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Anthropogenic influence on extreme temperature changes over the mid–high latitudes of Asia

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The influence of anthropogenic (ANT) activity and the other external factors on extreme temperature changes over the mid–high latitudes of Asia are analysed using the different forcing simulations from the Coupled Model Intercomparison Project Phase 6 (CMIP6) models. The optimal fingerprinting technique and the probability ratio (PR) are employed to detect and quantify the influences of the external forcings on extreme temperature changes, which include annual maximum daily maximum temperature (TXx), annual minimum daily minimum temperature (TNn). Results indicate that TXx and TNn have increased from 1979 to 2014, and the simulations from historical (anthropogenic plus natural; ALL), greenhouse gas (GHG), and anthropogenic (ANT) experiments reasonably reproduce the spatiotemporal characteristics of extreme temperatures. Based on the optimal fingerprinting method, the impact of ANT forcing, in which GHG forcing is critical, can be detected in the changes of warm extremes and cold extremes. ANT and NAT forcings are separately detectable for warm extremes. GHG forcing can be separated from other ANT forcings for cold extremes but not warm extremes. Furthermore, the analysis applying the PR method shows that the probability of observed warm extremes that occur once in 20 years over the mid–high latitudes of Asia has risen by approximately three times owing to the anthropogenic influence, whereas the cold extremes became once in 50 years. Briefly, the increased anthropogenic activity has exacerbated the warm extremes and soothed the cold extremes over the mid–high latitudes of Asia during the past decades.