The authors leverage air-water temperature relationship, derived from 35 river regimes over ~2004-2022, to backcast and forecast water temperature in rivers across the Czech Republic. The objective of this paper is to quantify the change in annual number of days with temperatures < 17 °C, 17-19 °C, 19-21 °C, 21-23 °C and > 23 °C as well as characterize heat wave events. Using modeled water temperature, authors show that the chronic warming of rivers is more prevalent than acute events and advocate for mitigation efforts concentrated on controlling sublethal warming of rivers.

The authors have taken the initiative to upscale monitoring station data from the Czech Republic to construct water temperature data at national scale for past and future time periods. This can pave the way for further improvement of river water temperature modeling in the Czech Republic and attract attention towards warming rivers. The work needs major revisions before publication.

For future predictions, water temperature predicted from various scenarios were aggregated to get their median on which analysis was done. According to the standard IPCC approach, the predicted temperatures should only be aggregated across different models for the same scenario. Please consider either selecting one scenario for this study or repeating the analysis separately for different scenarios. I suggest using trend analysis to consistently characterize the changes in annual number of days with different ranges of water temperature and assess their significance. In addition, there are some other methodological issues to be clarified. Please look at the detailed comments below. I also suggest making the code and data publicly available.

Detailed comments:

Introduction:

Please check the references correctly. The papers cited do not support the statements in some cases. For example, introduction states “Yet, equally important and often overlooked are changes in cold-season thermal conditions during autumn and early spring, which govern the most temperature-sensitive life stages of salmonids: spawning, egg incubation, and fry emergence (Sadayappan and Li, 2025; Van Vliet et al., 2023).” Both cited papers deal with changes in river water temperature and not with how the changes impact aquatic life. Check the full manuscript to ensure the right citations are inserted in the right places.

Line 91-82: I suggest making the hypothesis clear. Currently, the phrasing suggests that the “increasing summer thermal stress” was quantified but the paper quantifies only the change in water temperature during Feb-May and Oct-Jan.

Methods:

Please add the location of the monitoring sites in Figure 1 map.

Please add the number of data points available for each site as well in Table 1.

Line 118: Is the year 2002 or 2004? According to Table 1, earliest sensor data is from 2004.

Line 125 – The use of visual inspection in data cleaning can compromise the reproducibility of the workflow. I suggest encoding the rules used to flag and remove data. For example, what temperatures were considered as "implausible" for particular river or what conditions - flat temperature for long period of time or sudden spikes, etc. – were considered to indicate sensor failure? This data cleaning workflow should be made available in code.

Line 159-160: This is already in "Results" and can be removed here.

Line 161-165: It is not clear for which purpose global model versus site-specific model was used. Why was the site-specific model not calibrated on part of data (70 or 80%) and tested on rest?

Line 175: Can you explain more about how these models were evaluated and summarize the evaluation metrics for different models?

Line 190: Do you mean the 35 river profiles here?

Line 190-192: Why were model ensembles under different scenarios combined? For example, SSP1-2.6 will be very different from SSP5-8.5 and therefore should be analyzed separately. It makes more sense to get ensemble average across different models under same scenario but not across all model-scenario combinations.

Line 192-196: These are repeated in next section and can be removed here

Line 204: Please add references to support this definition of river heat wave. Please add some rationale on why a fixed threshold was used.

Line 207-214: Please explain the reason behind choosing 12 °C and 10 °C as thresholds for seasonal analyses along with references.

Line 215: Please clarify whether the global or site-specific air-water temperature relationships were used to predict water temperature in different stretches of rivers. If site-specific relationships were used, how was the relationship for each river stretch or grid was selected from among 35 relationships.

Line 220: The air temperature was from a gridded product, yet in figure 1c the maps show river network. What is the source of river network data and what is its resolution?

Results:

Lines 246-255: Please add the number of regimes in different classes.

Figure 3: Figure 3 is supposed to show binary condition – whether each grid/stretch has <= 350 days of <17 °C. But maps show the annual number of days with <17 °C. Please correct it. I suggest using two colors to indicate stretches that met this condition and those that didn't.

Figure 4: Consider adding a subpanel for > 23 °C as last row so that readers can get a full picture. For example, legend of figure 5 indicates that annual number of days with > 23°C can be as high as 40 days in some river profiles. Therefore, they can be substantial for some river profiles.

