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CURRENT URBAN CO_2 CONCENTRATION IN DIFFERENT PLACES IN CLUJ-NAPOCA TOWN

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ABSTRACT. CO_2 enrichment in the atmosphere through quantify of urban emissions remains a challenge. It is a directly links between urban CO_2, CO_2 emission in the cities and the urban form, functions, and climate. Has been measured the current CO_2 concentration in two different important road nodes connected by an important road artery; one located at a higher altitude–Zorilor-Calea Turzii and the other at low altitude Cipariu-Calea Turzii. Also, current urban CO_2 concentration on different road in Cluj-Napoca town is presented. Following the idea of low carbon city, such relationship have important implication in re-organization of cities, modeling of activities, technologies, setting the direction on certain major road or bypass road. The measurement has happened between June-July 2019. Additionally the correlation with number and type of autos was done. With this study we try to create a better understanding on implication of the spatial form in low carbon urban development.

Key words: *urban CO_2, emission CO_2, low carbon, CO_2 monitoring*

AIMS AND BACKGROUND

At the urban scale, the sources of CO_2 can be attributed to the combustion of fossil fuels for heating, ventilation, and air conditioning (HVAC), transportation, industrial processes and power generation (Kennedy et al., 2009; Mitchell et al., 2018) along with biological sources, namely soil, plant and human respiration; CO_2 is also taken up by photosynthesis.

Air pollutant emission from transport are a main contributor to air quality problems in Europe and not only, (California Clean Air, EPA Doket, NHTSA.Docket 2016; EEA Report 2018).

Emission of particulate matter (PM), nitrogen oxides (NOx) unburnt hydrocarbons (HC) and carbon monoxide (CO) are regulated in the EU. In 2016, road transport contributed nearly 21% of the EU's total emission of carbon dioxide –the main greenhouse gas. On 17 April 2019, the European Parliament and the Council adopted Regulation (EU) 2019/631 setting new CO_2 emission standards for cars and vans. The new regulation will apply from 1 January 2020. EU legislation requires Member States to ensure that relevant information is provided to consumers, including label showing a car's fuel efficiency and CO_2 emissions.

EXPERIMENTAL

Telaire 7001 CO_2 Monitor has been used to measure the all (CO_2) concentrations. At the same time the temperature of air, humidity and wind rate have been registered. All these parameters were necessary to estimate the air quality into the town (Haiduc et al., 2005; Beldean-Galea et al., 2007[a,b]).

Procedure: Monitoring of CO_2 concentration was done in the morning and after the lunch, in the same day, in different road nodes, but also in other different days at the same time. In the end, the average for each point was done and the value up to limit accepted was represented.

Google map and Google Earth program were necessary for placing the measurement point on the map. Statistical program used was excel and origin 7.0.

RESULTS AND DISCUSSIONS

The values recorded on the same day for two important roundabouts in Cluj-Napoca: Cipariu and Zorilor, we can say that a lower temperature, while higher humidity influences the atmospheric concentration of CO_2. Thus relating to a value of 500 ppm limit, the excess is an increase of about 7.8% for values in the Cipariu roundabout (table 1) and figure 1.

Table 1. *Temperature, humidity, atmospheric pressure and CO2 concentrations recorded on the same day in two major roundabouts in Cluj-Napoca, Zorilor and Cipariu*

Date	Temperature (°C)	Humidity (%)	Atmospheric pressure (mb)	Wind (Km/h)	CO_2 concentrations (ppm)
28.06.2019 At noon, Zorilor	25.5	64	1015	15	483
28.06.2019 In the morning, Cipariu	23.9	68	1015	15	539

