater resources could be behind this resilience, as the distance to the groundwater table is within reach for trees in the near vicinity of the river (3-4 meters, Hackmann et al., 2025). Decrease in groundwater levels however could easily disable this connection, putting more stress on the vegetation in drought conditions.

Our study showed several limitations in the existing observation infrastructure: most notably the lack of soil moisture data did not allow us to investigate in detail drought stress development in the vegetation.

RC: L28 Please rephrase this. It sounds now, as if the country would be a wet region. While Brandenburg does have many surface waters, it is overall a water limited region, which is not a contradiction but I guess needs more than this single reference and a better explanation (the tight water balance with very low precipitation for a temperate humid climate and the high atmospheric demand (evapotranspiration)).

AC: Thank you for pointing out the misleading phrasing. We have adjusted the paragraph as follows, taking your comments into account, and added additional references:

Although often associated with abundant surface water bodies, Berlin/Brandenburg is characterized by a tight water budget, with low annual precipitation relative to its temperate humid climate and high atmospheric demand through evapotranspiration, especially in the spring and summer months (Köstner et al., 2007; Germer et al., 2011; Kahlenborn et al., 2021). This makes this inherently water-limited region, which is heavily reliant on both surface and groundwater systems, particularly vulnerable to droughts (Cullmann et al., 2022), presenting a compelling case for an empirical study.

RC: L34 As you describe a cascade, maybe put the declining groundwater table as the last argument in the list

AC: We rearranged the cascade to a logically causal order reflecting how one phenomenon leads to the next, starting with the deficit in available water and progressing to typical hydrological and ecological impacts:

Droughts in the region have cascading effects, including water stress, declining groundwater tables, increased fire risk, and significant reductions in agricultural productivity (Reyer et al., 2021).

RC: L45 – if there are a few studies, you should cite them here and summarize what they found

AC: In the Introduction, we have referenced and summed up these research as follows:

"there are only a few studies that have investigated drought in this particular region. For instance, Kuhlemann et al. (2021) used stable isotope analysis to trace changes in urban water balances during the 2018–2019 drought, revealing strong evaporative losses and altered groundwater-surface water interactions across Berlin. Using remote sensing indices, Ihinegbu and Ogunwumi (2022) examined the geographical extent of the 2018 drought in Brandenburg and discovered that more than 90% of the territory was hit by high to extreme drought conditions, with agricultural regions being among the most severely affected. These results demonstrate that the Tegeler Fließ landscape and the surrounding area have been more severely affected by recent drought occurrences. In the last decade, this area has experienced several dry spells leading to significant effects on the environment (Helmholtz Institut, 2023). This setting provides a chance to examine how surface water and groundwater levels interact in a peri-urban landscape in an area that is heavily reliant on both surface water and groundwater sources."

RC: L46 –also be precise here – what significant effects did they find?

AC: Please see our previous answer.

RC: L50ff merge the two paragraphs, shorten (or move parts to the methods section, there is some overlap)

AC: We revised this section after your and R#1's recommendations as:

"Given its multifaceted nature, a universal drought definition does not exist; rather, it depends on the perspective and objective of a study (Van Loon, 2015). To capture this complexity, a range of indices has been developed for different components of the hydrological cycle (Heim Jr, 2002; Smakhtin and Schipper, 2008; Yihdego et al., 2019).

Meteorological drought is commonly assessed using indices such as the Standardized Precipitation Index (SPI) and the Standardized Precipitation-Evapotranspiration Index (SPEI). The SPI, introduced by McKee et al. (1993), is valued for its simplicity and effectiveness. It only requires precipitation data and is widely used to detect meteorological droughts across various timescales. However, its main limitation is that it does not take into account the effects of temperature or evapotranspiration, which have become increasingly important factors in the context of climate change. In contrast, the SPEI developed by Vicente-Serrano et al. (2010) incorporates both precipitation and potential evapotranspiration, offering a more comprehensive assessment of drought severity. The added complexity and data requirements of the SPEI, however, can restrict its application in regions where such data are scarce. SPI and SPEI are both recommended by the World Meteorological Organization for drought assessment (Svoboda and Fuchs, 2016). Studies show that although SPEI is more accurate due to its consideration of temperature, SPI and SPEI often provide comparable results (Pei et al., 2020; Ohja et al., 2021; Abu Arra and Si̧sman, 2024). "

RC: L77, not sure, if "persistent" is already an appropriate word, considering the rather short time frame of the analysis overall

AC: Revised as:

"The objectives of this study is to identify specific drought events and examine their propagation at individual stations as well as between stations, and to assess the impact of these droughts on vegetation health using the Normalised Difference Vegetation Index (NDVI) as an indicator of vegetation stress. By conducting a long-term trend analysis, we aim to better understand the drought-vegetation dynamics over the study period."

