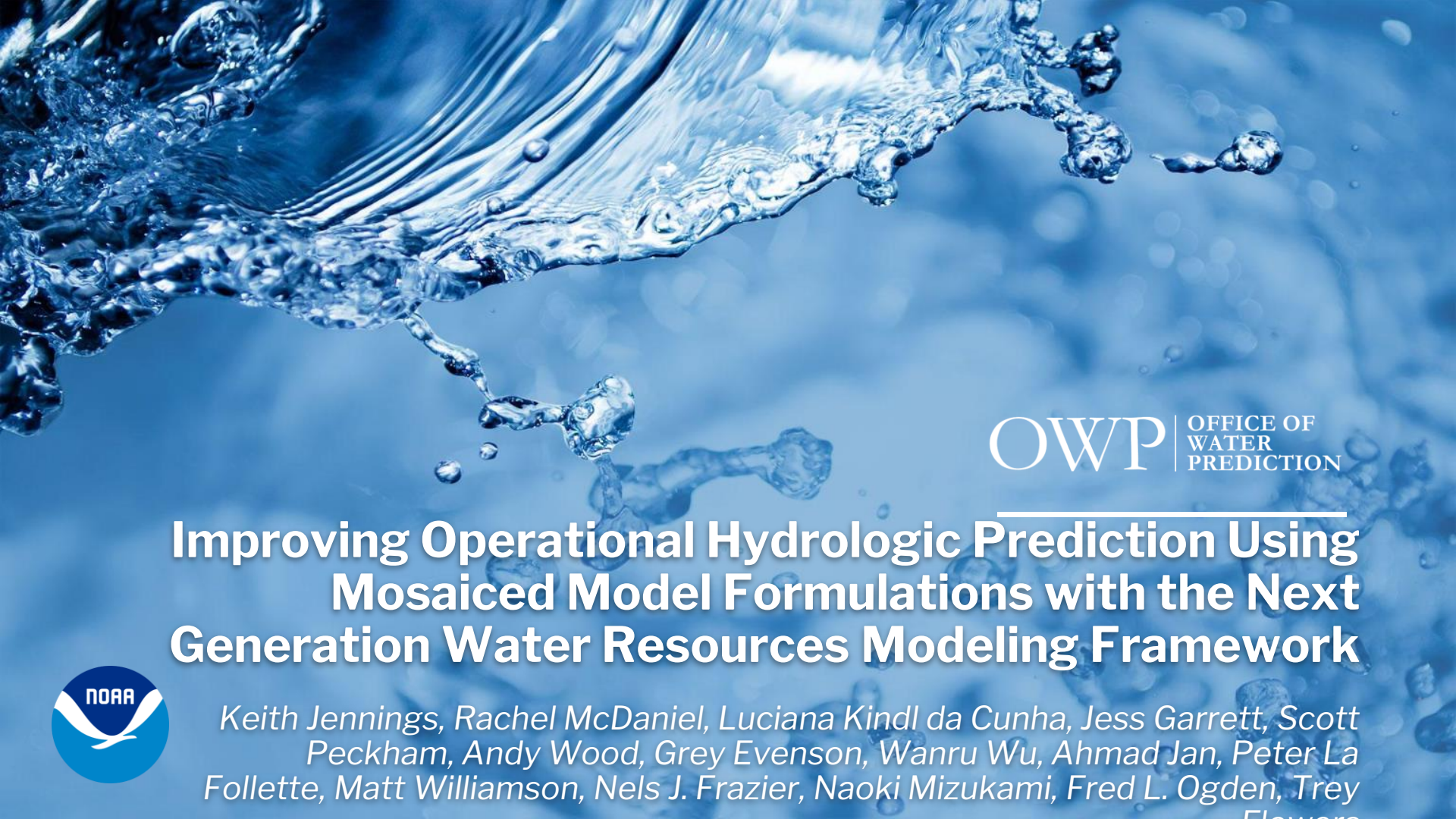


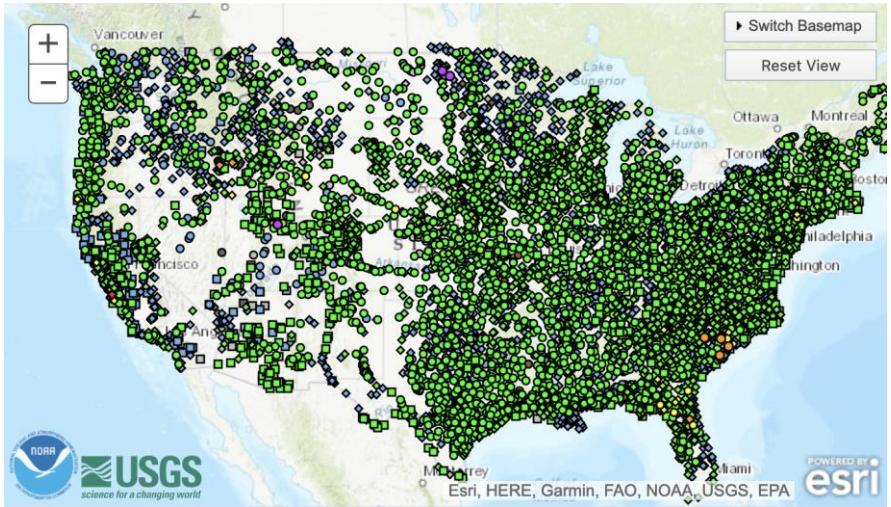
OWP | OFFICE OF WATER PREDICTION

# Improving Operational Hydrologic Prediction Using Mosaiced Model Formulations with the Next Generation Water Resources Modeling Framework

*Keith Jennings, Rachel McDaniel, Luciana Kindl da Cunha, Jess Garrett, Scott Peckham, Andy Wood, Grey Evenson, Wanru Wu, Ahmad Jan, Peter La Follette, Matt Williamson, Nels J. Frazier, Naoki Mizukami, Fred L. Ogden, Trey*

