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Asymmetry in ENSO teleconnection with regional rainfall, its multi-decadal variability, and impact

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An region because of an asymmetry in the impact: the La Niña-rainfall relationship is asymmetry, and its multi-decadal variability, in a rainfall teleconnection with El Niño-Southern Oscillation (ENSO) are described. Further, the breakdown of this relationship since 1980 is offered as a cause for a rainfall reduction in an ENSO-affected region, southeast Queensland (SEQ). There, austral summer rainfall has been declining since around the 1980s, but the associated process is not understood. We demonstrate that the rainfall reduction is not simulated by the majority of current climate models forced with anthropogenic forcing factors. We then show that ENSO is a rainfall-generating mechanism for the statistically significant, in which rainfall increases with La Niña amplitude; by contrast, the El Niño-induced rainfall reductions do not have a statistically significant relationship with El Niño amplitude. Since 1980, this asymmetry no longer operates, and La Niña events no longer induce a rainfall increase, leading to the observed SEQ rainfall reduction. A similar asymmetric rainfall teleconnection with ENSO Modoki exists and shares the same temporal evolutions. This breakdown is caused by an eastward shift in the Walker circulation and the convection centre near Australia's east coast, in association with a post-1980 positive phase of the Interdecadal Pacific Oscillation (IPO). Such a breakdown occurred before 1950, indicating that multi-decadal variability alone could potentially be responsible for the recent SEQ rainfall decline. An aggregation of outputs from climate models to distil the impact of climate change suggests that the asymmetry and the breakdown may not be generated by climate change, although most models do not perform well in simulating the ENSO-rainfall teleconnection over the region.