RC: L87 Add information, to which larger river the Tegeler Fließ is a tributary of.

AC: We will add:

"The Tegeler Fließ is an approximately 30 km long stream that crosses the northern border between Berlin and Brandenburg. It is the tributary of the Havel river, and part of the Elbe river system."

RC: Section 2.3.1 and 2.3.2 – why does one index gets its own section, while the others are combined in one?

AC: After your and Reviewer #1's recommendation, we will change this in the revised manuscript:

"2.3 Drought and Vegetation Indices Calculation

(...)

2.3.1 Standardised Precipitation Index (SPI)

(...)

2.3.2 Standardized Surface Water Level Index (SSWLI)

(...)

2.3.3 Standardised Groundwater Level Index (SGLI)

(...)

2.3.4 Normalized Difference Vegetation Index (NDVI)"

RC: Section 2.4 and Figure 2, consider to rename the section heading to "statistical tests and measures"

AC: We will revise the heading and the caption accordingly.

RC: Your analysis process is not very difficult, so I think in such a linear process also Figure 2 is not required. Instead, structure the section with line breaks/paragraphs between the different statistical tests and measures you describe.

AC: We agree, and we also think the new conceptual model figure is more important to be in the main text. Therefore we will move Fig. 2 to the supplements in the revised manuscript.

RC: Figure 3: Precipitation over what time frame? I don't think the graph in its current form is very useful. The groundwater level plot show just the groundwater gradient the landscape along the Tegeler Fließ and the water level in the river actually doesn't say a lot at all (as you also correctly mention its limitations). However, with only this data available – the critical thing to show is the relation between the groundwater level and the surface water level, as well as the distance of the groundwater level to the land surface. So either include surface water level statistics in absolute heights, or think of a better way also to include the important land surface to groundwater level information.

AC:

We will modify this figure after the recommendations from both reviewers. Surface water levels will be presented with absolute heights, and groundwater levels will be presented in relation to the surface elevation, to indicate the distance-to-groundwater better.

RC: L196 You seem to show monthly cumulative precipitation amounts in Figure 3. Even if there is outliers in your distribution (extreme precipitation for the time frame you consider) – this is by no means to be determined as heavy rainfall from this graph! Heavy rainfall is actually large amounts over very short time frames (<day).

AC:

Based on multiple comments, we decided to move figure S2 into the main text of the manuscript (here referred as Fig. #). This should help with the clarification here.

We also rephrased the sentence in question:

"At glance over Fig. 3, the precipitation patterns at the Tegel-DWD station averaged 45 mm per month, with some outlier months exceeding 100 mm, as the result of heavy rainfall events. These heavy rainfall events are likely to contribute to localised water level surges as it is shown in Fig. #."

RC: L197 Either you have data to support your guess, or leave it out, or discuss in more detail why you guess this (related to the missing conceptual model I) – doesn't the Figure S2 support this claim?

AC: Revised as (with reference to Fig. S2 that will be moved to the main text):

"These heavy rainfall events are behind the localised water level surges, as it is shown in Fig. #."

RC: L204 how much "water management" is there for the Tegeler Fließ and the surrounding groundwater? If there is a lot of influence of water management on the field sites and observed water levels, then they would not be suited to assess the study goal of observing a drought propagation from precipitation to the surface and groundwater levels.

AC: There is minimal amount of water management within the catchment. The most notable installation is a water quality improvement system, where some of the river water is diverted to a phosphate-removal plant, then returned cleaned. This installation however is downstream from all three sites, hence could not affect our observations.

RC: L204ff The groundwater levels show the slope in the groundwater along the river stretch. How much is the elevation difference for the land surface? More interesting might be to discuss the variations of the water levels themselves.

