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URBAN DEVELOPMENT AND ENVIRONMENTAL IMPACT IN THE METROPOLITAN AREA OF CONSTANTA

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Abstract: The purpose of this article is to draw attention to a potential environmental effect of the Constanta Metropolitan Area's growth. In order to accomplish this goal, the proposed objectives were as follows: measuring the concentration of several environmental variables in three different locations in the Constanta Metropolitan Area as well as assessing the air quality; comparing the measurement results with the hourly records of pollutant concentrations in various locations within the area of interest; and assessing the impact of human activity on the environment. In order to conduct this research, measurements were made with an Air Quality Monitor model JSM-131 and data recorded and provided by the National Air Quality Network and uRad Monitor on hourly concentrations of some environmental parameters in the area of interest were used. Metropolitan areas, which are defined by dense populations and activity centres, can preserve environmental quality by implementing local policies that are tailored to the specific demands of the community. This necessitates identifying and continually maintaining monitoring on local environmental hazards.

Key words: *air quality, Constanta Metropolitan area, environmental impact, urban development.*

1. INTRODUCTION

We are living in a period marked by globalisation, increasing inequality and worsening environmental problems. Sustainable Development is the way forward. A solution for the sustainable development of Romania is represented by metropolitan areas, a concept regulated in Romania by law no. 351 of 6th July 2001 as “an area established by association, on the basis of voluntary partnership, between the major urban centres (the Romanian capital and the first-tier municipalities) and the urban and rural localities located in the immediate area, at distances of up to 30 km, between which cooperation relations have developed on multiple levels”.

It is now essential that the strategic development perspective goes beyond the geographical or administrative boundaries of the city and goes beyond the metropolitan area itself, in certain functional areas. Development must be understood on a much wider territory, in which there are organic links, economic or otherwise. [1] In metropolitan areas, decisions can be taken at local level that contribute to sustainable development in which preserving the quality of the environment is a primary objective.

This article aims to highlight a probable impact on the environment as a result of the development of the Constanta Metropolitan Area. In order to achieve this aim, the proposed objectives were to measure the concentration of several environmental parameters in three locations of the Constanta Metropolitan Area and to assess the air quality; to compare the results of the measurements with the hourly records of pollutant concentrations in different points of the area of interest; to assess the anthropic influence on the environmental quality.

In order to conduct this research, measurements were made with an Air Quality Monitor model JSM-131 and data recorded and provided by the National Air Quality Network and uRad Monitor on hourly concentrations of some environmental parameters in the area of interest were used.

2. SUSTAINABLE URBAN DEVELOPMENT STRATEGIES AND THE SMART CITY CONCEPT

The European Union (EU) has presented a comprehensive discourse on cities and their development in recent decades. Since the late 1990s, regular meetings between ministers responsible for urban development have led to the consolidation of an “EU perspective” on the urban problem which can be translated into an EU approach to sustainable urban development. This approach has been refined over the years as it has been

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implemented on the ground, thanks to the urban initiatives promoted by the EU under its cohesion policy and in the form of other initiatives specifically targeted at the urban dimension. [2]

Emerging and long-standing issues related to urban development (e.g. urban regeneration, urban and regional planning, shrinking cities, urban sustainability, attracting investment, urban marketing, social segregation) require the development of a strategic framework and a revolution in traditional approaches to urban policy and planning.

Sustainable Urban Development (SUD), promoted under EU cohesion policy, consistently underlines the importance of a strategic framework. A key requirement for successful European Regional Development Fund (ERDF) interventions is to ensure that individual investments are part of a long-term strategy with a strong innovative component. To effectively improve city development trajectories, strategic planning requires collective planning processes and tailored and realistic visions. [3]

2.1 Metropolitan development in Romania

The process of growth of metropolitan areas reflects the history of urbanisation processes. Industrial and technological development, forms of transport, have crucially influenced the process of development or annexation of territories around urban centres.

The implementation of metropolitan development policies shall be in line with Romania's overall development objectives and priorities, as well as with the objectives in the field of urban and regional development and economic and social cohesion assumed by Romania as a member state of the European Union. Metropolitan development policy shall be based on the principles of local autonomy, cooperation and partnership.

Evidence shows that Romania’s metropolitan areas are vital for the country's economic growth and that population fluctuations in these areas need to be closely monitored and addressed by the authorities to ensure sustainable and balanced development across the country.

2.2 General analysis of air quality in Constanta Metropolitan Area

Constanta Metropolitan Area is the first administrative structure of its kind in Romania that fits the EU administrative model, established in 2007 and includes, in addition to the municipality of Constanta (first rank municipality of national importance with potential influence at European level, the most important city in the South-East Development Region), a number of urban and rural localities located in the immediate area, within a radius of about 35 km.

