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Dynamics of Coastal El Niño Events in present and future climates.

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Sudden and strong positive sea surface temperatures (SST) anomalies in the far eastern Pacific that are tied to the rather narrow NINO1+2 (0-10°S, 90°W-80°W) region are known as coastal El Niño events. In contrast to the well-studied features of typical basin-scale ENSO events, the frequency, origin and relevant processes of coastal El Niños are largely unknown. Here, we analyze their characteristics and future behavior using observational data and simulations with the Community Earth System Model (CESM), which exhibits skill in simulating precipitation, wind and SST fields associated with coastal El Niños. We find that tropical Pacific basin-scale ocean dynamics – in sharp contrast to a typical El Niño event – play no major role in the evolution of a coastal El Niño. On the other hand, we find that atmospheric circulation anomalies from the Southern Hemisphere lead the evolution of coastal El Niño events, by causing warm SST anomalies that then propagate into the NINO1+2 region. Once initiated, local thermodynamical feedback processes such as cloud radiation feedbacks are responsible for the growth and decay of the events. Greenhouse gas forcing leads to an increase in the frequency of coastal El Niño events and a shift of their peak month in CESM simulations, related to a shallowing of the thermocline and changes in Rossby wave forcing from the Southern Hemisphere. In conclusion, based on our results, we will demonstrate the potential for increased predictability of coastal El Niño events, whose intense coastal SST warming and associated extreme precipitation poses a serious threat for local communities via loss of life and severe economic damage.