Fig. S1. The JJA climatology of (a) Z850 (shaded), uv850 (vector) and integrated water vapor transport (IVT) (streamline); (b) Z500 (shaded), uv500 (vector) and IVT (streamline); (c) Z500 (shaded) and its daily standard deviation (contour) and uv500 (vector) during 1979 - 2016. The shaded interval is 25 m and the contour interval is 5 m.
Fig. S2. The time series (Top) of the daily WNPSH index calculated by the Z850 and Z500 anomalies averaged over the WNPSH-active region [18°N – 26°N, 127°E – 148°E] and the corresponding cross correlation (Bottom). Positive lags indicate the WNPSH index calculated by Z500 anomaly leads the WNPSH index by Z850 anomaly.
Fig. S3. (a) The proportion of ENSO events during positive WNPSH phase (the top 10% strongest WNPSHI days) and (b) negative WNPSH phase (the top 10% weakest WNPSHI days) in 38 summers during 1979-2016, with time lags from 16 months ahead (lag -16) to 16 months after (lag 16) the WNPSH onset. The El Niño and La Niña events are defined as the 5-month moving mean of the Nino3.4 index exceeding ±0.4°C for at least 6 consecutive months. Lag 0 bar is outlined in red, while bars with maximum percentages of total days (350 days) for El Niño and La Niña events are outlined in grey with the corresponding values shown. (c) The pie chart of various types of ENSO transitions from 10 months ahead (lag -10) to 2 months after (lag 2) the WNPSH onset during the positive WNPSH phase and (d) the negative WNPSH phase. “El”, “Neu” and “La” denote El Niño, Neutral and La Niña event, respectively. “El-Neu-La” denotes the transition from El Niño to La Niña state.
Fig. S4. The EA regions (identified by the red boxes) that are experiencing anomalous summer monsoons on day 3 of the positive WNPSH phase, including the eastern China (EC), the Korean Peninsula (KR), the central Japan (CJP), the western North Pacific (WNP) and the maritime continent (MC).
Fig. S5. Slopes of the linear quantile regression (LQR) (y-axis) are plotted against the quantiles (x-axis) selected among the dataset of JJA precipitation in the EC region and the WNPSHI in 38 summers during 1979-2016, with time lags ranging from lag -6 to lag 6. Here lag -6 (lag 6) denotes the regional PP anomalies is leading (lagging) the WNPSHI by 6 days. The plots inside the green boxes are those with most of the LQR slopes’ 95% C.I. (shadow areas) that do not overlap with the 95% C.I. of the linear regression (red dash line).
Changes of the LQR Slopes (KR region)

Fig. S6. As in Fig. S4, but for the KR region.
Changes of the LQR Slopes (CJP region)

Fig. S7. As in Fig. S4, but for the CJP region.
Fig. S8. Boxplots of the JJA precipitation (y-axis) in the MC region against the WNPSHI (x-axis) in 38 summers during 1979-2016, with time lags ranging from lag -6 to lag 6. Both precipitation values and the WNPSHI are scaled from 0 to 1 to well divide the 5 grouped boxplots with a band width of 0.2.