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Digital hydrograph filtering in small size rainfall-dominated terrigenous watershed

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The study aim is an analysis of the ability of digital hydrograph filtering tools for the characterization of the baseflow source contributing to total streamflow for a forested, terrigenous hard rock rainfall-dominated small catchment. Daily streamflow and electrical conductivity (EC) data for an experimental catchment, the T. Ciciriello catchment, a 3km2 watershed located in Southern Italy, have been collected to the purpose since 2012. The application of a mass balance filter (MBF using electrical conductivity as tracer data) has pointed out a seasonal characterization of the baseflow pattern, contributing to total streamflow by 90% during the low flow period and up to 40% during the high flow period. The Lyne and Hollick one parameter and the two parameter Eckhardt digital filters have been furthermore processed, both in an uncalibrated and calibrated application.
During the low flow period, the one parameter filter appears particularly suited for ungauged cases, as the uncalibrated and calibrated application are almost identical, with relative prediction errors, compared to MBF, smaller than 5%. The uncalibrated two parameters filter generates instead large relative error of about 35%. To improve the baseflow description in particular during the low flow period and to correct large (28%) underestimation of the minimum baseflow value, a seasonal calibration for the BFImax parameter was needed.
During the high flow period, the one and the two parameters filters are respectively associated to an overestimation (20%) and underestimation (10%). For this period of the year, the monitoring campaign strongly indicates a large range of variability for the EC values, probably caused by dilution and mixing processes from different water sources and flow paths. As the variability is intrinsically embedded within the MBF method, it is not at all accounted for by the digital filters, which are only able to distinguish between two different component and then between two main dominating runoff production mechanisms. Digital filters, at least for the case study and for similar conditions, appear then sufficiently adequate to estimate time averages at annual scale from daily data. At the same time, it is not suitable for a more realistic representation of the baseflow pattern and its seasonal variability at event scale. More articulate conceptualization of the hydrological behaviour of the catchment, including different runoff generation mechanisms and a high-frequency data recording would be needed, taking groundwater ridging, excess saturation and soil pipe runoff into account.