

## **ASPECTS OF TOPOCLIMATE REGIONALIZATION IN TÂRGOVIŞTE CITY (ROMANIA)**

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### **Abstract**

The urban type of climate can be considered an artificial transzonal one, due to the changes brought about by urbanization and industrialization during the last period of time, which is noticeable as well for Târgovişte City and its surroundings. The main meteorological parameters determined and analyzed to configure the microclimatic aspects were: the air temperature at the soil; the air temperature at a 1 m height; the air temperature at a 2 m height; the relative humidity; the wind speed. Following the determinations made, in the southern and south-western areas of the city, influenced by the existence of the industrial platform, we have noticed higher temperatures than in the eastern one, a fact confirmed by the topoclimatic profiles of all the seasons of the year. The periurban area (Dealul Monastery) has a slightly differentiated topoclimate, due to its location at an altitude over 400 m. This observation is valid as well for the eastern area of the city, influenced by the valley of the Ialomiţa River. An essential role in the variability of the values of the climatic elements is held by the built subjacent surface, and this is why in the urban residential neighborhoods, the temperature is sensibly higher, with a low humidity (Micro XI-XII and Micro V), compared to the areas benefiting of extended green zones (Metropolitan Church, Chindia Park and Priştea).

**Keywords:** climate, profiles, topoclimate, Târgovişte municipality.

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## **1. INTRODUCTION**

A strict delimitation of the topoclimates in an urban system is quite difficult, due to the fact that the approach methods differ from one researcher to the next, because of the complexity of the functioning of such a system, because of the influence imposed by the physical-geographic factors and because of the lack of homogeneity in the distribution of both the functional areas and the specific topoclimates.

The specialized terminology and methodology are punctually different, which makes the definitions be sometimes contradictory. So, we have considered it necessary to realize an elementary topoclimatic characterization, in which we regard as topoclimate the whole complex of the meteorological parameters in the air layer of up to a 2 m altitude, and also horizontally on the ground, where one can actually feel the influences of an active subjacent surface with similar features.

## **2. WORK DATA AND METHODS**

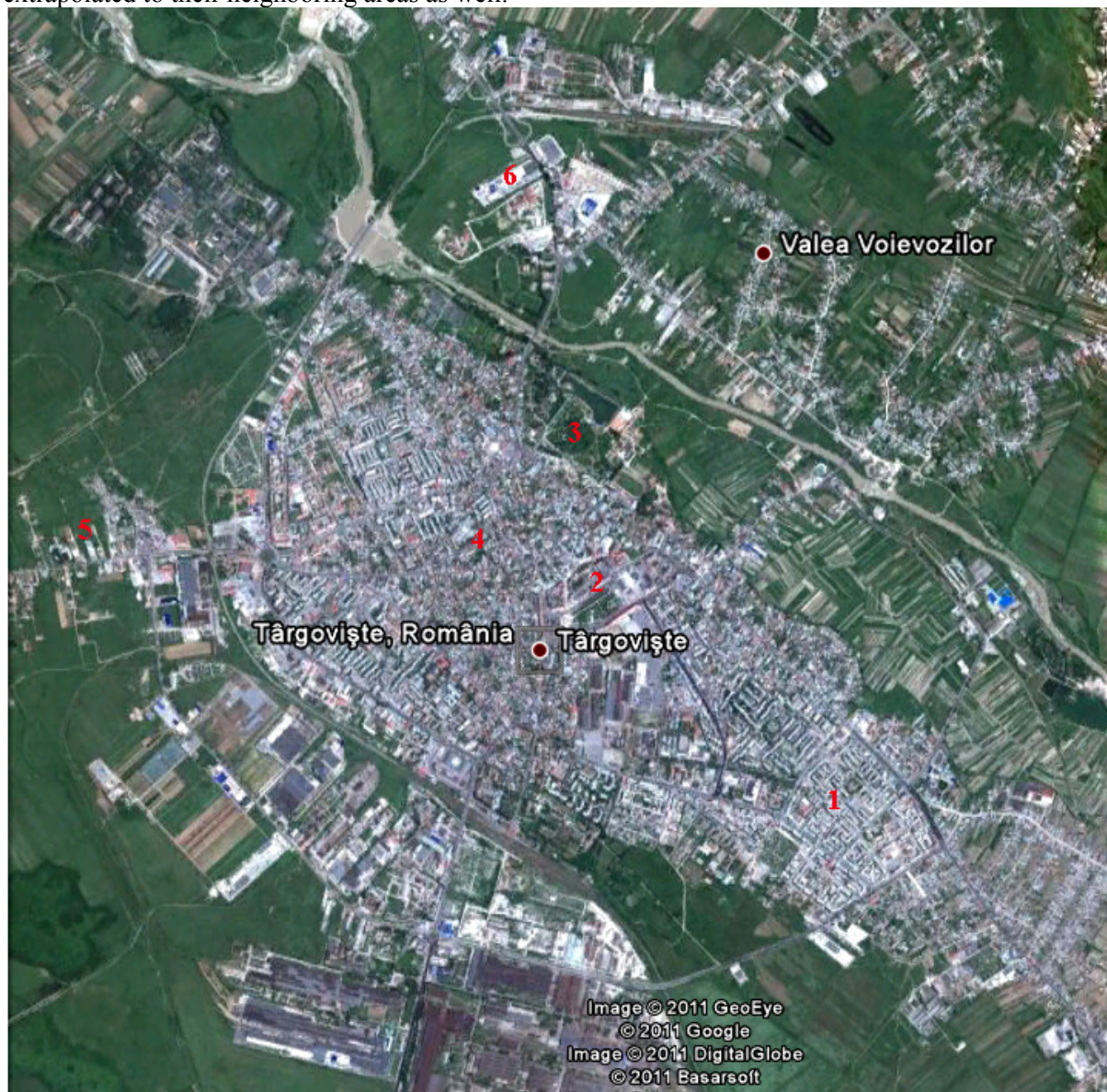
In order to highlight the climatic differences from the area of Târgovişte City and from the neighboring areas, a series of topoclimatic profiles have been made, taking into account the synoptic situation in Europe during the observations. Depending on the conditions out in the field, we have carried out profiles for the four seasons, generally focusing our attention on the variability of the climatic elements in the observation points. The latter were determined taking into account the purpose we had in view, which was different for each season, in order to be able to differentiate the meteorological parameters in agreement to the structure and the makeup of the active surface, and also to the forms of relief from within the city and the neighboring areas.

