

Investigation of Temperature Variability in Babolsar Urban Spaces for Urban Heat Island Detection

Yousefi, Yadollah (PhD)^a

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Abstract

The present study investigated the temperature difference in Babolsar. The main purpose of this work is to study the temperature differences and identify the urban heat island formation in Babolsar. To this end, we used collected data from three data loggers and hourly data from Babolsar Meteorological Station. Data loggers recorded data from 25 September 2018 to 10 March 2019 in three points of this city. Finally, 3478 hourly data were extracted and created one matrix (3478*5). Initially, time variations were investigated, with DTD and Δ DTD methods. Hourly observations showed that the differences between urban and suburban areas were not significantly different at night and day, and the minimum temperature variability of all stations was similar. Investigation of the effect of wind on the spatial temperature differences showed that with increasing wind speed the temperature variability of different parts of Babolsar increases. According to the indices needed for urban heat island formation, this study showed that there isn't a precise and acceptable sign of urban heat island formation in Babolsar.

Introduction

The mechanisms of human life greatly alter the status of the Earth's surface. The city is the most distinctive human manipulation in nature. Cities as special centers for human settlements have special characteristics. Urban heat Island Effect is the most obvious and best documented example of unwanted manipulation in the climate. The formation of the heat Island can be expected in most cities. But the geographical features of the place play a large role in shaping this phenomenon. Wetlands are one of the factors that reduce the intensity of urban heat island. The ideal conditions for the formation of a heat island are low winds with nocturnal air at night (Brandsma & Wolters, 2012). It is conducted that generally, in urban environments, the minimum temperature variability is lower than in rural and suburban environments

The purpose of this study is to determine are there significant reasons to show that Babolsar has urban heat island or not?

Materials and Methods

This study was conducted in Babolsar city in Mazandaran province. We used hourly data that recorded with three data logger (MIC 98583 USB-Data Logger, Taiwan) and Babolsar meteorological station. Two following integrated methods were used: 1) the day to day temperature variation (DTD); 2) the difference between day to day variability of daily maximum temperature (DTD max) and day to day variability of daily minimum temperature (DTDmin) (Tam, Gough, & Mohsin, 2015).

^a Assistant Prof. of Geography, University of Mazandaran, y.yousefi@umz.ac.ir

Investigating day-to-day variability of temperature was first used by (Karl, Knight, & Plummer, 1995) for climate purposes and subsequently developed by (Gough & Hu, 2016).

The day to day temperature variation is based on the following equations:

Equation 1:

$$DTD = \sum |t_i - t_{i-1}| / (n - 1)$$

Where \sum is the sum over all n data elements, t is daily temperature, i is the counter that marches through the days in a time period (e.g. a month), $| |$ is the absolute value, and n is the number of days elements.

Equation 2:

$$\Delta DTD = DTD(tmax) - DTD(tmin)$$

Results and Discussion

Examination of hourly temperature differences showed that highest difference in different parts of Babolsar occur during the day and around 4 pm and is lowest at night. Examination of day-to-day temperature (DTD) variations at stations showed that the maximum temperature variability at all the stations was higher than the minimum temperature variability. The day-to-day variability of the minimum temperature is not significantly different across all stations compared to the maximum temperature. This indicates that all stations have almost daily homogeneous minimum temperature variations. The study of the effect of wind in this city showed that with the increase of the wind speed the temperature differences in Babolsar are increasing. Considering that in the calm air the urban heat island and temperature differences will increase the study of the effect of wind in the city showed that with the increase of wind speed the temperature differences in Babolsar will increase. This can itself be a reason for the lack of a heat island in Babolsar.

Conclusion

Considering the conditions required for heat island formation, there is no significant difference in temperature variability between the studied stations. As a result, it can be seen as a very weak example of the role of the city in creating temperature differences in Babolsar. According other studies wetlands have a significant effect on temperature equilibrium and reduce temperature differences (Zhang, Zhu, & Jiang, 2016) and reduce or decrease urban heat island size. Also studies in the Kochi region of India show this condition (Thomas & Zachariah, 2016). The study shows that in Babolsar, given the size and location of a coastal city and two canals on both sides, it is not possible to form a thermal island as it does in large cities.

Keywords: Variability, Day to day, Temperature, Heat Island, Babolsar

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