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Comparison of different approaches to predict the spatial distributed of critical source areas to manage the water quality on the catchment scale

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Diffuse losses of agrochemicals from agricultural fields to surface water are in general limited to certain areas in a catchment prone to fast flow processes, also called critical source areas (CSA) or hydrologically sensitive areas (HSA). Effective mitigation strategies to reduce those losses rely on an accurate identification of those CSA/HSA. Different approaches to identify such areas are available. To compare them, we applied six approaches to the same small agricultural catchment in Switzerland, where spatial data on herbicide losses are available. The investigated approaches are a risk map integrated in the local soil map, an approach to delineate the Dominant Runoff Processes (DRP), an adaptation of the classification schema of HOST (Hydrology Of Soil Types), a regression model to predict the spatial distribution of the Fast Flow Index (FFI), the topographic wetness index (l) and the continuous physically-based water balance Soil Moisture Distribution and Routing model (SMDR). Despite their conceptual difference the spatial agreement in the prediction of risk classes is surprisingly high given the fact that not all approaches use the same input data. The risk map, DRP, HOST and FFI approaches are all based on the local soil map. In contrast, the l and the SMDR approaches are primarily based on the digital elevation model. This observation indicates that topography reflects important aspects of the soil distribution in this landscape. A comparison with observed spatial variability of herbicide losses revealed that all approaches fail to accurately predict the variability if the surface connectivity is not accurately considered.