The measurements were carried out during three different years, in six points – two for each year – approximately similar in point of the constitution of the underlying surface, in order to have an image as objective as possible.

On the basis of the topoclimatic profiles resulted following the determinations made up to a 2 m altitude, we went on to the elaboration of a topoclimatic regional mapping, carried out following the study of a specialized bibliography, of which we selected the theoretical solutions oriented towards the definition and the delimitation of the different topoclimates.

### 3. RESULTS

In order to realize the topoclimatic profiles on the level of the city of Târgoviște and of its neighboring areas, we have chosen *six observation points* that we consider representative (Fig. 1), which can be extrapolated to their neighboring areas as well.



**Fig. 1. Geographic position of the climatic observation points**

(1 - Micro XI-XII; 2 – Metropolitan Church; 3 – Chindia Park; 4 - Micro V; 5 - Priseaca; 6 – Dealu Monastery)

The first observation point was placed in the Micros (neighborhoods) XI-XII, near the automatic station of the APM Dâmbovița (Environmental Protection Agency of Dâmbovița County), in order to be able to correlate the values recorded with the ones from this station. The subjacent (underlying) active surface is characterized by a grassy zone, surrounded by average buildings (4 levels), with a well developed street network. The tree vegetation is averagely high, and the meteorological data recorded in this point can be extrapolated for the whole southern area of the city, respectively for the neighborhoods (quarters) Sârbi and Prepeleac, which, in their turn, are under the influence of the industrial activities from the south of the city (SC Mechel SA, namely the Special Steels Aggregate Works, etc.).

The following observation point, situated in the center of the city (the Metropolitan Church Park), is characterized (except for the park area, which contains high trees of about 7 m), by a residential and administrative area with tall buildings (7-10 floors), with a well developed street network, oriented east-west and north-south, where one can notice wind speed intensifications. The data can be extrapolated for the entire central area, from the Old Center of the city, the Rector's Office of "Valahia" University Târgoviște and the Micro (quarter) IX.

The third observation point is situated in the Chidia Park, which lies in the eastern area of Târgoviște City, near the Valley of Ialomița River. The characteristic underlying surface is one of well-developed tree vegetation, influenced by the channeling of the air masses along the valley of the above-mentioned river. It is representative for the eastern area of the city, which is developed along the Ialomița River.

The following observation point, the fourth, was placed in Micro (quarter) V, in the center-north of the city, in a residential area with tall buildings and a dense street network. This could be representative as well for the Micros (neighborhoods) IV and VI, up to the Bus terminal (Autogara).

