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Substantial increase in daytime-nighttime compound heat waves and associated population exposure in China

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Daytime-nighttime compound heat waves (HWs) (i.e. concurrent occurrence of HWs both in daytime and nighttime) were documented to amplify the damages of high temperatures during daytime or nighttime. Nevertheless, the future change in compound HWs remains an open issue. This research presents the projected changes in compound HWs and associated population exposure in China under the shared socioeconomic pathway (SSP)2-4.5 and SSP5-8.5 scenarios based on the Coupled Model Intercomparison Project phase 6 simulations. The results generally indicate an aggravated risk of compound HWs in China in the future under warmer scenarios. Compound HWs in China are projected to increase significantly toward the end of the 21st century, with larger increase under SSP5-8.5 than that under SSP2-4.5. The greatest changes occur in northwestern China and southern China. Compared with the daytime HWs (i.e. occurring only in daytime) or nighttime HWs (i.e. occurring only in nighttime), the projected increase in compound HWs is the greatest. Accordingly, the proportion of compound HWs to the total HW events tends to increase and that of daytime HWs tends to decrease toward the end of the 21st century. Due to substantial increases in compound HWs, the population exposure to compound HWs will increase significantly across the entire country. The projected increase of nationally averaged population exposure is 12.2-fold (7.9-fold) of the current in the mid-century (2046–2065) and further enhances to 16.3-fold (12.4-fold) in the end-century (2081–2100) under SSP5-8.5 (SSP2-4.5). The largest increases are distributed in western China and southern China. These findings raise the necessity and urgency for policy-makers and the public to develop measurements to address compound HW risks.