

## Supplementary Information

### Trends and Spatio-Temporal Variability of Summer Mean and Extreme Precipitation across South Korea for 1973-2022

Hye-Ryeom Kim<sup>1,3</sup>, Mincheol Moon<sup>2,4</sup>, Junghee Yun<sup>3,4</sup>, and Kyung-Ja Ha<sup>1,2,3,4\*</sup>,

<sup>1</sup>BK21 School of Earth and Environmental Systems, Pusan National University, Busan, Republic of Korea.

<sup>2</sup>Department of Climate System, Pusan National University, Busan, Republic of Korea.

<sup>3</sup>Department of Atmospheric Sciences, Pusan National University, Busan, Republic of Korea.

<sup>4</sup>Center for Climate Physics, Institute for Basic Science, Busan, Republic of Korea.

\* *Corresponding author*: Kyung-Ja Ha, BK21 School of Earth and Environmental Systems, Pusan National University, Busan, Republic of Korea. *e-mail* : [kjha@pusan.ac.kr](mailto:kjha@pusan.ac.kr)

The one supplementary table and figure are included in this document.

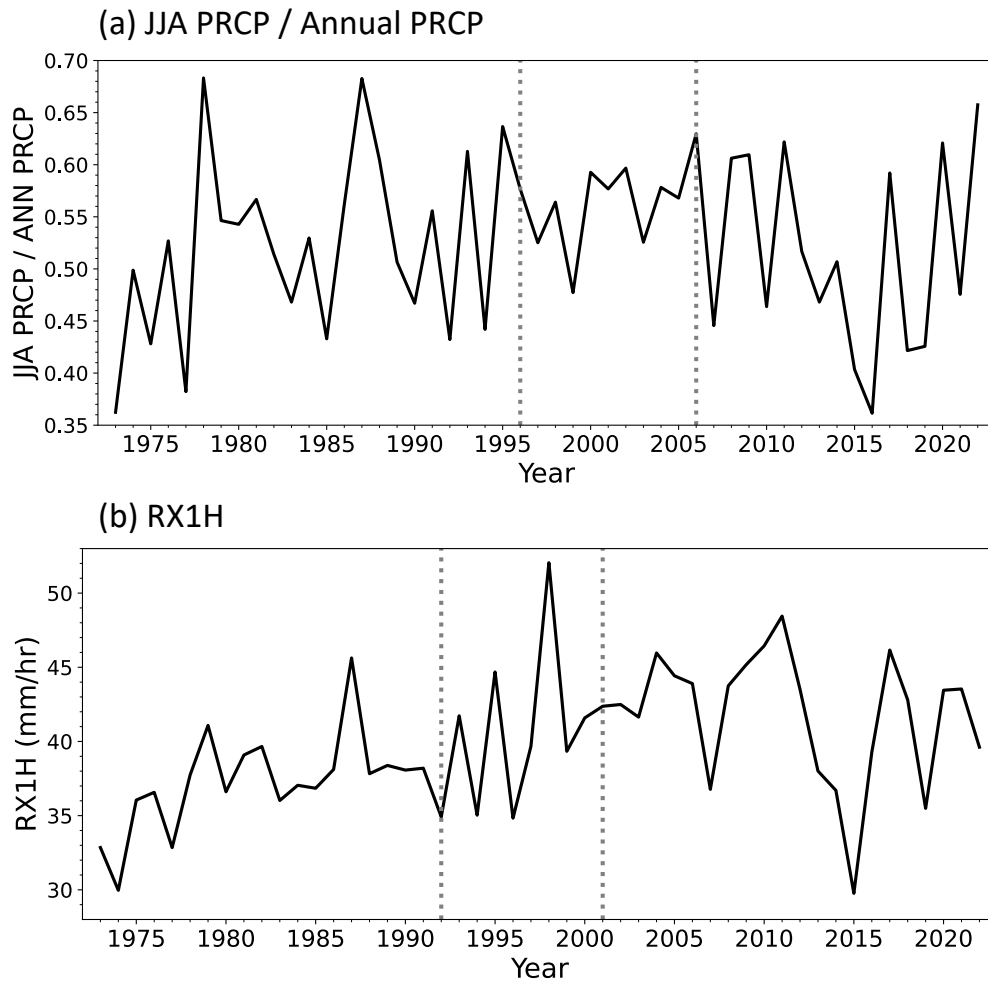
**Table S1** The trend of precipitation indices for 60 ASOS stations over the past 50 years (1973–2022). The star (\*) indicates statistical significance above a 90% confidence level.

