Distinct response of Asian summer monsoon rainfall during the first and third years of triple-dip La Niña events

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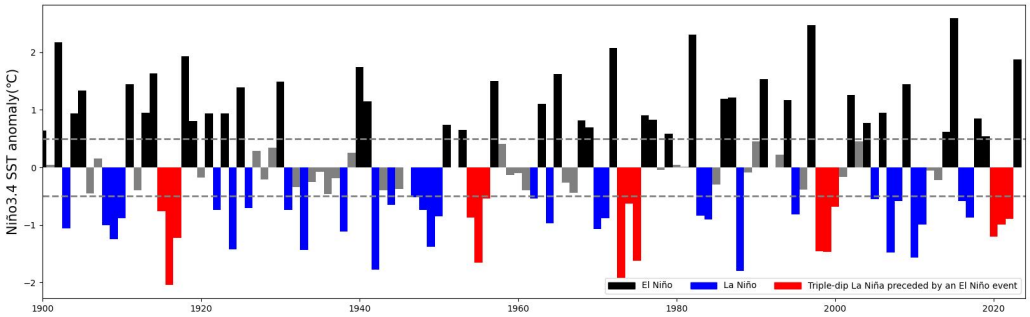
Supplementary Figures 1 to 6

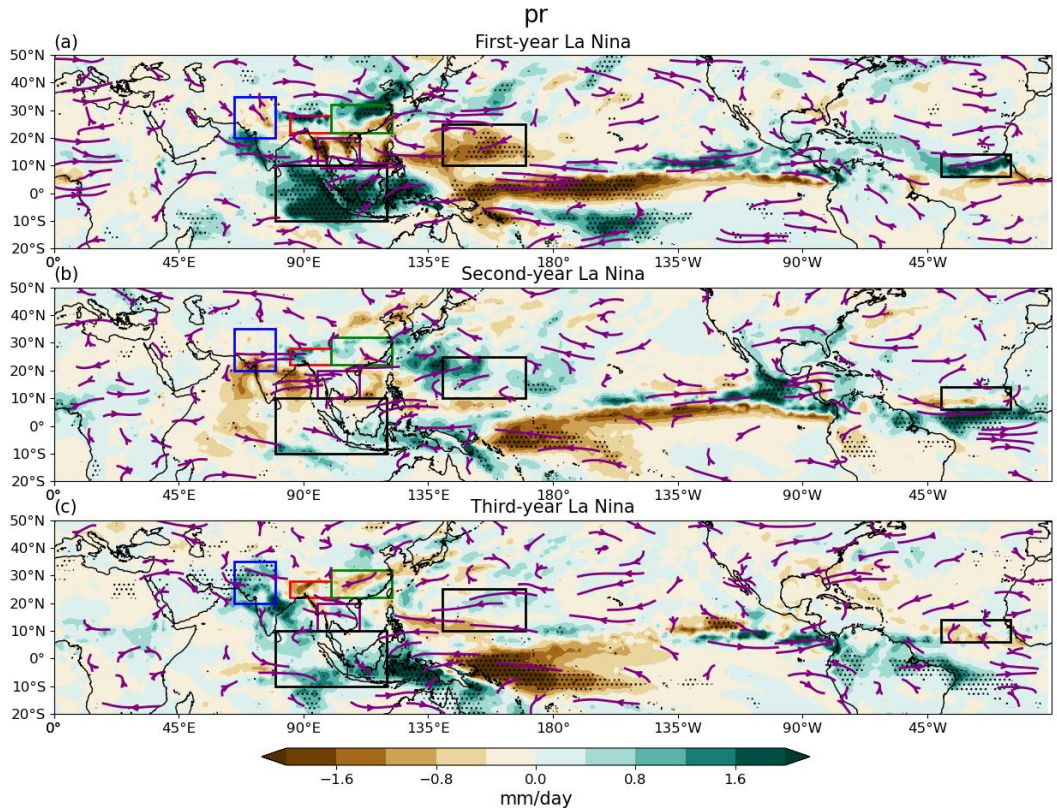
Supplementary Figure 1



Extended Data Figure 1: Temporal evolution of Niño 3.4 sea surface temperature anomalies.

