



Facilitating reproducible science: a workflow for setting up SUMMA simulations anywhere on the globe

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- Hydrologic research is poorly reproducible in approximately 95% of cases^[1].
- End-to-end workflows make complex modelling studies reproducible, without needing to save all input and output data.
- We present an open workflow to setup a spatially distributed process-based model (SUMMA^[2,3]) and vector-based routing scheme (mizuRoute^[4]).

Shapefiles^[5] outlining the (l) river network and (r) (sub-)catchments go into the workflow.

Shapefiles should include:
- Basin geometry -
- Basin lat/lon -
- Basin area -
- Unique basin IDs -
- Stream downstream -
- connection
- Stream length -
- Stream slope -

Bow at Banff setup
- Canadian Rocky mountains
- 51 sub-catchments (left), 2216 km²
- 118 model elements (right; elevation bands)

↑ Mean HRU elevation
(blue = low, white = high)

A variety of Python and Bash code then...

Downloads and installs SUMMA and mizuRoute.



Downloads and pre-processes forcing data and parameter fields.

Mapping between forcing grid and catchments^[6]

Maps forcing and parameter data to catchment shapes.

Creates all model input and control files.

Runs both models in sequence.

Mean annual streamflow
(blue = high, white = low)
Mean annual maximum SWE
(white = high, brown = low)

- Model setup is fully traceable.
- Easy to use for novice modelers through a single workflow-control file.
- Highly efficient model setup with global coverage – setup and initial simulations for Bow river at Banff takes approximately 1 day.
- Soon openly available; get in touch to try this out early:** wouter.knoben@usask.ca

How does this fit into a typical study?

Catchment delineation

Model setup

Parameter estimation

Model runs

Analysis

[1] Stagge et al., 2019. Scientific Data. <https://doi.org/10.1038/sdata.2019.30>
[2] Clark et al., 2015a. Water Resources Research <https://doi.org/10.1002/2015WR017198>
[3] Clark et al., 2015b. Water Resources Research <https://doi.org/10.1002/2015WR017200>
[4] Mizukami et al., 2016. Geoscientific Model Dev <https://doi.org/10.5194/gmd-9-2223-2016>
[5] Based on Lin et al., 2019. Water Resources Res. <https://doi.org/10.1029/2019WR025287>
[6] Gharari, S., 2021. EASYMORE. <https://github.com/ShervanGharari/EASYMORE>
Background: Keirnan Fowler