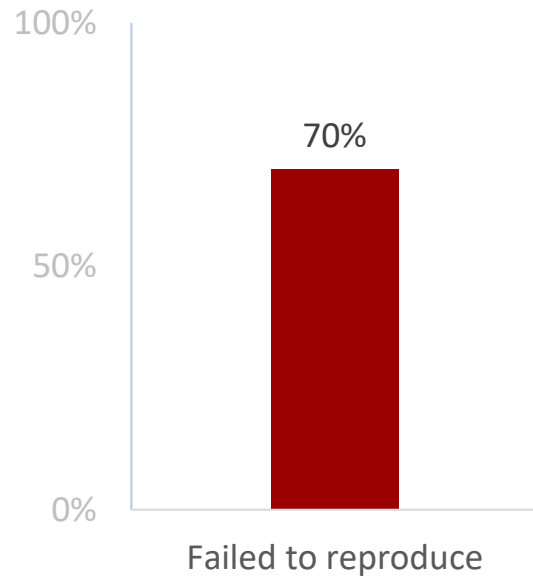


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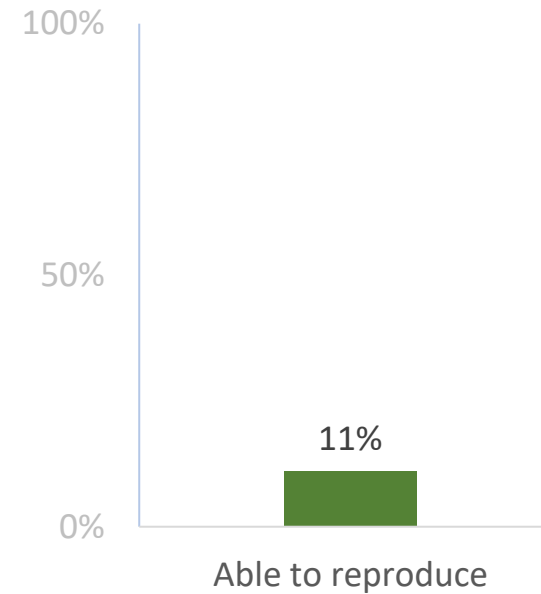
User-friendly workflows for catchment modelling: Towards reproducible SWAT+ model studies