The establishment of the association has opened the door to permanent cooperation between the localities that make up the metropolitan area and has created the possibility of joint implementation of projects of regional interest, using existing funds from the 2007-2013 financial year, thus contributing to reducing the existing disparities between urban and rural areas by improving living conditions and creating new jobs.

For the assessment of air pollution in Constanta, 3 automatic air quality monitoring stations have been installed (Culture House area; City Hall Park area; Prelungirea Liliacului street no. 6), as well as two other stations in Năvodari (Victoria Camp; Lazăr Edeleanu High School), which provide the public and decision makers with data and information with a degree of certainty.

The stations are equipped with analysers for sulphur dioxide, nitrogen dioxide and oxides; carbon monoxide; ozone; particulate matter (PM 10, PM 2.5,); benzene; VOCs (volatile organic compounds) and transmit results in real time. Measurements are carried out continuously and an hourly average for each quality indicator is integrated from the values obtained, which can be compared with the maximum permissible value for that range (as required by the European Union).

The monitored pollutants are those provided for in the Romanian legislation, transposed from the European one, the limit values imposed by Law 104/2011 (Law on the quality of the environment) aiming to avoid, prevent and reduce harmful effects on human health and the environment.

These pollutants have an acidifying effect on the environment due to the presence of halogen compounds that cause a series of chemical reactions in the atmosphere, leading to changes in the pH of the air, precipitation and soil.

Acid deposits affect surface water, groundwater and soil, with significant damage to lakes and fish life, forests, agriculture and animals.

Dust pollution of the atmosphere can have natural sources, such as the entrainment of particles from the ground surface by wind, or anthropogenic sources: production processes (metallurgical industry, chemical industry, etc.), energy sector burns, construction sites and road transport, industrial and municipal landfills and dumps, individual heating systems, especially those using solid fuels, etc.

For sedimentable particulate matter (PM 10; PM 2.5) exceedances are relatively frequent, caused both by pollution from traffic, industrial activities and the operation of bulk commodities, as well as desertification trends in the area.

3. THE METROPOLITAN AREA OF CONSTANTA AND THE ENVIRONMENTAL IMPACT OF THE URBAN DEVELOPMENT

The Constanta metropolitan area has experienced intense development in recent years. For the assessment of the impact of anthropogenic activities on the quality of the environment, 3 points of the metropolitan area were chosen: CET (Thermal Energy Complex)

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Constanta (44.15703°N, 28.60974°E), Năvodari, near Midia platform (44.32857°N, 28.64110°E) and Ovidiu Waterfront Park (44.25576°N, 28.57348°E). CET Constanta and Midia Platform represent two of the areas with the highest risk for air quality in Constanta municipality; Ovidiu Waterfront Park was chosen to highlight the possible influence of transport on air quality in an area considered to be a relaxing place for the population.

In these locations, from February to May 2023, 7 sets of measurements of concentrations of total volatile organic compounds (TVOC), formaldehyde, particulate matter with a diameter of 2.5 and 10 μm (PM2.5 and PM10 respectively) and carbon dioxide were carried out. Measurements were made with an Air Quality Detector model JSM-131. The results of the measurements were then compared with those provided by the Environmental Protection Agency following air quality monitoring in stations CT1 - Constanta Culture House area, CT2 - Constanta City Hall Park area and CT3 - Năvodari area.

3.1 Variation in concentration of total volatile organic compounds

The concentration of volatile organic compounds (TVOC) recorded a minimum on 5 May of 0.022 mg/m^3 at CET Constanta station and a maximum of 1.589 mg/m^3 at Midia-Năvodari station on the same day. On average, the highest TVOC concentration was calculated at Midia - Năvodari with a value of 0.78 mg/m^3, followed by Ovidiu Waterfront with a value of 0.7 mg/m^3, at CET the average value recorded for this parameter was 0.43 mg/m^3, representing 54% of the average calculated at Năvodari (Table 1).

Table 1. Statistical parameters of volatile organic compounds concentration [mg/m^3]

	CET Constanta	Năvodari - Midia	Ovidiu Waterfront
Maximum	1.292	1.589	1.429
Minimum	0.022	0.064	0.434
Average	0.430	0.785	0.700

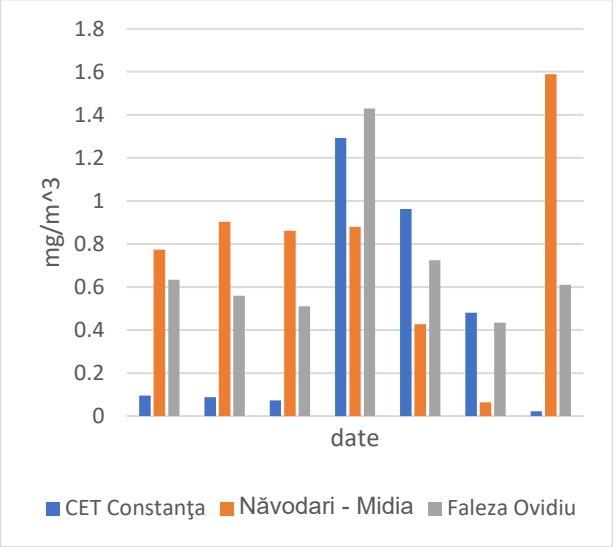

Figure 1 Variation in concentration of volatile organic compounds [mg/m^3]

In four out of the seven sets of measurements the TVOC values were higher at Midia-Năvodari station. (Figure 1).

