

Make sure you have read the “*exercise\_calibration\_preparation.pdf*” before getting started here.

This exercise is the **parallel version of exercise C<sub>1</sub>**. It is the calibration of a **simple hydrologic model with 6 parameters** with its objective to maximize the Nash-Sutcliffe efficiency. We will again use the **OSTRICH toolbox** and the **hydrologic framework RAVEN**. The calibration algorithm will be the parallel version of **Dynamically Dimensioned Search (Parallel-DDS)**.

## Task 1: Getting started

We will first make sure that all the settings are correct! This is similar steps as in exercise C<sub>1</sub>.

1. Go to the exercise folder Demo\_C3.
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\_C3 matching your operating system. This time we will need an OSTRICH executable that was compiled/built with MPI to allow for the usage of multiple cores in parallel. It is hence another OSTRICH executable than used for exercises C<sub>1</sub> and C<sub>2</sub>. Write it down:  
  
Ostrich\_\_\_\_\_ .exe (name needs to contain something like MPI)  
In case you need to compile OSTRICH yourself under Windows, you can find some helpful hints in Demo\_C3/README\_Install\_MPI\_under\_Windows.
  - 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.

Keep in mind that the WHOLE setup is exactly the same as in C<sub>1</sub>. We are only using the parallel version of OSTRICH.

7. Go to the main folder Demo\_C3.
8. Execute the Ostrich executable matching your operating system (see 2a. above) on TWO cores by running the following command in the terminal/ command line:  
Under Windows:  
`mpiexec -n 2 Ostrich_____ .exe`  
Under Linux/ MacOS:  
`mpirun -np 2 Ostrich_____ .exe`
9. The calibration starts and will finish with some Algorithm Metrics. There need to be TWO subfolders created during the run: Demo\_C3/processor\_0 and Demo\_C3/processor\_1. This is a good test to see if OSTRICH was running on multiple cores.
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. dds\_status.out \_\_\_\_\_
  - b. OstDDSPn.txt \_\_\_\_\_
  - c. OstErrors[0,1].txt \_\_\_\_\_
  - d. OstModel[0,1].txt \_\_\_\_\_
  - e. OstOutput[0,1].txt \_\_\_\_\_
  - f. 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. How much faster is the parallel version compared to the sequential version we've used in exercise C<sub>1</sub>? You can compare with the tables under task 13 of exercise C1. Can you observe any trend in the optimal NSE values?

Budget	Nash-Sutcliffe efficiency NSE		
	Trial #1	Trial #2	Trial #3
<b>50</b>			
<b>200</b>			
<b>500</b>			

Budget	Run time [s]		
	Trial #1	Trial #2	Trial #3
<b>50</b>			
<b>200</b>			
<b>500</b>			

Good luck!