# National Water Model (NWM)

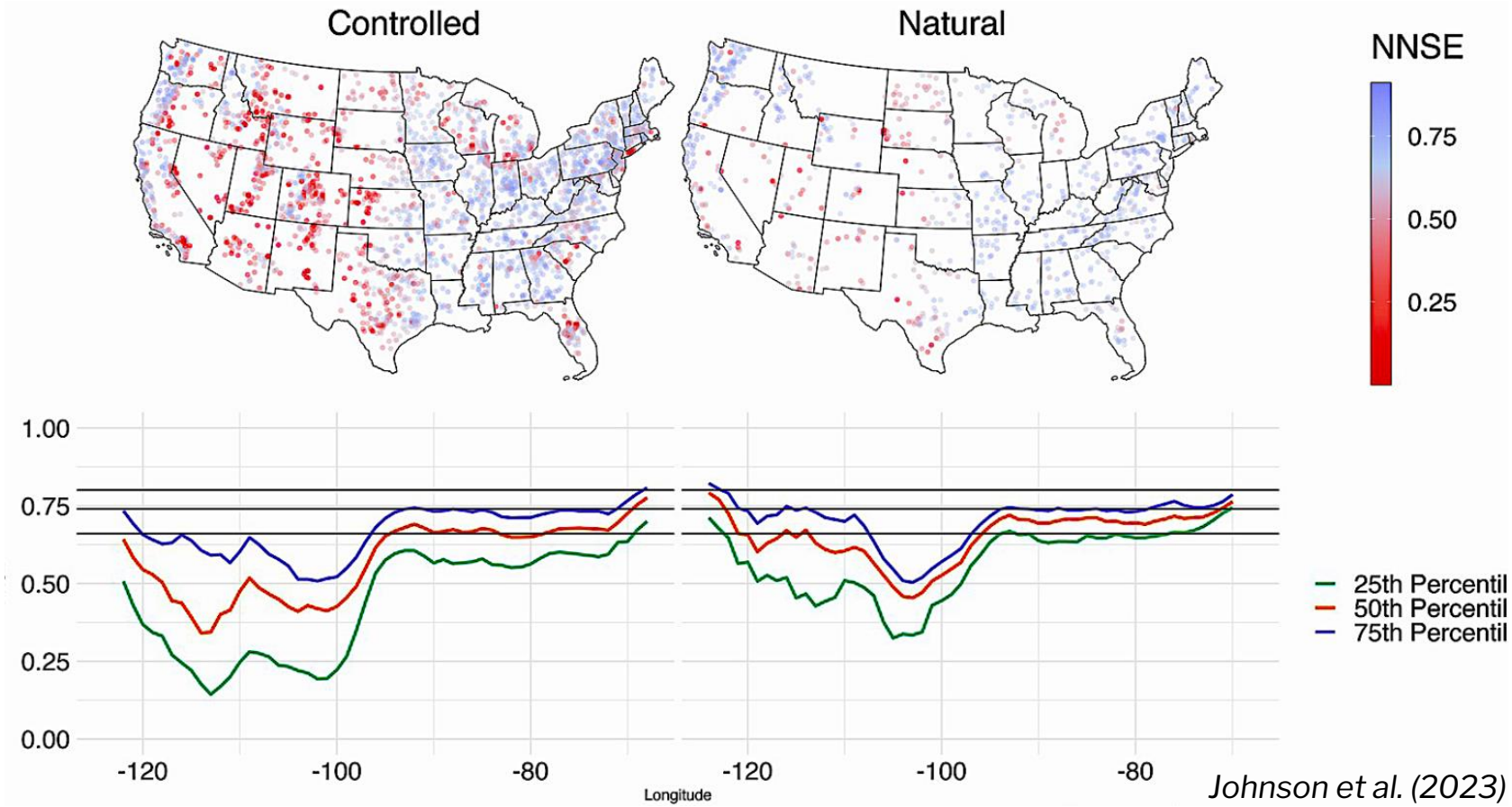
- The NWM first became operational in 2016 with v. 1.0
- It provides complementary and first-time streamflow guidance
  - Increasing guidance from 110,000 river miles to over 3.4 million river miles





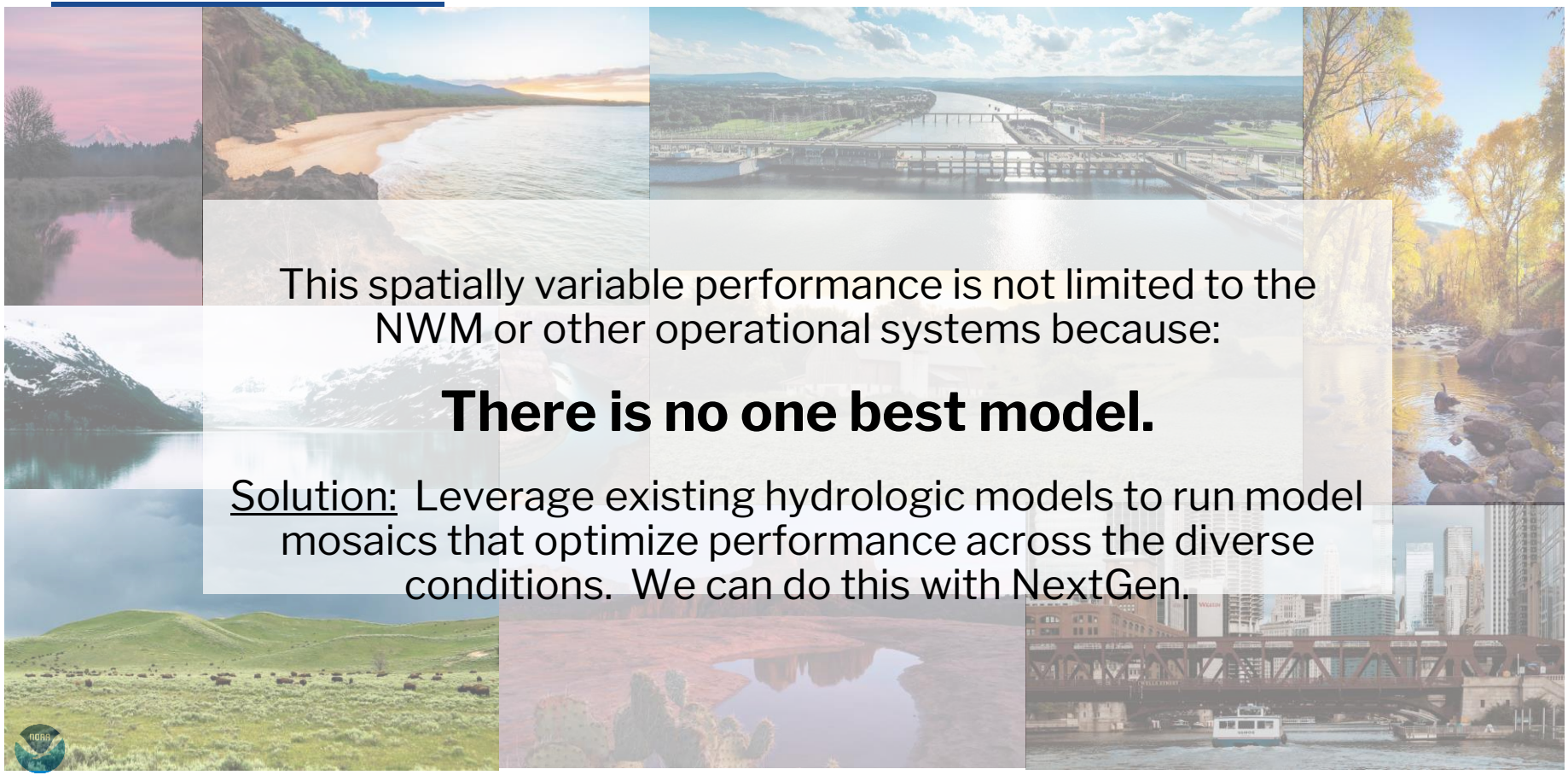
- In 2023, OWP launched v. 3.0, the 7th version of the NWM
  - Domain expansion, more capabilities, version-over-version performance gains