| Station       | JJA mean<br>PRCP<br>(mm/day) | RX1H<br>(mm/hr) | R95p<br>(mm) | R99p<br>(mm) | R95pF<br>(days) | R99pF<br>(days) |
|---------------|------------------------------|-----------------|--------------|--------------|-----------------|-----------------|
| Sokcho        | 1.50                         | 16.00 *         | 164.50 *     | 82.50        | 1.50 *          | 0.50            |
| Daegwallyeong | - 0.50                       | 7.00            | 32.00        | 40.00        | 0.50            | 0.50            |
| Chuncheon     | 2.00                         | 14.50 *         | 167.00 *     | 134.00       | 1.00            | 1.00            |
| Gangneung     | 1.50                         | 17.50 *         | 122.50       | 95.00        | 1.00            | 0.50 *          |
| Seoul         | 2.00                         | 11.00           | 208.50 *     | 106.00       | 1.50 *          | 0.50            |
| Incheon       | 2.00                         | 13.50 *         | 225.00 *     | 147.50 *     | 1.50 *          | 1.00 *          |
| Wonju         | 0.50                         | -4.00           | 28.00        | 15.00        | 0.10            | -0.05           |
| Ulleungdo     | 1.50                         | 4.50            | 109.00 *     | 109.00 *     | 1.00            | 1.00 *          |
| Suwon         | 2.50                         | 6.00            | 267.00 *     | 59.50        | 2.00 *          | 0.15            |
| Chungju       | 1.00                         | 8.50            | 24.50        | 60.50        | 0.05            | 0.50            |
| Seosan        | 1.00                         | 15.00           | 119.50       | 71.00        | 1.00            | 0.50            |
| Ulsan         | 1.00                         | 5.00            | 114.00       | 27.00        | 1.50            | 0.20            |
| Cheongju      | 0.50                         | 5.00            | 26.00        | 73.00        | -0.15           | 0.50            |
| Daejeon       | 0.50                         | -3.00           | 3.50         | 35.00        | -0.15           | 0.20            |
| Chupungnyeong | 0.50                         | 2.00            | 31.50        | -33.50       | 0.50            | -0.50           |
| Pohang        | 0.10                         | 7.00            | 18.50        | 0.25         | 0.50            | 0.10            |
| Gunsan        | 0.50                         | 8.50            | 74.50        | 104.50       | 0.50            | 0.50 *          |
| Daegu         | 0.50                         | 6.00            | 38.00        | 26.00        | 0.50            | 0.20            |
| Jeonju        | 1.00                         | 8.50            | 76.50        | -12.00       | 1.00            | -0.10           |
| Ulsan         | 0.10                         | 7.00            | 47.50        | 26.00        | 0.50            | 0.50            |
| Gwangju       | 0.50                         | 8.50            | 6.00         | -5.50        | -0.02           | -0.10           |
| Busan         | 2.00                         | 23.00 *         | 204.00 *     | 67.50        | 1.50 *          | 0.50            |
| Tongyeong     | 1.00                         | 17.00 *         | 127.00       | 25.00        | 1.00            | 0.50            |
| Mokpo         | 0.50                         | 6.50            | -25.00       | -14.00       | -0.20           | -0.10           |
| Yeosu         | 0.50                         | 10.00 *         | 74.50        | 2.50         | 1.00            | -0.05           |

