SEASONAL AND TEMPORAL BEHAVIOR OF BACKGROUND NO_2 POLLUTION OVER BULGARIA ON THE BASE OF SENTINEL P5 DATA

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Abstract: *Tolking about air pollution it is important to know backgroun pollution level and level of increase over this level. In case of NO_2 in Bulgaria there are many close positioned sources such as big cities, high rouds 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 show background NO_2 level behavior, measured from monthly Sentinel P5 data.

СЕЗОННО И ВРЕМЕВО ПОВЕДЕНИЕ НА ФОНОВО ЗАМЪРСЯВАНЕ С NO_2 НАД БЪЛГАРИЯ ПО ДАННИ ОТ SENTINEL P5

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Ключови думи: *атмосферно замърсяване, дистанционни изследвания, азотен диоксид*

Резюме: *Говорейки за замърсяването на въздуха, важно е да знаете нивото на фоново замърсяване и нивото на увеличение над това ниво. В случая на NO_2 в България има много близки източници като големи градове, високи пътища и индустриални райони. За да може да се измери импактът на всеки един от тях, е разумно първо да се получи фоновото ниво и неговото сезонно и временно поведение.*

В тази статия ние показваме поведението на фоновото ниво на NO_2, измерено от месечните данни на Sentinel P5.

Introduction

Nitrogen Dioxide (NO_2) 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. NO_2 is used as the indicator for the larger group of nitrogen oxides.

NO_2 primarily gets in the air from the burning of fuel. NO_2 forms from emissions from cars, trucks and buses, power plants, and off-road equipment [1].

Breathing air with a high concentration of NO_2 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 NO_2 may contribute to the development of asthma and potentially increase susceptibility to respiratory infections. People with asthma, as well as children and the elderly are generally at greater risk for the health effects of NO_2.

NO_2 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 (NO_2) is a pungent gas that, along with fine airborne particulate matter, contributes to the reddish-brown haze characteristic of smoggy air in California. NO_2 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. NO_2 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 NO_2 and nitric oxide (NO), and the combination is often referred to as NO_X [2].

Satellite data from Tropomi instrument [3] gives us a possibility fo obtain a NO_2 column ones each day above Bulgaria with spatial resolution of 3.5 x 5.5 km. So we can obtain NO_2 pollution sources as well as background value and averaged value for different time periods.

In this work we pay attention on background value of NO_2 becouse this is the only air pollutant, measured from Tropomi, wich shows very large differences in values, so we can clearly separate pollution sources from a clear areas.

Used data and methods

In this work we use monthly averaged data for NO_2 from Sentinel P5 satellite data. Data source is TEMIS portal [4]. For some visualization 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/sm^2].

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 exmple of dayly and monthly NO_2 picture and show one of sellected areas for bachground value calculating.

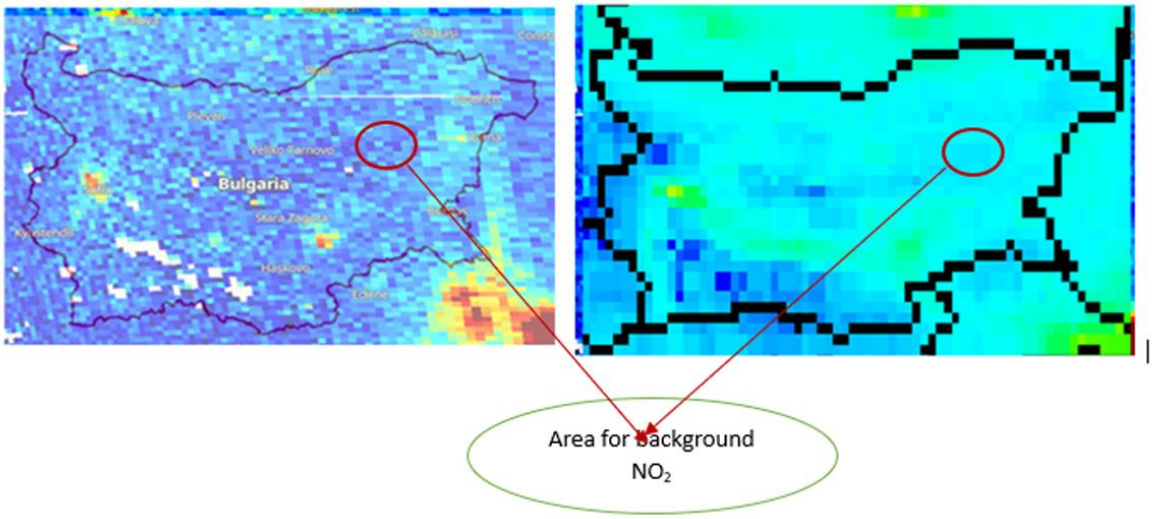

Fig. 1. An example for area for calculating background NO_2 air pollution. On the left- dayly NO_2 [5]. On the right — manthly NO_2 [4]

Results

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.

