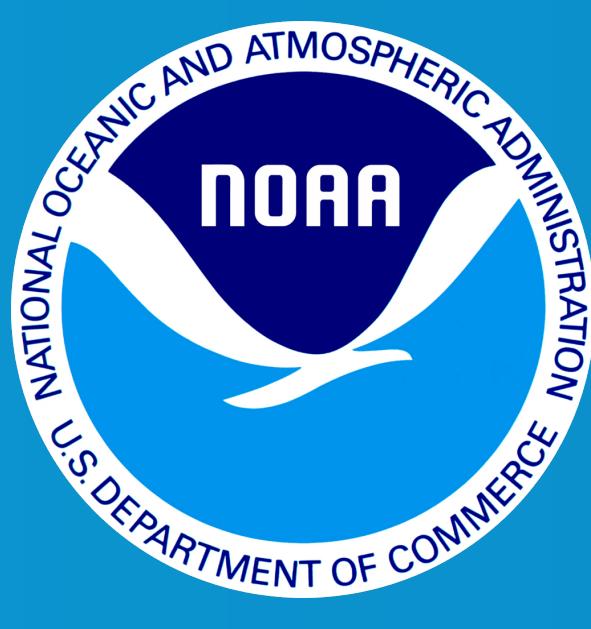


H31W-1805 Using the NextGen Modeling Framework to drive Noah-OWP-Modular on a grid



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Introduction

- Next Generation Water Resources Modeling Framework (NextGen) will be used to drive the multiple models required to simulate the full suite of National Water Model (NWM) v4.0 output variables
- NextGen will be used to drive Noah-OWP-Modular — a modularized version of Noah-MP with a Basic Model Interface (BMI) — to simulate a subset of surface processes and output variables for NWM v4.0
- We adapted Noah-OWP-Modular to provide additional user flexibility for regular-gridded representations of the modeling domain

Primary changes to codebase

- Added capacity to read-in gridded model attributes via NetCDF
- Added capacity to record model variables on a grid via Fortran-based derived data types and iterate over grid to execute the model following the modeling workflow and architecture demonstrated by He (2023)
- Amended BMI ‘initialize()’ function to initialize added gridded derived data types (Figure 4)
- Amended BMI ‘update()’ function to advance time and iterate over added gridded derived data types (Figure 4)
- Amended BMI ‘get_value()’ and ‘set_value()’ functions to work with added gridded derived data types (Figure 4)
- Added capacity to write gridded model outputs to NetCDF (Figure 1)

