Monitoring and protection of the Marmont Alley

Primary School Dubovac Karlovac

Snježana Marković - Zoraja
Biology and Chemistry teacher,
teacher advisor

Kristina Fratrović
Math and ICT engineer,
teacher special advisor

The research question

- Marmont Alley is a plane tree alley near the Primary School Dubovac

- Planted from 1809. to 1811. (Karlovac - Dubovac, Grobničko Polje, Rijeka) during the construction of the Louisiana Road (Karlovac – Rijeka)

- In Karlovac the road begins with the plane tree line, named in the honour of the Marshal Marmont (1774. – 1852.) from the Napoleon Bonapartes time

- The alley is a monument of park architecture from 1968.

In June 2019 the construction work had began on the national road D6 which begins with the Marmont Alley in Karlovac and concerns the community about possible tree damage.

Research questions:

What is the importance of the Marmont Alley for Dubovac and the city of Karlovac in the carbon cycle?

How much CO_2 is absorbed during the life of trees and what is the amount of carbon stored in trees?

What is the amount of gas pollution?

Are the values of harmfull gases higher when the air humidity is higher?

Hypotheses

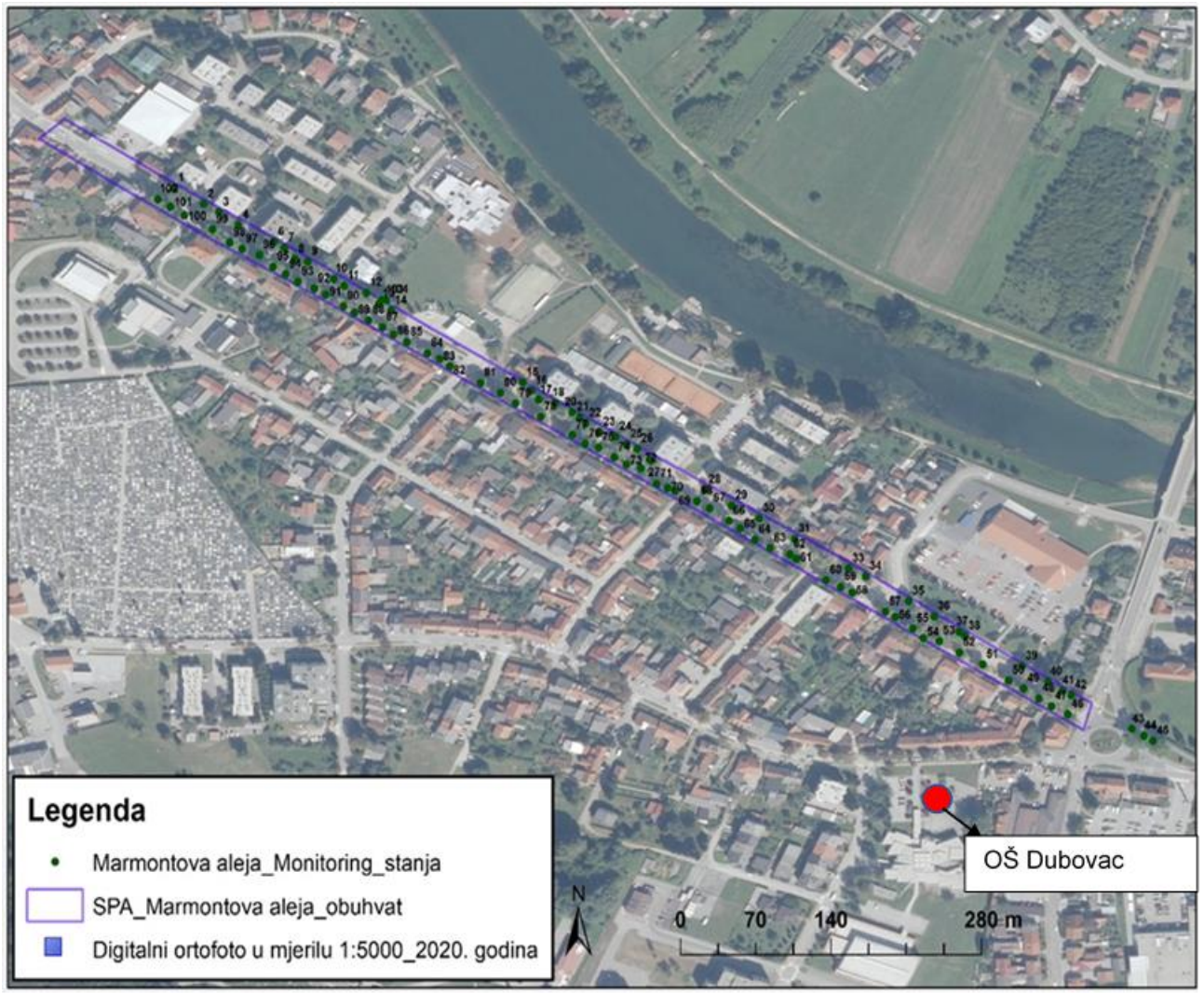
- Marmont Allley is an important factor in the carbon cycle, in the city of Karlovac and city's district Dubovac because the plane trees have absorbed large amounts of carbon during their existence