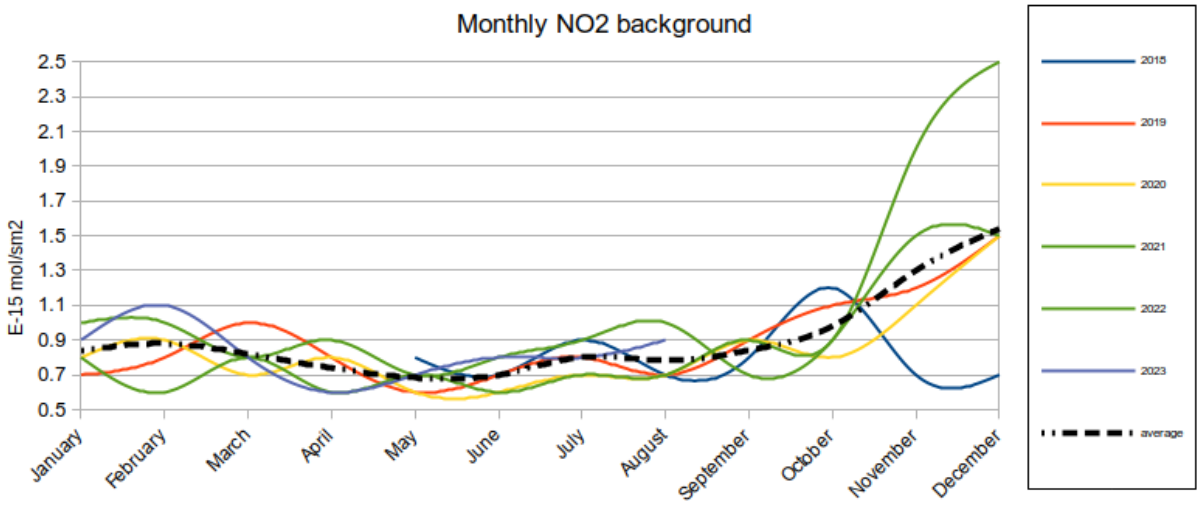

Fig. 2. Seasonal background NO2 behavior

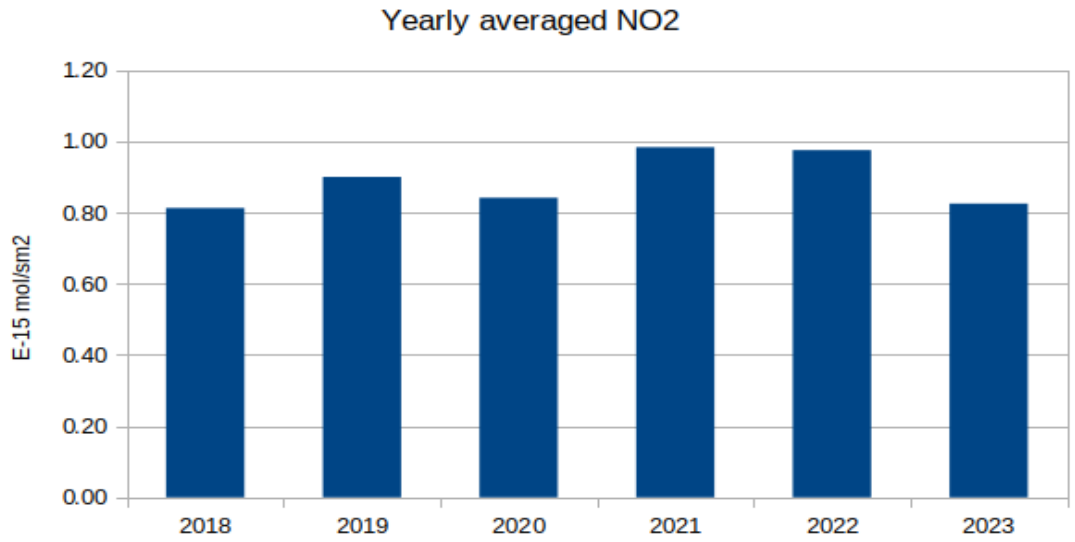

Fig. 3. Temporal background NO_2 behavior

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

Yearly background values varies between 0.81 and 0.98 $x10^{-15}$ malecules/sm^2.

Discussions and conclusion

Seasonal background NO_2 value shous 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 first eight monts. If we assume that monthly values will be simmilar with previous years and larger then in previous months, we can say, that NO^2 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/.