

The background of the slide is a high-speed photograph of water splashing, creating a dynamic and textured blue surface with many droplets and ripples.

OWP | OFFICE OF
WATER
PREDICTION

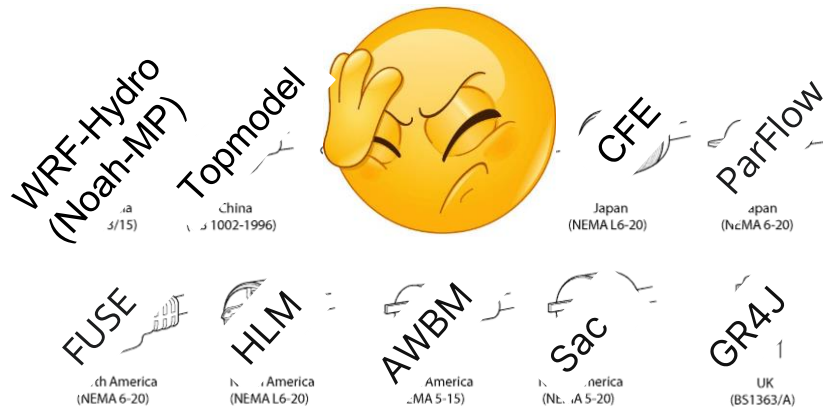
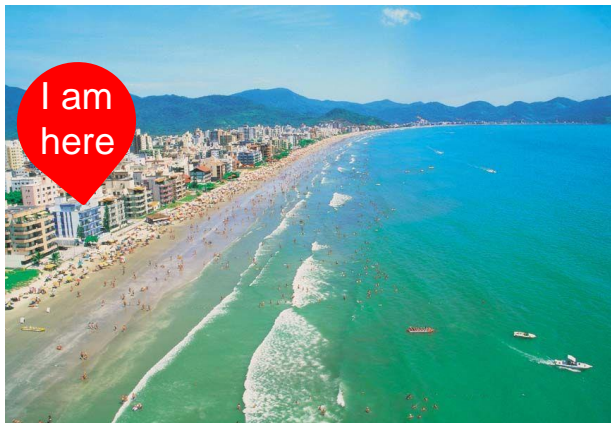
Identifying Optimal Model Sets and Configurations in the Next Generation Water Resources Modeling Framework



The NOAA OWP NextGen Team

Luciana Cunha

NextGen: an analogy



User

Where and how?

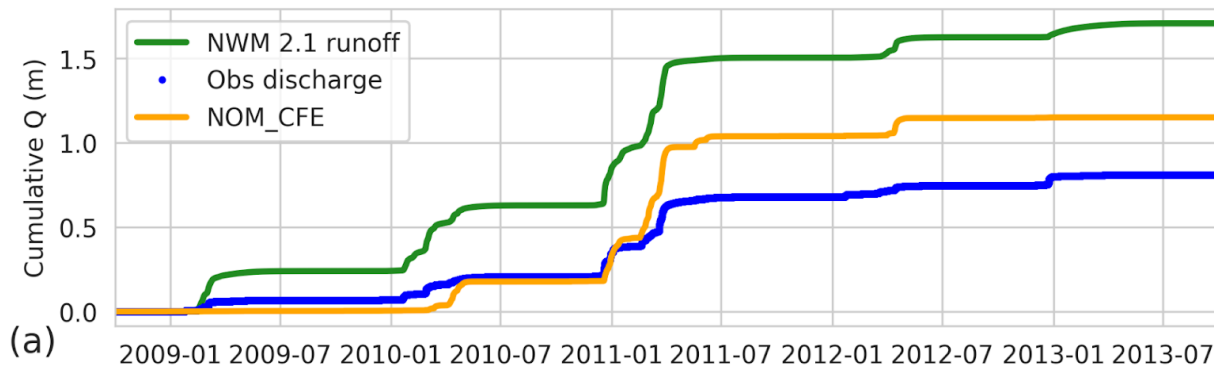
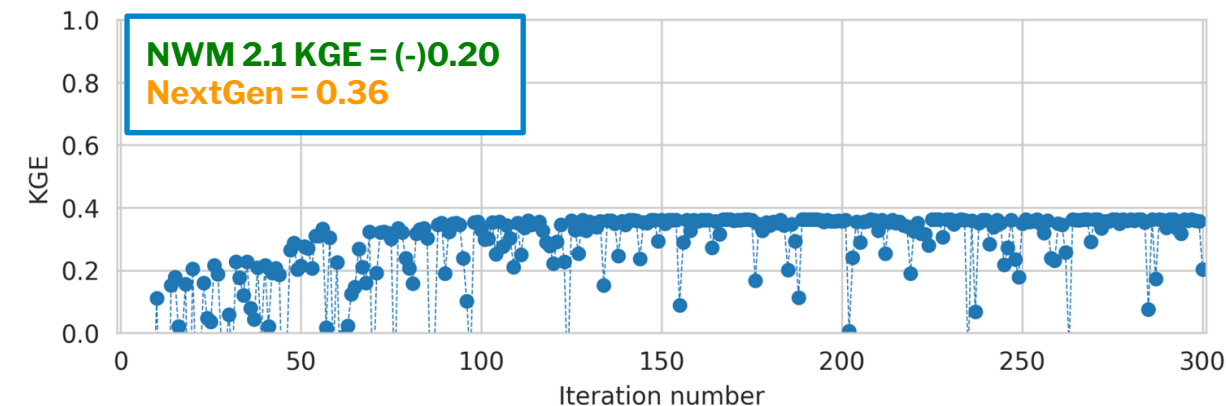