- Air humidity has an impact on the amount of gasses

- The amount of gas pollutants is higher in the period without vegetation and in higher air humidity

Research methods

Research period: January 2022. – December 2023.
Total number of trees in the alley : 102



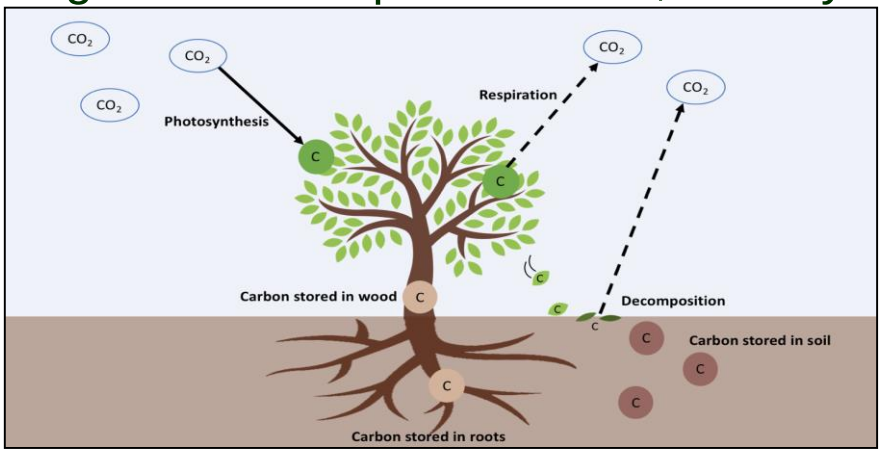
1. GLOBE protocols:

- location determination - GLOBE Observer App
- tree height - GLOBE Observer App
- tree circumference - measuring tape
- atmospheric station GLOBE: air humidity, air temperature, precipitation

2. Calculation of stored carbon and absorbed CO_2

Tree age = tree circumference / 1 year growth

1 year growth of the plane tree: 2,75 cm/year



fresh mass (green weight-GW) in kg

$GW = 0{,}0346 * d^2 * h$ (if the d> 28 cm)

or $GW = 0{,}0577 * d^2 * h$ (if the d< 28 cm)

