A NOTE ON THE EFFECT OF URBANISATION ON AIR TEMPERATURE AND HUMIDITY OF AKURE, NIGERIA

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ABSTRACT
The effects of urbanization on the temperature and humidity characteristics of Akure (7º 15' N, 5º 12' E), a fast growing medium sized tropical city and administrative capital of Ondo state in the south-western part of Nigeria are examined. Fixed point observations have been made since May 2008 and still ongoing using shielded electronic temperature and relative humidity loggers mounted on street lamp post above head height in the city core classified as urban climate zone 2 and the seldom used Akure airport classified as urban climate zone 9.
The magnitudes of the urban - rural temperature, humidity and vapour pressure differences, their diurnal and seasonal variation and influence of weather variability are investigated. Daily course of the temperature, humidity and vapour pressure fluctuations between the urban and rural site are observed to be function of the season of the year. Rural areas are characterized by higher relative humidity than the rural throughout the day regardless of the month or season. Current efforts and future plans are also discussed.

Keywords: Urbanisation, Air temperature, Humidity, Vapour pressure, Akure, Nigeria

1. INTRODUCTION
The city of Akure has seen remarkable growth in its urbanization in recent years, and its population during the past few decade has more than doubed from 239,124 in 1991 to 484,798 in 2006.
Urbanisation has been reported to modifiy local city climates. This modification involves the alteration of local air temperature and humidity. However, studies on the urban microclimate and urban climatology of tropical regions are scarce, the few that are also available in Nigeria have used mean monthly climatological data or 2-3 hourly interval short term manual measurements (Adebayo, 1987; Adebayo, 1991 and Balogun et al. 2009). These studies are also mostly limited to daytime conditions. This inadequacy of data has lead to uncertainties about the true nature of the effect of urbanisation on the characteristics of the urban heat/cool island intensity (UHI/UCI) and the urban moisture excess/deficit (UME/UMD) in general in Nigeria.
This paper reports results from studies investigating the mean monthly diurnal variation of urban – rural differences of (a) air temperature, (b) relative humidity and (c) vapour pressure in Akure (7.25° N, 5.20° E) a rapidly growing humid tropical city in south-western Nigeria. The paper focuses on the differences of the aforementioned climatic parameters between an urban (city centre) and rural (Airport) sites in the city over a 6-month (October, 2008 – March, 2009) period that covers both the end of the monsoon (wet) and harmattan (dry) seasons.

2. DATA AND METHODOLOGY
Data were obtained from shielded portable Lascar EL-USB-2 temperature/humidity data loggers, sampled at 5 minute intervals that were mounted on a lamp post above head height (3 m) in the city centre classified as urban climate zone 2 (UCZ 2), and on a mast at same height in the local Airport located about 15 km east on the outskirt of the city, classified as urban climate zone 7 (UCZ 7), see Fig. 1. Values of saturation vapour pressure were calculated empirically using the Goff-Gratch equation (WMO, 2000) with the measured temperature data, the vapour pressure was subsequently determined using also the measured relative humidity data.

