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Development of an Integrated Suspended Sediment Sampling System - Prototype Results

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The Mediterranean region is characterized by a unique micro-climate and a complex geologic and geomorphologic environment caused by its position in the Alpine orogenesis belt. Unique features of the region are the temporary rivers that are dry streams or streams with very low flow for most of the time over decadal time scales. One of their key characteristics is that they present flashy hydrographs with response times ranging from minutes to hours. It is crucial to monitor flash-flood events and observe their behavior since they can cause environmental degradation of the river's wider location area. The majority of sediment load is transferred during these flash events. Quantification of these fluxes through the development of new measuring devices is of outmost importance as it is the first step for a comprehensive understanding of the water quality, the soil erosion and erosion sources, and the sediment and nutrient transport routes. This work proposes an integrated suspended sediment sampling system which is implemented in a complex semi-arid Mediterranean watershed (i.e. the Koiliaris River Basin of Crete) with temporary flow tributaries and karstic springs. The system consists of sensors monitoring water stage and turbidity, an automated suspended sediment sampler, and an online camera recording video sequence of the river flow. Water stage and turbidity are continuously monitored and stage is converted to flow with the use of a rating curve; when either of these variables exceeds certain thresholds, the pump of the sediment sampler initiates sampling with a rotation proportional to the stage (flow weighted sampling). The water passes through a filter that captures the sediment, the solids are weighted after each storm and the data are converted to a total sediment flux. At the same time, the online camera derives optical measurements for the determination of the two-dimensional river flow velocity and the spatial sediment distribution by analyzing the Hue, Saturation and Intensity (HSI color model) components of the image. Suspended sediment concentration is correlated to both turbidity and image color analysis output data, while the suspended sediment sampler offers the possibility of laboratory analysis for the retained sediment. Each component cooperates with the others in an integrated manner, aiming for the quantification of the suspended sediment and the determination of its spatial distribution throughout a flood event. The innovative system, which has been made compact and portable, is currently tested at the Koiliaris River Basin and the results of the first trials will be presented.
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