



Changes in monthly hot and cold records reveal an increase in variance

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The last decade, which was globally the warmest in the instrumental record, has seen many record-breaking heat waves. At the same time a number of unusual winter cold spells occurred in the Northern Hemisphere mid-latitudes.

Here we analyze the number of local record-breaking hot and cold extremes in gridded monthly surface temperature observations with global coverage. The number of observed records is compared with those expected in a stationary climate, for which the simple $1/n$ relationship holds, with n the number of previous years.

We show that, worldwide, the number of monthly hot records is now 5 times larger than expected in a stationary climate. The number of monthly cold records, however, did not significantly decrease compared to a stationary climate. These results thus indicate an increase in the variance of monthly mean temperatures. In fact, this widening of the probability density function (pdf), in association with a shift in its mean, is clearly observed during the post-1960 warming period. During the pre-1940 warming period, the number of hot records increased while the number of cold records decreased with a similar magnitude, indicating a shift in the mean without any significant widening of the pdf. We will discuss this different character of the pre-1940 versus the post-1960 warming as well as possible mechanisms that could explain this. Such mechanisms include shifting circulation patterns and changes in aerosol forcing.

Preliminary analysis of the 20th century simulations of CMIP5 models (Climate Model Intercomparison Project) suggests that these models do not capture the observed widening of the pdf in the post-1960 period.