IMPACT OF AIR POLLUTION ON COV-19 CONTAMINATION IN SOFIA FOR THE PERIOD 2020-2022

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Abstract: *In this paper we present the results of comparison between air pollution over Sofia city and numbers of new and active COV-19 cases. Air pollution measurements are on the base of Sentinel 5P data and 5 ground stations (AIS), based in Sofia city. Results show a good compliance between air pollution level and COV-19 cases*

ВЛИЯНИЕ НА АТМОСФЕРНОТО ЗАМЪРСЯВАНЕ ВЪРХУ COV-19 ЗАБОЛЕВАЕМОСТТА В СОФИЯ ЗА ПЕРИОДА 2020-2022

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Ключови думи: *дистанционни изследвания, спътникови данни, COV-19*

Резюме: *В тази статия представяме резултатите от сравнението между замърсяването на въздуха над град София и броя на новите и активни случаи на COV-19. Измерванията на замърсяването на въздуха са на базата на данни от Sentinel 5P и 5 наземни станции (AIS), базирани в град София. Резултатите показват добро съответствие между нивото на замърсяване на въздуха и случаите на COV-19*

Introduction

Coronavirus disease 2019 (COVID-19) is a contagious disease caused by a virus, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first known case was identified in Wuhan, China, in December 2019 [1]. The disease quickly spread worldwide, resulting in the COVID-19 pandemic.

Symptoms of COVID-19 are variable, but often include fever [2] cough, headache [3] fatigue, breathing difficulties, loss of smell, and loss of taste [4, 5, 6]. Symptoms may begin one to fourteen days after exposure to the virus. At least a third of people who are infected do not develop noticeable symptoms [7] Of those people who develop symptoms noticeable enough to be classed as patients, most (81%) develop mild to moderate symptoms (up to mild pneumonia), while 14% develop severe symptoms (dyspnoea, hypoxia, or more than 50% lung involvement on imaging), and 5% develop critical symptoms (respiratory failure, shock, or multiorgan dysfunction) [8]. Older people are at a higher risk of developing severe symptoms. Some people continue to experience a range of effects (long COVID) for months after recovery, and damage to organs has been observed [9]. Multi-year studies are underway to further investigate the long-term effects of the disease.

At the beginning of 2020, COV-19 pandemic made humanity to think about such actual problems as the air quality and it impact over human health. This involves us also to study the impact of other sources of respiratory distress on the increase of COV-19 morbidity.

Data and methodic

For this investigation we chose the biggest Bulgarian city – Sofia.

Our choice is to use grand station measurements and satellite data for air quality inventory.

On Fig. 1 we show positions of the 5 used ground measurement station – AIS: Mladost, Drujba, Nadejda, Hipodruma and Pavlovo. The sixth one – the one at Orlov most doesn't provide free data at the moment [10].

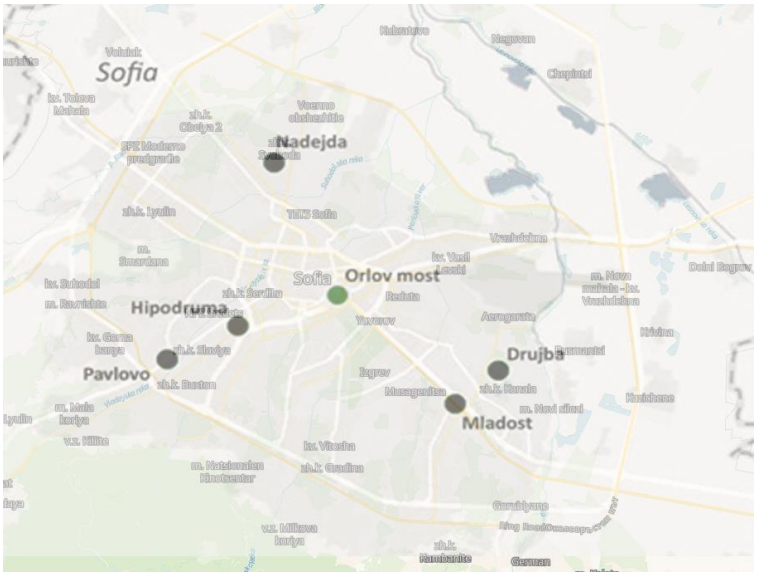

Fig. 1. Positions of AIS in Sofia

From all the five AIS we use data for PM10, NO_2 and CO. Only one station – the one at Hipodruma provides data for PM2.5 and we use this data too.

