

Supporting Information for

A methodological framework for improving the performance of data-driven models, a case study for daily runoff prediction in the Maumee domain, U.S.

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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 |

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|-----|----------|--|--------------------------------|
| 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 ⁻¹ |
| 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 ³ m ⁻³ |
| 36. | SOIL_W2 | Liquid volumetric soil temperature at layer 2 | m ³ m ⁻³ |
| 37. | SOIL_W3 | Liquid volumetric soil temperature at layer 3 | m ³ m ⁻³ |
| 38. | SOIL_W4 | Liquid volumetric soil temperature at the bottom layer | m ³ m ⁻³ |
| 39. | SNOW_T | Snow temperature | K |
| 40. | SNOWH | Snow depth | m |
| 41. | SNEQV | Snow water equivalent | kg m ⁻² |
| 42. | QSNOW | Snowfall rate at the surface | mm hr ⁻¹ |
| 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 ⁻¹ |
| 50. | CHB | Exchange coefficient from the bare ground | m hr ⁻¹ |
| 51. | CHLEAF | Exchange coefficient from leaf surface | m hr ⁻¹ |

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|-----|-------------|--|---|
| 52. | CHUC | Exchange coefficient from below the canopy | m hr^{-1} |
| 53. | CHV2 | Exchange coefficient from the vegetation to atmosphere at 2m | m hr^{-1} |
| 54. | CHB2 | Exchange coefficient from the bare ground at 2m | m hr^{-1} |
| 55. | RTMASS | Root carbon mass | g C m^{-2} |
| 56. | STMASS | Stem carbon mass | g C m^{-2} |
| 57. | WOOD | Wood and woody roots carbon mass | g C m^{-2} |
| 58. | NEE | Net ecosystem exchange | $\text{g m}^{-2} \text{hr}^{-1}$ 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.

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