AC:

Following the groundwater levels along the three sites could be misleading, as due to local hydrogeological settings, the well at the Luebars site is screening a different groundwater body then the other two. Although these groundwater bodies are connected, we cannot assume a direct groundwater connection or flow along our groundwater site locations.

Regarding groundwater level variations, the most interesting is the dampened variation at the Tegel site compared to the other two locations. This could be caused by the higher sand content in the aquifer and hence the increased storage. The Tegel site also has the most sealed surfaces that can reduce the connection with the atmosphere.

In the revised manuscript we will include a section on introducing the hydrogeological setting of the site. Please also see our response to Reviewer #1, regarding the hydrogeological differences at the sites and the variations of water levels.

RC: L211 Not sure, what you want to say with this sentence – what the reader will see in section 3.2? Then place before the subsection heading – or consider to remove completely.

AC: We will remove this sentence to avoid any confusion.

RC: Figure 4: This is the main figure of your study – give it more space. Make sure the time series of SPI and other indices directly comparable by sharing the same x-axis! Either placing all the panels below each other (a one-page plot) or showing SPI twice, above each of the columns. The caption should give more information, especially also about the dashed line, that does not appear in the legend.

AC: We will revise this figure according to your recommendations, by showing the SPI plot twice.

RC: L241 Check again – generally lower is not directly what I see from Figure 4. What is with the drought event in 2016 at the Tegel site? There is none corresponding strong event in the precipitation and none at the other sites. Is this a water management related effect? Add to the following sentence: "… fluctuating between negative *and positive* values …"

AC: The SSWLI3 index shows negative values much more at the Tegel site, especially before 2017. Although these drought events are not so severe, they are different from the observations at the two other sites.

We don't think the 2016 drought would be a management related effect, as the raw timeseries (supplementary figure S2) do not show any strong outlying behavior. It could be a local artefact of the measurement station (it is located at a very shallow part of the river), but also a result of weather patterns. With the available information we can only guess, and we would require a more detailed investigation to understand this phenomena.

We will add:

"One interesting anomaly at this site is the SSWLI3 drought in 2016 which is not visible in any other locations, and cannot be linked to a meteorological drought directly. Based on our available information we can only speculate on the reason behind this event, but a targeted study would be required for a better understanding."

We will correct the next sentence accordingly.

RC: L243 "noticeable transition…" I do not clearly see a transition.

AC: We would like to argue that here after 2013 more drought events are visible than before, and their length is also increased. We rephrased this section as:

"Initially, between 2008 and 2011, the SSWLI3 fluctuated between negative values, indicating periods of drought alternating with periods of recovery; however, after 2013 the drought periods became more frequent and more severe."

RC: L241ff the findings drawn in this paragraph from the visual inspection of the time series of the indices remain rather vague and seemingly subjective/only qualitative description.

AC: We believe that the visual inspection of the drought index timeseries could highlight well the differences and the temporalities of the drought propagation. However to avoid being seemingly subjective, we will perform a quantitative assessment over our results where we will assess the individual drought events more in details. Specifically we propose to do in the revised manuscript to:

- *count the number of drought events detected per index and site, disaggregated by drought severity class,*
- *quantify the frequency of drought propagation by tracking whether a drought identified in one compartment (e.g., meteorological) is followed by drought conditions in downstream compartments (e.g. surface or groundwater),*
- *calculate drought transition rates (e.g., how often an SPI drought is followed by an SDI or GDI drought in subsequent months),*
- *where feasible, evaluate how often certain types of drought propagate and to what extent this varies across sites.*

RC: L247 – but the surface water index at the end of the time series shows a faster and more pronounced recovery from the drought event, while at other sites the drought persists and index values stay below 0. Stating here, a higher vulnerability of the surface waters to drought seems far fetched, also the recovery at the end of the time series suggests resilience in my opinion. Or am I missing something?

AC: Compared to Luebars, the indices at this site show higher drought classes, but indeed they show a faster recovery. We think our original sentence "the persistent drought from 2016 to 2020 highlights the vulnerability of Tegel's surface water systems to prolonged period" is valid, but we agree that the fast recoveries are indeed showing resilience. Therefore we add the following to the end of this section:

"The Tegel site shows resilience in the sense of having the fastest recovery times of the three sites, but the severity within the shorter times could be equal, or higher."

RC: L248 "severe meteorological drought period in 2015-2016…" there is only a moderate drought (for 1 month?).

