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# Role of hydrometeorological variables and catchment area to flood generation over the monsoonal climate region of India

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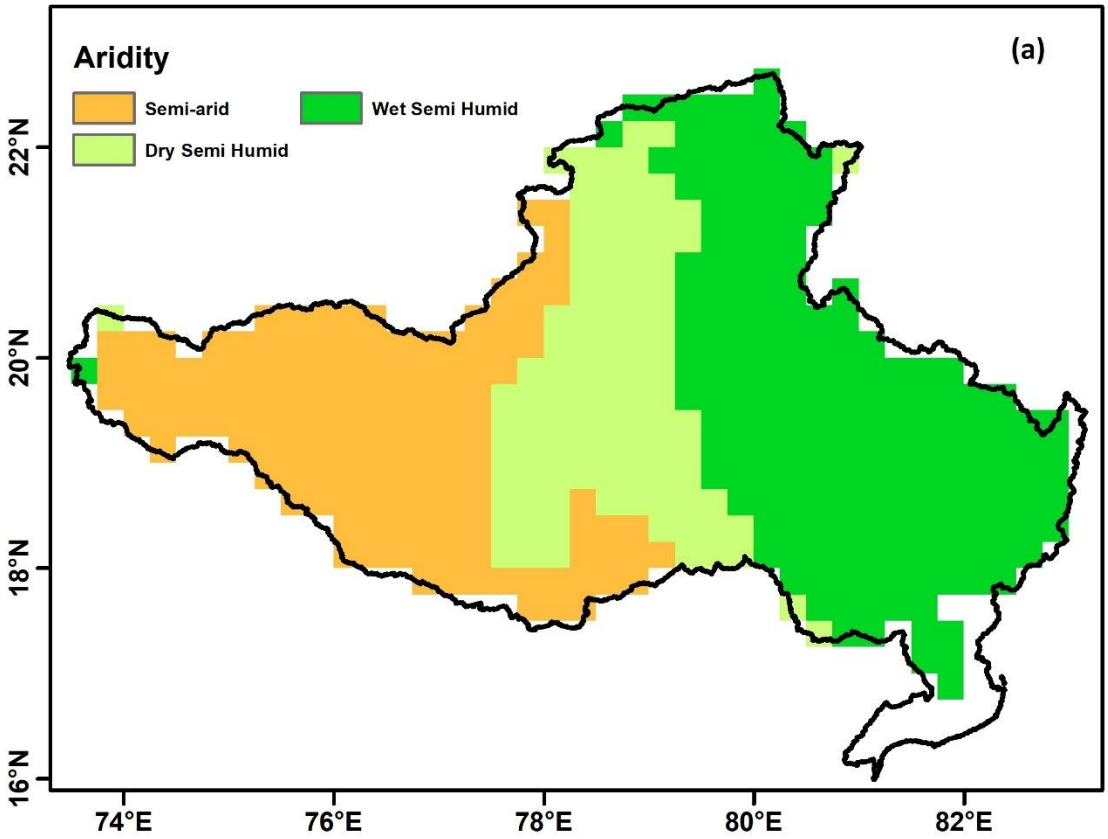



Figure S1. Climatic zones in the Godavari Basin using the aridity Index (AI = mean annual precipitation/mean annual PET). Climate zones are classified as semiarid ($0.2 \leq AI < 0.5$), dry semi-humid ($0.5 \leq AI < 0.65$), and wet semi-humid ($0.65 \leq AI < 1.33$) regions.

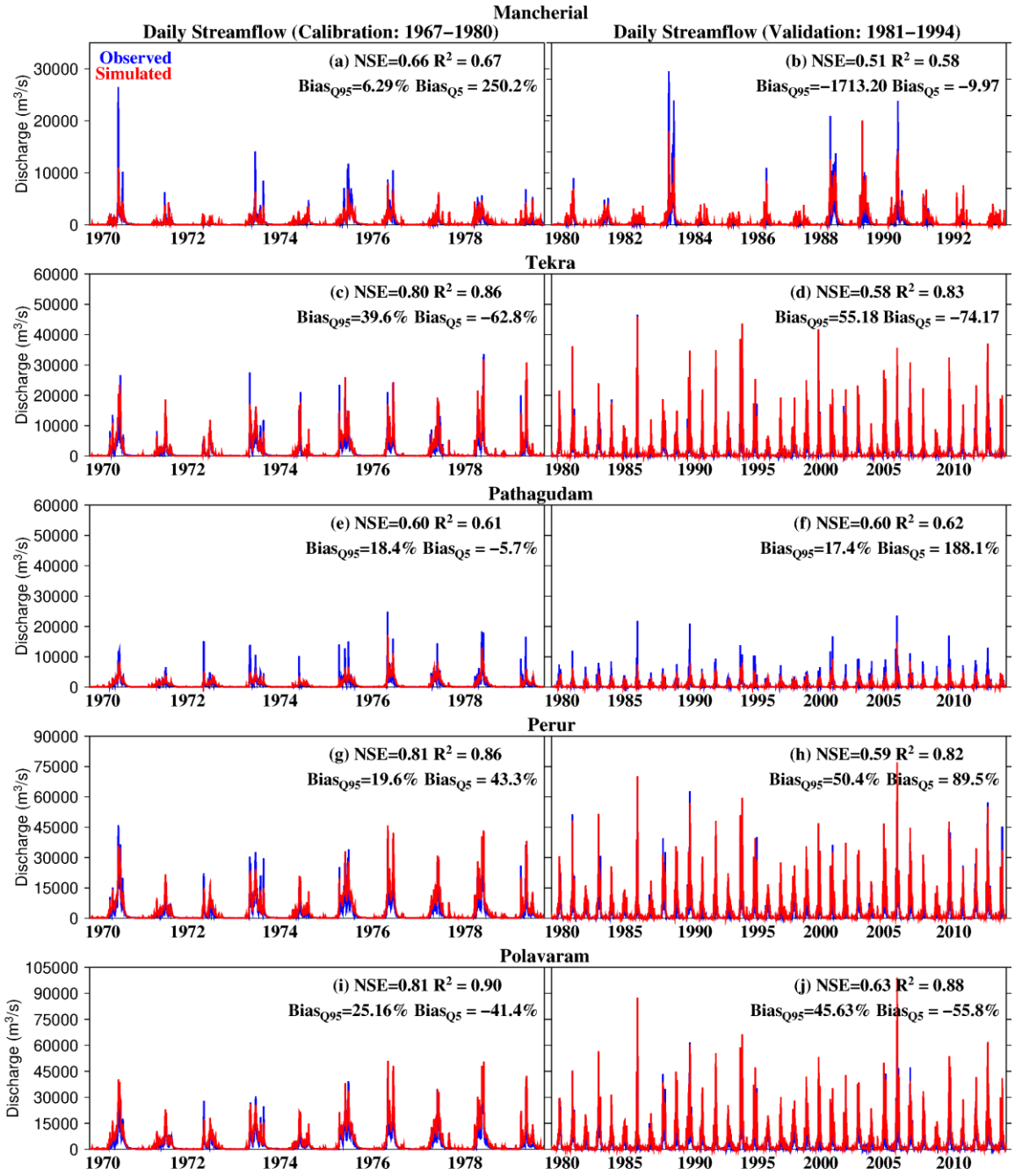



**Figure S2.** Calibration and validation of the VIC model-simulated streamflow against observed streamflow data at Mancherial, Tekra, Pathagudam, Perur, and Polavaram, for the period 1970-2014. The model was calibrated for the period 1970-1979 and validated for the period 1980-2014 (except for the Mancherial station, which was validated for 1980-1993).

