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Separation of drainage runoff during rainfall-runoff episodes using the stable isotope method and drainage water temperature

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Stabile isotopes of 2H 18O and drainage water temperature were used as natural tracers for separation rainfall-runoff event hydrograph on several tile drained catchments located in Bohemian-Moravian Highland, Czech Republic. Small agricultural catchments with drainage systems built in slopes are typical for foothill areas in the Czech and Moravian highland. Often without permanent surface runoff, the drainage systems represent an important portion of runoff and nitrogen leaching out of the catchment. The knowledge of the drainage runoff formation and the origin of its components are prerequisites for formulation of measures leading to improvement of the drainage water quality and reduction of nutrient leaching from the drained catchments.
The results have proved presence of event water in the drainage runoff during rainfall-runoff events. The proportion of event water observed in the drainage runoff varied between 15 – 60 % in the summer events and 0 - 50 % in winter events, while the sudden water temperature change was between 0,1 – 4,2 °C (2 – 35 %). The comparison of isotope separation of the drainage runoff and monitoring the drainage water temperature have demonstrated that in all cases of event water detected in the runoff, a rapid change in the drainage water temperature was observed as well. The portion of event water in the runoff grows with the growing change in water temperature. Using component mixing model, it was demonstrated that water temperature can be successfully used at least as a qualitative and with some degree of inaccuracy as a quantitative tracer as well. The drawback of the non-conservative character of this tracer is compensated by both its economic and technical accessibility.
The separation results also resemble results of separations at small streams. Together with a similarly high speed of the discharge reaction to beginning of precipitation, it is obvious that the mechanism of surface runoff formation and drainage runoff formation is similar. The fast component (or direct runoff) of the drainage runoff is formed by a mixture of pre-event and event water at various ratios, with pre-event water, both subsurface and surface, prevailing especially in winter, getting to the drainage runoff from the melting snow cover by preferential ways.

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