The last but one observation point is situated near the meteorological platform of Târgoviște Station, also for the sake of value correlation, being specific for the northern area, with the residential quarter of Priseaca, and to the north-western industrial area.

The last observation point is placed near Dealu Monastery, at an altitude of about 400 m, in the north-east of Târgoviște, in an open area with well-developed vegetation and with low and not so dense buildings.

After the realization of the topoclimatic profiles, we were able to highlight a series of topoclimates, which are presented below.

### 3.1. Complex topoclimates

Following the analysis of the underlying active surface and of the meteorological parameters recorded in the observation points, we were able to highlight two complex topoclimates, for Târgoviște City and its surroundings: one of *plain* and one of *hills*.

*The plain topoclimate.* It unfolds at relatively low altitudes, in our case 200-297.5 m altitude, having a large extension, relatively uniform, towards the outskirts. Yet, the existence of some obstacles in the periurban area leads to an influence on the air circulation, the small and medium vegetation influencing it as well. Due to these natural conditions, the air temperatures during the hot temperature of the year are sensibly higher, by about 3<sup>0</sup>C in the actual urban area, compared to the outskirts, especially at the contact with the External Subcarpathian Hills of Ialomița.

The wind speed grows, favored by the opening towards the outskirts, the orientation of the main arteries and the courses of the Ialomița and Dâmbovița Rivers.

As far as the values of the atmospheric humidity are concerned, they are lower than those of the surrounding hilly area, yet inside the city they vary in agreement to the structure of the active underlying surface. For instance, in the residential areas, which have a developed street network, the values go down with up to 15-25% compared to the zones characterized by the existence of areas with agricultural plants or public parks.

The average precipitations quantity is around 600-650 mm/year, sensibly lower than the one recorded in the Subcarpathian Hills (700-730 mm/year).

*The hill topoclimate.* It is characteristic, in the case of our research, only for the observation point situated at Dealu Monastery, this location being part of the External Subcarpathian Hills.

During the analysis of the meteorological parameters under observation, we noticed that the air temperature is lower by up to 1.5<sup>0</sup> C compared to the lower area, and the relative atmospheric humidity is higher, its values being with up to 10-25% above those recorded in the plain. This situation is triggered by the altitude, but also by the presence of the vegetal layer, which contributes to this increase of the humidity value, by means of the evaporation-transpiration. On the other hand, the precipitations quantities are higher by 50-80 mm/year.

### 3.2. Elementary topoclimates

Following the detailed analysis of the subjacent active surface from the area of Târgoviște City and its neighborhoods, we can notice the particularization of several *elementary topoclimates* (Fig. 2).

*The topoclimate of the central area (Metropolitan Church, Micro IX).* It is determined by the features of the fragmentary active underlying surface, with influences triggered by the large built areas, with a high caloric capacity and conductivity and a low albedo. The vertical development of the constructions contributes to the increase of the surface that can receive the caloric radiation, which determines a more significant heat increase in the proximity of these buildings. At the same time, the storage of the caloric energy during the daytime and its release during the nights lead to the presence of certain thermal contrasts between day and night, a phenomenon that is less marked in the neighborhood and in the area of the