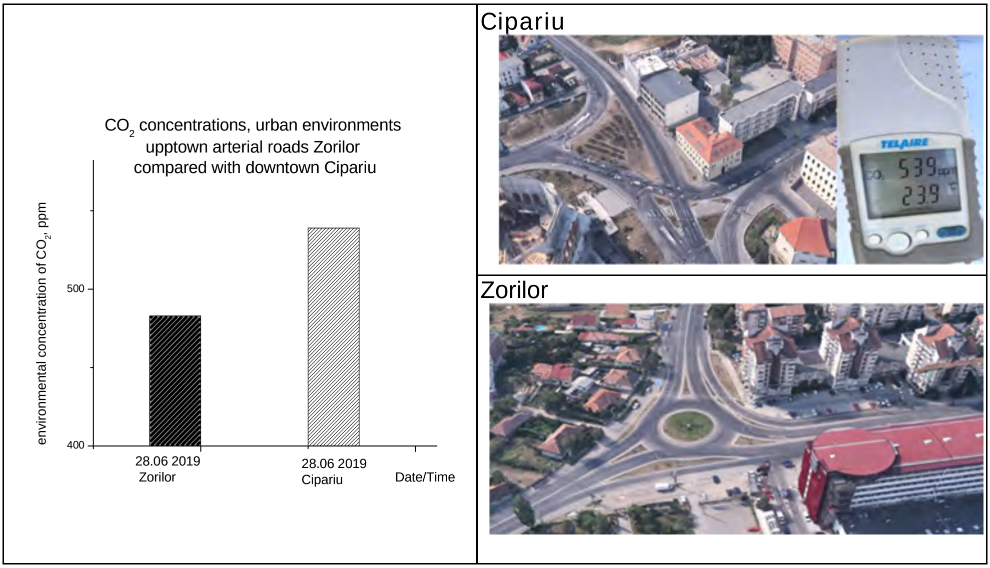


Fig. 1. *Monitoring CO_2 concentration in Cipariu Square roundabout, up to Calea Turzii street, Cluj-Napoca and Zorilor roundabout, near UTCN*

When CO_2 concentration measurement was performed in the same roundabout – Zorilor, at noon, on two different days - late June and early July, even with some difference of about 7.8°C temperature, 6% of humidity and 6 mb pressure, obtained values were less the reference numeral 500 ppm (table 2, figure 2).

CO_2 concentration measurements were made again in the same day, within a range of 3 hours around noon on different roads. It is worth mentioning the fact that the measurements were recorded in the car with the windows open. Even so, all the values were 500 ppm under the mark (figure 3).

Table 2. *Temperature, humidity, atmospheric pressure and concentrations of CO_2 recorded on two different days, at noon on the Zorilor roundabout*

Date	Temperature (ºC)	Humidity (%)	Atmospheric pressure (mb)	Wind (Km/h)	CO_2 concentrations (ppm)
28.06.2019 At noon, Zorilor	25.5	64	1015	15	483
01.07.2019 At noon, Zorilor	33.3	50	1021	8	477

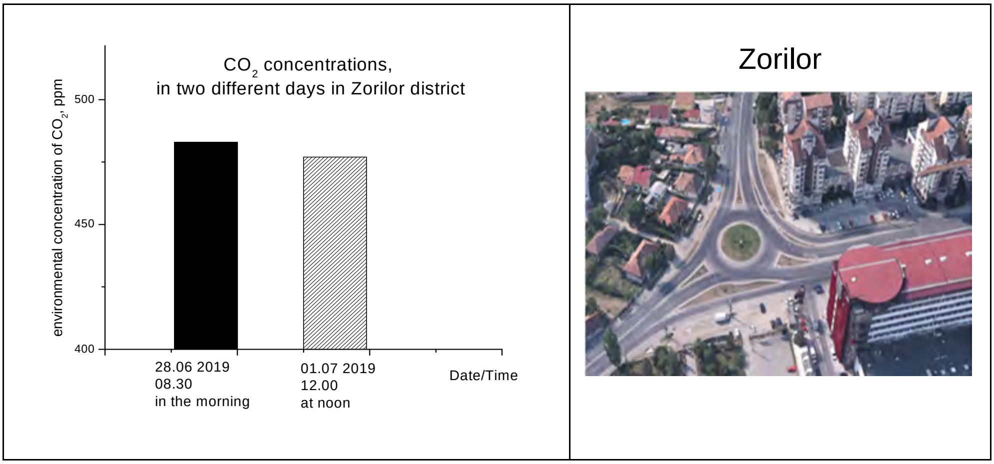
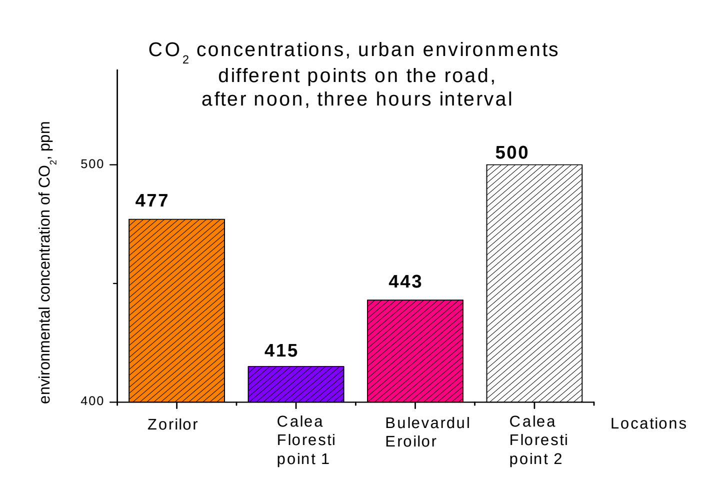


