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SEASONAL AND TEMPORAL BEHAVIOUR OF BACKGROUND NO2 POLLUTION OVER BULGARIA ON THE BASE OF SENTINEL P5 DATA

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ABSTRACT: Talking about air pollution it is important to know the background pollution level and the level of increase over this level. In case of NO2 in Bulgaria there are many closely positioned sources such as big cities, high roads and industrial regiones. To be able to measure impack of each one of them, it is reasonable first to obtain background level ant its seasonal and temporal behavior.

In this paper we showthe background NO2 level behavior, measured from monthly Sentinel P5 data.

1. INTRODUCTION

Nitrogen Dioxide (NO2) is one of a group of highly reactive gases known as oxides of nitrogen or nitrogen oxides (NOx). Other nitrogen oxides include nitrous acid and nitric acid. NO2 is used as the indicator for the larger group of nitrogen oxides.

NO2 primarily gets in the air from the burning of fuel. NO2 forms from emissions from cars, trucks and buses, power stations, and off-road equipment [1].

Breathing air with a high concentration of NO2 can irritate airways in the human respiratory system. Such exposures over short periods can aggravate respiratory diseases, particularly asthma, leading to respiratory symptoms (such as coughing, wheezing or difficulty breathing), hospital admissions and visits to emergency rooms. Longer exposures to elevated concentrations of NO2 may contribute to the development of asthma and potentially increase susceptibility to respiratory infections. People with asthma, as well as the children and the elderly are generally at a greater risk for the health effects of NO2.

NO2 and other Nox interact with water, oxygen and other chemicals in the atmosphere to form acid rain. Acid rain harms sensitive ecosystems such as lakes and forests [1].

Nitrogen Dioxide (NO2) is a pungent gas that, along with fine airborne particulate matter, contributes to the reddish-brown haze characteristic of smoggy air in California. NO2 is comprised of one atom of nitrogen and two atoms of oxygen, and is a gas at ambient temperatures. It has a pungent smell, and is brownish red in color. NO2 is a member of a family of chemicals comprised of nitrogen and oxygen that are collectively known as nitrogen oxides. The two most prevalent nitrogen oxides are NO2 and nitric oxide (NO), and the combination is often referred to as NOX [2].

Satellite data from Tropomi instrument [3] gives us a way to obtain NO2 column ones each day above Bulgaria with spatial resolution of 3.5 x 5.5 km. So we can obtain NO2 pollution sources as well as background value and averaged value for different time periods.

In this work we pay attention on the background value of NO2 becouse this is the only air pollutant, measured from Tropomi, which shows very large differences in values, so we can clearly separate pollution sources from a clear areas.

2. USED DATA AND METHODS

In this work we use monthly averaged data for NO2 from Sentinel P5 satellite data. Data source is TEMIS portal [4]. For some visualizations we use NASA worldview portal too [5].

Monthly data for NO2 from TEMIS are in TOMS format – with 0.125 degree steps between pixels [4] and in units [x10-15 molecules/sm2].

To obtain background value, we sellect areas with no antropogenic NO2 pollution sources – as big cities, industrial areas and so on. Then values from sellected areas are averaged again.

On fig. 1 we show an example of daily and monthly NO2 picture and show one of selected areas for background value calculating.

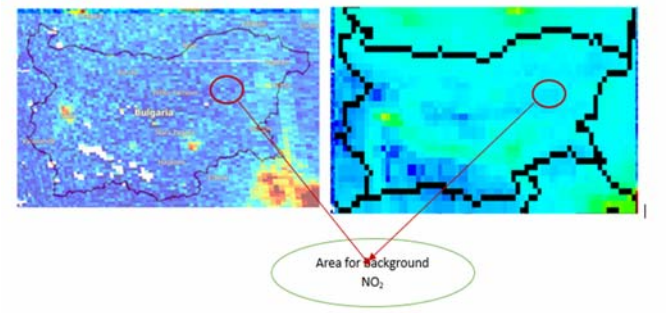

Fig. 1 An example for area for calculating background NO2 air pollution. On the left- daily NO2 [5]. On the right — monthly NO2 [4]

3. RESULTS

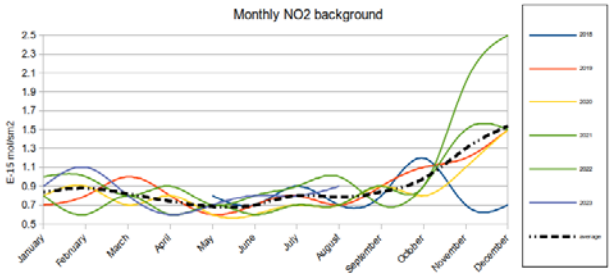

Fig.2 Seasonal background NO2 behavior

On fig. 2 we show obtained background values for each month for the period May 2018 till August 2023, as well as averaged seasonal behavior.

As we see from tha graphics, background NO2 value shows clear maximum at the end of the year — in December, and a minimum value in the middle of the year — May, June.

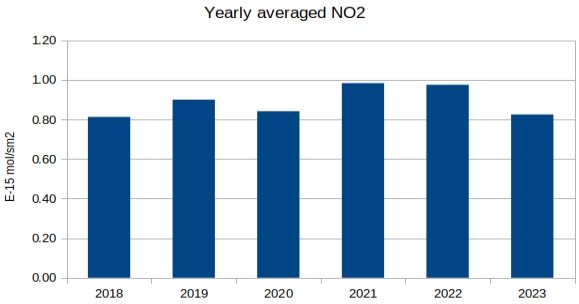

Fig. 3 Temporal background NO2 behavior

As we see from the fig. 3, there is no evidence for any signifficant temporal tendency during the last six years.

Yearly background values varies from 0.81 to 0.98 x10-15 molecules/sm2.

4.DISCUSSIONS AND CONCLUSION

Seasonal background NO2 value shows maximum in Decenber almost every year and a minimum at May, June.

We must point that value for the 2023 is not comparable with others, becouse there we average values only for the first eight monts. If we assume that monthly values will be similar with previous years and larger then in the previous months, we can say, that NO2 background value shows temporal increase.

Refferences:

1. United State Environmental Protection Agency – EPA - https://www.epa.gov/
2. California Air Resources Board - https://ww2.arb.ca.gov/
3. Sentinel 5P data HUB - https://s5phub.copernicus.eu/dhus/#/home
4. Tropospheric Emission Monitoring Internet Servise – TEMIS - https://www.temis.nl/index.php
5. NASA Worldview - https://worldview.earthdata.nasa.gov/