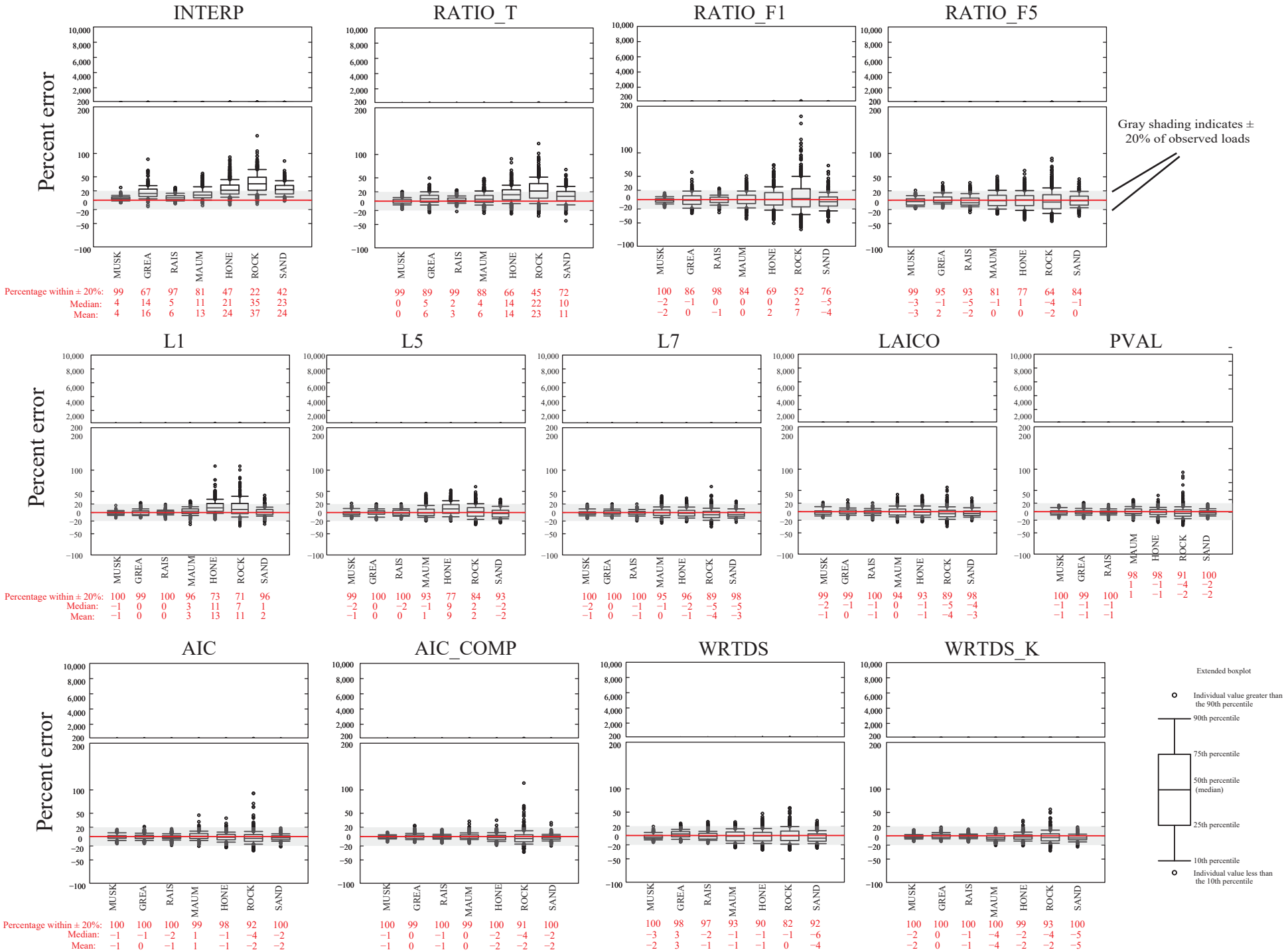
Figure 4.1

# Comparison of estimation method errors for computing annual chloride loads.

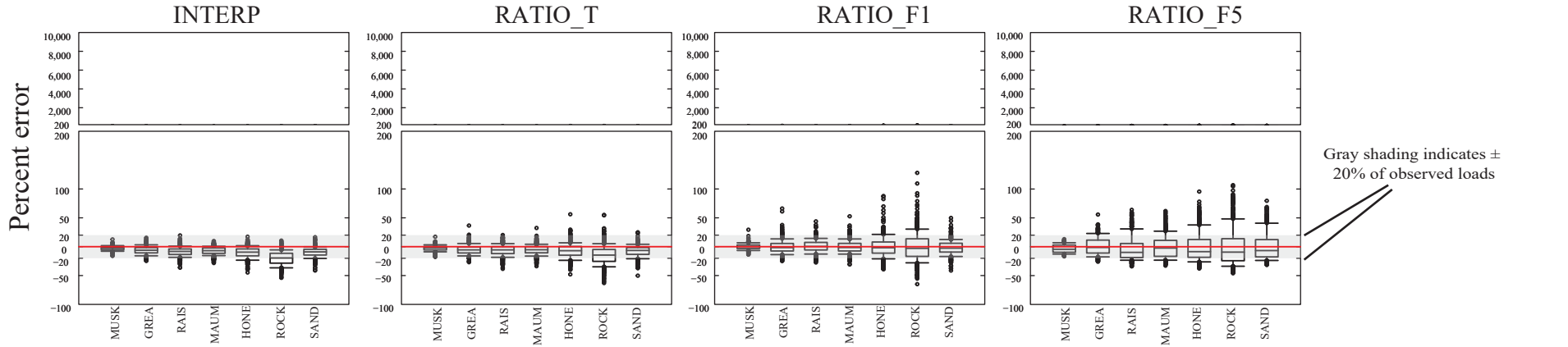
[INTERP, interpolation of sampled values; RATIO_T, Beale's ration estimation with time-based stratification; RATIO_F1, Beale's ratio estimation with flow-based stratification from the target year only; RATIO_F5, Beale's ratio estimation with flow-based stratification on the most recent 5 years of data; L1, LOADEST stock 1-parameter model using data from the target year only; L5, LOADEST stock 5-parameter model; L7, LOADEST stock 7-parameter model; LAICO, LOADEST stock "best selection model; AIC, LOADEST minimum Akaike information criteria method with cubic flow and flow anomaly variables; PVAL, LOADEST minimum