SWAT+ input data preparation in a scripted workflow - **SWATprepR**

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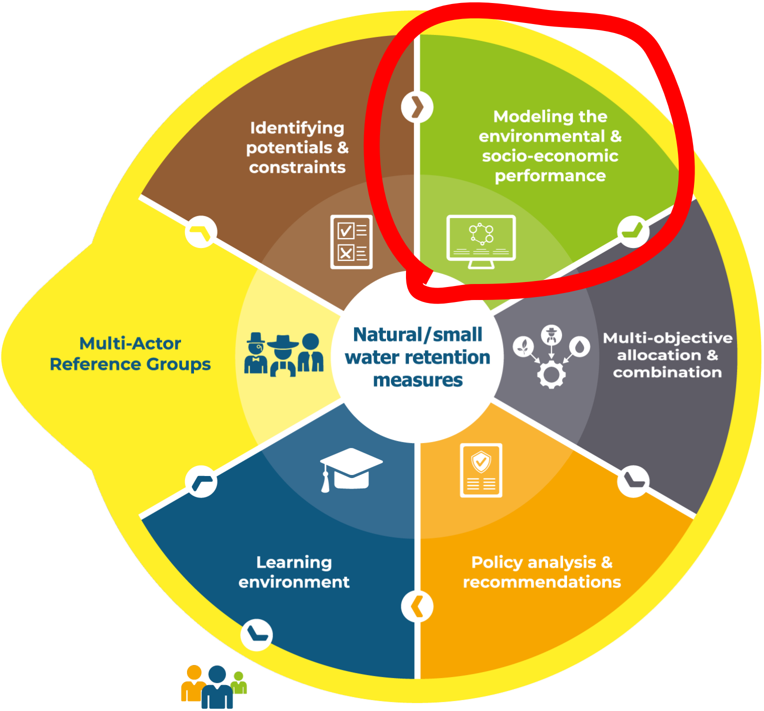
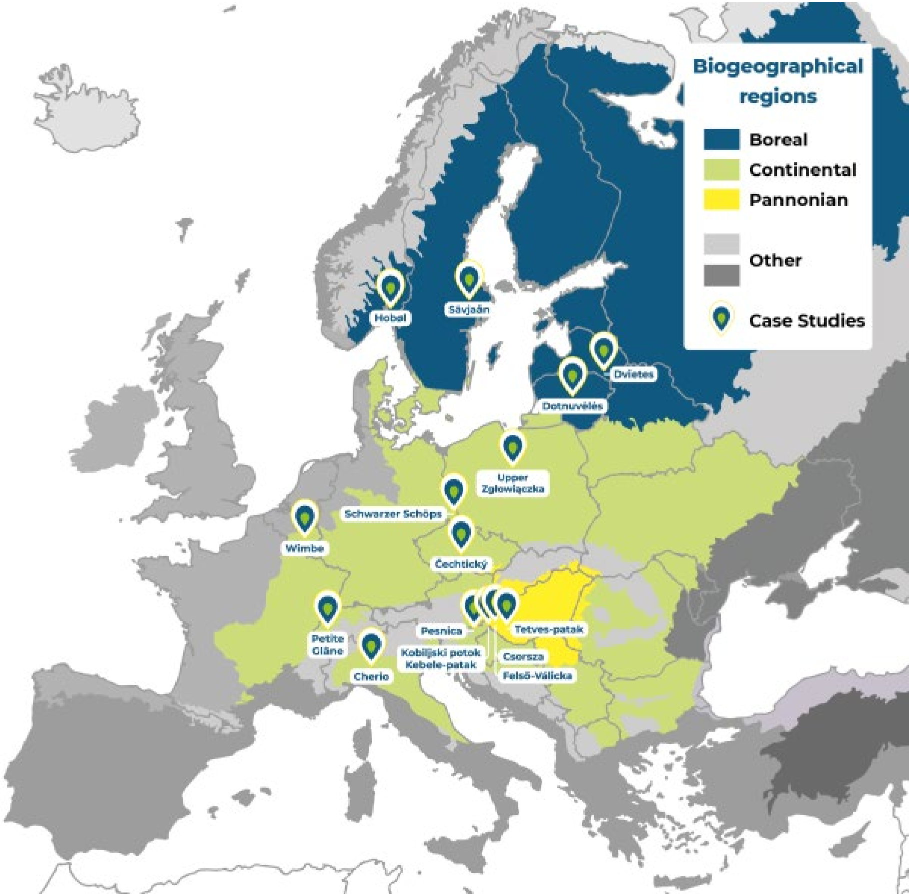
OPTAIN