# Spatial variability challenges single-model approaches




*Johnson et al. (2023)*

# Problem

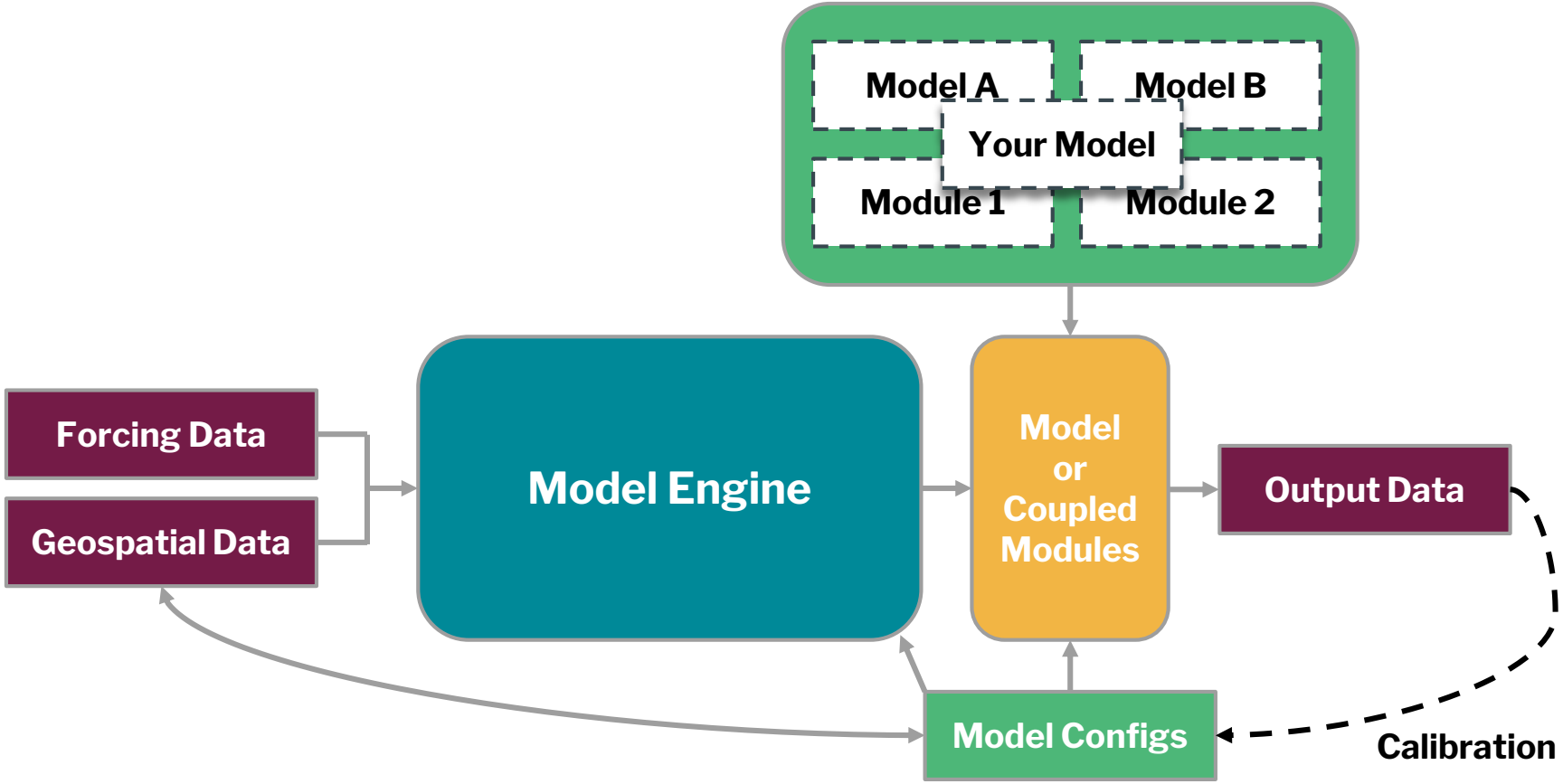


This spatially variable performance is not limited to the NWM or other operational systems because:

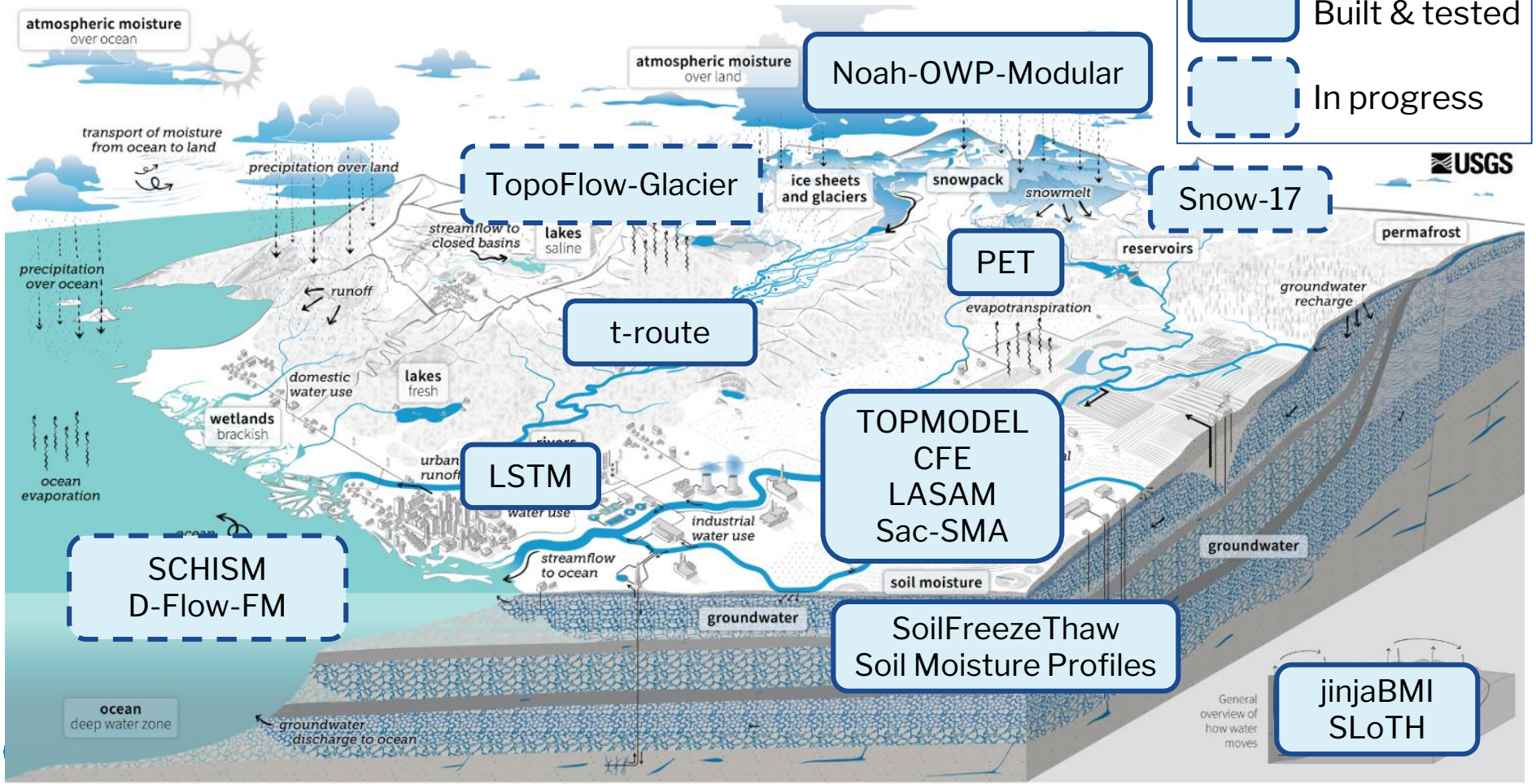
**There is no one best model.**

Solution: Leverage existing hydrologic models to run model mosaics that optimize performance across the diverse conditions. We can do this with NextGen.

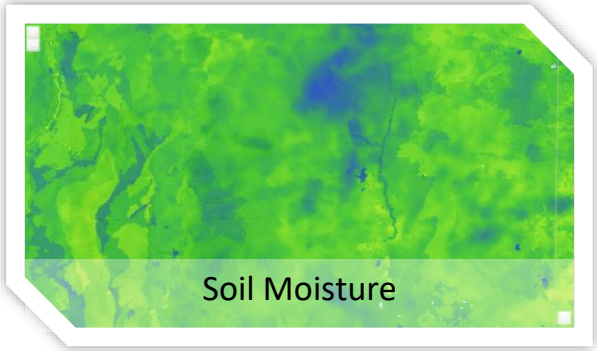
# Next Generation Water Resources Modeling Framework

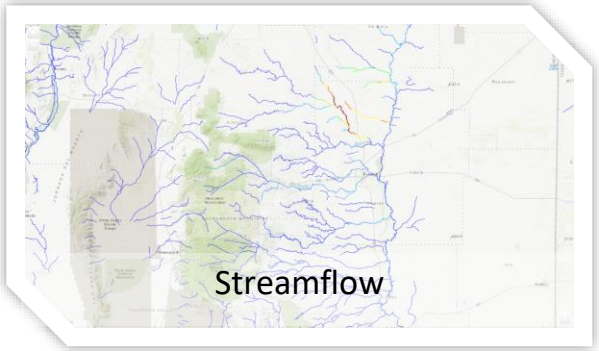


# NextGen Models and Modules



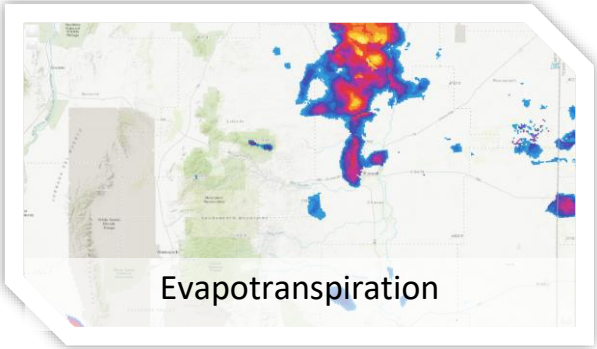
# NextGen formulations to meet OWP operational needs

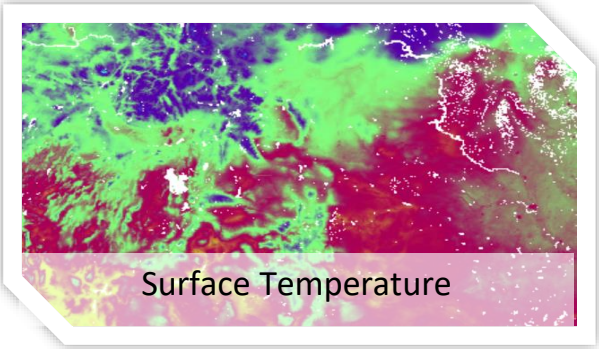


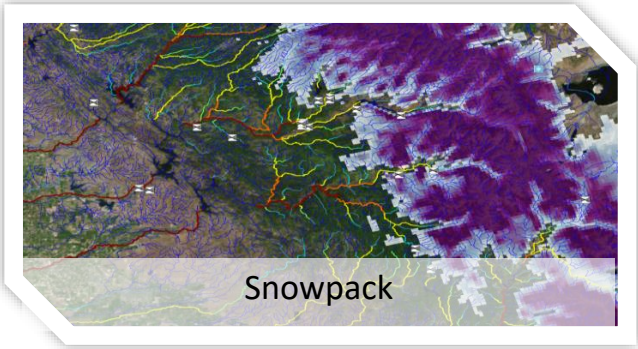




The NWM has a wide range of output variables that need to be produced for an operational model.

A select few are shown.