dry mass (dry weight -DW) = GW / 2

amount of absorbed carbon (Carbon storage) = DW / 2

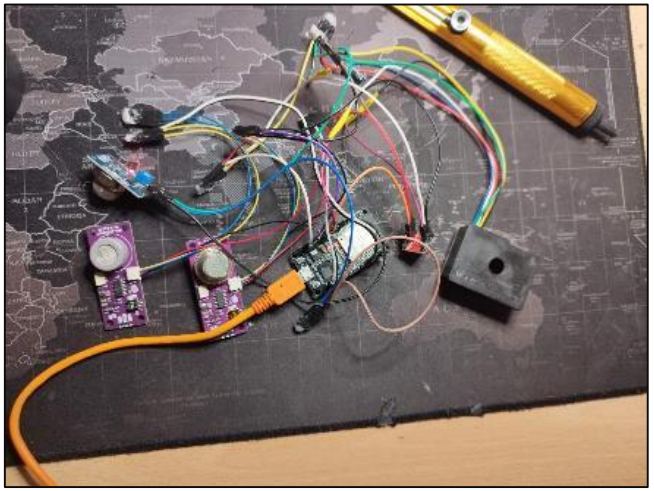
absorbed CO_2 in the lifetime of a three = Carbon storage * 3,67

because $Mr(CO_2) / Ar(C) = 3{,}67$

chest diameter of a tree in cm = tree circumference / π

3. meteo station_1 Arduino with sensor MQ135 (CO_2, NH_3, smoke, other gasses)

- The students (electronic and IT group) made a station which measures harmfull gases in **September 2022.**
- The station is located in the Marmont Alley
- The station was connected to the server via wi-fi.

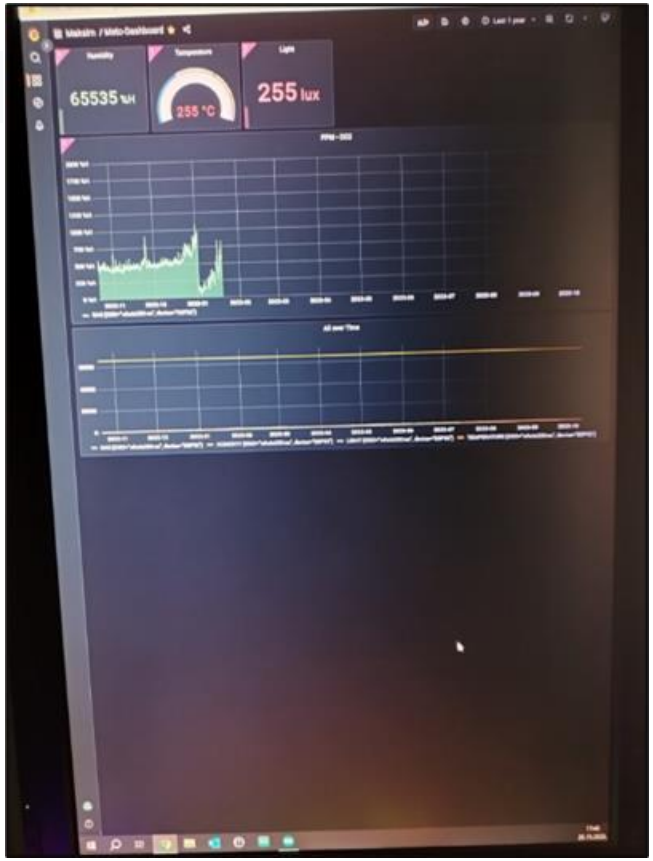


4. meteo station_2 Arduino with separate sensor

Ozone senzor- MQ131
CO senzor – MQ 7

- The students (electronic and IT group) made a new station in **October 2023.**

(in cooperation with a high school student – electrical engineering)



- The station is located in the Marmont Alley

- The station was connected to the server via wi-fi.

RESULTS

Measured for 102 plane trees.

