

# INVESTIGATION OF THE SYNERGISM OF AIR POLLUTION AND RUGGLE POLLENE LOAD

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## Abstract

*In summer, high atmospheric ozone levels not only burden the respiratory tract (mucous membrane irritation, respiratory distress, respiratory tract inflammation), but even the allergen content of plants can be increased. Ozone in the vicinity of the soil is formed from primary pollutants by photochemical means. Primary pollutants include nitrogen oxides, volatile organic compounds and solvents from vehicle exhaust fumes. Solar radiation generates ozone (O<sub>3</sub>) from nitrogen oxides. High levels of ozone can greatly aggravate the symptoms of people with pollen allergy.*

## 1. Introduction

In summer, high levels of atmospheric ozone not only burden the respiratory tract (mucous membrane irritation, respiratory distress, respiratory tract inflammation), but even the allergen content of plants can be increased according to research carried out by Vienna researchers [2]. Ozone in the vicinity of the soil is formed from primary pollutants by photochemical means. Primary pollutants include nitrogen oxides, volatile organic compounds and solvents from vehicle exhaust fumes. Solar radiation generates ozone (O<sub>3</sub>) from nitrogen oxides. High levels of ozone can greatly exacerbate the symptoms of people with pollen allergy [1].

## 2. Method

In July 2018. and October 10, 2018 only concentrations of airborne ozone (O<sub>3</sub>) and particulate matter (PM10) in the 10 µm range were available in Kecskemét measuring station, since other air pollutants (SO<sub>2</sub>, NO<sub>2</sub>, CO, NO<sub>x</sub>, NO, etc.) have concentrations below the limit values. The health limit values for ozone and particulate matter are given in Table 1.

Table 1.: Health limit values for air pollutants

Air pollutant	Health limit (µg/m <sup>3</sup> )
Ozone (O <sub>3</sub> )	120
suspended particulate matter (PM10) - small particle size	50
sulfur dioxide (SO <sub>2</sub> )	250
nitrogen dioxide (NO <sub>2</sub> )	100

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carbon monoxide (CO)

10 000

In July 2018 only ozone ( $O_3$ ) and particulate matter (PM10) were measured (Figure 1). In July, ozone was highest at 7 ( $124.4 \mu\text{g} / \text{m}^3$ ) and 25 ( $120.1 \mu\text{g} / \text{m}^3$ ) (at which point the health limit was exceeded) and 22 ( $6.8 \mu\text{g} / \text{m}^3$ ). was the lowest concentration. On the 25th, the particulate matter reached its highest level ( $57 \mu\text{g} / \text{m}^3$ ), already above the health limit, and on the 10th it was the lowest ( $2 \mu\text{g} / \text{m}^3$ ).

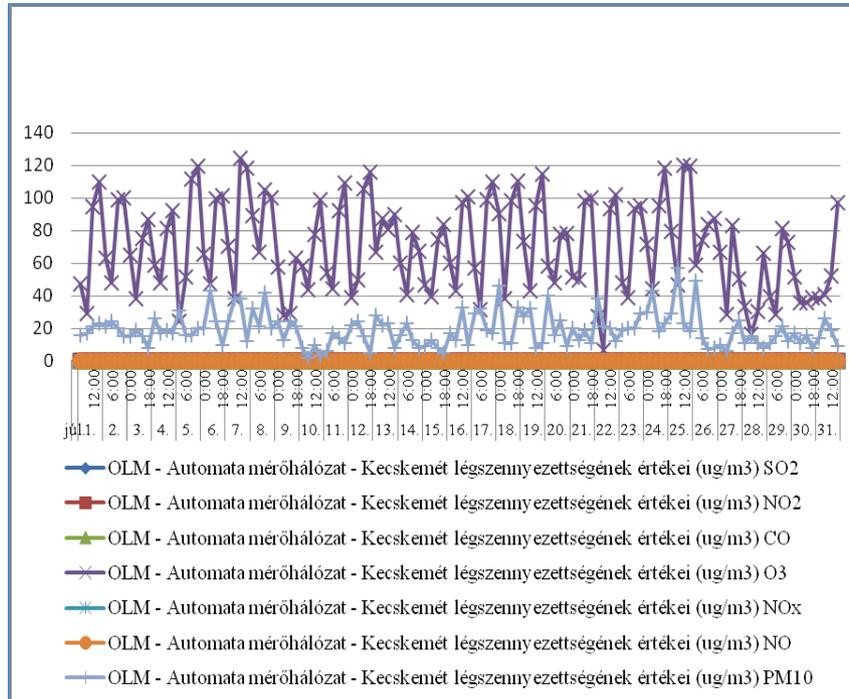


Figure 1: Air pollution data in Kecskemét, July 2018 Source: OLM data (2018) - own edited