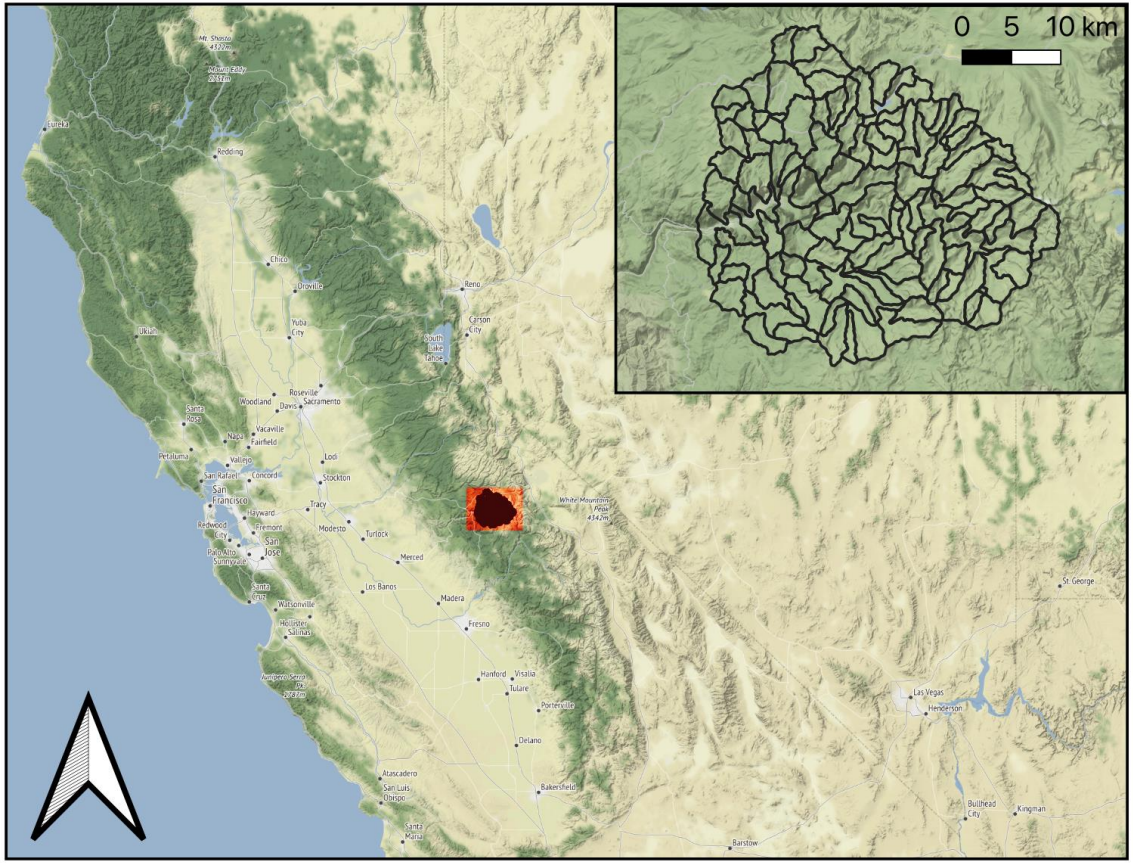


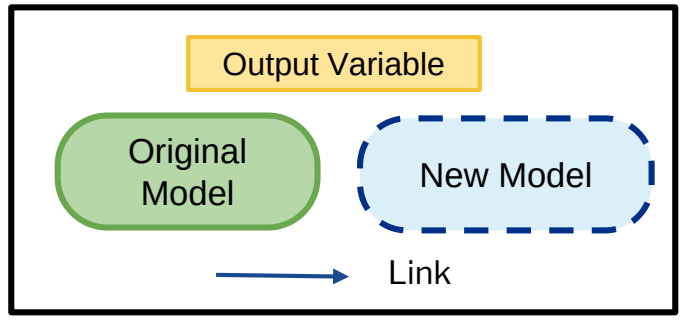
# Merced River headwaters test basin

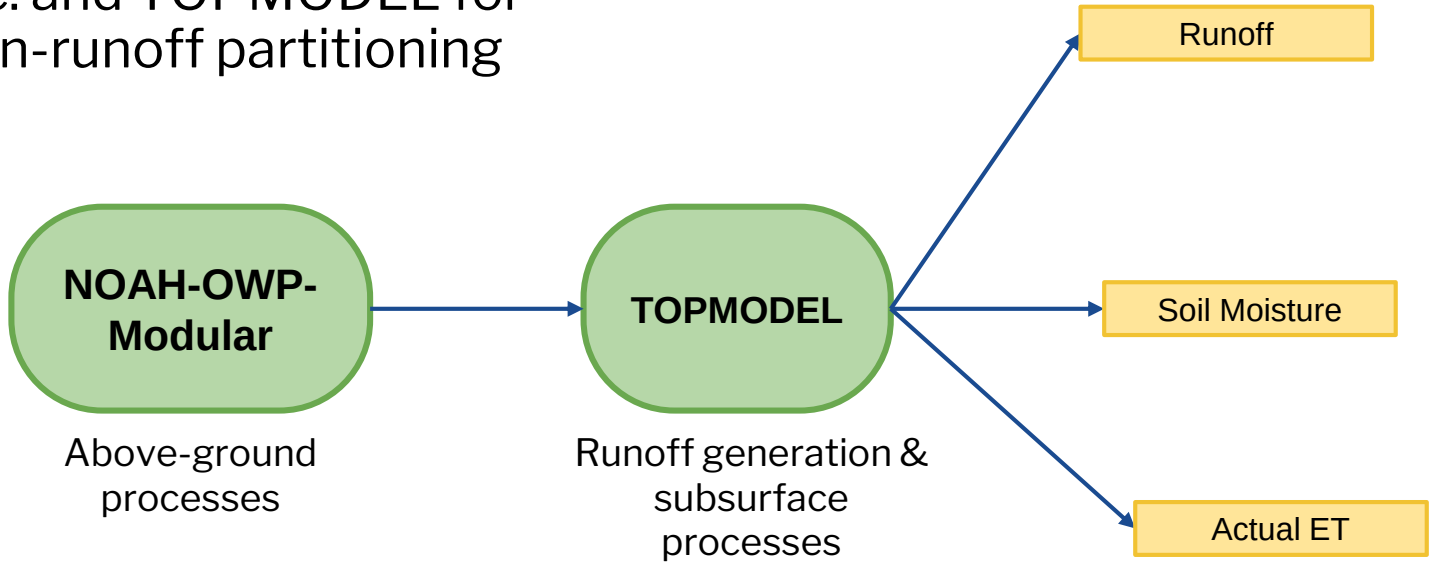
- Sub-basin info:
  - 1714 m to 3484 m elevation
  - 850 mm to 1270 mm annual precipitation
  - 44.4% to 94.4% annual snowfall fraction
- Let's use NextGen to run two formulations



