Easy to Use Workflows for
Catchment Hydrological Modelling

Towards Reproducible Catchment Modelling Studies

Celray James CHAWANDA
C. George, W. Thiery, A. van Griensven

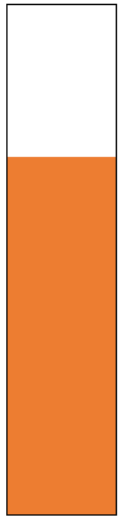
Reproducible research is the foundation
on which scientific progress is built

Preview

- Reproducibility of catchment hydrological modelling studies
- Improving reproducibility by using automated workflows
- How can catchment hydrology modelling community benefit?

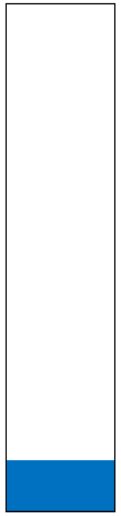
Large proportion of scientific research is not reproducible

> 70% failed to reproduce other scientists' work



Baker (2016)

Only 11% was reproduced successfully by peers



Begley (2012)

There is lack of transparency
in reporting scientific research

Tools/Code/Data unavailable

Balancing level of detail

Fraud

Overview

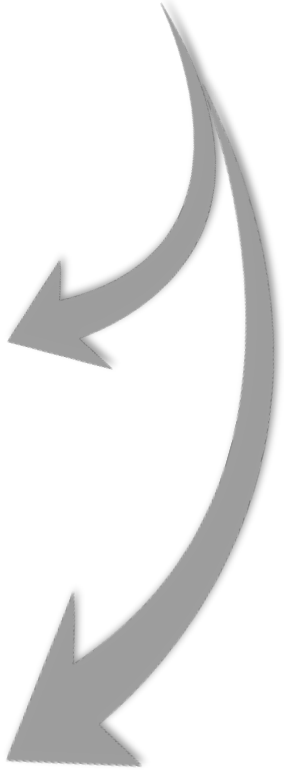
- Reproducibility of catchment hydrological modelling studies
- Improving reproducibility by using automated workflows
- How can catchment hydrology modelling community benefit?

Overview

- Reproducibility of catchment hydrological modelling studies
- Improving reproducibility by using automated workflows
- How can catchment hydrology modelling community benefit?

Using automated workflows addresses

lack of transparency in catchment modelling



Detailing model configuration

settings file

Making data available

data tied to the program

We created an automated workflow for the SWAT model

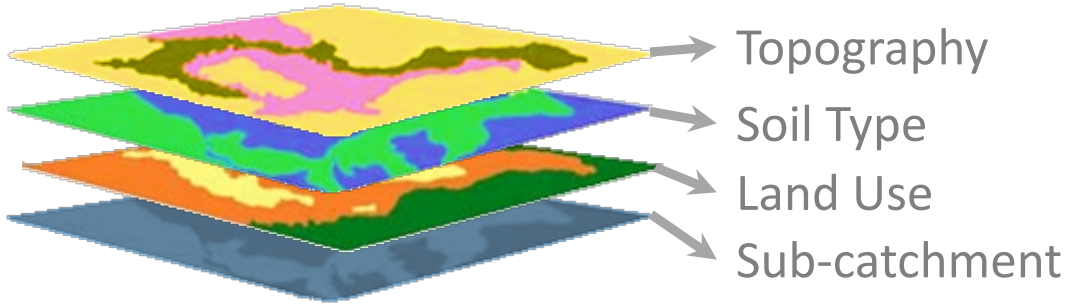
How is the model set up?

How does the new workflow work?