probability-value model with cubic flow and flow anomaly variables; AIC_COMP, LOADEST minimum Akaike information criteria method with local adjustments for residual departures using the composite method; WRTDS, Weighted Regressions on Time, Discharge, and Season; WRTDS_K, Weighted Regressions on Time, Discharge, and Season method with Kalman filtering; MUSK, Muskingum River at McConnelsville, Ohio; GREA, Great Miami River at Miamisburg, Ohio; RAIS, River Raisin at Monroe, Michigan; MAUM, Maumee River at Waterville, Ohio; HONE, Honey Creek at Melmore, Ohio; ROCK, Rock Creek at Tiffin, Ohio; SAND, Sandusky River near Fremont, Ohio; ±, plus or minus; %, percent]



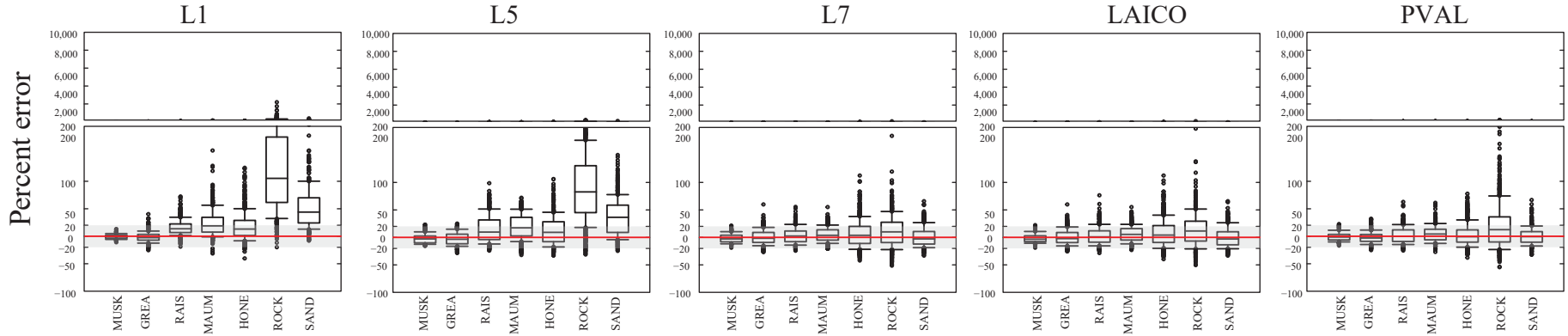
# Comparison of estimation method errors for computing annual total nitrogen loads.

