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The Influence of Nebulosity on the Air Pollution in the Area of Slatina City

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Abstract
The subject of the article is the detailed analysis of the nebulosity and the influence of meteorological parameters on the phenomenon of air pollution in the Slatina area. The nebulosity is described by specific and general climatic parameters: the monthly and annual averages, the monthly average and annual number of sunny days, the monthly average and annual number of cloudy days, the monthly average and annual number of covered days and the frequency monthly and annual average (number of cases) for main types of clouds, for the period 1977-2006. The purpose of this analysis is to highlight the spatial and temporal distribution of air nebulosity, especially to observe any changes this meteorological element in the urban perimeter and how air pollution affects, diminishing or exacerbating. The Slatina town called the aluminum city is known like the largest producer of primary aluminum in Central and Eastern Europe after Russia, ALRO SA. The article ends with the author's conclusions, highlighting the climate peculiarities of the city determined by the characteristics of the active surface. The active area - main underlying factor determining urban topoclimate and that due to economic and social development of the city changes occurring meteorological elements, as is illustrated for nebulosity.
Keywords: Cloudiness, Influence, Air Pollution, Slatina.

Introduction

Through its activities, the man contributes to changing the composition of normal environmental components: air, water, soil, by the intrusion of foreign elements harmful, long or short, causing the pollution. Feed-back changes in the environment of the human components manifest differently, reducing quality of life.

City Slatina municipality in the southern part of Romania, mathematical coordinates 44 ° 26 ' 33 " north latitude and 24 ° 1' 57 " east longitude (figure 1), being positioned on left bank of

Olt river in contact two major units relief Romanian Plain and Getic Plateau. The boundary between these units passing north of the town.

Fig. 1 The geographical position of Slatina in Romania
(processed www.google.com)

Within the Slatina town is the Olt meadow and upper terrace and Boian Plain, a subdivision of the Romanian Plain. General geomorphological aspects of plain and low terraces of land is fragmented, altitude area is between 50-60 m and 170-175 m. The overall look of the fireplace is open to the Olt River amphitheater in front of which stands an old erosion control. Slatina is a city with ancient attested in the second half of the fourteenth century, the border point.

Coverage of the sky with clouds defining atmospheric nebulosity. In Romania, the observations regarding nebulosity are usually visual in climatological terms. The database used for cloud analysis is the meteorological observations made and monitored at the meteorological station for the town of Slatina, located at latitude 45 ˚ 26 'N, longitude 24 ˚ 21' E and an altitude of 172 m will be performed for analysis long string of data (30 years), specifically for the period 1977-2006. Nebulosity analysis will be made of the following perspective: the average monthly and yearly regime, the monthly and annual average number of sunny days, cloudy days and days covered and average monthly and annual frequency of the main types of clouds, using graphic and statistical methods mathematics.

Results and Discussion

Cloud is directly influenced by the peculiarities of the general circulation of the atmosphere and surface assets. In turn influences the climate regime elements all stored altering the radiative balance - calories, reducing the intensity of direct solar radiation by reflection, diffuse radiation increases, decreases the effective radiation and brightness, and altitude limits visibility. Of clouds covering the sky, the most important are the clouds lower, including nimbostratus and cumulonimbus, because lets direct radiation clouds absorb terrestrial radiation and emit long-wave radiation. Heat energy and light solar radiation is reduced in the presence of clouds and at night due to their soil heat loss through emanation, are reduced.

In this analysis, the interpreted climatological data refer to total cloud cover and is expressed in tenths of sky. For urban atmosphere, cloud cover has some specific characteristics, being higher as a result of local convective dynamics and for many condensation nuclei in the atmosphere of the cities compared to the suburbs.

In the Slatina industrial area, due to more dust into the atmosphere condensing conditions are more favorable water vapor, so the cloudiness is more pronounced than in other areas of the city. In the peripheral area, located in the path of moist air masses, the conditions favorable to the development of clouds, because the air becomes have an upward motion in contact with the high buildings.

Yearly averages of cloudiness over Slatina, during 1977-2006 is 5.3 tenths of heavenly vault, the area being in an intermediate area between the western and the eastern half of the country and between high and low regions. The regime's annual monthly averages for cloud there is a downward trend from January to August, after which the evolution becomes upward until December, registering a maximum and a minimum. This scheme is due to different systems or stationary baric crossing over Romania.

