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Influence of the seasonal cycle in the termination of El Nino events in a coupled general circulation model

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In this study, we explore the mechanisms leading to El Niño peak and demise through a coupled general circulation model ensemble approach evaluated against observations. Our results suggest that the timing of the peak and demise for intense El Niño events is highly predictable as the evolution of the coupled system is strongly driven by a southward shift of the intense equatorial Pacific westerly anomalies during boreal winter. In fact, this systematic late year shift drives an intense eastern Pacific thermocline shallowing, constraining a rapid El Niño demise in the following months. This wind shift results from a southward displacement in winter of the central Pacific warmest SSTs in response to the seasonal displacement of solar insolation.

In contrast, the intensity of this seasonal feedback mechanism and its impact on the coupled system are significantly weaker in moderate El Niño events, resulting in a less pronounced thermocline shallowing. This shallowing transfers the coupled system into an unstable state in spring but is not sufficient to systematically constrain the equatorial Pacific evolution towards a rapid El Niño termination. However, for some moderate events, the occurrence of intense easterly wind anomalies in the eastern Pacific during that period initiates a rapid surge of cold SSTs leading to La Niña conditions. In other cases, weaker trade winds combined with a slightly deeper thermocline allows the coupled system to maintain a broad warm phase evolving through the entire spring and summer and a later El Niño demise, an evolution that is similar to the prolonged 1986-1987 El Niño event.