In August 2018, ozone ( $O_3$ ) concentrations peaked at 13 ( $133.5 \mu\text{g} / \text{m}^3$ ) and lowest ( $0.5 \mu\text{g} / \text{m}^3$ ) at 24 and 29 (Figure 2).

The health limit value ( $120 \mu\text{g} / \text{m}^3$ ) was exceeded several times by ozone air pollution on 13 August ( $133.5 \mu\text{g} / \text{m}^3$ ), 15 August ( $130.1 \mu\text{g} / \text{m}^3$ ), 16 August ( $126 \mu\text{g} / \text{m}^3$ ) and on August 31 ( $127.4 \mu\text{g} / \text{m}^3$ ). No data was available on August 30 from 6:00 to 18:00 and on 31 August from 0:00 to 6:00.

In August, suspended particulate matter (PM10) was at its highest level ( $85 \mu\text{g} / \text{m}^3$ ) on day 29 and was lowest in air ( $19 \mu\text{g} / \text{m}^3$ ) (Figure 2).

Exposure limit values ( $50 \mu\text{g} / \text{m}^3$ ) were exceeded on 12 August ( $55 \mu\text{g} / \text{m}^3$ ), 13 August ( $51 \mu\text{g} / \text{m}^3$ ), 14 August ( $59 \mu\text{g} / \text{m}^3$ ), 16 August ( $52 \mu\text{g} / \text{m}^3$ ), August 17 ( $53 \mu\text{g} / \text{m}^3$ ), August 28 ( $50 \mu\text{g} / \text{m}^3$  and  $62 \mu\text{g} / \text{m}^3$ ), and August 29 ( $85 \mu\text{g} / \text{m}^3$  and  $53 \mu\text{g} / \text{m}^3$ ).

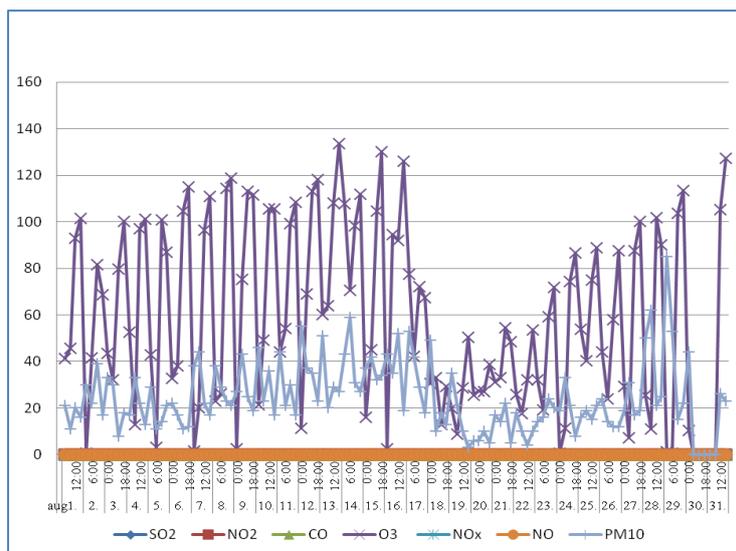


Figure 2: Air pollution data in Kecskemét in August 2018  
Source: OLM Data (2018) - self-edited

By September, the ozone concentration was no longer above the health limit ( $120 \mu\text{g} / \text{m}^3$ ), reaching its highest level ( $109.9 \mu\text{g} / \text{m}^3$ ) on 1 and the lowest on 26 ( $2.9 \mu\text{g} / \text{m}^3$ ) (3 . figure). Particulate matter exceeded the health limit ( $50 \mu\text{g} / \text{m}^3$ ) on several occasions this month: on 1 September ( $59 \mu\text{g} / \text{m}^3$ ), on 18 September ( $53 \mu\text{g} / \text{m}^3$ ) and on 25 September ( $51 \mu\text{g} / \text{m}^3$ ). The highest concentration was observed on September 1 ( $59 \mu\text{g} / \text{m}^3$ ), and the lowest on September 30 ( $2 \mu\text{g} / \text{m}^3$ ) (Figure 3).

