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How to identify hydrologic similarity/dissimilarity between small ungauged catchments? Contribution of a soft hydrological monitoring coupled with a Top-Down modelling approach

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Catchments in many parts of the world are either ungauged or poorly gauged. A typical problem often being faced is to simulate flow in these catchments. For that purpose, regionalization approaches are commonly applied and require an assessment of regional similarity in catchment response. Generally, those methods are based on statistical relationships (between catchment properties and lumped model parameters or catchment response dynamics and model parameters) and hence need hydrological data at a regional extent. Due to a lack of discharge and precipitation gauges and the frequency of data collection, usually daily, existing hydrological network, mask the hydrological processes that occur in a matter of hour on small catchments (< 1 km2). Therefore, new methods have to be developed to collect hydrological information at this scale and which allows identifying hydrologic similarity/dissimilarity between small ungauged catchment.

To address this question, this study argues that inter-site comparison using uncertain data, acquired with a soft hydrological monitoring (based on the "gauging the ungauged" concept, (Barthold, et al., 2008 ; Seibert & Beven, 2009)) coupled with a Top-Down modelling approach, may be a constructive way forward to identify and analyse similarity/dissimilarity between small ungauged catchment.

The study was conducted on 11 headwater ungauged catchments (0.1 to 0.6 km2) located in the French Mediterranean region. Rainfall and stage records have been collected using a soft hydrological monitoring during the year 2008-2009. The analysis has been conducted on 120 flood events. Stage-discharge estimation was realised using the Manning equation then catchment runoff was compared at both the event and the annual scale. Inter-catchment comparison was carried out considering different level of complexity: (I) first level, the runoff threshold that allows to determine either the catchment generates runoff or not, particularly important in a context of ephemeral streams, (ii) second level, the runoff coefficient that informs about the water yield during a runoff event and finally (iii) the entire hydrological behaviour dynamic which represent the highest level of complexity.

Results show significant variability between catchment's responses. This variability allows identifying similarity/dissimilarity between catchment responses, in spite of all the uncertainty associated with runoff estimation. Then, factors, such as catchment properties, that could explain such similarity/dissimilarity, were investigated through a Top-Down modelling approach. From first field reconnaissance to perceptual model development, model calibration and model evaluation, this approach led us from an initial state where very little was known about catchment behaviour towards a more complete insight of the catchment attributes impacting catchments behaviour, explaining the observed similarity/dissimilarity between catchments responses.

Bibliography

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