Figure 4.2

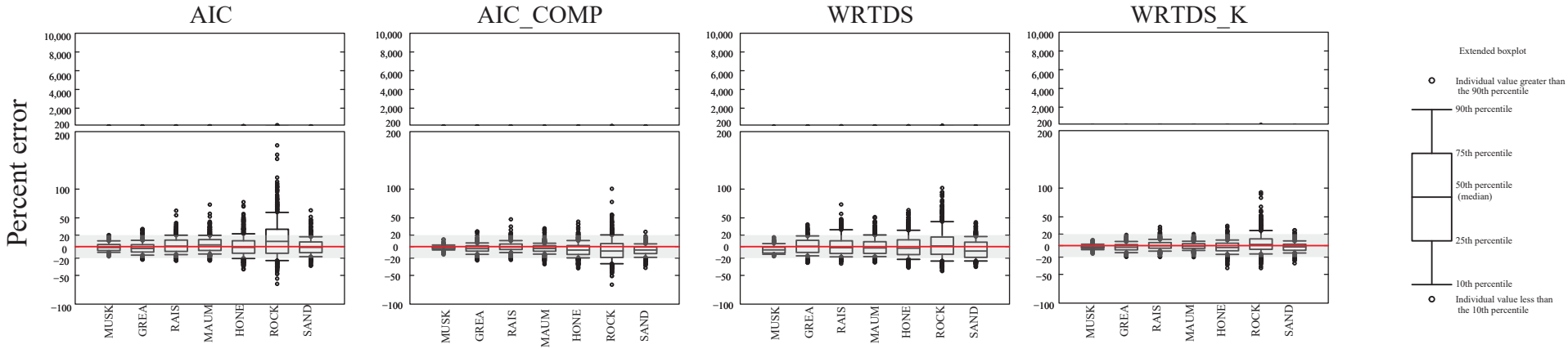
[INTERP, interpolation of sampled values; RATIO_T, Beale's ration estimation with time-based stratification; RATIO_F1, Beale's ratio estimation with flow-based stratification from the target year only; RATIO_F5, Beale's ratio estimation with flow-based stratification on the most recent 5 years of data; L1, LOADEST stock 1-parameter model using data from the target year only; L5, LOADEST stock 5-parameter model; L7, LOADEST stock 7-parameter model; LAICO, LOADEST stock "best selection model; AIC, LOADEST minimum Akaike information criteria method with cubic flow and flow anomaly variables; PVAL, LOADEST minimum probability-value model with cubic flow and flow anomaly variables; AIC_COMP, LOADEST minimum Akaike information criteria method with local adjustments for residual departures using the composite method; WRTDS, Weighted Regressions on Time, Discharge, and Season; WRTDS_K, Weighted Regressions on Time, Discharge, and Season method with Kalman filtering; MUSK, Muskingum River at McConnelsville, Ohio; GREA, Great Miami River at Miamisburg, Ohio; RAIS, River Raisin at Monroe, Michigan; MAUM, Maumee River at Waterville, Ohio; HONE, Honey Creek at Melmore, Ohio; ROCK, Rock Creek at Tiffin, Ohio; SAND, Sandusky River near Fremont, Ohio; ±, plus or minus; %, percent]