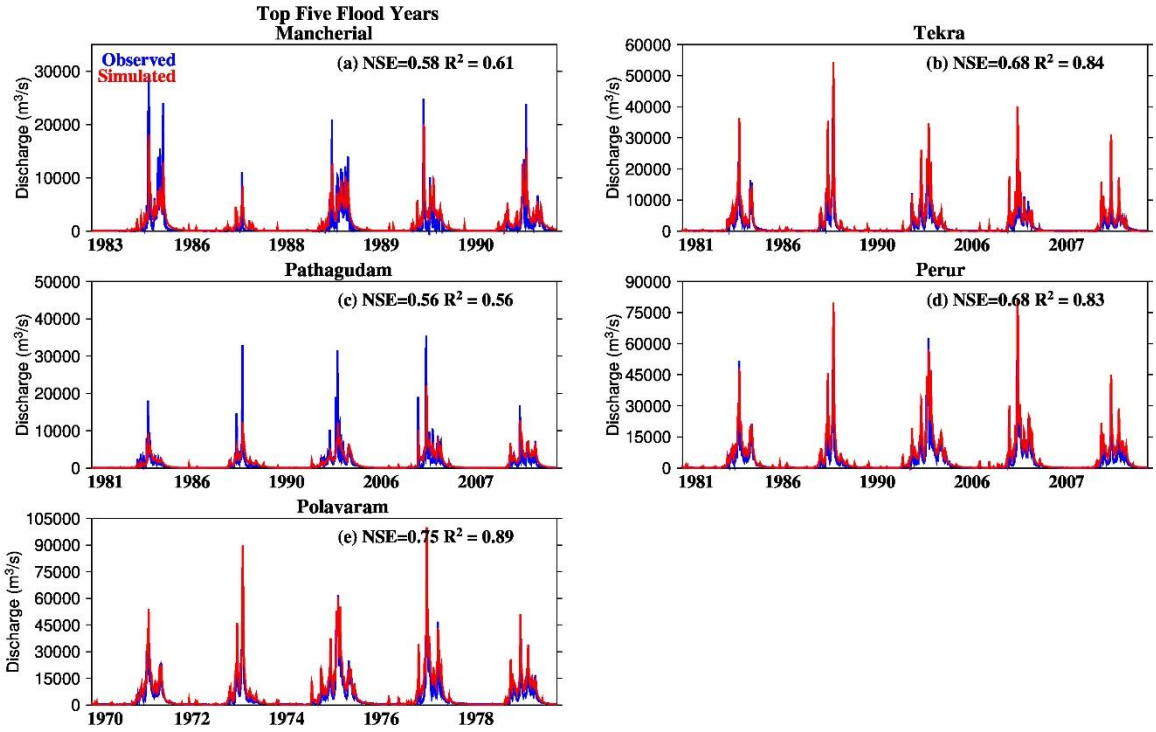



**Figure S3.** (a–e) Comparison of daily observed (blue) and VIC- simulated (red) streamflow ($m^3/s$) for the top five major flood years at Mancherial, Tekra, Pathagudam, Perur, and Polavaram during the validation period 1980-2014 (except for the Mancherial station, which was validated for 1980-1993).