The maximum value of cloudiness occurs in two consecutive months, December and January, the 6.5 tenths, and the minimum value recorded in August, the 3.5 tenths. The maximum value is caused by increased cyclonic activity over the Mediterranean Sea to the south following the withdrawal of the Azores High and middle latitudes of the Depression submission to Iceland, plus specific temperature inversions and cold season with frequent fogs and low layered clouds and minimum value is due the anticyclone regime caused by summer season (figure 2).

Cloud and air humidity have a similar distribution, influenced by geographical factors and dynamics, in the spring the monthly averages values are higher than the average monthly winter months, the difference varies between 1.2 and 0.1 tenths, as shown in the graph of figure 2. This is due to the greater frequency of invasions moist oceanic air this time of year.

The graphical representation in figure 2 is the result of mediation multiannual averages of each month of each year of the period analyzed, but nebulosity values vary from one year to another, the characteristics and frequency of air advection from different directions. Years with annual averages of nebulosity higher than the annual average of the period 1977-2006 were the years: 1979 - 6 tenths, 1984 - 5.8 tenths and 1996 - 5.9 tenths.

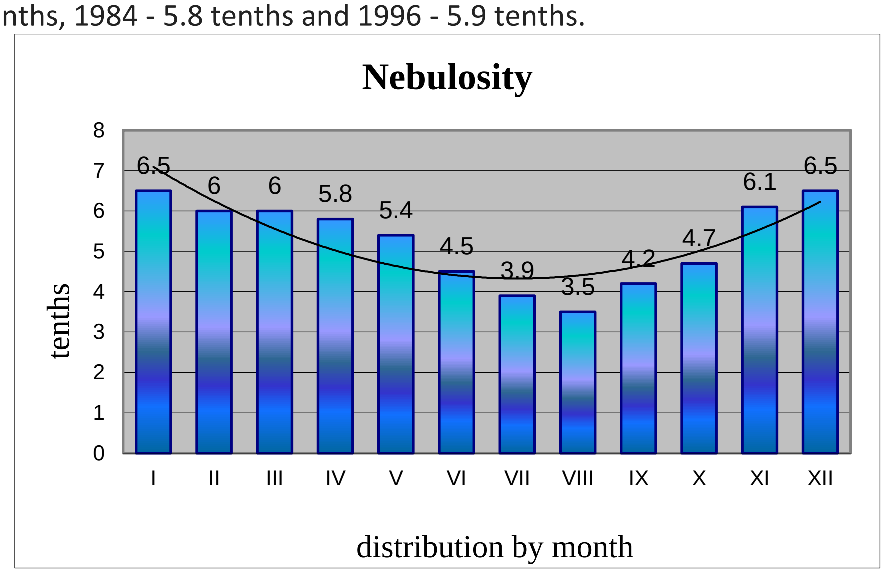

Fig. 2 Regime annual of average monthly nebulosity at Slatina station, during 1977-2006
(processed data ANM – CMR Oltenia SMA Craiova)

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These values are higher due to higher frequency of moist air from the Atlantic Ocean and the Mediterranean Sea. Years with annual averages lower than the annual average for the same period were the years: 1983 - 4.7 tenths, 1990 - 4.8 tenths, 1993 - 4.5 tenths and 2000 - 4.6 tenths. Lower values of annual mean cloud cover are the result of warm air advection and dry.

In terms of monthly averages, the variation is much larger compared to the monthly multiannual. The monthly average for the month of January 1996 was 9.3 tenths, and the monthly average for 2000 was 6.1 tenths. Semesters, urban nebulosity is 5.9 tenths in the second half cold and half hot decimal 4.5. 1.4 tenths difference is the consequence of increased air temperature and relative humidity less intense convection.

In the area of Slatina, cloud cover is higher in the morning between the hours 7-9, in the winter season due to loading the atmosphere with smoke, dust and gases from factories and vehicles, and in summer, the time interval 14 to 16, when air convection reaches maximum values. Cloud coverage of the sky changes from day to day due to genetic factors dynamics of the atmosphere. Conventionally, after average daily cloud cover are distinguished: *clear days*, between 0 and 3.5 decimals day with *cloudy sky*, between 3.6 - 7.5 tenths and *overcast days* with over 7.6 tenths.

Conditions for cloud filled the frequency of days with clear sky, cloudy sky overcast, the last two categories of days being in a relationship proportional annual cloudiness regime.