Identifying potentials & constraints
Modeling the environmental & socio-economic performance
Multi-Actor Reference Groups
Natural/small water retention measures
Multi-objective allocation & combination
Learning environment
Policy analysis & recommendations



Biogeographical regions
🟦 Boreal
🟩 Continental
🟨 Pannonian
Other
Case Studies
Hobøl
Sävjaån
Dvietes
Dotnuvėlės
Upper Zgłowiączka
Schwarzer Schöps
Wimbe
Čechtický
Petite Glâne
Cherio
Pesnica
Kobiljski potok
Kebele-patak
Tetves-patak
Csorsza
Felső-Válicka

Workflow in R

Dr. GuRu

SWATprepR

SWAT+ input data preparation

SWATbuildR

An object connectivity
based SWAT+ model builder

SWATfarmR

Simple rule based management
operation scheduling

SWATdoctR

Model diagnostics tool
for SWAT+ model setups

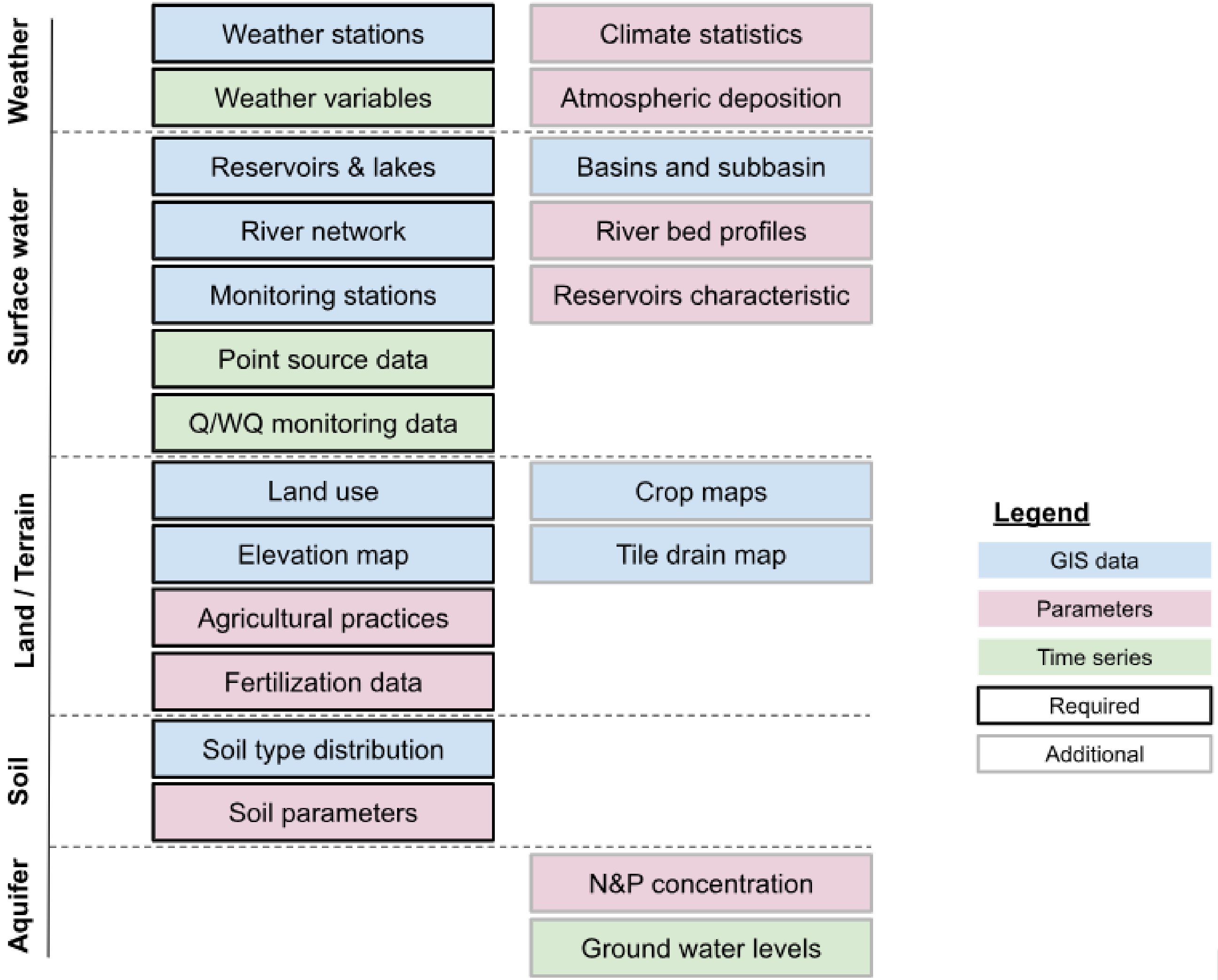
~~SWATplusR~~

SWATrunR

Running SWAT simulations in R

Vision: SWAT+ modelling process fully scriptable in R

SWAT/SWAT+ input data



Weather	Weather stations	Climate statistics
	Weather variables	Atmospheric deposition
Surface water	Reservoirs & lakes	Basins and subbasin
	River network	River bed profiles
	Monitoring stations	Reservoirs characteristic
	Point source data	
	Q/WQ monitoring data	
Land / Terrain	Land use	Crop maps
	Elevation map	Tile drain map
	Agricultural practices	
	Fertilization data	
Soil	Soil type distribution	
	Soil parameters	
Aquifer		N&P concentration
		Ground water levels

Legend

GIS data

Parameters

Time series

Required