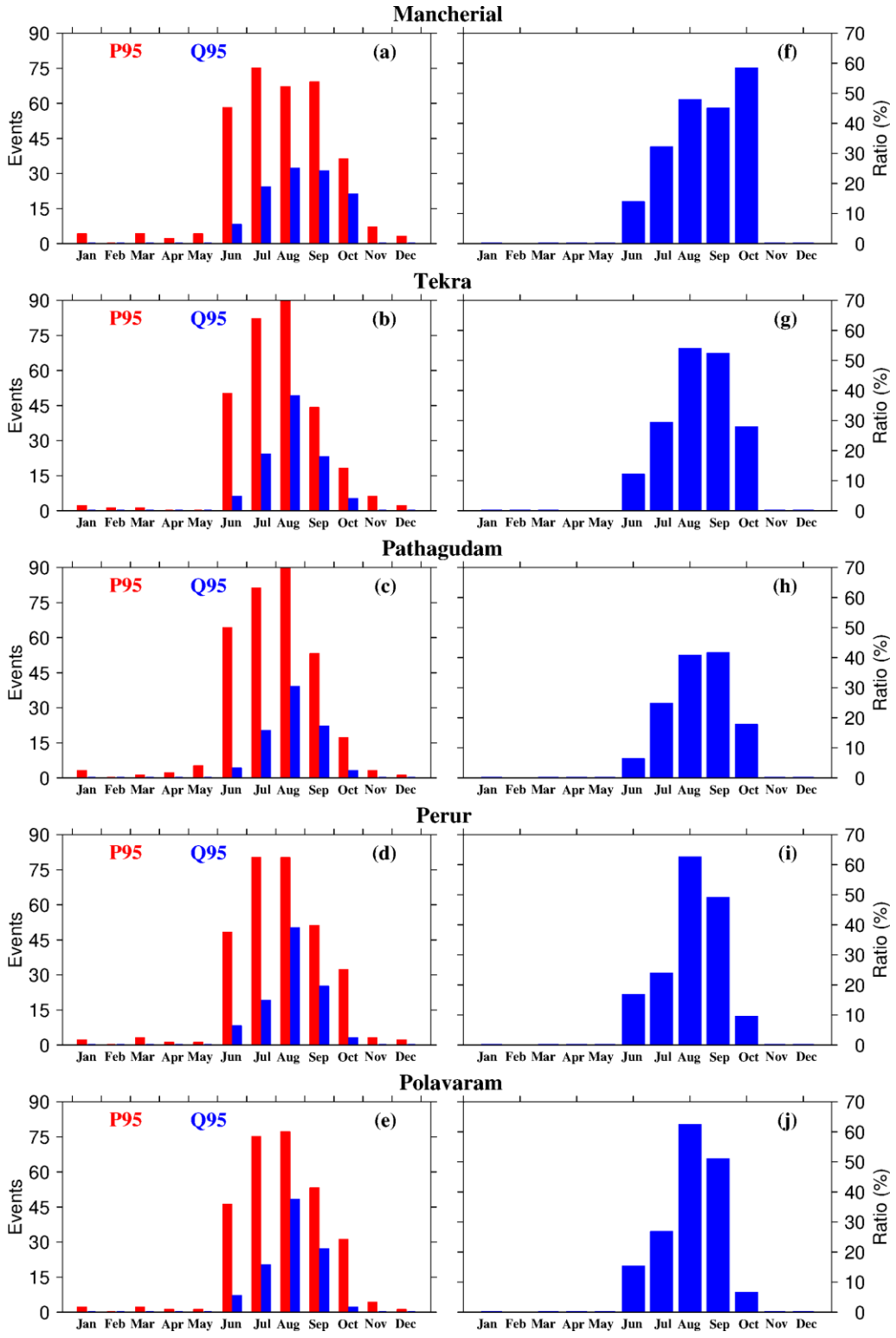



**Figure S4.** (a-e) Occurrence of high-intensity precipitation ($P_{95}$) and streamflow ($Q_{95}$) events (above 95$^{th}$ percentile) during 1967-2019 in each month at (a) Mancherial, (b)

Tekra, (c) Pathagudam, (d) Perur, and (e) Polavaram stations. (f-j) Ratio of the number of extreme streamflow and precipitation events in each month at Mancherial, Tekra, Pathagudam, Perur, and Polavaram stations, respectively.

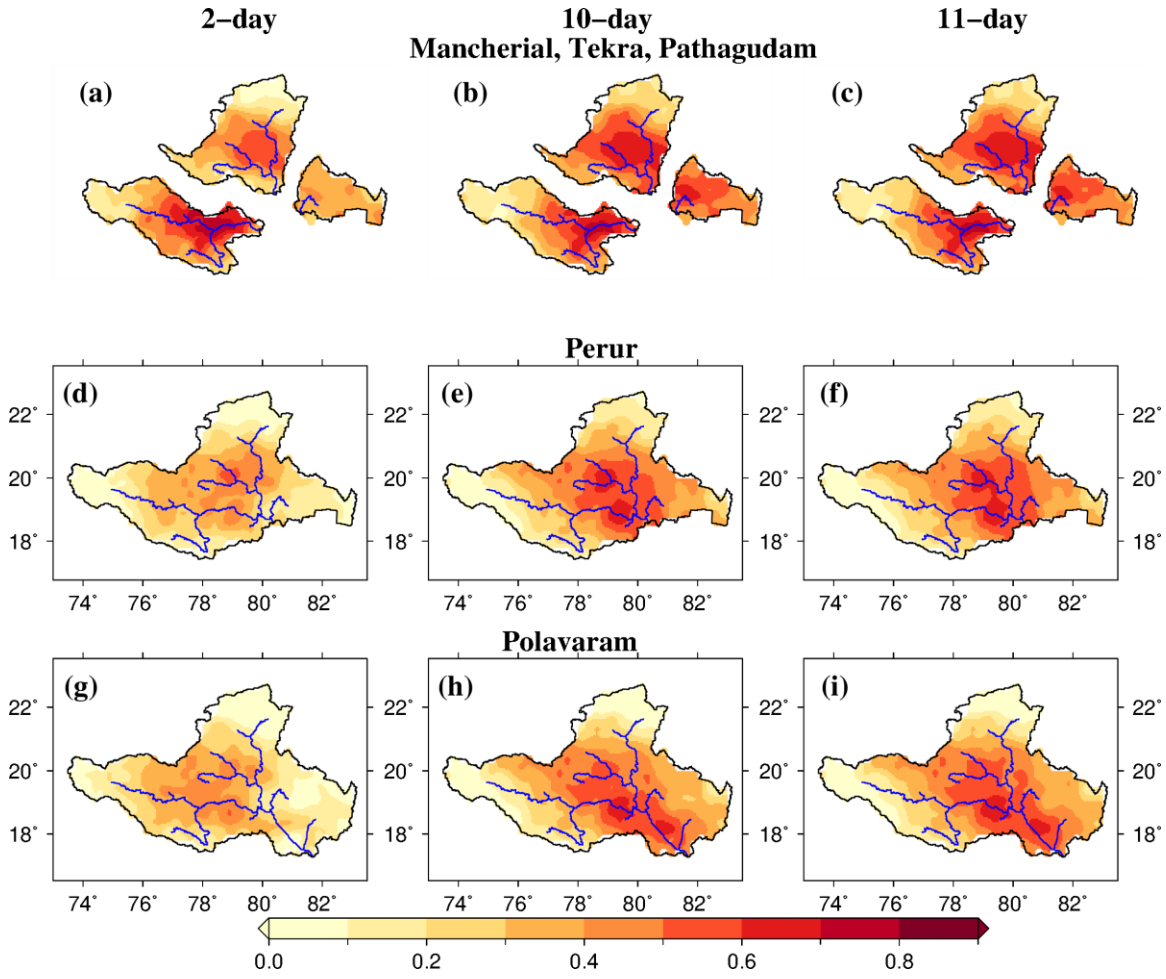



**Figure S5.** Correlation between upstream accumulated precipitation and high-intensity streamflow at the basin downstream during 1967-2019. (a-c) Correlation between upstream precipitation and high-intensity streamflow at Mancherial (left), Tekra (middle), and Pathagudem (right) sub-basins using (a) 2 days, (b) 10 days, and (c) 11

days cumulative precipitation with 2 days lag period. (d-f) Similar to (a-c) but for the Perur sub-basin. (g-i) Similar to (a-c) but for Polavaram.

