TILE DRAINAGE WATER TEMPERATURE AS AN IDENTIFIER OF TILE DRAINAGE RUNOFF FAST COMPONENT

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This paper deals with water regime of a small agricultural tile drained catchment Dehtáře, which is situated in the Bohemo-Moravian Highland. The main objective was to estimate the possibility of identification the fast runoff component using drainage water temperature and contribute to explanation of drainage runoff formation in slopes. The tile drainage location in the slope is typical for this region. As substrate, there are metamorphosed rocks – paragneiss, partly migmatised paragneiss and migmatite. Quaternary sediments are colluvial sands and loam.

Continual measurement of drainage discharge and drainage water temperature started in 2003. The runoff in tile drainage is not hydrologically homogeneous in this area, but it is composed of several components called traditionally base flow, direct runoff and interflow.

We found out that there exists a strong dependence of drainage water temperature on drainage discharge during discharge events (quick increase of discharges caused by sudden snowmelts or stormy rainfalls). This dependence is different (positive or negative) according to the season (Figure 1).

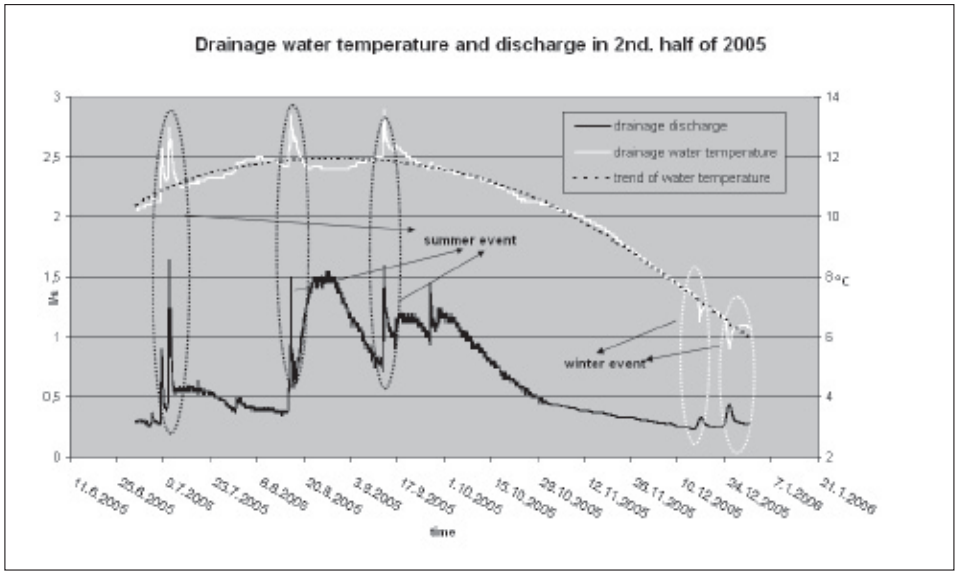

Figure 1. Discharge events in Dehtáře catchment (measuring profile K1) in the year 2005

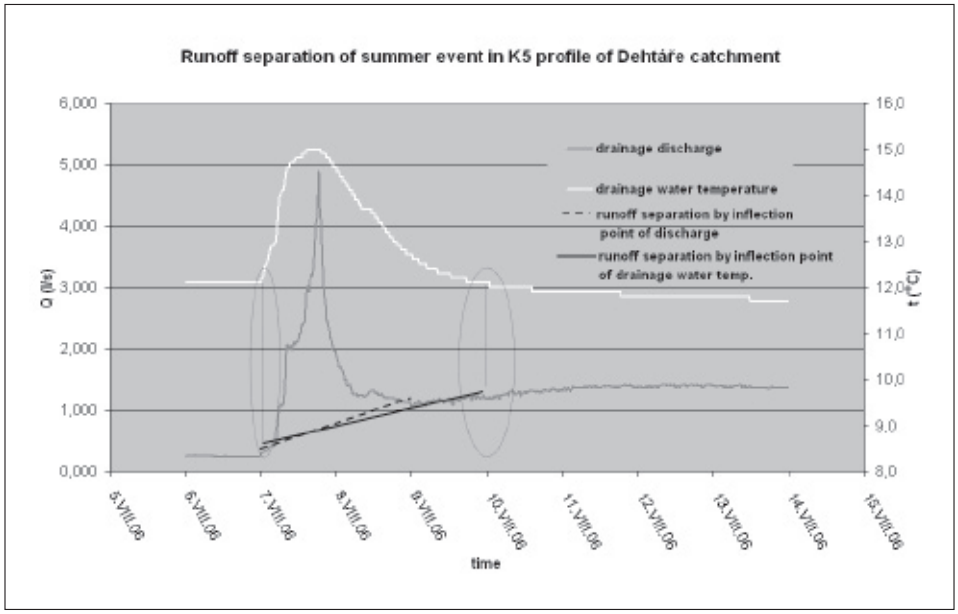

Figure 2. Attempt to fast runoff component separation by changed drainage water temperature

