Current urban CO_2 concentration in different places in Cluj-Napoca town

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Abstract. CO_2 enrichment in the atmosphere through quantification of urban emissions remains a challenge. It is a directly link between urban CO_2, CO_2 emission in the cities and the urban form, functions, and climate. The current CO_2 concentration has been measured 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 roads in Cluj Napoca town is presented. Following the idea of low carbon city, such relationship has 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 and July 2019. Additionally the correlation with number and type of motor vehicles 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, atmosphere.

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 (EEA 2018; Gately & Hutyra 2018; California Clean Air Act Waiver), along with biological sources, namely soil, plant and human respiration; CO_2 is also taken up by photosynthesis (Kennedy et al 2009).

Air pollutant emission from transport are the main contributor to air quality problems in Europe (NHTSA Docket 2016; EPA Doket). 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 CO2 emissions.

Material and Method. The current CO_2 concentration has been measured 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 roads in Cluj Napoca town is presented. The measurement were made between June and July 2019. Telaire 7001 CO_2 Monitor has been used to measure 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.

Monitoring of CO_2 concentration was done in the morning and after the lunch, in the same day, in different road nodes. In the end, the average for each point was done and the value up to limit accepted was represented (Haiduc et al 2005; Beldean-Galea et al 2007a, 2007b).

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

Results and Discussion. The values recorded on the same day for two important roundabouts in Cluj-Napoca: Cipariu and Zorilor. Wwe can say that a lower temperature and a higher humidity influence 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 (Figure 1, Table 1).

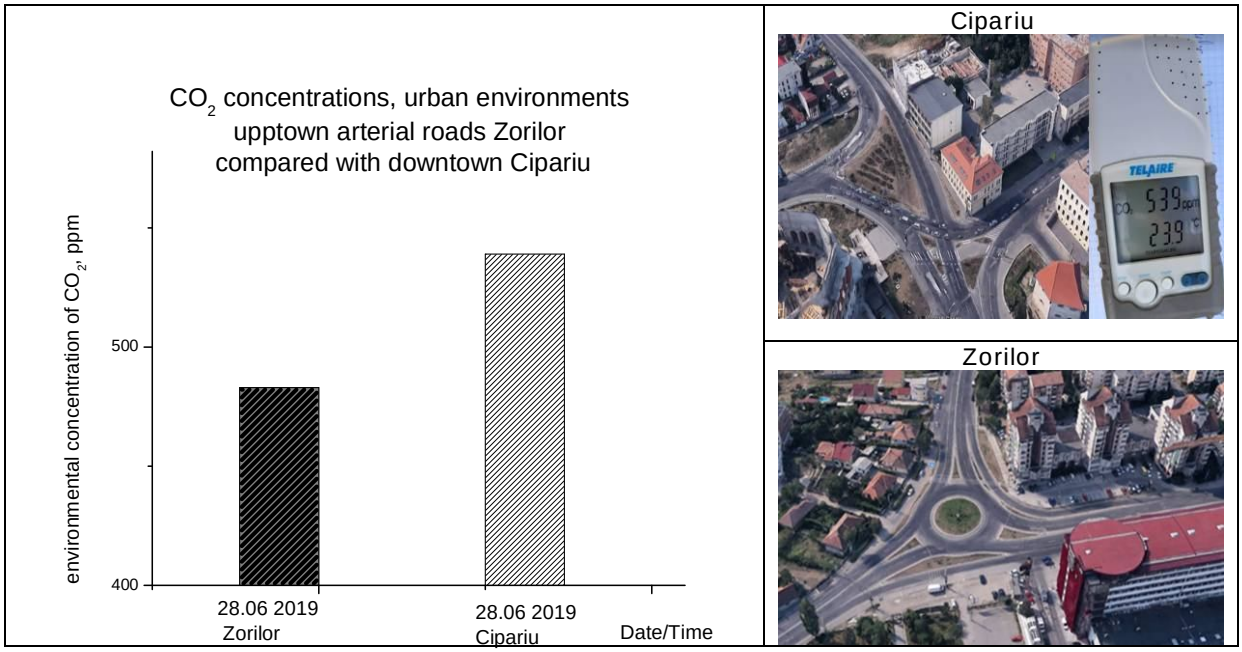


Figure 1. Monitoring CO_2 concentration in Cipariu Square roundabout, up to Calea Turzii street, Cluj-Napoca and Zorilor roundabout, near UTCN.