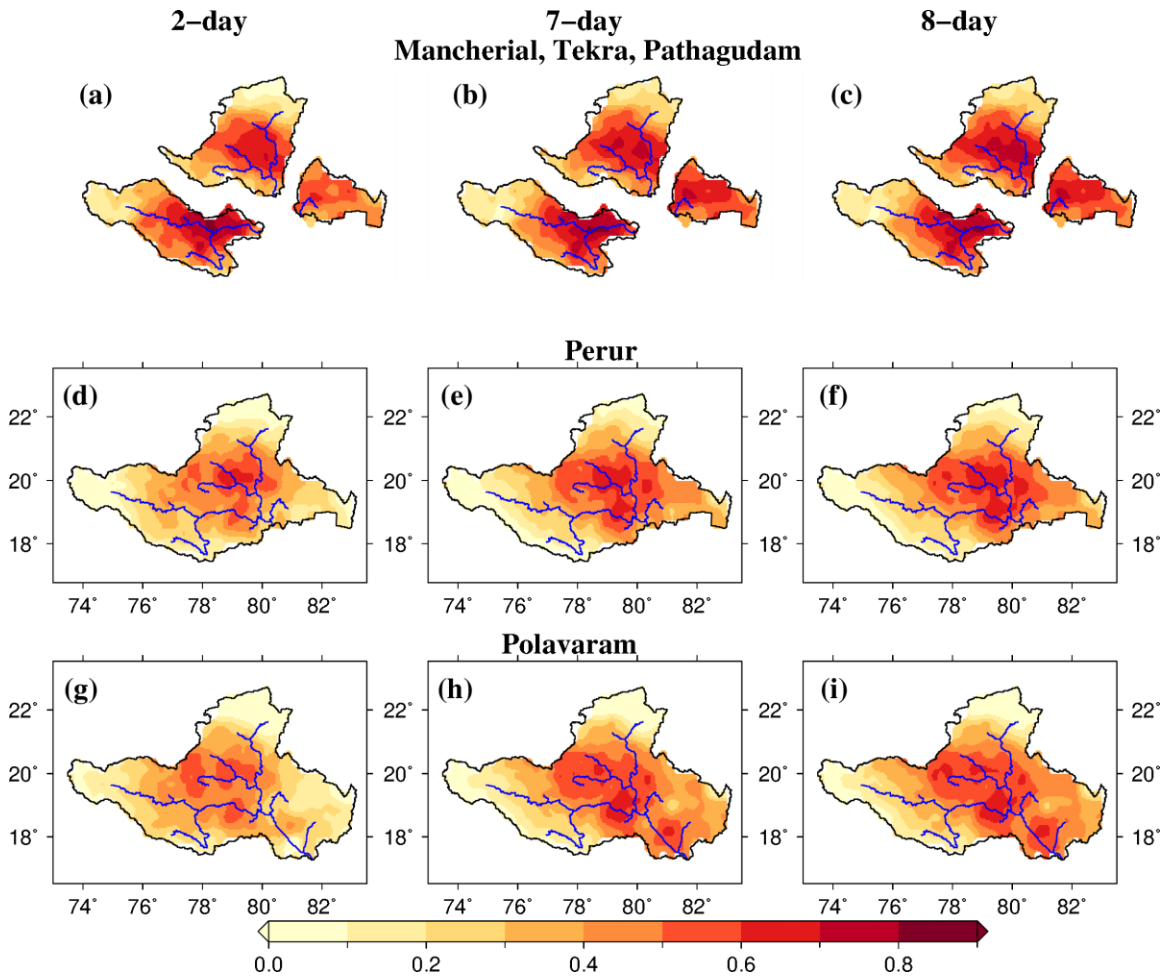



**Figure S6.** Correlation between runoff and high-intensity streamflow at the basin downstream during 1967-2019. (a-c) Correlation between upstream runoff and high-intensity streamflow at Mancherial (left), Tekra (middle), and Pathagudem (right) sub-basins using (a) 2 days, (b) 7 days, and (c) 8 days mean runoff with 2 days lag period. (d-f) Similar to (a-c) but for the Perur sub-basin. (g-i) Similar to (a-c) but for Polavaram.

**Table S1:** Values of performance indices [NSE, Coefficient of determination ($R^2$), high flow bias (Bias_Q95), low flow bias (Bias_Q5) and bias of the mean (Bias_mean)] during the calibration of VIC simulated discharge (against the observed discharge data) for the period 1970-1979.

| **Calibration (1970-1979)** | | | | | |
|---|---|---|---|---|---|
| Station | NSE | $R^2$ | Bias_Q95 (%) | Bias_Q5 (%) | Bias_mean (%) |
| Mancherial | 0.66 | 0.67 | 6.29 | 250.21 | 16.94 |
| Tekra | 0.8 | 0.86 | 39.57 | -62.85 | 28 |
| Pathagudam | 0.6 | 0.61 | 18.45 | -5.66 | 17.66 |
| Perur | 0.81 | 0.86 | 19.59 | 43.3 | 35.27 |
| Polavaram | 0.81 | 0.9 | 25.16 | -41.43 | 37.44 |

**Table S2:** Values of performance indices [NSE, Coefficient of determination ($R^2$), and Bias] during the validation of VIC simulated discharge (against the observed discharge data) for the period 1980-2014 (except Mancherial station; 1980-1993 for Mancherial sub-basin).

| **Validation (1980-2014)** | | | | | |
|---|---|---|---|---|---|
| Station | NSE | $R^2$ | Bias_Q95 (%) | Bias_Q5 (%) | Bias_mean (%) |
| Mancherial* | 0.52 | 0.59 | 88.52 | 190.3 | 79.26 |
| Tekra | 0.58 | 0.83 | 55.18 | -74.17 | 53.76 |
| Pathagudam | 0.6 | 0.62 | 17.44 | 188.08 | 21.47 |

| | | | | | |
|---|---|---|---|---|---|
| Perur | 0.59 | 0.82 | 50.43 | 89.53 | 63.7 |
| Polavaram | 0.63 | 0.88 | 45.63 | -55.78 | 56.37 |

*validated for 1980-1993

**Table S3:** Correlations between simulated streamflow peak and basin-averaged accumulated observed precipitation (prior to the flood peak) for different durations (days) and lags (days). The analysis is for high streamflow events at the Mancherial station for the period 1969-2019. Highlighted number is the best correlation value.

