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The Identification of Hydrological Threshold Variables

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The threshold groundwater levels limiting the drainage depth and tile drain runoff as well as runoff recession and runoff partitioning are case-specific. These are the characteristics that are usually necessary for setting up and calibration processes for such models as HYPE (Lindström et al. 2010) and SWAT (Neitsch et al. 2002).

The objective of the present study is to identify the thresholds of groundwater levels and runoff rates that limit the formations of such runoff components as base flow and tile drain runoff. This study utilizes the data that represents the daily runoff measurements in open ditch with such characteristics as total length 2.4 km, basin area 368 ha, loamy soils, agricultural lands with subsurface drainage systems installed in 98% of the area, average tile depth 1.2m below ground surface.

The runoff components were partly separated from the daily runoff hydrographs through the analysis of storm runoff recession gradients (eq.1) and groundwater level fluctuations during the period from 2006. to 2015. Baseflow and tile drain runoff were calculated as being linearly dependent on daily groundwater level fluctuations (eq.2).

$$R_{ci}=Q_{i+1}/Q_i, \quad (1)$$

$$Q_x=f_x(\text{GWT})=a_x*\text{GWT}+b_x, \quad (2)$$

Where: R_{ci} – recession gradient; Q_i and Q_{i+1} – runoff of day i and $i+1$ respectively; Q_x – runoff component; GWT – groundwater level; a_x and b_x – slope and intercept of a linear function.

Nash-Sutcliffe efficiency (NSE) and percent bias (PBIAS) were used for comparison of calculated and separated runoff components.

The results indicate a decrease in drainage intensity and reduction in specific yield during the study period. The groundwater level of 1.18m below ground surface limit the existence of the tile drain runoff, that, furthermore, is similar for rising and falling groundwater level. The results reveal that runoff could be contributed by 35%, 57% and 8% of baseflow, tile drain runoff and surface runoff respectively.