3.2 Variation in formaldehyde concentration

Among the volatile organic compounds an important role is played by formaldehyde; it showed concentrations ranging from 0.004 mg/m^3 on 5th May to 0.67 mg/m^3 on 28th April, both values being recorded near CET Constanta. The authors calculated an average formaldehyde concentration of 0.1 mg/m^3 at the Ovidiu station, 0.11 mg/m^3 at Năvodari and 0.18 mg/m^3 at CET Constanța (Table 2).

Table 2. Statistical parameters of formaldehyde concentration [mg/m^3]

	CET Constanţa	Năvodari - Midia	Ovidiu Waterfront
Maximum	0.67	0.228	0.196
Minimum	0.004	0.01	0.054
Average	0.182	0.117	0.101

In four out of the seven sets of measurements, the levels of formaldehyde were higher at the CET station in Constanta. Similar plots of TVOC and formaldehyde values are observed for 11th and 26th March, as well as for 5th May, indicating that formaldehyde is one of the main components of TVOC (Figure 2).

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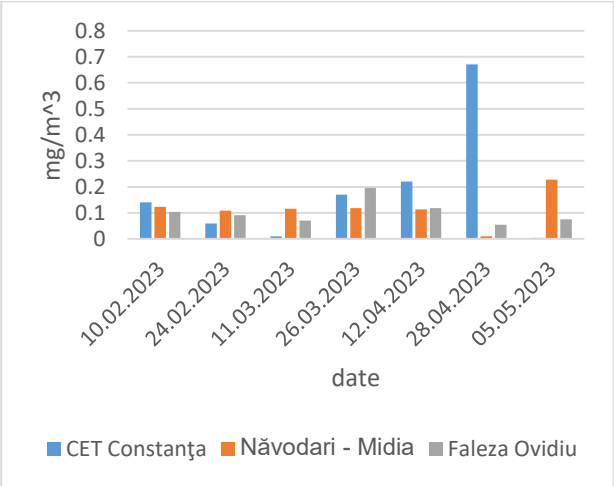

Figure 2 Variation in formaldehyde concentration [mg/m^3]

Values greater than 0.06 mg/m^3 recorded for formaldehyde exceed the odour detection threshold, those greater than 0.01 mg/m^3 exceed the eye irritation threshold and those greater than 0.1 mg/m^3 exceed the throat irritation threshold. Only the reading on 5th May 2023 at CET Constanta was lower than the threshold values mentioned above.

The highest average values of formaldehyde and TVOC were not found at the same air quality monitoring point, which allows us to assess that there is no permanent, point source of emission of volatile organic compounds.

3.3 Variation in carbon dioxide concentration

The CO_2 concentration ranged from 755 ppm recorded at CET Constanta on 5th May 2023 to 1894 ppm on 24th February 2023 also at CET. On average, the CO_2 values were 1185.43 ppm at CET Constanta, 1068.86 ppm near the Midia - Năvodari platform and 1036.57 ppm on the Ovidiu Waterfront (Table 3). The average CO_2 concentration values measured at Ovidiu Waterfront represent 87% of the average of the measurements made at CET Constanta.

In six out of the seven sets of measurements the CO_2 values were higher at the CET Constanta station (Figure 3).

Table 3. Statistical parameters of CO_2 concentration [ppm]

	CET Constanţa	Năvodari - Midia	Ovidiu Waterfront
Maximum	1894	1220	1179
Minimum	755	788	836
Average	1185.43	1068.86	1036.57

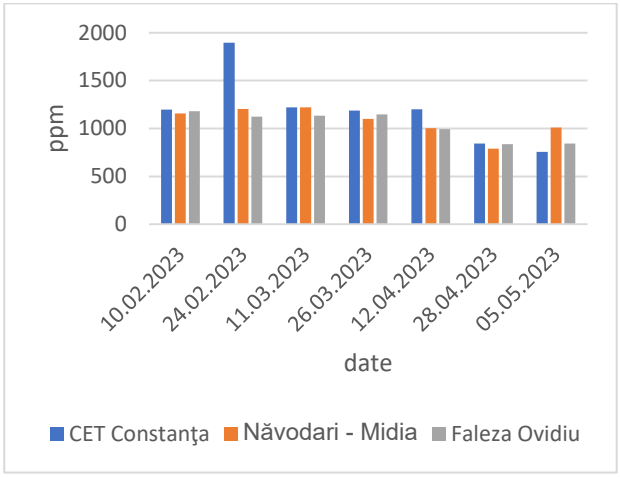

Figure 3 Variation in CO_2 concentration [ppm]