AC: This might not be well visible, but there is a multi-month severe drought in this time period.

RC: L249 I do not see a strong contrast between Tegel surface water and groundwater index – both in the same direction and mostly below 0 for the period, no?

AC: The strong difference is from the fact that we see no groundwater drought before 2016. Also the groundwater dynamics is different and much smoothed. We would argue that this is the site where the greatest difference is visible.

RC: Section 3.3: Why don't you consider the NDVI as a measurement, as the other data you look at (precipitation and water levels) and calculate a trend for the time series. "Normalizing" the vegetation observation by deriving an index as you do on the other data might show better a drought propagation/impact on vegetation?

AC:

Thank you for this recommendation, we will test out this approach. We were so far cautious on introducing a new index here, as the yearly periodicity of NDVI could lead to a false understanding of the vegetation conditions. We used NDVI so far as it is used as the standard method to characterize the condition of the vegetation.

RC: Section 4.1 stays vague as well, see my general comment on the missing conceptual model, I guess this section will require a revision. Includes quite some speculations, could be more precise of relying on additional data or relating to findings of other studies in the region (see maybe references within Altdorff et al. (2024): https://egusphere.copernicus.org/preprints/2024/egusphere-2024-3848/ (there are some studies cited, that deal with the 2018 -2020 drought period).

AC: Thank you for this comment.

We will strongly revise this section. We will frame the section in line with our proposed conceptual model.

We will put more focus on:

- *geological differences between the sites and their impact on groundwater drought*
- *include more comparison on studies on the 2018-2020 drought (Pohle et al., 2024; Warter et al., 2024)*
- *and we will note on the lack of soil moisture data*

RC: L343 There is no downward trend in your SPI3 data as shown in Figure 4 (or do you mean the indices related to surface water and groundwater?)

AC: We are not sure that we understand this comment exactly, we hope we answered what you meant.

There is no downward trend in SPI3 nor in NDVI data. Granger casualty test revealed that there is a relation between the different timeseries, but this does not necessarily mean that we see the exact trends, as this relation could appear on higher frequencies.

RC: L350 Why should groundwater impact vegetation? This is only relevant if land surface – groundwater level distances are low and vegetation can directly use groundwater for evapotranspiration (tap into the capillary fringe) – is this the case at your sites? Otherwise, this would not be a relation to test at all.

AC:

Near the river this assumption is mostly true. According to the data available in the Geoportal Berlin (https://gdi.berlin.de/viewer/main/) and at the Auskunftsplattform Wasser Land Brandenburg (https://apw.brandenburg.de/), on the river floodplains the distance to the groundwater is less than 1 meter, while in within most of our vegetation assessment area it is less than 7 meters.

The access to groundwater by the larger plants could buffer the drought impacts on vegetation, and could be a reason why we don't see a strong vegetation response in the NDVI values at the investigated sites.

We will quantify these areas and include them in the new hydrogeological description of the sites.

Please see our modification for this section in the next comment.

RC: L355 – was there irrigation? I thought there is rather little irrigation operated, so I would not expect a big effect on NDVI. Any information to support your guess?

AC: Unfortunately we do not have any information about irrigation. We modified this section in our revised manuscript to be less speculative:

"Not having a strong correlation between the drought indices and NDVI indicates a resilience within the ecosystem, likely to be influenced by different factors. These could include vegetation type, soil moisture, groundwater depth and land management practices.

In the regions around Schildow and Luebars, the NDVI remained stable, despite hydrological and groundwater drought conditions. The small distance to the groundwater table near the river allows for deep rooted plants to use groundwater resources directly, as a buffer for drought periods with low soil moisture content. While this connection could be severed due to groundwater level decrease, we did not see it happen during the study timeframe. Regional scale studies however warn about a general decreasing trend in groundwater levels (Somogyvari et al., 2024, Heudorfer et al., 2024), therefore the investigation of the groundwater-vegetation relationship stays relevant for the future.

Irrigation practices, and water infrastructure could also provide resilience. For example at the fields near Luebars there is a trench network that could help a more efficient distribution of water in the area after stronger rainfall events than natural runoff. We would also like to note that monitoring of vegetation health should go beyond the use of NDVI, as this index alone may not capture the extent of water stress, especially in areas of agriculture. Adaptive management strategies should focus on balancing the needs of both natural ecosystems and agricultural activities, which can further exacerbate water depletion in times of drought."