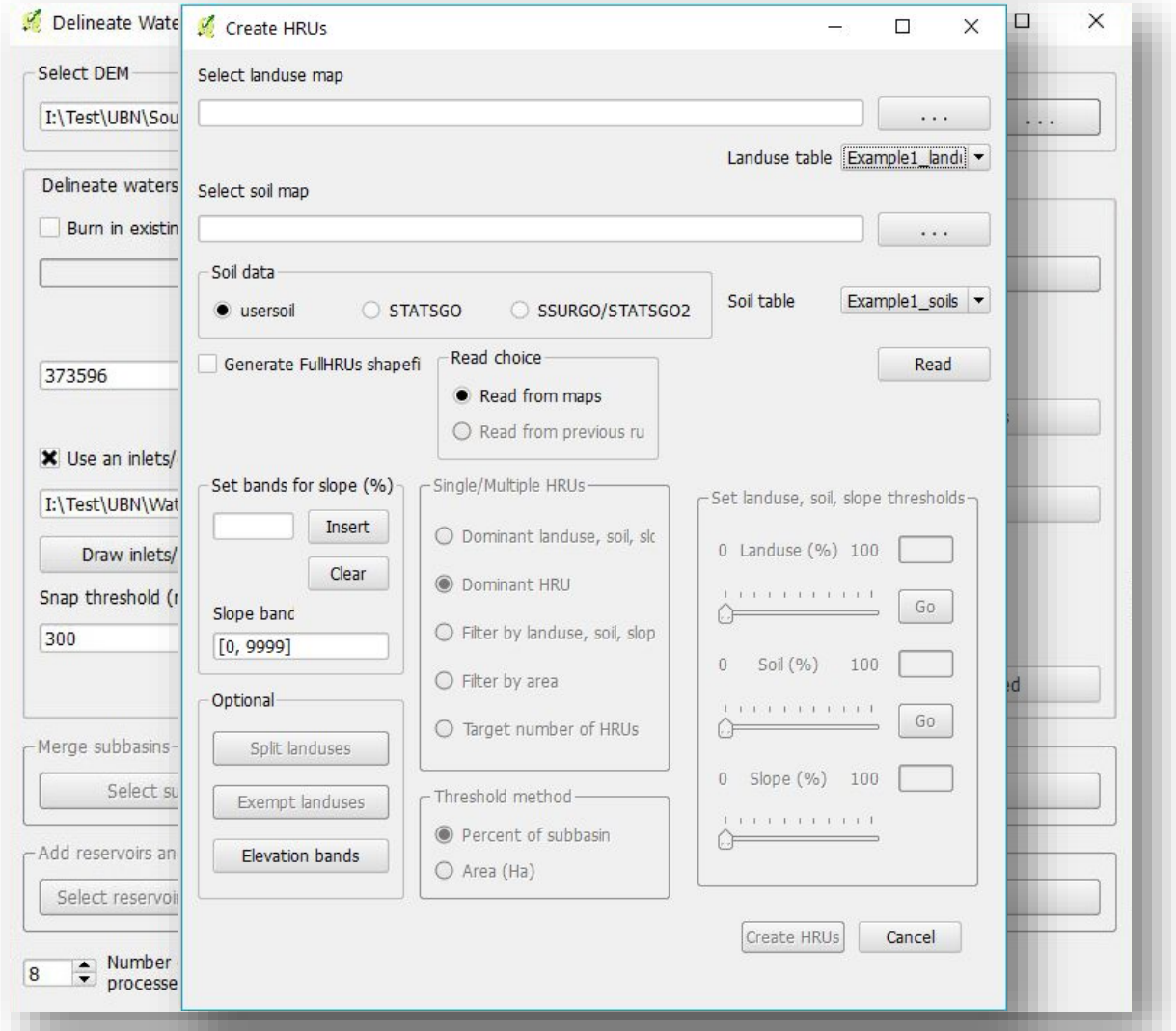
Inputs

Weather Data

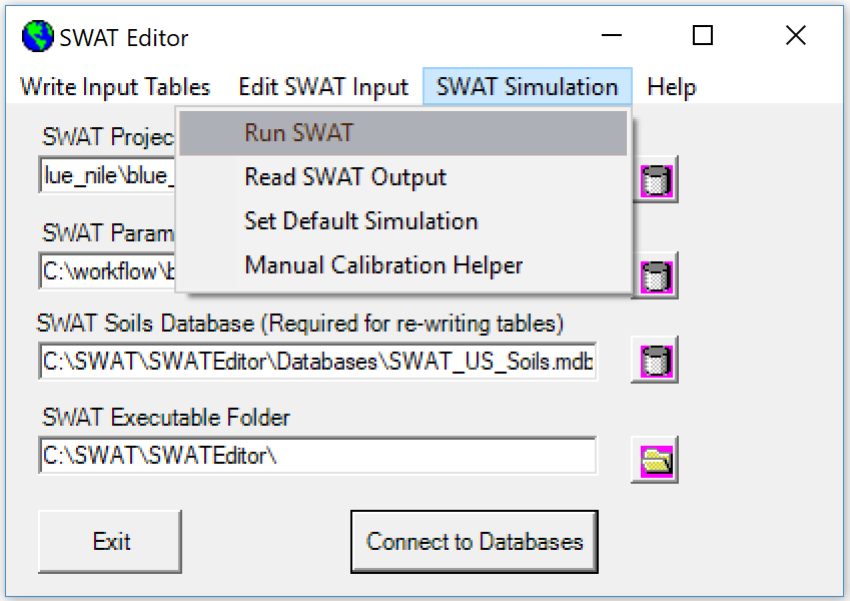
GIS Data

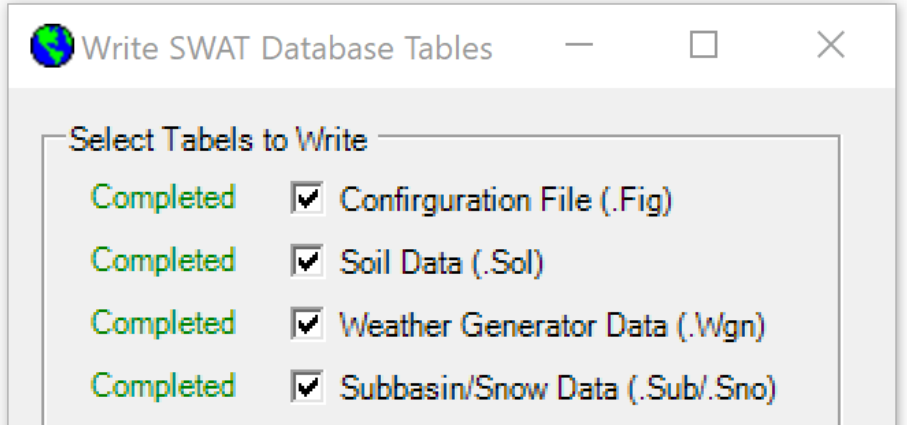


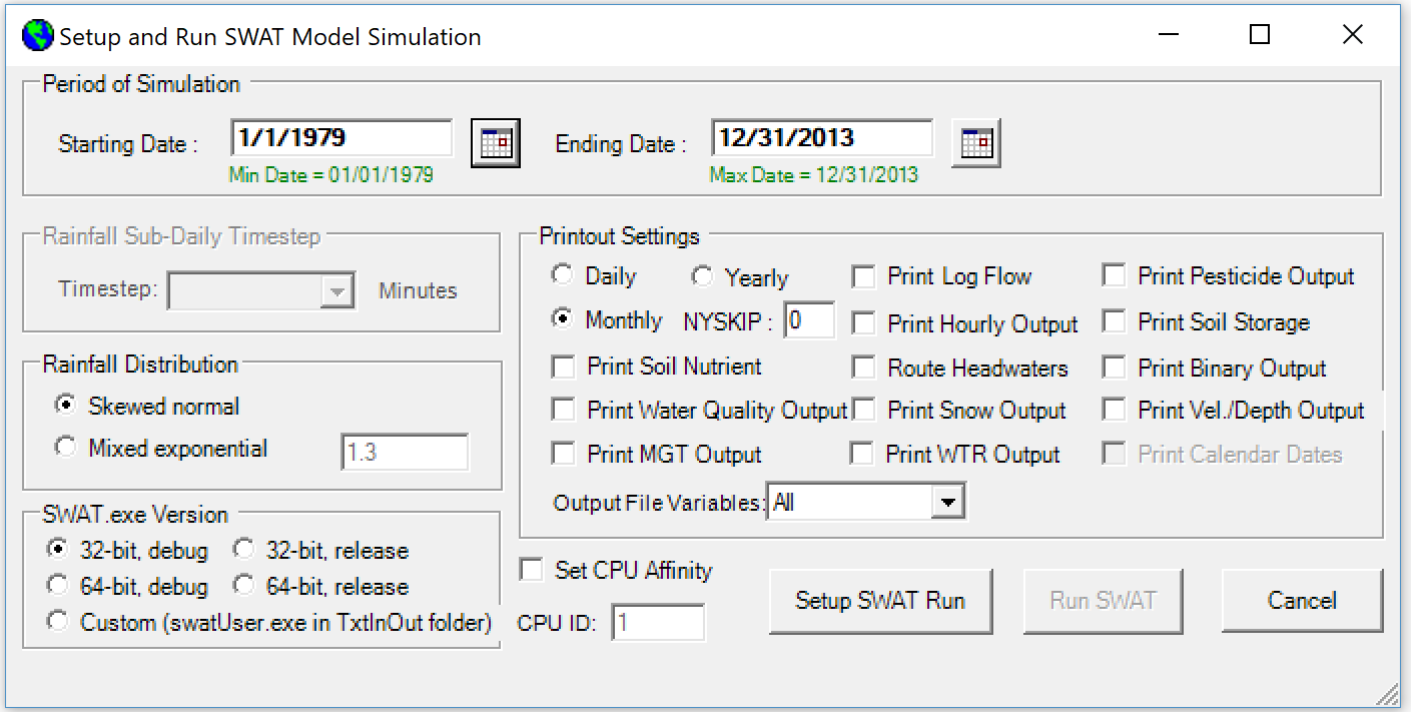
SWAT model preparation process