The results obtained, with the highest average value in the CET area, are plausible given that the measurements were taken at the time of year when heating was being supplied to the population. From the graphical representation it can be seen that emissions decreased in the second half of April and in the sets of measurements in May. It should be noted, however, that the CET values slightly exceed the measured CO_2 values at the other two locations and that the May results show a higher concentration in the Midia Platform area. According to the CO_2 concentration ranges and air quality classification, none of the measurements has a value belonging to the "very good" quality class (< 450 ppm CO_2); 6 out of 21 measurements classify the air in the "good" quality class, with CO_2 between 451 and 1000 ppm; 14 measurements classify the air in the "slightly polluted" range, with CO_2 concentrations between 1001 and 1500 ppm and one measurement shows the CO_2 concentration value for the polluted category (1894 ppm CO_2 at CET).

3.4 Variation in the PM2.5 concentration

The values for PM2.5 showed a minimum of 3 µg/m^3, recorded at all three stations on 28th April and 5th May, and on 26th March at CET and Midia. The highest value recorded from the measurements was 17 µg/m^3 on 11th March at Ovidiu Waterfront.

The averages at the 3 locations ranged from 6 µg/m^3 at Midia to 7.71 µg/m^3 at Ovidiu Waterfront (the average at Midia is 87% of that calculated at Ovidiu Waterfront) (Table 4).

There is a decrease of less than half of the PM2.5 concentration in the last 4 sets of measurements compared to the first measurements in February and the first half of March for each station (Figure 4).

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Table 4. Statistical parameters of PM2.5 concentration [µg/m^3]

	CET Constanţa	Năvodari - Midia	Ovidiu Waterfront
Maximum	13	10	17
Minimum	3	3	3
Average	7.14	6	7.71

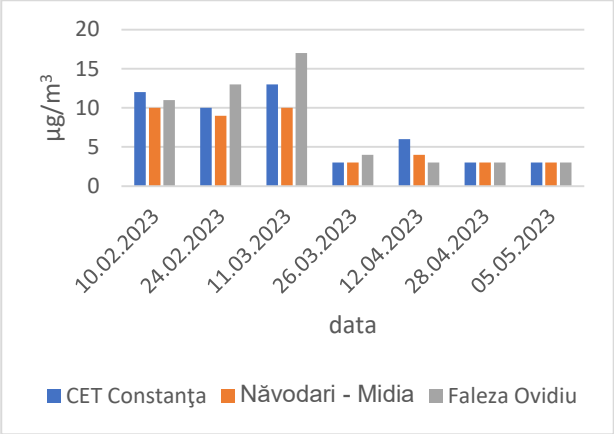

Figure 4 Variation in PM2.5 concentration [µg/m^3]

Of the values recorded with the PM2.5 portable monitor, 38% fall into the "acceptable" category, specific quality index 2, the remaining 62% into the good category, specific quality index 1 (Table 5).

The values recorded on site were compared with those provided by the air quality sensor on Aleea Nalbei, Constanța, (uRad Monitor). Thus, for 10th February the value recorded near CET of 12 µg/m^3 is close to the daily minimum recorded on Aleea Nalbei of 11 µg/m^3; on 24th February and 11th March, the values recorded with the portable monitor are higher than the values for q3 (9 µg/m^3) on Aleea Nalbei; on 26th March the value measured at CET is lower than the average values on Aleea Nalbei. For the rest of the measurements at CET the values are close to the average value recorded on those days. The highest value recorded by uRad Monitor was 39 µg/m^3 on 10th February (Table 6). The values recorded by this sensor place the air quality in the quality class "bad" for 10th February 2023, "moderate" for 24th February 2023 and 26th March 2023, "acceptable" for 11th March 2023 and 12th April 2023, "good" for 28th April 2023 and 5th May 2023.

Table 5. Variation of the air quality index for PM2.5

	CET Constanţa	Năvodari - Midia	Ovidiu Waterfront
10.02.2023	2	2	2
24.02.2023	2	1	2
11.03.2023	2	2	2
26.03.2023	1	1	1
12.04.2023	1	1	1
28.04.2023	1	1	1
05.05.2023	1	1	1

Table 6 PM2.5 variations recorded by the sensor on Aleea Nalbei, Constanta

	Min	Max	q1	q2	q3
10.02.2023	11	39	25	29	32
24.02.2023	2	21	4	7	9
11.03.2023	1	18	4	6	12
26.03.2023	0	21	1	5	10
12.04.2023	0	20	1	2	8
28.04.2023	0	9	1	2	3
05.05.2023	0	9	1	3	5

It is worth noting that the Environmental Protection Agency's sensors in Constanta did not provide data for PM2.5 on those days.