October 29, 2020

A large proportion of scientific research is not reproducible



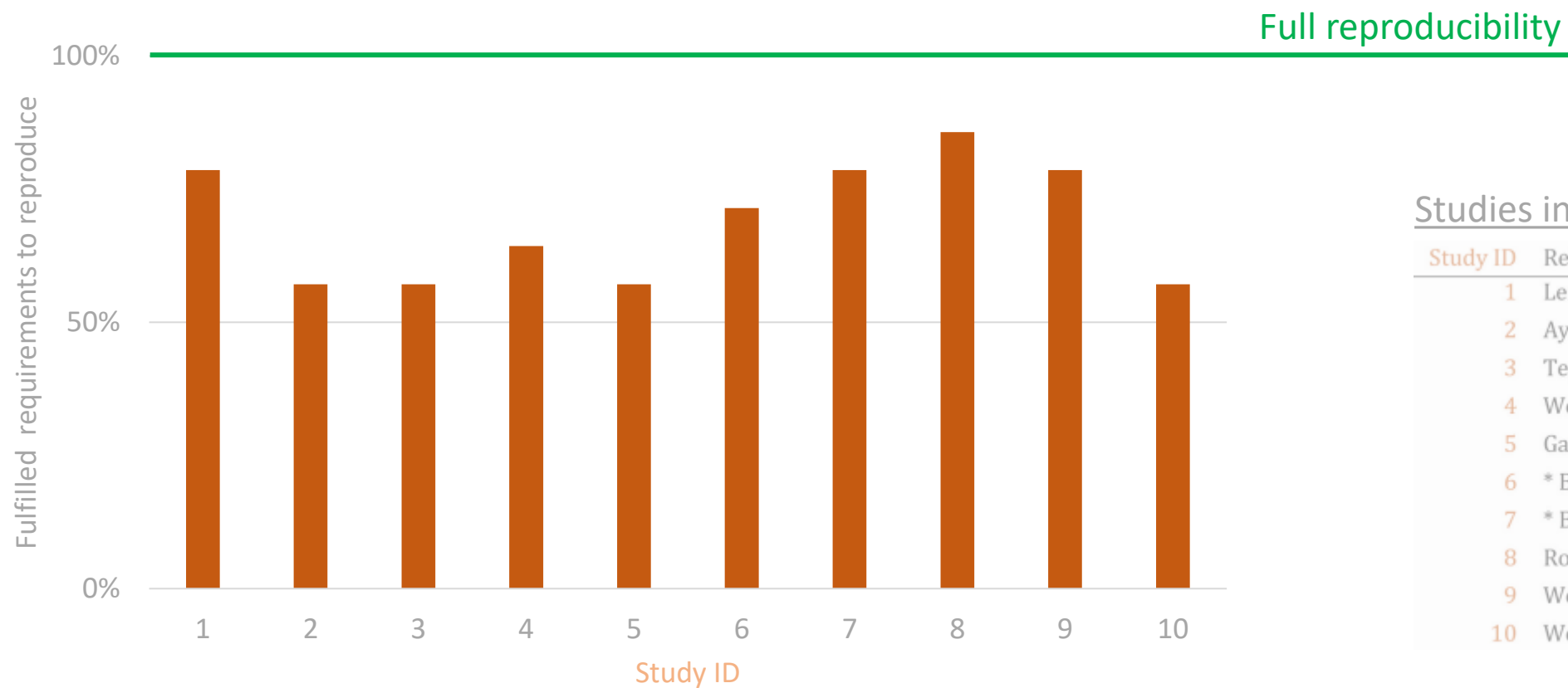
Baker and Penny (2016)



Begley and Ellis (2012),
Vasilevsky et al. (2013)

In many cases, major conclusions have not been confirmed, repeated by the same investigators.

Catchment hydrological modelling community also suffers from reproducibility issues



Studies in Blue Nile

Study ID	Reference
1	Lemann et al. (2016)
2	Ayele et al. (2017)
3	Tegegne & Kim (2018)
4	Woldesenbet et al. (2017)
5	Gashaw et al. (2018)
6	* Bayissa et al. (2018)
7	* Betrie et al. (2011)
8	Roth & Lemann (2016)
9	Worqlul et al. (2018)
10	Worku et al. (2017)

Reproducibility is still an issue in the catchment modelling community

Balancing level of
detail in reporting

Code that is used but
not made available

Fraud

Transparency
is the key

Reproducibility is still an issue **despite efforts** in the catchment modelling community



Ten iterative steps in development and evaluation
of environmental models (Jakeman et al., 2006)

Good modelling practice
(Crout et al., 2008)

Without transparency

*“modelling projects can be difficult to audit, and without a considerable effort it is
hardly possible to reconstruct, repeat and reproduce the modelling process and its
results”*

Refsgaard and Henriksen (2004)

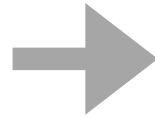
Automated workflows can boost reproducibility, transparency, provenance

