

Methodological Procedures for Fixed Points Measurements in Urban Areas

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ABSTRACT: One of the challenges of the research in urban climate is to standardize collection procedures and analysis of data, so that the transmission of the technology can be applied better to several realities. This article aims at to raise a methodological discussion for some procedures of measurements in fixed points that can be applied in urban areas of places with low latitude. The methodology synthesizes average practices in field studies, establishing necessary conditions for measurements in areas of hot and humid climate (collected data in 02 times a year, hour the hour, during at least 03 typical days), and it emphasizes to urban ventilation in the process of climatic amenization besides the statistical attendance from the research planning. A protection was developed outdoors for the recording equipments measurement and it was used cellular telephony lands. The option for locating the measurement points in those lands was gotten right and it allows the repetition of that methodology in other cities with same climate. The equipments stayed in safety and the diversity of soil use found allowed to accomplish the objective of the research; besides, there was rigorous control of the experiment, given to the conditions similar of exhibition for all of the equipments.

1 INTRODUCTION

One of the current challenges in the urban climate research area mentions the standardization of procedures for data collection and analysis (OKE, 2005); this involves nomenclatures and methods, so that the transmission of the developed technology can be better understood and applied in diverse realities. This is also a Brazilian concern that withholds several research consolidating groups in the area of urban climate, but those groups are frequently working in an isolated form.

Assis (2005) presents a critical revision of the issues of research in urban climate in Brazil, with the aim of identifying the advances of

the results for applications in urban design and planning. The author identifies that in the last two decades, there was an increase in the number of works in the area, however, with few contributions to studies in the tropical climates, since few researchs deal in a modeling basis to exploratory studies that can subsidize the decision making in urban planning and design. The author evidences advances in the predictive treatment of the influence of urban geometry and thermal inertia, in the variation of the parameters of temperature and air humidity; in the evaluation of the role of urban ventilation in the dispersion of atmospheric pollutants, as well as in the consideration about thermal comfort in outdoor spaces; emphasizing that most of these models are empirical, which restricts its generalized application.

Urban climate studies are relatively new, and the investigation methods and practical procedures in this type of study involve: conception, elaboration of theories, field development and modification. Some of these issues are already wide studied, however, there is a lot of work to develop the last four ones.

The recent advent of the IAUC - International Association for Urban Climate represents an effort in the performance of this role, through the promotion of scientific events and publication of works in the area. However, the complexity of the subject is aggravates in the lack of a common language that results in feasible proposals for adequate urban design and planning in relation to the climate of each locality, which could bring thermal comfort as the main benefit for the inhabitants.

The main objective of this paper is to draw a methodological discussion about some procedures for field work, with application in urban areas of low latitude and hot-humid climate.

2 PROPOSED METHODOLOGY

Several methodologies are applied in researches about urban climatic variations: combinations of measurements in fixed measurements or data obtained in meteorological stations, with mobile

either for the setting of the equipment either in relation to the proper characteristics of immediate neighborhood; the need to avoid interference of human activity in the measurement schedules, the guarantee that the physical structures of the collection points will not be modified in the interval between the field measurements; the possibility of repetition of this methodology in areas of

studies, modeling (statistical or numerical), validation of models, application in urban design and planning, impacts of settlements (pos-implementation), programming of

measurements in transects, remote sensing and the development of mathematical models.

Measurements in fixed points and the correlation of data with urban characteristics were analyzed by several authors in Brazilian cities: Souza (1996) in São Carlos/SP; Katzschner et al. (1999) in Salvador/BA; Duarte (2000) in Cuiabá/MT; Pezzuto; Labaki; Francisco Filho (2005) in Campinas/SP and Costa (2003) in Natal/RN. In other countries there can be found interesting researches such as Bai; Mikami (2006), Heisler et al. (2006) and Drebs, Vadjia, Tuomenvista (2006).

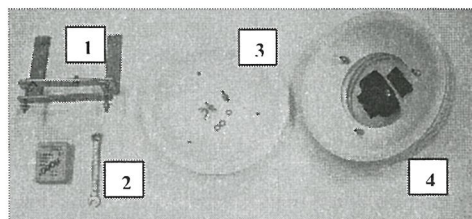
Due to the size, density and traffic of the study area it is frequently impracticable to record data through mobile measurements. A possible option is to collect environmental variables in fixed points of the city. However, concern in the selection of the points is necessary, such as: the security required for the permanence of the recording equipment; the adjusted distribution and space regularity of the points in the city, the need for these points to be outdoors; the diversity of morphologic typologies around each point, so that the measurement process covers most of them in the city; the facility of access to the points; the standardization similar climate. Taking into account all these factors a viable alternative is the adoption of mobile telephone towers to install the measurement equipment. These towers fulfill all these requirements and this kind of civil construction and technology are present in the majority of the Brazilian cities in the current days.

