AG-WaMED

Soil and Water Assessment Tool (SWAT) for sustainable water management in the Mediterranean Area

SWAT masterclass – 20/11/2023

PRIMA PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

Funded by the European Union

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Session 1: Setting up the SWAT+ Model

Outline:

1. Introduction to SWAT
2. Interfaces used
3. Input data description
4. Set up the model (Robit exercise)

Introduction

- The Soil and Water Assessment Tool (SWAT) was **introduced** in the early 1990s after the combination of previously developed USDA-ARS models (Arnold et al., 2012).
- **Several applications**: hydrological, water pollution, erosion, climate change, and crop yield simulations.
- Used **everywhere**: over 4300 SWAT-related publications (CARD, 2020), including 260 papers in the Mediterranean (Aloui et al., 2023).
- Applied at **different scales**, from field to continental.
- **Large community of users** that produces many useful tools and facilitate SWAT applications.

SWAT characteristics

- SWAT is an **integrated continuous-time**, **semi-distributed**, **process-based** river basin model that operates on a **daily** time step.
- **Water balance** is the driving force of the model, and the watershed hydrology is represented by the land and routing phases (Neitsch et al., 2011).
- SWAT is **computationally efficient**, but at the same time, it maintains a good level of discretization of the watershed.
- Many processes are simplified and broadly represented (e.g. groundwater).

SWAT+

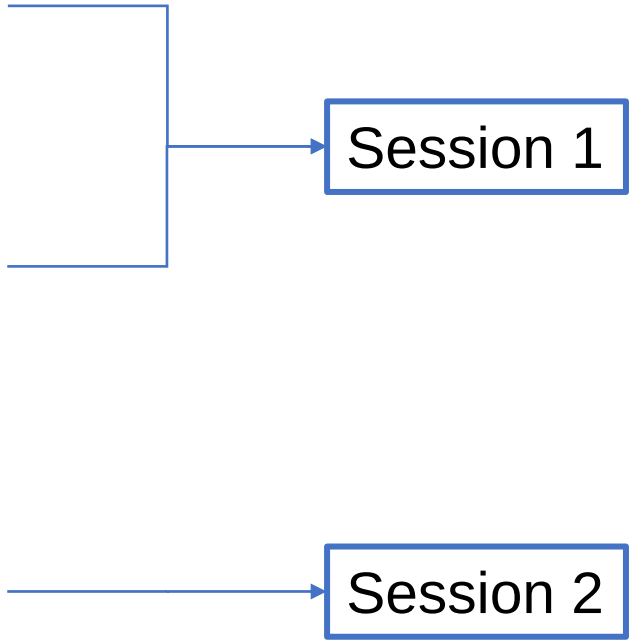
- Revised version expected to improve the code maintenance and provide a better representation of the spatial units after the introduction of **landscape units** (Bieger et al., 2017).
- **Decision tables** to represent complex land management and reservoir operations based on simple rules (Arnold et al., 2018).

Spatial units in SWAT+ (from Dile et al., 2023)

- The watershed is composed of multiple **subbasins** (areas draining into a stream reach)
- **Stream reaches** are sections of the stream network between significant points
- **Channels** are finer divisions and allow us to place more precisely watershed components such as landscape units, reservoirs and hydrological response units
- A **landscape unit (LSU)** is the region draining into a channel reach, further divided into the floodplain and upslope regions.
- **Regions** are formed by single LSUs.
- A **Hydrological Response Unit (HRU)** is the collection of pixels within an LSU that share the same land use, soil and slope range.

Interfaces used

1. QSWAT+: a QGIS interface for setting up the watershed.
   version 2.4.7
2. SWAT+ Editor: a user interface for modifying SWAT+ inputs and running the model.
   version 2.3.3
3. SWAT+ Toolbox: a user interface for performing sensitivity analyses, calibration and more.
   version 1.0.5



