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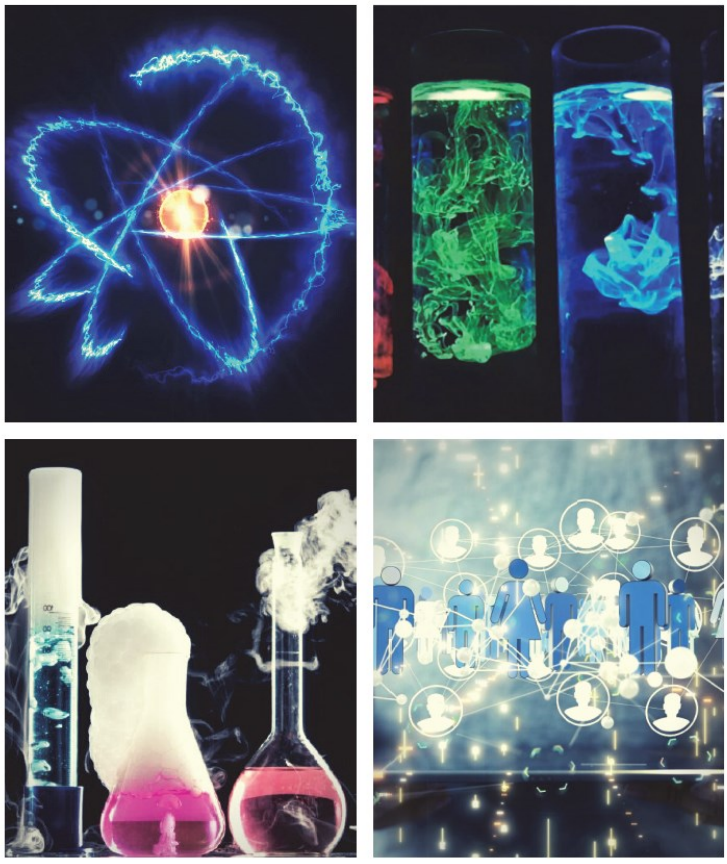

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Urban Heat Island in Songkhla Province, Thailand

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Abstract The Study of phenomenon of the urban heat islands in Songkhla Province Thailand, analysis via using the daily air temperature data and the monthly minimum-maximum air temperature from 3 Meteorological stations of Songkhla Province (Kho Hong, Hat Yai and Sadao) during 2008 - 2017. The result shows that the average daily air temperature in Kho Hong and Hat Yai is 1 - 2 ºC higher than in Sadao during the night time period. The intensity of the urban heat island phenomenon differs significantly by 1 - 3 ºC difference in the dry season (winter and summer). In addition, the geographic location (near-far distance to the sea) is an important factor in regulating the temperature changes of each station.

Keywords: Urban heat island, Urbanization, Rural, Climate

Introduction

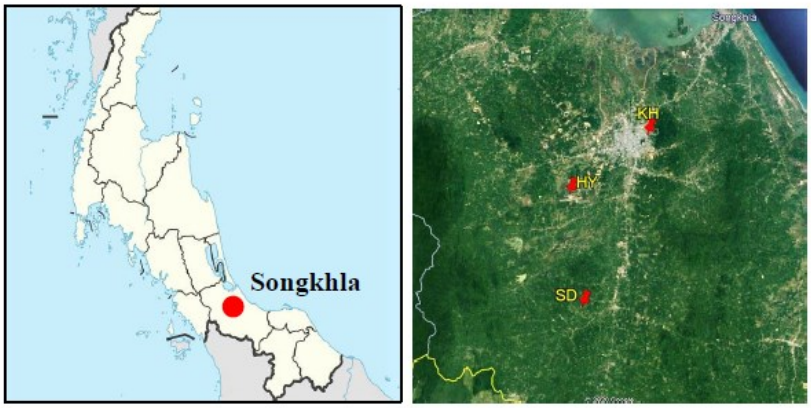
The urban heat island (UHI) phenomenon is an urban area where the air temperature is warmer than the surrounding area or the rural areas. The temperature increase occurs due to urbanization in the modification of the land surface process and the variety of human activities in 21th the century [1-9]. The urban-rural area temperature difference is usually higher contrast clearly at the night-time more than day-time during the daily period [1-9]. Obviously, the urban heat island phenomenon is most noticeable during the dry season of the year more than the wet season [1-7].

Therefore the characteristics of the UHI phenomenon in this study were analysed from the difference of the air temperature and minimum-temperature between the different sites of the urban and rural areas. The data analysis in a daily [1-9], annually [1-7] and a long term period [1-5], in terms of the ten years data records from 2008 to 2017.

