Applicability of Recession Extraction Approaches and Recession Analysis Methods Procedures to Karstic Springs

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INTRODUCTION

Recession analysis is a common method to characterize karstic aquifers and their discharge dynamics. The typically manual selection of recession curves is neither a practical technique to cover all candidate recession curves occurring during long spring discharge time series, nor it is allowing to extract the entire hydrological diversity of the recession behavior.

Research Outline

The automated recession analysis procedures, which are commonly used in streamflow recession curve analysis, were investigated for their applicability to extract candidate karst spring recession curves.

Research Questions:

- Could spring recession curve be selected via recession extraction procedure used in streamflow recession analyses?
- How could spring hydro-chemograph analysis be a complementary technique in determining candidate recession curve?

METHODOLOGY

Aksoy and Wittenberg method [AWM], Vogel method [VG], Brutsaert method [BRU] are comparatively evaluated by using four recession analysis method, RAMs.

Table 1. REMs and RAMs included in HYDRORECESSION (developed by Andreas Kupferschmitt, et al, 2017) (2).

Hydrochemical signature of karstic spring essentially contributes the information on systems hydrodynamic properties, most probably aquifer catchment characteristics, therefore electrical conductivity and spring water temperature are also evaluated in defining recession time and duration.

RESULTS-I

Collective Recession Curve Analyses

Recession coefficient is mostly dependent on which analysis procedure would be implemented. Boussinesq, 1904 method always provides the lowest estimated values with a consistent variation in all springs (see Figure 7).

Flow characteristics of Austrian Site Springs

Recession coefficient variations of springs in Austrian site, depending on REMs and REMs selection:

To interpret the dependency of estimated recession coefficients on parameter fitting techniques (PTTs), 10-year discharge data series of Hammerbachquelle spring was analyzed using linear regression (LR), lower envelope (LE), date-binning (DB) techniques, while the data are simulated by Coutagne, 1948 recession analysis method.

Rcession Coefficient Variations- Annual Rainfall Changes

There is a close relation between annual rainfall deviations and annually estimated recession coefficients, especially while capturing recession variability in extreme hydrological years.

RESULTS-II

Hydro-Chemograph Analysis-Recession Curve Analysis

Recession time and its duration are primary parameters impacting on recession variability, while determining recession coefficients. REM is convincingly a systematic approach to extract all recession candidates in an objective way, yet it does not necessarily correspond the best way in describing the hydrodynamics of the karst system.

The figure exemplifies that one could possibly identify the flow components in any recession curve with EC signals.

It is noticeable that seasonal variation takes place, reflecting virtually a same temporal variation during which the high discharge corresponds to high water temperature. This is particularly seen during June and July months.

CONCLUSION

- Automated selection procedure is a mathematical way of thinking, which do not entirely provide a reasonable way in extraction of recession segment(s).
- The drawback, therefore, would be overcome by spring hydrochemical signatures in recession curve selection procedure.
- Chemograph analysis could provide less uncertainty in defining the segment(s) that reflects a particular flow characteristics.