| Lag / Duration | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | -0.002 | 0.248 | 0.764 | 0.625 | 0.386 | 0.155 | 0.043 | 0.154 |
| 2 | 0.190 | 0.713 | 0.855 | 0.626 | 0.336 | 0.113 | 0.112 | 0.063 |
| 3 | 0.687 | 0.823 | 0.852 | 0.610 | 0.278 | 0.150 | 0.065 | 0.094 |
| 4 | 0.807 | 0.823 | 0.840 | 0.564 | 0.287 | 0.106 | 0.090 | 0.105 |
| 5 | 0.806 | 0.813 | 0.812 | 0.553 | 0.236 | 0.122 | 0.099 | 0.142 |
| 6 | 0.795 | 0.788 | 0.803 | 0.498 | 0.236 | 0.127 | 0.132 | 0.170 |
| 7 | 0.770 | 0.786 | 0.759 | 0.480 | 0.230 | 0.153 | 0.157 | 0.183 |
| 8 | 0.768 | 0.750 | 0.733 | 0.461 | 0.244 | 0.174 | 0.170 | 0.184 |
| 9 | 0.733 | 0.729 | 0.711 | 0.454 | 0.256 | 0.186 | 0.173 | 0.171 |
| 10 | 0.716 | 0.711 | 0.698 | 0.452 | 0.264 | 0.188 | 0.162 | 0.208 |
| 11 | 0.700 | 0.702 | 0.688 | 0.451 | 0.262 | 0.178 | 0.198 | 0.230 |
| 12 | 0.692 | 0.693 | 0.683 | 0.441 | 0.250 | 0.211 | 0.220 | 0.248 |
| 13 | 0.684 | 0.689 | 0.668 | 0.425 | 0.278 | 0.232 | 0.239 | 0.266 |
| 14 | 0.681 | 0.676 | 0.652 | 0.442 | 0.295 | 0.250 | 0.257 | 0.278 |
| 15 | 0.668 | 0.661 | 0.659 | 0.450 | 0.309 | 0.268 | 0.270 | 0.273 |
| 16 | 0.654 | 0.669 | 0.660 | 0.458 | 0.324 | 0.281 | 0.266 | 0.265 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 17 | 0.661 | 0.672 | 0.661 | 0.466 | 0.334 | 0.278 | 0.260 | 0.254 |
| 18 | 0.665 | 0.673 | 0.660 | 0.471 | 0.330 | 0.272 | 0.251 | 0.255 |
| 19 | 0.666 | 0.672 | 0.658 | 0.464 | 0.325 | 0.264 | 0.252 | 0.248 |
| 20 | 0.666 | 0.670 | 0.651 | 0.459 | 0.316 | 0.265 | 0.245 | 0.240 |

65

66 **Table S4:** Same as Table S3 but for the Tekra sub-basin.

| Lag / Duration . | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | -0.029 | 0.238 | 0.576 | 0.510 | 0.178 | 0.164 | 0.243 | 0.252 |
| 2 | 0.152 | 0.572 | 0.674 | 0.473 | 0.207 | 0.223 | 0.290 | 0.326 |
| 3 | 0.541 | 0.688 | 0.649 | 0.475 | 0.255 | 0.291 | 0.359 | 0.425 |
| 4 | 0.674 | 0.662 | 0.651 | 0.491 | 0.319 | 0.354 | 0.449 | 0.467 |
| 5 | 0.648 | 0.665 | 0.659 | 0.521 | 0.376 | 0.442 | 0.483 | 0.505 |
| 6 | 0.651 | 0.670 | 0.681 | 0.547 | 0.456 | 0.476 | 0.518 | 0.491 |
| 7 | 0.656 | 0.693 | 0.699 | 0.589 | 0.487 | 0.512 | 0.506 | 0.483 |
| 8 | 0.680 | 0.714 | 0.722 | 0.607 | 0.522 | 0.504 | 0.499 | 0.492 |
| 9 | 0.704 | 0.738 | 0.725 | 0.634 | 0.515 | 0.501 | 0.507 | 0.492 |
| 10 | 0.733 | 0.739 | 0.743 | 0.628 | 0.513 | 0.509 | 0.506 | 0.458 |
| 11 | 0.735 | 0.754 | 0.738 | 0.620 | 0.522 | 0.509 | 0.475 | 0.442 |
| 12 | 0.750 | 0.747 | 0.728 | 0.622 | 0.526 | 0.484 | 0.461 | 0.438 |
| 13 | 0.743 | 0.738 | 0.724 | 0.630 | 0.504 | 0.472 | 0.459 | 0.422 |
| 14 | 0.733 | 0.733 | 0.726 | 0.614 | 0.493 | 0.472 | 0.444 | 0.427 |
| 15 | 0.728 | 0.733 | 0.711 | 0.605 | 0.492 | 0.459 | 0.450 | 0.424 |
| 16 | 0.728 | 0.719 | 0.704 | 0.605 | 0.481 | 0.465 | 0.446 | 0.418 |
| 17 | 0.713 | 0.712 | 0.701 | 0.595 | 0.486 | 0.460 | 0.439 | 0.392 |
| 18 | 0.706 | 0.708 | 0.691 | 0.598 | 0.482 | 0.454 | 0.414 | 0.393 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 19 | 0.703 | 0.697 | 0.693 | 0.593 | 0.475 | 0.429 | 0.414 | 0.411 |
| 20 | 0.693 | 0.699 | 0.686 | 0.585 | 0.450 | 0.429 | 0.429 | 0.396 |

67

68 **Table S5:** Same as Table S3 but for the Pathagudam sub-basin.

| Lag / Duration . | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | -0.122 | -0.198 | 0.354 | 0.485 | 0.477 | 0.242 | 0.152 | 0.182 |
| 2 | -0.216 | 0.275 | 0.501 | 0.587 | 0.444 | 0.236 | 0.209 | 0.254 |
| 3 | 0.257 | 0.447 | 0.608 | 0.599 | 0.419 | 0.289 | 0.283 | 0.253 |
| 4 | 0.440 | 0.562 | 0.641 | 0.599 | 0.455 | 0.352 | 0.293 | 0.284 |
| 5 | 0.557 | 0.602 | 0.643 | 0.643 | 0.497 | 0.367 | 0.312 | 0.326 |
| 6 | 0.594 | 0.608 | 0.672 | 0.674 | 0.495 | 0.376 | 0.351 | 0.326 |
| 7 | 0.599 | 0.636 | 0.706 | 0.660 | 0.493 | 0.414 | 0.353 | 0.314 |
| 8 | 0.626 | 0.668 | 0.709 | 0.660 | 0.520 | 0.416 | 0.342 | 0.288 |
| 9 | 0.658 | 0.674 | 0.715 | 0.678 | 0.516 | 0.402 | 0.317 | 0.282 |
| 10 | 0.665 | 0.682 | 0.731 | 0.665 | 0.503 | 0.379 | 0.310 | 0.291 |
| 11 | 0.673 | 0.700 | 0.718 | 0.648 | 0.482 | 0.373 | 0.319 | 0.290 |
| 12 | 0.694 | 0.689 | 0.709 | 0.632 | 0.473 | 0.382 | 0.321 | 0.273 |
| 13 | 0.683 | 0.681 | 0.702 | 0.620 | 0.477 | 0.383 | 0.303 | 0.274 |
| 14 | 0.674 | 0.674 | 0.695 | 0.622 | 0.479 | 0.365 | 0.303 | 0.277 |
| 15 | 0.668 | 0.670 | 0.704 | 0.627 | 0.463 | 0.362 | 0.306 | 0.276 |
| 16 | 0.665 | 0.680 | 0.714 | 0.613 | 0.459 | 0.363 | 0.303 | 0.264 |
| 17 | 0.674 | 0.691 | 0.707 | 0.606 | 0.457 | 0.359 | 0.290 | 0.249 |
| 18 | 0.686 | 0.685 | 0.702 | 0.603 | 0.451 | 0.345 | 0.275 | 0.249 |
| 19 | 0.680 | 0.682 | 0.703 | 0.600 | 0.437 | 0.326 | 0.275 | 0.254 |
| 20 | 0.677 | 0.686 | 0.705 | 0.588 | 0.418 | 0.323 | 0.279 | 0.265 |