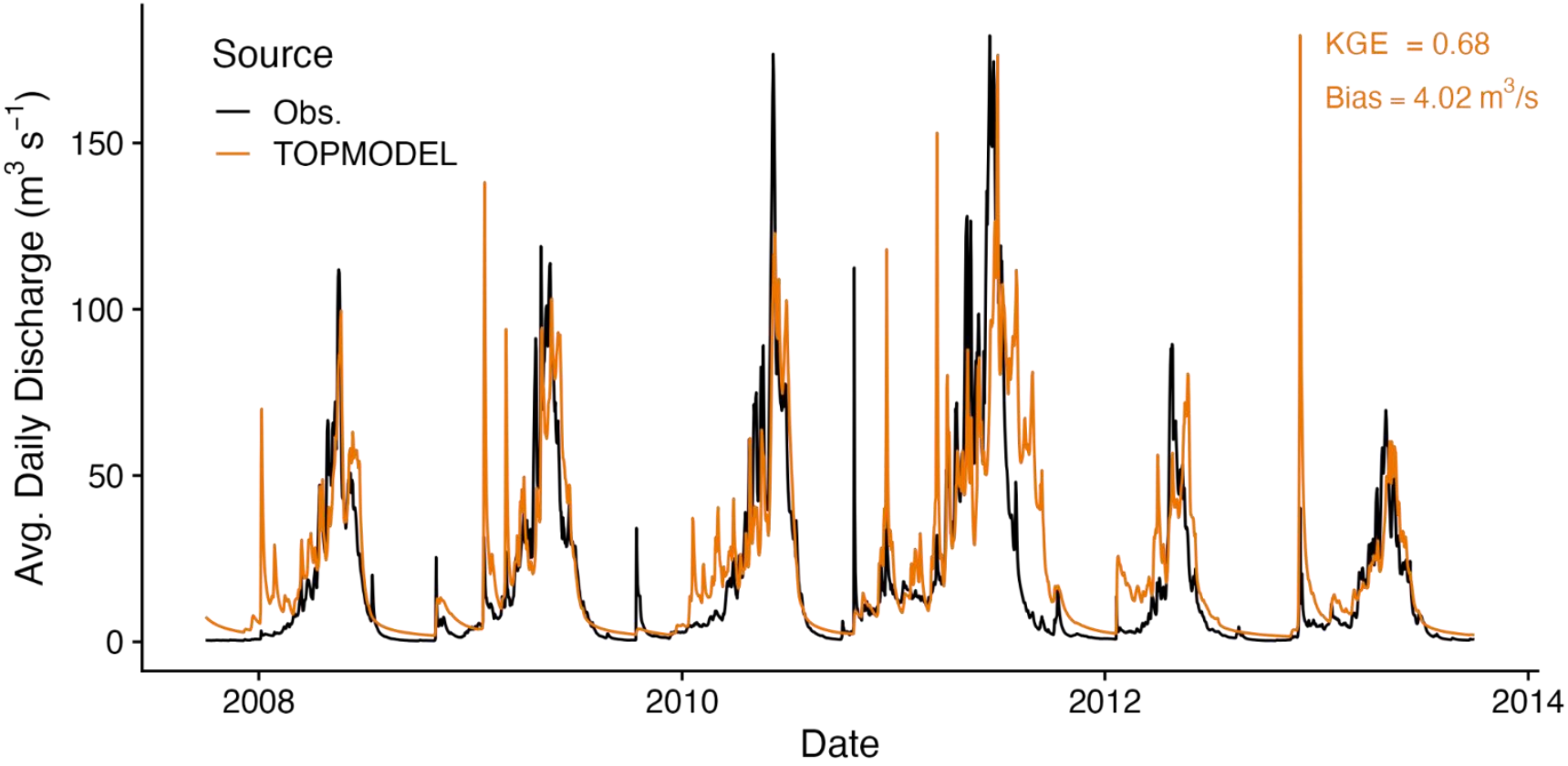
# Example Setup

Mountain basin with Noah-OWP-Modular for interception, snow, etc. and TOPMODEL for infiltration-runoff partitioning