constantly requires input from user

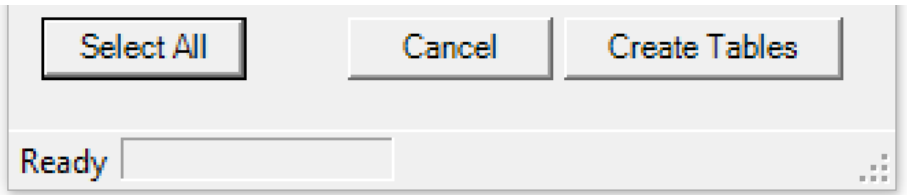


SWAT model preparation process
constantly requires input from user









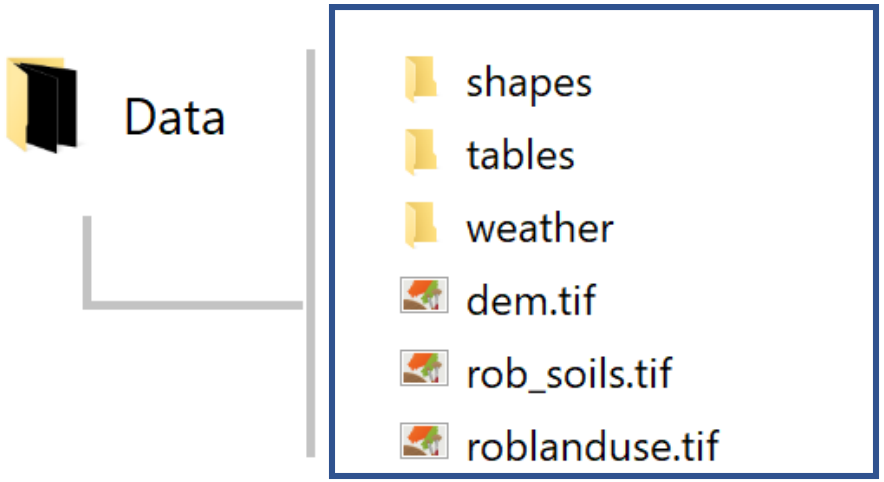
How is the model set up?

How does the new workflow work?