69

70 **Table S6.** Same as Table S3 but for Perur sub-basin.

| Duration \ Lag | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | -0.054 | 0.178 | 0.558 | 0.544 | 0.326 | 0.250 | 0.207 | 0.135 |
| 2 | 0.090 | 0.509 | 0.651 | 0.509 | 0.335 | 0.263 | 0.209 | 0.206 |
| 3 | 0.471 | 0.637 | 0.627 | 0.517 | 0.346 | 0.281 | 0.261 | 0.292 |
| 4 | 0.617 | 0.619 | 0.631 | 0.523 | 0.373 | 0.322 | 0.330 | 0.389 |
| 5 | 0.601 | 0.622 | 0.636 | 0.541 | 0.410 | 0.377 | 0.411 | 0.438 |
| 6 | 0.604 | 0.626 | 0.650 | 0.563 | 0.456 | 0.443 | 0.458 | 0.433 |
| 7 | 0.609 | 0.643 | 0.675 | 0.591 | 0.512 | 0.488 | 0.454 | 0.403 |
| 8 | 0.626 | 0.671 | 0.699 | 0.630 | 0.553 | 0.486 | 0.425 | 0.398 |
| 9 | 0.655 | 0.699 | 0.722 | 0.659 | 0.547 | 0.458 | 0.420 | 0.393 |
| 10 | 0.685 | 0.721 | 0.738 | 0.651 | 0.518 | 0.453 | 0.415 | 0.375 |
| 11 | 0.710 | **0.735** | 0.729 | 0.624 | 0.510 | 0.448 | 0.398 | 0.365 |
| 12 | 0.725 | 0.726 | 0.705 | 0.614 | 0.507 | 0.431 | 0.389 | 0.358 |
| 13 | 0.716 | 0.704 | 0.693 | 0.611 | 0.490 | 0.422 | 0.382 | 0.343 |
| 14 | 0.695 | 0.693 | 0.690 | 0.595 | 0.480 | 0.415 | 0.368 | 0.342 |
| 15 | 0.684 | 0.691 | 0.678 | 0.585 | 0.473 | 0.402 | 0.367 | 0.341 |
| 16 | 0.683 | 0.680 | 0.670 | 0.579 | 0.460 | 0.400 | 0.364 | 0.339 |
| 17 | 0.671 | 0.673 | 0.665 | 0.570 | 0.457 | 0.396 | 0.362 | 0.325 |
| 18 | 0.665 | 0.668 | 0.659 | 0.566 | 0.450 | 0.393 | 0.348 | 0.330 |
| 19 | 0.660 | 0.664 | 0.659 | 0.557 | 0.446 | 0.379 | 0.352 | 0.349 |
| 20 | 0.656 | 0.665 | 0.651 | 0.550 | 0.431 | 0.382 | 0.369 | 0.351 |

71

**Table S7:** Same as Table S3 but for the Polavaram sub-basin.

| Duration \ Lag | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.084 | 0.152 | 0.347 | 0.613 | 0.556 | 0.382 | 0.182 | 0.036 |
| 2 | 0.138 | 0.317 | 0.573 | 0.647 | 0.533 | 0.344 | 0.130 | 0.190 |
| 3 | 0.312 | 0.551 | 0.641 | 0.648 | 0.511 | 0.305 | 0.243 | 0.263 |
| 4 | 0.544 | 0.626 | 0.654 | 0.637 | 0.503 | 0.389 | 0.307 | 0.319 |
| 5 | 0.618 | 0.642 | 0.649 | 0.633 | 0.569 | 0.426 | 0.354 | 0.376 |
| 6 | 0.635 | 0.637 | 0.646 | 0.675 | 0.600 | 0.452 | 0.403 | 0.408 |
| 7 | 0.631 | 0.633 | 0.681 | 0.702 | 0.611 | 0.486 | 0.435 | 0.383 |
| 8 | 0.629 | 0.669 | 0.705 | 0.712 | 0.629 | 0.510 | 0.410 | 0.366 |
| 9 | 0.664 | 0.696 | 0.717 | 0.724 | 0.636 | 0.484 | 0.393 | 0.350 |
| 10 | 0.692 | 0.711 | 0.733 | 0.727 | 0.606 | 0.462 | 0.378 | 0.341 |
| 11 | 0.709 | 0.728 | 0.739 | 0.701 | 0.578 | 0.446 | 0.370 | 0.332 |
| 12 | 0.728 | **0.736** | 0.719 | 0.678 | 0.558 | 0.437 | 0.361 | 0.330 |
| 13 | **0.736** | 0.719 | 0.699 | 0.660 | 0.545 | 0.426 | 0.359 | 0.336 |
| 14 | 0.720 | 0.700 | 0.685 | 0.647 | 0.533 | 0.423 | 0.365 | 0.341 |
| 15 | 0.702 | 0.687 | 0.676 | 0.637 | 0.527 | 0.428 | 0.370 | 0.344 |
| 16 | 0.691 | 0.680 | 0.668 | 0.631 | 0.528 | 0.430 | 0.372 | 0.339 |
| 17 | 0.684 | 0.673 | 0.664 | 0.632 | 0.528 | 0.431 | 0.366 | 0.329 |
| 18 | 0.678 | 0.670 | 0.667 | 0.631 | 0.528 | 0.424 | 0.356 | 0.338 |
| 19 | 0.675 | 0.674 | 0.668 | 0.630 | 0.518 | 0.413 | 0.363 | 0.353 |
| 20 | 0.679 | 0.676 | 0.667 | 0.621 | 0.504 | 0.418 | 0.377 | 0.354 |

**Table S8.** Correlations between simulated streamflow peak and basin-averaged mean simulated surface runoff (prior to the flood peak) for different durations (days) and lags

(days). The analysis is for high streamflow events at the Mancherial station for the period 1969-2019. The highlighted number is the best correlation value.