3.5 Variation in the PM10 concentration

PM10 values ranged from 3 µg/m^3 at CET Constanta on 5th May to 30 µg/m^3 on 11th March on the Ovidiu waterfront. The average values recorded in the 7 days of measurements were 12.14 µg/m^3 at CET, 9.71 µg/m^3 at Midia and 14.57 µg/m^3 on Ovidiu Cliff (Table 3.7). The average value at Midia Năvodari represents 66.67% of the average value calculated for the Ovidiu Waterfront point.

It is noted that the values recorded in the first 3 sets of measurements are 3 to 6 times higher than the values in the last 4 sets of measurements. The graphs are generally similar in the 7 sets of measurements (Figure 5).

Table 7. Statistical parameters of PM10 concentration [µg/m^3]

	CET Constanţa	Năvodari - Midia	Ovidiu Waterfront
Maximum	24	19	30
Minimum	3	4	5
Average	12.14	9.71	14.57

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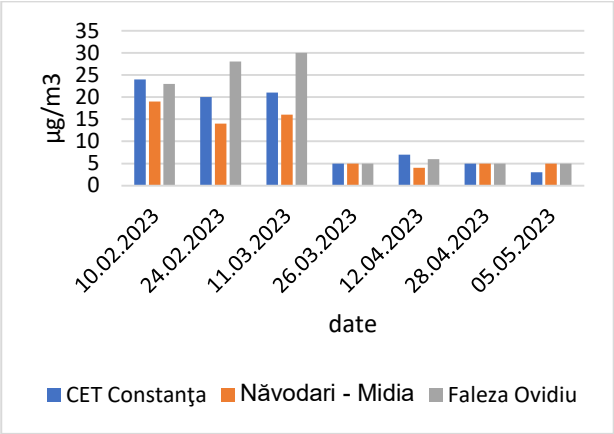

Figure 5. PM10 concentration in the measurement sets [µg/m^3]

Table 8. Variation of the air quality index for PM10

	CET Constanţa	Năvodari - Midia	Ovidiu Waterfront
10.02.2023	2	1	2
24.02.2023	2	1	2
11.03.2023	2	1	2
26.03.2023	1	1	1
12.04.2023	1	1	1
28.04.2023	1	1	1
05.05.2023	1	1	1

Of the values recorded with the handheld device for PM10, 71.4% fall into the "good" category, specific quality index 1, the remaining 28.6% into the "acceptable" category, specific quality index 2 (Table 8).

The measured values were compared with the hourly values provided by the Environmental Protection Agency from the air monitoring stations CT1 (Culture House Area) and CT2 (City Hall Park) in the city of Constanta and CT3 (Mamaia Nord - Midia) in Năvodari.

On 10th February 2023, the PM10 value measured with the air quality detector model JSM-131 at CET Constanta, 24 µg/m^3 was between the values recorded by the sensors of the Environmental Protection Agency - APM Constanta, which at the same time showed values of 28.14 µg/m^3 at the House of Culture (CT1) and 14 µg/m^3 at the Town Hall (CT2). The APM CT3 station in Năvodari recorded a value of 28,14 µg/m^3, while in Năvodari we measured 19 µg/m^3 and in Ovidiu 23 µg/m^3 (Figure 6) For the date of 10th February.2023 the hourly averages recorded by the APM sensors classify the air quality as "very bad" due to the values at CT1.

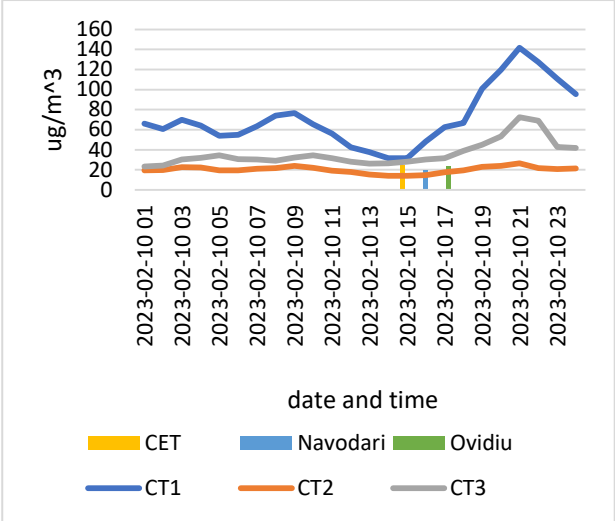

Figure 6 Hourly variation of PM10 concentration compared to measured values. 10th February 2023