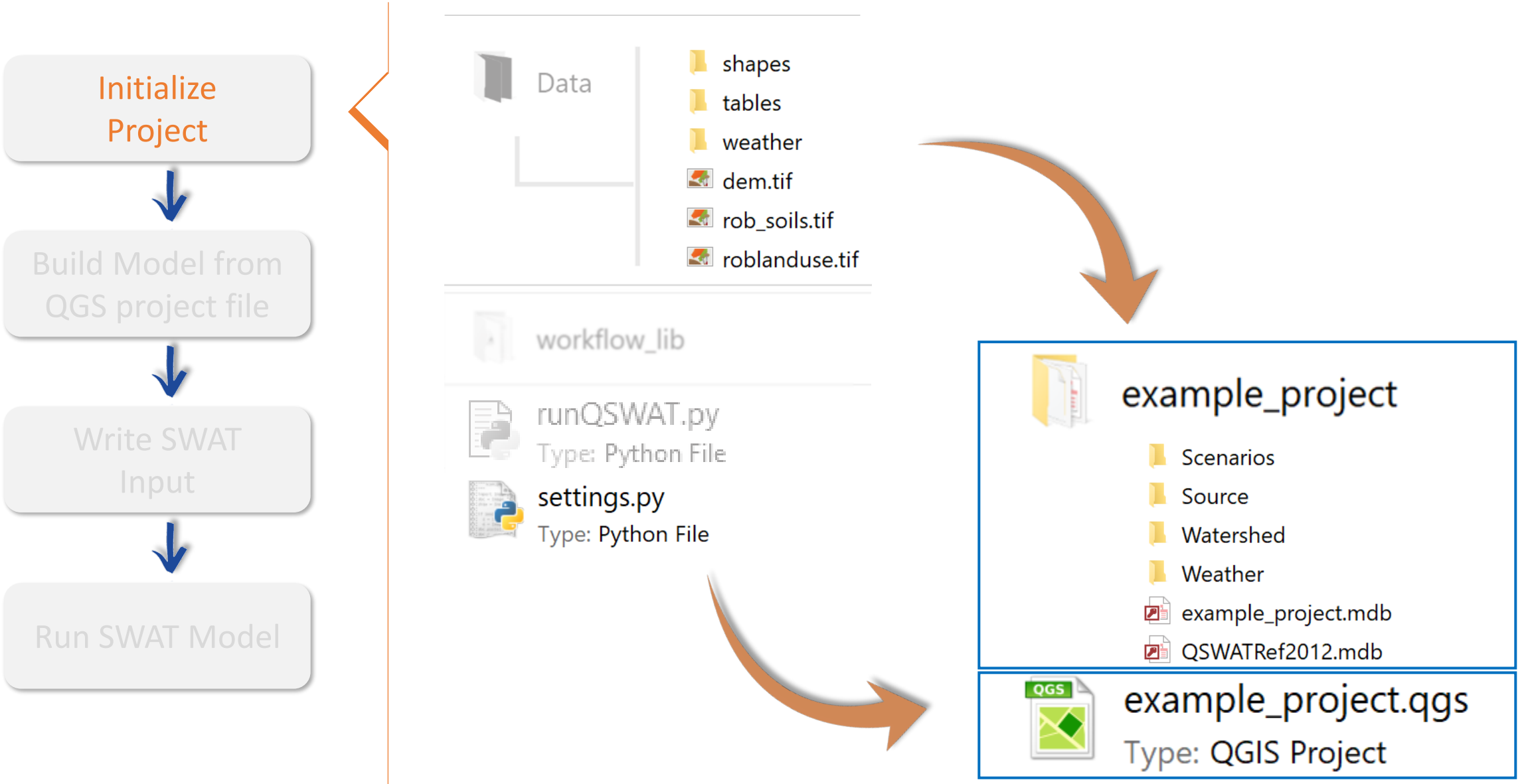
How is the model set up?

How does the new workflow work?

The Workflow requires a predefined folder structure



```
"""-----------------  QSWAT Workflow 1.5 Settings File--------------"""
# Project Identification
Project_Name     = "working_example"

"""--------------------------  File Names  --------------------------"""
# Raster files (Should be projected with the same projection)
Topography       = "dem.tif"
Soils            = "rob_soils.tif"
Land_Use         = "roblanduse.tif"
#Irrigation      = ""

# LookUp Files
soil_lookup      = "soil_lookup.csv"
landuse_lookup   = "landuse_lookup.csv"
#
Usersoil         = "usersoil.csv"
WGEN_user        = "WGEN_Robit.csv"

# Shape Files
Outlet           = "drawoutlets.shp" # it should have same format as in the example

# Weather forks
Precipitation    = "pcpRobStation.txt"
Temperature      = "tmpRobStation.txt"
Rel_Humidity     = "rhumRobStation.txt"
Solar_Radiation  = "solRobStation.txt"
Wind             = "windRobStation.txt"

"""--------------------------  Project Options  --------------------"""
# Watershed Deliniation (1 = Cells)
WS_thresholds_type   = 1
WS_threshold         = 792
OUT_Snap_threshold   = 300          # metres
Burn_in_shape        = ""           # leave as "" if none

#  -------------  HRU Definition  -------------
Slope_classes        = "0, 10, 50, 9999"

# HRU creation method  (1 = Dominant landuse, soil, slope ,     2 = Dominant HRU,
#                       3 = Filter by Area,     4 = Target Number of HRUs,
#                       5 = Filter by landuse, soil, slope)

HRU_creation_method = 3

# Thresholds (1 = Total Area , 2 = Percent)
HRU_thresholds_type  = 2

HRU_thres_Soil       = 10           # Only used if HRU_creation_method 5 is selected
HRU_thres_LandUse    = 12           #         can be set to "" if 5 is not selected
HRU_thres_Slope      = 7

Target_Value         = 20           # used if HRU_creation_method 3 and 4 are selected

# Log progress or not? If yes, you will not see updates
log                  = False # True or False
"""--------------------------  Settings End  ----------------------"""
```

