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Vineyard weeds control practices impact on surface water transfers: using numerical tracer experiment coupled to a distributed hydrological model to manage agricultural practices spatial arrangements.

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In rural basins, agricultural landscape management highly influences water and pollutants transfers. Landuse, agricultural practices and their spatial arrangements are at issue. Hydrological model are widely used to explore impacts of anthropogenic influences on experimental catchments. But planning all spatial arrangements leads to a possible cases count which cannot be considered. On the basis of the recent « numerical experiment » approach, we propose a « numerical tracer function » which had to be coupled to a distributed rainfall-runoff model. This function simulate the transfer of a virtual tracer successively spread on each distributed unit inside the catchment. It allows to rank hydrological spatial units according to their hydrological contribution to the surface flows, particularly at the catchment outlet. It was used with the distributed model MHYDAS in an agricultural context. The case study concerns the experimental Roujan vine-growing catchment (1km^2, south of France) studied since 1992. In this Mediterranean context, we focus on the soil hydraulic conductivity distributed parameter because it highly depends on weed control practices (chemical weeding induces a lot more runoff than mechanical weeding). We checked model sensitivity analysis to soil hydraulic conductivity spatial arrangement on runoff coefficient, peak discharge and catchment lag-time. Results show (i) the use of the tracer function is more efficient than a random approach to improve sensitivity to spatial arrangements from point of view of simulated discharge range, (ii) the first factor explaining hydrological simulations variability was practices area ratio, (iii) variability induced by practices spatial arrangements was significant on runoff coefficient and peak discharge for balanced practices area ratio and on lag-time for low area ratio of chemical weeding practices. From the actual situation on the experimental Roujan catchment (40% of tilled and 60% of non tilled vineyard), we search, using the “numerical tracer function”, the spatial arrangements of weeding practices to reduce outlet water flows modifying a minimum of fields usage. In conclusion, the proposed numerical tracer function and the associated surface unit ranking procedure could be used to analyze and/or anticipate impacts of agricultural landscape structure on water fluxes.