A La Niña year is defined by the below-normal (<−0.5 °C) Niño 3.4 index, the SST anomaly averaged over the index region (5° S–5° N, 120–170° W), during its mature phase from ONDJF. A triple-dip La Niña is characterized by at least three consecutive La Niña years. Black shading indicates El Niño years. The gray bars indicate neutral years, the red bars correspond to triple-dip La Niña preceded by an El Niño event and the blue bars denote other La Niña events.

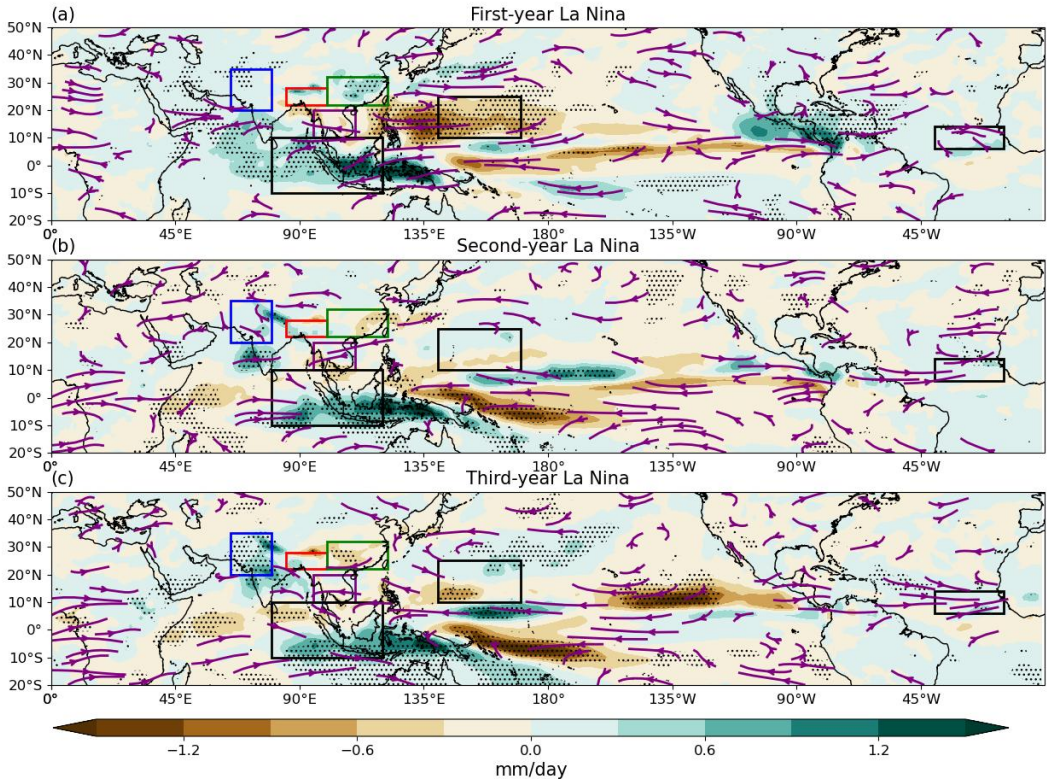
Supplementary Figure 2



Extended Data Figure 2: Rainfall and circulation pattern during the first, second and third years with ERA dataset

Similar to Figure 1, (a), (b), and (c) show the composite rainfall and 850 hPa wind fields for the first year, second year, and third year during the triple-dip La Niña events, respectively. Unlike Figure 1, the ERA reanalysis rainfall data are used here, which allow for a better representation of oceanic convection. The black boxes indicate regions of strong convection over the western North Pacific and the tropical North Atlantic, respectively.