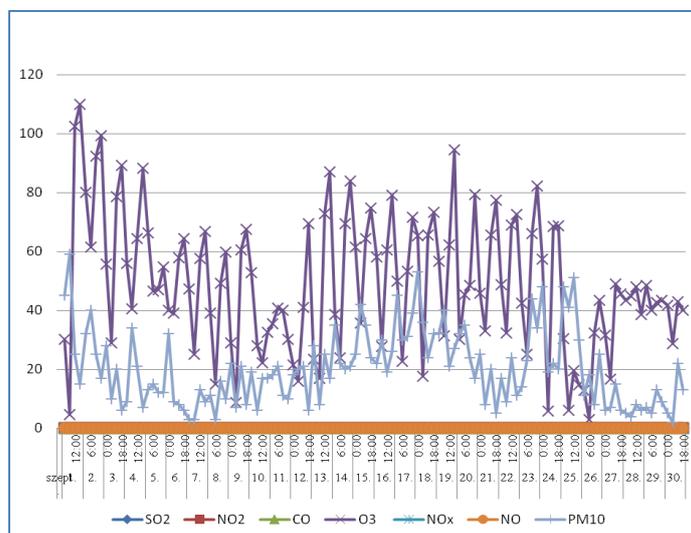


Figure 3: Air pollution data in Kecskemét in September 2018  
Source: OLM Data (2018) - self-edited

In October, ozone concentrations were well below the health limit ( $120 \mu\text{g} / \text{m}^3$ ). It was highest on October 4 ( $66.4 \mu\text{g} / \text{m}^3$ ) and lowest on October 30 ( $0.1 \mu\text{g} / \text{m}^3$ ) (Figure 5). Ozone air pollution data were not available on 22 October (0:00 and 6:00), 23 October (6:00), 24 October (6:00), on October 30 (6:00) and October 31 (0: 00-6: 00).

Concentration of particulate matter (PM10) reached its highest level in October of the 4 months.

Health limit values ( $50 \mu\text{g} / \text{m}^3$ ) were exceeded on October 22 ( $58$  and  $53 \mu\text{g} / \text{m}^3$ ), on October 26 ( $52 \mu\text{g} / \text{m}^3$ ), on 29 October ( $51 \mu\text{g} / \text{m}^3$ ), and on 30 October ( $51 \mu\text{g} / \text{m}^3$  and  $89 \mu\text{g} / \text{m}^3$ ) and 31 October ( $75 \mu\text{g} / \text{m}^3$ ,  $94 \mu\text{g} / \text{m}^3$  and  $65 \mu\text{g} / \text{m}^3$ , respectively) (Figure 4).

