

RATE OF TEMPERATURE INCREASE IN CITIES AS OPPOSED TO THE GLOBAL RATE

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ABSTRACT

This paper details the average temperature differences for the years 1948-1949 and 2010-2011 at the Tucson, Arizona airport. This study found that there was an increase of 2.49 degrees Fahrenheit at the Tucson airport, which was a much steeper increase than the global average. This indicates that there is a trend of cities warming at a much faster rate than the global average, indicating the possibility of increased rates of severe heat related illnesses and mortality rates, supported by literature review of similar studies.

Keywords: Climate change, temperature

INTRODUCTION

As humans have increased production of greenhouse gases, the global temperature has begun to increase, and the temperature in urban environments has been increasing even more rapidly (Zeleňáková et al 2015, Peterson 2003). Increased temperatures have been associated with increased incidents of heat-related illnesses in humans, and increased severity of heat-related illnesses (Sakakibara and Owa 2005). The increased levels of pollution found in urban areas also contribute to respiratory illnesses (Schwartz and Dockery 1991), which can cause severe complications in the event of a heat-related illness. The differences in temperature increase in urban areas are of increasing concern due to the potential for loss of life through heat-related illness, if the average temperatures should exceed the human capacity for thermoregulation (Torii 1995), and potential massive human migrations should urban areas become unfit for human habitation. One area of concern that has not been addressed is whether the temperature of cities will continue to increase at the same rate compared to global temperatures. This analysis focuses on the city of Tucson, Arizona with

the aim of providing additional evidence for the severity of the rate of temperature increase in cities, as well as relying on a meta-analysis of prior literature.

METHODS

For this analysis, hourly temperature records collected at the Tucson, Arizona airport were taken from the National Oceanic and Atmospheric Administration climate database for 10/01/1949 to 10/01/1950 and 10/01/2010 to 10/01/2011. The data was then cleaned to remove any records without a corresponding hourly match, and manually checked for the accuracy of the alignment. The data was analyzed for statistically significant differences between the temperatures of the 1948-1949 period and 2010-2011 period based on the differences between each set of corresponding temperature records using a paired t-test to compare each of the matched sets of data. This was then compared with the records from a similar study by NASA that focused on overall global temperature increases.

RESULTS

The examination of the Tucson data showed that there was a statistically significant increase in the mean differences of hourly temperatures recorded in the 2010-2011 time period and those recorded in the 1948-1949 time period when matched with their corresponding date and time pairs. The results of the test showed a highly statistically significant mean temperature difference of 2.49 degrees fahrenheit, with the specific test results of $t(8711) = 22.192$, $p = 2.2e-16$, and a 95%CI of $2.27 > 2.49 > 2.71$.

DISCUSSION

The temperature difference produced by this study showed a mean difference of 2.49 degrees fahrenheit at the weather station located at the Tucson airport. A study conducted by NASA found a global temperature difference of 0.6 degrees celsius, or 1.08 degrees fahrenheit over the same period (NASA GISS 2013). This has severe implications, as it reaffirms that a global average increase is not distributed evenly, and urban areas will be much more severely affected by increasing global temperatures (Zeleňáková et al 2015). Coupling this support for an uneven distribution of temperature along with the established theory of heat islands, it becomes clear that cities will be more heavily impacted by the increasing temperatures of climate change (Peterson 2003). The more concerning piece of these results are the ratio of global temperature increase to the temperature increase found in an inland city. These results indicated that inland cities are warming 2.3 times faster than the global average. Given the heightened risk of heat related illnesses (Kalkstein 1991) associated with higher temperatures, the effects of this ratio are likely to grow more pronounced as time goes on and the planet continues warming. These results point to an urgent need for further study to investigate whether or not this 2.3 warming rate holds true in other major cities, and the potential implications of that, which does not appear to have been examined to date.

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