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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Technical note: Fourier approach for estimating the thermal attributes of streams" *by* M. Ryo et al.

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1. Page 1, line 16-17: "The results confirm that the developed method can infer stochastic behaviors in stream thermal attributes at spot-measured sites." It would be beneficial to the reader to reword this sentence so that it reflects the requirement of having highly resolved temperature data at a reference site and the assumption of spatial autocorrelation between the reference site and data poor site that this method relies on.

—[Our reply]—

As the reviewer has suggested, we would modify the sentence as follows:

Before (p.1, line 16): The results confirm that the developed method can infer stochastic

behaviors in stream thermal attributes at spot-measured sites.

After: The results confirm that the developed method, spatially extrapolating thermal attributes based on Fourier analysis, can infer stochastic behaviors in stream thermal attributes at a data poor site.

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In addition, to increase readability, we described the method more precisely in abstract:

Before (p.1, line 11): This study developed an analytical method to estimate seasonal and diel periodicities as well as irregularities in stream temperature at data-poor sites based on Fourier analysis.

After: This study developed an analytical method to estimate seasonal and diel periodicities as well as irregularities in stream temperature at data-poor sites based on Fourier analysis extrapolating thermal attributes from highly resolved temperature data at a reference site, on the assumption of spatial autocorrelation.

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2. Page 2, line 3-13: The introduction correctly stresses the importance of knowing "thermal attributes" at a given site with regards to an ecosystem. The authors go on to describe that determining "thermal attributes" can be difficult and unrealistic because of the need for highly resolved temperature data. They present a strong argument for the need for improved modeling that can rely on sparsely collected temperature data. The introduction makes it sound as if the temperature modelling method presented in this manuscript does just that. However, the authors' model is dependent on having two years' worth of hourly temperature data at a reference site. In addition, it relies on the assumption that there is spatial autocorrelation between the reference site and the data poor site. It would be beneficial to reword the introduction so that this information is more explicit.

—[Our reply]—

As another reviewer has also pointed out the lack of explanation which can mislead readers, we would modify the last two sentences in this paragraph and a sentence in the next paragraph:

Before (p.2, line 10-): Often in these cases, researchers rely on spot-measures of temperature at study sites and thus lack time-series temperature, thereby limiting understanding of the ecological consequences of thermal attributes in freshwaters. Clearly, an estimate of the thermal attributes at spot-measured sites would benefit this understanding.

After: Often in these cases, researchers rely on spot-measures of temperature at study sites lacking time-series temperature or refer to temperature time-series monitored at a nearby hydrological station along the streamline, although likely being biased in thermal attributes. Both datasets have caveats (a lack of time-series or bias in data) when estimating the thermal attributes at a data-poor site, thereby limiting understanding of the ecological consequences in freshwaters. Regardless, estimating thermal attributes from both spot-measurements at study sites and time-series at the nearest hydrological station would allow more robust estimates.

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Before (p.2, line 15): For instance, regression models employ correlative relationships with air temperature (e.g., Pilgrim et al., 1998) and streamflow (Webb et al., 2003).

After: For instance, regression models employ correlative relationships with air temperature (e.g., Pilgrim et al., 1998) and streamflow (Webb et al., 2003), whereas a correlative approach considering water temperature at a nearby hydrological station along the streamline has not been implemented yet.

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3. Page 4, line 9-10: The authors do not include discharge and air temperature data in their methods for simplicity. Would adding this information to the Fourier analysis

method improve its performance when compared to the linear regression method?

—[Our reply]—

Yes, adding information on discharge and air temperature has a potential to increase accuracy, especially if these factors contain unique information which is unexplained by the spatial correlation of water temperatures between sites. For example, if discharge can represent a volume of snow-melting water that may influence the correlative relationship of water temperature between sites, the inclusion of discharge into the model's structure would increase the accuracy.

We would include this point in discussion:

(After p.6, lines 28–29): This type of model was not addressed in a recent review on temperature models (Benyahya et al., 2007). As the statistical expression of our approach is linear (Eqs. 1 and 6), it can be easily coupled with approaches in the review; i.e., using other regression models employing air temperature (e.g., Pilgrim et al., 1998) and streamflow (Webb et al., 2003). Adding such information has the potential to increase accuracy, especially if these factors contain unique information that is unexplained by the spatial correlation of water temperature between sites. For example, if discharge represents a volume of snowmelt water that can influence the correlative relationship of water temperature between sites, inclusion of discharge into the model's structure would increase accuracy.

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4. Page 6, line 3-5: It appears that the method performs comparably to a linear regression with the exception that the presented method captures extreme thermal pulses and their probability. The linear regression method does not do this. It would be beneficial to emphasize this result and include it in the Abstract.

—[Our reply]—

We fully agree with the reviewer's suggestion. We would modify the text to better stress

out the success in our primary aim recreating extremes:

Results part: We would insert the following sentence in p. 5 line 2 before the sentence starting from “At site B, . . .” “This result indicates that our approach can accurately estimate periodic components and extremes, including the variability in irregularity that cannot be represented by linear regression focusing on an average estimate.”

Abstract part: We would insert the following sentence in p. 1 line 16 before the sentence starting from “The results confirm that the developed method. . .” “The result of the performance evaluation indicated that our approach can reasonably estimate periodic components and extremes, including the variability in irregularity, that cannot be represented by linear regression focusing on an average estimate.”

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5. Technical, spelling, and grammatical edits: Page 1, line 10: It would be beneficial to define explicitly what “thermal attributes” are earlier in the manuscript. The authors do so on Page 2, line 21-22. However, the term is used several instances before this definition. Page 1, line 11: “Based on Fourier analysis, this study developed. . .” Misplaced modifier Page 1, line 12-13: “We first quantified. . .Stream temperature was accurately decomposed. . .” The first sentence is active voice while the second sentence is passive voice. The introduction should remain in active voice. Page 2, line 5: Progress in understanding response patterns has been delayed. . .” Subject verb agreement

—[Our reply]—

We would modify these technical corrections accordingly.

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