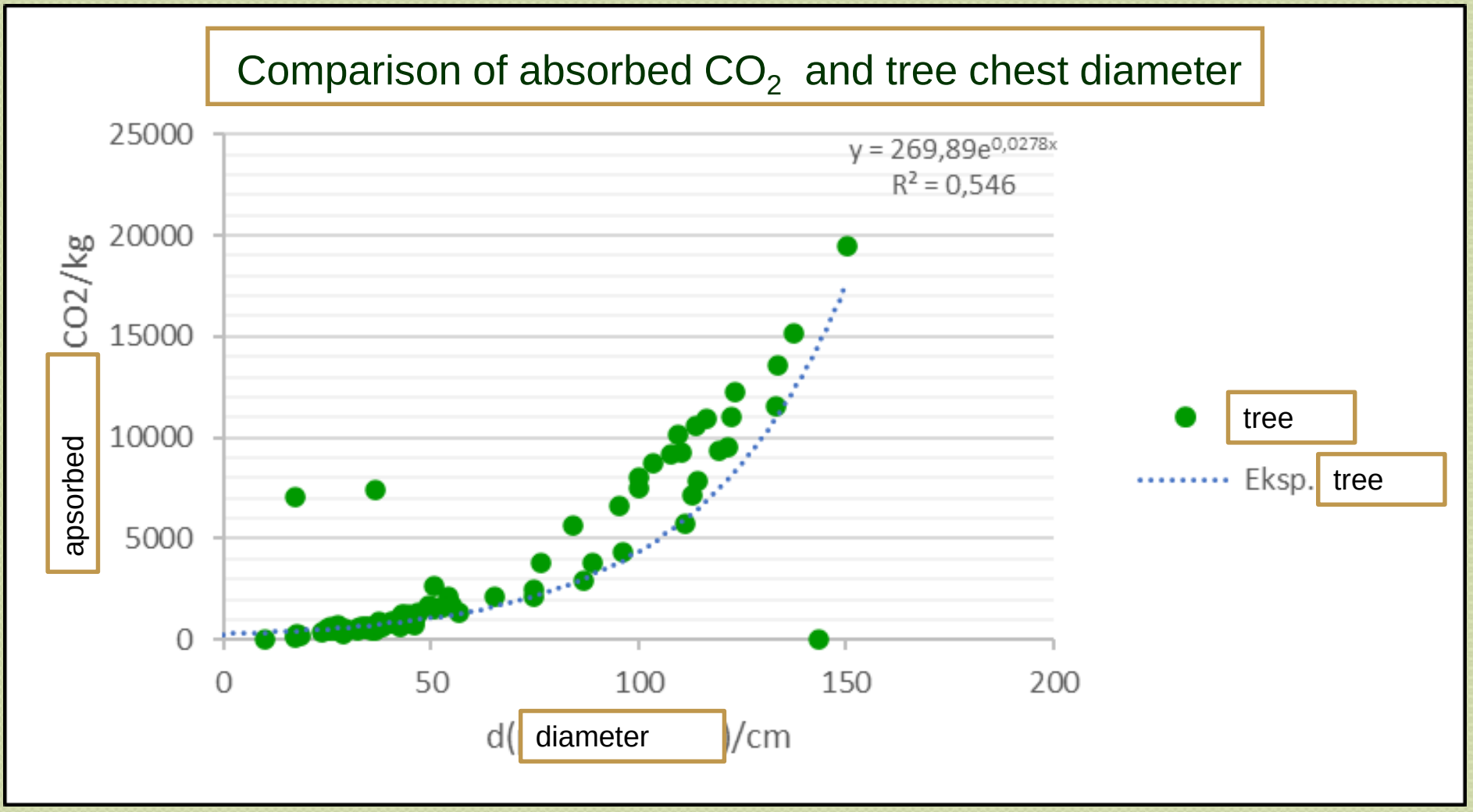
Average tree height: 17,48 meters
Average tree age: 67,23 years

Total mass of a green weight (GW) = 333132 kg
Total dry mass (DW) = 256565 kg
Total mass of carbon storage = 85097 kg
Total mass of stored CO_2 = 297589 kg