We use Sentinel 5P satellite data [11, 12] On Fig. 2 we show space resolution of this data above the Sofia region. Each differently colored rectangle is one data pixel.

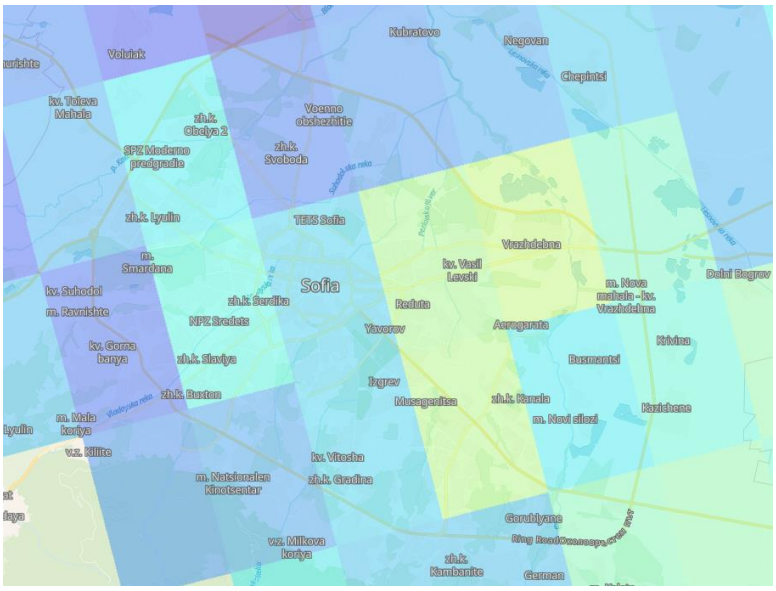

Fig. 2. Illustration of the spatial Sentinel 5P resolution

For the data for COV-19 new and active cases in Sofia city we use data from the official government open data portal [13].

Results

On Fig. 3 we show the distribution of the new COV-19 cases in Sofia city on a daily scale.
On Fig. 3, 5 and 6 we show AIS data for PM10, NO_2 and Co respectively.
On Fig. 7 we show the distribution of active COV-19 cases in Sofia city.