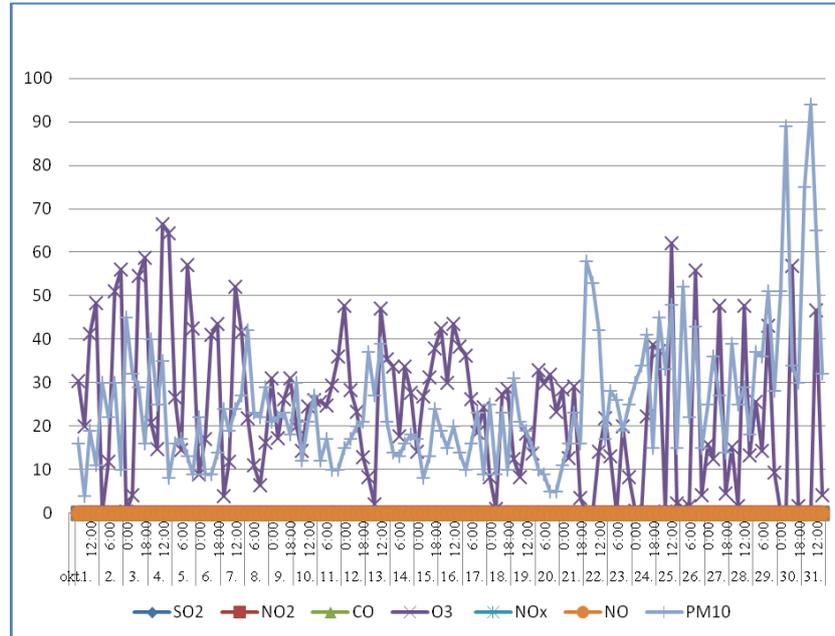


Figure 4: Air pollution data in Kecskemét, October 2018  
Source: OLM Data (2018) - self-edited

### 3. Results

#### 3.1. Comparison of ragweed pollen data and air pollution measurement data from The National Public Health and Medical Officer Service in Kecskemét, 2018

Ragweed pollen levels reached a very high level from week 32 to week 38 (08/08/2018 - 18/09/2018), at which time allergy symptoms were severe. The concentrations of ozone ( $\text{O}_3$ ) and  $10 \mu\text{m}$  fly-dust (PM10) were also variable during this time interval.

Ozone levels increased gradually between August 24 and September 1, followed by a fall between September 2 and September 11. Subsequently, between 13 September and 19 September, ozone air pollution levels increased again.

The concentration values of the particulate matter showed great fluctuation in the period from August 24 to September 19. PM10 levels increased from August 24 to August 29, but a decrease was observed as of mid-day 29. It rose again at 0:00 on August 30, then no data was available from 6:00 am to 6:00 am on August 31, since it was well below the limit. From August 31, there was an increase again until mid-September, when the concentration decreased again, and this fluctuation continued until 19.

Ozone concentrations peaked in August, exceeding several times the health limit ( $120 \mu\text{g} / \text{m}^3$ ). However, the concentration of airborne dust showed very high values in October.

### 3.2. Number of patients with respiratory allergy in Kecskemét

Table 1.: Number of patients with respiratory allergy in Kecskemét (2018)

Total number of registered respiratory allergy sufferers (persons) in 2018	5 493
Total number of patients suffering from pollen allergy in 2018 (persons)	4 033
Number of pollen allergies registered in 2017 (persons)	3 811
Number of newer pollen allergies registered in 2018 (persons)	222

(Source: Kecskemét Lung Care Institute data (2018) - self-edited)

Table 2 shows that in Kecskemét the Lung Care Institute registered a total of 5,493 patients with respiratory allergies in 2018, accounting for nearly 5% of the city's population (111,836 as of January 1, 2018). Of the 5,493 patients with respiratory allergy, a total of 4,033 were allergic to pollen, accounting for 3.6% of the population of Kecskemét (111,836).

Nearly 80% of the 4,033 registered patients (3,220) are allergic to ragweed pollen.

## 4. Discussion

Researches from Vienna confirmed that plants with high levels of ozone, including ragweed, have increased allergenic content. The main reason for this is that the protein extract of plant species heavily exposed to ozone reacts strongly with Immunglobulin-E antibodies, which play an important role in the development of allergies. Nitrogen oxides (NOx) scrub the outer sheath of ragweed pollen, under which the released claws irritate the airway.

Increasing atmospheric CO<sub>2</sub> concentration and global warming are also responsible for the high pollen production of ragweed.

Concentrated dust (PM10) concentrations exceeded the health limit (50 µg / m<sup>3</sup>) 13 times during high and very high ragweed pollen production (03/08/2018 - 18/09/2018), which is very dangerous because even at the lowest concentration can be very harmful.

## 5. Conclusion

The main emission sources of particulate matter are exhaust gas and coal combustion. As a result, the proportion of respiratory diseases (asthma and chronic bronchitis) is increased, including pollen allergy.

In 2018, nearly 80% (3,220) of the 4,033 patients with pollen allergies registered at the Kecskemét Lung Care Institute also developed allergic symptoms to ragweed pollen. Compared to 2017, the number of registered pollen allergies increased by 222 persons.

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