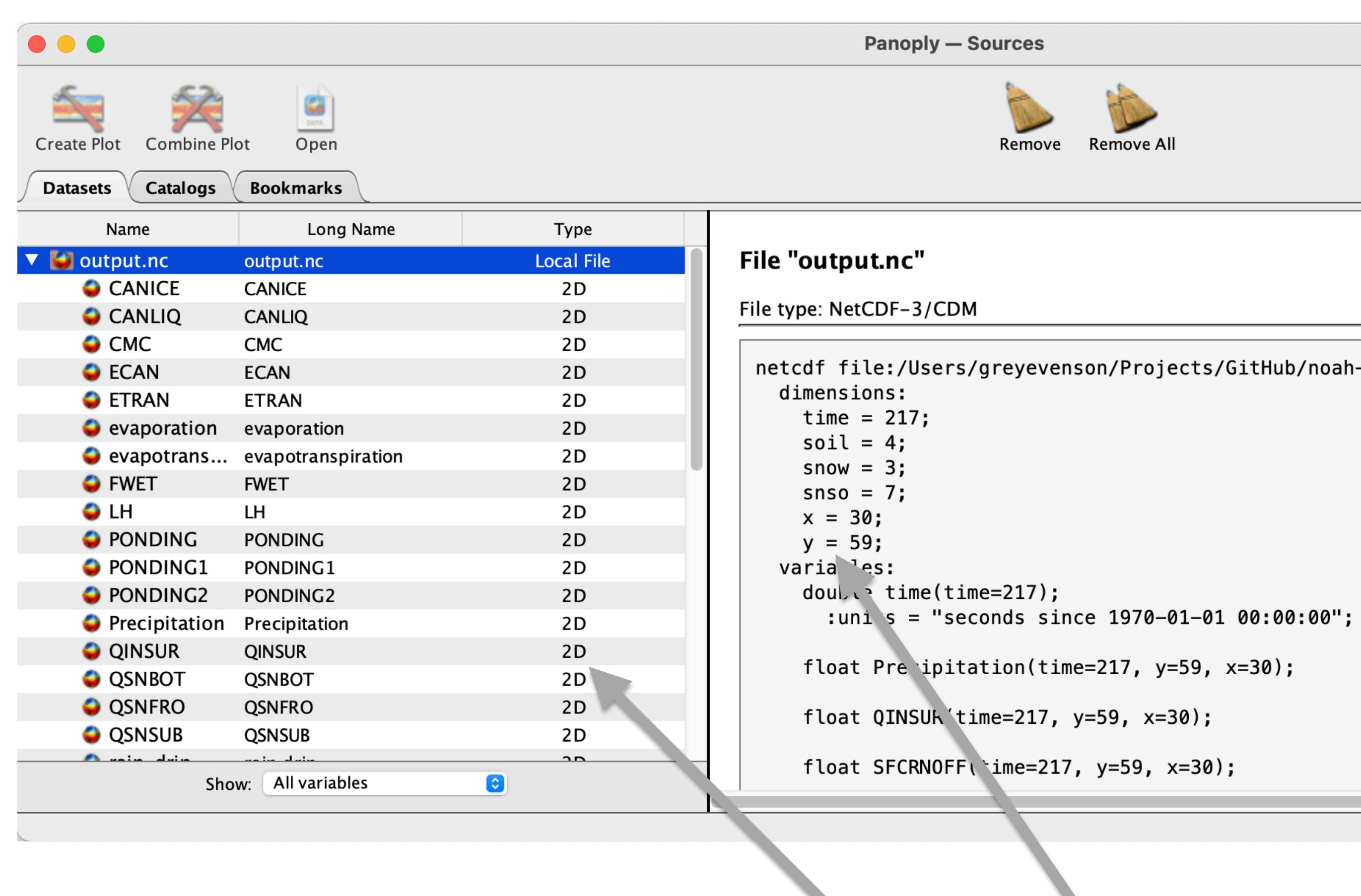


Figure 1: Most model output variable are now provided as 2D arrays with x and y dimensions

Noah-OWP-Modular now offers users the flexibility to run over a regular grid or at the lumped basin scale, in standalone mode or via NextGen

