Extreme Heat events during 1971-2011 in Xi’an, China

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Exposure to extreme heat is already a significant public health problem nowadays. In this study, the daily data of the maximum temperature and mean temperature in Xi 'an from 1971 to 2011 were used to statistically analyze the monthly, inter-annual and inter-decadal change of heat events and the high temperature days in Xi 'an, and the global mean NCEP reanalysis data were used for explaining the cause of the most and least heat events and high temperature days in 1997 and 1983 respectively. Urban heat island effect was also analyzed using the difference of temperature between Xi’an and the suburbs. The causes of the abnormal high temperature were explained using synoptic weather maps of 500hPa and 700hPa. WMO defined heat wave as the daily maximum temperature is above 32^{0}C and lasts more than 3 days. In this paper, heat wave was defined as the daily maximum temperature was above 35^{0}C and lasted more than 3 days according to the “stove” climate of Xi’an. If the daily maximum temperature is above 38^{0}C and 40^{0}C, it is called severer high temperature and the severest high temperature (or intense heat) day respectively. It revealed that: (1) high temperature in Xi’an appeared frequently in June, July and August. The annual number of high temperature days and heat wave peaked in 1997 and reached a minimum in 1983 in Xi’an. The numbers of high temperature days were 60 and 1 respectively. The heat waves were 9 and zero respectively. The numbers of high temperature days and heat waves were consistent, (2) the average temperature and maximum temperature increased obviously from the 1980’s and increased more outstanding in urban areas than in the suburbs. The linear increase trend of average temperature were 0.621 ^{0}C /10a in downtown, much higher than 0.216 ^{0}C /10a and 0.350 ^{0}C /10a in the suburb of Chang’an district and Gaoling respectively. The average numbers of high temperature days were 27.3, 26.9 and 28.7 in downtown, suburb and outer suburb respectively. And the frequencies of heat wave were 3.9, 3.6 and 3.9 in downtown, suburb and outer suburb respectively. (3) the differences of average temperature between urban and the suburbs (suburb and outer suburb) increased obviously. The linear trends of differences were 0.385 ^{0}C /10a and 0.231 ^{0}C /10a in suburb and outer suburb respectively. Urban heat island effect was a big factor of heat events in Xi’an, (4) circulation analysis showed the cause of the least heat waves in 1983 and the most in 1997. In July 1997, the Tibetan high and Western Pacific subtropical high were very strong and connected each other in northern Xi’an on 500hPa. And south-west and south-east airflow controlled Xi’an during the heat waves, resulting humid and hot weather. In July 1983, the Western Pacific high was weaker and located in lower latitude. Therefore, southern airflow to Xi'an was weak, resulting the least high temperature days in 1983.

Keywords: Heat events, Urban heat island , atmospheric circulation analysis

