Hydrol. Earth Syst. Sci. Discuss., 10, C6036–C6041, 2013
www.hydrol-earth-syst-sci-discuss.net/10/C6036/2013/

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Riparian forest as a management tool for moderating future thermal conditions of lowland temperate streams" *by* P. B. Kristensen et al.

P. B. Kristensen et al.

peter.b.kristensen@biology.au.dk

Received and published: 31 October 2013

Dear anonymous referee #2

On behalf of the author team I would like to thank you for the comments on the manuscript "Riparian forest as a management tool for moderating future thermal conditions of lowland temperate streams". Referee 2 raises some important questions about the novelty in the two first points of specific comments and refers to important literature. Overall we agree there is some overlap in approaches with other studies; however still claim that our study provides novel insight to the effect of riparian forest, on stream

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

thermal dynamics. We have revised the manuscript addressing your concerns and lengthened the introduction in order to provide a more thorough review; but still keeping it strict and concise. We are therefore confident that the revised manuscript is significantly improved relative to the initial submission. Below is an itemized response to your comments and questions.

Specific comment 1:

The influence of riparian forest on stream thermal dynamics is of great interest in the context of aquatic habitat, and has received a great detail more attention in the literature than indicated by the limited review offered by Kristensen et al., particularly in the form of rigorous experiments using a before-after/control-impact design (see review by Moore et al., 2005, and more recent studies by Gomi et al., 2006; Wilkerson et al., 2006; Gravelle and Link, 2007; Groom et al., 2011; Janisch et al. 2012; Rex et al., 2012; Newton and Cole, 2013). These studies consistently demonstrated that a reduction of stream shading results in an increase in stream temperature during summer. Furthermore, it has been well established that the main cause of this warming is an increase in solar radiation associated with the loss of shade (e.g., Johnson, 2004). Therefore, the conclusion that forest cover had a significant influence on stream temperature is not novel.

Author reply:

We certainly agree with anonymous referee number 2 that the influence of riparian forest on stream thermal dynamics has received a great deal of attention and that it is well established that a reduction in stream shading results in an increase in stream summer temperature, mainly caused by solar radiation. Therefore we do not attempt to claim novelty in this broad sense. However, specifically, our aim was to contribute with new knowledge on the length of a forested reach required obtaining a significant temperature decrease and how dense the canopy cover should be. This is novel we believe. In the revised version of our manuscript, we include more references in the

HESSD

10, C6036–C6041, 2013

review of literature as suggested by reviewer and make a more thorough introduction on the existing knowledge. We have sought to provide the most relevant references and keep the introductory review strict and concise as appropriate for publications in a top journal as HESS, but this may have resulted in under-referencing.

Specific comment 2:

The longitudinal changes in temperature that occur when water flows from an unshaded environment into a reach shaded by riparian forest have also been documented by a number of studies (e.g., Greene, 1950; Brown et al. 1971; McGurk, 1989; Caldwell et al., 1991; Storey and Cowley, 1997; Keith et al. 1998; Zwieniecki and Newton, 1999; Story et al., 2003; Johnson, 2004). These studies revealed a broad range of behaviors that cannot be explained in the absence of knowledge about the specific energy and water exchanges in the shaded reach. Therefore, the finding that the shaded reaches of the five study streams exhibited a range of thermal patterns is not novel.

Author reply:

Although the references listed by the reviewer in point two of specific comments amongst others describe temperatures in streams with shaded and open reaches of various degrees in a longitudinal direction, our study specifically aims to determine the length of a forested reach, required to obtain a significant temperature decrease, using leaf area index methodology to quantify canopy cover. We did not find this exact approach in any of the references listed by referee #2; however recognize that some overlap exists. Therefore we insist that our study is novel and provides a significant and important contribution to the research of thermal conditions of lowland temperate streams. However, we should have included at least some of these studies in the references, why they have been included in a revised and improved version of the manuscript.

Specific comment 3:

HESSD

10, C6036–C6041, 2013

Two broad approaches are typically used to gain insight into the processes or factors that control a phenomenon of interest: a statistical approach based on variability across a landscape, and a deterministic approach involving field measurements to quantify the underlying processes. In this study, the authors have employed a landscape-scale approach, and found that three predictor variables were correlated with the observed thermal patterns: canopy cover, width:depth ratio and the water temperature at the upstream end of the forested reach. Unfortunately, the small sample size (n = 5) does not permit a more detailed analysis to understand whether these correlations reflect true cause-and-effect relations or simply reflect a confounding due to multi-collinearity. For example, it may be that canopy cover and upstream temperature independently influence longitudinal temperature changes (as one might infer from an understanding of the underlying energy exchange processes) but that the correlation with width:depth ratio is spurious. The authors have performed a stepwise multiple regression analysis to try to identify which of the candidate predictor variables are most important. However, the results are unlikely to be robust, considering that the initial number of predictor variables is the same as the sample size. A common guideline is that the sample size should be at least ten times the number of predictor variables in a regression model.

Author reply:

Referee #2 raises important questions about the stepwise multiple regression analysis and sample size. We acknowledge and agree on these concerns and therefore have removed the stepwise multiple regression analysis from the revised manuscript. However, this does not change our conclusions regarding the results of the linear regressions.

Specific comment 4:

A more rigorous approach to understanding thermal patterns in time and space is to quantify the energy and water budgets of the stream reaches. Hannah et al. (2008) compared surface energy exchanges between open and forest reaches, and at least

HESSD

10, C6036–C6041, 2013

three studies have applied this approach for shaded reaches below open areas (Brown et al., 1971; Story et al., 2003; Johnson, 2004). If the authors had adopted this approach here, then the comparison of results among the five reaches would have provided significant new knowledge and would have merited publication in HESS. A process-based approach would also provide a basis for making inferences regarding thermal dynamics in a changing climate. See next comment.

Specific comment 5:

The authors aim to use their results to judge the importance of forest cover as a tool for climate change adaptation. However, thermal patterns observed under current climatic conditions, particularly contrasts between open and shaded reaches, will likely not be valid under an altered climate. A process-based modeling approach is required to make inferences about future thermal dynamics (e.g., Gooseff et al., 2005).

Author reply to comment 4 and 5:

In comment 4 and 5 referee #2 infers that a process-based approach with comparison of results of the five reaches would have provided significant new knowledge. Furthermore, that we aim to use results to judge the importance of forest cover as a tool for climate change adaptation and argue that thermal patterns under current climatic conditions will not be valid under an altered climate. Instead referee #2 recommends a process-based modeling approach. However, we do not attempt to transfer the observed thermal patterns to future conditions; i.e. we do not have a process-based modeling approach. But we do provide new knowledge on the length and density of forested reaches necessary to obtain a significant cooling of stream water; that must also apply in the future. We argue that this is a valid approach and useful for managers of streams and riparian areas in a future warmer climate.

Specific comment 6:

The authors provide a number of statistical comparisons of temperatures between up-

HESSD

10, C6036–C6041, 2013

stream and downstream locations. It is not clear from the description of the analysis, but I presume that the authors are treating each day in the study period as an independent replicate in the statistical test. However, daily stream temperature data are typically highly autocorrelated, which violates an important assumption that underlies standard statistical approaches like Student's t. Approaches that can explicitly account for the temporal autocorrelation are appropriate in such cases (e.g., Groom et al., 2011; Janisch et al., 2012; Newton and Cole, 2013).

Author reply:

Referee #2 has an important point here. In the revised manuscript, we will therefore apply approaches that accounts for autocorrelation. We do not expect that main conclusions will be affected, however will show upon testing.

On behalf of the authors, kind regards,

Peter

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 6081, 2013.