Table 1

Temperature, humidity, atmospheric pressure and CO_2 concentrations recorded on the same day in two major roundabouts in Cluj-Napoca, Zorilor and Cipariu

Date	*Temperature (^oC)*	*Humidity (%)*	*Atmospheric pressure (mb)*	*Wind, (Km/h)*	*CO_2 concentration (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

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 (Figure 2, Table 2).

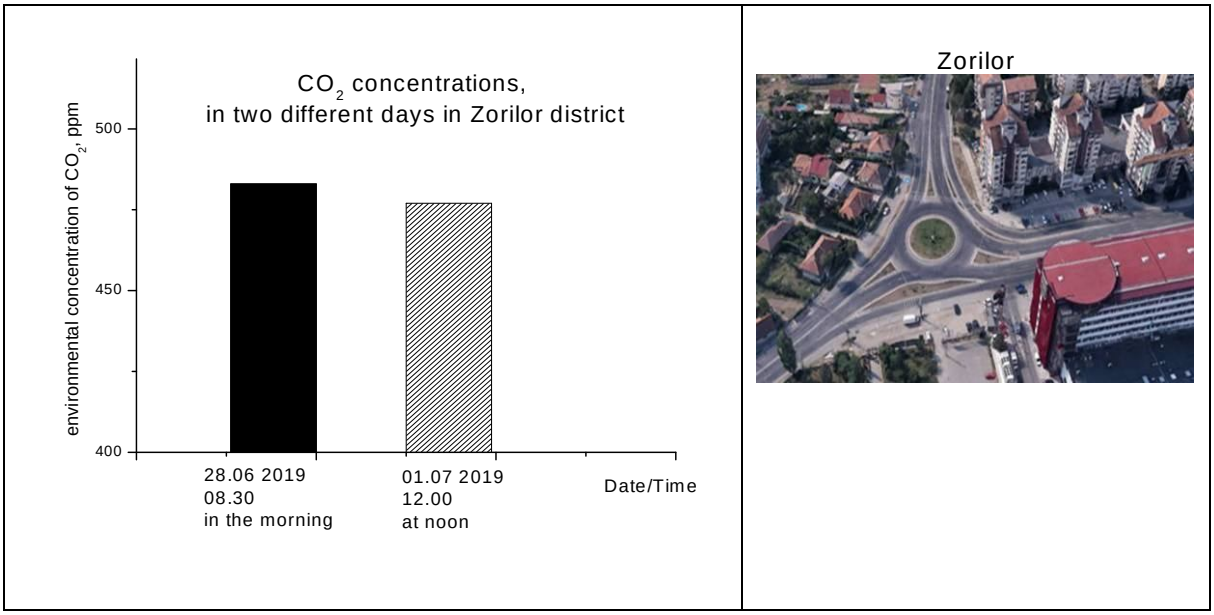
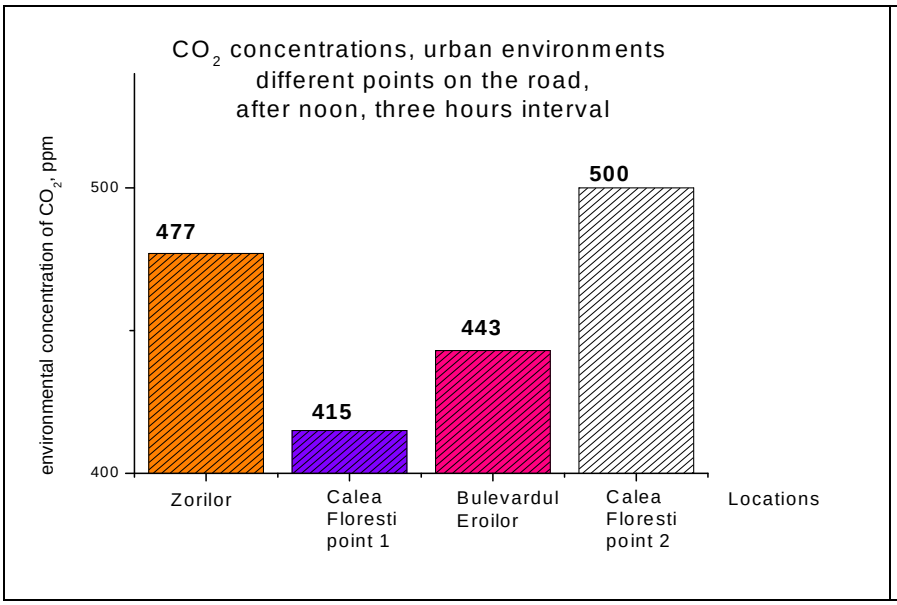


Figure 2. CO_2 measurement in UTC Zorilor roundabout (morning and noon).