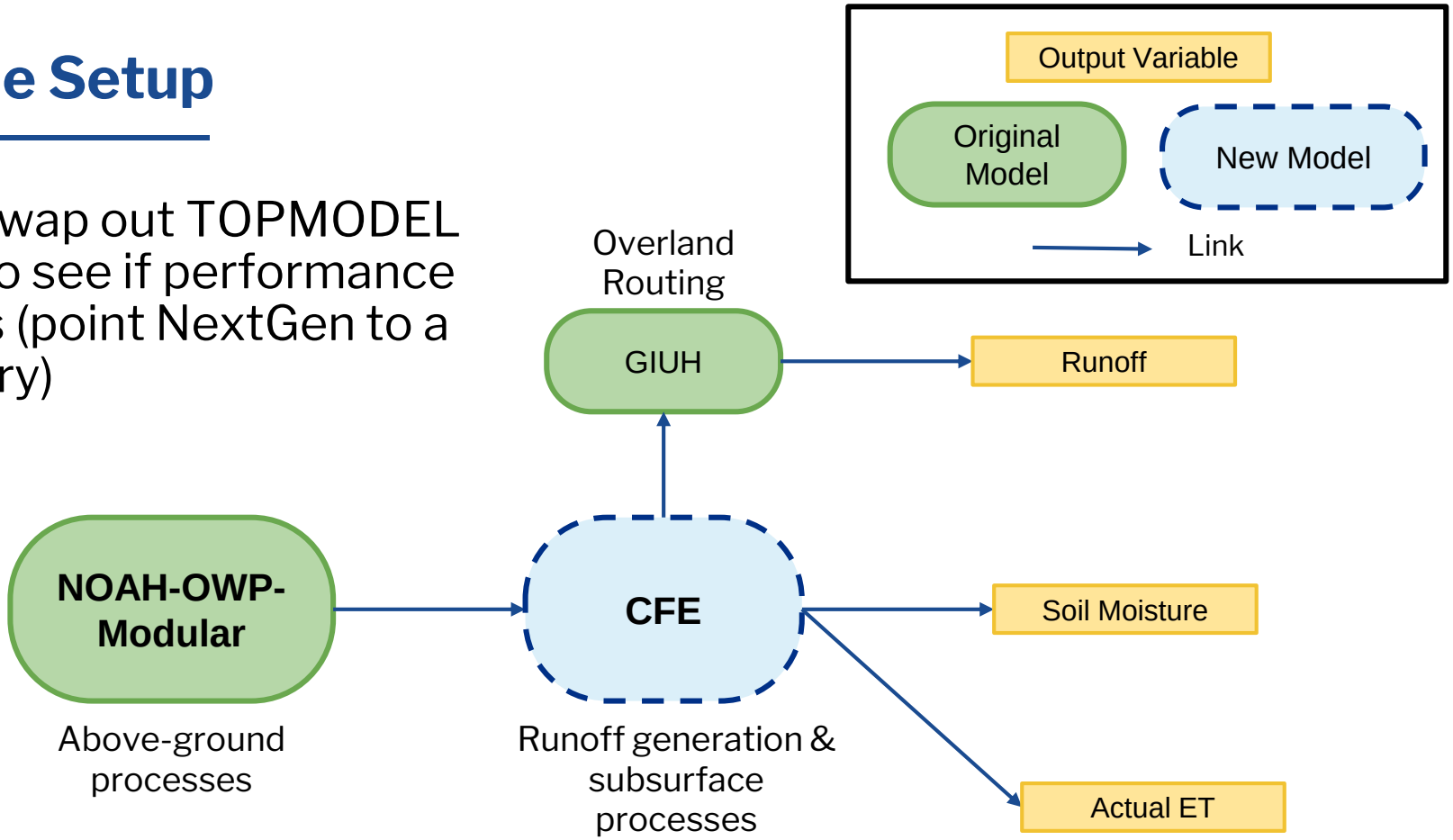



# Noah-OWP-Modular coupled to TOPMODEL

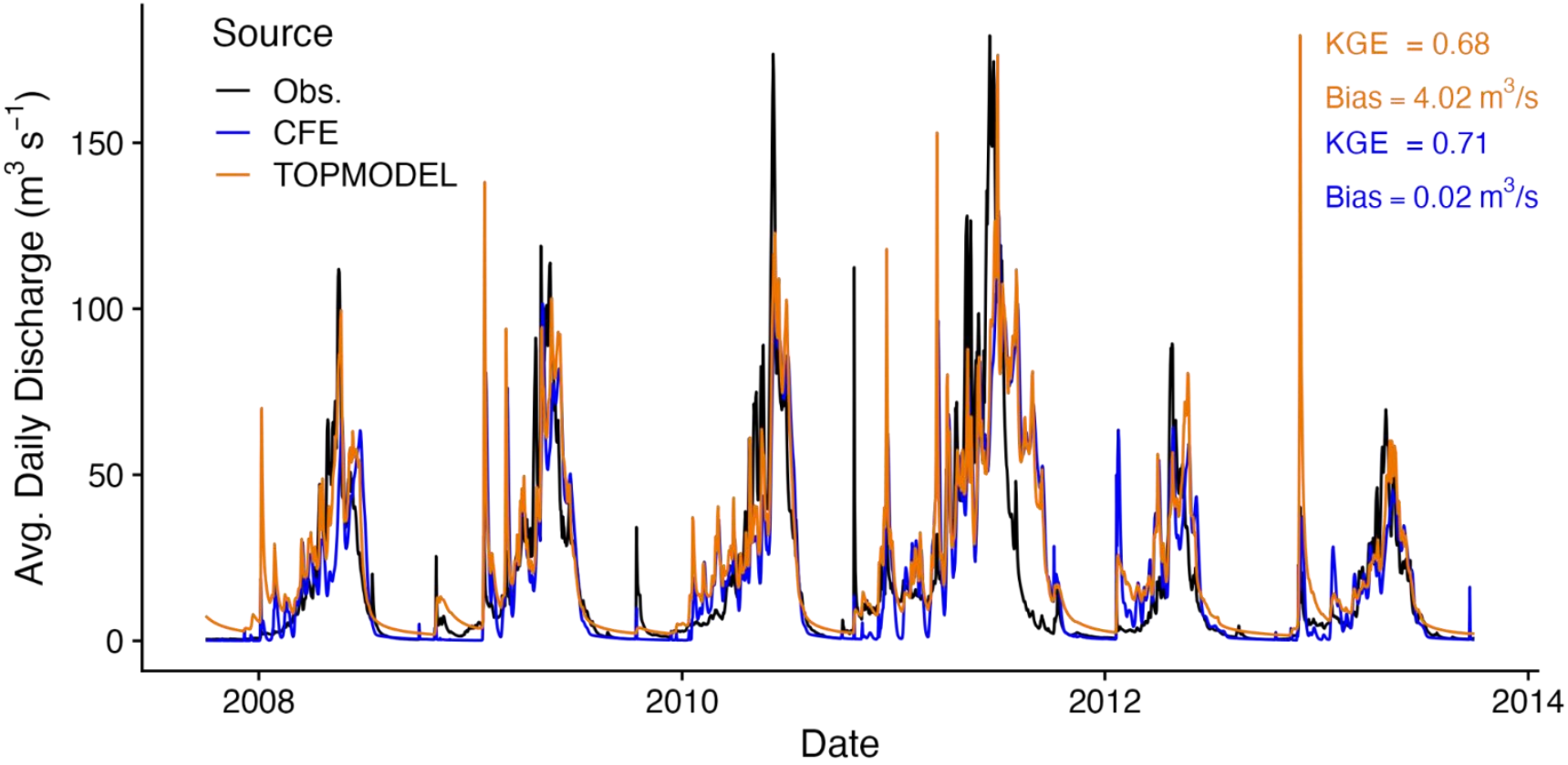


# Example Setup

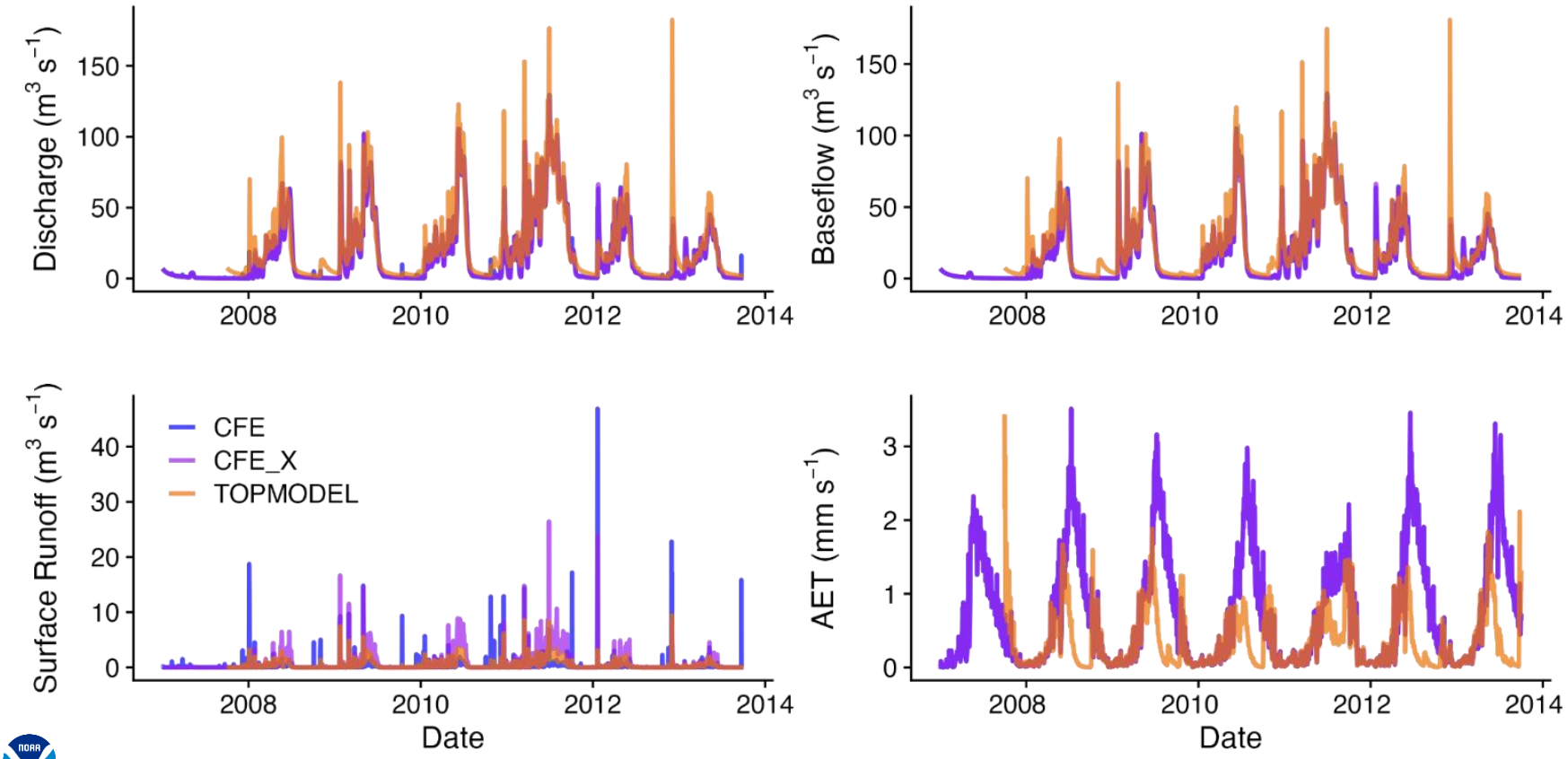
Quickly swap out TOPMODEL for CFE to see if performance improves (point NextGen to a new library)