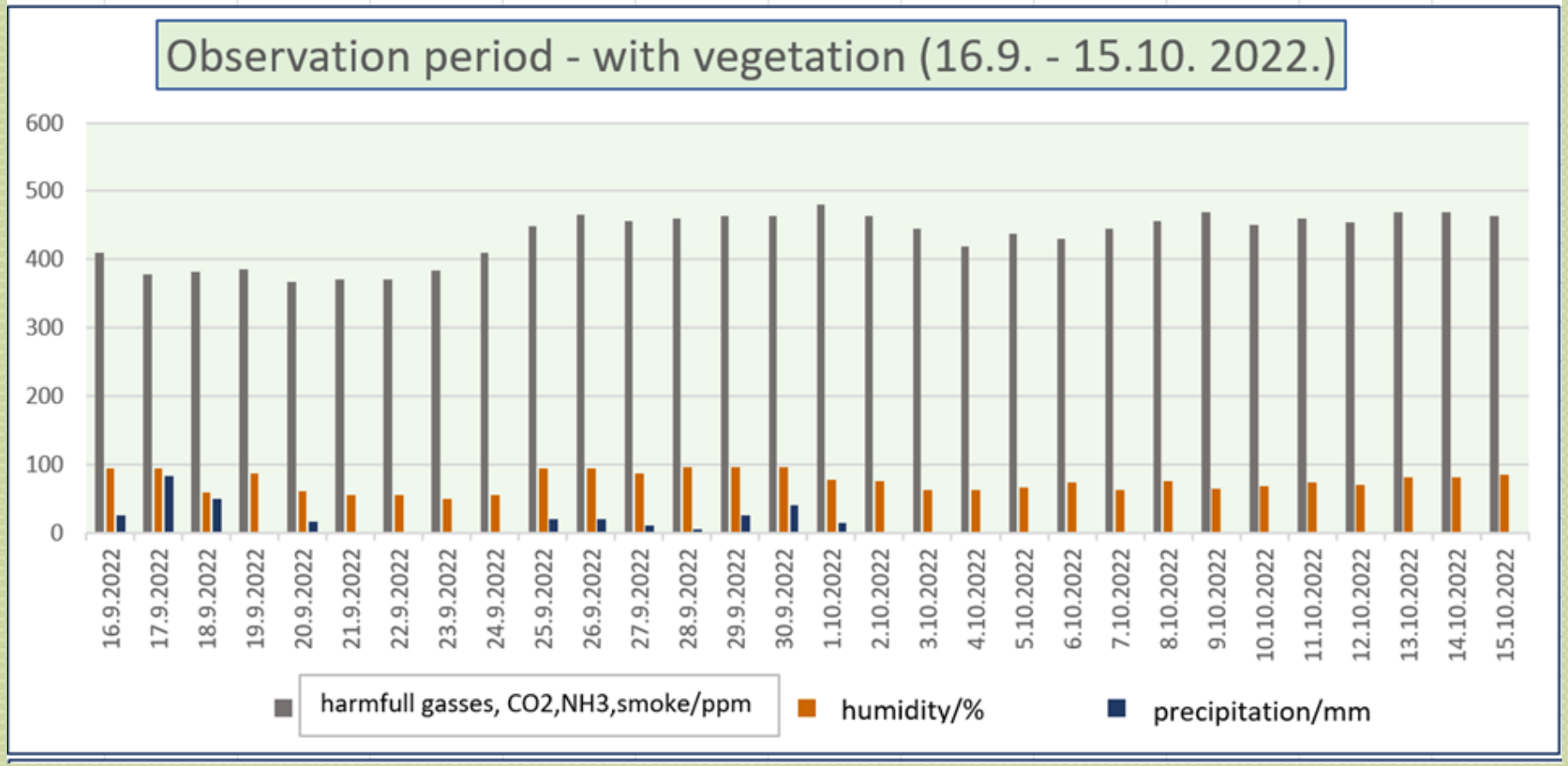
Comparison of three trees of different ages and sizes with the amount of GW, DW, carbon storage and absorbed CO_2

Mark of tree	Age of tree/Years	circumference/cm	dimeter/cm	Tree height/m	GW(green weight)/kg	DW (dry weight)/kg	Carbon storage/kg	Apsorbed CO_2/kg
S11	37,8	104	33,1	18,67	708,64	354,32	177,16	650,18
S17	61,8	170	54,11	22,91	2323,48	1161,74	580,87	2131,8
S57	152,7	420	133,7	23,92	14807,32	7403,66	3701,83	13585

Amount of absorbed CO_2 for all plane trees in the street (102)



Comparison of air humidity (%), amount of gasses (ppm) and precipitation (mm) Meteo 1.



