Study project/master's thesis @HFM:
Investigating model parameter interdependence during and post calibration

Problem description and steps

A model is a set of equations that links inputs to outputs via some parameters. Regardless if a model is empirical, conceptual or physically-based, all or a subset of parameters need to be calibrated due to problems such as error in input data or model conceptualization to name a couple.

It turns out that some model parameters may produce the same results with different sets of parameters i.e., they are interdependent and may compensate for each other in an unknown manner. The exact way in which they compensate for each other is difficult to determine in cases where more than 2 parameters are used as they may have a high dimensional dependence that is difficult to detect/visualize/evaluate.

The interdependence of parameters leads to wastage of time and computational power as many combinations need not be evaluated. This study aims to find a way to avoid sampling parameters in the high dimensional space where it is meaningless. This could be done by monitoring the model parameters and their resulting performance on the fly during calibration, recognizing if model parameters are dependent. If some are accepted to have dependence then dynamic constraints are enabled for those parameters that should limit the range from which the samples are taken and consequently the number of iterations required to converge.

There is another important aspect to this problem. Whether model parameters are dependent can be a result of the objective function used during calibration. Generally, simpler objective functions result in more of interdependence problems as compared to sophisticated ones. This aspect needs to be investigated as well as the choice of the objective function is arbitrary. Model interdependence is a relatively uninvestigated research area. The results of this work are likely to be original and helpful to people who deal with models on a regular basis.

Requirements

The student is expected to have some background in rainfall-runoff modeling, statistics, operations research and programming in python as everything mentioned above is coded in it. The required background could be acquired before and/or during the study.

Contact

Interested students may write to me **(faizan.anwar@tum.de)** for further discussion. The work load can be adjusted depending on the student if they want to pursue a study project or a master's thesis.