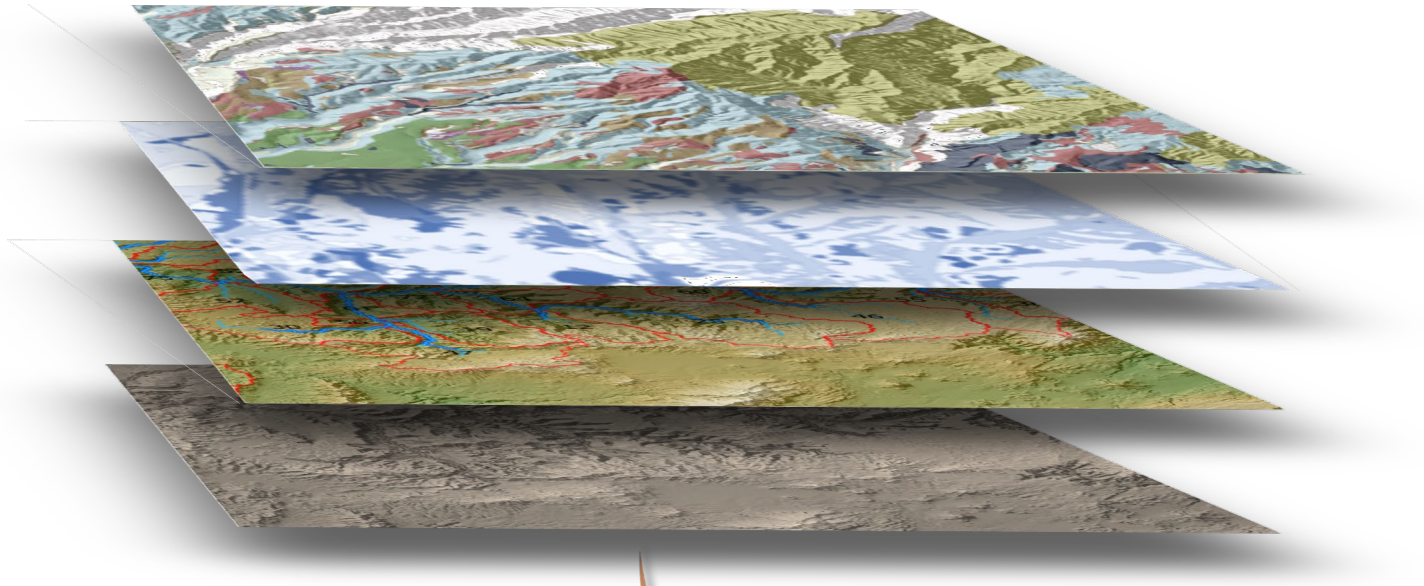

Initialize Project
Build Model from QGS project file
Write SWAT Input
Run SWAT Model
Data
shapes
tables
weather
dem.tif
rob_soils.tif
roblanduse.tif
workflow_lib
runQSWAT.py
Type: Python File
settings.py
Type: Python File
example_project
Scenarios
Source
Watershed
Weather
example_project.mdb
QSWATRef2012.mdb
QGS
example_project.qgs
Type: QGIS Project

