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Roles of Tropical-Pacific Interannual–Interdecadal Variability in Forming the Super Long La Niña Events

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The super long La Niña phenomenon, which has an extremely long duration, like the recent 2020–2023 La Niña event, is less concerned than the super El Niño. In this study, we identify five super long La Niña events after 1950 and investigate roles of the 2–3-year quasi-biennial (QB) and 3–7-year low-frequency (LF) ocean–atmosphere coupled processes of El Niño–Southern Oscillation (ENSO), and the interdecadal background in forming the basin-scale prolonged negative sea surface temperature anomalies (SSTAs) during these events. We group the five events into the thermocline-driven type (the 1983–1986 and 1998–2002 events) and the wind-driven type (the 1954–1957, 1973–1976, and 2020–2023 events). The former inherited a sufficiently discharged state of equatorial upper-ocean heat content from the preceding super El Niño and dominated by the thermocline feedback, leading to a LF oceanic dynamical adjustment to support the maintenance of negative ENSO SSTAs. The latter were promoted by the relatively more important zonal advective feedback and Ekman pumping feedback and deeply affected by a strongly negative equatorial zonal wind stress background state that sourced from the strong negative phase of the Interdecadal Pacific Oscillation. Besides, the QB ENSO variability with casual contributions during these events is less important. Results show that both the LF ENSO variability and the interdecadal Pacific background could assist to the genesis of such elongated La Niñas.