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Reorganization of the tropical climate during El Nino: a weak temperature gradient approach

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We investigate the reorganization of the tropical climate during El Niño using the idealized dynamical framework of a weak temperature gradient (WTG) assumption combined with a consistent mass budget to solve for the divergent part of the tropical circulation. An intermediate level complexity model (the Quasi-equilibrium Tropical Circulation Model or QTCM) reconfigured with the WTG framework is used to simulate El Niño conditions and is found to yield a level of tropospheric warming appropriate to El Niño, a plausible pattern of remote tropical precipitation anomalies in the tropical Pacific source region of the El Niño-Southern Oscillation (ENSO, and a gross precipitation deficit over the tropics outside the Pacific (hereafter the 'remote tropics'). Additional successful tests of the WTG framework with La Niña forcing conditions and enhanced greenhouse gas concentrations confirm its applicability. However, the ENSO response under the framework fails in several respects when compared to simulations with the 'standard' QTCM: in particular, the WTG QTCM produces a gross-scale remote tropical precipitation deficit under El Niño conditions that is only 60% as large as the standard version's deficit, and regional features of the anomalous precipitation response in the remote tropics differ markedly between the two model versions. We show that these discrepancies can be partly remedied when appropriate gradients in the tropospheric temperature are included.