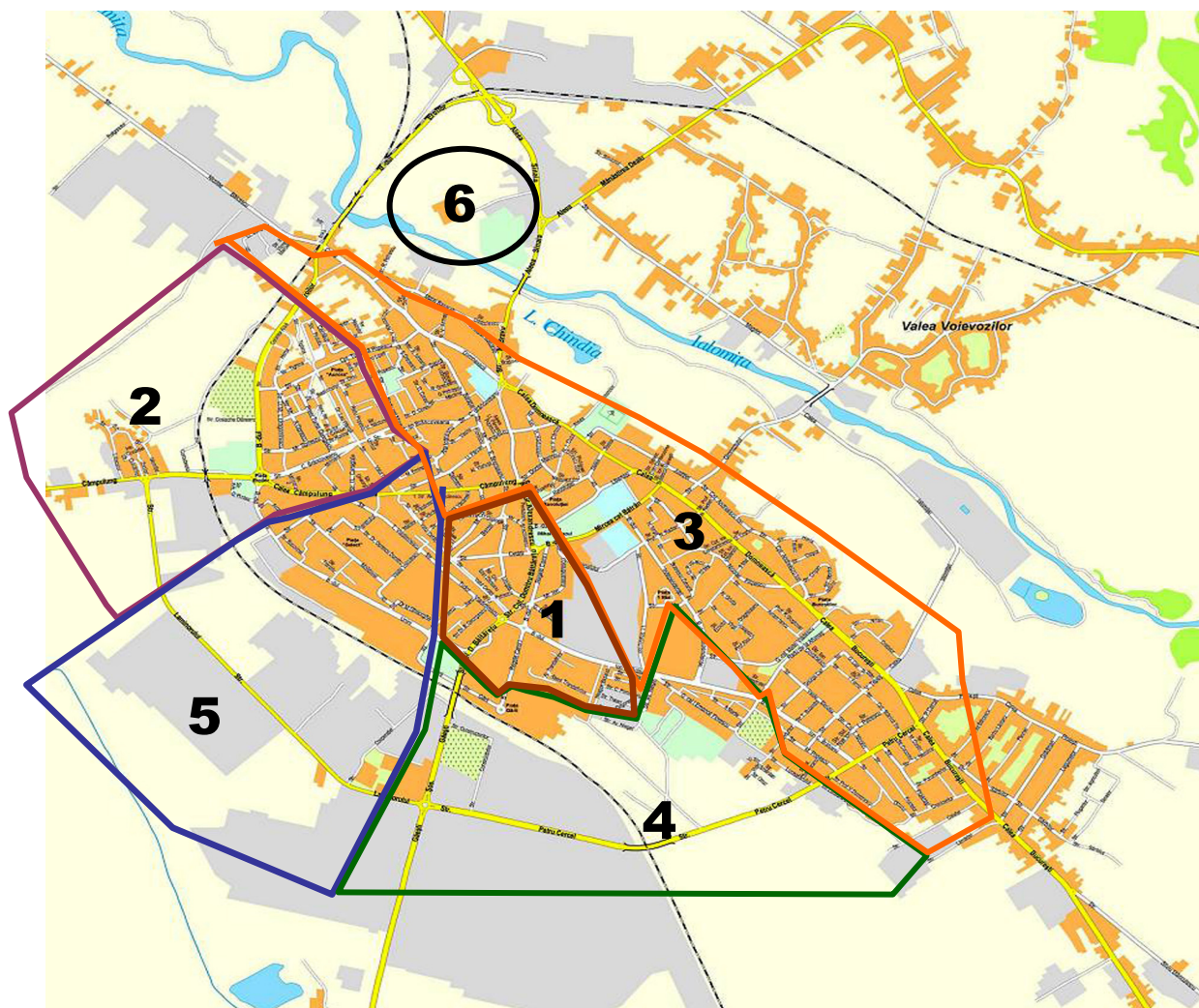
Metropolitan Church Park from Târgoviște City.

At the same time, the air humidity is low, with some small increases in the area of the Metropolitan Church Park. Similarly, the wind speed changes to a certain extent in point of direction and intensity, due to the orientation of the boulevards, which favors the channeling of the air masses.

*The topoclimate of the northern area (Priseaca - Autogara - quarters II and III).* This type of topoclimate appears on a highly complex, active underlying structure, due to the presence of an infrastructure characterized by tall buildings, alternating with low ones (Micro I and II, similarly to the residential neighborhood of Priseaca), with an extended and dense tree layer. The solar energy received is turned into caloric energy and released into the air above the ground. Due to the variability of the buildings' height, the radiant energy quantity is slightly fluctuant from one micro-zone to the next.

The agglomeration of the tall buildings in a relatively restrained area (as in the case of Micro (quarter) I and II) favors the lowering of the wind speed and intensity, compared to the situation present in Priseaca, where this phenomenon is almost impossible to seize.

*The topoclimate of the eastern zone (Chindia Park – Ialomița Valley).* It presents particularities determined by the structure of the active surface, with low air temperatures, due to the absence of the extended built surfaces. This is why these values are lower by about  $1.5-2^{\circ}\text{C}$  compared to the residential quarters. This topoclimate has higher air humidity values and a lower wind speed, and it also receives influences from Ialomița River, situated immediately near Târgoviște City.