Additional

Problems

- Accessing data
- Data quality questions
- Questions with preparing parameters from available information
- *Mucho* manual work & steps, prone to errors
- Dealing with file formats and file formatting
- Extracting relevant data, parts
- Repeatability of preparation operations
- Updating with new/additional data
- Multiple tools

Das ist solution

- **SWATprepR** package in R
  - Loading data in R from templates or directly internet
  - Plotting in multiple ways and data cleaning
  - Calculating SWAT+ model input parameters/data
  - Preparing model SWAT+ model input files

Current version includes functions

- Soil parameters preparation
- Weather
  - Time series
  - Weather generator
  - Climate projections
- Atmospheric deposition
- Crop rotation preparation
- Calibration data assessment, cleaning
- ….

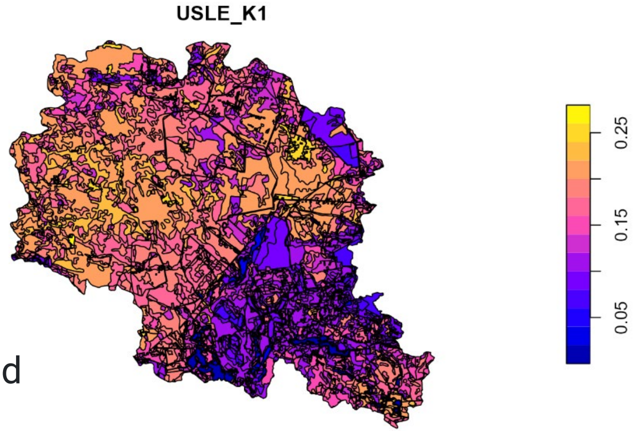
Examples

Soil parameters

- If you have
    - *NLAYERS* value for soil type representing number of soil layers;
    - For each layer in soil type profile:
        - *SOL_Z* value for soil layer to represent max depth of soil layer;
        - *SAND* sand content in %;
        - *SILT* silt content in %;
        - *CLAY* clay content in %;
        - *SOL_CBN* organic carbon content in %.
- Apply single function `get_usersoil_table`

and *voilà*…

Missing SOL_BD, SOL_AWC, SOL_K, USLE_K, SOL_ALB will be computed from above available layer data with European data-based algorithms