Section 3.5: Why were trends and significance of trend in different classes and thermal ranges not calculated? That could give a more comprehensive picture.

Line 284-286: How was this trend calculated and over what time period? How can this trend indicate that the shift is already underway? Was it based only on historical data reconstructed from air-water temperature relationships?

Line 332-334, 339-340: It is not clear how P25 (25^{th} percentile) exceeding 0 indicates the signal is robust.

Line 349-350: This definition seems arbitrary. Can you please support this definition with some literature? Considering that > 23 °C is also a clear loss of thermal refugia, shouldn't this be days with water temperature exceeding 21°C rather than in the range of 21-23 °C?

Line 355-356: The use of words "episodic" and "persistent" is misleading here. These are better descriptors of heat wave events, not annual number of days. I suggest changing the phrasings here.

Line 357-358: How does P25 being close to zero indicate that stressful conditions are interannually variable?

Section 3.6: Since this section discusses how number of days with water temperatures change annually, a figure showing annual changes can support them better than figure 4 showing decadal changes.

Line 362-364: This is premature as results on heat wave events have not even been presented yet.

Line 376-379: Delayed response indicates a response to some driver, so please change the wording.

Line 385: It is not clear how this was quantified. Was the first occurrence of those temperatures considered as onset of related stress? How was consistency calculated?

Line 294-395: There is no figure showing the duration of heat wave events to support this statement.

Discussion:

Line 440: It looks like there is a high increase in number of days with 21-23 °C as well.

Line 443: I suggest using “less prevalent” rather than “episodic”.

Lines 443-445: This is a strong statement, considering this paper studies the changes in water temperature and not the impact of thermal changes on aquatic life. I suggest softening it and making it sound more like a hypothesis.

Line 446: It is little confusing how the grid scale air temperature was used to get reach-scale water temperature. Please make this clear in methods.

Line 469-470: This line might be better placed in the next paragraph than here.

Section 4.3: This section discusses the spatial connectivity of thermally suitable river reaches. The paper currently summarizes percent length of river network with suitably cool temperatures but not their spatial connectivity. I suggest calculating an index that summarizes structural connectivity of thermal refugia in river network for different years or decades and its change over time to support the argument that spatial connectivity is decreasing.

Section 4.4: Local conditions can influence water temperature over the whole temperature range and not only above 23 °C. For example, groundwater-fed rivers are only cooler in summer but also warmer in winter. This should be made clear.

The air-water temperature relationships derived from few rivers, when used to calculate temperatures in the whole network, can result in substantial uncertainties as the catchment characteristics of the 35 river profiles often might not cover the whole spectrum of conditions at national scale. This should be discussed too.

Is there any pattern in model performance among different river profiles that can shed some light on where (or under what conditions) the uncertainties can be higher?

This paper considers 23 °C as the fixed threshold for detection of heat waves. Yet several riverine heat waves consider a flexible threshold since aquatic life in different rivers are acclimatized to different thermal conditions. Can you add some discussion on how using a variable threshold might change the picture?

Section 4.5: Good call on recognizing the importance of stream flow on water temperature. I suggest editing this section to tighten it. For example, declining snowpack and increasing temperatures are reiterated multiple times.

Lines 597-606: This should either be a different section or integrated into conclusion.

Conclusion:

Lines 611-613- The paper summarizes changes in water temperatures rather than ecological response to different types of thermal changes. Therefore, this statement is not supported by results. Please alter it accordingly.

Minor comments:

Figure 1 -> I don't see a dotted line on sublot b? Also, Figure 1a is not discussed in the main text at all. Considering mentioning somewhere about how annual brown trout catch has been declining.

Line 207: there is a formatting error here

Figure 3 – Description repeats the same things twice.

Figure 3: The table is so small that it is hard to make out the numbers. Consider moving it to separate table. In general, font size on all figures can be increased.

Line 276 – This line sounds a bit awkward. By thermally exposed, do you mean rivers that are warmer (lowland) or those experiencing highest increase in days with water temperature > 17°C?

Line 282 – 35 monitored profiles

Line 558: consider alternative term for "stagnating"

Line 565: maybe "inverse relationship" instead of "negative relationship"

Figure S1 is not cited anywhere.