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Evaluation of detailed water quality and quantity monitoring system in a small agricultural catchment – discrete vs. continuous approach

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To achieve the obligatory limits set up by the WFD (Water Frame Directive) in water bodies, there is an urgent need of attainments conc. water quality and quantity dynamics which can be gained only by a detailed monitoring. Continuous monitoring system of surface, subsurface and ground waters is one of the essential tools, enabling to thoroughly understand the processes of water quality dynamics in a catchment as well as to trace the sources and pathways of pollutants during various rainfall – runoff events.

In this paper, there are described results of concentrations and loads of N-NO_3, N-NH_4 and P_{tot}, realized by assessment and comparison of two different approaches – regular and intensive monitoring concepts. The analysis was carried out in five measuring points – in the catchment closing profile and in four subcatchments (three of them tile drained) of a small agricultural catchment during the year 2009. Monitored catchment is located on the Kopaninský stream, which is situated in the south – eastern part of the Švihov drinking water reservoir basin on the Želivka river, in the Bohemo-Moravian Highland in the Czech Republic. The experimental catchment occupies 7.1 km^2, dominating land use type is ploughland (50%), followed by forests (37%) and grasslands (12%). The catchment contains several measuring sites – profiles, equipped with V – notch type weirs and ultrasound probes connected to dataloggers for water level recording.

The regular (discrete) monitoring lied in a fortnightly accomplished manual withdrawal of a 0.5 l sample from the upper third share of actual water column in the case of surface water courses, or directly from the tile drainage outlet, and measuring the actual water level (discharge). Average monthly load L (kg*month^{-1}) was then calculated according to the following relationship:

$L = \left[\frac{c_i * Q_i + c_{i+1} * Q_{i+1}}{n} * 0.0864\right]$, where c_i is concentration of a substance at the time of sampling (mg*l^{-1}), $Q_i$is discharge (l*s^{-1}) at the sampling time, n is the number of withdrawals in a month and 0.0864 is the coefficient of time and units conversion.

The intensive (continuous) monitoring pattern consisted of water discharge measuring by ultrasonic probes with a 10 min. data record, from which were calculated daily average discharges. Water quality was evaluated on the basis of average daily composite samples (1l volume), comprised of ca. 0.150 ml water withdrawn every 4 hours. An automatic sampler (ISCO 6712) was used, with suction basket permanently placed in the lowermost part of the water column or at the bottom of a drainage outlet pipe. Moreover, single-shot samples (1l) were took out more frequently during the selected discharge waves. Sampling intervals were different with regard to individual monitored subcatchments - respecting the peculiar hydrograph shape, as well as to the cause of discharge rise – during spring thawing the sampling interval was in the order of hours, during summer storm events in tens of minutes.

Comparing the results from discrete and intensive sampling programmes, it was found out, that for all the three investigated solutes, the individual values of concentrations and also basic statistical indicators, were almost similar from both of the employed approaches along the whole year. However, when focused on results from the continuous monitoring programme during the rainfall – runoff events, we realized that the concentration rates differed from those from the regular programme significantly, because this approach missed the continuous discharge data as well as the information of concentration dynamics during the elevated water levels (we noticed even double difference). Taking into account the discharge volume, there is a difference between used monitoring approaches up to 17%

in the calculation of the total runoff volume and up to 23% in the calculation of the total load per the year 2009 (the results were over- or underestimated). These results were noted within the annual summary; in the individual months they were higher (even multiple). The differences might be caused not only by the used type of monitoring but also by the way and place of sampling (at the streambed bottom or close below the water level surface).

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