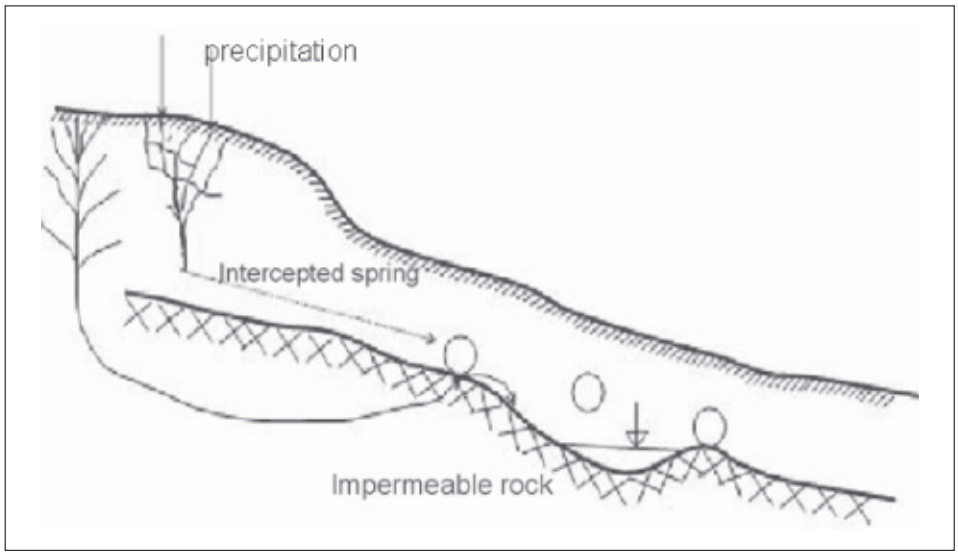

Figure 3. Tile drainage runoff formation by springs

In cold season, drainage water temperature falls with inreasing discharge, in warm season water temperature rises with increasing discharge. Discharge responses to precipitation quickly. The water temperature is changing practically immediately with increasing discharge. So we can claim, that changed drainage water temperature indicates presence od fast runoff component.

Thus separation of fast component of drainage runoff using drainage water temperature looks rather different than separation using only inflex points of hydrograph. (Figure 2).

There are three main ways of drainage runoff formation:

a) by infiltration
b) by rising groundwater table
c) by springs

Precipitation can infiltrate only directly over the tile drained area – this water has probably only small contribution to event discharge due to low hydraulic conductivity (based on our field measurments) or the precipitation can infiltrate over the whole catchment area and flow to tile drains on the non permeable subsoil. But this water is very slow componet, approximately 13 month old (based on isotope experiments).

Groudwater table can rise by direct infiltration in recharge area, which is improbable due to values of hydraulic conductivity, or can rise quickly by ,,piston flow", when precipitation infiltrating in recharge zone rises hydraulic head and then the groundwater table level in discharge zone. But this water wouldn´t have changed the temperature as during analysed events occured.

Hypothesis of tile drainage runoff generation by springs assumes that that the majority of precipitation flown off infiltrates in recharge area (where relatively high values of hydraulic conductivity are found). Rechargwe area is connected with springs by preferential flowpaths, mostly cracks (which are supposed here due to crystalline rocks substrate and partly proofed of hydro-geological exploration). The springs intercepted by systematic tile drainage cause fast culmination discharge (Figure 3).

The overall runoff is generated by all above described ways, but regarding to fast response of discharge and temperature at the beginning of the rainfall and very slow infiltration of precipitations in the discharge zone, the drainage runoff during discharge events consists only of small portion of water infiltrated directly in the tile drained area and the majority of water flown off infiltrates in recharge area, which is connected with tile drains by springs. Nevertheless the base flow is also increasing because of immediately rise of the groundwater table level. As the result, we can say that drainage water temperature is suitable tracer for identification and separation of the fast runoff component during runoff events.

Acknowledgement

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