| | MUSK | GREA | RAIS | MAUM | HONE | ROCK | SAND |
|---|---|---|---|---|---|---|---|
| INTERP Percentage within ± 20%: | 100 | 98 | 92 | 96 | 83 | 51 | 90 |
| INTERP Median: | −3 | −6 | −8 | −7 | −9 | −20 | −9 |
| INTERP Mean: | −3 | −6 | −9 | −7 | −10 | −20 | −10 |
| RATIO_T Percentage within ± 20%: | 100 | 97 | 92 | 95 | 83 | 61 | 88 |
| RATIO_T Median: | −2 | −6 | −6 | −5 | −7 | −15 | −6 |
| RATIO_T Mean: | −2 | −5 | −6 | −6 | −7 | −15 | −8 |
| RATIO_F1 Percentage within ± 20%: | 99 | 90 | 92 | 93 | 77 | 61 | 90 |
| RATIO_F1 Median: | 0 | −2 | 0 | −1 | −2 | −3 | −3 |
| RATIO_F1 Mean: | 0 | 0 | 1 | 0 | 0 | 0 | −2 |
| RATIO_F5 Percentage within ± 20%: | 100 | 81 | 65 | 67 | 59 | 45 | 63 |
| RATIO_F5 Median: | −4 | −1 | −10 | −2 | −9 | −9 | −7 |
| RATIO_F5 Mean: | −3 | 1 | −3 | −1 | −1 | −1 | 0 |




| | MUSK | GREA | RAIS | MAUM | HONE | ROCK | SAND |
|---|---|---|---|---|---|---|---|
| L1 Percentage within ± 20%: | 100 | 94 | 69 | 53 | 62 | 6 | 19 |
| L1 Median: | −1 | −2 | 14 | 19 | 13 | 105 | 44 |
| L1 Mean: | 0 | −2 | 16 | 23 | 18 | 158 | 52 |
| L5 Percentage within ± 20%: | 98 | 92 | 60 | 48 | 54 | 10 | 32 |
| L5 Median: | −3 | −3 | 10 | 17 | 9 | 83 | 37 |
| L5 Mean: | −3 | −3 | 16 | 19 | 13 | 91 | 38 |
| L7 Percentage within ± 20%: | 99 | 89 | 84 | 86 | 64 | 54 | 76 |
| L7 Median: | −3 | −2 | 2 | 4 | 4 | 10 | −3 |
| L7 Mean: | −2 | 0 | 3 | 5 | 7 | 11 | 1 |
| LAICO Percentage within ± 20%: | 98 | 86 | 82 | 82 | 63 | 50 | 73 |
| LAICO Median: | −3 | −2 | 1 | 5 | 4 | 12 | −3 |
| LAICO Mean: | −2 | 0 | 3 | 6 | 8 | 14 | 0 |
| PVAL Percentage within ± 20%: | 98 | 95 | 86 | 84 | 76 | 46 | 86 |
| PVAL Median: | −1 | −3 | 0 | 4 | −1 | 12 | −1 |
| PVAL Mean: | −1 | −2 | 2 | 5 | 2 | 19 | 0 |




| | MUSK | GREA | RAIS | MAUM | HONE | ROCK | SAND |
|---|---|---|---|---|---|---|---|
| AIC Percentage within ± 20%: | 99 | 95 | 88 | 89 | 78 | 49 | 86 |
| AIC Median: | −2 | −3 | 1 | 3 | −1 | 9 | −1 |
| AIC Mean: | −1 | −2 | 2 | 4 | 0 | 13 | 0 |
| AIC_COMP Percentage within ± 20%: | 100 | 96 | 97 | 96 | 87 | 67 | 91 |
| AIC_COMP Median: | −2 | −3 | −1 | −3 | −6 | −8 | −6 |
| AIC_COMP Mean: | −2 | −3 | 0 | −3 | −5 | −6 | −6 |
| WRTDS Percentage within ± 20%: | 100 | 87 | 77 | 84 | 70 | 60 | 69 |
| WRTDS Median: | −6 | 0 | −2 | −2 | −3 | 1 | −8 |
| WRTDS Mean: | −5 | 1 | 2 | 0 | 0 | 5 | −5 |
| WRTDS_K Percentage within ± 20%: | 100 | 100 | 98 | 100 | 95 | 81 | 96 |
| WRTDS_K Median: | −2 | −3 | 0 | −1 | −3 | 2 | −2 |
| WRTDS_K Mean: | −2 | −3 | 1 | −1 | −3 | 4 | −2 |

