**Supplemental Material for:**

# The Applicability of SWOT's Non-Uniform Space-Time Sampling in Hydrologic Model Calibration

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Table S1 provides details for the USGS gauges used in the study, active between 2010–2018. Table S2 compares statistics for the top 3 model choices depending on which timeseries was used for calibration. Figure S1 plots Kling-Gupta Efficiency (KGE) values vs drainage area for all three calibration methods across the 39 gauges. Tables S3, S4, and S5 provide detailed results of the sensitivity analyses using different synthetic mission lifetimes. Comparisons use different discharge timeseries for hydrologic model calibration: daily gauge (Qg), SWOT temporal sampling (Qgs), and synthetic SWOT sampling with uncertainty as well as the temporal sampling (Qs).

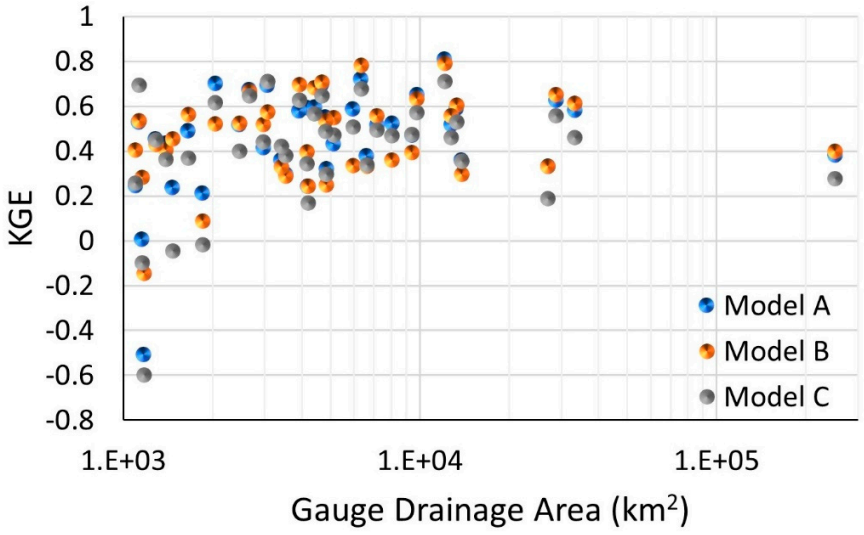


**Figure S1.** Plot of KGE vs. Drainage area across all 39 gauges for each timeseries calibration method (Qg, Qgs, and Qs).

