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Relevance of hydraulic shortcuts for the transport of plant protection products from arable land to surface waters

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Agricultural plant protection products (PPPs) can enter surface waters through various pathways and impair the water quality. In the past, numerous studies were conducted for certain entry paths such as surface runoff, direct drift into water bodies or preferential flow to drainage systems. Man-made hydraulic shortcuts (e.g. road storm drains collecting drift onto roads or manholes of tile drainage systems) might also play a major role for PPP inputs into surface waters. However, they have been largely overlooked in the past.

In this study we investigated the relevance of such shortcuts for the PPP transport from arable land to surface waters in Switzerland. 20 subcatchments were selected as study areas by performing a weighted random selection on a nation-wide hydrological catchment stratification dataset. The area of arable land within each subcatchment was used as weighting factor. The selected subcatchments are distributed throughout the whole Swiss midlands. On average they have an area of 3.5 square kilometres with a fraction of 44 % of arable land. In the agricultural areas of these subcatchments we mapped potential hydraulic shortcuts using different data sources: Field surveys, high resolution aerial images captured by a fixed-wing drone as well as plans of the road storm drains and the tile drainage systems. In addition to the location of the shortcuts also their properties (e.g. cover type, height above surface) were mapped.

We will present a quantification of the density of different shortcut types for each of the studied subcatchments. Preliminary analyses in three subcatchments resulted in an average shortcut density of 70 to 280 potential shortcuts per square kilometre of agricultural land. Between 33 and 51 % of these potential shortcuts have a cover allowing water to enter and can therefore effectively act as shortcuts. In addition, we will present the results of a connectivity analysis based on a digital elevation model. This includes a comparison of the areas directly connected to surface waters with the areas connected to hydraulic shortcuts. The ratio between these areas will provide an estimate on the relevance of hydraulic shortcuts for PPP transport.

In a next step we will create a model predicting the shortcut density in a catchment depending on auxiliary quantities (i.e. length of roads of a certain type, land use, slope, ...). Using these auxiliary quantities we plan to extrapolate the shortcut density to a nationwide scale.