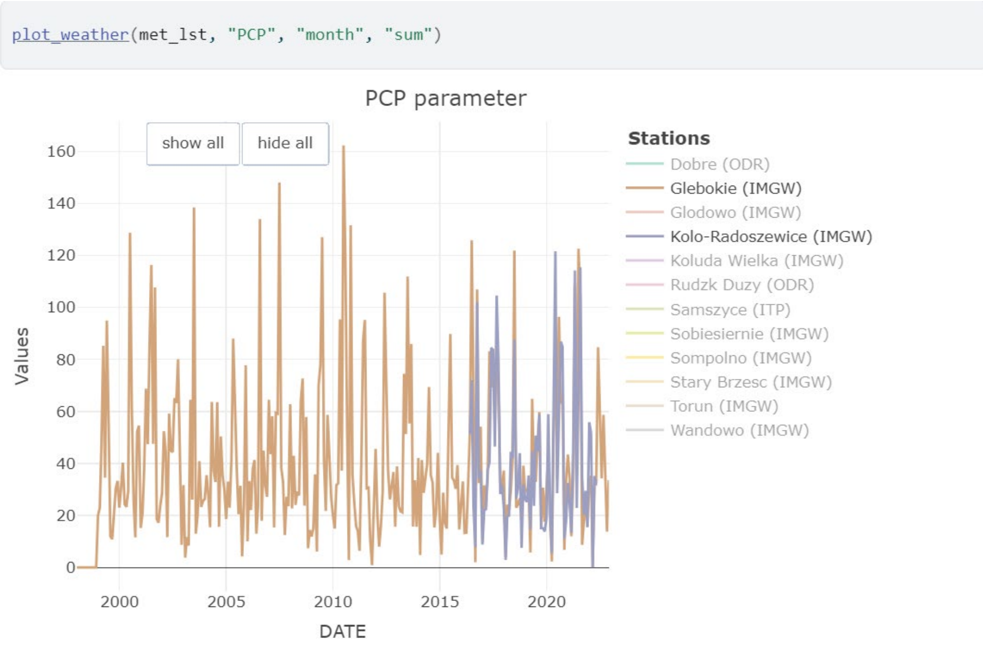
Weather data - time series

- Load with simple excel template

  `load_template`

- Plot in interactive figures with various temporal aggregation

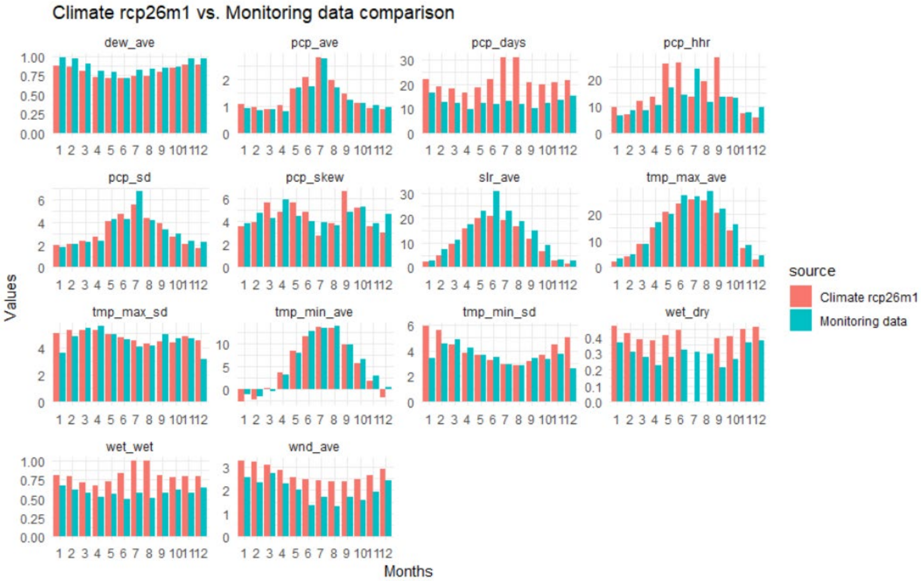
  `plot_weather`



```
plot_weather(met_lst, "PCP", "month", "sum")
```

Weather data - weather generator

- Prepare weather generator parameters `prepare_wgn`
- Compare with other dataset statistical parameters `plot_wgn_comparison`