**Fig. 2. Topoclimatic map sketch for Târgoviște City and its neighborhoods** (processed based on a Google Earth image) - 1: Metropolitan Church, Micro (quarter) IX; 2: Priseaca, Bus terminal (Autogara), Micro (quarters) I-II; 3: Chindia Park, Ialomița River Valley; 4: Micro (quarters) XI-XII, neighborhoods Sârbi and Prepeleac; 5: Micro (quarters) V-VI; 6: Dealu Monastery

*The topoclimate of the south, south-east and south-west area (neighborhoods XI and XII, quarters Sârbi and Prepeleac).* It has some specific features, determined by the large area occupied by the industrial

(especially metallurgical) units, whose effect is the increase of the pollution degree in the area concerned.

Based on the meteorological observations made out in the field, we were able to notice that the air temperature is sensibly higher, by  $0.5-1.5^{\circ}\text{C}$  compared to the other residential quarters of Târgoviște City, and the atmospheric humidity is lower by 5-10% compared to the zones covered by vegetation from the actual urban area.

At the same time, the wind speed is relatively low, presenting some intensification on the boulevards oriented north-south, and the wind direction changes depending on the punctual obstacles. A quite frequent phenomenon is the fog, which, associated to the polluting emissions from the nearby industrial units, presents a morbidity potential.

*The topoclimate of western zone (Micro (quarters) V-VI and the afferent industrial platform).* We have in view a type of topoclimate sensibly similar to the previous one, negatively influenced by the presence of both certain industrial units and some public (urban and extraurban) transport (South Train Station Târgoviște, ATYC Bus terminal (Autogara ATYC) etc.), with a major influence on the increase of the atmospheric and noise-related pollution.

The meteorological observations made out in the field allowed us to notice that the air temperature is slightly higher, by  $0.3-1^{\circ}\text{C}$  compared to the other residential quarters of Târgoviște City, yet lower than the temperatures recorded in Micro (quarters) XI-XII.

The wind speed was also low, with some intensifications along the boulevards oriented north-south. Fog is also a frequent phenomenon, amplifying the negative effects of the pollutant emissions in the western industrial area of the city.

*The topoclimate of the periurban area (Dealul Monastrey).* It is characteristic for the periurban area from the north-east of the city. The climatic peculiarities are determined by the configuration of the relief, the altitude and the vegetation present there.

The air temperature is generally lower by  $1.5-2^{\circ}\text{C}$  compared to the rest of the area, and the atmospheric humidity is higher by about 15-25%, while the pollution degree is lower. The wind speeds are higher due to the lack of any natural or anthropic obstacles.

#### 4. CONCLUSIONS

Despite the fact that the topoclimatic profiles realized were brief, it is possible to highlight a few main aspects as far as they are concerned. So, in the south and the south-west of the city, which are under the influence of the industrial platform, one can notice higher temperatures than in the east, a fact confirmed by the topoclimatic profiles of all the seasons. The periurban area (Dealul Monastery) has a slightly different topoclimate, being situated at an altitude over 400 m. The same observation is valid for the east of the city, which is under the influence of the Valley of Ialomița River.

Among others, for the seasons spring and autumn, one can note the action of the vegetal factors on the main climatic parameters. At the same time, an essential role in the variability of the values of the climatic elements goes to the underlying constructed area, which is why in the residential urban quarters the temperature is sensibly higher, with a low humidity (Micro (quarters) XI-XII and Micro (quarter) V), compared to the zones benefiting of extended green areas (Metropolitan Church, Chindia Park and Priseaca).

The presence of the hydrographic arteries, in our case of the Ialomița River, and, from a distance, of the Dâmbovița River, allows the accumulation of colder and wetter air masses from the alpine and the Subcarpathian neighboring area towards the urban area under analysis.

Following the comparative analysis of the values of the meteorological elements under consideration present in between the urban and the peripheral area, one can highlight the manifestation of a certain *heat island* above the city. That is why the warmer and drier air situated above the urban area determines a circulation from the peripheral areas towards the center of the city, favored as well by the street network, which constitutes an *urban breeze*, leading to the moderation of the thermal values and of the wind speed intensity.

According to what we have presented, one can elaborate an overall image of the spatial variability of the climatic factors and of the associated elements determining these fluctuations. So, we can express the opinion that an important role in the spatial-temporal variability of the meteorological parameters' evolution goes to the physical-geographic factors, yet we need to highlight that the urban area presents major influences modifying the relative balance present in the environment.

A deeper knowledge of the changes brought about by the urban area on the climate would require a continuation of the observational approaches during a longer time span, under diverse climatic conditions,

concomitantly to the monitoring of the environmental quality.

Following the territorial extension of the urban area of Târgoviște City towards the outskirts, it has become increasingly necessary to approach the area under analysis from a topoclimatic and regional perspective, too.

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