

## Effects of the Australian monsoon on the duration of La Niña longer than that of El Niño

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In general, La Niña has longer duration than El Niño. That is, La Niña tends to remain for one year or longer, while El Niño decays within a year. The Australian monsoon plays an essential role for this long duration of La Niña. In spring after the mature phase of La Niña, the precipitation anomaly around the Indonesian maritime continent (IMC) is positive with the upward branch of Walker circulation. The positive precipitation anomalies further remain due to the temperature difference between IMC and northern Australia (NA). When La Niña occurs, the sea surface temperature (SST) is barely high around IMC, while land cooling is strong over NA due to the positive precipitation anomalies there, both of which make the large temperature difference between IMC and NA (IMC > NA). From boreal spring to summer, i.e., from austral fall to winter, the temperature of NA seasonally decreases. Such seasonal and anomalous temperature decreases over NA give rise to the substantial large-scale land breeze from NA to IMC, i.e., the stronger-than-normal Australian “winter” monsoon forcing positively large precipitation anomalies over IMC and to the south through the activation of vertical instability near the surface. The positive precipitation anomalies retain the upward branch of Walker circulation around IMC and overcome the effects of Kelvin wave from the tropical Indian Ocean and others inducing the transition from La Niña to El Niño. Thus, La Niña continues until boreal fall or winter, while El Niño decays by boreal spring or summer without such self-maintenance mechanism.

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