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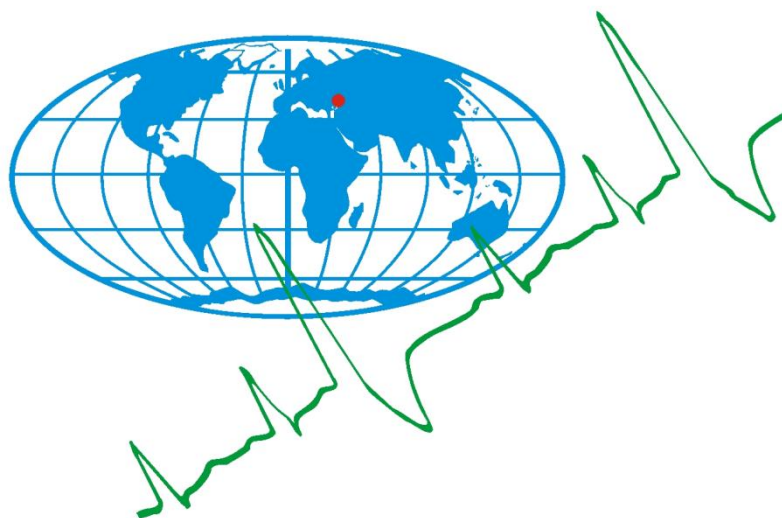


## ТЕЗИСЫ ДОКЛАДОВ

**Международной научно-практической конференции  
«Системы контроля окружающей среды – 2023»**

## CONFERENCE ABSTRACTS

**International Scientific and Practical Conference  
"Environmental Control Systems – 2023"**



Севастополь  
07 – 10 ноября 2023 г.

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*Конференция посвящена  
300-летию Российской академии наук,  
проводится в рамках научно-технического сотрудничества  
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В сборнике представлены тезисы докладов Международной научно-практической конференции, посвященной обсуждению процессов, определяющих глобальные и региональные климатические аномалии и экологические условия в прошлом, настоящем и будущем; современных технических средств, информационных технологий и математических моделей для прогнозирования широкого спектра природно-техногенных процессов и комплексного научно-методического обеспечения рационального природопользования, безопасности жизнедеятельности и обороноспособности Российской Федерации.

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# ESTIMATION OF ATMOSPHERIC METHANE LEVELS OVER THE REPUBLIC OF TATARSTAN TERRITORY USING SATELLITE REMOTE SENSING DATA

Nikitin O.V.<sup>1</sup>, Kuzmin R.S.<sup>1</sup>, Safin A.A.<sup>2</sup>, Latypova V.Z.<sup>3,4</sup>

<sup>1</sup>LLC Ecoaudit, Kazan, Russia

<sup>2</sup>Center for Children's Creativity "Tankodrom", Kazan, Russia

<sup>3</sup>Kazan Federal University, Kazan, Russia

<sup>4</sup>Research Institute for Problems of Ecology and Mineral Wealth Use of Tatarstan Academy of Sciences, Kazan, Russia

olnova@mail.ru

Methane (CH<sub>4</sub>) is the second most prevalent greenhouse gas after carbon dioxide. Its concentration in the atmosphere has been increasing at an accelerated rate in recent years, primarily attributed to anthropogenic activities. At present, it is feasible to quickly assess atmospheric methane levels using information provided by the European Space Agency's Sentinel-5 Precursor satellite. Access to the data and key operations were conducted through the Google Earth Engine cloud platform. Maps were created using QGIS 3.12. Data processing was carried out using Statistica 10.0 and MS Excel 2007.

As an example, a map of the averaged methane content over the the Republic of Tatarstan territory in 2023 (from January to October) is presented, along with the indicator's trend from 2019 to 2023 (Figure 1). On average, methane concentration in 2019 was 1837±8 (mean ± standard deviation), in 2020 – 1851±13, 2021 – 1867±13, in 2022 – 1871±11, and in 2023 – 1879±11 ppb (parts per billion), respectively.

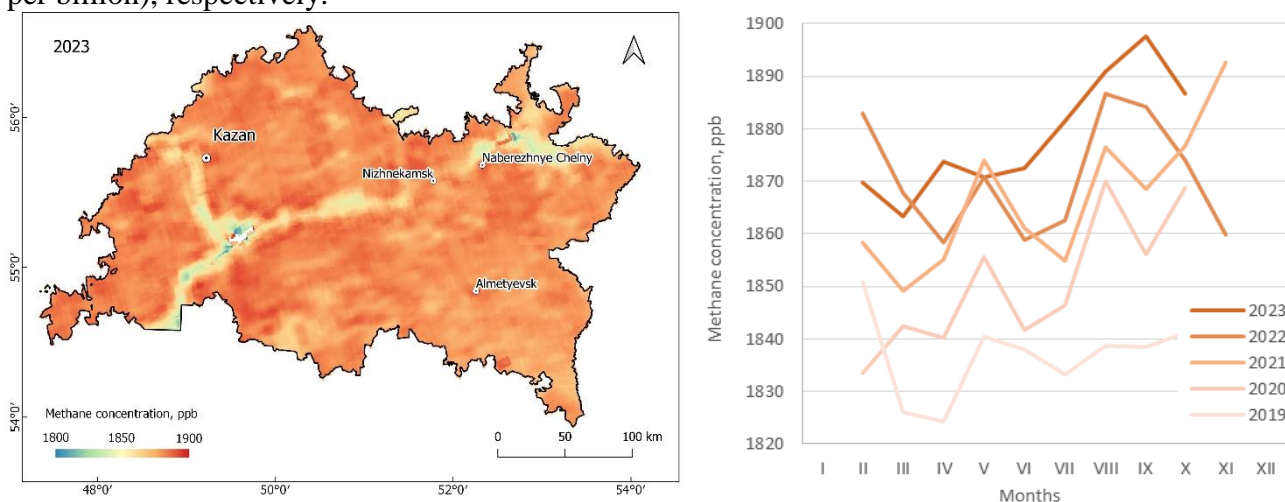


Figure 1 – Average methane concentration in the atmosphere over the Republic of Tatarstan territory in 2023 (left) and the indicator's monthly dynamics from 2019 to 2023 (right)

