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Sensitivity analysis with external stochastic forcings for robust calibration : application to a water and pesticide transfer model

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Environmental and hydrological models have become important decision-making tools. The PESHMELBA model [1] is a pesticide transfer model used to simulate and compare possible land-use planning scenarios in order to identify developments that reduce the impact of pesticides in surface waters.

When calibrating environmental models, one of the first steps is a sensitivity analysis [2]. However, this analysis can vary for different realizations of the external conditions (such as rainfall, evapotranspiration, or date of pesticide application) under which the model operates. Indeed, even the external conditions as an uncontrollable stochastic quantity means that the hydrological model itself becomes stochastic. Sobol indices can then be seen as random variables [3], where randomness is given by their dependence on rainfall.

In this study, we calculate the sensitivity indices on two examples: first, on soil hydrodynamic parameters on a vineyard plot in PESHMELBA under several realizations of the same type of rainfall, corresponding to events measured on the field. Second, on a omore complex situation considering the whole watershed and pesticides output variables. The stochasticity of that second case comes from the difference between the rainfall and the date of pesticide application, whicih is a key unknown in pesticide transfer simulations.

We show that the hierarchy of input parameters varies according to the forcings used. In particular, heavier rainfall mainly activates processes in the deep saturated horizon, involving parameters governing saturated soil properties (water content at saturation, for example), which is not the case for lighter rainfall, for which PESHMELBA is essentially influenced by unsaturated soil parameters.

The aim of this work is to take this dependency into account within the sensitivity analysis and to propose a global indice which is valid condidering the forcings uncertainties.

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