During 1977 - 2006, in the Slatina area, the annual average days of clear skies is 68.1 days of total cloud cover and 146.8 days of inferior nebulosity. The annual regime of days with clear sky, for high nebulosity, the maximum monthly record is in August month 10.8 days and for minimum is in May month for 3 days, and after lower nebulosity, the monthly peak recorded in August for 16.6 days, followed a secondary maximum in September for 16 days, and the minimum principal monthly record in December of 8.5 days, followed in January by secondary minimum 9 days (table 1).

Over the years, the average annual number of days with clear sky varied from 97 days of cloudiness total in 2000 to 41 days in 1997, and after the lower cloud cover from 187 days in 2000 to 106 days in 1980. Favorable conditions for heating pronounced urban and larger number of dust are prerequisites for decreasing the number of sunny days. To these may be added a subjective question, the visual observation of the amount of cloud.

The annual regime cloudy days weather station Slatina, during 1977 - 2006 there was a total of 203.4 days of total cloud cover and cloud cover 180.1 days after below. Days with cloudy sky represents the largest frequency range nebulosity, so only one value is indicative, in order to grasp the general trends of long-term evolution of cloud amount.

Tab. no. 1 – The monthly average and annual number of sunny days, cloudy days and overcast days at weather station Slatina, during 1977 – 2006

Weather / nebulosity	Number days/month												Total days/ year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Clear days after total nebulosity	4.1	4.7	4.5	3.3	3	5.5	8.6	10.8	8.7	7.7	3.7	3.5	68.1
Clear days after bottom nebulosity	9	10.6	11.4	11.3	12.1	12.1	14.7	16.6	16	14.7	9.8	8.5	146.8
Cloudy days after total nebulosity	13.9	13.2	16	18.7	21.6	20.6	19.9	17.9	16.5	17.1	14.3	13.7	203.4
Cloudy days after bottom nebulosity	14.4	12.5	14.9	17.4	18.3	17.6	16.1	14.1	12.9	14.6	13.3	14	180.1
Overcast days after total nebulosity	13	10.1	10.5	8	6.4	3.9	2.5	2.3	4.8	6.2	12	13.8	93.5
Overcast days after bottom nebulosity	7.6	4.9	4.7	1.3	0.6	0.3	0.2	0.3	1.1	1.7	6.9	8.5	38.1

processed data ANM – CMR Oltenia SMA Craiova

Local conditions of turbulence and atmospheric currents increased emissions of industrial pollutants are conditions that favor the growth of monthly and annual average number of cloudy days and thus emphasizing nebulosity**.** In May, June and July are recorded most days with cloudy skies, the maximum being 21.6 days in May and the minimum in February of 13.2 days after total cloud cover and cloud cover as lower maximum and the lowest recorded in the same month of 18.3 days and 12.5 days respectively. The annual regime overcast day in Slatina area, according to table 1, there was a total of 93.5 days of total cloud cover and cloud cover 38.1 after lower, with a maximum monthly in December, for both types of cloudiness, 13.8 days and 8.5 days respectively and the minimum monthly registered in July, 2.5 days and 0.2 days for total cloud cover as the cloudiness bottom. Monthly maximum is caused by the greater frequency of thermal inversions and layered clouds, and the minimum monthly anticyclone regime is determined by specific and clear during the summer season.

Between monthly values of days with total sky covered with clouds (high nebulosity) and low nebulosity, there is a difference, the latter having a lower frequency, as is normal. From one year to another record high fluctuations due to permanent changes in the general circulation of the atmosphere, so most days of the year with overcast 1996 was 132 days after total cloud cover and 1984 66 days of cloudiness partial, and the opposite was the year 1992 for both categories of cloud, 60 days and 14 days.

Annual evolution of the frequency of days with clear sky, days with cloudy sky and days with overcast sky are shown in figure 3.

The clouds are the product of upward movement of air, water vapor condensation and thermal convection. As for cloud meteorological station Slatina, the four terms are determined visually main types of clouds of three levels:

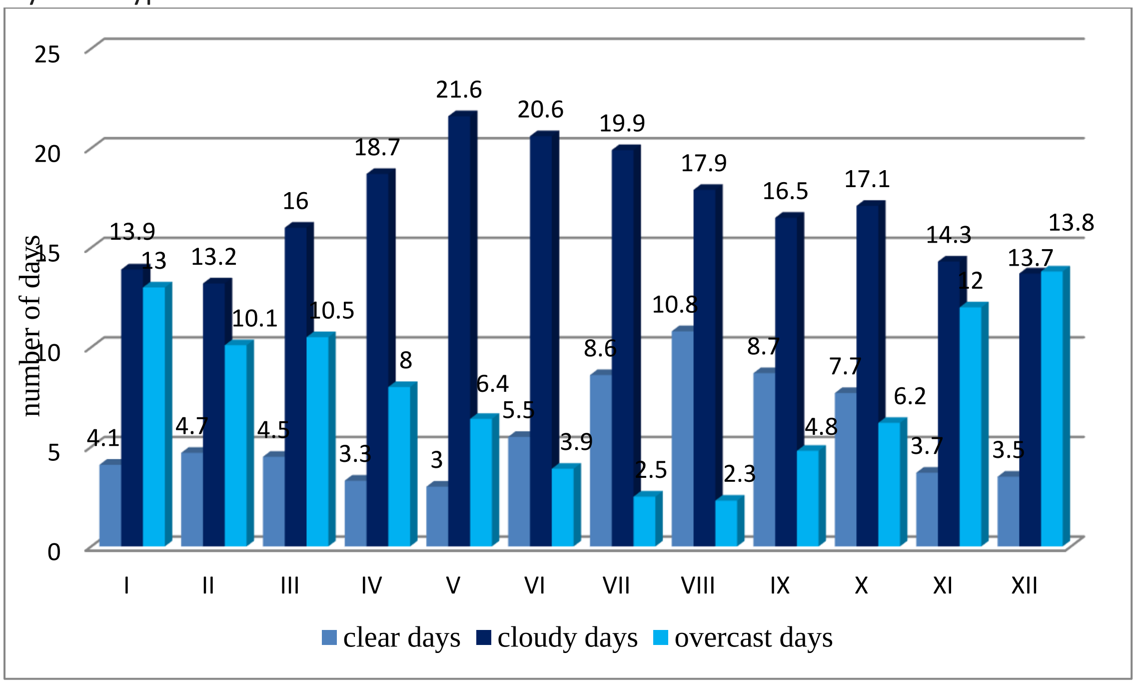

Fig. 3 Monthly average number of days with clear sky, day with cloudy sky and days with overcast sky, at weather station Slatina, during 1977 - 2006
(processed data ANM – CMR Oltenia SMA Craiova)

- *Lower floor comprising*: Stratus (St), Stratocumulus (Sc), Nimbostratus (Ns), Cumulus (Cu) and Cumulonimbus (Cb), the last two genera have strong vertical development;
- *Middle floor comprising*: Altostratus (As) and Altocumulus (Ac);
- *Upper floor comprising*: Cirrus (Ci), Cirrostratus (Cs) and Cirrocumulus (Cc).

Observations made on the characteristics of clouds enable shaping an image as complex climatic conditions in the area of Slatina.

For the area of Slatina, clouds are mostly alien provenance, being tied to the general circulation of air masses from the Atlantic Ocean, the Mediterranean and less than other regions of the globe. There are situations where the clouds are local when heat is added to the turbulence of mechanical turbulence and escalating volumes of air in the direction of the prevailing wind over warm air over the city is accompanied by adiabatic cooling of the air and the formation of convective clouds. Clouds are the decisive factor in the presence of precipitation and play an important role in dispersing and directing air pollutants, thereby reducing or enlarging urban air pollution.

The frequency of the main types of clouds to the area Slatina, during 1977- 2006 is presented in table 2.

According to the values in table 2, the annual regime of each kind of clouds we find the following:

- *Stratus clouds* are more frequent in winter season, something which is reflected in the monthly average December and January from 6.4 to 6.7, and the lowest values recorded in June, July, August, the same amount of 0.3. The average yearly rate is 31 cases;
- *Stratocumulus clouds* have a higher frequency than the Stratus with an annual average 291.5, peak recorded in December from 40.4 cases for cloud overlapping maximum and minimum in July from 7.7 cases month low cloudiness. It's the sort of clouds with the third frequency Slatina area;
- *Nimbostratus clouds* are clouds front with greater presence in the winter months when frontal activity is more intense with a annual average of 81.9, the maximum recorded in January is 13.7, and in July recorded a minimum of 0.4, due to the predominance anticyclone regime;
- *Cumulus clouds* are the result of thermal convection with a high frequency in summer, when exceeding the value of 20, and low values are recorded monthly in the winter months in March, with a minimum in December and January to 1.1. Annual average is 139.9;

Tab. no. 2 – Frequency (number of cases) monthly and annual average of the main types of clouds from meteorological station Slatina, during 1977-2006