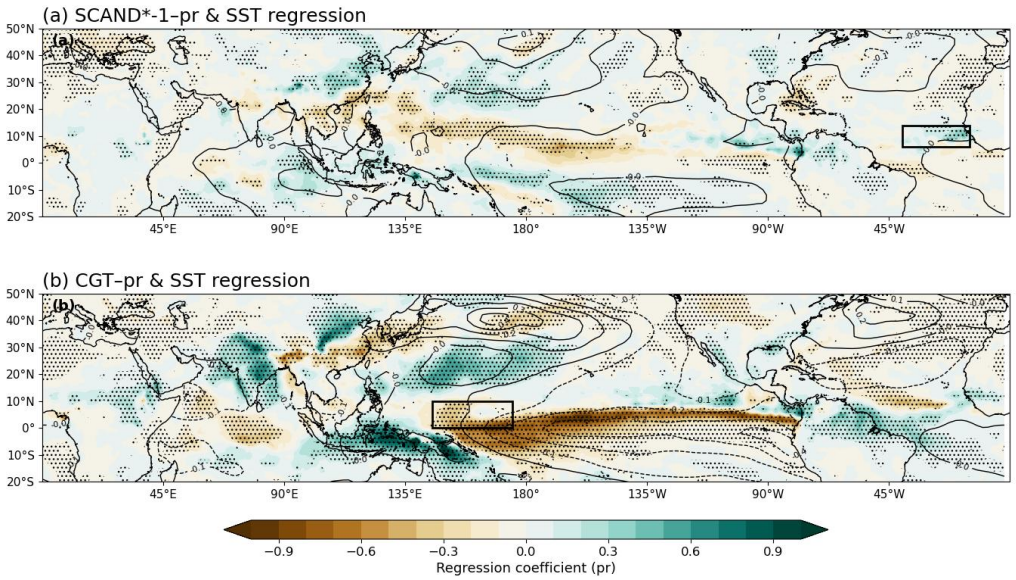
Supplementary Figure 3



Extended Data Figure 3: Rainfall and circulation pattern during the first and third years with pacemaker experiment

As in Extended Data Figure 2, but for the pacemaker experiment

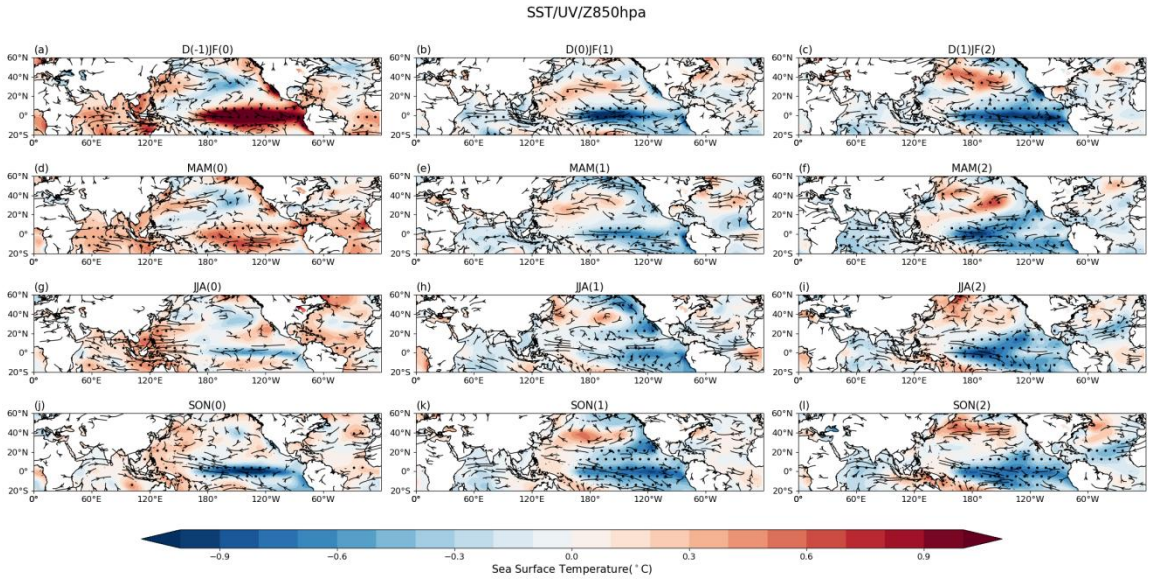
Supplementary Figure 4



Extended Data Figure 4: JJA rainfall and SST anomalies regressions for SCAND and CGT

