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New Assessment of the Analysis of Wastewater Quality on a Wastewater Treatment Plant Using the RAPS Method

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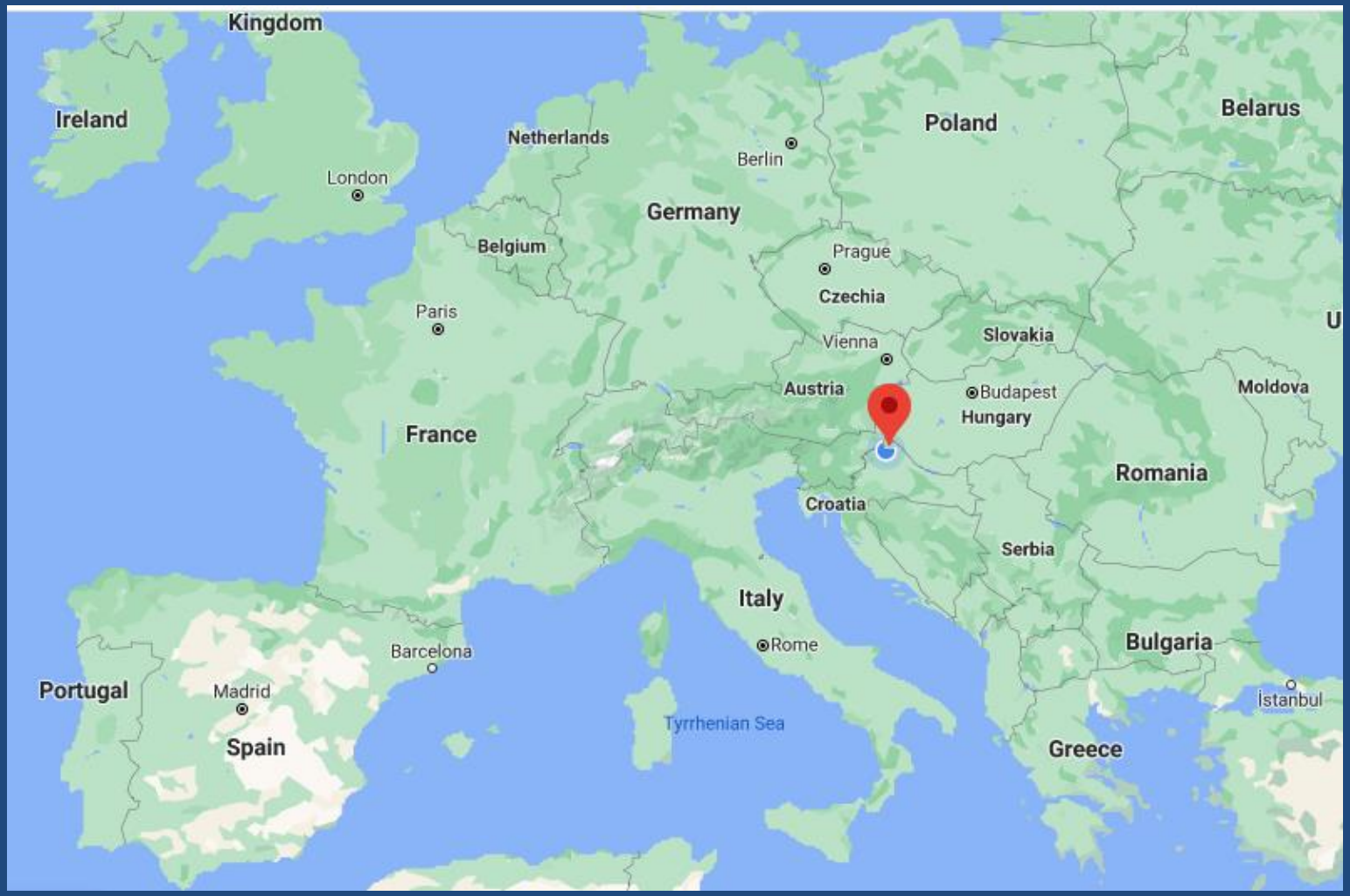
The Wastewater Treatment Plant (WWTP) of the city of Čakovec, Croatia:



- Mixed type (comunal and precipitations), capacity of 91000 ES, mechanical and biological treatment.

