

# **Hiatus and acceleration of surface global warming due to tropical Pacific decadal variability**

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Annual global-mean surface temperature (GMST) has risen since the late 19th century. This temperature increase is not monotonic but with notable interannual and decadal variability, suggesting influence from internal variability. In our former study, we performed a coupled model experiment called Pacific Ocean-Global Atmosphere (POGA), which restores tropical Pacific sea surface temperature anomalies toward the observed history. When forced with the historical radiative forcing, POGA reproduced the observed annual-mean GMST variability strikingly well for 1970-2012 including the recent global-warming hiatus period. In the present study, we have extended the POGA experiment back to the late 19th century, to examine the role of tropical Pacific variability on the observed history of global climate. POGA reproduces annual-mean GMST variability with  $R = 0.96$  and 15-year running GMST trend with  $R = 0.80$  since 1870. We quantify relative contributions from the radiative forcing and tropical Pacific variability by comparing POGA with another experiment forced solely by the radiative forcing. We identify four epochs for which the tropical Pacific decadal cooling decelerated the forced GMST increase, indicating ubiquitousness of global-warming slowdown in the instrumental records. Between these epochs are accelerations of warming due to tropical Pacific variability. POGA further captures observed regional trend of surface temperature for these periods, especially over the tropical Indian Ocean, Indian subcontinent, North and South Pacific and North America. While radiative forcing is the primary cause of the GMST increase since the end of the 19th century and the prolonged hiatus in the mid-20th century, the tropical Pacific decadal variability affected the timing of the warming and hiatus periods.

Key words: coupled model, global warming hiatus, IPO, teleconnection