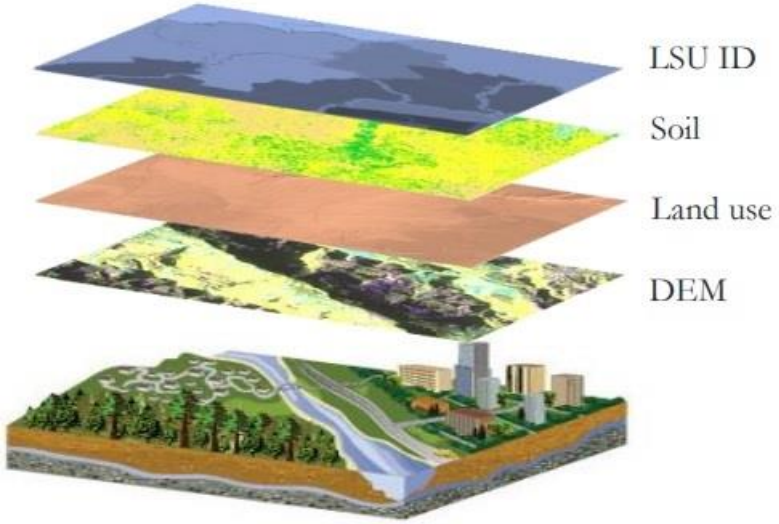
Input data description

- DEM
- Streams (optional)
- Main outlet
- Land use
- Soil map
- Climate

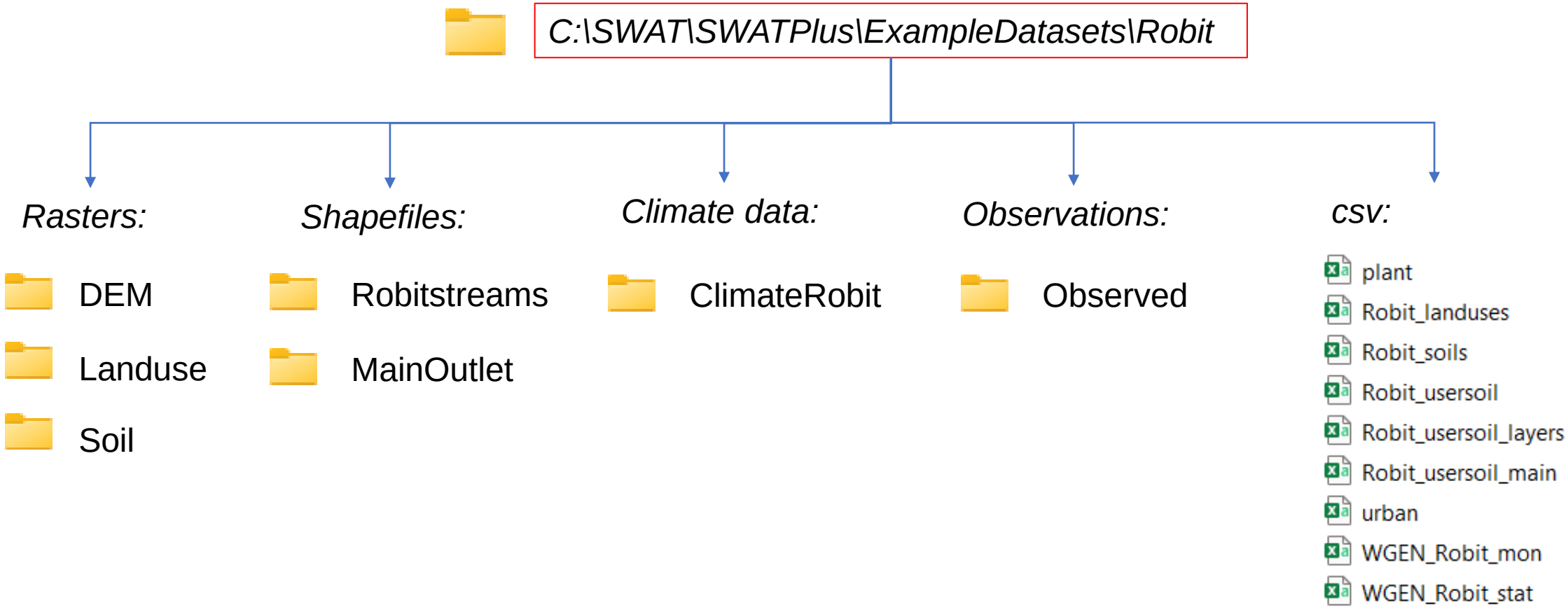
Session 1

- Observations (for calibration and validation)

Session 2



Input data directory



DEM, land use, soil, weather, warm up ..

- All the maps must have the same projections (equal area projection, UTM).
- **Lookup tables** (.csv) to convert from the numeric values to SWAT+ landuse codes and soil names respectively.
- **Usersoil** (.csv) to define soil properties.
- A **weather generator** to fill missing data using monthly statistics (SWAT+ creates one based on CFSR, but the user can also prepare it).

Set up the model (Robit exercise)

C:\SWAT\SWATPlus\Documents

QSWATPlus Manual v2.4

References

- Aloui, S., Mazzoni, A., Elomri, A., Aouissi, J., Boufekane, A., Zghibi, A., 2023. A review of Soil and Water Assessment Tool (SWAT) studies of Mediterranean catchments: Applications, feasibility, and future directions. Journal of Environmental Management 326, 116799.
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- CARD, 2019. SWAT Literature Database for Peer-Reviewed Journal Articles.
- Dile, Y., Srinivasan, R., George, C., 2023. QGIS Interface for SWAT+: QSWAT+ Step by Step Setup for the Robit Watershed. Lake Tana basin Ethiopia, Version 2.4.
- Neitsch, S. L., Arnold, J. G., Kiniry, J. R., & Williams, J. R., 2011. Soil and water assessment tool theoretical documentation version 2009. Texas Water Resources Institute.

Useful links

- https://swat.tamu.edu/software/plus/
- https://celray.github.io/docs/swatplus-toolbox/v1.0/index.html
- https://www.wateritech.com/data

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