3) Case Studies

1) Motivation

- LISFLOOD [1] is a fully-distributed hydrological model used for flood forecasting at Pan-European scale within the European Flood Awareness System (EFAS, www.efas.eu), and for Climate Change studies in Europe.
- Model parameters are estimated through calibration [2]-[3], in order to constrain simulated discharges to the corresponding observed values.
- So far, nine (9) parameters of the model have been selected as sensitive, mostly through expert knowledge accumulated over years in the research group. However, for highly non-linear models that approach may not result in a proper identification of the most sensitive parameters for model calibration.

2) Aims

- To use Global Sensitivity Analysis (GSA) as a formal method to identify relevant parameters that contribute significantly to model performance.
- To elucidate if the model performance obtained by calibrating sensitive parameters identified by GSA is higher than the model performance obtained by calibrating parameters identified by prior expert knowledge.

3) Case Studies

3.1) Motivation

- LISFLOOD is a fully-distributed hydrological model that is used for flood forecasting at the Pan-European scale.
- Model parameters are estimated through calibration, where nine (9) parameters have been selected as sensitive.
- The parameters selected are mostly through expert knowledge, and for highly non-linear models, this approach may not result in a proper identification of the most sensitive parameters for model calibration.

3.2) Aims

- To use Global Sensitivity Analysis (GSA) as a formal method to identify relevant parameters that contribute significantly to model performance.
- To elucidate if the model performance obtained by calibrating sensitive parameters identified by GSA is higher than the model performance obtained by calibrating parameters identified by prior expert knowledge.

4) Hydrological model

- The LISFLOOD model [1] has many parameters that may be calibrated.
- Based on prior expert knowledge on the research group, 26 parameters have been selected for sensitivity analysis. Remaining parameters were mostly GIS-related, so they were assumed to already have their best possible value.
- A single model run takes ~1 or 2 minutes to make computationally unfeasible to run a large number of model runs.
- Model outputs (daily time series) were transformed into a real value by using the Nash-Sutcliffe efficiency as a measure of model performance:

\[ r = 1 - \frac{\sum (O_i - M_i)^2}{\sum (O_i - \bar{O})^2} \]

where:
- \( O_i \) = observed values, [m³/s]
- \( M_i \) = simulated values, [m³/s]

5) Methodology

5.1) Parameters definition

- Parameters defined in the model, \( N = 26 \) (parameters, \( \bar{O} \) = mean, \( M \) = simulated values, [m³/s]

5.2) Sensing

- Sensing parameters defined in the model, \( N = 26 \) (parameters, \( \bar{O} \) = mean, \( M \) = simulated values, [m³/s]

5.3) Sensitivity analysis

- Sensitivity analysis is a formal method to identify relevant parameters that contribute significantly to model performance.

5.4) Global Optimisation

- Global Optimisation is a formal method to identify relevant parameters that contribute significantly to model performance.

5.5) Results

- Results are shown for the two case studies using the LISFLOOD model.

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