



URBAN CLIMATE IN THE CONTEXT OF A SUSTAINABLE DEVELOPMENT

L. Katzschner; M. Reinhold; L.D.Lourenco

University Kassel

Planning Department

Henschelstr. 2

D - 34127 Kassel

e-mail: katzschn@hrz.uni-kassel.de

Resumo: A Análise do clima Urbano é uma importante base para o desenvolvimento sustentável. A redução da ventilação e o efeito "Ilha de Calor" nas cidades levam a um consumo grande de energia gerado pelo uso do ar condicionado. A metodologia da análise climática das cidades se baseia na estrutura da cidade e sua situação topográfica em uma região climática quente que levam a um planejamento com propostas específicas em termos do uso de energia, problemas de poluição do ar e a situação dos espaços livres.

ABSTRACT Urban climate analysis are delt as one background knowledge for sustainability. The reduced ventilation and the heat island of cities lead to an high energy consumption caused by air condition. The methodology of a urban climate analysis based on city structures, topographical situation in a regional climate frame lead to specific planning proposals in terms of energy use, air pollution problems and free space situations.

1 Introduction

Urban city analysis are one tool of sustainable development planning. In the framework of actions within the AGENDA 21 Program, as follow up from the Rio Convention (1992), the communities have to carry out their own actions on the base of local climate and energy studies.

Urban climate analysis are used as tool for urban planning in the context of energy saving campaigns by using the natural ventilation and for thermal comfort conditions in cities by creating bioclimatic comfort zones through influencing the microclimate conditions in free city spaces. The definition of the "ideal urban climate" given by Mayer (Mayer, 1990) is a guideline to conduct urban climate qualities for the air pollution as

well as for the thermal complex and energy use, which gives the guideline for sustainability.

So for all cities it is important to develop a qualitative urban climate description, which include the ventilation pattern and the heat island situation, so that it can be used by planners. In a comparison between Brazilian and European cities it became clear, that a common investigation methodology with derived planning aspects can be used.

2 The Urban Climate

The definition of urban climate by the World Meteorological Organisation is the change of meteorological conditions which is caused through the built up areas combined with the antropogeneous air particles. But this means that the urban climate is connected to all weather situations and does not occur during special conditions. Urban climate is defined also as a mesoclimate with at least 5 km wideness. Through the densely built up ares in principle a disturbance of air flow is seen, which has a vertical dimension of ca. 1000m. The disturbance can be listed as follows:

- the city is a barrier against the regional winds
- the city has an inhomogeneous higher surface roughness
- the city creates. compared to the surrounding areas, a heat island, which is depending from surface conditions and the amount of buildings
- cites have a high discomfort through a change in the radiation balance
- the city has to be considered as air polluting system.

Therefore a city has its own meteorological system on a mesoscale level, which can be clearly separated from the surroundings. Within these systems different microclimates exists. Especially the Urban Canopy Layer (UCL), this is the atmosphere between surface and mean roof height. Here the described changes in climate have their maximum.

3 Urban Climate and Planning

In urban climate studies different aspects have to be considered, as they directly influence urban planning and effect the health conditions. The definition of these complexes are derived from the interaction processe between climate and man.

- air pollution complex

Under this aspect mainly the ventilation and the local circulation systems have to be judged. This is to avoid high concentration of air particles in different areas. The meteorological parameters used are wind and turbulances,

- thermal complex (thermal comfort conditions)

Here the thermal comfort conditions in form of heat stress is described. This is a complex function out of the meteorological parameters of wind, radiation, air temperature and humidity. Different indices can be calculated.

- architecture and building design

Heat balance of buildings are depending on wind speed, this changes the k-factor (heat transfer) of houses.

- energy saving aspects

Natural ventilation and air exchange in the buildings is considered in the context of urban climate situation

As it is shown in figure 1 it is important to develop a working scheme in order to have a actual description of the urban climate circumstances, an evaluation of that an a derived urban climate advicory map.

This can be done on different levels, which are dependent from architectural or planning aims. For all theses levels criterias for planning has to be found in order to be able for implementations. Criterias can be the improvement the ventilation situation (airpaths, local circulation systems) or the reduction of the heat island by the heat storage capacities and more green in open spaces.