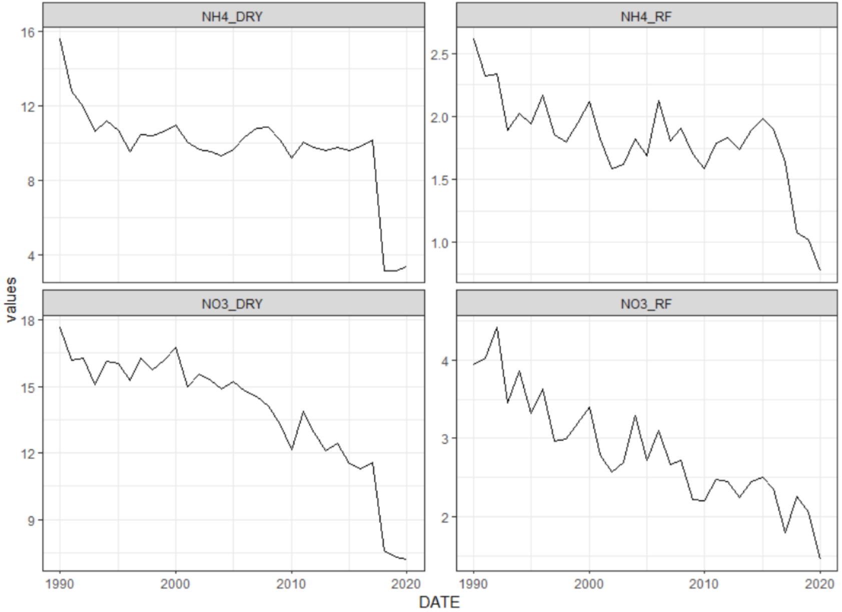


Weather data - model input & climate data

- Write weather related SWAT+ input into .sqlite database `add_weather`
- Update/write SWAT+ text files `prepare_climate`
- Load from NetCDF files `load_climate_lst`
- Load from SWAT+ input text files `load_swat_weather`

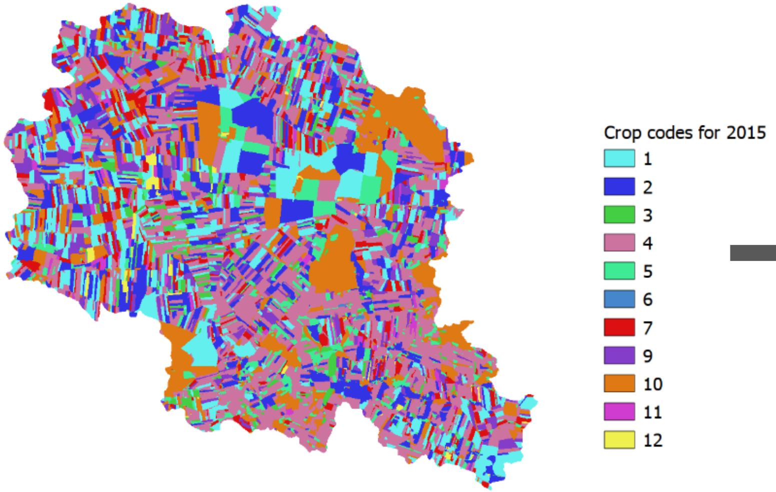
Atmospheric deposition

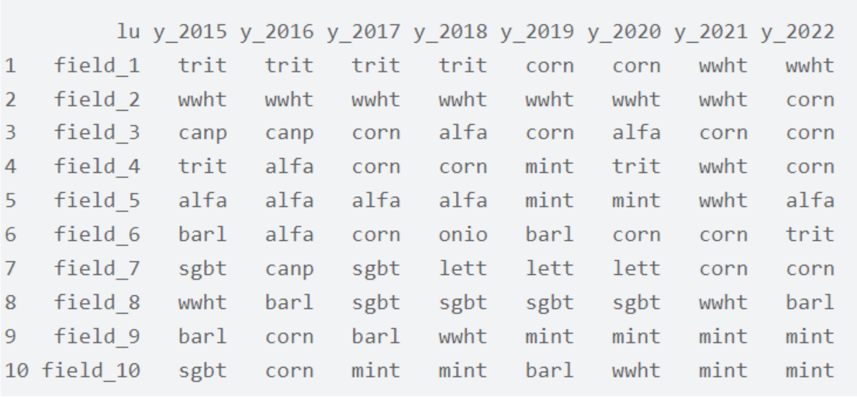
- Download atmospheric deposition data directly from EMEP server `get_atmo_dep` (only basin shape file required)
- Add into SWAT+ .sqlite database and prepare .cli file `add_atmo_dep`



Crop rotations

- Description of workflow for using remote sensing Sentinel 1 satellite radar images with provided script in Google Earth Engine platform to generate crop data raster for each year
- Postprocessing with `extract_rotation`

