



Have human activities changed the frequencies of absolute extreme temperatures in eastern China?

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Extreme temperatures affected the populous regions, like eastern China, causing substantial socio-economic losses. It is beneficial to explore whether the frequencies of absolute or threshold-based extreme temperatures have been changed by human activities, such as anthropogenic emissions of greenhouse gases (GHGs). In this study, we compared observed and multi-model-simulated changes in the frequencies of summer days, tropical nights, icing days, and frost nights in eastern China for the years 1960-2012, using an optimal fingerprinting method. Observed long-term trends in the regional mean frequencies of these four indices are +2.36, +1.62, -0.94, -3.02 days decade⁻¹. Models perform better in simulating the observed frequency change in daytime extreme temperatures than nighttime ones. Anthropogenic influences are detectable in the observed frequency changes of these four temperature extreme indices. The influence of natural forcings cannot be robustly detected in any indices. Further analysis found that the effects of GHGs changed the frequencies of summer days (tropical nights, icing days, frost nights) by $+3.48 \pm 1.45$ ($+2.99 \pm 1.35$, -2.52 ± 1.28 , -4.11 ± 1.48) days decade⁻¹. Other anthropogenic forcing agents (dominated by anthropogenic aerosols) offset the GHGs effect and changed the frequencies of these four indices by -1.53 ± 0.78 , -1.49 ± 0.94 , $+1.84 \pm 1.07$, $+1.45 \pm 1.26$ days decade⁻¹, respectively. Little influence of natural forcings was found in the observed frequency changes of these four temperature extreme indices.