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Hydrological cycle and circulation responses over tropical rainforests to idealised global warming perturbations

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Large inter-model diversity is evident in CMIP5 simulations of tropical hydrological cycle changes under a variety of global warming scenarios. This leads to uncertainty in future projections of tropical precipitation changes, especially over land. To reduce this uncertainty and improve our understanding of these changes, we examine the distinct atmospheric responses to idealised surface temperature perturbations and greenhouse gas forcing. An ensemble of HadGEM2-A atmosphere-only simulations is used to assess the transient and equilibrium tropical hydrological cycle responses to SST and CO_2 forcing. A moisture budget decomposition is applied to identify the dynamic and thermodynamic mechanisms contributing to tropical precipitation changes across a variety of timescales. A robust result is a link between the pattern of land warming and circulation change, which subsequently leads to a significant dynamic component of the tropical precipitation change over land. In addition, we demonstrate a sensitivity of theses hydrological cycle responses to the ENSO phase. This suggests relatively large future changes in ENSO-related anomalous precipitation. These results improve our understanding of the competing mechanisms which lead to tropical precipitation changes in coupled climate model simulations under more realistic future scenarios.