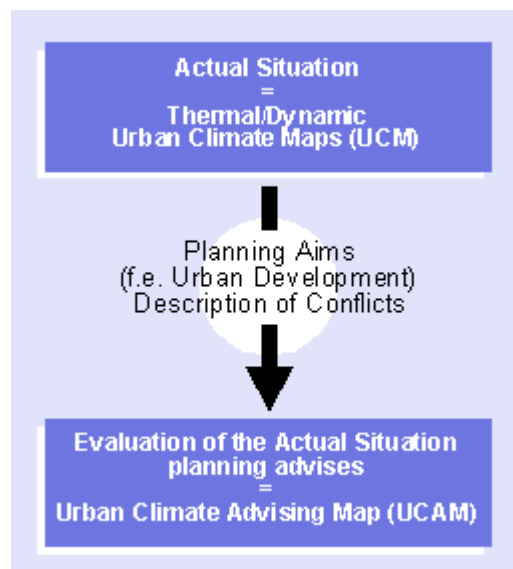


Figure 1: Working scheme for urban climate studies

4 Methods

In a first paper (Katzschner, 1997) the methodology was generally introduced and a qualitative approach was desciped. A detailed development goes into a GIS based model for an areal classification with an theoretical part and measurements for evaluation. The main focus is on the thermal and ventilation aspect.

As an example the wind measurements are shown here. in the city of Kassel wind measurements were carried out in different characteristic weather types. from that typical ventilation and air mass flow was derived. Here the important areas for ventilation is seen (figure 2).

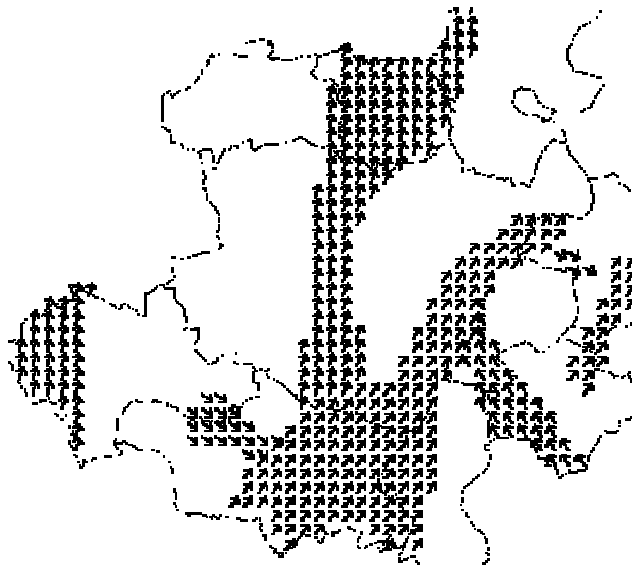


Figure 2 Measurement and their areal presentation

5. The Example of Rio Claro

The methodology was also used in Rio Claro, a Brazilian city near Sao Paulo. With simple investigation programmes and using different known meteorological data mainly three steps were derived, which allows to draw maps of the climatological relevant parameter and combine this to a urban climate map. Moreover it was possible to conduct different planning proposals out of this. As done also in Kassel it was important to draw areal pattern of the climatological characteristics as seen in figure 3, which is the topographical situation and 4, which is the sealing degree deducted out of the city structure. The topographical situation together with land use is taken as the base for the urban climate map, which is drawn in figure