Methodology

Study Area

Hatyai is the largest city in the south of Thailand, located near the border with Malaysia as shown in figure 1(a), and has a population of 156,802 (2019) in the city itself and about 800,000 in the greater Hatyai area. Hatyai is the largest city of Songkhla province, the largest metropolitan area in the south, and the third-largest metropolitan area of the country. Sadao district is a district next to the border of Malaysia in Songkhla province, southern Thailand, and is situated below the Hatyai district, which has a distance of about 40 kilometers from there [10]. Hatyai city is in the region that almost surrounds the human structures, but the Sadao district is different. Sadao was surrounded by the agricultural region (the rubber plantations).



(a)

(b)

Figure 1. Study Area (a) Songkhla province and 3 Meteorological stations location, and (b) Surrounding of Meteorological stations in Kho Hong (KH), Hatyai (HY) and Sadao (SD).

Data collection

The investigation on temperature data retrieved from three meteorological stations are shown in figure 1(b), 1) Khohong (KH) station in the urban site, 2) Hatyai (HY) stations in the semi-urban sites (Hatyai International Airport) and 3) Sadao (SD) station in the rural site which location are shown in table 1. [11]. The collections of air temperatures are 2 catalogues, the daily temperature cycle at 3-hourly time-step and the minimum temperature of the day. In each station of the study area, the air temperature in terms of a mean form is analysis for a period of ten years recorded from 2008 to 2017. Data records come from the automated and human-facilitated of each observation station in the Thai Meteorological Department (TMD) network-daily database.

Table 1 Meteorological stations location.

No.	Station	Location	Ele. (m.)	Type of area
1.	Khohong (KH)	7.00.00ºN 100.30.00ºE	7	Urban
2.	Hatyai (HY)	6.55.00ºN 100.26.00ºE	27	Semi-urban
3.	Sadao (SD)	6.47.53ºN 100.23.26ºE	25	Rural

Result and discussion

The time series from 2008 – 2017 of the mean air temperatures ± standard deviation analysed from 3 meteorological stations (KH, HY and SD) during 10 years from 2008 to 2017 were shown in figure 2. It can be seen that the comparison of spatial temperature variation between the urban (KH), the semi-urban (HY) and the rural areas (SD) were the strongest contrasts in this period (2008-2017). The mean daily temperature contrasts of the urban were high than in a semi-urban and rural areas in the night-time period of the day (19.00-07.00) [1-9], especially in the second half of the night-time (01.00-07.00) in a range of the temperature contrasts about 0.2-1.0 ºC, shown in figure 2(A). Similarly, the mean monthly minimum-temperature contrasts of the urban areas were high than in a semi-urban and rural areas in the dry season of the year (winter and summer) [1-7], especially at the end of the winter period (January - February) in a range of the temperature contrasts about 1.0-3.0 ºC, shown in figure 2(B). In terms of the spatial temperature in ten-years periods [1-5], the mean minimum-temperature of the urban areas was the strongest contrasts high clearly than a semi-urban and rural area, shown in figure 2(C). In the case of the urban site (KH) temperature was obviously higher than a semi-urban (HY) and rural site (SD) due to the fact that an urban had a larger population (156,802: KH (2019), 48,211: HY (2019), and 21,753: SD (2018)) [10] were associated with increased human activity generating the waste heat from traffic vehicles and machines (air conditioners). Another cause of the urban heat island effect is the modification of land surfaces, significantly different thermal bulk properties, the urban (KH) is an urban with concentrations of the buildings (concrete) while the rural (SD) area is a mostly green area with vegetation and trees of the agricultural. The noticeable temperature differences in these two regions (KH and SD) will create a significant climatic difference between the urban and rural areas. Furthermore the electricity consumption of air conditioners in urban residential areas will also increase.