Output

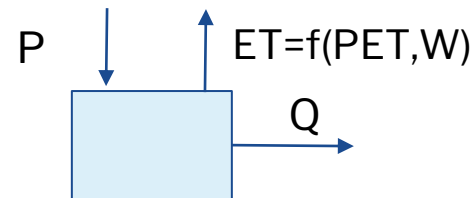
Hydrofabrics, forcing, configuration files, units,
connection between models written in different languages,...

First calibration attempt: not promising

11284400 BIG C AB WHITES GULCH NR GROVELAND CA



(a)



Overestimation of discharge



Underestimation of ET

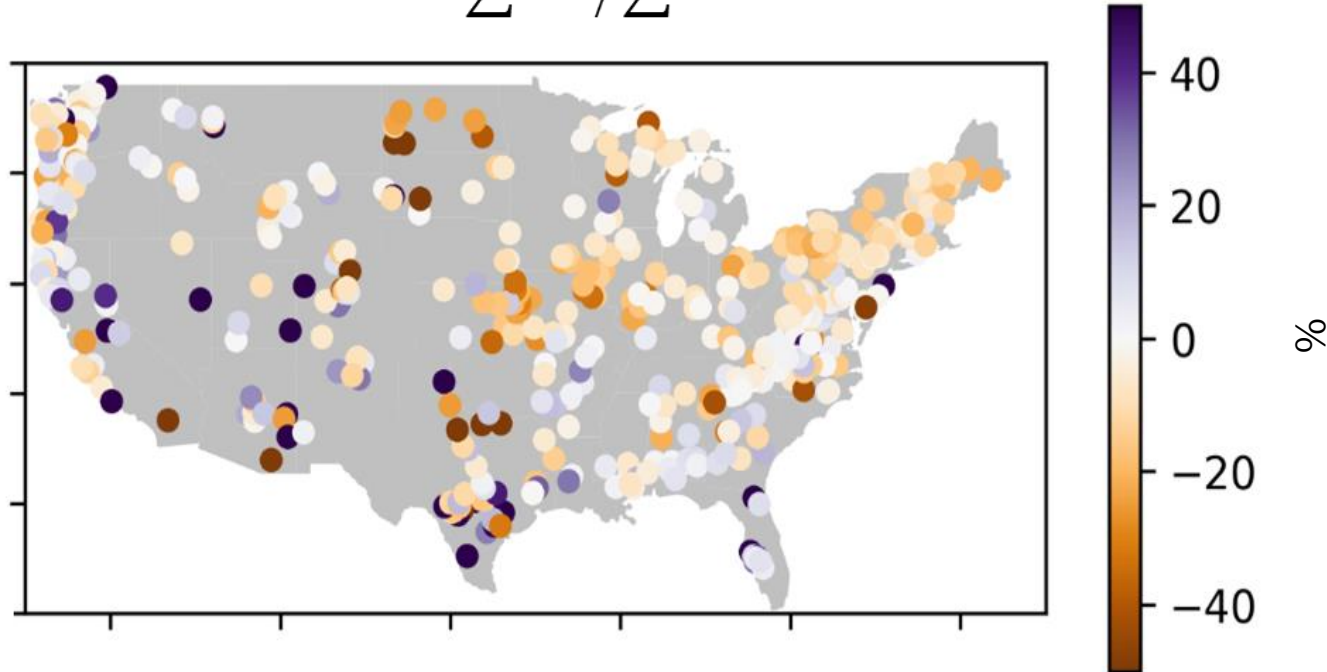
KGE = -0.20

KGE = 0.36

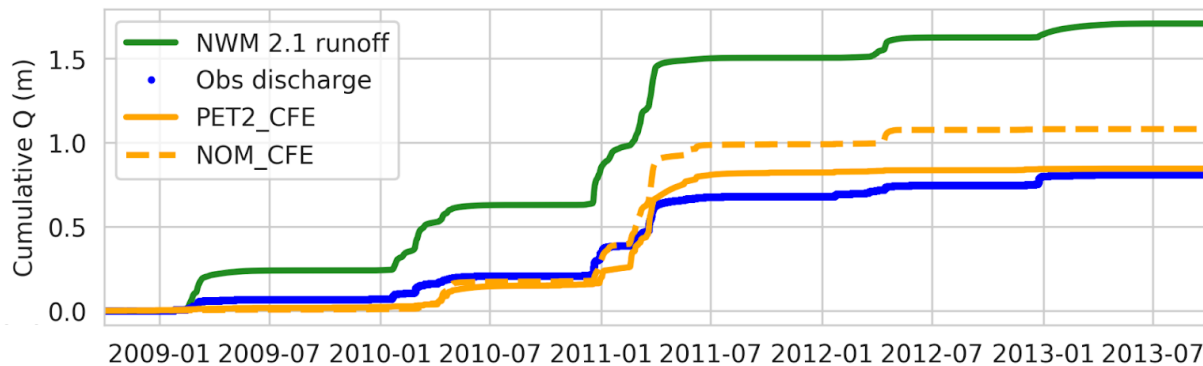
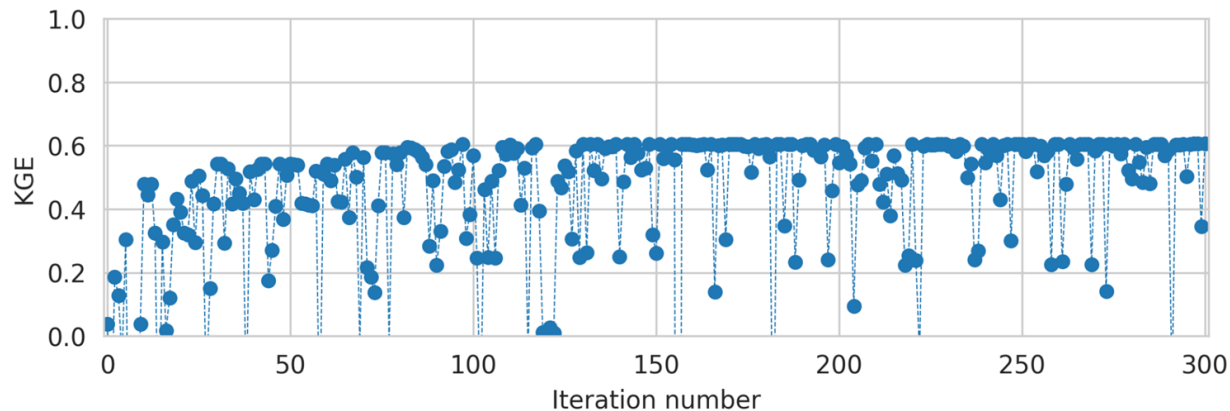
Does the NWM 2.1 (Noah-MP) capture total runoff (AET)?

Relative difference in total runoff [%] =

$$100 * T * \sum Q_{obs} / \sum Q_{sim}$$



Can PET be one of the issues?