Workflows capture all steps

all settings

+

data



Transparency

Ideal workflow should care for
both the novice and the expert

We created a 'user-friendly' Python workflow for SWAT+ Model

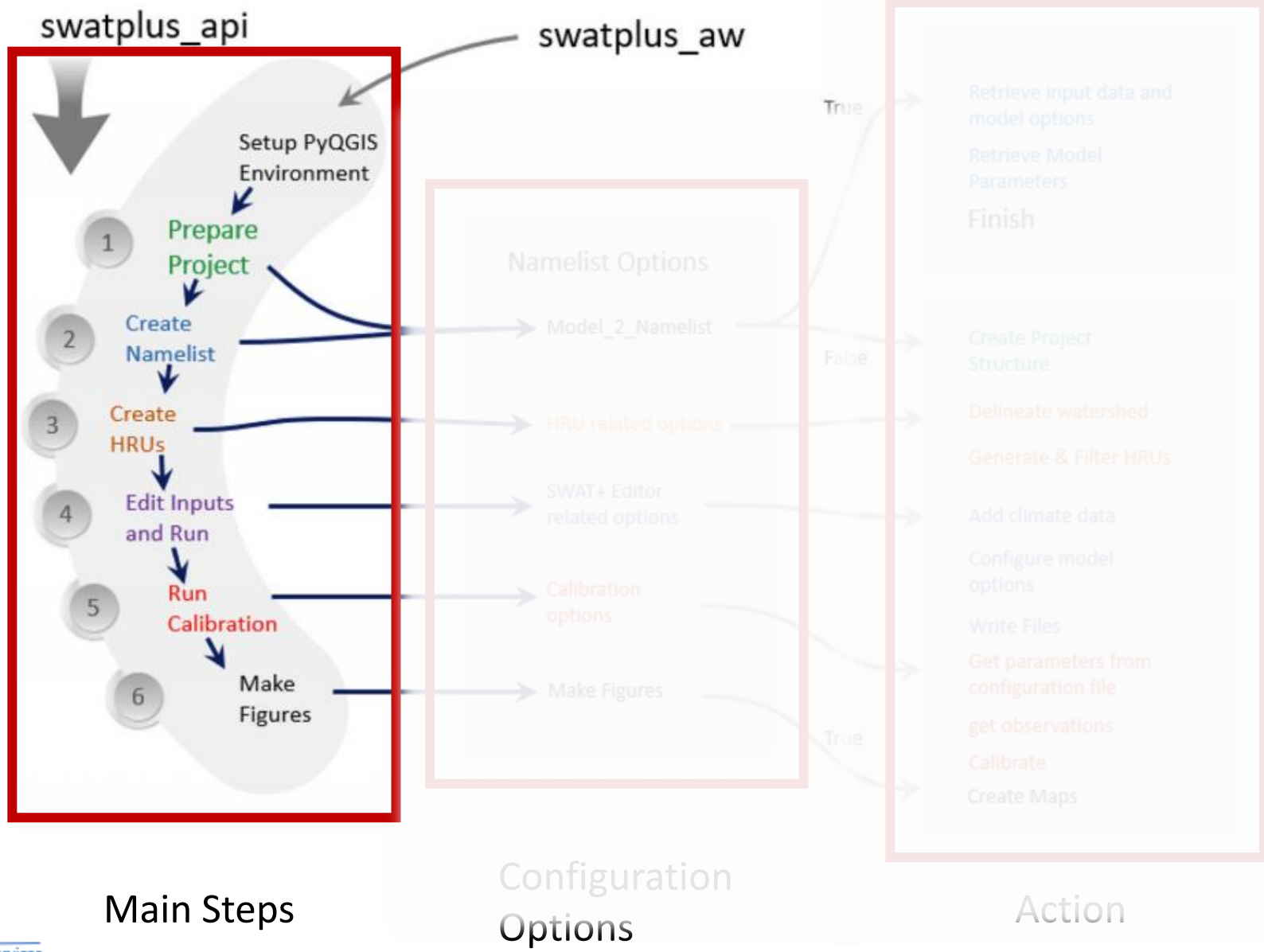
All model configuration options
are saved in one file

Simple setup and uses simple commands
(swatplus_aw, swatplus_api)

Interoperable with GUI for setting up SWAT+

Users can transfer their GUI model to 'workflow version'