JJA mean (a) inverted SCAND index and (b) CGT index regression patterns with rainfall and sea surface temperature (SST) during 1901–2023. Shading indicates the linear regression coefficients of rainfall onto each index, with dotted hatching denoting regions significant at the 95% confidence level. Black contours represent the regression coefficients of the high-pass–filtered (9-year cutoff) SST onto each index. The rectangular boxes highlight the key oceanic regions discussed in the text.

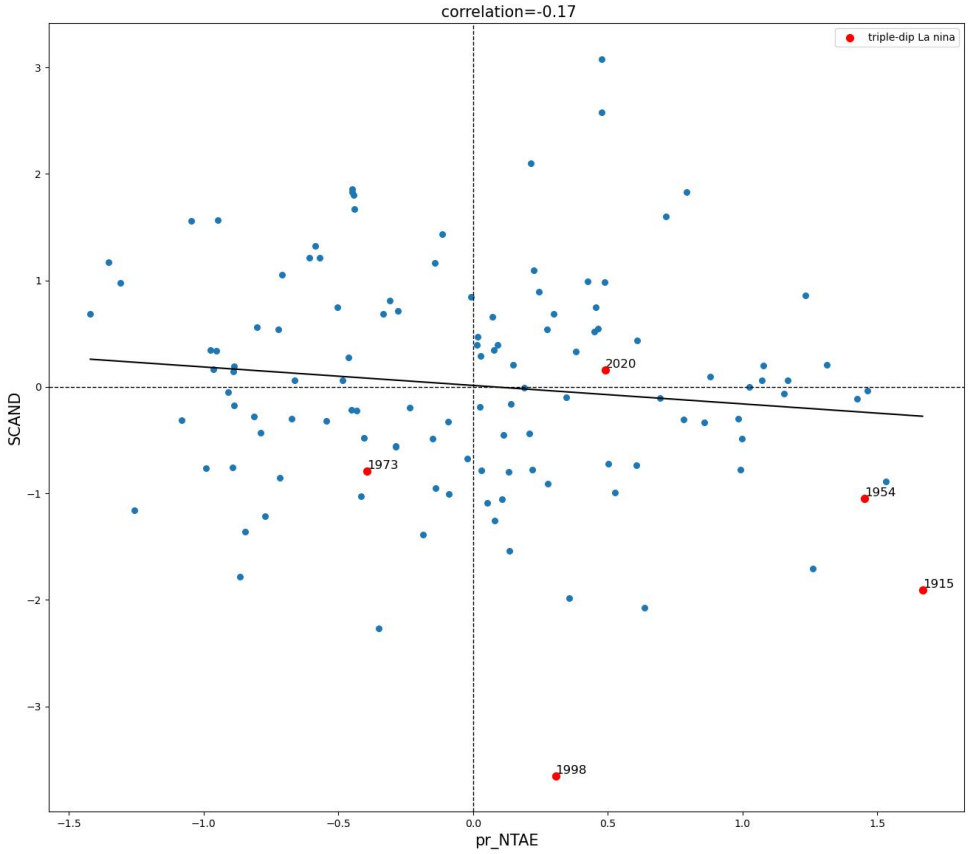
Supplementary Figure 5



Extended Data Figure 5: Composite SST–Wind Anomalies Across La Niña Years

Observed composite analysis of SST anomalies (shaded; ℃) and 850-hPa wind anomalie(vectors, m/s). '-1' refers to the previous year which is an El Niño year and '0', '1', '2' refers to the first, second and third year of triple-dip La Niña.

Supplementary Figure 6



Extended Data Figure 6: Relationships of eastern NTA rainfall index with SCAND index

Scatterplots of the eastern NTA rainfall index versus SCAND index during 1901 –2023. Blue points represent other years and red points represent the third year of triple-dip La Niña. Black line indicates the regression line.