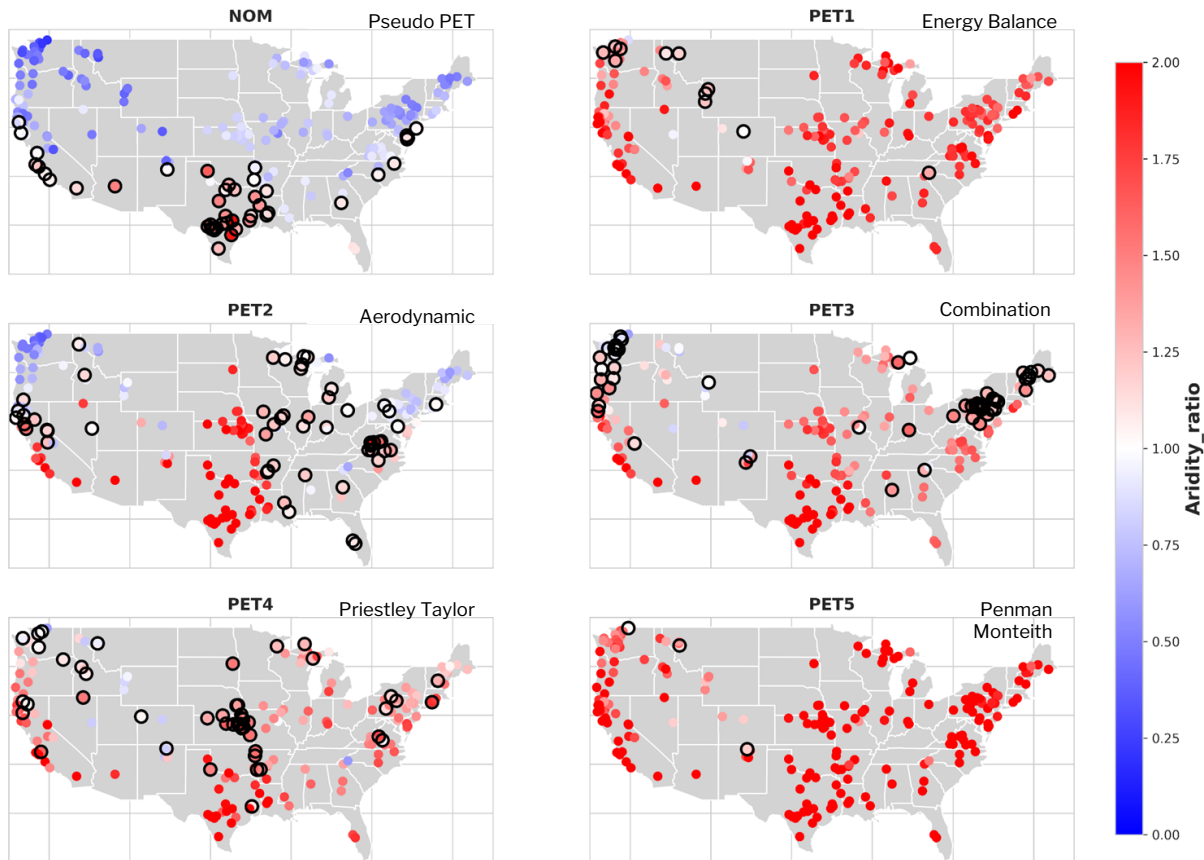


KGE = -0.20

KGE = 0.36

KGE = 0.61

Identifying the optimal surface routine



Aridity index = $PET/Rain$

$AI_{baseline}$ = uses calibrated Priestley-Taylor formulation (CAMELS)

Aridity ratio = $AI_{ngen}/AI_{baseline}$

○ Aridity index > 0.99 and closest to 1

Formulations under consideration

Example Formulation NOM-PET1-CFE		All Combinations	Pre-selected PET
Surface processes (Snow, interception,...)	NOAH-OWP	1 option	1 option
Potential Evapotranspiration	PET-1	6 options	1 option
Rainfall Runoff Overland flow transport Baseflow Groundwater flow	CFE Schaake	3 options	3 options
Routing	T-route	1 option	1 option
		18 formulations = 12,960 iterations /basin	3 formulations = 720 iterations /basin



NextGen vs. NWM 2.1 calibration comparison

NextGen (Objective: $\max(\text{KGE})$)

