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Projections of tropical heat stress constrained by atmospheric dynamics

Yi Zhang[1], Isaac Held[1], and Stephan Fueglistaler[1,2]
[1]Program in Atmospheric and Oceanic Sciences, Princeton University, United States of America
[2]Department of Geosciences, Princeton University, United States of America

Extreme heat under global warming is a concerning issue for the growing tropical population. However, model projections of extreme temperatures, a widely used metric for extreme heat, are uncertain on regional scales. In addition, humidity also needs to be taken into account in order to estimate the health impact of extreme heat. Here we show that an integrated temperature-humidity metric for the health impact of heat, namely the extreme wet-bulb temperature (TW), is controlled by established atmospheric dynamics and thus can be robustly projected on regional scales. For each 1°C of tropical mean warming, global climate models project extreme TW (the annual maximum of daily-mean or 3-hourly values) to increase roughly uniformly between 20°S and 20°N latitude by about 1°C. This projection is consistent with theoretical expectations based on tropical atmospheric dynamics, and observations over the past 40 years, which gives confidence to the model projection. For a 1.5°C warmer world, the likely (66 per cent confidence interval) increase of regional extreme TW is projected to be 1.33-1.49°C, whereas the uncertainty of projected extreme temperatures is 3.7 times as large. These results suggest that limiting global warming to 1.5°C will prevent most of the tropics from reaching a TW of 35°C, the limit of human adaptation.