Initialize Project

Build Model from QGS project file

Write SWAT Input

Run SWAT Model



HRUs

Saved to databases

example_project.mdb

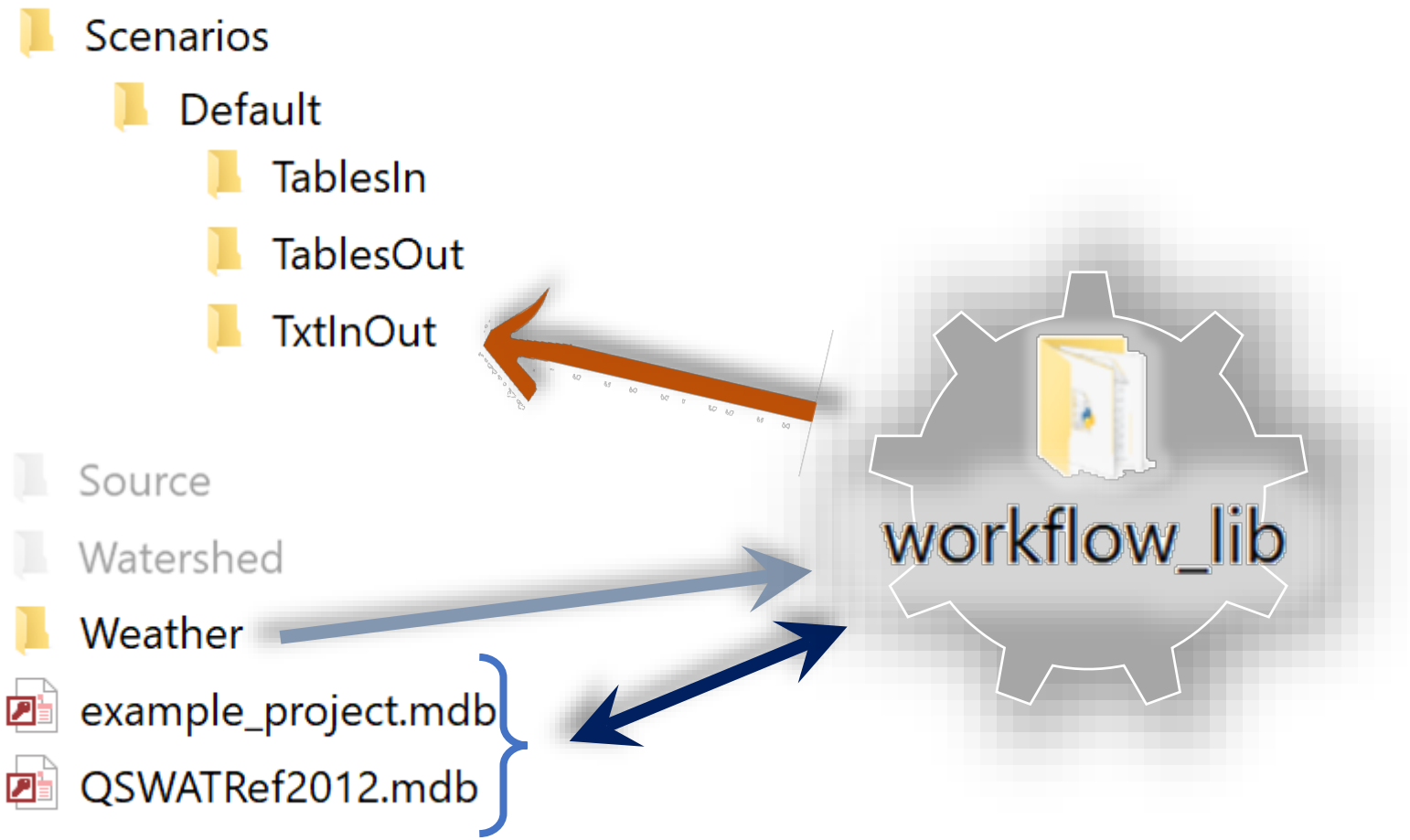
QSWATRef2012.mdb

Initialize Project

Build Model from QGS project file

Write SWAT Input

Run SWAT Model



Initialize Project

Build Model from QGS project file

Write SWAT Input

Run SWAT Model

Scenarios

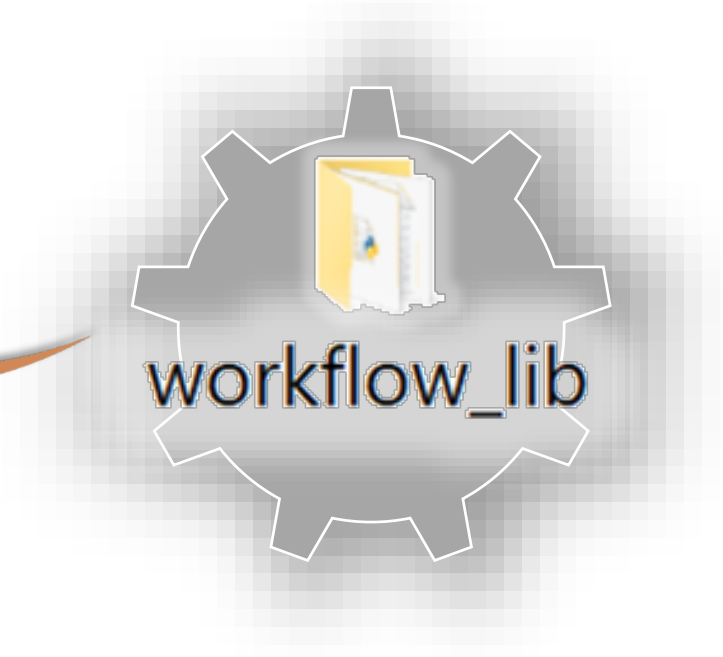
Default

TablesIn

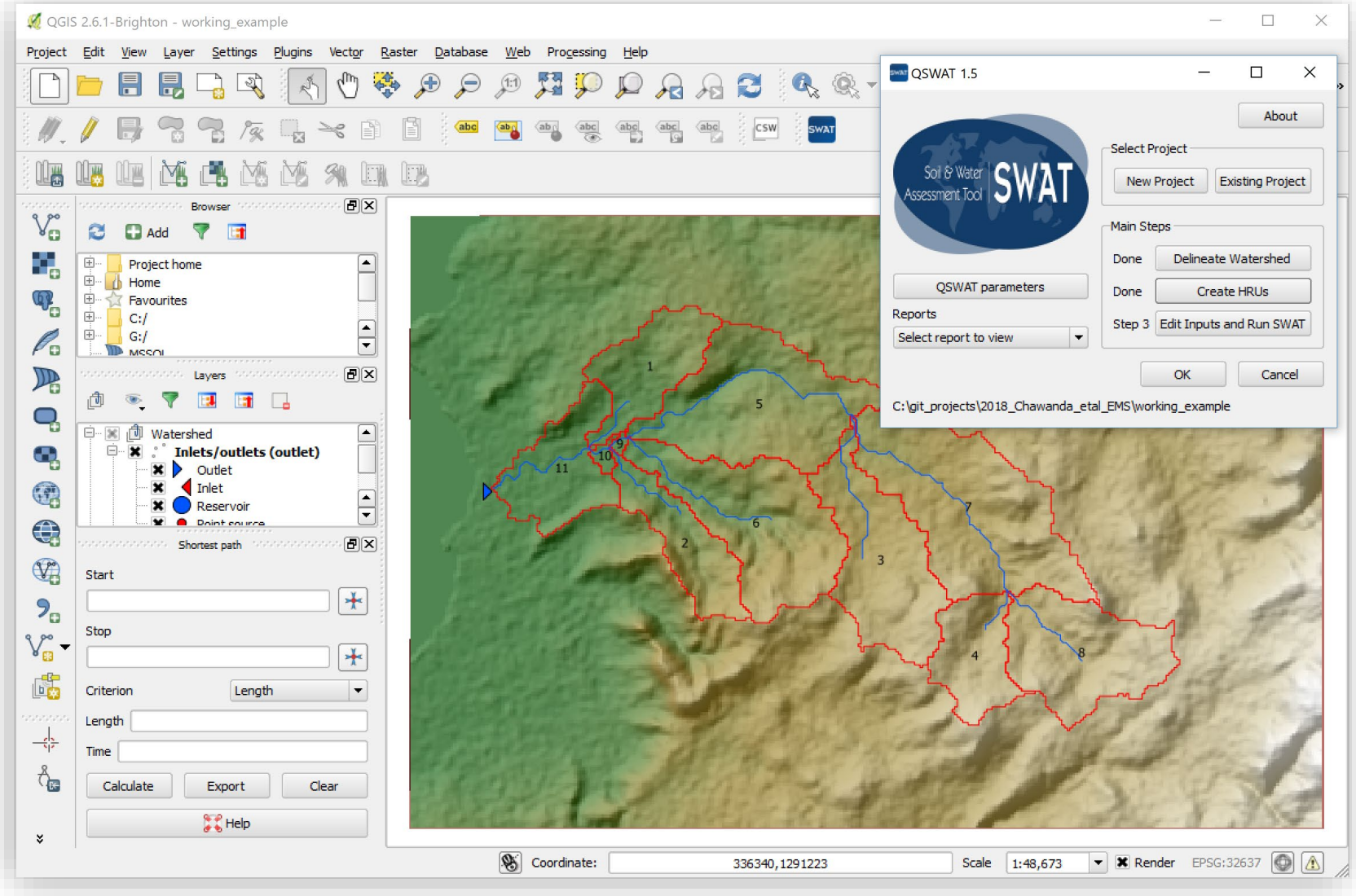
TablesOut

TxtInOut

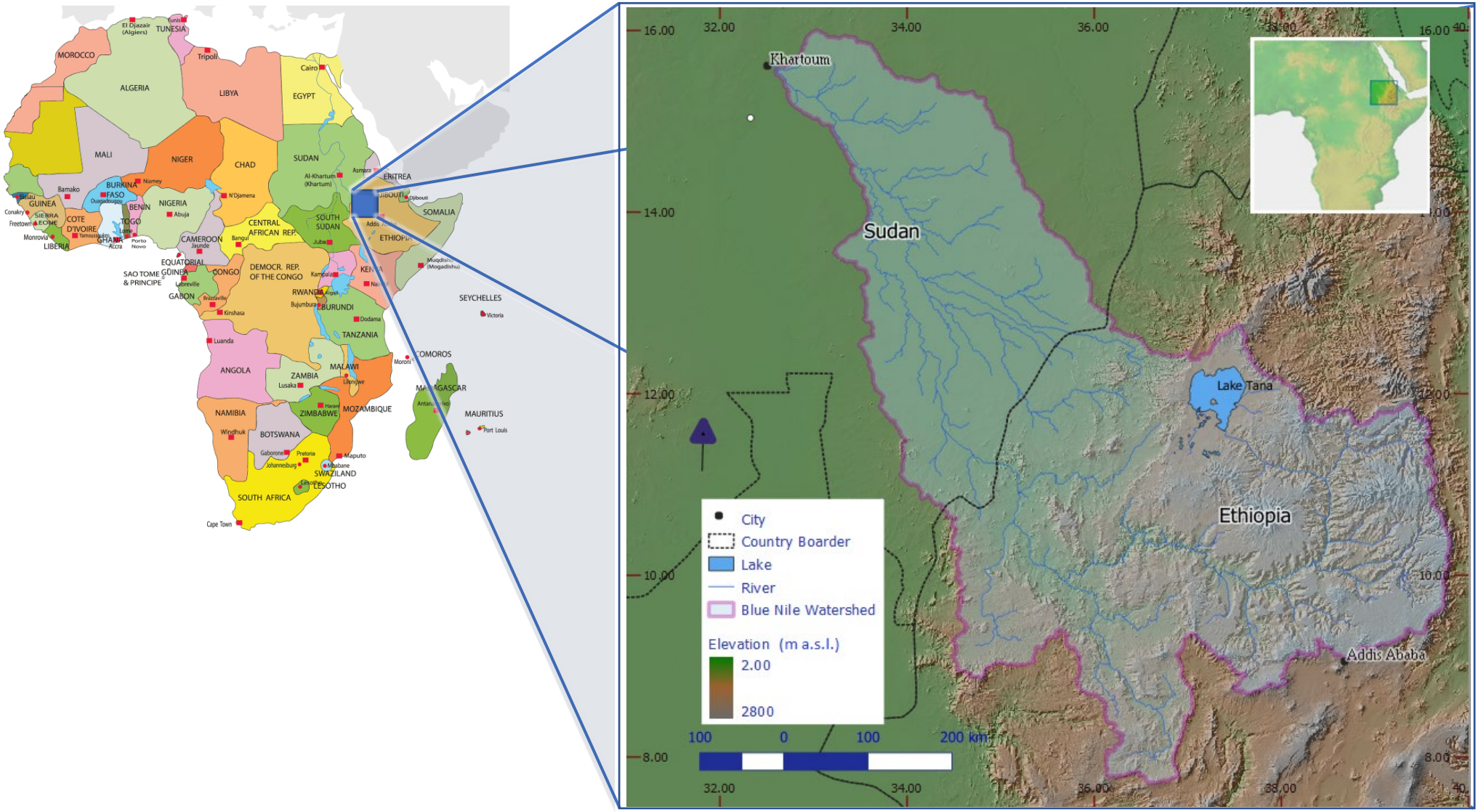
swat_64rel.exe



The model can be visualised and Modified in the GUI

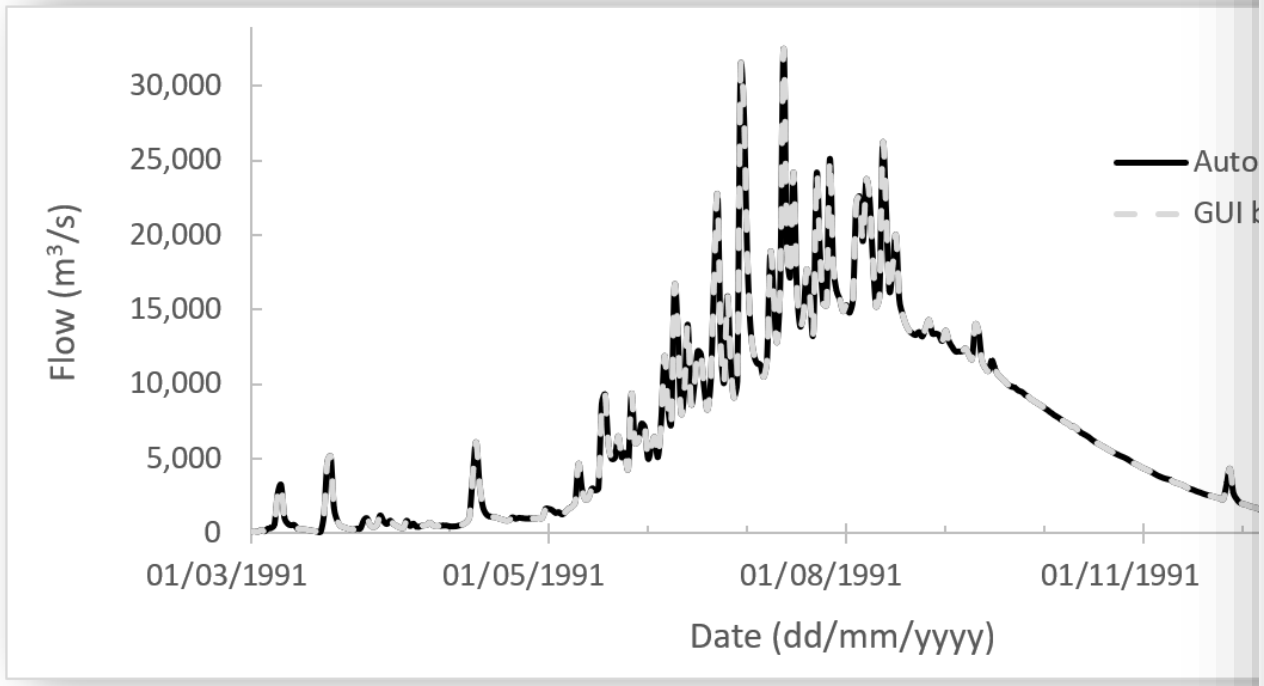


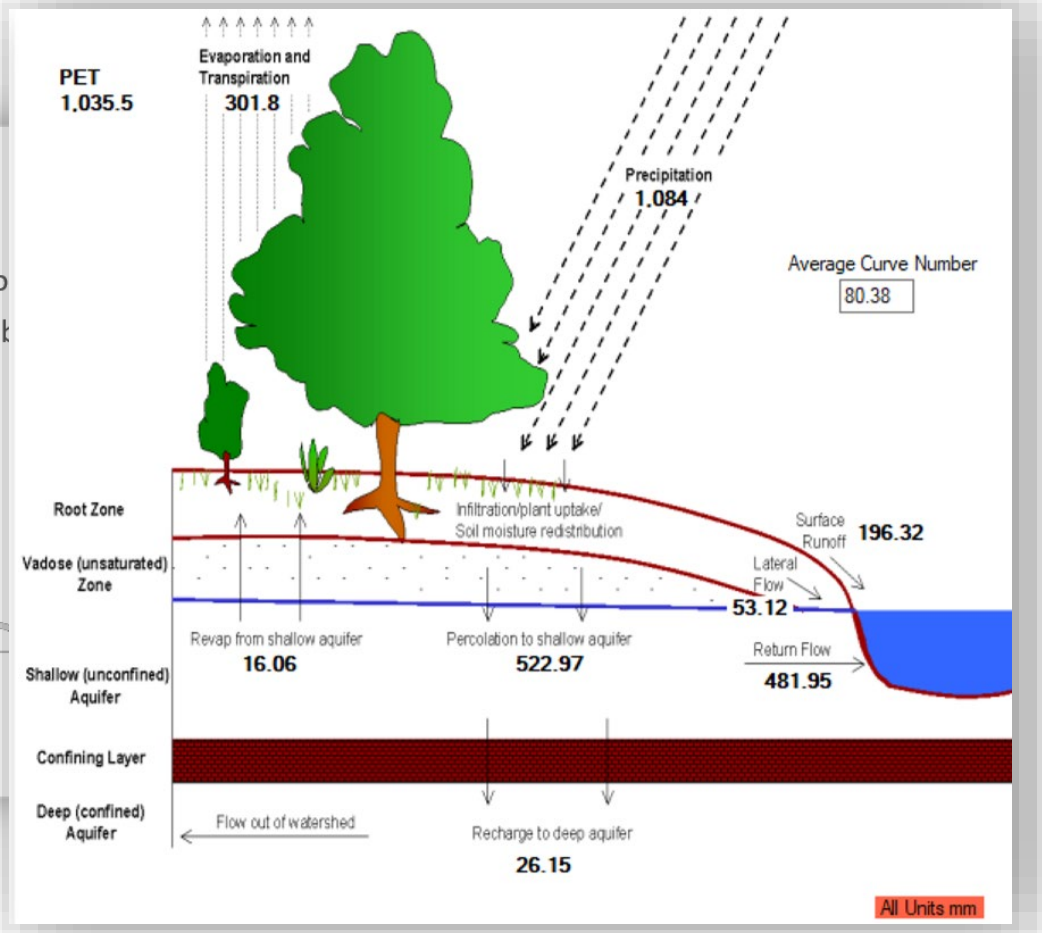
Application on Blue Nile



We compared the model setups

scripted workflow vs GUI set-up





Overview

- Reproducibility of catchment hydrological modelling studies
- Improving reproducibility by using automated workflows