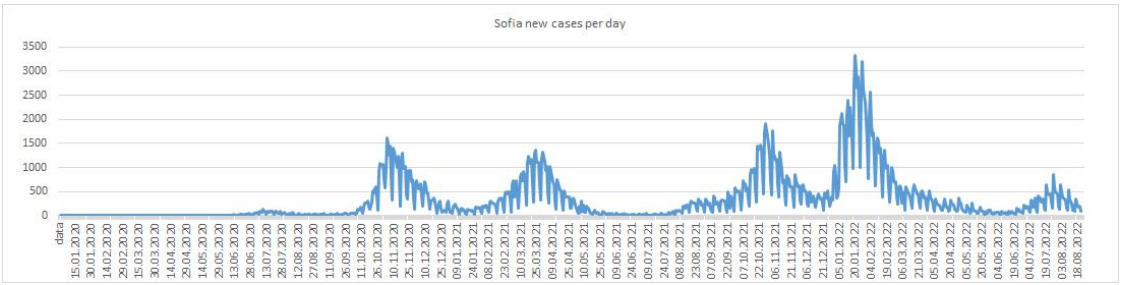

Fig. 3. Distribution of new COV-19 cases in Sofia city

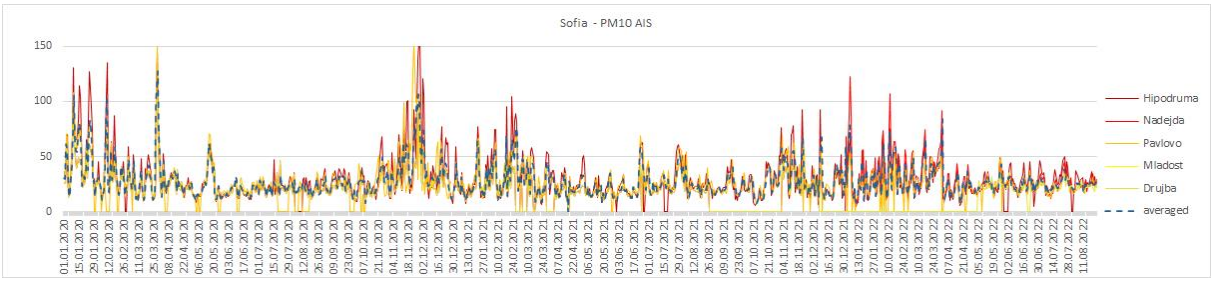

Fig. 4. PM10 in Sofia city measured from AIS and averaged PM10 value

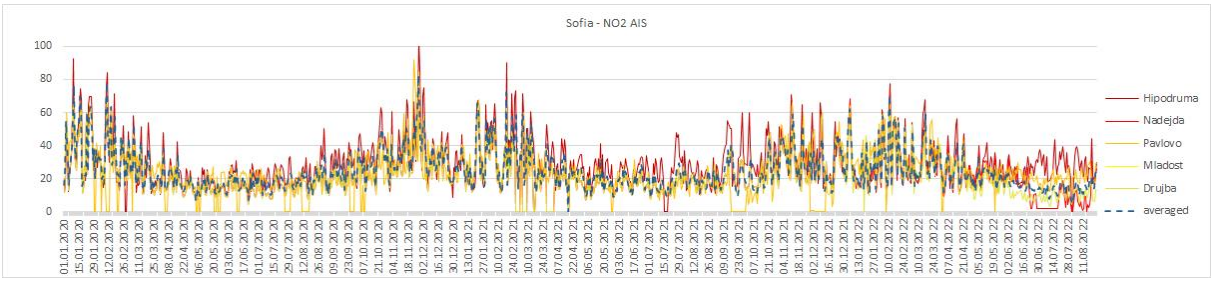

Fig. 5. NO_2 in Sofia city measured from AIS and averaged NO_2 value

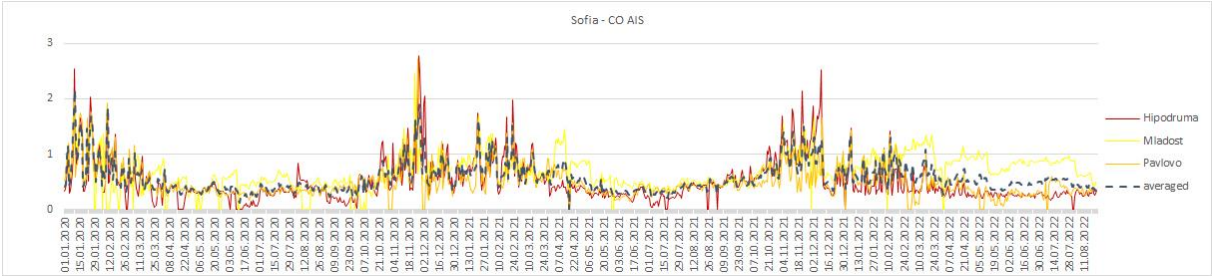

Fig. 6. CO in Sofia city measured from AIS and averaged CO value

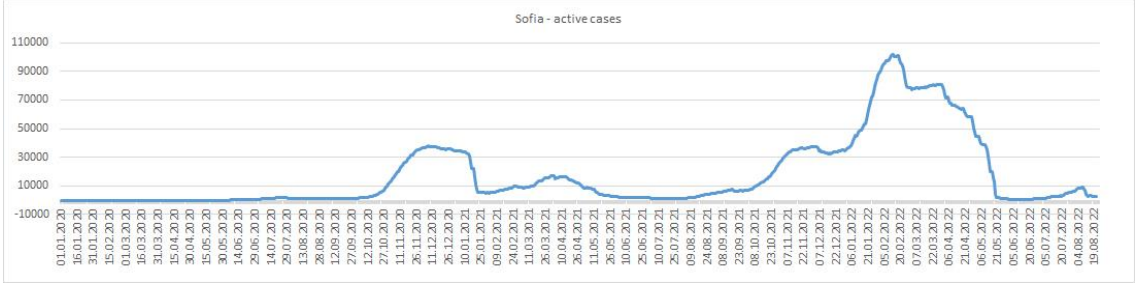

Fig. 7. Distribution of active COV-19 cases in Sofia city

As we see in Fig. 3 – 6, there is a very good match between the daily new COV0-19 cases and all three air pollutants.

