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Uncertainty analysis of different hydrometric recordings systems by using stages-discharge rating curves

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The reliability of the resulting hydrometric data of surface water resources requires a temporal continuity and a system of inspection and maintenance of the gauging stations. Accordingly, the efficient maintenance of the gauging network must be established as a norm and be subject to a continuous process of optimization. Obtaining representative hydrometric values is essential for characterizing extreme events, hydrological dynamics and detecting possible changes. However, data scarcity at temporal scale may lead to unrepresentative values, especially in the calculation of mean flow in ephemeral and intermittent hydrological regimes.

This study evaluates the uncertainty of an analogical hydrometric network (AHN) comparing their records with a digital hydrometric network (DHN) in the island of Mallorca. This evaluation was carried out in the same section of four gauging stations through a propagation of errors analysis in the process of hydrometric values estimation: data collection for water stage measurement and elaboration and management of stage-discharge rating curve (SQRC). From the basic and non-parametric statistics, the magnitude of the mean and maximum discharge was assessed, in addition to the total contribution at the event scale during a representative range of floods. Likewise, their impact was evaluated at the annual scale during a representative hydrological year at each station to assess the degree of uncertainty in the quantification of surface water resources.

Significant differences were detected between AHN and DHN. Both recording systems led to a propagation of errors of significant consequences in the surface water resources quantification in Mallorca, a Mediterranean island where these resources are eco-sociologically crucial. The uncertainty analysis reveals that the main source of errors lies in the SQRC uncertainty. For all the stations, these errors were higher in the AHN (145%, 28%, 49% and 64%) than DHN (28%, 22%, 17% and 38%).

It has been demonstrated that AHN presents a higher uncertainty than DHN. The AHN worked for quantifying water resources from 1960s to 2000s. DHN has substantially improved the instrumentation due to technological advances and can be considered as a smart tool for the management of water resources, essential in an island prone to drought periods in a global change context. Although more accurate results have been obtained using digital instead of analogical instruments, the hydrological processes monitoring can not only be based on the systematic and/or automatic data collection. Continuous digital recording systems must then validate the water stage and Q values by calibrating the SQRCs, performing periodic fieldwork to observe the dynamics of those processes and measuring them in a range of different magnitudes at event scale.