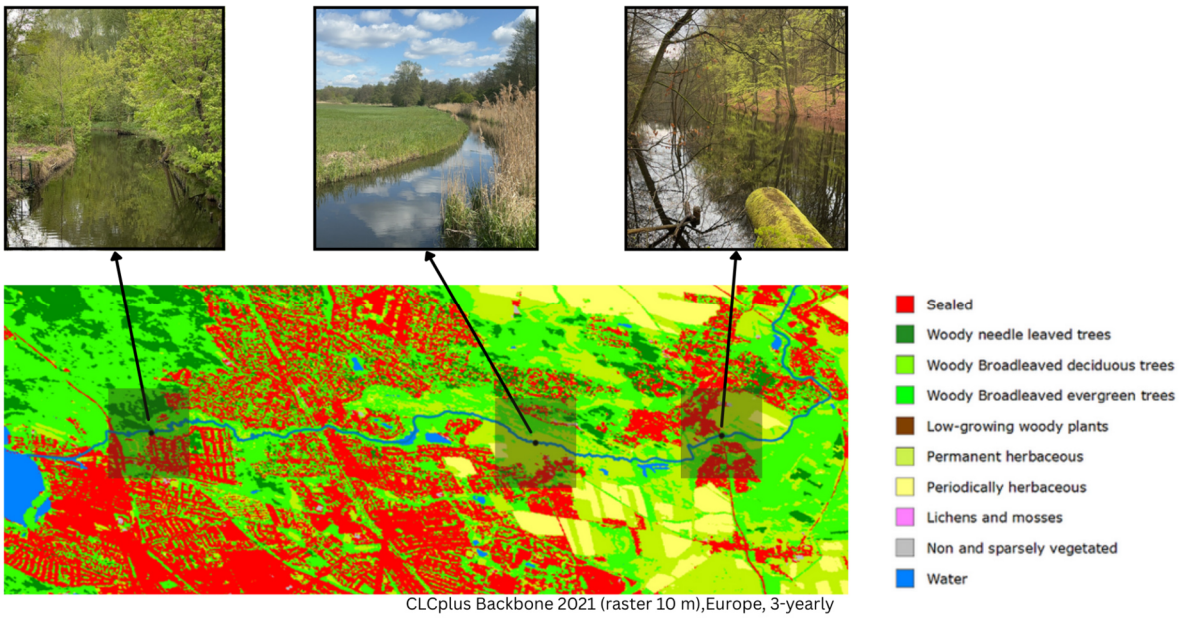
RC: L362 – what are "shallow-rooted plants typical of these areas"?

AC: We removed this statement at the revision for the previous comment.

RC: L363 plants rely, if at all, on shallow groundwater, never on deeper groundwater. I get what you mean though, but please stay precise and rephrase the sentence accordingly. It then again strongly depends what type of vegetation/land use you have. In this respect it would be good to show somewhere a bit more detailed what land use is covered by your NDVI data (agriculture, forest...).

AC: Please see our previous modification for this section.

In the revised manuscript we have prepared a new figure to present the land use distribution and the diverse landscapes at the three sites.



CLCplus Backbone 2021 (raster 10 m),Europe, 3-yearly

RC: L365 – How would the decline in groundwater tables (and surface waters) affect vegetation (the long term decline in the data, Fig. S2)? This is a rather vague statement – again missing is the agricultural or soil moisture drought that would be actually relevant for vegetation (see general comments).

AC: During our timeframe we did not see an impact. For the long term however, we expect this to be an issue as the decreasing groundwater levels could lead to a disconnection between the deep rooted plants and the groundwater table. Please see our previous responses.

RC: L378 – I would like to see this point mentioned earlier in the manuscript (describing the data itself, potentially including Fig. S2 in the main manuscript). Looking at your interpolation (the Figure is good to keep in the appendix) – I do not think the interpolation introduces a lot of uncertainty here. So definitely not the interpolation/gap filling a key limitation of your study.

AC: We will include fig. S2 in the main manuscript.

As the region is getting more and more extreme rainfall events due to climate change, we think it is important to emphasize this limitation. Such data gaps could easily miss peak river levels, and could lead to incorrect conclusions.