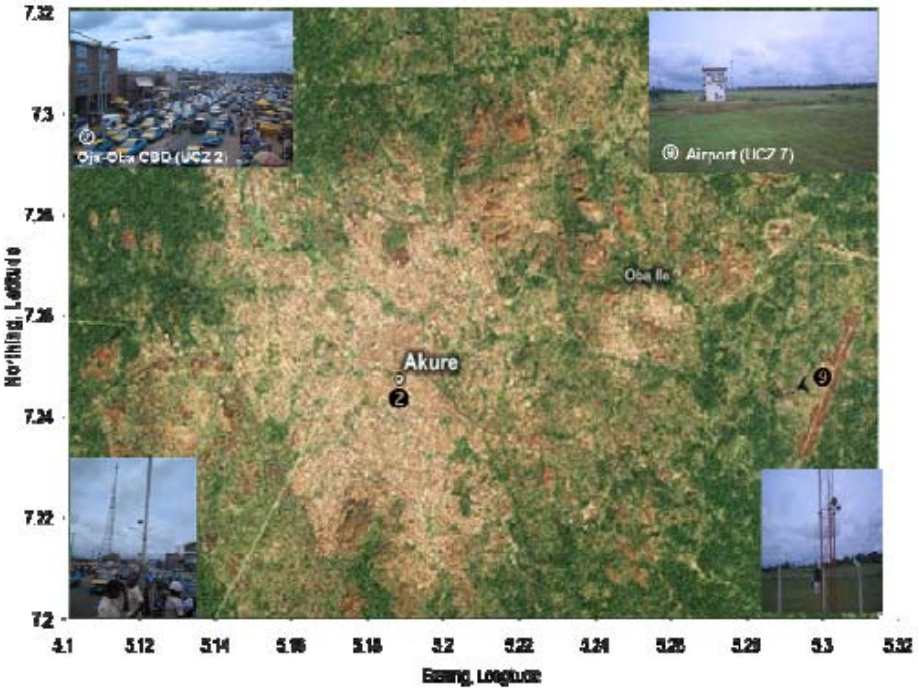
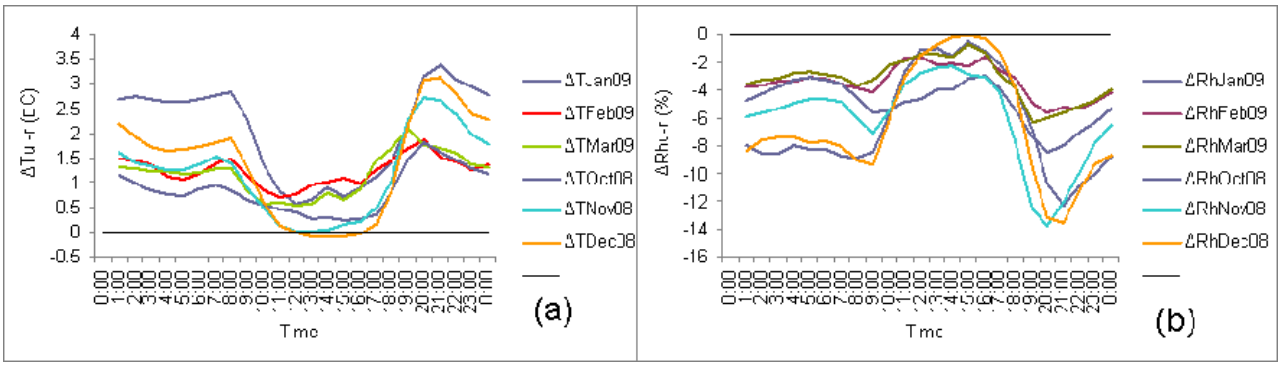


Fig.1: Google Map of Akure showing the City centre (2) and Airport (9) sites. Inset (left and right) are photos of the sites and measurement systems respectively.

3. RESULTS AND DISCUSSION

3.1 <u>Air temperature differences:</u> Fig. 2a show that the UHI exists in Akure throughout the day except in November and December where UCI is observed for few hours in the afternoon in both months and also at night in November. The highest UHI is also observed in the dry season. This agrees with Balogun et al. 2009 that reported UCI at 1500 in October/November and higher UHI values in January/February in Akure. The figure further show that the maximum UHI occurs between 1800 to 2200 hours local time. This is however different from earlier reports that indicate that the maximum UHI occurs during the day time. This disagreement is because earlier studies were restricted to daytime periods. This result therefore provides new information on the diurnal characteristics of the UHI in Akure.



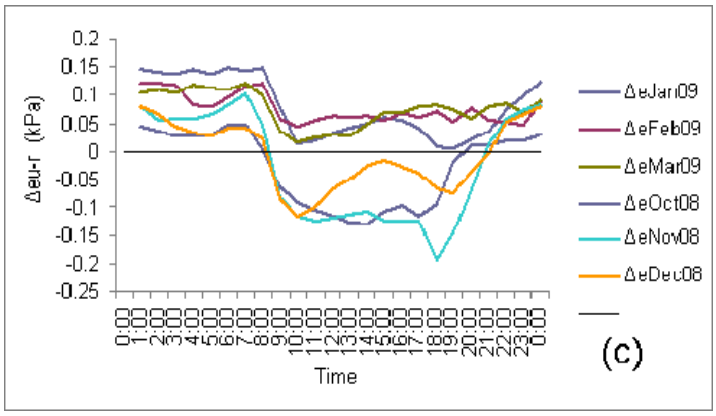


Fig.2: Diurnal variation of mean monthly urban – rural differences of (a) air temperature, (b) relative humidity and (c) vapour pressure.