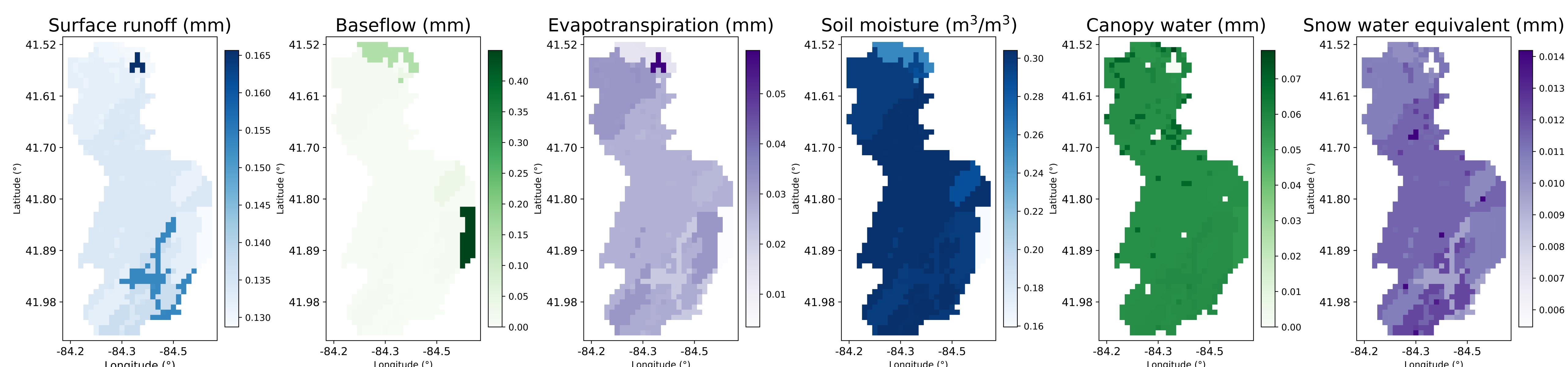


Figure 2: We plotted a subset of gridded Noah-OWP-Modular output variables from the test application for the model for the Tiffin Watershed (OH, USA). The plots show the mean hourly simulation per grid cell, calculated over the simulation period.

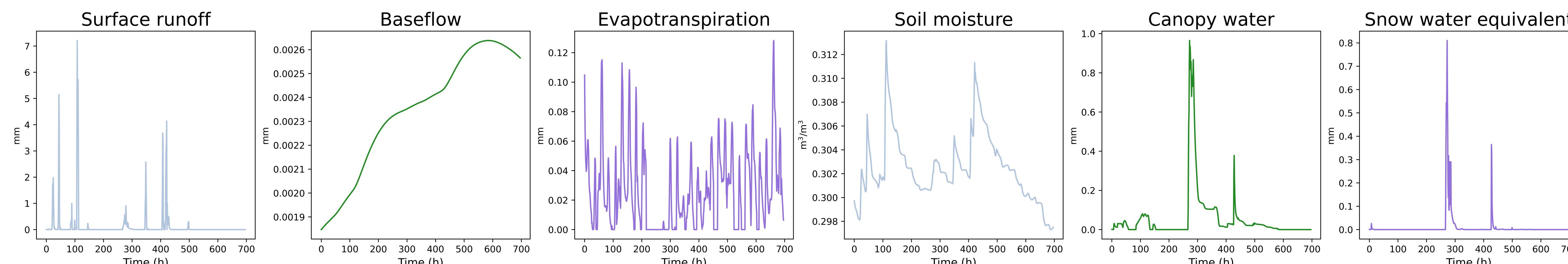


Figure 3: We plotted time-series for a subset of Noah-OWP-Modular variables for a single grid cell within the modeling domain (longitude = -84.37, latitude = 41.78) for our test application of the model for the Tiffin Watershed (OH, USA).