RC: L382 first: all your ecosystems seem to show resilience, as you define it. Second, I think again the missing link here is the soil water storage (as you discuss just then a couple of lines below) – I would like to see this as part of the discussion chapter and not within the conclusions.

AC: We will add a sentence on the importance of soil moisture in relation to the vegetation health, and commenting on the lack of this information in the revised section 4.2.

RC: L390 I do not think assessing single plant species would make sense here – as you are interested in the effect on the ecosystem. Rather including additional data on temperature, evapotranspiration or atmospheric demand or soil moisture might close the missing gap you have so far.

AC: Thank you, we revised this sentence as:

"Future research should extend this work by using more long-term datasets or incorporating additional drought indicators, such as soil moisture or temperature-based indices.

The investigation of soil moisture is especially important, as its dynamics is a key element to understand the vegetation response to drought conditions and to understand how ecosystems could recover from prolonged drought. In addition, higher resolution data or a vegetation index that better accounts for different vegetation types and conditions would improve the accuracy of monitoring vegetation health."

RC: For all the manuscript: The figure and table captions should contain more information, to make the graph/table self-explanatory without the need for the reader to go into detail in the text, also including the explanation again for abbreviations.

AC: We will revise the captions according to your comment.

RC: Please go through the manuscript to check the units of precipitation, it should be clearly stated, over which time interval cumulative amounts are given, so not only mm but mm/day or mm/week.

AC: We will revise them accordingly.

RC: L11 Rephrase the sentence for NDVI. To a reader it is not clear, what "moderate to dense classes" are. Either add "vegetation" or rather just say, that there was no, or only a moderate effect to be observed in the NDVI

AC: Thank you for drawing our attention to this lack of clarity in the abstract. We will revise the sentence as suggested to ensure it is clear to readers, specifying that the NDVI analysis showed little to no observable effect or only moderate changes in vegetation. Additionally, as part of the methodological improvements planned for the revised manuscript (e.g. use of higher-resolution NDVI data), we will further clarify this point. Please also refer to our earlier comments regarding planned methodological adjustments.

RC: L19 These studies are projections, so include "likely" or similar

AC: Thank you for pointing this out. We revised the sentence to include "likely", as you recommended, to reflect the nature of projections.

RC: L44 Not in references list, no date, please fix. I guess it is some authorities? So spelling out the abbreviation would be helpful.

AC: Thank you for pointing that out. The SenMVKU reference refers to a website that unfortunately does not contain any information about the year in which the information was made available. Following the NHESS submission guidelines examples for reference types for websites, we have therefore added the date at which the information was accessed and written out the abbreviation to make it easier for the reader to understand.

(Berliner Senatsverwaltung für Stadtentwicklung, 2025)

Berliner Senatsverwaltung für Stadtentwicklung (Eds.): Natura 2000-Gebiet Tegeler Fließtal. Retrieved from https://www.berlin.de/sen/uvk/natur-und-gruen/naturschutz/natura-2000/natura-gebiete/tegeler-fliesstal/. Last accessed 11 July 2025.

RC: Figure 1: I found the legend hard to read, usually it is first the symbol then the legend entry (left aligned close to its according symbol). As it is, the first symbol and the second column of the legend are best aligned. Additionally: is it possible, to zoom in a little on each of the sites to better see the landuse for the NDVI area? (there is a lot of blank space in the lower right of the map)

AC: Thank you for the valuable suggestion. We have revised the legend such that the symbols are now aligned to the left, followed by the corresponding legend entries, ensuring improved readability. Unfortunately, further zooming is not feasible without excluding the Tegel DWD station, represented by a black triangle near the southern boundary of the map. However, to enhance the reader's understanding of the study sites, we have included a land cover graphic featuring representative images for each class.

RC: L107 Two different authorities is not "various"

AC: We replaced "various" with "two" to be more precise.

RC: L108 I know that data integration is a challenge – this is always the case, I would delete the sentence

AC: We will delete this sentence in the revised version of the manuscript.

RC: L109 Awkward sentence, rephrase

AC: We propose the following rephrasing:

The groundwater measurement station at Schildow provided only weekly data, whereas groundwater records at Tegel and Luebars were more complete but contained some minor gaps.

RC: L300 line break and new paragraph following "analyses."

AC: Thank you for your suggestion. We agree that splitting the text into more paragraphs would improve its readability, and we will implement this change in the revised version.

References #2

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