| Lag / Duration | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.100 | 0.368 | 0.850 | 0.743 | 0.485 | 0.226 | 0.060 | 0.232 |
| 2 | 0.340 | 0.831 | 0.955 | 0.750 | 0.453 | 0.174 | 0.177 | 0.107 |
| 3 | 0.825 | 0.937 | 0.960 | 0.745 | 0.391 | 0.239 | 0.107 | 0.142 |
| 4 | 0.929 | 0.943 | 0.955 | 0.713 | 0.421 | 0.174 | 0.136 | 0.169 |
| 5 | 0.935 | 0.940 | 0.943 | 0.719 | 0.359 | 0.189 | 0.155 | 0.205 |
| 6 | 0.931 | 0.929 | 0.943 | 0.677 | 0.354 | 0.201 | 0.188 | 0.243 |
| 7 | 0.921 | 0.934 | 0.923 | 0.659 | 0.351 | 0.225 | 0.224 | 0.264 |
| 8 | 0.925 | 0.917 | 0.905 | 0.647 | 0.359 | 0.254 | 0.245 | 0.266 |
| 9 | 0.909 | 0.903 | 0.896 | 0.630 | 0.371 | 0.272 | 0.249 | 0.247 |
| 10 | 0.896 | 0.895 | 0.884 | 0.623 | 0.383 | 0.275 | 0.233 | 0.288 |
| 11 | 0.889 | 0.887 | 0.875 | 0.620 | 0.380 | 0.260 | 0.275 | 0.300 |
| 12 | 0.882 | 0.880 | 0.871 | 0.610 | 0.365 | 0.296 | 0.290 | 0.319 |
| 13 | 0.875 | 0.876 | 0.860 | 0.593 | 0.391 | 0.310 | 0.309 | 0.334 |
| 14 | 0.872 | 0.866 | 0.849 | 0.599 | 0.397 | 0.329 | 0.325 | 0.343 |
| 15 | 0.863 | 0.857 | 0.847 | 0.591 | 0.412 | 0.344 | 0.335 | 0.335 |
| 16 | 0.853 | 0.857 | 0.836 | 0.596 | 0.422 | 0.354 | 0.329 | 0.326 |
| 17 | 0.852 | 0.849 | 0.834 | 0.598 | 0.429 | 0.348 | 0.322 | 0.315 |
| 18 | 0.845 | 0.848 | 0.829 | 0.597 | 0.421 | 0.342 | 0.312 | 0.315 |
| 19 | 0.844 | 0.843 | 0.823 | 0.588 | 0.416 | 0.332 | 0.313 | 0.310 |
| 20 | 0.840 | 0.837 | 0.815 | 0.583 | 0.406 | 0.333 | 0.308 | 0.303 |

**Table S9.** Same as Table S8 but for the Tekra sub-basin.

| Lag / Duration . | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.014 | 0.391 | 0.774 | 0.748 | 0.343 | 0.224 | 0.342 | 0.301 |
| 2 | 0.310 | 0.775 | 0.910 | 0.758 | 0.339 | 0.311 | 0.369 | 0.395 |
| 3 | 0.762 | 0.913 | 0.924 | 0.747 | 0.394 | 0.381 | 0.447 | 0.492 |
| 4 | 0.909 | 0.922 | 0.928 | 0.758 | 0.451 | 0.449 | 0.528 | 0.533 |
| 5 | 0.916 | 0.929 | 0.933 | 0.762 | 0.505 | 0.530 | 0.560 | 0.561 |
| 6 | 0.922 | 0.933 | 0.933 | 0.767 | 0.574 | 0.562 | 0.581 | 0.553 |
| 7 | 0.924 | 0.936 | 0.937 | 0.775 | 0.599 | 0.588 | 0.575 | 0.550 |
| 8 | 0.927 | 0.943 | 0.931 | 0.777 | 0.621 | 0.583 | 0.572 | 0.560 |
| 9 | 0.937 | 0.942 | 0.920 | 0.784 | 0.616 | 0.584 | 0.580 | 0.562 |
| 10 | 0.940 | 0.930 | 0.917 | 0.776 | 0.615 | 0.591 | 0.579 | 0.535 |
| 11 | 0.929 | 0.925 | 0.910 | 0.771 | 0.624 | 0.590 | 0.554 | 0.515 |
| 12 | 0.924 | 0.918 | 0.905 | 0.769 | 0.624 | 0.569 | 0.536 | 0.506 |
| 13 | 0.917 | 0.913 | 0.897 | 0.769 | 0.606 | 0.554 | 0.529 | 0.489 |
| 14 | 0.911 | 0.905 | 0.892 | 0.755 | 0.590 | 0.548 | 0.514 | 0.497 |
| 15 | 0.902 | 0.899 | 0.879 | 0.741 | 0.584 | 0.535 | 0.522 | 0.493 |
| 16 | 0.896 | 0.887 | 0.867 | 0.732 | 0.570 | 0.542 | 0.516 | 0.482 |
| 17 | 0.884 | 0.875 | 0.857 | 0.720 | 0.576 | 0.535 | 0.505 | 0.466 |
| 18 | 0.873 | 0.864 | 0.844 | 0.718 | 0.568 | 0.524 | 0.490 | 0.482 |
| 19 | 0.862 | 0.851 | 0.841 | 0.708 | 0.556 | 0.509 | 0.504 | 0.504 |
| 20 | 0.849 | 0.848 | 0.831 | 0.696 | 0.541 | 0.522 | 0.522 | 0.478 |

80

81 **Table S10.** Same as Table S8 but for the Pathagudam sub-basin.

| Lag / Duration . | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | -0.059 | -0.088 | 0.528 | 0.697 | 0.584 | 0.289 | 0.187 | 0.185 |
| 2 | -0.102 | 0.480 | 0.765 | 0.758 | 0.547 | 0.289 | 0.229 | 0.302 |
| 3 | 0.480 | 0.735 | 0.851 | 0.764 | 0.523 | 0.335 | 0.333 | 0.322 |
| 4 | 0.736 | 0.834 | 0.873 | 0.768 | 0.549 | 0.416 | 0.362 | 0.365 |
| 5 | 0.836 | 0.862 | 0.872 | 0.799 | 0.596 | 0.444 | 0.391 | 0.412 |
| 6 | 0.857 | 0.864 | 0.887 | 0.820 | 0.602 | 0.459 | 0.436 | 0.415 |
| 7 | 0.858 | 0.877 | 0.910 | 0.804 | 0.602 | 0.502 | 0.442 | 0.404 |
| 8 | 0.870 | 0.896 | 0.907 | 0.800 | 0.632 | 0.510 | 0.433 | 0.375 |
| 9 | 0.888 | 0.895 | 0.905 | 0.815 | 0.635 | 0.501 | 0.407 | 0.359 |
| 10 | 0.889 | 0.893 | 0.916 | 0.810 | 0.627 | 0.478 | 0.392 | 0.364 |
| 11 | 0.887 | 0.905 | 0.909 | 0.802 | 0.608 | 0.465 | 0.396 | 0.360 |
| 12 | 0.901 | 0.898 | 0.907 | 0.787 | 0.594 | 0.468 | 0.394 | 0.345 |
| 13 | 0.895 | 0.897 | 0.900 | 0.773 | 0.592 | 0.464 | 0.380 | 0.351 |
| 14 | 0.894 | 0.891 | 0.891 | 0.768 | 0.588 | 0.450 | 0.384 | 0.351 |
| 15 | 0.888 | 0.882 | 0.892 | 0.765 | 0.575 | 0.450 | 0.384 | 0.349 |
| 16 | 0.881 | 0.884 | 0.894 | 0.752 | 0.572 | 0.448 | 0.380 | 0.334 |
| 17 | 0.882 | 0.888 | 0.888 | 0.747 | 0.566 | 0.442 | 0.364 | 0.323 |
| 18 | 0.885 | 0.883 | 0.882 | 0.737 | 0.556 | 0.424 | 0.353 | 0.330 |
| 19 | 0.880 | 0.878 | 0.873 | 0.728 | 0.539 | 0.409 | 0.359 | 0.337 |
| 20 | 0.875 | 0.871 | 0.868 | 0.713 | 0.523 | 0.412 | 0.364 | 0.346 |

