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 evaulations. This package impelements 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 retrievew 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)
```