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Increasing trends in weather-timescale disturbances due to tropospheric warming and stratospheric cooling

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The effect of human-induced climate change on altering the probability of extreme weather events have recently received much attention. One possible link between climate change and changes in weather extremes is changes in weather-timescale atmospheric disturbances. Previous studies hypothesized that a reduce of near-surface temperature difference between the Arctic and mid-latitudes under global warming – a phenomenon known as Arctic amplification – may lead to a wavier jet stream that favors persistent weather patterns. However, there is a lack of robust observational evidence and model simulations to confirm the hypothesis. Here we note that due to tropospheric warming and stratospheric cooling, the equator-to-pole temperature difference in the upper troposphere and lower stratosphere is, unlike the near-surface, strengthened under global warming. We propose that the strengthening of meridional temperature gradients may result in larger eddy activities. We find increasing trends in weather-timescale eddy kinetic energy accompanied by steepened poleward temperature gradient in 1) CMIP5 climate model experiments with increased level of greenhouse gases and 2) Reanalysis data for the case of Southern Hemisphere during the past six decades. A positive correlation (r$\sim$0.6-0.8) is found between 200-hPa area-averaged eddy kinetic energy and meridional thickness gradient in the northern and southern midlatitudes (45N-75N and 45S-75S) during the past sixty DJF and JJA. The findings suggest that if greenhouse-gas-induced warming continues to amplify equator-to-pole temperature contrast, extratropical weather-timescale disturbances may become more and more active in the future.