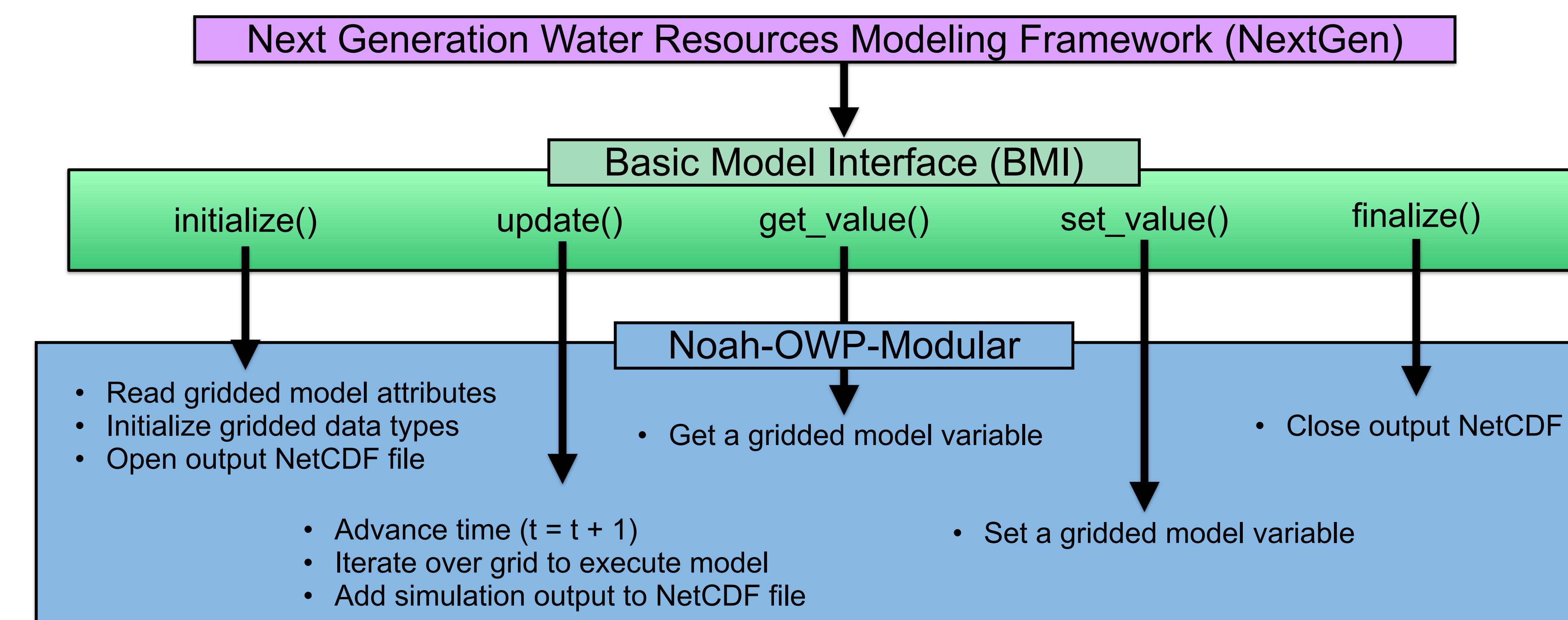


Figure 4: NextGen may be used to drive Noah-OWP-Modular via the model's BMI interface.

Quality assurance

- Updated unit tests to work with gridded data types and reviewed unit test output for BMI assessable variables (Figure 5)

```
VARIALBE INFORMATION*****  
The variable SFCPRS  
has a grid id of 1  
has a grid row count (n_y) of 61  
has a grid column count (n_x) of 50  
has a total cell count (n_x * n_y) of 3050  
has a type of real  
units of Pa  
a size (bytes per grid cell or variable instance) of 4  
and total n bytes (bytes across grid) of 12200
```

Figure 5: We inspected unit test output for BMI-exposed model variables

- Created script to ensure 1:1 match of model outputs between modified and unmodified codebase where using the same inputs and forcings
- Code review with GitHub (see repo QR at bottom right of poster)

Test application

- We tested the modified codebase using NWM 3.0 gridded model attributes (Figure 7) and AORC forcings for the Tiffin Watershed (OH, USA, Figure 6) for the simulation period 11-01-2017 to 11-30-2017. Figures 2-3 show a subset of outputs for this test application of Noah-OWP-Modular.



Figure 6: The Tiffin Watershed, OH, USA.