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 concentration (ppm)*
28.06.2019 At noon, Zorilor	25.5	64	1015	15	483
28.06 2019 In the morning, Cipariu	33.3	50	1021	8	477

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).



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

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

The highest concentration of CO_2' was also seen in the afternoon, in downtown, near crosswalks. 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, its release back into the atmosphere will be even greater as amplitude of breathing process will be higher (includes both the processes of decay, rotting matter wood and the breathing metabolic 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, R_H, 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.

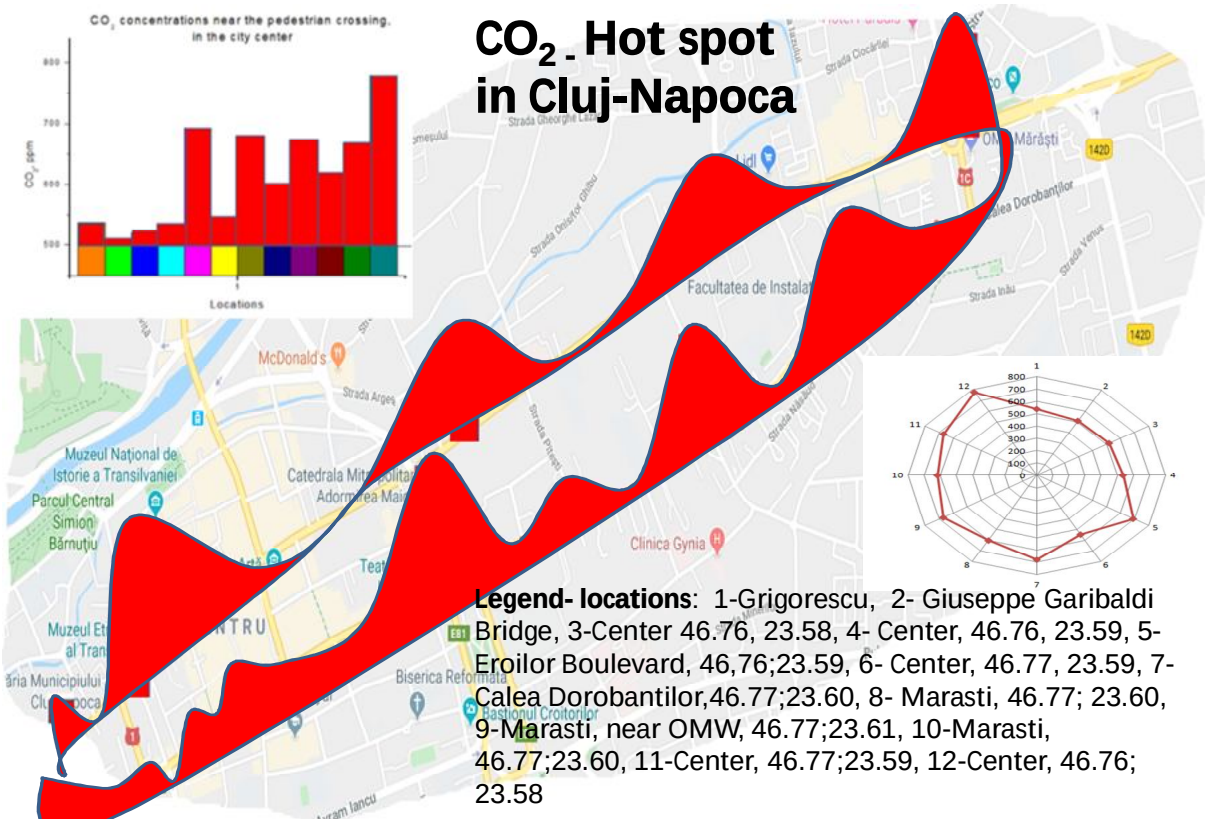


Figure 4. CO_2 hot spots in Cluj-Napoca.

The difference between Net primary production, NPP and carbon released CO_2 R_H characterized net exchange of an ecosystem, NEE. Carbon Tracker CT2017 CT 2017 also takes into account emissions from fossil fuels, taking into account both the diurnal variability and weekly variability time. Considering the low vegetation existing downtown, Figure 4, according to papers 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.

Considering the existence of poor vegetation in downtown, Figure 4, according to taken map 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.

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Received: 21 August 2019. Accepted: 12 September 2019. Published online: 30 October 2019.
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How to cite this article:
Cenan A., 2019 Current urban CO_2 concentration in different places in Cluj-Napoca town. Ecoterra 16(3):1-5.