NWM 2.1

Objective: $\min(1 - (\text{NSE} + \text{LogNSE})/2)$

CFE Schaaake

CFE Xinanjiang

Topmodel

10 parameters
300 iterations

10 parameters
300 iterations

4 parameters
120 iterations

14 parameters
300 iterations

satdk
b
maxsmc
expon
Max_gw_storage
refkdt

satdk
b
maxsmc
expon
Max_gw_storage

t0
szm
srmax
xk0

satdk
b
maxsmc
expon
Max_gw_storage
refkdt

Cgw
satpsi
Klf
Kn

Cgw
satpsi
Klf
Kn
x_Xinanjiang_shape

Rsurfexp
Slope
RETDEPRTFAC
LKSATFAC
CWPVT
VCMX25
MP
MFSNO

Green: also calibrated for the NWM, Purple: Unique of CFE,

Magenta: parameters that affect AET in NWM calibration

Same calibration period: 2008-2013



NextGen vs. NWM 2.1 calibration comparison

NextGen (Objective: $\max(\text{KGE})$)

CFE Schaake

CFE Xinanjiang

Topmodel

DOES NOT CALIBRATE:

Snow
Actual evapotranspiration
Pounding water

Overland flow:
Uses a simple GIUH

NWM 2.1

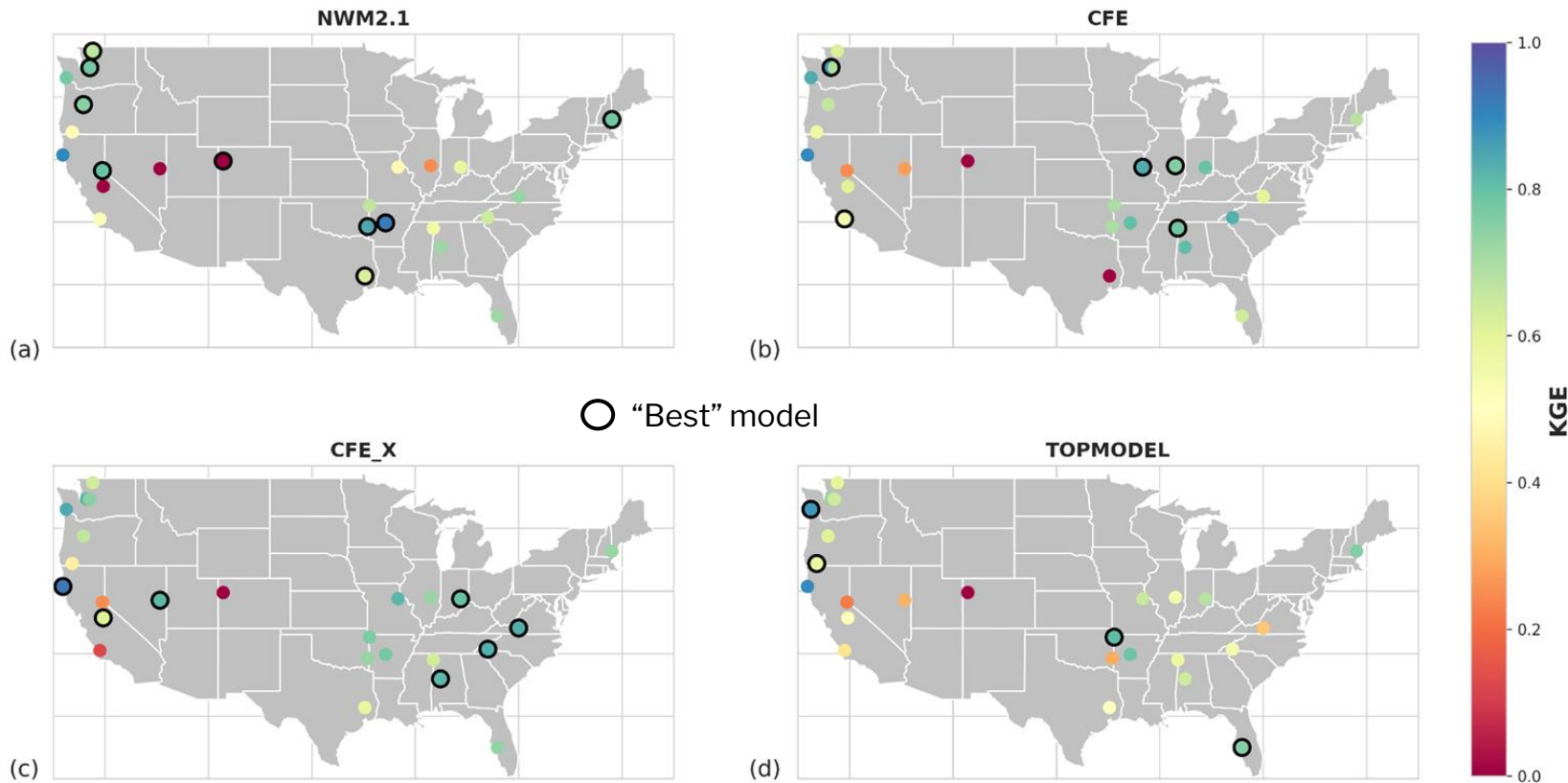
Objective: $\min(1 - (\text{NSE} + \text{LogNSE})/2)$