Types of clouds	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total year
Ci	10.2	10.5	17	22.3	27.7	24.7	19.2	16.2	18	16.2	12.1	11.7	205.8
Cc	0.3	0.1	0.2	0.3	0.6	0.7	0.3	0.3	0.5	0.2	0.2	0.2	3.9
Cs	3.6	3.6	5	7.1	6.8	4.6	2.5	2.2	3	3.8	2.7	3.1	48
Ac	30.7	33.5	44.2	51.1	52.5	44.8	41.2	38.1	40	42.3	36	35.2	489.6
As	25.7	28.7	36.9	41.2	40.7	31.2	26.7	26.1	29.5	34	29.4	29	349.7
Ns	13.7	12	11.7	6.2	3.4	0.8	0.4	0.9	3	4.6	12.2	13	81.9
Sc	37.7	30.5	35.2	23.7	17.2	8.4	7.7	9.7	17	29	35	40.4	291.5
St	6.4	4	2.7	0.6	0.7	0.3	0.3	0.3	0.5	1.5	7	6.7	31
Cu	1.1	3.1	9	15	20.1	23.3	24	19.7	13.9	6.9	2.7	1.1	139.9
Cb	0.2	0.5	4.8	18.2	26.8	28.8	25.5	19.2	11	5.5	1.7	0.7	142.9

processed data ANM – CMR Oltenia SMA Craiova

- *Cumulonimbus clouds* are clouds of origin Cumulus convection - like distribution, but with a higher annual rate of 142.9. Monthly values in summer are higher than those of cumulus clouds, the maximum being 28.8 recorded in June, and the winter had

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lower values compared to the same kind of clouds, the minimum was recorded in January of 0.2;

- *Altostratus clouds* have an annual average rate of 349.7 cases ranking second cloud regime in Slatina area. The highest values recorded monthly frequency in the spring with a maximum of 41.2 in April and the lowest frequency recorded in January to 25.7;
- *Altocumulus clouds* have the highest frequency of 489.6 cases exceeding the value of 30 months in all cases the frequency. Maximum recorded in 52.5, and the minimum is 30.7 in January;
- *Cirrus clouds* are clouds upper front with a multiannual frequency of 205.8, with low values in the range from January to February of 10.2 and 10.5 respectively, values due to lower cloud cover which shields. High values are specific to the months of May and June, the maximum being 27.7 in May;
- *Cirrocumulus clouds* have monthly frequency values below 1, multi registering 3.9 cases. Were more frequent in summer;
- *Cirrostratus clouds* have the highest value of 6.8 in May and the lowest is 2.2 in August. Multiannual frequency value is 48 and ranks second in frequency to higher clouds.

In conclusion, the different types of clouds have different frequencies over periods of a year due to the characteristics of the processes that generate them. The clouds in the middle floor have the highest frequency in the number of cases in the area of Slatina and the opposite pole of the genera Stratus clouds and Cirrocumulus last type having the lowest frequency, expressed in number of cases. Along with air temperature, precipitation and wind, cloud cover has an important role in achieving the air pollutant dispersion and self-purification.

Conclusions

Climate towns formed under the action of local factors, characteristics of urban centers and particularly industrial centers such as: the specific nature of the active surface - underlying the existence of a curtain of mist, escaping the city heat in the atmosphere resulting from various combustion processes, and so on, making changes in solar radiation and atmospheric circulation. As a result, the city creates its own local climate -sensitive differentiated from the surrounding area. And, as city size increases, the differences between city and surrounding areas are growing.

Nebulosity regime in the city is distinguished by higher values of monthly and annual averages and prevalence cloudy days. Cloud formation and dispersion is caused by exposure to air masses in travel over the city, the intensity of caloric processes, urban morphology and urban air pollution levels. Mechanical turbulence and dynamics are critical in the formation of clouds. Cloud develops an important role on air pollution. The clouds formed over the city of Slatina, because strong thermal convection caused by overheat, have a greater vertical development than those formed in the same way over neighboring fields and thus influencing air pollution in that impurities lower atmospheric layers are raised to high and represents the best conditions for dispersion of pollutants in the cities of the plain of which the city of Slatina. The clear sky not produces pollution critical situations. The sky may happen only pollution episodes in the winter season, the values of the nebulosity of 9:10 tenths of the heavenly vault and cloudy sky completely covered critical episodes may occur in summer, when cloud cover has values 10 tenths of sky.

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Of all the components of the environment, the air is the main element for the maintenance of life, and therefore we must be careful to keep the normal limits set by environmental legislation, air quality, so that we protect the health of the population.

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