Fig. 7 shows time delay between COV-19 active cases and air pollution. Such time delay is naturally caused by COV-19 duration.

For PM2.5 not only we have data from just one station in Sofia, but also it has a gap of data for a full year between March 2020 and March 2021. On Fig. 8 we show the existing PM2.5 data from Hipodruma station.

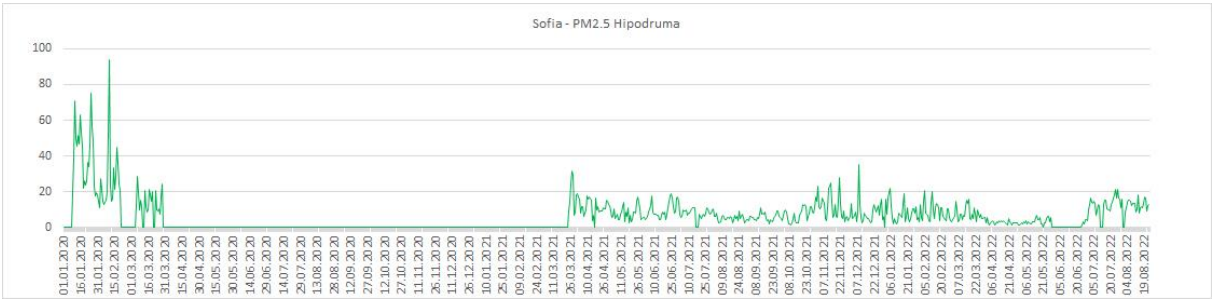

Fig. 8. PM2.5 in Sofia AIS Hipodruma

From the Sentinel 5P satellite data we find days with NO_2 pollution in the atmosphere over the city. In Fig. 9 we show diagram of days with pollution.

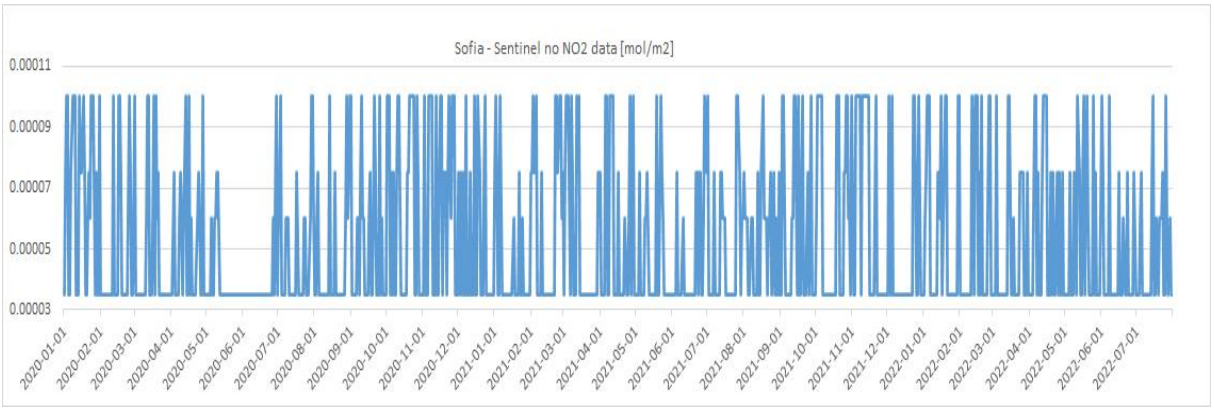

Fig. 9. NO_2 pollution days over Sofia

As we see on the Fig. 9, there is a gap in the days with pollution during the lockdown in Sofia during the spring of 2020, the increase of days with pollution during the second and third COV-19 wave, as well as at the end of 2021 (forth COV-19 wave).

The increase of other pollutant (CO and dust) we can not see from Sentinel 5P data. Their concentration over the city didn't show significant increase over Sofia.

The case of dust pollution registration from satellite data is very complicated as whole. Satellite data contain only AI (aerosol index) or AAI (absorption aerosol index) but no direct dust measurements.

Conclusions

As we see from the previous chapter, both new and active COV-19 cases per day show perfect correlation with air pollution increases in Sofia city in the first half of the spread of COV-19. This made us think that we must pay bigger attention to the decreasing of greenhouse gases not only to prevent future Global Warming, but also to prevent future respirator pandemics.

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