**Appendix**

**Details of the indices used from the dataset of 142 circulation indices:**

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| **No.** | **Index** | **Detail** |
| 1 | TIOD index | The SST different between Tropical Indian Ocean Dipole (TIOD; 10S-10N/50-70E and 10S-0/90-110E) |
| 2 | SIOD index | The SST different between Subtropical Indian Ocean Dipole (SIOD; 45S-30S/45E-75E and 25S-15S/80E-100E) |
| 3 | SST anomaly in Kuroshio region | The average of SST anomaly in Kuroshio region (35N/140-150E, and 25N-30N/125-150E) |
| 4 | NINO SST index in region 1+2 | The average of SST anomaly in NINO region (0-10S, 90W-80W) |
| 5 | NINO SST index in region 3 | The average of SST anomaly in NINO region 3 (5N-5S, 150W-90W) |
| 6 | NWP warm pool index | The cumulative value of the difference between the SST (>28°C) of the grid point and 28.0°C multiplied by the area of the grid point in Northwest Pacific warm pool |
| 7 | SOI | SOI gives an indication of the development and intensity of El Niño or La Niña events in the Pacific Ocean. The SOI is calculated using the pressure differences between Tahiti and Darwin. |
| 8 | Subtropical High Area index over the Eastern Pacific: | Spherical area of subtropical high (>5880 gpm) over the Eastern Pacific (175W-115W) |
| 9 | Subtropical High Area index over the Pacific: | Spherical area of subtropical high (>5880 gpm) over the Pacific (110E-115W) |
| 10 | Subtropical High Intensity index over the Eastern Pacific | The cumulative value of the difference between the grid point potential height (≥5880 gpm) and 5870 gpm multiplied by the spherical area of the grid point over the Eastern Pacific (175W-115W) |
| 11 | Subtropical High Intensity index over the Pacific | The cumulative value of the difference between the grid point potential height (≥5880 gpm) and 5870 gpm multiplied by the spherical area of the grid point over the Eastern Pacific (110E-115W) |
| 12 | Ridge Line of Subtropical High over the Eastern Pacific | The average of the latitude of the location of the center of subtropical high on each meridian (≥5880 gpm) over the Eastern Pacific (175W-115W) |
| 13 | Ridge Line of subtropical high over the Atlantic | The average of the latitude of the location of the center of subtropical high on each meridian (≥5880 gpm) over the Atlantic (55W-25W) |
| 14 | Ridge point of subtropical high over the western Pacific | Longitude of the westernmost position of 5880 gpm contour over the western Pacific (110E-150E) |
| 15 | Northern boundary of Subtropical High over the northern hemisphere | Average of longitude of northern 5880gpm contour over the northern hemisphere(5E-360) |
| 16 | Northern boundary of Subtropical High over the Pacific | Average of longitude of northern 5880gpm contour over the Pacific (110E-115W) |
| 17 | Northern boundary of Subtropical High over the Atlantic | Average of longitude of northern 5880gpm contour over the Atlantic (55W-25W) |
| 18 | Northern boundary of Subtropical High over the North American-Atlantic | Average of longitude of northern 5880gpm contour over the North American-Atlantic(110W-20W) |
| 19 | Area index of the Arctic vortex over the Atlantic-Europe | Spherical area of Arctic vortex over the Atlantic-Europe (30W-60E) |
| 20 | Area index of the Arctic vortex over the Asia | Spherical area of Arctic vortex over the the Asia (60E-150E) |
| 21 | Intensity index of the Arctic vortex over the Asia | The total air mass between the 500hPa isobar and the contour of the southern boundary of the Arctic vortex over the the Asia (60E-150E) |
| 22 | Intensity index of the Arctic vortex center | The total air mass between the 500hPa isobar and the contour of the southern boundary of the Arctic vortex center (0-360) |
| 23 | Latitudinal position of Arctic vortex center | The longitude position of Arctic vortex with the lowest potential height in the 500hPa height field over the Northern Hemisphere |
| 24 | AO index | The normalized series of time coefficients of the 1st mode obtained from the empirical orthogonal function analysis (EOF) of the 1000hPa height anomaly field |
| 25 | Meridional Circulation Index over Eurasia | The average north-south component of the geostrophic wind along the longitudinal circle over Eurasia (0-150E) |
| 26 | Meridional Circulation Index over Asia | The average north-south component of the geostrophic wind along the longitudinal circle over Asia (60E-150E) |
| 27 | Latitudinal Circulation Index over Asia | The average east-west component of the geostrophic wind along the latitudinal circle over Asia (60E-150E) |
| 28 | Pacific Transition Pattern (PT) | The normalized series of time coefficients of the 10th mode obtained from the empirical orthogonal function analysis (EOF) of the 500hPa height anomaly field |
| 29 | C-type circulation over the Atlantic-Europe | The number of days that exhibit a C-type circulation in the 500hPa height field over the Atlantic-Europe. (C-type: high ridge over the west coast of Europe and long wave trough over the Ural Mountains region) |
| 30 | W-type circulation pattern over Atlantic-Europe | The number of days that exhibit a W-type circulation in the 500hPa height field over the Atlantic-Europe. (W-type: a flat westerly circulation and prevalent latitudinal circulation.) |
| 31 | E-type circulation pattern over Atlantic-Europe | The number of days that exhibit a E-type circulation in the 500hPa height field over the Atlantic-Europe. (E-type: the opposite of C-type, with a high ridge in the Ural Mountains and increased longitudinal direction in East Asia.) |