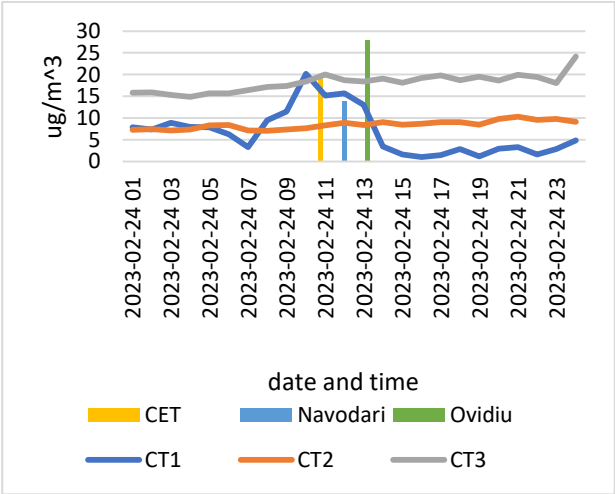

Figure 7 Hourly variation of PM10 concentration compared to measured values. 24th February 2023

The PM10 concentration value measured at CET on 24th February at 11.00 AM of 20 µg/m^3 is between the concentration values recorded at CT1 at 10.00 AM and 11.00 AM, 20.17 µg/m^3 and 15.16 µg/m^3 respectively. The APM sensor - CT2, recorded values of 8 - 9 µg/m^3 during the same period. The value measured at Năvodari at 12.00, 14 µg/m3, is below the value provided by the CT3 sensor at the same time, i.e. 18.69 µg/m^3. On Ovidiu Waterfront, at 13.00 the highest PM10 value of that day was measured, i.e. 28 µg/m^3, exceeding the maximum recorded at CT3 at 24.00 (24,13 µg/m^3) (Figure 7). For 24th February 2023 the PM10 hourly averages place the air quality in the "acceptable" quality class.

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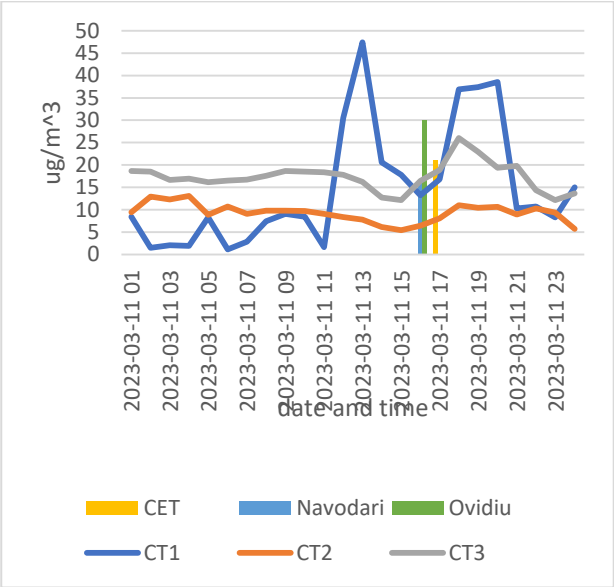

Figure 8 Hourly variation of PM10 concentration compared to measured values. 11th March 2023

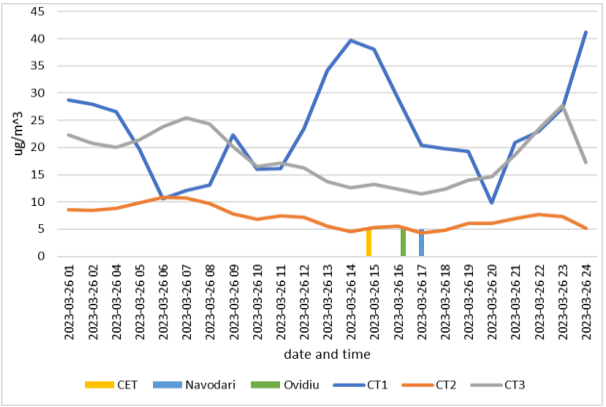

Figure 9 Hourly variation of PM10 concentration compared to measured values. 26th March 2023

On 11th March, at 16.00, at Năvodari, the measured value of 16 µg/m^3, matches the hourly average of the CT3 sensor - 16.46 µg/m^3, and at CET the value of 21 µg/m^3 at 17.00 exceeds the CT1 hourly average of 16.84 µg/m^3. Again, at Ovidiu the highest PM10 concentration was measured, i.e. 30 µg/m^3, which exceeds the hourly maximum recorded at CT3 with the value of 26.05 µg/m^3 (Figure 8). The hourly averages recorded by the APM sensors in the Constanta metropolitan area classify the air in the "moderate" quality class.