82

83 **Table S11.** Same as Table S8 but for the Perur sub-basin.

| Lag / Duration . | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | -0.005 | 0.338 | 0.742 | 0.776 | 0.475 | 0.323 | 0.290 | 0.221 |
| 2 | 0.249 | 0.724 | 0.891 | 0.764 | 0.470 | 0.357 | 0.318 | 0.290 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3 | 0.714 | 0.888 | 0.896 | 0.766 | 0.487 | 0.401 | 0.368 | 0.373 |
| 4 | 0.884 | 0.892 | 0.900 | 0.774 | 0.535 | 0.440 | 0.427 | 0.462 |
| 5 | 0.884 | 0.896 | 0.906 | 0.795 | 0.563 | 0.482 | 0.495 | 0.508 |
| 6 | 0.888 | 0.900 | 0.920 | 0.791 | 0.592 | 0.531 | 0.537 | 0.506 |
| 7 | 0.891 | 0.916 | 0.930 | 0.787 | 0.626 | 0.572 | 0.534 | 0.483 |
| 8 | 0.907 | **0.930** | 0.924 | 0.797 | 0.659 | 0.571 | 0.513 | 0.479 |
| 9 | 0.921 | **0.930** | 0.917 | 0.809 | 0.651 | 0.551 | 0.508 | 0.473 |
| 10 | 0.923 | 0.923 | 0.916 | 0.797 | 0.629 | 0.545 | 0.500 | 0.452 |
| 11 | 0.917 | 0.919 | 0.903 | 0.778 | 0.621 | 0.537 | 0.480 | 0.438 |
| 12 | 0.914 | 0.906 | 0.889 | 0.765 | 0.613 | 0.517 | 0.467 | 0.431 |
| 13 | 0.902 | 0.894 | 0.876 | 0.756 | 0.592 | 0.503 | 0.459 | 0.416 |
| 14 | 0.889 | 0.880 | 0.867 | 0.736 | 0.577 | 0.496 | 0.446 | 0.417 |
| 15 | 0.876 | 0.873 | 0.853 | 0.721 | 0.569 | 0.483 | 0.446 | 0.416 |
| 16 | 0.869 | 0.860 | 0.839 | 0.714 | 0.556 | 0.481 | 0.443 | 0.408 |
| 17 | 0.855 | 0.847 | 0.833 | 0.703 | 0.551 | 0.477 | 0.435 | 0.397 |
| 18 | 0.843 | 0.841 | 0.824 | 0.694 | 0.543 | 0.468 | 0.424 | 0.415 |
| 19 | 0.837 | 0.833 | 0.819 | 0.683 | 0.532 | 0.457 | 0.440 | 0.439 |
| 20 | 0.829 | 0.829 | 0.808 | 0.669 | 0.521 | 0.472 | 0.461 | 0.433 |

84

85 **Table S12.** Same as Table S8 but for the Polavaram sub-basin.

| Lag / Duration . | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.132 | 0.310 | 0.532 | 0.857 | 0.692 | 0.443 | 0.279 | 0.149 |
| 2 | 0.274 | 0.523 | 0.845 | 0.865 | 0.658 | 0.441 | 0.258 | 0.281 |
| 3 | 0.531 | 0.833 | 0.895 | 0.853 | 0.657 | 0.439 | 0.360 | 0.343 |
| 4 | 0.829 | 0.884 | 0.888 | 0.855 | 0.681 | 0.513 | 0.403 | 0.397 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5 | 0.877 | 0.880 | 0.891 | 0.869 | 0.736 | 0.524 | 0.446 | 0.451 |
| 6 | 0.875 | 0.882 | 0.904 | 0.890 | 0.738 | 0.546 | 0.487 | 0.480 |
| 7 | 0.877 | 0.894 | 0.923 | 0.890 | 0.738 | 0.573 | 0.515 | 0.459 |
| 8 | 0.891 | 0.915 | 0.920 | 0.882 | 0.740 | 0.593 | 0.495 | 0.447 |
| 9 | 0.910 | 0.917 | 0.913 | 0.876 | 0.737 | 0.571 | 0.482 | 0.438 |
| 10 | 0.914 | 0.913 | 0.910 | 0.865 | 0.713 | 0.554 | 0.473 | 0.426 |
| 11 | 0.912 | 0.912 | 0.902 | 0.846 | 0.693 | 0.544 | 0.461 | 0.416 |
| 12 | 0.913 | 0.906 | 0.888 | 0.830 | 0.677 | 0.532 | 0.450 | 0.411 |
| 13 | 0.907 | 0.893 | 0.874 | 0.815 | 0.660 | 0.520 | 0.445 | 0.416 |
| 14 | 0.895 | 0.880 | 0.862 | 0.798 | 0.646 | 0.513 | 0.450 | 0.419 |
| 15 | 0.882 | 0.869 | 0.850 | 0.785 | 0.636 | 0.516 | 0.452 | 0.422 |
| 16 | 0.872 | 0.857 | 0.840 | 0.776 | 0.635 | 0.516 | 0.454 | 0.416 |
| 17 | 0.861 | 0.849 | 0.832 | 0.773 | 0.631 | 0.516 | 0.446 | 0.407 |
| 18 | 0.853 | 0.842 | 0.829 | 0.766 | 0.629 | 0.507 | 0.437 | 0.425 |
| 19 | 0.846 | 0.839 | 0.824 | 0.763 | 0.617 | 0.497 | 0.453 | 0.447 |
| 20 | 0.845 | 0.835 | 0.820 | 0.751 | 0.605 | 0.511 | 0.473 | 0.442 |