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# Comparing runoff on 11 poorly-gauged headwater catchments using a soft monitoring approach

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Catchments in many parts of the world are either ungauged or poorly gauged, and the dominant processes governing their streamflow response are still poorly understood. The analysis of runoff coefficients provides essential insight into catchment response, particularly if both range of catchments and a range of events are compared.

An original soft water level sensor is proposed to characterize rainfall and stream flows on agricultural catchments. This sensor works as a capacitor coupled with a capacitance to frequency converter and measures water level at an adjustable time step acquisition. It was designed to be handy, minimally invasive and optimised in terms of energy consumption and low-cost fabrication so as to multiply its use on several catchments under natural conditions. It was used as a stage recorder to measure water level dynamics in a channel during a runoff event and as a rain gauge to measure rainfall amount and intensity.

Innovative work has been performed under controlled experimental conditions to estimate Manning's coefficient values for the different cover types observed in studied streams: non-aquatic vegetations (giant reed, bramble and thistle), grass and coarse granular deposits. The results show that estimates derived using roughness coefficients differ from those previously established for larger streams with aquatic vegetation.

Based on these results, water discharge with a given uncertainty and hence runoff volume were estimated at the event and the annual scale. The sensor was tested under controlled conditions in the laboratory and under real conditions in the field. Comparisons of the sensor to reference devices (tipping bucket rain gauge, hydrostatic pressure transmitter limnimeter, Venturi channels, ...) showed accurate results: rainfall intensities and dynamic responses were accurately reproduced and discharges were estimated with an uncertainty usually acceptable in hydrology (Crabit et al., in Sensors 11, 2011).

This device were used to compare the runoff of 11 small catchments with ephemeral streams (0,1-0,6 $km^2$) with the given uncertainty at both the event and the annual scale (Crabit et al., in Hydrological Processes 25 (18), 2011). The results indicate significant variability between the catchment's responses. This variability allows for classification in spite of all the uncertainty associated with runoff estimation. This study highlights the potential of using a network of poorly gauged catchments. From almost no catchment understanding the proposed methodology allows to compare poorly gauged catchments and highlights similarity/dissimilarity between catchment responses.