On 26th March the PM10 concentration measured in the 3 monitoring points were below those recorded by APM sensors in Constanța and Năvodari and had the same value of 5 µg/m^3. Thus, at CET the measured PM10 concentration is close to the hourly average recorded by CT2 - 5.26 µg/m^3. The values measured at Năvodari and Ovidiu Waterfront are below the hourly average of 11.45 µg/m^3 recorded at CT3 (Figure 9). The hourly averages recorded by the APM sensors place the air in the "moderate" quality class.

Values below the averages recorded by the APM sensors were also measured on 12th April 2023, except that the value on the Ovidiu waterfront at 16.00 of 6 µg/m^3 and that in Năvodari at 17.00 of 7 µg/m^3 are close to the CT3 (Năvodari) hourly averages of 7.22 µg/m^3 at 16.00 and 8.65 µg/m^3 at 17.00 respectively (Figure 10).

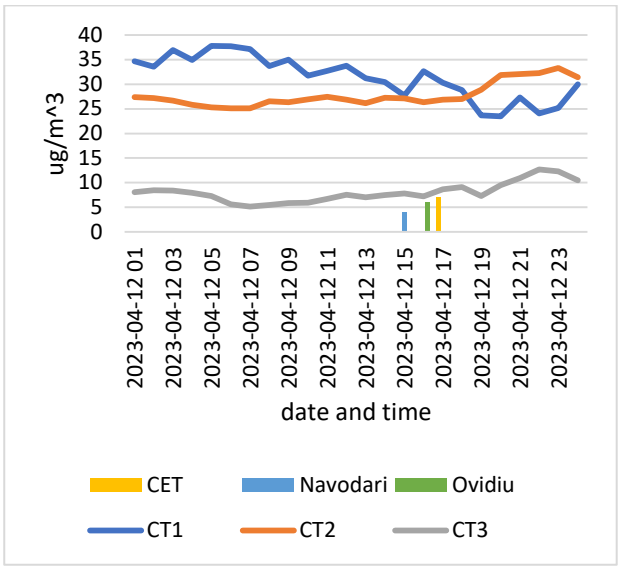

Figure 10 Hourly variation of PM10 concentration compared to measured values. 12th April 2023

Hourly averages from 12th April 2023, recorded by APM sensors in the Constanta metropolitan area, classify the air quality as "acceptable.

On 28th April 2023, the measurements taken between 17.00 and 18.00 at the three locations in the Constanta metropolitan area, had a value of 5 µg/m^3 close to the CT3 hourly average recordings of 6.36 µg/m^3 at 17.00, 7.28 µg/m^3 at 18.00 and 5.56 µg/m^3 at 19.00 respectively. The hourly averages from sensors in Constanta varied between 14.23 µg/m^3 and 21.17 µg/m^3 for CT1 and 29.66 µg/m^3 and 31.96 µg/m^3 for CT2 (Figure 11). The hourly averages recorded by APM sensors in the Constanta metropolitan area place the air in the "acceptable" quality class.

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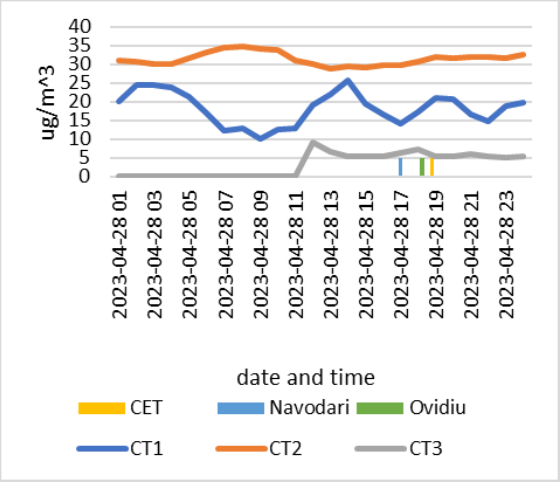

Figure 11 Hourly variation of PM10 concentration compared to measured values. 28th April 2023

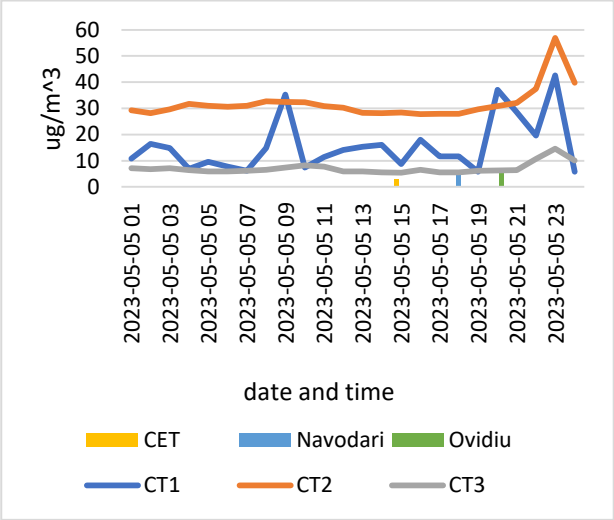

Figure 12 Hourly variation of PM10 concentration compared to measured values. 5th May 2023

