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Emulation and global sensitivity analysis for model calibration in groundwater hydrology

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We present some recent applications of the use of polynomial chaos expansion (PCE) for global sensitivity analysis (GSA) of model output and as an emulator for model calibration. GSA pinpoints the model parameters that can be subject to robust identification/calibration on the basis of available measurements of state variables and PCE provides the global sensitivity indices in a straightforward manner (Sudret, 2008). Besides, the PCE is an approximate of the original model and is associated with affordable CPU times and significant ac- curacy. One can then use a PCE-based reduced model in the inverse procedure instead of the original model. We show that, depending on the relationship between the input parameters and the output of inter- est (i.e. the observable variable that has been measured during some experiments), the methodology performs well or needs to be slightly adapted in order to obtain the calibrated parameters set.
In the first part of the presentation, we will first describe the link between PCE and GSA. Then, we will discuss the different sampling (i.e. non intrusive) methods to build a polynomial chaos and present some results for (a) non-reactive and reactive transport in fully sat- urated porous media (Fajraoui et al., 2010) and (b) a partially satu- rated flow scenario (Younes et al., 2010). Finally, we will show how the methodology can be implemented in the presence of heterogeneous distributions of hydraulic parameters (Fontaine et al., 2010) and how it could be extended for characterizing such a random field from avail- able experimental data.

References

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