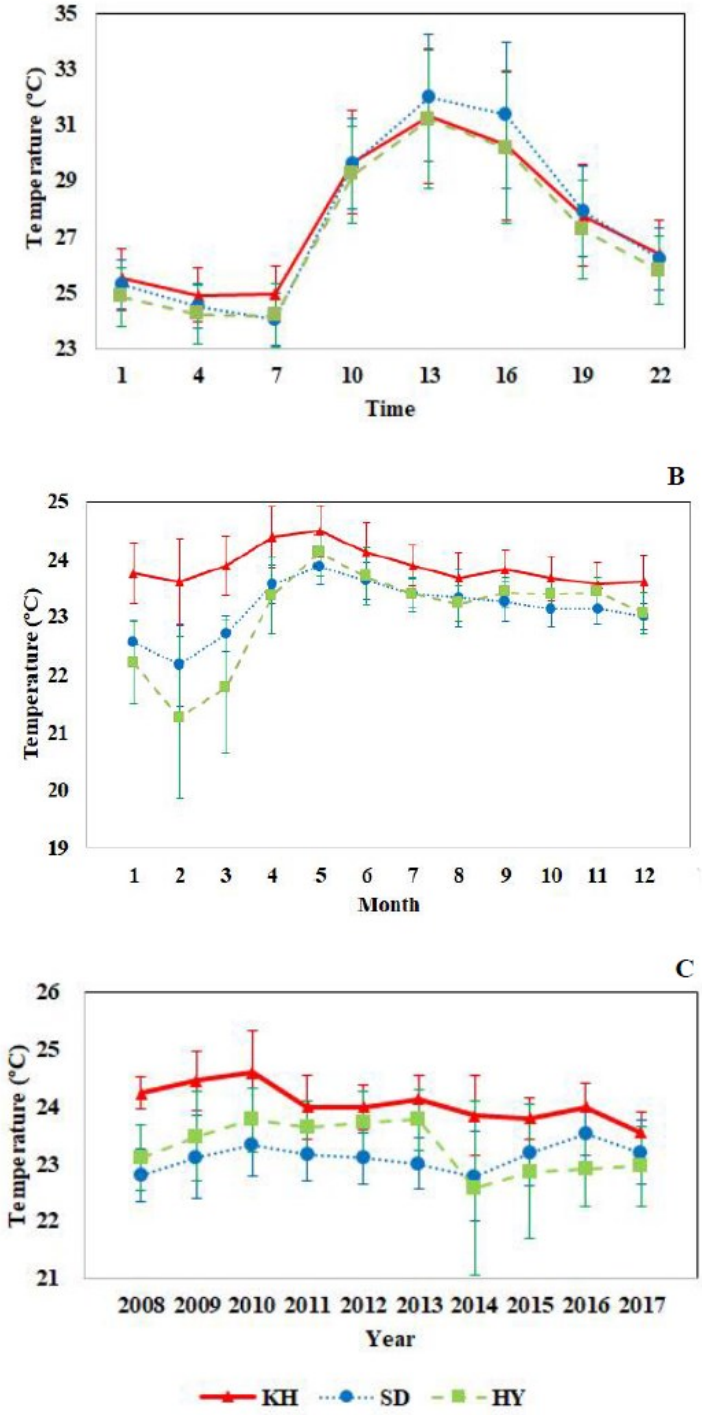


Figure 2. The time series 10 years from 2008 – 2017 of the mean air temperatures ± standard deviation analysed from 3 meteorological stations in Songkhla ; KH (red), SD (blue) and HY (green): (A) The daily temperature, (B) The monthly minimum-temperature, and (C) The yearly minimum-temperature.

Conclusion

The results indicate the possession of urban heat island (UHI) in the Hatyai city (KH) in terms of the thermal contrasts between 3 stations, urban (KH) semi-urban (HY) and rural (SD) areas. They were positive which indicated that most of the air temperatures in the urban area were higher than the surrunding area. The study reveals the strongest UHI intensity in daily air temperature detection occurred during in the second half of night-time (01.00-07.00) and the seasonal analysis showed the UHI intensity in the minimum temperature was strongest in the dry season (November-April). Furthermore, an annual minimum temperature of the urban (KH) is higher than outside the city (HY and SD). Therefore, the urban heat island effect that comes from the variety of human activities (heat generated), the modification of land surfaces of the urban area and the buildings are emitted and evolved heat. The UHI more was very evident when the temperature is in the low range (night-time and winter season) and It's evaluating their impacts on the urban extreme climates in the future.

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References

[1] Sigit D A and Takahiro T, Procedia - Social and Behavioral Sciences. 195 (2015) 423 – 428
[2] Charnwit K, Yenrutai J and Surat B, Modern Applied Science. 5 (2011) 105-110
[3] Yurdanur S U, Cemre Y S, Selahattin I, Sema H T, Deniz H D-U and Perim H T, Theoretical and Applied Climatology. 139 (2019) 175–190
[4] Diego O S and Regina C S A, Meteorol. Appl. 21 (2014) 186-193
[5] Gantuya G, Ji-Young H, Young-Hee R and Jong-Jin B, Asia-Pacific J. Atmos. Sci. 49 (2013) 535-541
[6] Theodore M G and Dimitrios M, Atmospheric Research. 118 (2012) 103–120
[7] George T, Sherin AP, Shareekul A and Zachariah E J, Procedia Environmental Sciences. 21 (2014) 3–13
[8] Chaobin Y, Ranghu W, Shuwen Z, Caoxiang J and Xie F, Int. J. Environ. Res. Public Health. 16 (2019) 1-19
[9] Logaraj R, Nasrin A, Chng S F, Amirhosein G, Li P W and Nik M S, Sustainable Cities and Society. 44 (2019) 748-762
[10] Hatyai and Sadao district, Songkhla province, Thailand. Retrieved from: https://en.wikipedia .org/wiki/Hat_Yai and https://en.wikipedia.org/wiki/Sadao_District
[11] Meteorological stations location. Retrieved from: https://tmd.go.th/province.php?id=69