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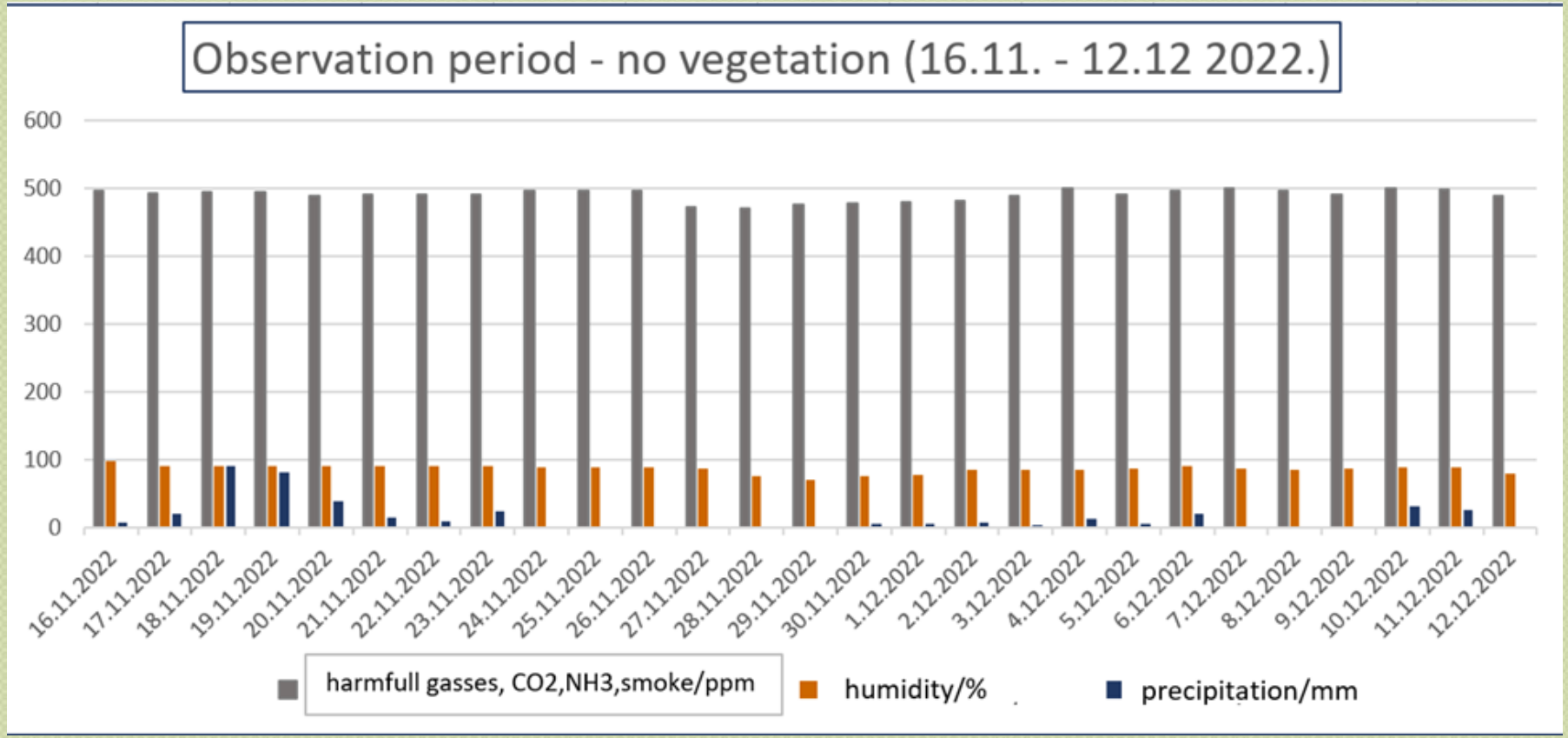
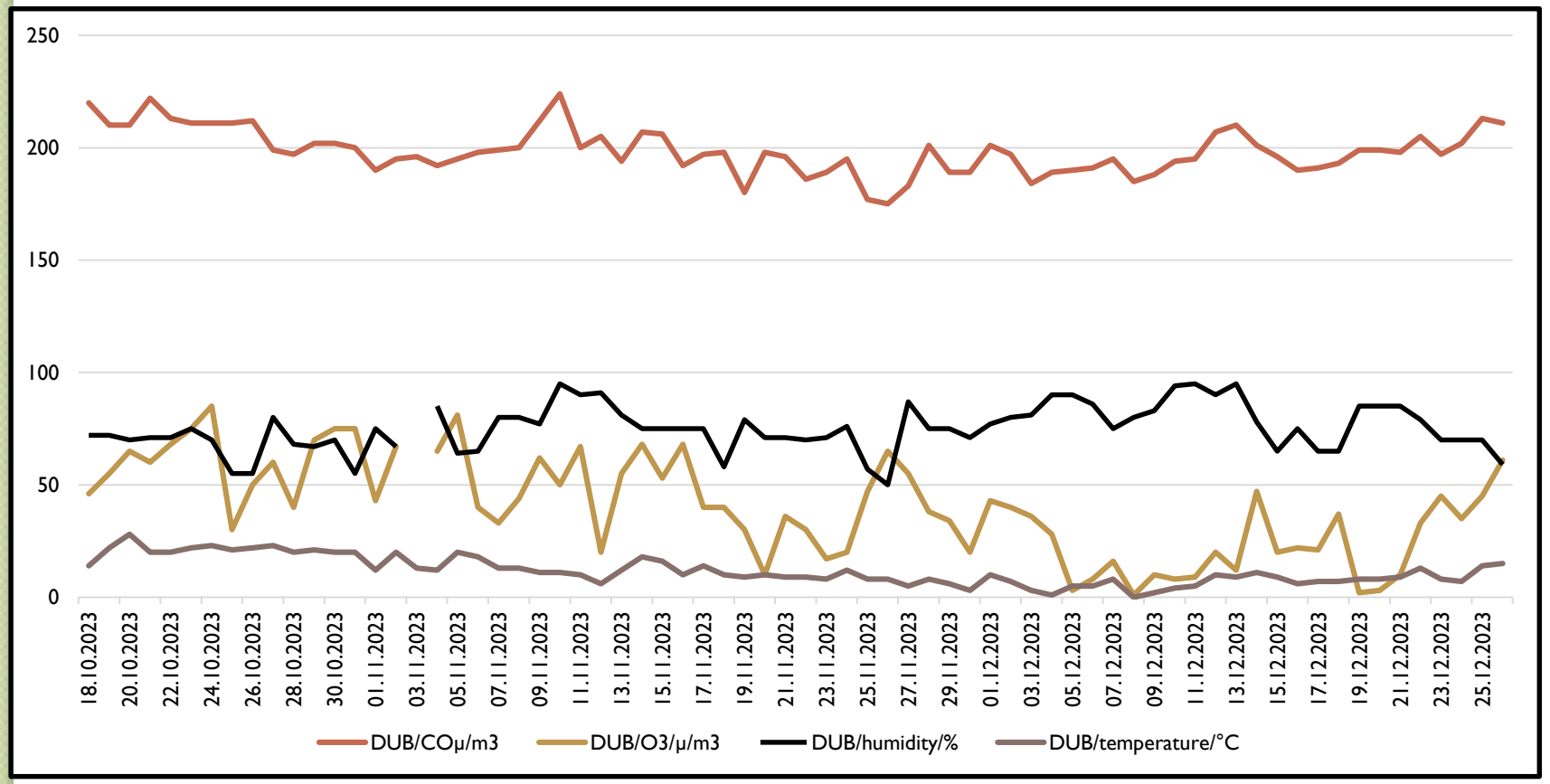