- How can catchment hydrology modelling community benefit?

Overview

- Reproducibility of catchment hydrological modelling studies
- Improving reproducibility by using automated workflows
- How can catchment hydrology modelling community benefit?

The catchment modelling community
can benefit from automated workflows

Easy and transparent way of sharing modelling
settings, options and data used in a publication

Saves time
and effort

Opens up opportunities for using high
performance computing and cloud computing

Most catchment modelling research does not provide enough
information to audit and reproduce the published results

We propose automated workflows that are easy
to use as demonstrated with the QSWAT workflow

Once the data bound to the workflow is publicly made available and
cited there will be more reliable background material for further research

VUB-HYDR / QSWAT_Automated_Workflow

Watch 2 | Star 3 | Fork 0

Code | Issues 0 | Pull requests 0 | Projects 0 | Wiki | Insights | Settings

The automated workflow for setting up SWAT Models presented in Chawanda et al., 2018 EMS

Edit

swat hydrology workflow tool Manage topics

16 commits | 1 branch | 0 releases | 1 contributor | MIT

Branch: master | New pull request | Create new file | Upload files | Find file | Clone or download

celray version 1.5.0 — Latest commit 99017de 27 days ago

Data	version 1.5.0	27 days ago
workflow_lib	version 1.5.0	27 days ago
.gitignore	initial commit	3 months ago
LICENSE	version 1.5.0	27 days ago
README.md	version 1.5.0	27 days ago
runQSWAT.py	version 1.5.0	27 days ago
settings.py	version 1.5.0	27 days ago

README.md

QSWAT_Automated_Workflow v1.5

Automated workflow for setting up the SWAT Model presented in Chawanda et al., 2018 EMS.

To Install

Qgis 2.6.1 (32bit)
QSWAT 1.5
gdal

Celray James CHAWANDA
celray.chawanda@vub.be