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Method for AI-enhanced litter detection in aquatic environments using action cameras combined with net-based device for measuring submerged plastics

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Plastic waste finds its way to the ocean often through rivers: it is estimated that between 1.15 and 2.41 million tons of plastic waste enters the ocean every year from rivers. Out of the 1500+ rivers that are estimated for being responsible for 80% of the riverine plastic emissions, around 70 of these rivers are located in Vietnam which highlights the importance of further investigating the plastic waste situation in its rivers.

The aim for this study was to develop a method for machine learning based measuring several types of plastic litter (in particular floating, trapped and submerged) in riverine systems. By considering the combined information of various litter categories this methodology is able to draw a holistic picture of plastic transport in riverine systems.

Two different methodological components were set up: (i) an AI (artificial intelligence) based litter detection algorithm which analyses imagery gathered by bridge-installed action cameras for floating and trapped plastic waste items in terms of abundances and waste types and (ii) a net-based sampling method which measures floating as well as submerged plastics at the bridge locations. The applied AI-based litter detection algorithm was originally developed for plastics detection in an aquatic environment in Cambodia for drone imagery. Within this framework, this approach was further developed and applied to detect floating and trapped plastic litter in polluted rivers captured with action cameras in Vietnam. The complementing net-based sampling for submerged plastics was applied in parallel to calibrate the continuous camera-based sampling with direct measurements.

Within this study it was shown that the combination of the two presented approaches provides a suitable methodology for the measurement of plastic transport along a river. Calibration of the continuous camera-based method showed that about 50% of the litter was transported at the surface and was thus directly detectable by AI. The methodology is relevant to the remote sensing community focusing on plastics detection and to researchers addressing plastic waste. The continuous assessment of plastic quantities transported by rivers will be key for policy makers to identify main polluters and to understand the impacts of any taken measures to reduce plastics pollution. Increasing the understanding of plastic types through these measurements is key for policy makers to develop the right measures which can target the items responsible for the majority of plastics pollution in rivers, as typically only few items are responsible for the majority of plastics leakage. The achievements of this study aim to fill these knowledge gaps by enhancing the litter detection method. As a next step, this method could be scaled up to be tested for a longer time period and at additional sites. The results of such longer-term measurements of surface and submerged plastics may allow for extrapolation of floating plastics to total transported plastics.

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