A similar situation is observed on 5th May 2023, when the measured values of 3 µg/m^3 at CET and 5 µg/m^3 in Năvodari and Ovidiu Waterfront are close to the hourly averages of CT3 in Năvodari, which vary between 5.41 µg/m^3 and 6.27 µg/m^3 in the hourly interval in which the measurements with the portable monitor were carried out. The hourly average sensor values in Constanta ranged from 8.68 µg/m^3 to 37.15 µg/m^3 for CT1 and from 27.75 µg/m^3 to 32.14 µg/m^3 for CT2 (Fig. 12). On 28th April 2023, measurements taken between 17.00 and 18.00 at three locations in the Constanta metropolitan area had a value of 5 µg/m^3 close to the CT3 hourly average recordings of 6.36 µg/m^3 at 17.00, 7.28 µg/m^3 at 18.00 and 5.56 µg/m^3 at 19.00, respectively. The hourly averages from the Constanta sensors ranged from 14.23 µg/m^3 to 21.17 µg/m^3 for CT1 and from 29.66 µg/m^3 to 31.96 µg/m^3 for CT2 (Figure 12).

The hourly averages from 5th May 2023, recorded by APM sensors in the Constanta metropolitan area classify the air quality as "bad".

On completion of this study, the values measured by the portable air quality meter are found to be in the same order of magnitude as the hourly averages recorded by the APM sensors. Between the 3 points of the Constanta metropolitan area monitored with respect to air quality, no variations greater than 50% were recorded. Increased values of carbon dioxide and particulate matter during the cooler period of the year are highlighted for all 3 points where measurements were taken. The hourly average PM10 values recorded in the Constanta Culture House Area, at TC1 show, unlike the other 2 stations, evident oscillations over 24 hours, which leads to the conclusion that air quality in this area is influenced by anthropogenic activity in a much more pronounced manner. Moreover, this station is an urban traffic type station, unlike the other 2 stations: CT2 - urban background type station and CT3 - suburban background type station.

4. CONCLUSIONS

This article on the analysis of environmental quality in the Metropolitan Area of Constanta has highlighted the following aspects:

1. The concentration values of some environmental parameters obtained from measurements at 3 points in the metroplitan area, CET Constanta, Midia Năvodari and Ovidiu Waterfront, areas where the risk of impact of anthropogenic activities is higher, were classified as good, acceptable or slightly polluted.
2. In general, air quality was poorer in February - March, influenced by the exhaust from heating systems.
3. Total volatile organic compounds were recorded with the highest concentration in the Midia Năvodari area.
4. Formaldehyde and carbon dioxide showed the highest values in the CET Constanta area.
5. The highest concentration of particulate matter was recorded in the Ovidiu Waterfront area, probably under the influence of the heavy traffic nearby.
6. However, there are small differences, between 13% and 45%, in the average concentration of pollutants in the 3 monitored points.
7. The measured values are within the daily averages reported by the National Air Quality Monitoring Network and uRad Monitor.
8. The hourly oscillations of the values of environmental factors in the area of the House of Culture, provided by the National Air Quality Monitoring Network, allow the conclusion that air quality in this area is influenced by anthropogenic activity in a much more pronounced manner.

Metropolitan areas, characterised by concentrations of activities and population, can maintain a balance with environmental quality through appropriate measures taken at local level, according to the needs of the

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moment. This requires identifying and monitoring environmental risks in the area.

7. REFERENCES

[1] https://romania.europalibera.org/a/recensamant-zone-metropolitane/32216054.html

[2] Fioretti, C., Pertoldi, M., Busti, M. and Van Heerden, S. editor(s),2020, *Handbook of Sustainable Urban Development Strategies*, EUR 29990 EN 30285 EN (Exec Summ), Publications Office of the European Union, Luxembourg

[3] European Commission (EC), Directorate-General for Regional and Urban Policy, *Cities of tomorrow. Challenges, visions, ways forward*, Brussels, 2011

[4] Ghita S., Hnatiuc M., 2018, *Studies concerning flora from different protected areas in Constanta county by applying ecological and statistical methods*, Journal of Marine Technology and Environment, vol.1, pp 23-28, Nautica publishing House, Constanta, Romania.

[5] Nichita E., Panaitescu M., Panaitescu F.V., 2016, *Data of pollution on surface water and groundwater*, Journal of Marine Technology and Environment, vol.2, pp 39-42, Nautica publishing House, Constanta, Romania.