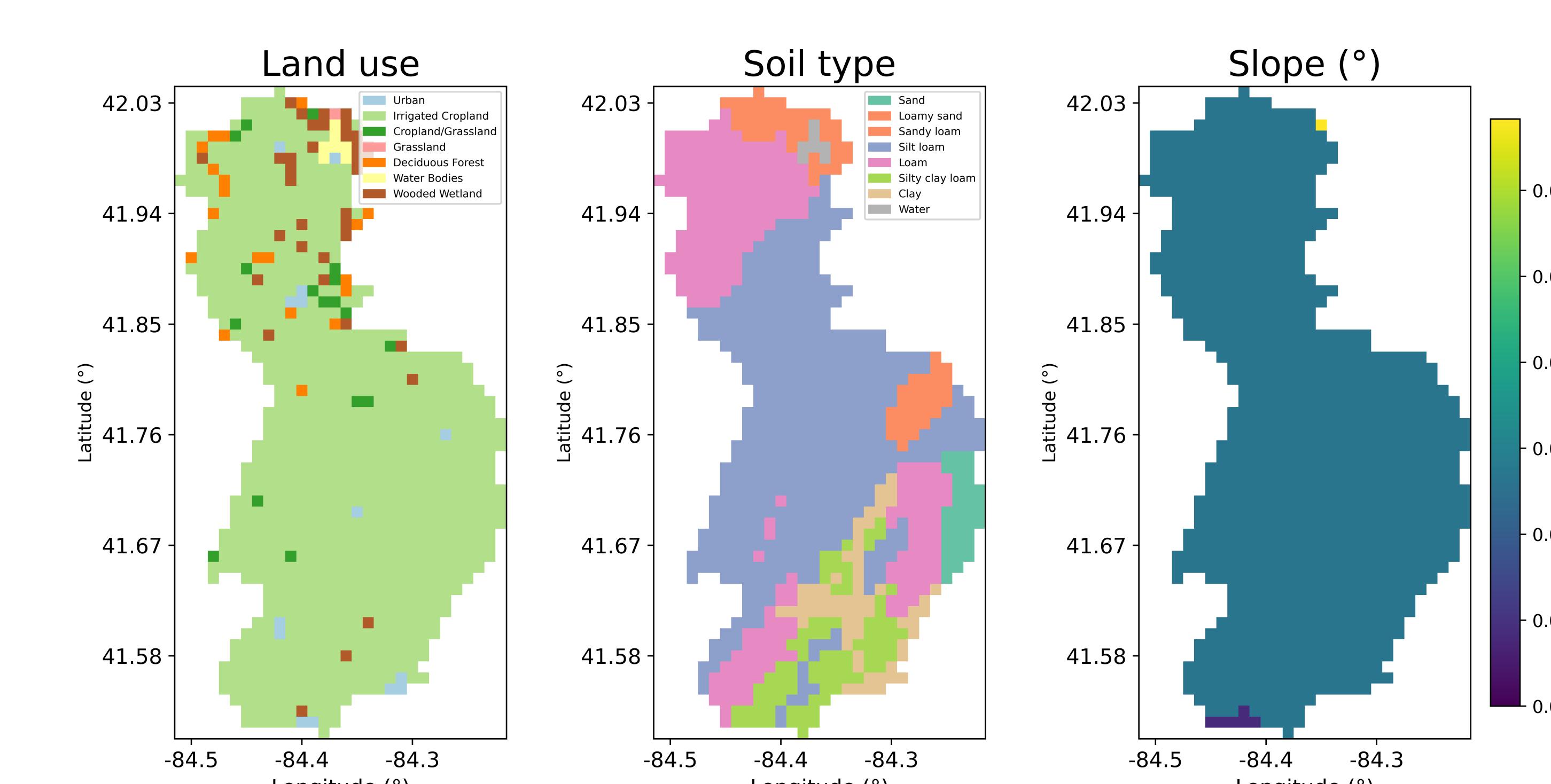


Figure 7: A subset of NWM 3.0 gridded attributes for the Tiffin Watershed, OH, USA.



ACKNOWLEDGEMENTS:

We wish to thank members of the Hydrometeorological Applications Program at NCAR — and particularly Cenlin He — for their help in the initial development of Noah-OWP-Modular. We also wish to acknowledge He (2023), because Noah-OWP-Modular gridded simulations were facilitated by the modeling workflow and architecture demonstrated in Noah-MP v. 5.0.

REFERENCES:

He, C., Valayamkunath, P., Barlage, M., Chen, F., Gochis, D., Cabell, R., Schneider, T., Rasmussen, R., Niu, G.-Y., Yang, Z.-L., Niyogi, D., and Ek, M.: Modernizing the open-source community Noah with multi-parameterization options (Noah-MP) land surface model (version 5.0) with enhanced modularity, interoperability, and applicability, Geosci. Model Dev., 16, 5131–5151, <https://doi.org/10.5194/gmd-16-5131-2023>, 2023.

Noah-MP: <https://github.com/NCAR/noahmp/>
BMI: <https://cdms.colorado.edu/wiki/BMI/>

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Noah-OWP-Modular
GitHub Repo

Poster