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Storylines of East Asian cold extremes in 2020/2021 under different warming climate

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Whether cold-air outbreak over mid-latitude in a warmer climate would become more or less extreme is a subject of debate, particularly due to uncertainty links between Arctic amplification and these cold extremes, which complicated by the atmosphere internal variability. Here we employ an event-based storyline approach, which fixed the atmospheric circulation to the observed through spectral nudging, to quantify thermodynamic effect on extreme cold events during the winter of 2020/2021 in East Asia under different warming scenarios. Notably, we detect the strongest warming, up to +10K, over Eastern Siberia in the +4K-warmer climate, which is related to warmer cold air mass originating from unfrozen sea ice over Siberia region. In contrast, in the southern China, due to the observed and expected increasing aerosol concentration, peaking by the mid-21st century and altering the radiative balances, a mild cooling is present from pre-industrial to present-day climates. The cooling in this region is likely to persist in +2K-warmer scenario but was not observed when up to the +4K warmer climate. Correspondingly, no prominent temperature variation is observed in the middle East Asia, with the warming extent largely mirroring the overall climate background.