- RAPS method:

$$RAPS_k = \sum_{t=1}^{k} \frac{Y_t - \overline{Y}}{S_y}$$

- Y_t is value of the analyzed member (parameter) of the considered time serie;

$\overline{Y}$ is average value of the considered time serie;

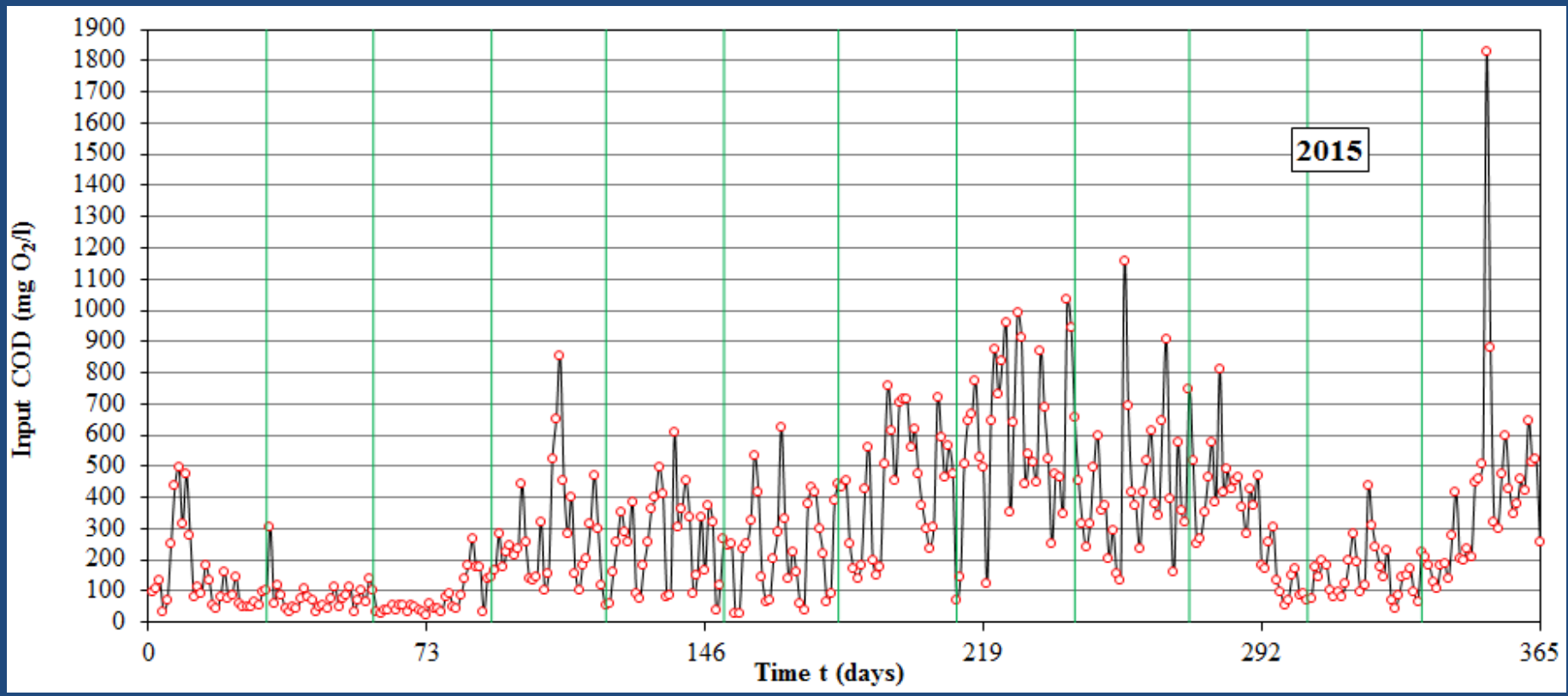
S_y is standard deviation of the considered time serie;

