

# Session 2: SWAT simulation, calibration, and sensitivity analysis in R

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The goal of this second session is that you get familiar with the `SWATplusR` package. After the package installation we will load a demo SWAT project and explore the functionality of the `SWATplusR` package. The essential part of this session will be to learn how to utilize the package functionality and combine it with other R packages. In a small case study we will execute the SWAT model with different model parametrizations, extract simulation results, evaluate and visualize the simulation results (using the packages `HydroGOF` and the `tidyverse`), perform a parameter sensitivity analysis (employing packages such as `sensitivity` or `fast`), and perform a first model calibration.

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## Package installation

### *Package dependencies*

Below you find a list of packages that are required to install SWATplusR. Among these packages you find tools that can be useful in your daily routine when analyzing data in R (e.g. most of the packages included in the tidyverse). Please install all the packages by executing the following lines of code.

```
install.packages(c("doSNOW", "foreach", "RSQLite", "tidyverse"))
```

### *SWATplusR*

You can install the SWATplusR package from my *github* repository (set to public for the course). To install from repositories with ease you can use the package devtools

```
install.packages("devtools")  
  
# use the function install_github from the devtools package to install  
devtools::install_github("chrisschuerz/SWATplusR")
```

### *Additional packages*

To perform our analyses we require further functionality provided by other R packages. Here I provide a list of packages you have to install. I briefly outline what each of these packages does for you.

#### *lhs*

This package provides different methods to draw Latin Hypercube Samples. We will sample the SWAT model parameters in the calibration example using latin hypercube sampling.

```
install.packages("lhs")
```

#### *hydroGOF*

This package provides a comprehensive library of objective criteria used in hydrology (e.g. NSE, KGE, pbias, etc.) to evaluate time series of simulated discharge etc.

```
install.packages("hydroGOF")
```

#### *sensitivity*

sensitivity provides a large variety of methods to perform Global Sensitivity Analysis (GSA, e.g. Sobol or Delsa).

```
install.packages("sensitivity")
```

*fast*

The Fourier Amplitude Sensitivity Test (FAST) is a method to perform GSA with few model evaluations. This package implements this method in R.

```
install.packages("fast")
```

## Loading the SWAT demo project

The SWATplusR package provides very simple model setups of a head watershed of the Little River Experimental Watershed (LREW). Model setups can be retrieved for SWAT2012 and for SWAT+. The goal is to provide the demos for all operating systems in the future. At the moment the SWAT2012 demo is available for Windows and Linux and the SWAT+ demo is only available for Windows. For this workshop this means that you can work with SWAT+ if you use Windows as your operating system. Linux users have to work with SWAT2012 at the moment. The provided functionality is however very similar for both models.

```
# The path where the SWAT demo project will be written
demo_path <- "replace:/with/your/path"
# The SWAT version you want to use
swat_version <- "SWATplus" #or "SWAT2012" on Linux
# The function writes the demo folder to the defined path and returns the final
# path of the project folder in R
project_path <- load_demo(type = swat_version, path = demo_path)
```