EGU22-7118, updated on 06 Oct 2022
https://doi.org/10.5194/egusphere-egu22-7118
EGU General Assembly 2022

The upper bound of mid-latitude extreme temperatures

Yi Zhang[1,2] and William Boos[1,2]
[1]University of California, Berkeley, Earth and Planetary Science, United States of America (y-zhang@berkeley.edu)
[2]University of California, Berkeley, Miller Institute, United States of America (y-zhang@berkeley.edu)

Extreme temperatures have a wide societal impact yet remain a major uncertainty in climate projections. Past studies have identified several drivers of heatwaves, including atmospheric blocking and soil moisture-atmosphere feedback. However, it remains unknown what limits the magnitude of extreme temperatures, and a quantitative understanding of heatwaves is lacking. Here we provide a theory of mid-latitude extreme temperatures based on a convective-instability mechanism. We formulate the upper bound of the surface temperature as a function of the temperature at the 500-hPa pressure level (T500), which is supported by observations and reanalysis data. Based on this theory, we project that the annual hottest daily maximum temperature (TXx) should increase by 1.9 K for each 1 K of increase in T500 over mid-latitude land if there is no evident drying or moistening of surface air on the annual hottest days. The observed TXx trend over the past four decades between 40°N-65°N is consistent with our projection. With T500 within 40°N-65°N increasing slightly faster than the global warming, the warming rate of TXx of this region will be on average around twice of the global warming if specific humidity does not change on the hottest days. However, TXx will increase at a faster rate over regions with a decrease in specific humidity on the hottest days, and *vice versa*.