Fig. 2. *CO_2 measurement in UTC Zorilor roundabout (morning and noon)*

The highest concentrations of CO_2's, was also seen in the afternoon, in downtown, near crosswalks.

Map and figure 4 presents suggestive locations and magnitude recorded on hot-spots. The surplus was observed between 55.8% and were within 2%.

Measurement of CO_2 corresponds to monitoring of air quality and the final target is the reduction of greenhouse gases. Estimating weight also means polluting sources to quantify CO_2 emissions from fossil sources, customized by region. The CO_2 in the atmosphere corresponds to the exchange of CO_2 between tanks. If CO_2 is absorbed by plants during photosynthesis is greatest during periods of plant growth, his release back into the atmosphere will be even greater as amplitudidea process of breathing will be higher (includes both the processes of decay, rotting matter wood and the breathing metabolic



Obsevation: There were no significant differences recorded in different locations on main arteries in Cluj.

Fig. 3. *CO_2 concentration in different places in city, when the measurement has been made from the inside of car while driving*

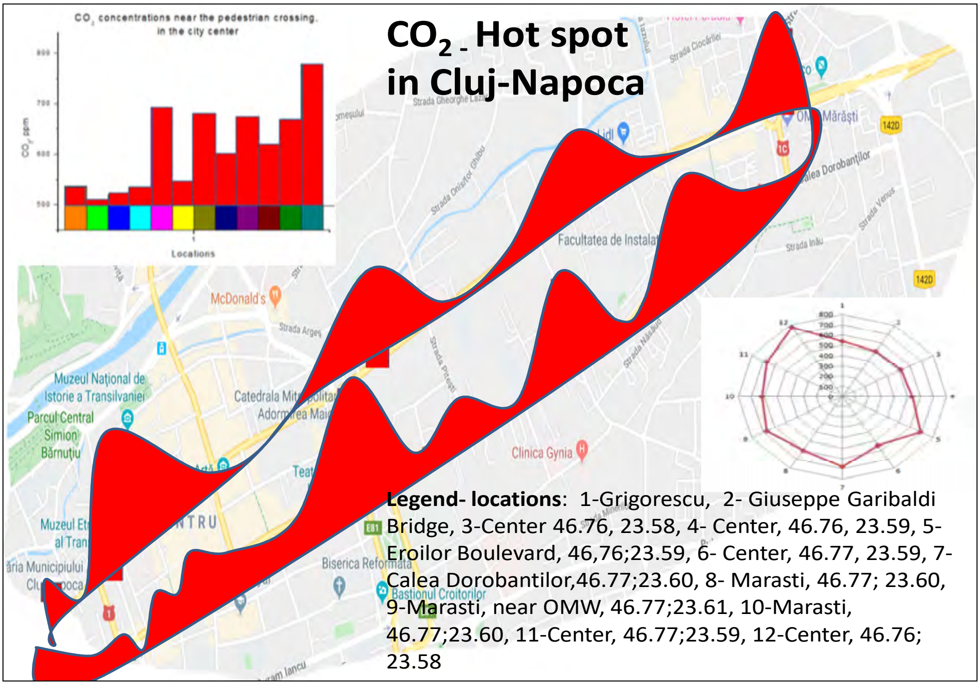


Fig. 4. *CO_2 - Hot spot in Cluj-Napoca*

green plants. CT 2017 version Carnegie-Ames Stanford Approach (CASA) calculates flows global carbon equivalent CO_2 stream, taking into account climate models coordinated by biophysical processes and difference normalized index of vegetation NDVI - based on satellite observations. Net primary production, NPP and heterotrophic respiration, RH, will thus be simulated for each cell in terrestrial broadcast, which is a difference between charges with NPP photosynthetic carbon (coarse primary - Production GPP) and carbon released by same plant due to “maintain breathing” or just breathing autotrophic $R_{A.}$

