Heat extremes in a warming world

The largest negative impacts of climate change typically manifest in response to extreme events. However, the inherently rare nature of extremes raises a number of challenges in their study, including a potentially large role of natural variability and the quantification of the probability of never-before-seen events. Here, we first explore the extent to which observed changes in the distribution of summertime temperatures in the Northern Hemisphere -- including the probability of extremes -- can be explained by a "shift" in the distribution without changes in shape. Using quantile regression to allow for non-normality, we find that the vast majority of the observed behavior is explained by the "shift" mode, and climate model ensembles suggest that many of the shape changes are due to sampling of internal variability. We then test this understanding for the recent record-smashing 2021 Pacific Northwest heatwave. Similar to the hemispheric-wide results, there was not evidence in advance of 2021 of significant greater warming of the upper tail compared to the mean, and a comparison to a range of analogs in a climate model large ensemble indicates that the 2021 Pacific Northwest heatwave can occur without the tails shifting more than the mean, although its probability is astonishingly small. Importantly, we find many cases in the climate model where traditional extreme value analysis based on fitting Generalized Extreme Value distributions would fail to predict events as large as simulated. Finally, we expand to compound heat/humidity extremes and present new methodologies to estimate changes in humidity conditional on temperature. In contrast to expectation from climate models, the results show widespread decreases in humidity on hot days across the globe's semiarid regions. In the American Southwest, the decreases are likely explained by a lack of moisture available from the land surface, which deprives the atmosphere of moisture during the warm season.

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Location: EOA 1050 (Group Attendance)

Zoom Link: https://fsu.zoom.us/j/92687419844?pwd=eG1RQWJ0VHgyU284UGthbkdVZTVBZz09

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