Figure 4.3

# Comparison of estimation method errors for computing annual nitrate plus nitrite loads

[INTERP, interpolation of sampled values; RATIO_T, Beale's ratio estimation with time-based stratification; RATIO_F1, Beale's ratio estimation with flow-based stratification from the target year only; RATIO_F5, Beale's ratio estimation with flow-based stratification on the most recent 5 years of data; L1, LOADEST stock 1-parameter model using data from the target year only; L5, LOADEST stock 5-parameter model; L7, LOADEST stock 7-parameter model; LAICO, LOADEST stock "best selection" model; AIC, LOADEST minimum Akaike information criteria method with cubic flow and flow anomaly variables; PVAL, LOADEST minimum probability-value model with cubic flow and flow anomaly variables; AIC_COMP, LOADEST minimum Akaike information criteria method with local adjustments for residual departures using the composite method; WRTDS, Weighted Regressions on Time, Discharge, and Season; WRTDS_K, Weighted Regressions on Time, Discharge, and Season method with Kalman filtering; MUSK, Muskingum River at McConnelsville, Ohio; GREA, Great Miami River at Miamisburg, Ohio; RAIS, River Raisin at Monroe, Michigan; MAUM, Maumee River at Waterville, Ohio; HONE, Honey Creek at Melmore, Ohio; ROCK, Rock Creek at Tiffin, Ohio; SAND, Sandusky River near Fremont, Ohio; HADD, Connecticut River at Middle Haddam, Connecticut; POTO, Potomac River near Washington, D.C., Little Falls Pump Station; SAC, North Raccoon River near Sac City, Iowa; VALL, Illinois River at Valley City, Illinois; BATO, Mississippi River at Baton Rouge, Louisiana; ±, plus or minus; %, percent]