CALIBRATES:

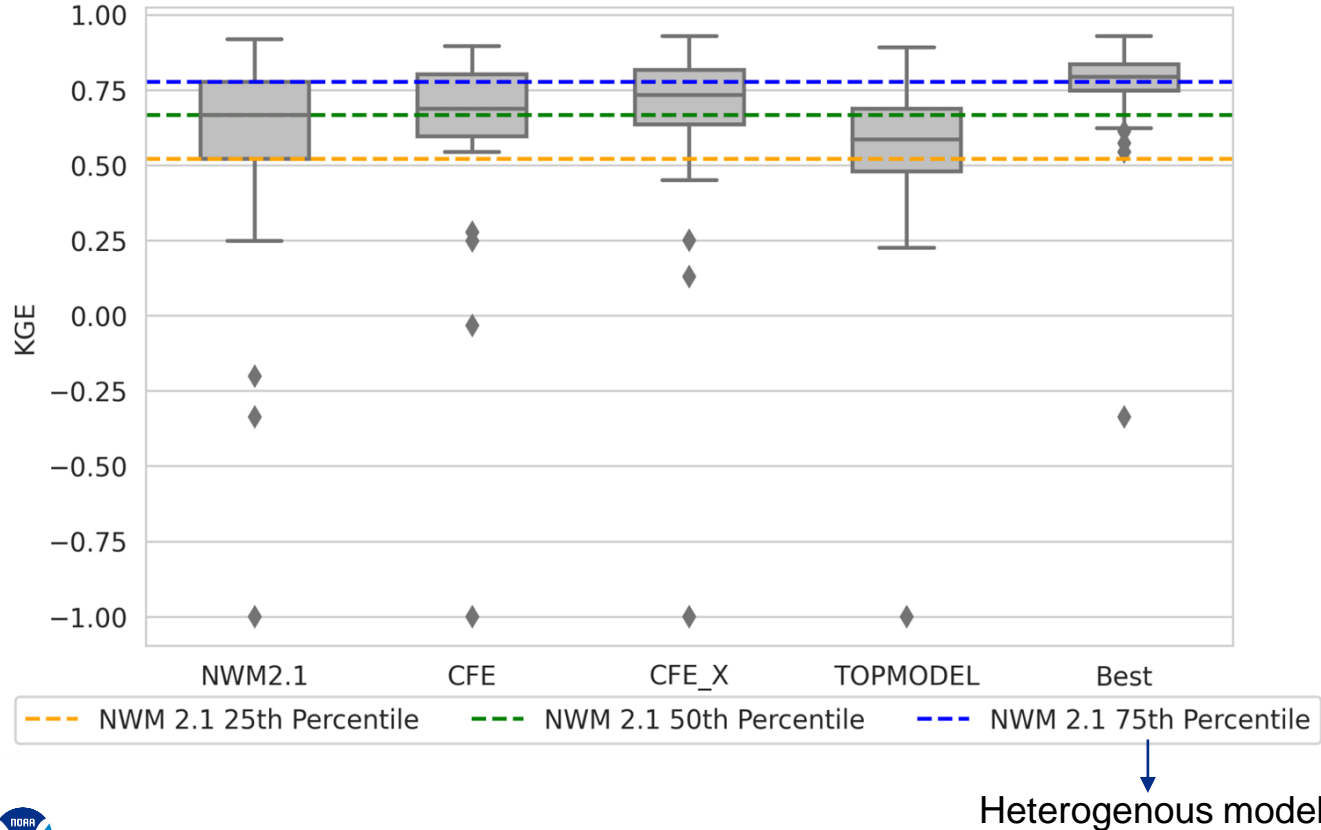
Snow
Actual evapotranspiration
Pounding water

