Stage-cameras to monitor water level in headwaters

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**Abstract.** Understanding runoff formation in ephemeral and intermittent streams is fundamental for the comprehension of natural systems; however, monitoring such watercourses remains a major challenge in hydrology. Direct field observations are best to detect spatial patterns of flow persistence but they are time and labour intensive and may be impractical in difficult-to-access environments. Moreover, instrumentation deployed in the riverbed can provide information about the streamflow state, nevertheless these methods lack in streamflow quantification.

Inspired by latest advancements in digital cameras and computer vision, we propose the development and application of a stage-camera setup to monitor the water level in an ungauged headwater stream. This system encompasses a camera with near infrared (NIR) night vision capabilities and a white pole that serves as reference object in the collected images. To evaluate the efficacy of this system in the detection of river dynamics, a set of 21 stage-camera stations is installed along the entire river network of the 4 km2 Montecalvello catchment, near Viterbo (VT, Italy). Time-lapse imagery is processed through a computationally inexpensive algorithm featuring image quantization and binarization and water level time series are filtered thought a simple statistical scheme. The feasibility of this approach is demonstrated through a set of benchmark water level estimations obtained from a supervised procedure. Preliminary evaluations are encouraging and support the usability of this approach in monitoring ephemeral and intermittent stream dynamics.