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## Role of Interdecadal Pacific Oscillation (IPO) in modulating recent changes in tropical large-scale atmospheric circulations

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The Pacific Walker circulation (PWC) and Hadley circulation (HC) are the most prominent circulations of the Earth, which can exert far-reaching impacts on global and regional hydrological cycles. Both of these two large-scale circulations have experienced significant changes under global warming. Specifically, the PWC is reported to strengthen since the 1980s while the HC is proposed to widen. The causes behind these observed changes have been the subject of climate research, with divergent views on the influence of external forcing versus internal variability. Here, based on initial-condition large ensemble simulations, we quantify the relative contributions of internal variability and external forcing in modulating recent changes in tropical large-scale atmospheric circulations. We find that the recent PWC strengthening and HC widening is robust consequences of internal variability rather than external forcing. We further reveal that Interdecadal Pacific Oscillation (IPO) is the dominant internal mode, with its phase evolution contributing about 63% of the observed PWC strengthening and at least 73% of the HC widening in the Northern Hemisphere.