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Are model crashes informative for our global sensitivity analysis?

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Global Sensitivity analysis (GSA) is an essential tool for providing a detailed understanding of the model behavior and subsequently, improving its predictions. Numerical implementation of GSA techniques is very computationally demanding as it requires thousands of model simulations using parameter sets sampled from a multi-dimensional parameter space. One of the main challenges often faced during this process, especially for complex models with many parameters, is crashing of model simulations. Crashes are mainly caused by “unrealistic” combination of parameter sets resulting in violation of the “physics” represented within the model. These crashes are extremely computationally costly during a GSA because they prevent completion of GSA and basically, waste the rest of (e.g., thousands) of other model runs already completed. The common practice between modellers to address this issue is generally reducing (perhaps several times) the ranges for parameter(s) responsible for the crashes in a hope to prevent them for the next GSA experiment.

In this study, we aim to investigate some innovative strategies to deal with model crashes during GSA that are more efficient as they don’t require re-running the entire GSA experiment again. We examine these strategies using a new variogram-based GSA technique, VARS, with a test function and a hydrological model. Furthermore, we discuss which strategy is more suitable depending on the sampling strategy and/or GSA method used.