Overland flow:
250 x 250 grid

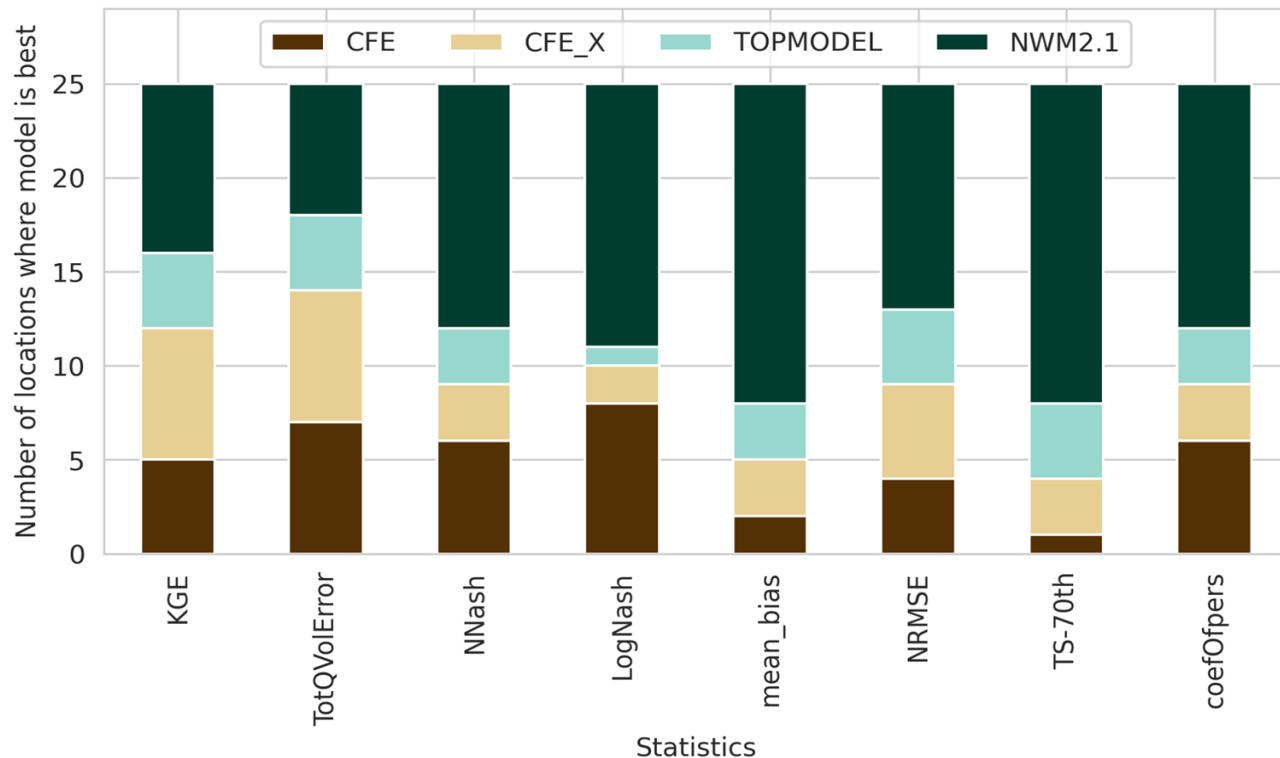
Spatially variable outcomes in performance