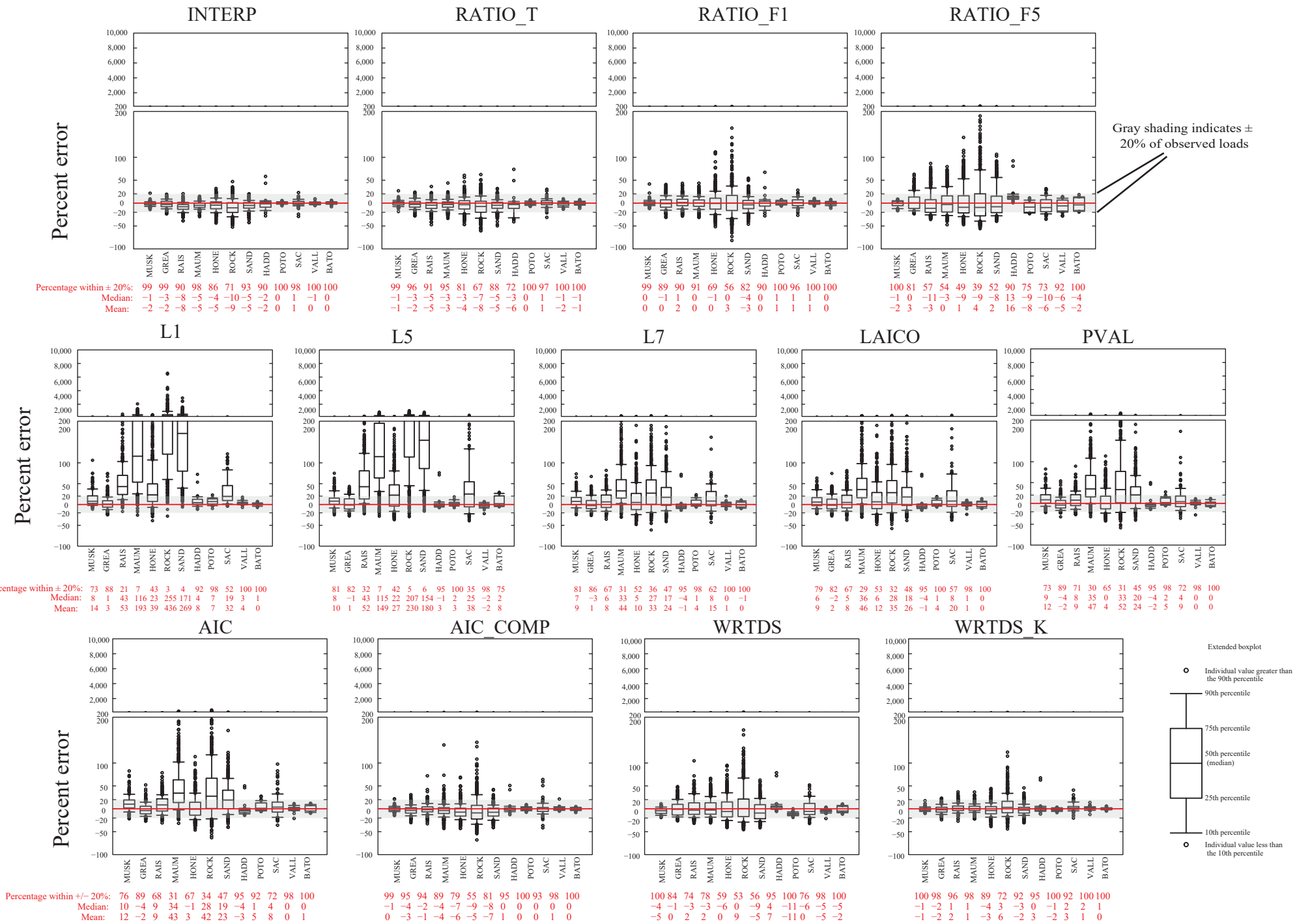
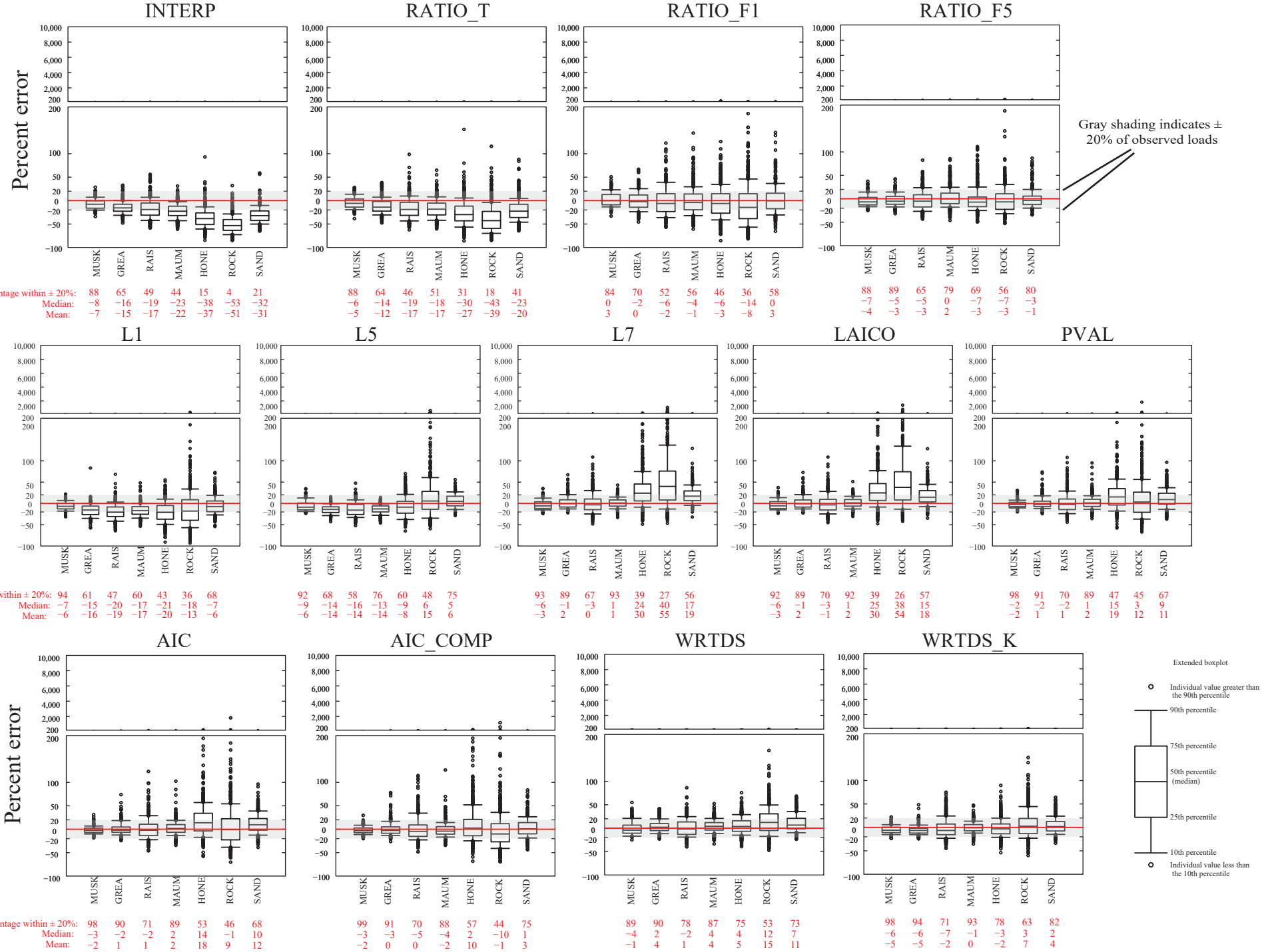