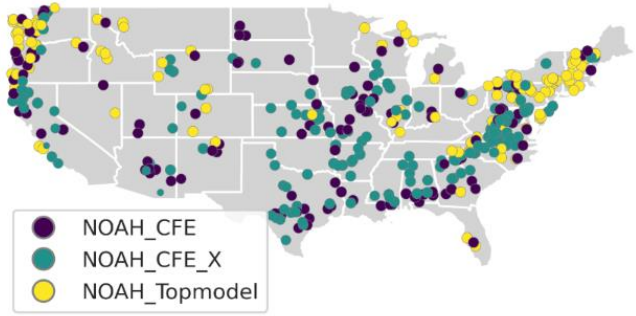
# Noah-OWP-Modular coupled to CFE w/Schaake



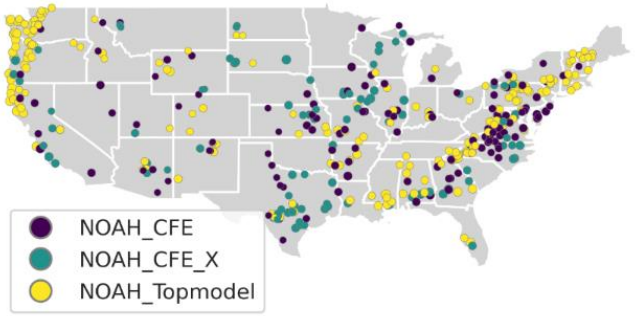
# Example output data from coupled models



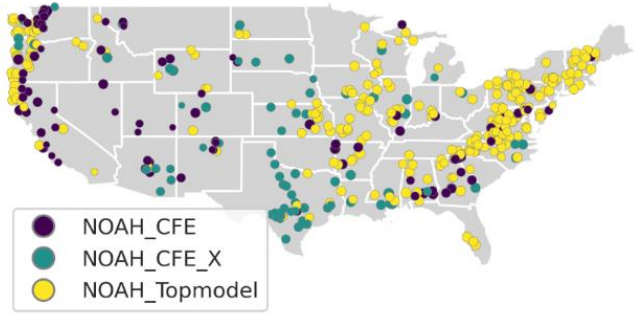
# Using NextGen to identify and run optimized mosaics—quickly and efficiently!



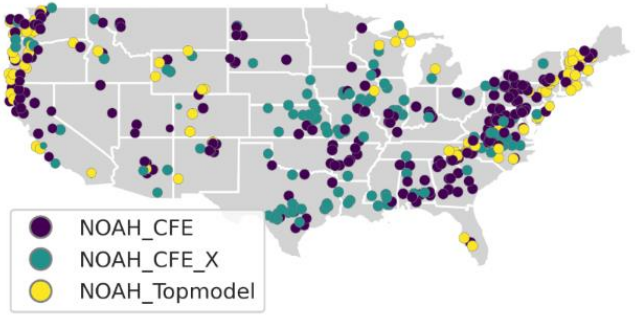

Hydrological Signature




Threat Score (Q> Q95 percentile)




Normalized Nash

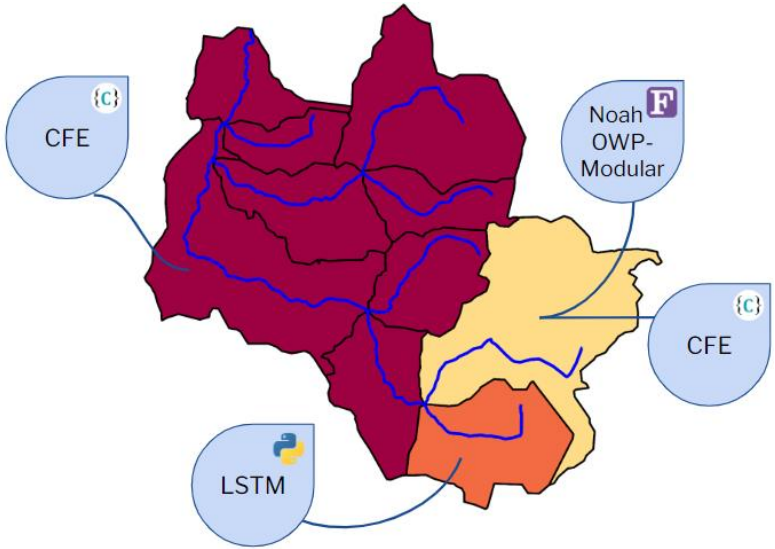



KGE

# What does this all mean?

We can use NextGen to:

- Produce all NWM output variables
- Couple different models and modules using standard forcing and geospatial data
  - Swaps are quick!
- Run model mosaics to maximize continental-scale performance




**Multiple catchments - Multiple formulations**

With NextGen, we can deploy different models in different basins to **run the right model in the right place for optimal performance.**

# Be a NextGen contributor!

- https://github.com/NOAA-OWP ...
  - /ngen
  - /ngen-cal
  - /hydrofabric
  - /noah-owp-modular
  - /cfe
  - /topmodel
  - /lstm
  - /evapotranspiration
  - /soilfreezethaw
  - /snow17
  - /sac-sma
  - /t-route

# *Thank You!*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https://water.noaa.gov

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