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Kriging-based metamodeling with qualitative variables to design grassed buffer zones in small agricultural catchment

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In France, a significant presence of contaminants is found in surface water, partly due to pesticide applications. Vegetative filter strips or buffer zones (VFS) are a common best management practice to reduce non-point source pollution of water by reducing surface runoff. However, they need to be adapted to the agroecological and climatic conditions, both in terms of position and size, in order to be efficient. In this context, IRSTEA developed a guide accompanying the use of different tools, which allows designing site-specific VFS by simulating their efficiency to limit transfers using the mechanistic model VFSMOD. This method which is very complete assumes that the user provides detailed field knowledge and data, which are not always easily available. In order to fill in the lack of real data in many practical applications, a set of virtual scenarios was selected to encompass a large range of conditions, considering both the upslope agricultural field (slope, soil, humidity, etc.) and the VFS characteristics (water table depth, soil). The sizing method was applied on these scenarios and lead to abacus that are available through a user-friendly webtool. In this study however, instead of choosing specific scenarios to simulate, we applied some metamodeling methods to generate a response surface for each specific climatic region. These methods are based on an optimal sampling, and are able to answer to any other parameters combination that was not simulated, with an associated uncertainty. Several methods based on Gaussian process regression or GAM gave very good results comparing to the specific abacus, explaining more than 80% of the variance. The study focused particularly on how the Kriging approach is able to deal with qualitative variables (such as type of soil or type of climate). We compared several solutions to deal with qualitative variables in the kriging approach. These results will allow extending the sizing tool to other climatic situations at low cost. The tool is particularly useful to compare field scenarios, and to validate or improve actual existing placements and VFS sizing for catchment management.