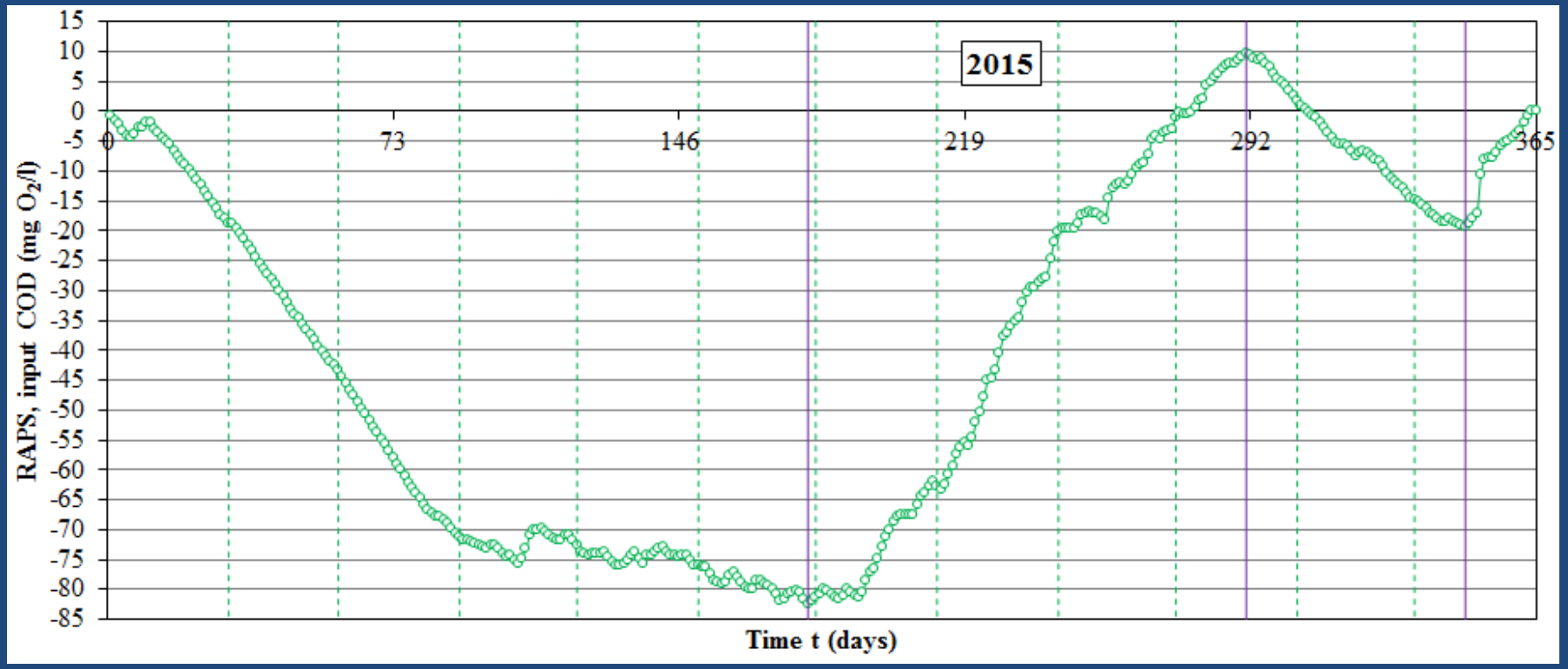
n is number of members of the considered time serie;