How it works



Main Steps

Configuration Options

Action

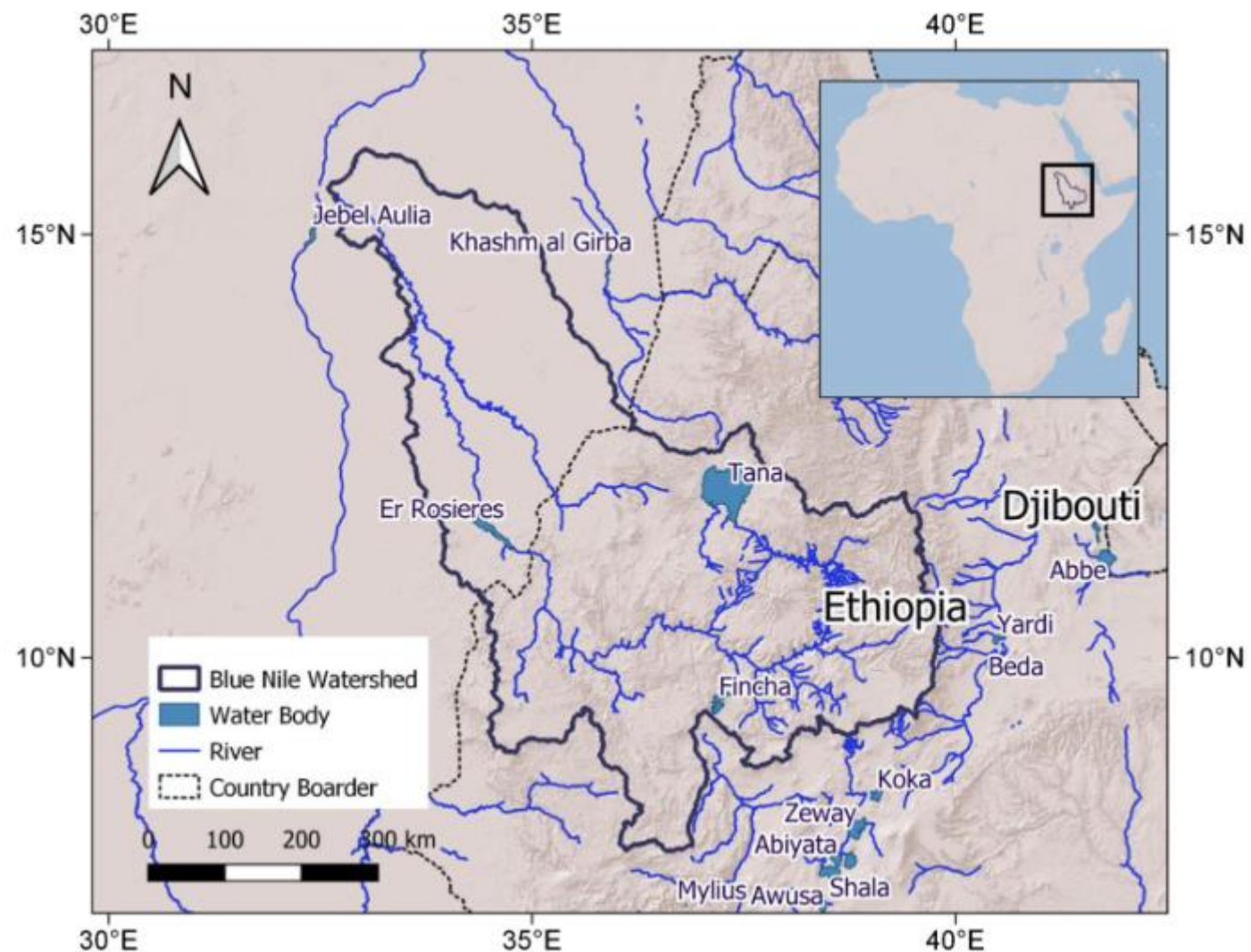
We tested the workflow against GUI on the Blue Nile catchment

Both models had 209
LSUs and 1329 HRUs.

Comparing flow time-series
from the two models yielded

- NSE value of 1.00
- RMSE of 0.00.

Water balance components from
the two models were identical



Strengths, Opportunities and next steps

Easy reproducibility: users can share the config file to allow others to run the workflow to re-create models

Provides a path to total transparency. config files and datasets can be published with a DOI

Allows the retrieval of a config file and data from a model created in the GUIs. Beginners are not left out

Strengths, Opportunities and next steps

Users can script model runs using different config files
and create models with varying configurations

Enhancing the modelling process if deployed on Cloud Computing
systems and High-Performance Computing (HPC) facilities.