The difference between Net primary production, NPP and carbon released CO_2 R_H characterized net exchange of an ecosystem, NEE.

CarbonTracker CT2017 CT 2017 also takes into account emissions from fossil fuels, taking into account both the diurnal variability and weekly variability time (Gately and Hutyra, 2017; 2018).

Considering the low vegetation existing downtown, figure 4, according to image taken from Google Earth, one can conclude that in that short measure when weather changes were insignificant surpluses recorded were due to strict emissions from transport.

CONCLUSIONS

The registered values in Cluj-Napoca center, near the road nodes was up to 500 ppm, considered the normal value limit. All these suggested the used terms of urban thermal island or urban hot spots. Time analysis of these emissions associated with changing transport patterns could influence urbanization process thus favoring suburban development areas. A solution of hot spots should be recorded and the construction of a metropolitan belt.

REFERENCES

Beldean-Galea M.S., Anton M., Haiduc I., Ristoiu D., 2007[a], Masurarea gazelor de esapament intr-o intersectie din municipiul Cluj-Napoca. *Environment & Progress*, **10**, pp. 53-57.

Beldean-Galea M.S., Anton M., Roba C., Haiduc I., 2007[b], Variatia diurna a emisiilor de gaze de esapament intr-o intersectie din municipiul Cluj-Napoca. *Environment & Progress*, 11, pp. 38-42.

California Clean Air Act Waiver, Available at https://www.epa.gov/regulations-emissions-vehicles-and-engines/california-greenhouse-gas-waiver-request, accessed on 2020 June 11.

EPA Doket, Available at https://www.epa.gov/dockets, accessed on 2020 June 11.

EEA Report No 13, 2018, *Electric vehicles from life cycle and circular economy perspectives*, TERM 2018: Transport and Environment Reporting Mechanism (TERM) report.

Gately C.K., Hutyra L.R., 2017, Large uncertainties in urban-scale carbon emissions. *Journal of Geophysical Research: Atmospheres*, **122** (11), pp. 242–260.

Gately C., Hutyra L.R., 2018, CMS: *CO_2 Emissions from Fossil Fuels Combustion*, ACES Inventory for Northeastern USA. ORNL DAAC, Oak Ridge, Tennessee, USA. Available at https://doi.org/10.3334/ORNLDAAC/1501, accessed on 2020 June 11.

Haiduc I., Roba C., Boboş L., Oltean A., 2005, Poluanţii aerului rezultaţi din traficul clujean*. Environment & Progress,* **4**, pp. 201-206.

Kennedy C., Steinberger J., Gason B., Hansen Y., Hillman T., Havranck M., Pataki D., Phdungsilp A., et al., 2009, Greenhouse gas emissions from global cities. *Environmental Science and Technology*, **43**, pp. 7297–7302.

Lopez-Coto I., Ghosh S., Prasad K., Whetstone J., 2017, Tower-based greenhouse gas measurement network design, The National Institute of Standards and Technology North East Corridor Testbed. *Adv. Atmos. Sci.,* **34**, pp. 1095–1105.

Mitchell L.E., Lin J.C., Bowling D.R., Pataki D.E., Strong C., Schauer A.J., Bares R., Bush S.E., Stephens B.B., Mendoza D., Mallia D., Holland L., Gurney K.R., Ehleringer J.R., 2018, Long-term urban carbon dioxide observations reveal spatial and temporal dynamics related to urban characteristics and growth. *PNAS*, **115** (12), pp. 2912–2917.

NHTSA.Docket, Available at https://www.napt.org/files/NHTSA%20DOCKET%20NO_%20NHTSA-2016-0121-Final.pdf, accessed on 2020 June 11.