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Role of Global Warming in recent Speedup of the Wintertime Pacific Walker Circulation

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The strengthening of the wintertime Pacific Walker Circulation (PWC) in the past 2-3 decades[1−7] is in apparent contradiction to its century-scale weakening under global warming[8−10]. Although there are several proposed mechanisms, the contribution of global warming to this speedup is still unclear[3,11,12]. We analyse global SSTs and find the first two EOF modes, a global warming mode (GWM) and an ENSO-like mode (ELM)[13], account for over 73% ($\pm$17%) of the PWC's post-1976 strengthening trend in winter, its mature phase. We find the GWM weakens the PWC, but the ELM enhances it by over twice as much, with a ratio of -0.37($\pm$0.08):1($\pm$0.23). We further use an atmosphere-only general circulation model to demonstrate the contrasting effects of the GLM and ELM in modulating the PWC. We conclude that global warming is weakening the PWC through the GWM but both modes are needed to resolve the apparent contradiction of recent observations.