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Thermal infrared imagery as a tool for analysing the variability of surface saturated areas at various temporal and spatial scales

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Surface saturated areas are important for the on- and offset of hydrological connectivity within the hillslope-riparian-stream continuum. This is reflected in concepts such as variable contributing areas or critical source areas. However, we still lack a standardized method for areal mapping of surface saturation and for observing its spatiotemporal variability. Proof-of-concept studies in recent years have shown the potential of thermal infrared (TIR) imagery to record surface saturation dynamics at various temporal and spatial scales. Thermal infrared imagery is thus a promising alternative to conventional approaches, such as the squishy boot method or the mapping of vegetation.
In this study we use TIR images to investigate the variability of surface saturated areas at different temporal and spatial scales in the forested Weierbach catchment (0.45 km2) in western Luxembourg. We took TIR images of the riparian zone with a hand-held FLIR infrared camera at fortnightly intervals over 18 months at nine different locations distributed over the catchment. Not all of the acquired images were suitable for a derivation of the surface saturated areas, as various factors influence the usability of the TIR images (e.g. temperature contrasts, shadows, fog). Nonetheless, we obtained a large number of usable images that provided a good insight into the dynamic behaviour of surface saturated areas at different scales. The images revealed how diverse the evolution of surface saturated areas can be throughout the hydrologic year. For some locations with similar morphology or topography we identified diverging saturation dynamics, while other locations with different morphology / topography showed more similar behaviour. Moreover, we were able to assess the variability of the dynamics of expansion / contraction of saturated areas within the single locations, which can help to better understand the mechanisms behind surface saturation development.