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Riverscape-scale airborne TIR assessment of weirs and riparian cover effects on lowland river temperature

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The development of Airborne Infrared Thermal sensing (TIR) is an example of how technological advancements and the field that they focus on have fostered one another. The pace at which global change is occurring has fed the demand for better understanding of the thermal behaviour of rivers. In turn, the improvement of remote sensing and data processing techniques has provided researchers and managers with new tools to apprehend such aspects at ever larger scales. Still, recent studies have mostly focussed on rivers showing little human alteration, with a particular interest on groundwater–surface water interactions. Lowland streams are scarcely considered when it comes to the study of temperature despite their widespread occurrence, their relatively high degree of disturbance and the risks that they face in the light of temperature rising following climate change. Some of these streams already display critically high maximum summer temperatures and their state is likely to worsen in the future, putting all compartments of biota at risk.

The aims of this project were twofold. We first tested the applicability of airborne TIR to study lowland, slow-flowing stream reaches draining agricultural catchments, some of which being particularly narrow and sinuous. We then sought to understand the role of different environmental factors, observed in such context, on driving river temperature during the warmest days of the year. A number of anthropogenic actions such as clear-cutting of riparian trees, stream rectification and the construction of weirs are likely to influence the longitudinal temperature profile of such streams. By choosing rivers with no or limited groundwater inputs, we were able to quantify the relative role of each of the three tested factors and identify stream sections showing critically high maximum temperature over the summer.

A final step was proposed to upscale these results in order to identify sections of streams showing high risks of reaching critically high summer temperature at a regional network scale. To do so, we used a combination of high resolution land-cover data, digital elevation models and other existing databases (e.g. national inventory of weirs). Identification of the risks in relation with the relative contribution of the different factors is key to process-based river management. This type of output

is valuable to river basin managers and decision makers as it can be used to implement targeted restoration initiatives or remediation actions in areas where these have higher chances of being effective.