Figure 3: Topographical situation for local circulation's



Figure 4: Sealing degree as base for thermal analysis

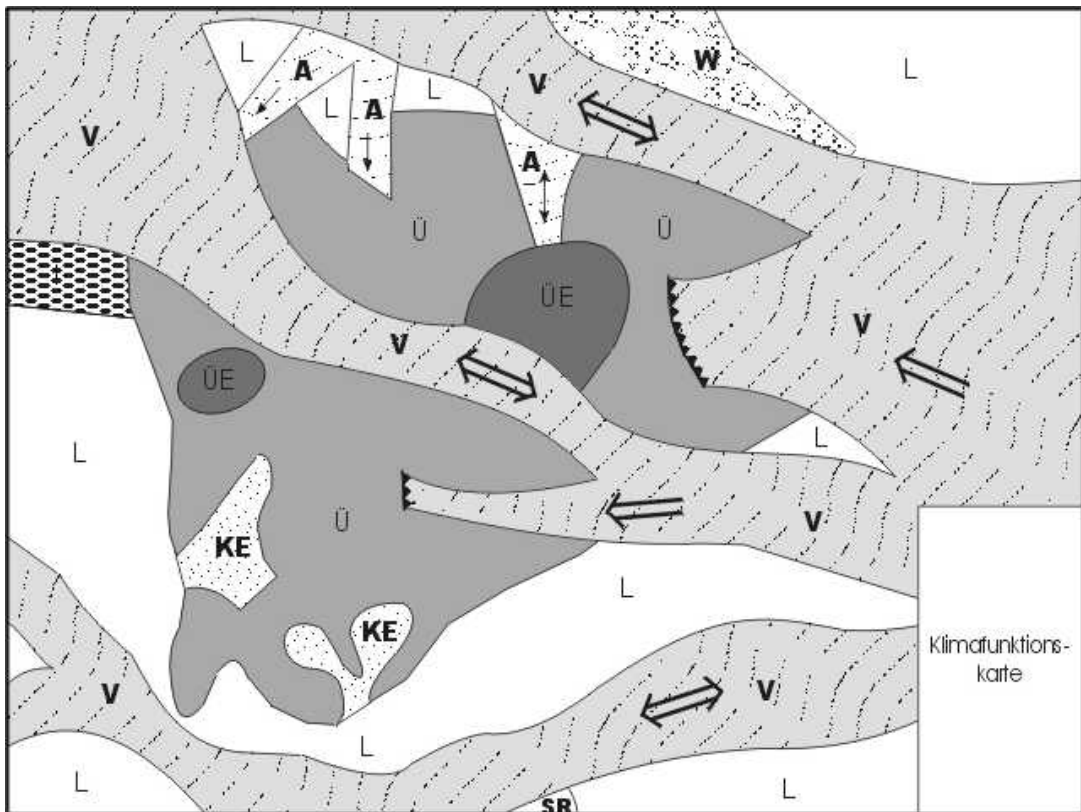


Figure 5: Urban climate map

6 Conclusions

From all the different meteorological analysis criteria's were developed and evaluated. The Evaluation ends in a translation of climate contences into planning proposals. The methodology is seen in figure 6. To every classification from figure 6 a detailed planning proposal was connected.

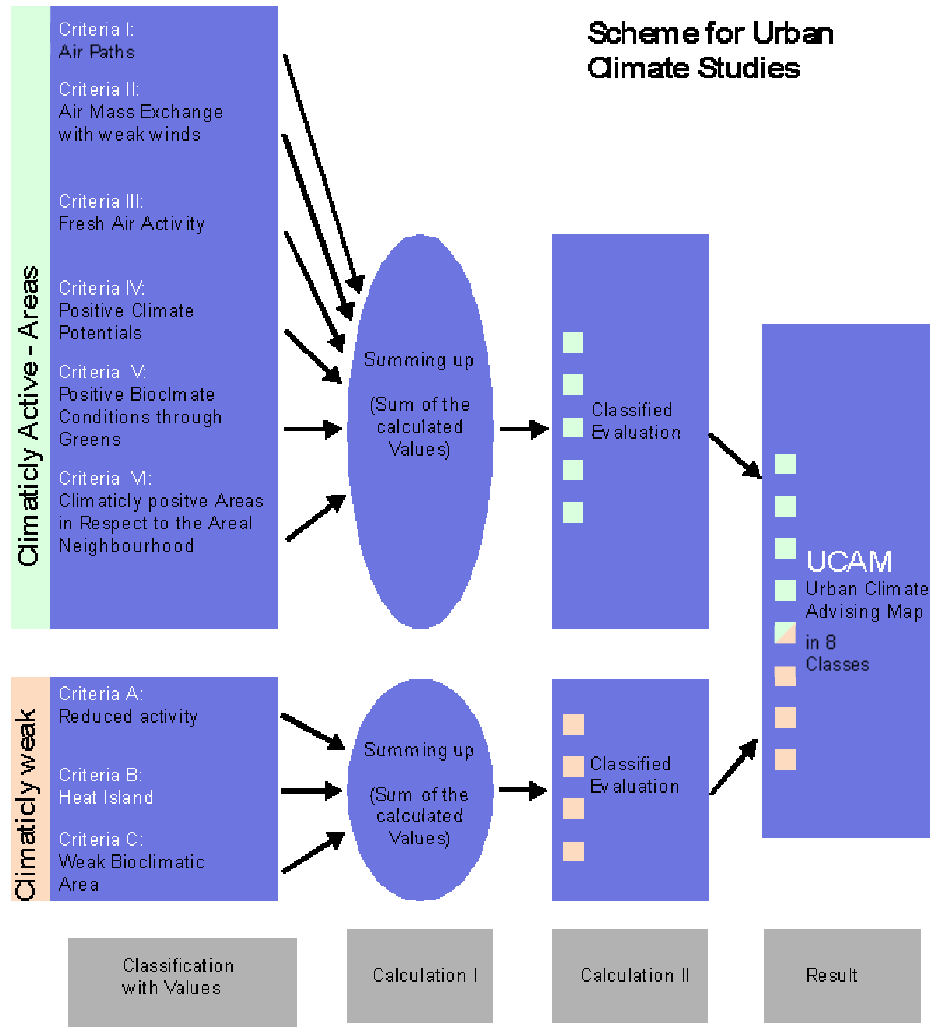


Figure 6: Evaluation of urban climate criteria's

7 References

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