Better calibration mechanisms can be added
(it is open source)

In Summary

Lack of reproducibility of SWAT(+) models is largely due to the lack of information in reporting

We tackle this issue by providing a software that summarizes all user settings in a single **config file**

Attaching this file as supplementary information provides enough information to allow for reproducible model results.

The innovative element is that the workflow is fully interoperable with the GUI

Can be deployed on a server

VUB-HYDR / SWATPlus-AW

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Languages

celray fixed bug when mapping irrigation		9ec298c on May 14	45 commits
.github/ISSUE_TEMPLATE	Update issue templates		7 months ago
editor_api	Added compatibility with linux (Ubuntu)		7 months ago
main_stages	fixed bug when mapping irrigation		6 months ago
packages	version 1.0.4		6 months ago
qswatplus	enable hru shapefile creation		6 months ago
.gitattributes	updating editor api with wgn database		7 months ago
LICENSE	Initial commit		7 months ago
README.md	version 1.0.4		6 months ago
code_of_conduct.md	Create code_of_conduct.md		7 months ago
example_dataset.zip	version 1.0.4		6 months ago



SWAT+ AW

SWAT+ Automatic Workflow Documentation
Version 1.0.4

[Home](#)

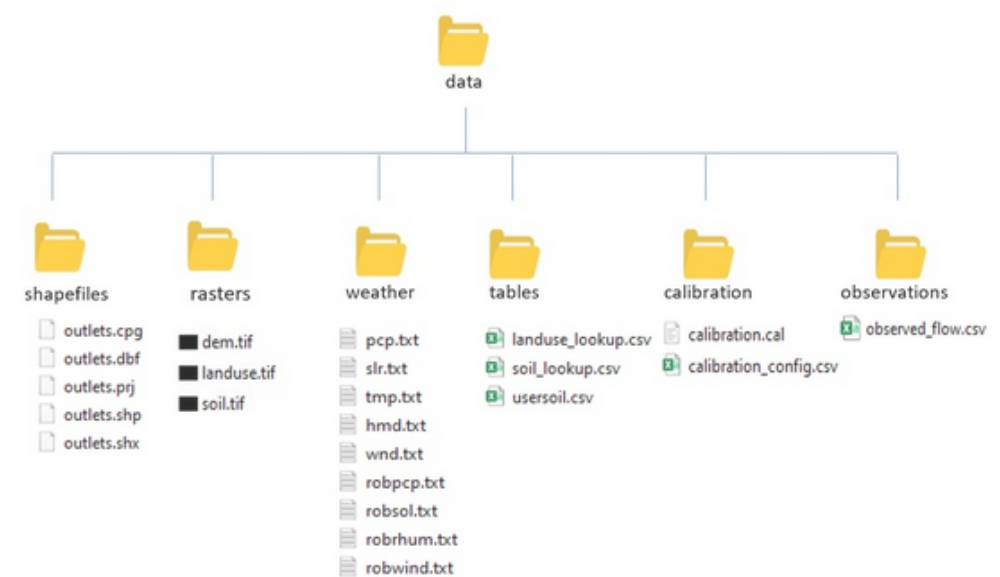
[SWAT+ Toolbox](#)

SWAT+ AW

- Introduction and setup
- **Data**
- Config File P1
- Config File P2
- Config File P3
- Config File P4
- Running SWAT+ AW
- References

[Data](#)

The data requirements for the SWAT+ AW are the same as data requirements for QSWAT+ and SWAT+ Editor. Thus, users can use the same data formats as the GUI counterparts. For more information on SWAT+ data formats refer to QSWAT guide (Dile, Srinivasan, & George, 2017).





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3. New workflow for SWAT+: The SWAT + Autom...

4. Application of the workflow

4.4. Results

5. Discussion

6. Conclusions

Declaration of competing interest

Acknowledgement

Appendix A. Supplementary data

References

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Figures (7)



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