Comparison of air humidity (%), temperature (°C) with O_3 and CO (µ/m3) October - December 2023. - Meteo 2.



Conclusions

- Plane trees have absorbed more than 200 tons of CO_2 during their existence and they contain more than 80 t of carbon storage thus removing that amount of carbon from the atmosphere
- The amount of CO_2, NH_3, smoke and other gasses is higher when air humidity is higher
- The amount of CO_2, NH_3, smoke and other gasses is higher in the period without vegetation
- As air temperature decreases and air humidity increases, ozone values are lower
- The values of CO in the research period ranges from 170 – 220 μ/m3

Analysis

For futher research it is necessary to:

- Prolong the measurements of all parameters
- Compare measured parameters throughout the year
- Permanent system setup for gas monitoring
- Set up the sensors for PM10, PM2,5

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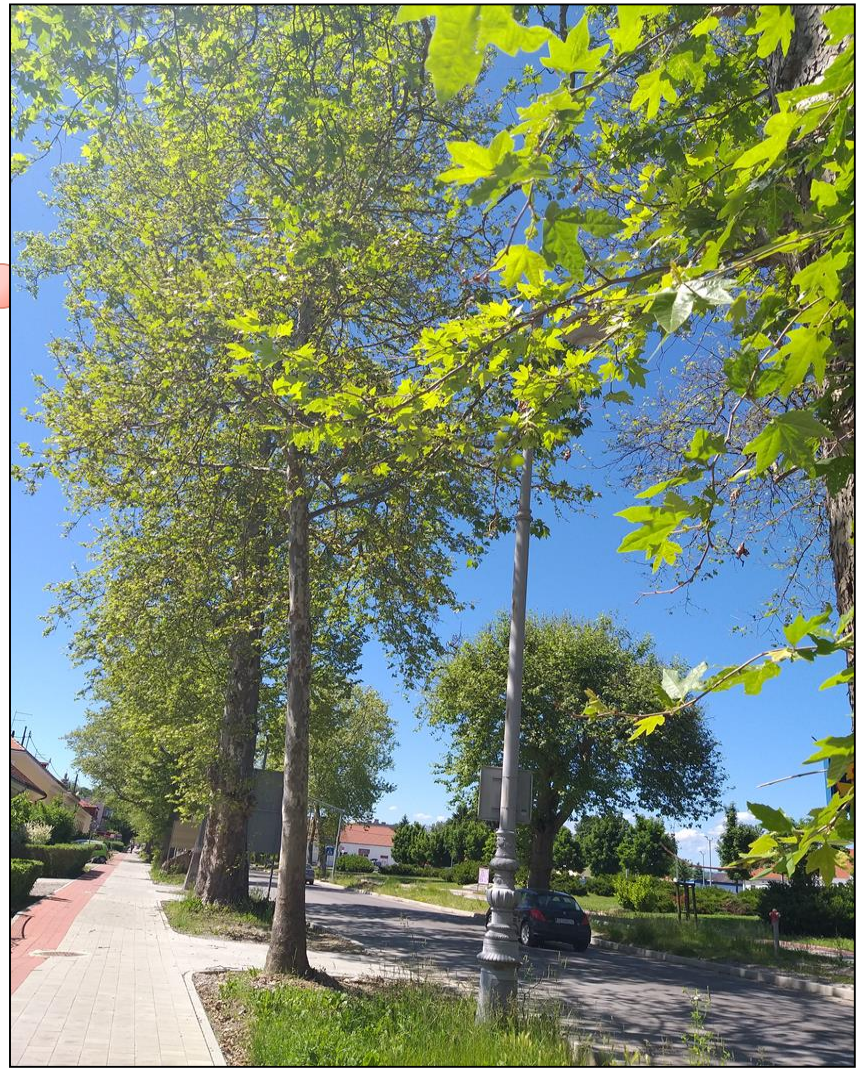

THANK YOU FOR YOUR ATTENTION!