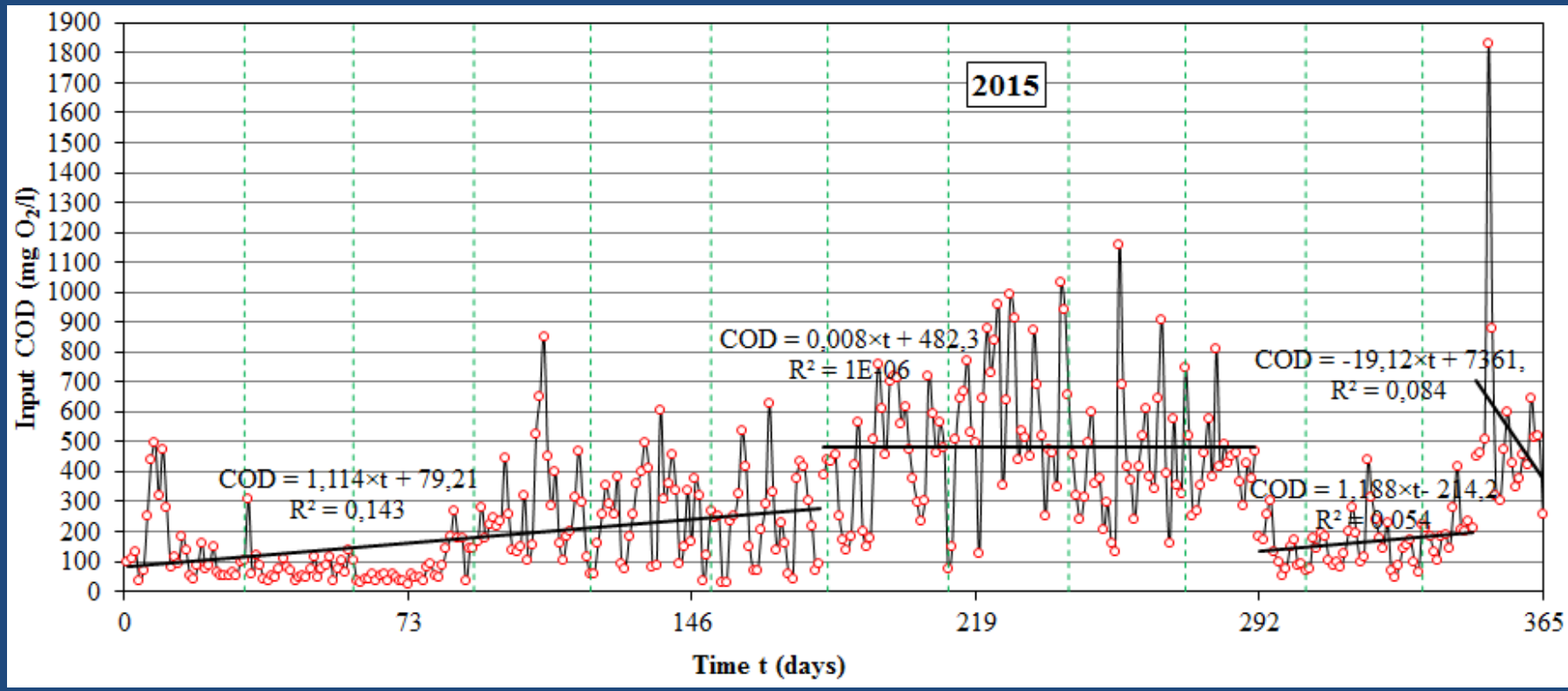
$k = 1, 2, \ldots, n$ is counter during sumation.

- The graphical representation of the RAPS method indicates the existence of several subseries that have similar characteristics, a larger number of trends, etc.

Input time serie:

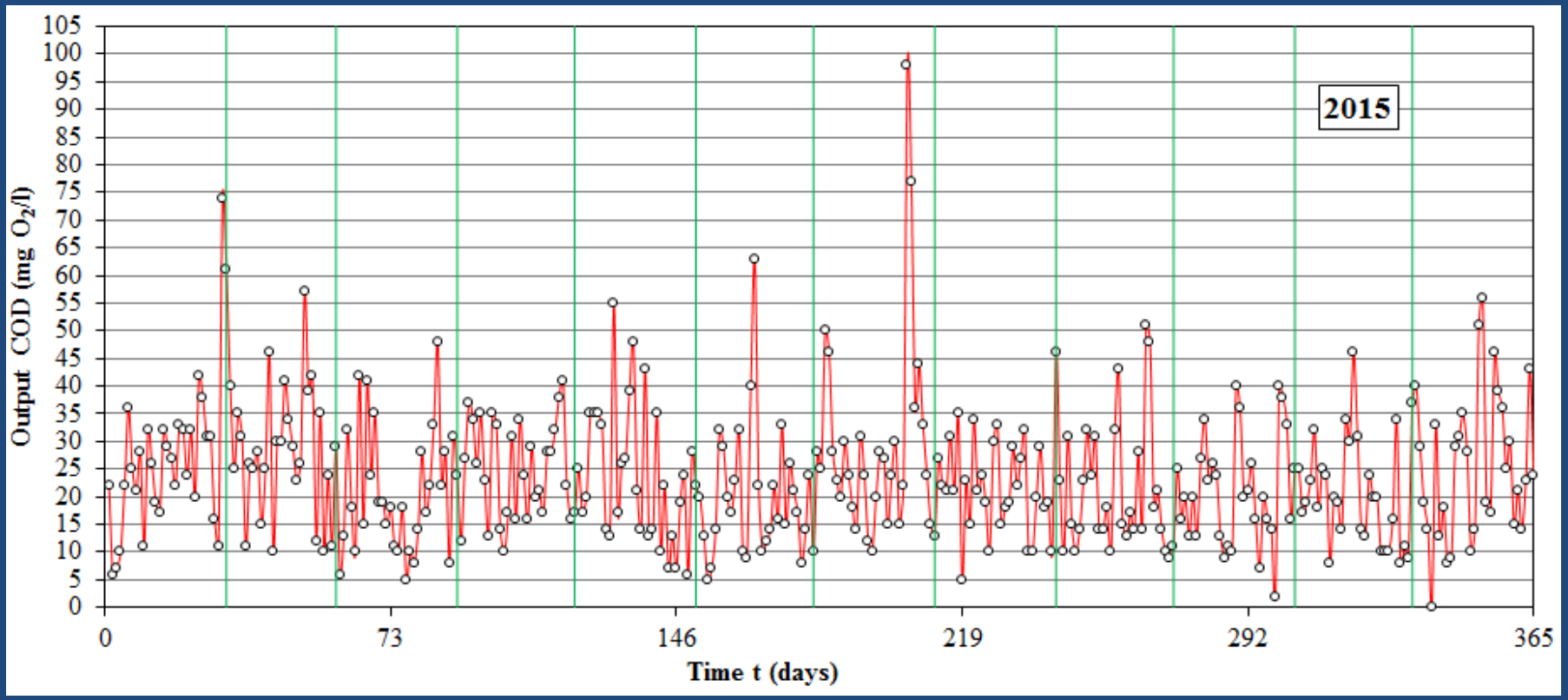


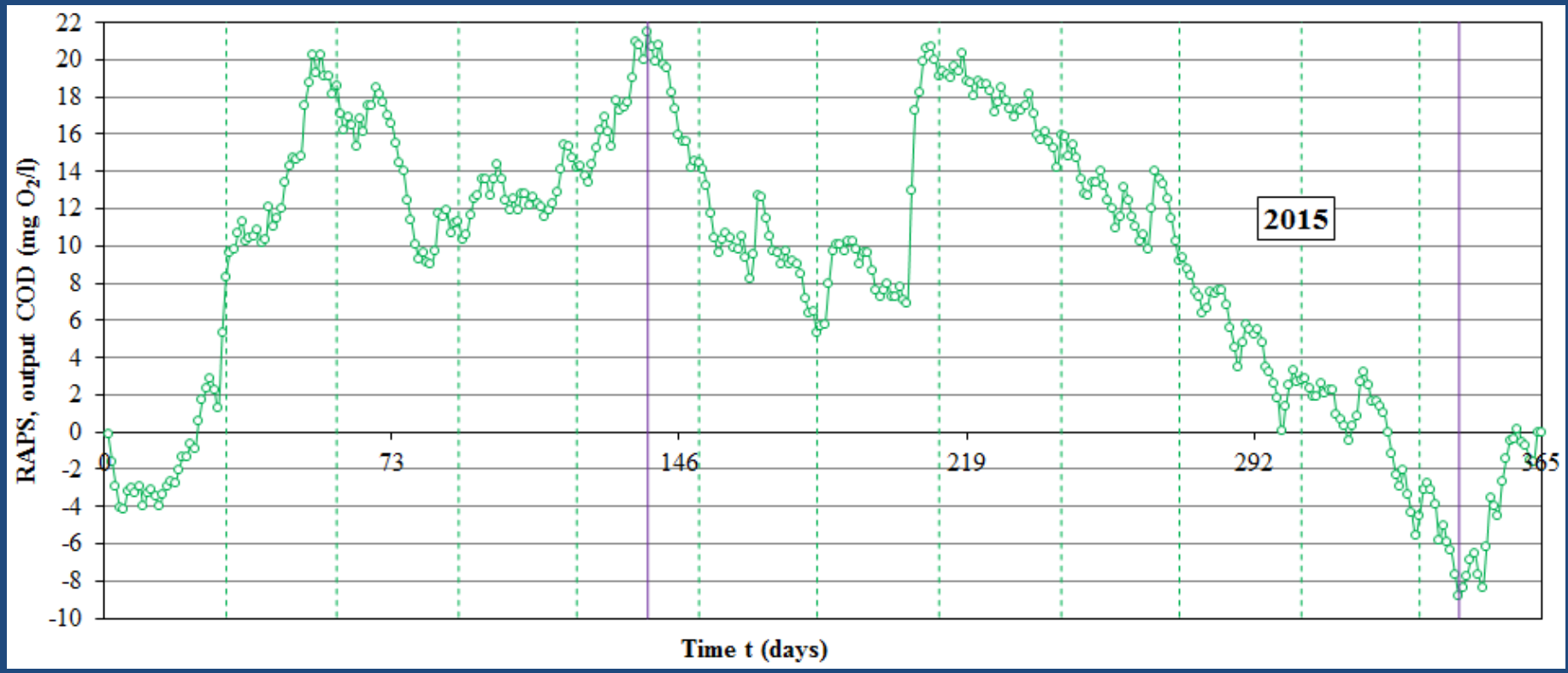

2015
RAPS, input COD (mg O_2/l)
Time t (days)
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
-85
0
73
146
219
292
365

