



*Supplement of*

**A methodological framework for improving the performance of data-driven models: a case study for daily runoff prediction in the Maumee domain, USA**

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## **Introduction**

The supplementary information contains the list of 72 candidate variables from NOAA's NWM (Table S1), among which we selected seven influential variables for the Maumee Domain (Table S2).

**Table S1.** List of candidate variables from the National Water Model.

No.	Variable Name	Definition	Units
1.	SWFORC	Shortwave radiation forcing	$W m^{-2}$
2.	LWFORC	Longwave radiation forcing	$W m^{-2}$
3.	RAINRATE	Precipitation in model timestep	$mm s^{-1}$
4.	EMISS	Emissivity: grid-average	-
5.	FSA	Total absorbed SW radiation	$W m^{-2}$
6.	FIRA	Total net LW radiation (+ to atmosphere)	$W m^{-2}$
7.	HFX	Sensible heat flux: grid-average (+ to atmosphere)	$W m^{-2}$
8.	LH	Latent heat flux: grid-average (+ to atmosphere)	$W m^{-2}$
9.	EDIR	Direct soil evaporation rate	$kg m^{-2} hr^{-1}$
10.	ETRAN	Transpiration rate	$kg m^{-2} hr^{-1}$
11.	ZWT	Depth to the water table	m
12.	WA	Water in aquifer	$kg m^{-2}$
13.	WT	Water in aquifer and saturated soil	$kg m^{-2}$
14.	TR	Transpiration heat flux	$W m^{-2}$
15.	IRG	Ground net longwave radiation	$W m^{-2}$
16.	SHG	Ground sensible heat	$W m^{-2}$
17.	EVG	Ground evaporation heat	$W m^{-2}$
18.	SAG	Solar radiation absorbed by the ground	$W m^{-2}$
19.	IRB	Net emitted longwave radiation by the bare ground	$W m^{-2}$
20.	SHB	Sensible heat flux by the bare ground to the atmosphere	$W m^{-2}$
21.	EVB	Latent heat flux by the bare ground to the atmosphere	$W m^{-2}$
22.	TRAD	Surface radiative temperature	K
23.	TG	Ground temperature	K
24.	TGV	Ground temperature with vegetated ground	K

25.	TGB	Ground temperature with bare ground	K
26.	T2MV	2m temperature with vegetated ground	K
27.	Q2MV	2m mixing ratio with vegetated ground	kg kg <sup>-1</sup>
28.	ZSNSO_SN	Snow layer depths from snow surface	m
29.	SNICE	Snow layer ice	mm
30.	SNLIQ	Snow later liquid water	mm
31.	SOIL_T1	Soil temperature at the top layer	K
32.	SOIL_T2	Soil temperature at layer 2	K
33.	SOIL_T3	Soil temperature at layer 3	K
34.	SOIL_T4	Soil temperature at the bottom layer	K
35.	SOIL_W1	Liquid volumetric soil temperature at the top layer	m <sup>3</sup> m <sup>-3</sup>
36.	SOIL_W2	Liquid volumetric soil temperature at layer 2	m <sup>3</sup> m <sup>-3</sup>
37.	SOIL_W3	Liquid volumetric soil temperature at layer 3	m <sup>3</sup> m <sup>-3</sup>
38.	SOIL_W4	Liquid volumetric soil temperature at the bottom layer	m <sup>3</sup> m <sup>-3</sup>
39.	SNOW_T	Snow temperature	K
40.	SNOWH	Snow depth	m
41.	SNEQV	Snow water equivalent	kg m <sup>-2</sup>
42.	QSNOW	Snowfall rate at the surface	mm hr <sup>-1</sup>
43.	ISNOW	Number of snow layers	-
44.	FSNO	Fraction of surface covered with snow	fraction
45.	ACSNOW	Accumulated snowfall	mm
46.	ACSNOM	Accumulated melting water out of snow bottom	mm
47.	CM	Momentum drag coefficient	-
48.	CH	Grid average sensible heat exchange coefficient	-
49.	CHV	Exchange coefficient from vegetation to atmosphere	m hr <sup>-1</sup>
50.	CHB	Exchange coefficient from the bare ground	m hr <sup>-1</sup>
51.	CHLEAF	Exchange coefficient from leaf surface	m hr <sup>-1</sup>

52.	CHUC	Exchange coefficient from below the canopy	$\text{m hr}^{-1}$
53.	CHV2	Exchange coefficient from the vegetation to atmosphere at 2m	$\text{m hr}^{-1}$
54.	CHB2	Exchange coefficient from the bare ground at 2m	$\text{m hr}^{-1}$
55.	RTMASS	Root carbon mass	$\text{g C m}^{-2}$
56.	STMASS	Stem carbon mass	$\text{g C m}^{-2}$
57.	WOOD	Wood and woody roots carbon mass	$\text{g C m}^{-2}$
58.	NEE	Net ecosystem exchange	$\text{g m}^{-2} \text{hr}^{-1}$ $\text{CO}_2$
59.	GPP	Net instantaneous carbon assimilation	$\text{g m}^{-2} \text{hr}^{-1} \text{C}$
60.	ACCET	Accumulated total evapotranspiration	mm
61.	SOILICE	Fraction of soil moisture that is ice	fraction
62.	SOILSAT	Fraction of soil saturation, column integrated	fraction
63.	SNOWT_AVG	Average snow temperature (by layer mass)	K
64.	ZWATTABLRT	Depth of saturated layers	m
65.	QBDRYRT	Accumulated flow volume routed outside of the domain	mm
66.	SFHEADSUBRT	Depth of ponded water on the surface	mm
67.	QQSFC_ACC	Accumulated depth of surface water leaving a cell	mm
68.	SOIL_M1	Volumetric soil moisture in the top layer	$\text{m}^3 \text{m}^{-3}$
69.	SOIL_M2	Volumetric soil moisture in layer 2	$\text{m}^3 \text{m}^{-3}$
70.	SOIL_M3	Volumetric soil moisture in layer 3	$\text{m}^3 \text{m}^{-3}$
71.	SOIL_M4	Volumetric soil moisture in the bottom layer	$\text{m}^3 \text{m}^{-3}$
72.	ALBEDO	Surface albedo	-

**Table S2.** Influential variables for the Maumee Domain.

<b>No</b>	<b>Variables</b>	<b>Definition</b>	<b>Units</b>
1	RAINRATE	Daily Precipitation	mm d <sup>-1</sup>
2	ACSNOM	Daily accumulated melting water out of snow bottom	mm d <sup>-1</sup>
3	SFHEADSUBRT	Daily average depth of ponded water on the surface	mm d <sup>-1</sup>
4	FIRA	Total net LW radiation (+ to atmosphere) per day	W m <sup>-2</sup> d <sup>-1</sup>
5	SOIL_T4	Daily average soil temperature at the bottom layer	K d <sup>-1</sup>
6	SOIL_M3	Daily average volumetric soil moisture in layer 3	m <sup>3</sup> m <sup>-3</sup> d <sup>-1</sup>
7	SOILSAT	Fraction of soil saturation, column integrated per day	d <sup>-1</sup>