Hess – Isaak et al.: Principal components of thermal regimes in mountain river networks

General comments

This manuscript presents an elegant analysis of different components (magnitude, frequency, duration, timing) of thermal events for a large number of time series points in the United states. Two variations of Principal Components Analysis (T-mode and S-mode analyses) refine the analysis very nicely into spatial regions and temporal seasons of thermal homogeneity and seasonality. By disaggregating time series into metrics, and accounting for high levels of redundancy between metrics, together with the PC analyses, this research presents a novel approach to optimising site locations for water temperature gauging networks. In my opinion, this is a very useful addition to thermal research in lotic systems. The approach is generic and applicable to a global audience.

The manuscript is clearly and well written, methodologically elegant and scientifically sound. I recommend publication given minor comments corrected below.

Specific comments

Section 3.1 – Does one need to specify that the study assumed stationarity in the data, in order to generate temperatures for 365 days based on five-year time series?

Line 207 – Please provide a summary of the environmental gradients; it may be worth including a table on these.

Line 212 – Please explain why the thermal year started on 1 December. In South Africa, we typically use 1 October – 30 September for the Hydrological year, but I am aware that this varies regionally, being based on the onset of the highest discharge season.

Line 234 – It would make more sense to me to represent the thermal gradient per 100m. This would be a useful figure in defining a water temperature lapse rate. For air temperatures, this is typically expressed as something like 0.7°C per 100m.

Technical comments

Title and elsewhere in text: please check for correct spelling of “Principle [as in components]”, which needs to be corrected to PRINCIPAL and checked throughout text, as there are instances of both. Nothing serious – I get confused between these two spellings!

Lines 37-40: Sentence does not read well. Suggested revision “Knowledge of the local thermal regime, based on the annual sequence of temperatures characteristic to specific locations within a river network, is key to understanding natural conditions and diagnosing anthropogenic impairments.”

Lines 62-64: Suggested revision “While that may bring..., most warm stream...correlated with each other and therefore redundant. If redundancy is also reflected across a broader...”

Paragraph beginning line 146: Be explicit that these time series refer to water temperatures, as later on in the manuscript air temperatures are also used.

Line 218 – “sites, an S-mode”

Line 253 – Figure 4a

Line 257 – insert Figure 4c

Table 1 – write US in full; standardise on number of decimal points down columns (also applies for Table 3).

Figure 2 – I like this figure! Please include the range of R^2 values, and I would recommend that the caption explicitly describes the month(s) with the highest thermal gradient.

Figure 4 – caption revision to say “...show principal component scores for axes 1-2...”. Please also check there are no other occurrences of “principle”.

Figure 7 – “...and discharge (c-f)”

References: Carlisle et al. 2017; Fuhrman et al. 2018; Isaak et al. 2016b; Josse and Husson 2012; Steel et al. 2017 not cited in text.

Inconsistencies in citations: Line 51 – Rieman et al 2015a; Line 80 Piechota 2001 or 1997?; Line 84 Gallacher 2016 or 2017?; line 90 Trumbo et al. Not referenced; line 175 – correct to R Development Core Team; Line 205 correct to SAS Institute Inc.; line 326 – spelling of Nusslé; line 352 – Jackson et al. 2017 or 2018?

Table 3 not cited in text.