

**Riparian vegetation mitigates river warming: exploring its large scale effects on past and future thermal regimes**

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RS13. Climate change and freshwaters: challenges and solutions

RS11. Restoration, conservation and management of freshwater systems

SS05. Freshwater Macroecology research and perspectives

**Abstract – 250 words max.**

As air temperature increases worldwide due to climate change, stream temperature ( $T_w$ ) is expected to follow a similar trajectory with even faster changes. In this study, we aimed at investigating and quantifying the extent to which riparian shading can help mitigate river warming at a large scale ( $10^5$  km<sup>2</sup>). To do so, a physical process-based thermal model coupled with a semi-distributed hydrological model was used to reconstruct (1963-2019) and project (2005-2100)  $T_w$  for 52000 hydrographic sections of the Loire basin (France). This high spatial resolution (1 km) model includes a novel routine to account for riparian shading dynamically across seasons. Results showed that past and future increases in  $T_w$  were greater in relatively large rivers (Strahler order  $\geq 5$ ), which was attributed partly to the mitigation effect of riparian shading observed on smaller streams. Indeed, riparian vegetation shading mitigated spring and summer  $T_w$  increases by up to 0.16°C per decade in headwater streams (i.e. < 30 km from the source) over the past six decades. Moreover, riparian shading could mitigate the future increase in summer  $T_w$  in small streams by 3.75°C to 5.17°C by the end of the 21<sup>st</sup> century, depending on the climate model and scenario from sparsely shaded reaches to highly shaded reaches. We complemented these results by exploring the consequences of theoretical scenarios of large-scale riparian restoration or loss on  $T_w$  changes. Our results suggest that the restoration and maintenance of riparian forests holds great promise to help mitigate the effects of global warming on rivers and their biodiversity.