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Are streamflow recession characteristics characteristic?

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Streamflow recession analysis methods reveal relationships between catchment storage and discharge when precipitation, evapotranspiration, surface storage and groundwater withdrawals are negligible. The falling limb of a hydrograph typically declines over several orders of magnitude and discharge (Q) versus rate of change (-dQ/dt) relationships illustrate a characteristic non-linearity in this storage-outflow dynamic. In the past many different recession analysis methods have been applied in order to quantify the characteristics of this dynamic. Hence there is a need to investigate the influence of the choice of method on recession characteristics. This study assesses a variety of different recession analysis methods to provide information about the reliability and uncertainty of the derived recession characteristics. The different methods can be distinguished by a two-step procedure: first, three different extraction methods select suitable recession segments either with stepwise algorithms from declining hydrographs or supported by precipitation data. The extraction methods lead to a variety of -dQ/dt-Q-plots. Second, the parameters of a commonly used non-linear storage-outflow relationship were estimated from fitting the equation to binned means or to lower envelopes. Finally, the influence of hourly versus daily time step for recession extraction is analyzed. Since each combination of methods may result in different parameters of the non-linear storage-outflow relationships these parameters as well as other characteristic of the derived streamflow recessions like half-life, 30day-low flow or relative storage volume are compared. For 25 meso-scale catchments with different topography and geology in southwest Germany, the observed variability within each catchment was relative large compared to the overall variability among the catchments. In addition, the derived streamflow recession characteristics were not only different due to the methodological approach, but the approaches produced systematically different results with relative low correlation among them for several of the methods. We conclude that different methods to characterize streamflow recessions provide non-unique descriptions of the storage-discharge dynamics and hence make a characterization and also regionalization of these recession characteristics problematic.