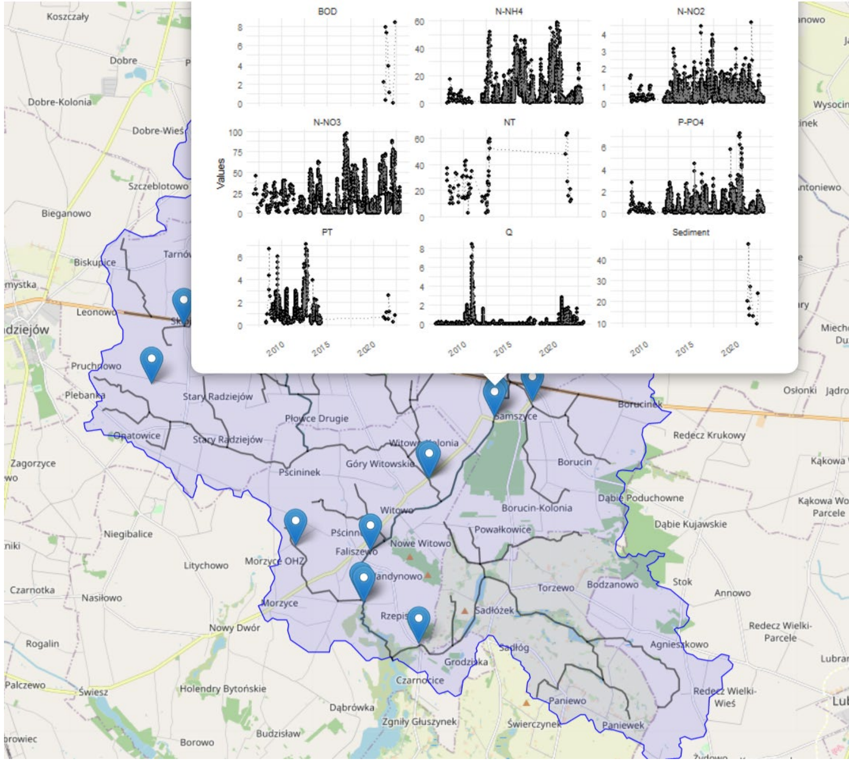


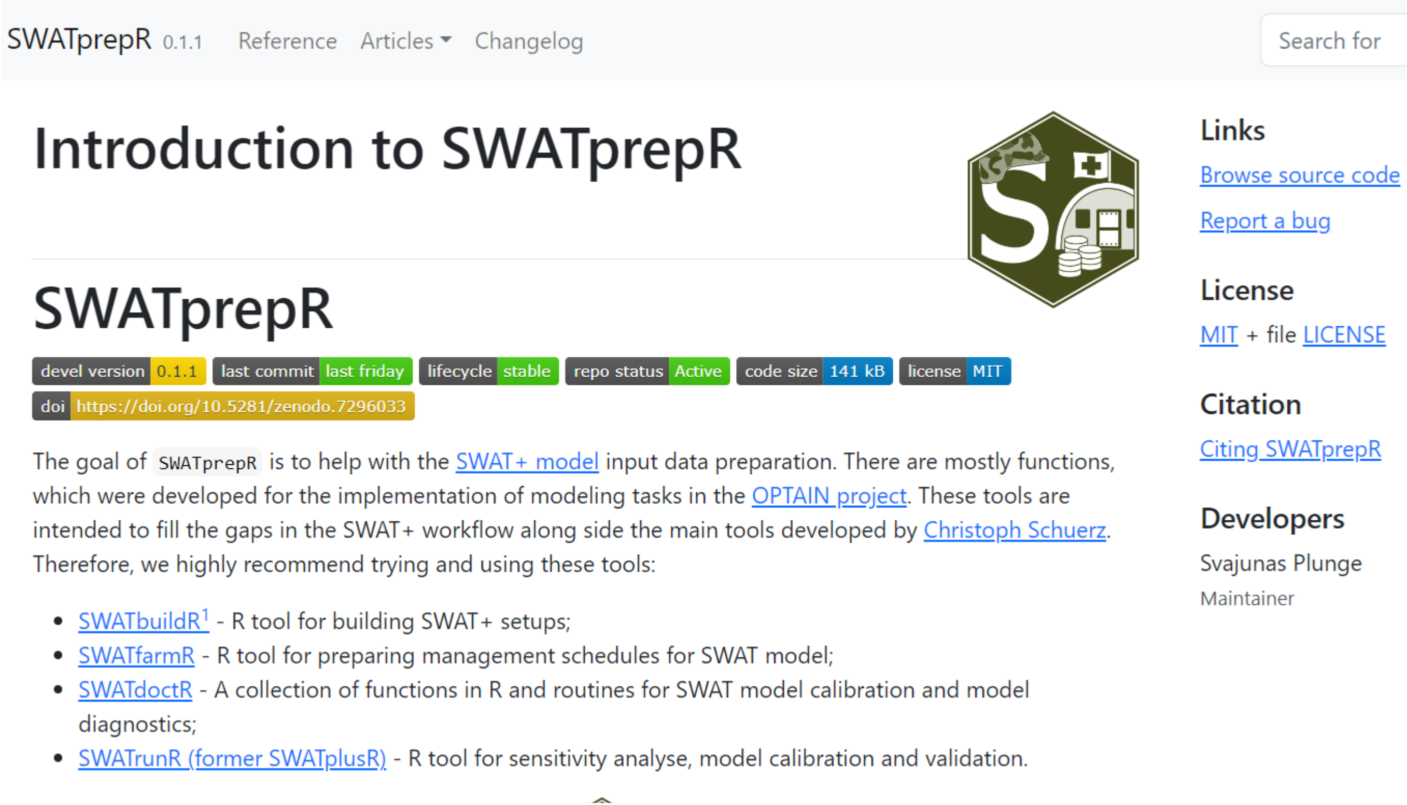


```
         lu y_2015 y_2016 y_2017 y_2018 y_2019 y_2020 y_2021 y_2022
1   field_1   trit   trit   trit   trit   corn   corn   wwht   wwht
2   field_2   wwht   wwht   wwht   wwht   wwht   wwht   wwht   corn
3   field_3   canp   canp   corn   alfa   corn   alfa   corn   corn
4   field_4   trit   alfa   corn   corn   mint   trit   wwht   corn
5   field_5   alfa   alfa   alfa   alfa   mint   mint   wwht   alfa
6   field_6   barl   alfa   corn   onio   barl   corn   corn   trit
7   field_7   sgbt   canp   sgbt   lett   lett   lett   corn   corn
8   field_8   wwht   barl   sgbt   sgbt   sgbt   sgbt   wwht   barl
9   field_9   barl   corn   barl   wwht   mint   mint   mint   mint
10 field_10   sgbt   corn   mint   mint   barl   wwht   mint   mint
```

Calibration data

- Loading from excel template `load_template`
- Plotting interactive figures in:
  - Time series `plot_cal_data`
  - Monthly average `plot_monthly`
  - Fractions of nutrients `plot_fractions`
  - Interactive map `plot_map`
- Cleaning
  - Common wq issues `clean_wq`
  - Outliers `clean_outliers`





Introduction to SWATprepR

SWATprepR

The goal of `SWATprepR` is to help with the SWAT+ model input data preparation. There are mostly functions, which were developed for the implementation of modeling tasks in the OPTAIN project. These tools are intended to fill the gaps in the SWAT+ workflow along side the main tools developed by Christoph Schuerz. Therefore, we highly recommend trying and using these tools:

- SWATbuildR[1] - R tool for building SWAT+ setups;
- SWATfarmR - R tool for preparing management schedules for SWAT model;
- SWATdoctR - A collection of functions in R and routines for SWAT model calibration and model diagnostics;
- SWATrunR (former SWATplusR) - R tool for sensitivity analyse, model calibration and validation.

Links

Browse source code

Report a bug

License

MIT + file LICENSE

Citation

Citing SWATprepR

Developers

Svajunas Plunge

Maintainer

https://biopsichas.github.io/SWATprepR/

Take-home points

- Scripting input data preparation is important
  - Reproducibility
  - Automatization
  - Documentation
  - Easy update
- Packages allows easy sharing, maintenance
- Documentation of packages crucial
- Scripted workflows + SWAT+

Invite you

- Test
- Comment
- Contribute

Contact: svajunas_plunge@sggw.edu.pl

Read: https://biopsichas.github.io/SWATprepR/