**Table S1**. IDs, locations, and drainage areas for 39 USGS gauges in the Ohio River basin.

| Gauge ID | Gauge Station Name | Lat (dec) | Long (dec) | Area (sqkm) |
|---|---|---|---|---|
| **03011020** | Allegheny River at Salamanca, NY | 42.156 | –78.715 | 4165 |
| **03024000** | French Creek at Utica, PA | 41.438 | –79.956 | 2663 |
| **03030500** | Clarion River near Piney, PA | 41.193 | –79.440 | 2463 |
| **03041500** | Conemaugh River at Seward, PA | 40.419 | –79.026 | 1852 |
| **03057000** | Tygart Valley River at Colfax, WV | 39.435 | –80.133 | 3530 |
| **03075070** | Monongahela River at Elizabeth, PA | 40.262 | –79.901 | 13831 |
| **03107500** | Beaver River at Beaver Falls, PA | 40.763 | –80.315 | 8045 |
| **03146500** | Licking River near Newark, OH | 40.059 | –82.340 | 1391 |
| **03155000** | Little Kanawha River at Palestine, WV | 39.059 | –81.390 | 3926 |
| **03171000** | New River at Radford, VA | 37.142 | –80.569 | 7166 |
| **03184000** | Greenbrier River at Hilldale, WV | 37.640 | –80.805 | 4193 |
| **03192000** | Gauley River above Belva, WV | 38.233 | –81.181 | 3411 |
| **03197000** | Elk River at Queen Shoals, WV | 38.471 | –81.284 | 2966 |
| **03198000** | Kanawha River at Charlestown, WV | 38.371 | –81.702 | 27060 |
| **03219500** | Scioto River near Prospect, OH | 40.420 | –83.197 | 1469 |
| **03226800** | Olentangy River near Worthington, OH | 40.110 | –83.032 | 1287 |
| **03234500** | Scioto River at Higby, OH | 39.212 | –82.864 | 13289 |
| **03274000** | Great Miami River at Hamilton, OH | 39.391 | –84.572 | 9402 |
| **03303280** | Ohio River Cannelton Dam at Cannelton, IN | 37.900 | –86.706 | 251229 |
| **03322900** | Wabash River at Linn Grove, IN | 40.656 | –85.033 | 1173 |
| **03324300** | Salamonie River near Warren, IN | 40.713 | –85.454 | 1101 |
| **03328500** | Eel River near Logansport, IN | 40.782 | –86.264 | 2044 |
| **03329000** | Wabash River at Logansport, IN | 40.746 | –86.378 | 9788 |
| **03333050** | Tippecanoe River near Delphi, IN | 40.594 | –86.770 | 4841 |
| **03340500** | Wabash River at Montezuma, IN | 39.793 | –87.374 | 28795 |
| **03354000** | White River near Centerton, IN | 39.498 | –86.401 | 6330 |
| **03360500** | White River at Newberry, IN | 38.928 | –87.011 | 12142 |
| **03364000** | East Fork White River at Columbus, IN | 39.200 | –85.926 | 4421 |
| **03373500** | East Fork White River at Shoals, IN | 38.667 | –86.792 | 12761 |
| **03404500** | Cumberland River at Cumberland Falls, KY | 36.837 | –84.343 | 5120 |
| **03421000** | Collins River near McMinnville, TN | 35.708 | –85.732 | 1658 |
| **03431500** | Cumberland River at Nashville, TN | 36.161 | –86.773 | 33297 |
| **03455000** | French Broad River near Newport, TN | 35.982 | –83.161 | 4812 |
| **03466500** | Nolichucky River below Nolichucky Dam, TN | 36.066 | –82.866 | 3067 |
| **03503000** | Little Tennessee River at Needmore, NC | 35.336 | –83.527 | 1129 |
| **03566000** | Hiwassee River at Charleston, TN | 35.295 | –84.760 | 5952 |
| **03584600** | Elk River at Prospect, TN | 35.014 | –86.995 | 4675 |
| **03603000** | Duck River above Hurricane Mills, TN | 35.930 | –87.743 | 6623 |
| **03604000** | Buffalo River near Flat Woods, TN | 35.496 | –87.833 | 1158 |

**Table S2.** Comparison of modeled results (A, B, C) for the top parameter sets selected from table 2 for the median values of the 39 gauges per statistic. Kling Gupta Efficiency (KGE) values are given for the Qm modeled result following each parameter set vs. the Qg, Qgs, and Qs timeseries. The average of the annual statistics derived from the median values of the 39 gauges (mean annual flow and peak annual flow) are given and the percent difference calculated among them.

| | Median KGE | | |
|---|---|---|---|
| **Model** | **A** | **B** | **C** |
| **Qm vs Qg** | 0.51 | 0.50 | 0.46 |
| **Qm vs Qgs** | 0.48 | 0.52 | 0.43 |
| **Qm vs Qs** | 0.50 | 0.49 | 0.46 |

| | Average of Annual Median Values | | | Percent Difference | | |
|---|---|---|---|---|---|---|
| **Model** | **A** | **B** | **C** | **A vs. B** | **A vs. C** | **B vs. C** |
| **Mean ($m^3/s$)** | 74 | 75 | 74 | –1.2% | 0.9% | 2.1% |
| **Max ($m^3/s$)** | 441 | 484 | 436 | –9.8% | 1.1% | 9.9% |