There is a trend of increasing annual methane background levels. For instance, in comparison to the year 2019, the concentration on the territory of the Republic increased by 2,3% in 2023. Additionally, substantial monthly variations in background methane concentrations are highly noticeable (with the highest values occurring in autumn and the lowest in the spring season). A statistically significant ( $p<0,01$ ) inverse relationship between atmospheric methane content and the degree of forestation of the area and a direct relationship with the percentage of pastures in the region have been identified. It is worth noting that despite the convenience of working with Sentinel-5 Precursor satellite data, due to the strong influence of cloud cover on methane measurements, it is advisable to map its concentration with long-term averaging (monthly, seasonal, annual).

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# NITROGEN DIOXIDE CONTENT ESTIMATION WITHIN THE TROPOSPHERE OVER THE REPUBLIC OF TATARSTAN TERRITORY BASED ON TROPOMI SPECTROMETER DATA

*Nikitin O.V.<sup>1</sup>, Kuzmin R.S.<sup>1</sup>, Vaziev I.I.<sup>2</sup>, Latypova V.Z.<sup>3,4</sup>*

<sup>1</sup>LLC Ecoaudit, Kazan, Russia

<sup>2</sup>Center for Children's Creativity "Tankodrom", Kazan, Russia

<sup>3</sup>Kazan Federal University, Kazan, Russia

<sup>4</sup>Research Institute for Problems of Ecology and Mineral Wealth Use of Tatarstan Academy of Sciences, Kazan, Russia

olnova@mail.ru

Air pollution is one of the primary factors negatively affecting both public health and the environment. Therefore, a comprehensive atmospheric monitoring system is needed, which includes the assessment of the concentration of individual substances. One of the efficient ways to carry out environmental monitoring is satellite remote sensing, for instance, using the European Space Agency's Sentinel-5 Precursor spacecraft. Within the scope of this study, a nitrogen dioxide content estimation within the troposphere over the Republic of Tatarstan territory was performed in 2023 (from January to October). Access to the data and primary operations were carried out using the Google Earth Engine cloud platform. Maps were created in QGIS v.3.12. The processing of the acquired data was performed using the Statistica 10.0 software.

In Figure 1, a map of tropospheric nitrogen dioxide pollution in the Republic of Tatarstan for the year 2023 is presented. On average, the nitrogen dioxide content was  $25 \pm 6 \mu\text{mol}/\text{m}^2$  (mean  $\pm$  standard deviation), ranging from 17 to  $77 \mu\text{mol}/\text{m}^2$  with a variation of 60 units.

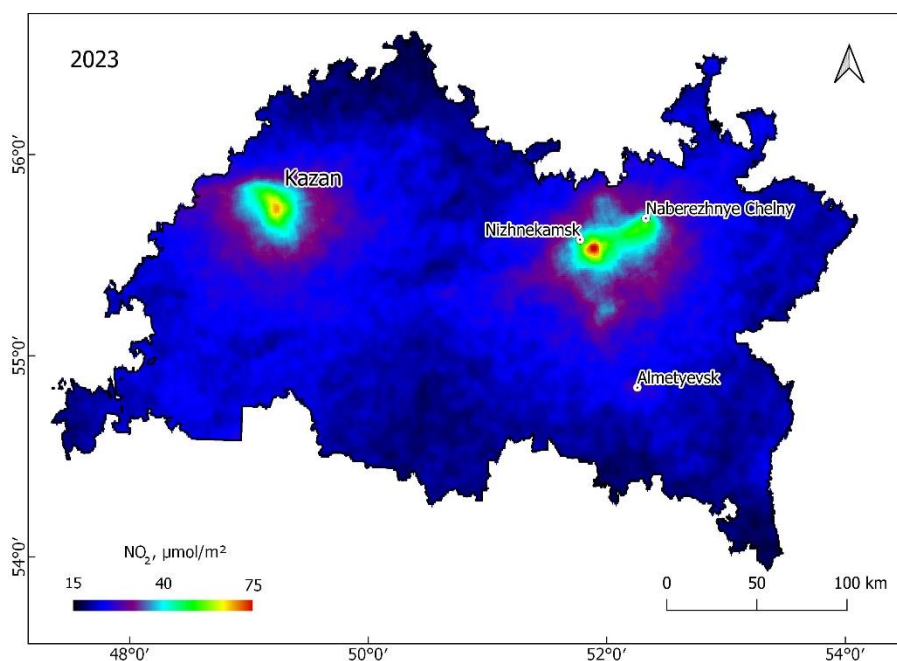


Figure 1 – Averaged nitrogen dioxide concentration in the troposphere over the Republic of Tatarstan territory in 2023 based on satellite monitoring data

Due to the contrast between natural and anthropogenic sources of pollution,  $\text{NO}_2$  is a convenient atmospheric component for satellite-based mapping. As seen in the figure, major metropolitan areas, such as Kazan, Naberezhnye Chelny, Nizhnekamsk, and Yelabuga, are the primary contributors to nitrogen dioxide pollution in the troposphere over the Republic. Owing to the high density of vehicular traffic and the abundance of industrial facilities, these areas display significantly higher concentrations of this gas, far surpassing background levels.

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