Figure 4.4

# Comparison of estimation method errors for computing annual total phosphorus loads

[INTERP, interpolation of sampled values; RATIO_T, Beale's ratio estimation with time-based stratification; RATIO_F1, Beale's ratio estimation with flow-based stratification from the target year only; RATIO_F5, Beale's ratio estimation with flow-based stratification on the most recent 5 years of data; L1, LOADEST stock 1-parameter model using data from the target year only; L5, LOADEST stock 5-parameter model; L7, LOADEST stock 7-parameter model; LAICO, LOADEST stock "best selection" model; AIC, LOADEST minimum Akaike information criteria method with cubic flow and flow anomaly variables; PVAL, LOADEST minimum probability-value model with cubic flow and flow anomaly variables; AIC_COMP, LOADEST minimum Akaike information criteria method with local adjustments for residual departures using the composite method; WRTDS, Weighted Regressions on Time, Discharge, and Season; WRTDS_K, Weighted Regressions on Time, Discharge, and Season method with Kalman filtering; MUSK, Muskingum River at McConnelsville, Ohio; GREA, Great Miami River at Miamisburg, Ohio; RAIS, River Raisin at Monroe, Michigan; MAUM, Maumee River at Waterville, Ohio; HONE, Honey Creek at Melmore, Ohio; ROCK, Rock Creek at Tiffin, Ohio; SAND, Sandusky River near Fremont, Ohio; ±, plus or minus; %, percent]