3.2 <u>Relative humidity differences:</u> Fig. 2b shows the diurnal course of differences in relative humidity between the urban and rural site. The figure show that UMD exists throughout the day for all months with the highest difference observed at night and less in the afternoon. Also the UMD was more pronounced in the dry season (December/January). Fig. 2 also shows that the time of maximum UHI coincides with the time of maximum UMD, hence the mirror image pattern of the temperature and humidity differences. Fig.3a shows the relationship between the relative humidity differences and the intensity of the UHI. The high negative correlation indicate significant role the UHI plays in shaping the differences in the humidity content of urban and rural areas.

3.3 <u>Vapour pressure differences</u>: Fig. 2c shows the diurnal course of differences in vapour pressure between the urban and rural site. The figure show that UME exists throughout the day for all months with the highest difference observed in the early morning, except in months of October, November and December where UMD was predominant between 0900 and 2100. Fig.3b shows relationship between the vapour pressure differences and the intensity of the UHI. The positive correlation indicate significant role the UHI plays in shaping the differences in the humidity content of urban and rural areas. Similar patterns have been reported in Lodz, poland and Krefeld, Germany (Charciarek, 2003; Kuttler et. al. 2007). The processes directly or indirectly related to the formation of the UME have also been discussed by Kuttler et. al. (2007).

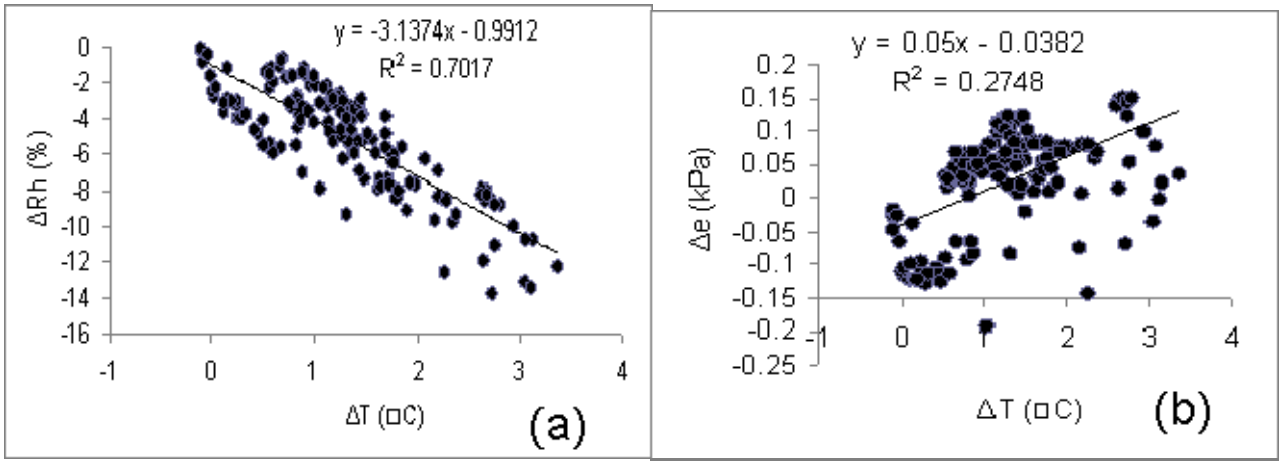


Fig.3: Relationship between mean monthly hourly, (a) vapour pressure differences (Δeu-r), (b) relative humidity differences (ΔRhu-r) and heat island intensity (Δ Tu-r).

4. CONCLUSION

The effects of urbanisation on temperature and humidity in Akure have been investigated and results reveal some interesting new findings on the diurnal characteristics of the UHI and urban-rural humidity difference in Akure.

The UHI has been found to occur throughout the day and night except for a few hours after noon in November and December. Results also show that the highest UHI intensity occurs at night between 1800 to 2200 hours and the intensity are also higher in the dry than the wet seasons. This result is just coming to light now as earlier studies were restricted to the daytime.

Relative humidity was observed to be higher at the rural location with the highest difference occurring at night and predominantly in the extreme months of the dry season. The pattern of the vapour pressure differs from that of the relative humidity, as higher vapour pressure were observed throughout the day for all months with the highest difference observed in the early morning, except in October, November and December where UMD was predominant between 0900 and 2100. Strong linear relationships also exist between both humidity differences and the UHI.

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