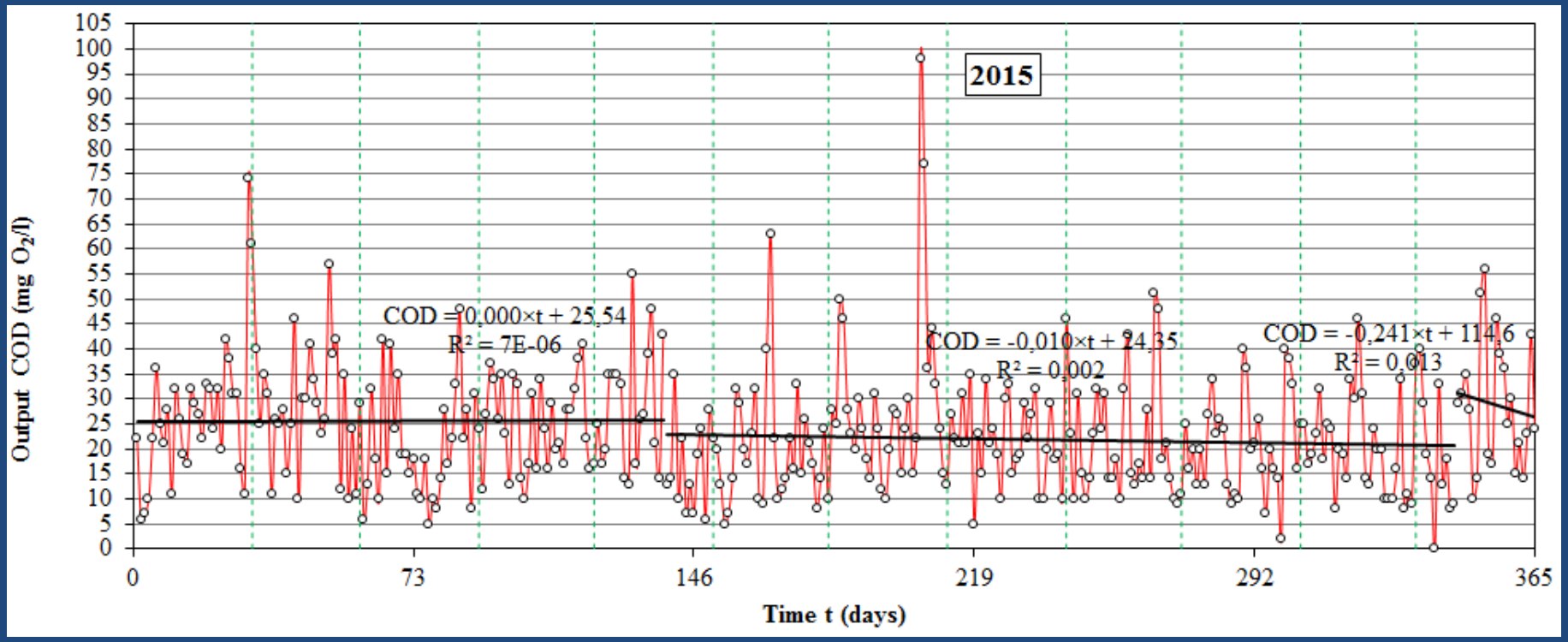

2015
Input COD (mg O2/l)
Time t (days)
COD = 1,114×t + 79,21
R² = 0,143
COD = 0,008×t + 482,3
R² = 1E-06
COD = -19,12×t + 7361,
R² = 0,084
COD = 1,188×t- 214,2
R² = 0,054
0
73
146
219
292
365
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900

- The values of input indicators of wastewater quality for 2015 are in second half of the year above the value of the Maximum allowed value (MAV), which is 700 mg O_2/l for the COD.
- Based on the performed analysis, it can be seen that the highest measured value of the coefficient of determination R^2 of an input serie is equal to 0.1439, while the lowest calculated value of R^2 is 10^{-6} => In both cases, there are insignificant.
- Growing trends of all subseries are observed, but given the negligible values of R^2, this has no argumentative significance.

Output time serie:




RAPS, output COD (mg O2/l)
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
0
73
146
219
292
365
2015
Time t (days)


2015
COD = 0,000×t + 25,54
R² = 7E-06
COD = -0,010×t + 24,35
R² = 0,002
COD = -0,241×t + 114,6
R² = 0,013
Output COD (mg O2/l)
Time t (days)
0
73
146
219
292
365
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0

- Declining trends of output subseries are observed, but given the negligible values of R^2, this has no argumentative significance, just as with input subsequences.
- Accordingly to the explanations and analysis at the laboratory in WWTP Čakovec, the output values of COD in 2015 did not exceed the permitted limit of 125 mg/l.
- Biological treatment efficiencies, expressed as a percentage reduction in COD values deviated in the first quarter of the year is a result of changes in COD inputs (reductions), due to the inflow of large amounts of precipitation.

- Equally important is the quality of the sewer system, i.e. its water tightness, especially in those parts where the old concrete sewer is.
- All deviations from the efficiency of COD reductions are due to poorly loaded water.
- In the conditions of inflow of very dilute wastewater, it is not biologically possible to achieve the required treatment efficiencies.
- RAPS has justified purpose of the application!
- Further research will include analysis for the longer time period, comparison with the time series of the hydraulical load, precipitation and insolation, as well as extension for the other indicators of the waste water quality.

THANK YOU VERY MUCH!!!