Heterogeneous formulations provide optimal performance

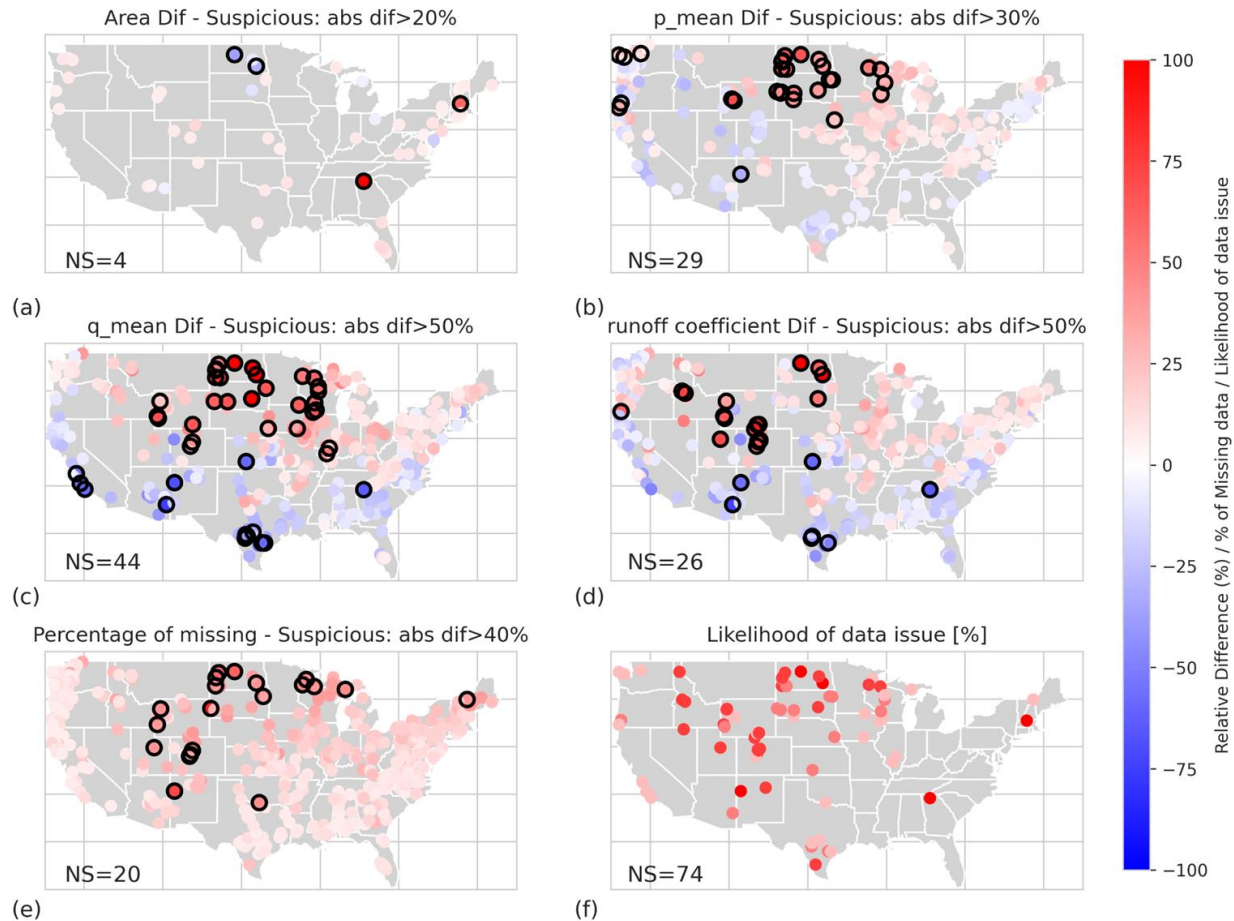


“Best” formulation varies by performance metric



TotVolError: relative difference in total runoff; **TS-70th**: thread score using 70% percentile as threshold; **coefOfPers**: Coefficient of persistence

Should we always blame the models? Data challenges



In summary: the working hypothesis works

- ✓ Showoff capabilities: NextGen + hydrofabrics + Model as a Surface
- ✓ Demonstrate: heterogeneous approach is the superior approach
- ✓ Test NextGen and model formulations

Future work:

- Additional locations
- Other models
 - Snow-17, Sac-SMA, LGAR, LSTM, TopoFlow, and others
- Improve other processes (e.g. snow)
- Translate into operational systems

**Many hands make light work:
thank you NextGen workstreams
& community!**





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Thank You!



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<https://water.noaa.gov>