After the choice of the measurement points an experimental planning must be carried through with the participation of statisticians, objectifying to assure the accuracy and real distribution of the data to be collected, in accordance to the climatic reality of the city. With basis in the hot-humid climate, present to a large extent of the coastal northeastern region of the country, it is necessary to collect field data in two different periods: the dry one (generally between October the March) and the rainy one (from April to September). The period of data collection must include work days and weekends due to the differences in the behavior of urban traffic and anthropic activities. Days of measurements must also to characterize days whose climatic behaviors are “typical” of each period. In general seven days are enough, but with a good amount of results the statistical analysis will be more precise.

The kind of available equipment and its storage capacity will define the schedule for collecting data, which must be at least each hour for air temperature and relative humidity, and at each ten minutes for wind data. The number of measurement points depends on the available equipment. For coastal cities, where the influence of the sea with a thermoregulatory effect reduces the thermal amplitudes, measurements carried out in a certain time interval can be considered simultaneous (GARCIA, 1999). This fact shows the importance of wind data (velocity and direction) for this kind of study climate, together with temperature and humidity.

Measurements in urban areas are influenced by the bulk around the point, so it is important to define points in the very open, free from obstacles. To achieve this, it is necessary to develop protection for the equipment, from solar radiation and rain. A protection model (Figure 1) was developed at the Applied

Physics and Environmental Comfort Laboratory LACAF/ UNICAMP, (COSTA; LABAKI, 2006), based on the model of the standard meteorological protector.



Legend (from left to right): 1 - Screwed cramp to fix protection in stairs; 2 - datalogger for air temperature and relative humidity; 3 - Plastic Cover; 4 - Set of white plastic plates

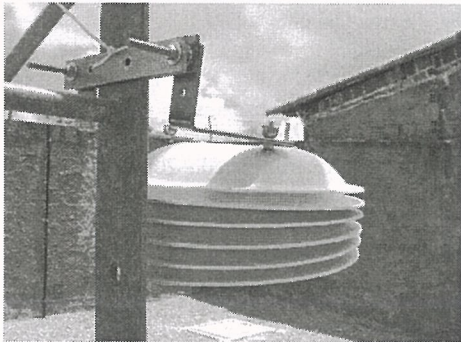
Figure 1 – Components of the equipment protection

The final proposal takes in account the following requirements:

- The equipment inside the protection has the measurement sensor duly ventilated,
- The equipment is free of the direct solar radiation for the whole period,
- The plastic part of the protection is capable to support the heat without deforming, but the iron parts when oxidation occurs must be substituted,
- the protection is white, so it is not radiation absorbing
- The protection can be dismountable, easy to mounting and a cheap solution

Since all the stations possess a security stair for access to the tower, the equipment was installed in the stairs, fixed at a 1,5m-2m height from the ground. This is a recommended value for studies about human thermal comfort. (Figures 2 and 3).

The methodology describes in this paper was applied to study the urban climate in Natal, the capital of the State Rio Grande do Norte, in Brazil.



Figures 2 and 3 – Installed equipment in the stair and details of the fixing kit.

It is very important to consider the area of influence of the measurement point as representative of a spatial reality. Oke (2004) considers that the influence area of the sensor is not a symmetrical ray - it is an ellipse, with the major axis in the wind direction. The radius of the circle of influence of the air temperature and relative humidity is 0,5km on average depending on the density of the area.

Grimmond (2006) states that the area of influence of a measurement is function of the

observed variable, the measurement method, the location of the equipment, the nature of the surface of the observed site, and in some cases of the meteorological conditions.

To define the area to be adopted, it was considered a radius of 150m, established by Katzschner (2002) for the local climatic unit, in the directions North and West from the collection point, and a radius of 350m for the directions South and East, so that the resultant radius was 500m (or 0,5km according to Oke); so it was considered the importance of the ventilation as climatic attenuator for the studied city, with predominantly Southeastern winds.

It is consensus in the literature, that for hot-humid climate the urban form windward significantly influences the possible microclimatic alterations in the collection point than that situated lee-side of this point. Figure 4 details the composition of the area. This procedure considers then an area of 0,31km² around each point for the study of the physical variables.

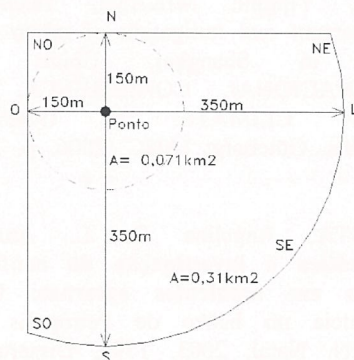


Figure 4 – Definition of radius of influence for the measurement points

3 RESULTS

The presented methodology for measurement in fixed points was tested in the city of Natal. The option for locating the points of measurement in cellular telephony towers proved to be correct and can allow the repetition of this methodology in other cities with the same type of climate. The equipment was not in risk in relation to security. The diversity of land use allowed fulfilling the objective of the research, that is, study areas with different occupation; moreover, the involved equipment allowed enough rigorous control of the experiment with similar exposure conditions in all points.

In conclusion, the proposed methodology for measurement in fixed points located in cellular telephony towers proved viable for studies in urban climatology - a step for a possible standardization of field procedures as required and related by OKE (2005) as necessary and urgent.

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