Geophysical Research Abstracts
Vol. 20, EGU2018-11678, 2018
EGU General Assembly 2018

Increasing potential for intense tropical and subtropical thunderstorms under global warming

Martin Singh (1), Zhiming Kuang (2), Eric Maloney (3), Walter Hannah (4), and Brandon Wolding (3)

(1) School of Earth, Atmosphere & Environment, Monash University, Melbourne, Australia (martin.singh@monash.edu), (2) Department of Earth & Planetary Sciences, Harvard University, Cambridge, USA, (3) Department of Atmospheric Sciences, Colorado State University, Fort Collins, USA, (4) Lawrence Livermore National Laboratory, Livermore, USA

Intense thunderstorms produce rapid cloud updrafts and may be associated with a range of destructive weather events. An important ingredient in measures of the potential for intense thunderstorms is the convective available potential energy (CAPE). Climate models project increases in summertime mean CAPE in the tropics and subtropics in response to global warming, but the physical mechanisms responsible for such increases and the implications for future thunderstorm activity remain uncertain. Here, we show that high percentiles of the CAPE distribution (CAPE extremes) also increase robustly with warming across the tropics and subtropics in an ensemble of state-of-the-art climate models, implying strong increases in the frequency of occurrence of environments conducive to intense thunderstorms in future climate projections. The increase in CAPE extremes is consistent with a recently proposed theoretical model in which CAPE depends on the influence of convective entrainment on the tropospheric lapse rate, and we demonstrate the importance of this influence for simulated CAPE extremes using a climate model in which the convective entrainment rate is varied. We further show that the theoretical model is able to account for the climatological relationship between CAPE and a measure of lower-tropospheric humidity in simulations and in observations. Our results provide a physical basis on which to understand projected future increases in intense thunderstorm potential, and they suggest that an important mechanism that contributes to such increases may be present in Earth's atmosphere.