| | MUSK | GREA | RAIS | MAUM | HONE | ROCK | SAND |
|---|---|---|---|---|---|---|---|
| INTERP | | | | | | | |
| Percentage within ± 20%: | 88 | 65 | 49 | 44 | 15 | 4 | 21 |
| Median: | −8 | −16 | −19 | −23 | −38 | −53 | −32 |
| Mean: | −7 | −15 | −17 | −22 | −37 | −51 | −31 |
| RATIO_T | | | | | | | |
| Percentage within ± 20%: | 88 | 64 | 46 | 51 | 31 | 18 | 41 |
| Median: | −6 | −14 | −19 | −18 | −30 | −43 | −23 |
| Mean: | −5 | −12 | −17 | −17 | −27 | −39 | −20 |
| RATIO_F1 | | | | | | | |
| Percentage within ± 20%: | 84 | 70 | 52 | 56 | 46 | 36 | 58 |
| Median: | 0 | −2 | −6 | −4 | −6 | −14 | 0 |
| Mean: | 3 | 0 | −2 | −1 | −3 | −8 | 3 |
| RATIO_F5 | | | | | | | |
| Percentage within ± 20%: | 88 | 89 | 65 | 79 | 69 | 56 | 80 |
| Median: | −7 | −5 | −5 | 0 | −7 | −7 | −3 |
| Mean: | −4 | −3 | −3 | 2 | −3 | −3 | −1 |
| L1 | | | | | | | |
| Percentage within ± 20%: | 94 | 61 | 47 | 60 | 43 | 36 | 68 |
| Median: | −7 | −15 | −20 | −17 | −21 | −18 | −7 |
| Mean: | −6 | −16 | −19 | −17 | −20 | −13 | −6 |
| L5 | | | | | | | |
| Percentage within ± 20%: | 92 | 68 | 58 | 76 | 60 | 48 | 75 |
| Median: | −9 | −14 | −16 | −13 | −9 | 6 | 5 |
| Mean: | −6 | −14 | −14 | −14 | −8 | 15 | 6 |
| L7 | | | | | | | |
| Percentage within ± 20%: | 93 | 89 | 67 | 93 | 39 | 27 | 56 |
| Median: | −6 | −1 | −3 | 1 | 24 | 40 | 17 |
| Mean: | −3 | 2 | 0 | 1 | 30 | 55 | 19 |
| LAICO | | | | | | | |
| Percentage within ± 20%: | 92 | 89 | 70 | 92 | 39 | 26 | 57 |
| Median: | −6 | −1 | −3 | 1 | 25 | 38 | 15 |
| Mean: | −3 | 2 | −1 | 2 | 30 | 54 | 18 |
| PVAL | | | | | | | |
| Percentage within ± 20%: | 98 | 91 | 70 | 89 | 47 | 45 | 67 |
| Median: | −2 | −2 | −2 | 1 | 15 | 3 | 9 |
| Mean: | −2 | 1 | 1 | 2 | 19 | 12 | 11 |
| AIC | | | | | | | |
| Percentage within ± 20%: | 98 | 90 | 71 | 89 | 53 | 46 | 68 |
| Median: | −3 | −2 | −2 | 2 | 14 | −1 | 10 |
| Mean: | −2 | 1 | 1 | 2 | 18 | 9 | 12 |
| AIC_COMP | | | | | | | |
| Percentage within ± 20%: | 99 | 91 | 70 | 88 | 57 | 44 | 75 |
| Median: | −3 | −3 | −5 | −4 | 2 | −10 | 1 |
| Mean: | −2 | 0 | 0 | −2 | 10 | −1 | 3 |
| WRTDS | | | | | | | |
| Percentage within ± 20%: | 89 | 90 | 78 | 87 | 75 | 53 | 73 |
| Median: | −4 | 2 | −2 | 4 | 4 | 12 | 7 |
| Mean: | −1 | 4 | 1 | 4 | 5 | 15 | 11 |
| WRTDS_K | | | | | | | |
| Percentage within ± 20%: | 98 | 94 | 71 | 93 | 78 | 63 | 82 |
| Median: | −6 | −6 | −7 | −1 | −3 | 3 | 2 |
| Mean: | −5 | −5 | −2 | 0 | −2 | 7 | 4 |

Figure 4.5

# Comparison of estimation method errors for computing annual suspended-sediment loads

[INTERP, interpolation of sampled values; RATIO_T, Beale's ratio estimation with time-based stratification; RATIO_F1, Beale's ratio estimation with flow-based stratification from the target year only; RATIO_F5, Beale's ratio estimation with flow-based stratification on the most recent 5 years of data; L1, LOADEST stock 1-parameter model using data from the target year only; L5, LOADEST stock 5-parameter model; L7, LOADEST stock 7-parameter model; LAICO, LOADEST stock "best selection" model; AIC, LOADEST minimum Akaike information criteria method with cubic flow and flow anomaly variables; PVAL, LOADEST minimum probability-value model with cubic flow and flow anomaly variables; AIC_COMP, LOADEST minimum Akaike information criteria method with local adjustments for residual departures using the composite method; WRTDS, Weighted Regressions on Time, Discharge, and Season; WRTDS_K, Weighted Regressions on Time, Discharge, and Season method with Kalman filtering; DELA, Delaware River at Trenton, New Jersey; POTO, Potomac River near Washington, D.C., Little Falls Pump Station; RAPP, Rappahannock River at Remington, Virginia; MAUM, Maumee River at Waterville, Ohio; IOWA, Iowa River at Wapello, Iowa; SKUN, Skunk River at Augusta, Iowa; ILLI, Illinois River at Valley City, Illinois; MISS, Mississippi River at Thebes, Illinois; RIO, Rio Grande at Otowi Bridge, New Mexico; COLO, Colorado River near Cisco, Utah; SACR, Sacramento River at Freeport, California; ±, plus or minus; %, percent]