|            |       |         |          |          |        |        |
|------------|-------|---------|----------|----------|--------|--------|
| Wando      | -1.00 | -7.00   | -33.50   | -71.00   | 0.20   | -0.50  |
| Jeju       | -1.00 | 15.50   | -28.50   | 26.00    | -0.50  | 0.10   |
| Seongsan   | 1.00  | 16.50   | 56.50    | -38.50   | 0.50   | -0.20  |
| Seogwipo   | 0.50  | 9.00    | 115.00   | -12.50   | 1.00   | -0.05  |
| Jinju      | -0.50 | -2.50   | 14.00    | -27.00   | 0.20   | -0.15  |
| Ganghwa    | -1.00 | -13.00  | -28.50   | -3.50    | -0.15  | -0.05  |
| Yangpyeong | 2.50  | 5.00    | 177.00   | 131.00   | 1.00   | 0.50   |
| Icheon     | 0.50  | -2.00   | 54.00    | 69.50    | 0.20   | 0.50   |
| Inje       | 1.50  | 11.50 * | 104.50   | 154.00 * | 0.50   | 1.00 * |
| Hongcheon  | 1.00  | 9.50    | 119.50   | 48.00    | 1.00   | 0.20   |
| Jecheon    | 1.50  | 6.00    | 114.00   | 65.50    | 1.00   | 0.50   |
| Boeun      | 1.00  | 7.50    | 1.00     | 35.50    | -0.02  | 0.50   |
| Cheonan    | 0.25  | -0.15   | -39.00   | 51.00    | -0.50  | 0.50   |
| Boryeong   | -0.50 | -3.00   | -20.50   | -34.50   | -0.10  | -0.15  |
| Buyeo      | 0.50  | 4.50    | -10.50   | 27.50    | -0.20  | 0.50   |
| Geumsan    | 0.50  | 8.50    | -8.00    | 29.50    | -0.20  | 0.15   |
| Buan       | 0.50  | 3.50    | 21.50    | 12.00    | 0.05   | 0.05   |
| Imsil      | 1.00  | 10.00 * | 62.00    | 64.50    | 0.20   | 0.50   |
| Jeongeup   | 0.50  | 10.00   | 69.00    | 70.50    | 0.35   | 0.50   |
| Namwon     | 0.50  | 12.00   | 47.50    | 78.00    | 0.10   | 0.50   |
| Jangheung  | -0.50 | 13.50 * | -26.50   | -5.50    | -0.30  | 0.00   |
| Haenam     | -1.00 | 8.50    | -27.50   | -2.50    | -0.40  | -0.05  |
| Goheung    | -0.50 | 7.00    | 24.50    | 45.50    | -0.05  | 0.10   |
| Yeongju    | 1.00  | -7.00   | 45.00    | 24.50    | 0.50   | 0.20   |
| Mungyeong  | 1.00  | 5.50    | 99.50    | 18.50    | 1.00   | 0.05   |
| Yeongdeok  | 0.50  | 7.00    | 58.50    | 27.00    | 0.50   | 0.50   |
| Uiseong    | -0.20 | -4.00   | -18.50   | -32.00   | -0.20  | -0.50  |
| Gumi       | 1.00  | 11.50 * | 117.50 * | 59.00    | 1.50 * | 0.50   |
| Yeongcheon | 0.50  | 5.00    | 44.00    | 3.50     | 0.50   | 0.10   |
| Geochang   | -0.50 | 2.50    | -23.50   | 15.50    | -0.50  | 0.05   |
| Hapcheon   | 0.50  | 7.00    | 49.00    | 26.50    | 0.50   | 0.15   |

|           |       |         |        |        |       |        |
|-----------|-------|---------|--------|--------|-------|--------|
| Miryang   | -0.50 | 1.00    | -53.00 | -54.00 | -0.50 | -0.50  |
| Sancheong | 0.50  | 4.00    | 70.50  | 52.00  | 0.50  | 0.25   |
| Geoje     | 1.50  | 22.50 * | 86.00  | 35.00  | 0.50  | 0.20   |
| Namhae    | 0.50  | 6.50    | 103.00 | 97.00  | 0.50  | 0.50 * |

**Figure R1** The time series of (a) the ratio of JJA precipitation to annual precipitation and (b) the hourly maximum precipitation. The window is 11 years and vertical dashed lines indicate the statistically significant change point above a 95 % confidence level.



**Figure R2** The spatial distribution of standard deviation for each ASOS station over the past 50 years.