**Table S3.** Selected parameters and resulting median KGE values from the best iterations per timeseries (Qg, Qgs, and Qs) for all tested calibration time periods.

| Mission Life | Timeseries | bi | usoilD (m) | Dsmax (mm/d) | Ds | Median KGE | Maximum KGE |
|---|---|---|---|---|---|---|---|
| **9yr (2010–2018)** | Qg | 0.16 | 1.4 | 20 | 0.3 | 0.51 | 0.81 |
| | Qgs | 0.04 | 1.2 | 12 | 1.0 | 0.52 | 0.79 |
| | Qs | 0.16 | 1.4 | 40 | 0.1 | 0.46 | 0.71 |
| **3yr (2010–2012)** | Qg | 0.04 | 1.4 | 40 | 1.0 | 0.50 | 0.77 |
| | Qgs | 0.12 | 1.2 | 36 | 0.5 | 0.51 | 0.75 |
| | Qs | 0.04 | 1.2 | 40 | 1.0 | 0.45 | 0.76 |
| **3yr (2013–2015)** | Qg | 0.12 | 1.0 | 40 | 0.9 | 0.46 | 0.76 |
| | Qgs | 0.24 | 1.0 | 24 | 0.1 | 0.44 | 0.76 |
| | Qs | 0.32 | 1.2 | 28 | 0.2 | 0.43 | 0.72 |
| **3yr (2016–2018)** | Qg | 0.08 | 1.2 | 40 | 1.0 | 0.49 | 0.79 |
| | Qgs | 0.04 | 1.0 | 20 | 1.0 | 0.48 | 0.75 |
| | Qs | 0.04 | 1.2 | 12 | 1.0 | 0.47 | 0.72 |

**Table S4.** Average median KGE of all sets of top 100 ordered iterations for each timeseries (Qg, Qgs, and Qs) for all tested calibration time periods.

| Mission Life | Average of Top 100 Qg Order Iterations Median KGE | | | Average of Top 100 Qgs Order Iterations Median KGE | | | Average of Top 100 Qs Order Iterations Median KGE | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Qg** | **Qgs** | **Qs** | **Qg** | **Qgs** | **Qs** | **Qg** | **Qgs** | **Qs** |
| **9yr (2010–2018)** | 0.50 | 0.49 | 0.44 | 0.48 | 0.50 | 0.45 | 0.49 | 0.50 | 0.46 |
| **3yr (2010–2012)** | 0.49 | 0.49 | 0.41 | 0.46 | 0.50 | 0.40 | 0.45 | 0.47 | 0.44 |
| **3yr (2013–2015)** | 0.46 | 0.39 | 0.39 | 0.43 | 0.42 | 0.41 | 0.43 | 0.39 | 0.43 |
| **3yr (2016–2018)** | 0.48 | 0.45 | 0.45 | 0.44 | 0.48 | 0.39 | 0.47 | 0.45 | 0.46 |

**Table S5.** Validation exercise comparing median and maximum KGE values for the 9-year period using top iteration parameters gleaned from each calibration period per timeseries (Qg, Qgs, and Qs).

| Timeseries | 9yr (2010–2018) Calibration Period | | 3yr (2010–2012) Calibration Period | | 3yr (2013–2015) Calibration Period | | 3yr (2016–2018) Calibration Period | |
|---|---|---|---|---|---|---|---|---|
| | Median KGE | Max KGE | Median KGE | Max KGE | Median KGE | Max KGE | Median KGE | Max KGE |
| **Qg** | 0.51 | 0.81 | 0.49 | 0.78 | 0.46 | 0.72 | 0.48 | 0.78 |
| **Qgs** | 0.52 | 0.79 | 0.50 | 0.79 | 0.42 | 0.70 | 0.48 | 0.75 |
| **Qs** | 0.46 | 0.71 | 0.44 | 0.69 | 0.36 | 0.62 | 0.43 | 0.74 |