Principles of Hydrologic Modeling

Make sure you have read the "exercise_calibration_preparation.pdf" before getting started here.

*In this first exercise you will learn how to run a calibration of a **simple hydrologic model** with **6 parameters** that need to be calibrated. The objective function is to maximize the Nash-Sutcliffe efficiency. We will use the **OSTRICH toolbox** for calibration and the **hydrologic framework RAVEN** as our hydrologic model. The calibration algorithm will be the **Dynamically Dimensioned Search (DDS)**.*

Task 1: Getting started

We will first make sure that all the settings are correct!

1. Go to the exercise folder `Demo_C1`.
2. Depending on your operating system (Windows, Linux, or MacOS), you might have to make a few adjustments:
   a. Identify the OSTRICH executable in the main folder `Demo_C1` matching your operating system. Write it down:

      Ostrich_____.exe
   b. Identify in the subfolder `model` the name of the Raven executable matching your operating system. Write it down:

      Raven_____.exe
   c. Go back to the main folder and open the file Ost-RAVEN.bat (Windows) or Ost-RAVEN.sh (Linux, MacOS) with a text editor. Make sure that the correct name of the Raven executable is used here. It needs to be the one you wrote down under 2b.
   d. You will find two files named `ostIn_Windows.txt` and `ostIn_Unix.txt` in the main folder. Take the one matching your operating system, copy it and save it under the new name `ostIn.txt`. The two files are basically the same, only some "/" and "\" conversions are necessary between the Unix (=Linux or MacOS) and Windows systems.

Task 2: Run Raven only

We will only run Raven- no calibration yet. This is to make sure that Raven is running without any problem.

3. Go to the `model` subfolder.
4. Make sure that you find a subfolder `output` there. If not, please create this folder. It will later contain all Raven specific output files such as discharge time series etc.
5. Execute the Raven executable matching your system (see 2b. above). This is done by opening a terminal/ command line.
   Under Windows:
   > Open Command Prompt, navigate to the model subfolder, type and execute (use the right executable name):
   > `Raven_____.exe Irondequoit -o output\`
   Under Linux/ MacOS:
   > Open terminal, type and execute (use the right executable name):
   > `./Raven_____.exe Irondequoit -o output/`
6. The simulation should finish with
   > `Exiting Gracefully: Successful Simulation`
   Model results can be found in the `output` subfolder.

Task 3: Calibration

We will now start a calibration of the model we have just run with one parameter set in Task 2.

7. Go to the main folder `Demo_C1`.
8. Execute the Ostrich executable matching you operating system (see 2a. above) by running the following command in the terminal/ command line:
   Under Windows:

   `Ostrich_____.exe`

   Under Linux/ MacOS:

   `./Ostrich_____.exe`
9. The calibration starts and will finish with some `Algorithm Metrics`.
10. The OSTRICH results and information will be stored in the main folder in several files.
    Browse all of them and write down what they contain:
    a. OstDDSPn.txt   _____

    b. OstErrors0.txt   _____

    c. OstModel0.txt   _____

    d. OstOutput0.txt   _____

    e. OstStatus0.txt   _____

11. We calibrated NSE as you can see in the `BeginResponseVars` and `BeginTiedRespVars` block in the ostIn.txt file.
    How many iterations were used?
    a. # iterations: _____
    What is the final (best) calibration result?
    b. final NSE: _____
12. Your neighbor probably got exactly the same result although DDS takes a random path. This is because we all used the same `RandomSeed` (see ostIn.txt). Change the `RandomSeed` to a random number (e.g., your date of birth). What are the results now?
    a. # iterations: _____
    What is the final (best) calibration result?
    b. final NSE: _____
13. Repeat the calibration with increasing budgets. Let's see who gets the best NSE value!
    And let's track the time the calibrations need to see how different machines perform!

Budget	Nash-Sutcliffe efficiency NSE			Budget	Run time [s]		
	Trial #1	Trial #2	Trial #3		Trial #1	Trial #2	Trial #3
50				50			
200				200			
500				500			

Good luck!