Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., author comment AC2
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Reply on CC1

Efrain Noa-Yarasca et al.

Author comment on "An improved model of shade-affected stream temperature in Soil & Water Assessment Tool" by Efrain Noa-Yarasca et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-116-AC2, 2022

Response to comments and suggestions from the second reviewer:
CC1: 'Comment on hess-2022-116', Virgil Alexandru Iordache, 16 Sep 2022

Q19

In the current form of the article, the shade factor and restoration scenarios approach is simplistic and almost decoupled from plant diversity management in the riparian area. I would suggest adding a paragraph in the introduction and perhaps a comparative table about the existing literature ….

Most of the literature related to the shade factor in the riparian context for stream temperature has been reviewed and added in the different sections of the article, dor example, in line 112 and line 124. Here, I summarized some points to specifically answer this question. These answers are also included/added in the article.

The literature shows a significant number of studies to evaluate the shade of riparian vegetation on streams (Abbott G., 2002; DeWalle, 2010; Fuller et al., 2022; Garner et al., 2017; LeBlanc & Brown, 2000; Li et al., 2012; Loicq et al., 2018; Roth et al., 2010; Wondzell et al., 2019). Models for determining shading or shade factor often included hydraulic and morphological properties of the river, plant characteristics in the buffer zone, and meteorological data such as solar radiation. Complex models, conducted mainly at a local scale (at specific sections of a river or short stretches of a river), have incorporated variables such as canopy shape, canopy overhang, stream bank height, canopy transmittivity, planta species, and others. These complex models also required detailed information at field level on river morphology, detailed canopy features, and in situ meteorological measurements (Davies□Colley et al., 2009; Davies-Colley & Rutherford, 2005; Li et al., 2012). However, in large stretches of rivers where information at the field level is not available yet due to limited resources, simplified models have been employed to determine the shade factor with good enough results (Fuller et al., 2022; Marteau et al., 2022; Seyedhashemi et al., 2022; Spanjer et al., 2022). As mentioned above, accurate assessment of SF has been conducted only at specific points or sections of rivers or short reaches of rivers.

Beyond the calculation of the shading factor, in a broader context of evaluation of the temperature of the stream, no physically based hydrological model has considered the calculation of stream temperature including a detailed mass and energy balance equation that includes riparian vegetation. The challenge of this work is not essentially to improve the accuracy of the SF calculation over existing methodologies, but rather to incorporate the shade component that represents riparian vegetation into a large-scale physically based hydrological model. In this aspect, this study takes a straightforward methodology to determinate the shade factor maintaining the more representative stream and canopy features. When larger and more detailed measurements are available to make a finer calculation of the shade factor in following years, outcomes of the hydrological model might be updated considering this study's approach of incorporating riparian vegetation in the evaluation of stream temperature at the sub-basin and watershed levels.

Notwithstanding, a paragraph indicating the main scope of the SF calculation methodologies was added to the article (line 124).

Q20

There are only 89 articles for "shade factor" AND riparian on Google Scholar; many are highly relevant to the paper's topic. An analysis of the most relevant ones would provide the reader with an image of the role of plant species and their measurable traits on the shade factor….

The main works in the literature that involve the calculation of the shade factor have been reviewed. However, the goal of this work is not to improve the accuracy of the shade factor over existing methodologies, but rather to incorporate the shade factor representing the riparian vegetation into a large-scale physically based hydrological model. The study considered the typical features of Oregonian conifers. Future research should examine how tree species affect shading factor and consequently stream temperature at sub-basin level using the SWAT model.

Q21

I don't know if your scenarios could be refined in sub-scenarios with different species compositions to test the model's sensitivity to species diversity. This would be extremely valuable for biodiversity management. If it cannot be done now, it could be at least discussed.

Evaluating different species would involve including variables such as density, transmissivity that are not available for the more common Oregon species (hemlocks, true firs, spruce, Douglas fir and pine, Douglas maple, bigleaf maple, and others). This study considered the general features of long-lived tree species, such as the evergreen forest that is quite common in DMW river buffer zones (ODA, 2018; ODEQ, 2008). As more data is collected, such as tree species and canopy shapes throughout the DMW, more sophisticated shade factor models can be used to assess the effects of plant species on stream temperature at the DMW sub-basin level.

Q22

The context can then be used in the discussion to analyze the potential cooperation between hydrologists and ecologists for riparian forest management. Riparian vegetation is involved in producing many ecosystem services, not only in water temperature control, and some tradeoffs are between….

Added discussion of other riparian vegetation services to article in section 3.3.5 "Evaluating additional effects of riparian vegetation for optimal restoration (future research)" (Line 462)

Please also note the supplement to this comment:
https://hess.copernicus.org/preprints/hess-2022-116/hess-2022-116-AC2-supplement.pdf