

The effects of the war on air pollution in Ukraine

- measured from space -



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**ЧИСТЕ ПОВІТРЯ
ДЛЯ УКРАЇНИ**
cleanair.org.ua

- introduction
- methodology
- key findings
- Limits of the study



Introduction

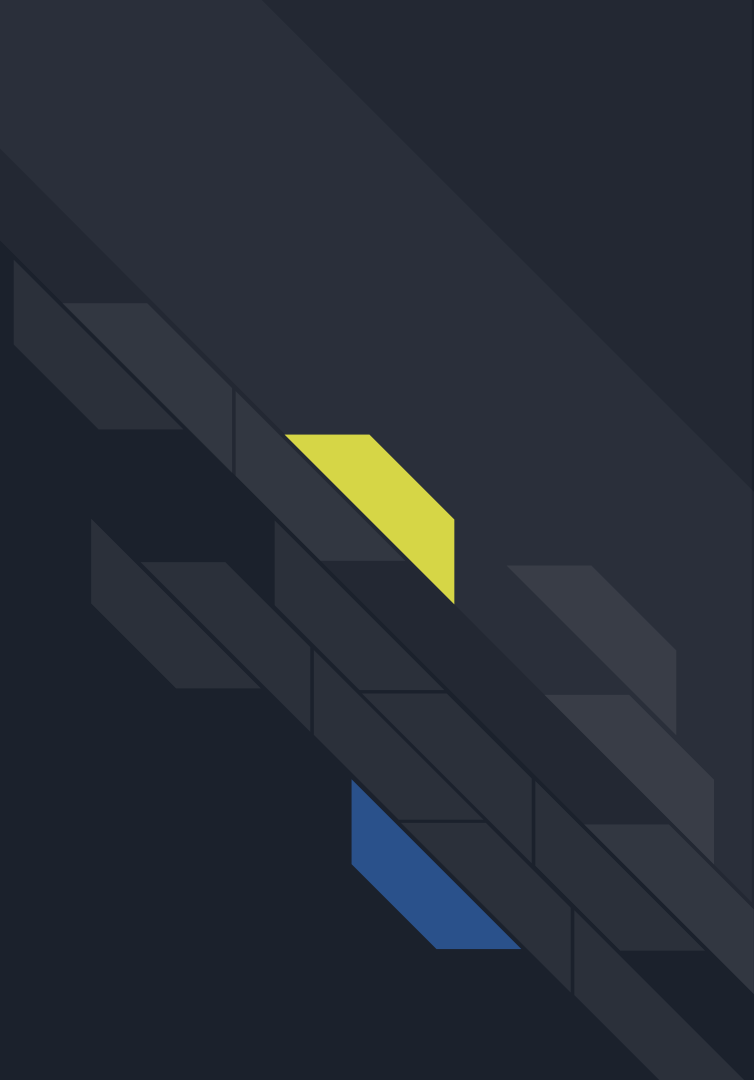




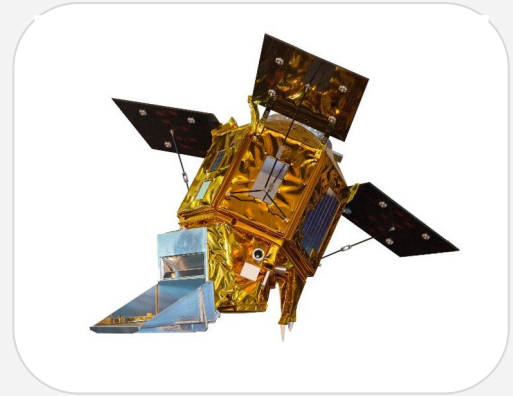
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- WFS is a technology company
- builds on its expertise in EO
- cover a wide range of areas
 - agriculture, environment in cities, air pollution etc.
- **2021 - analyzing air pollution in Ukraine**
 - overall situation
 - impact of industry and population
 - focus on covid-19

Methodology



- Basic data-driven analysis
- Satellite Sentinel-5P data
- Nitrogen dioxide
- Pre-war vs. war period
 - looking for increase in NO₂ values in connection with the shelling of Ukrainian cities (daily based analysis)
 - relationship between depopulation and NO₂ concentrations (long-term analysis)






Nitrogen dioxide

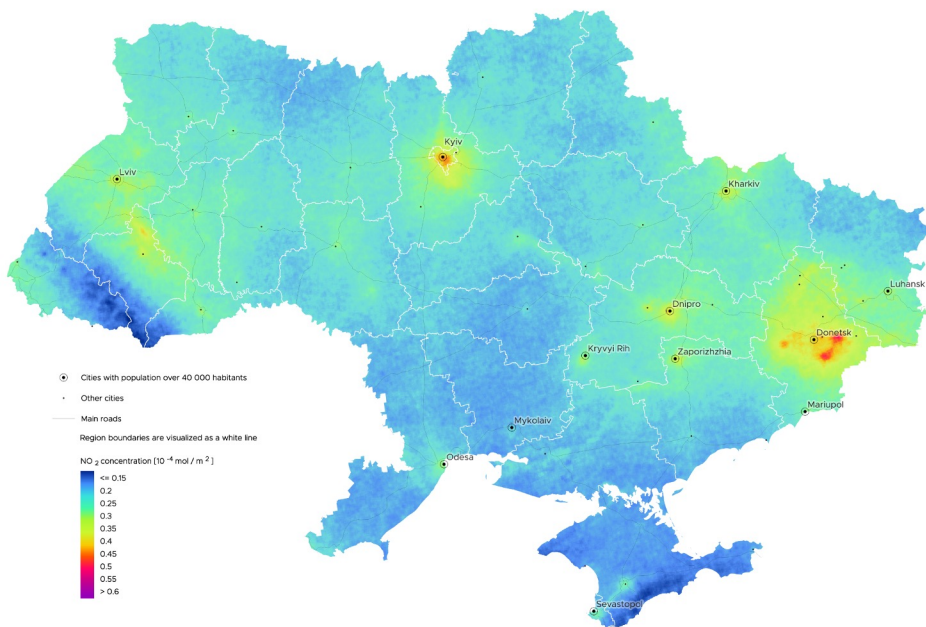
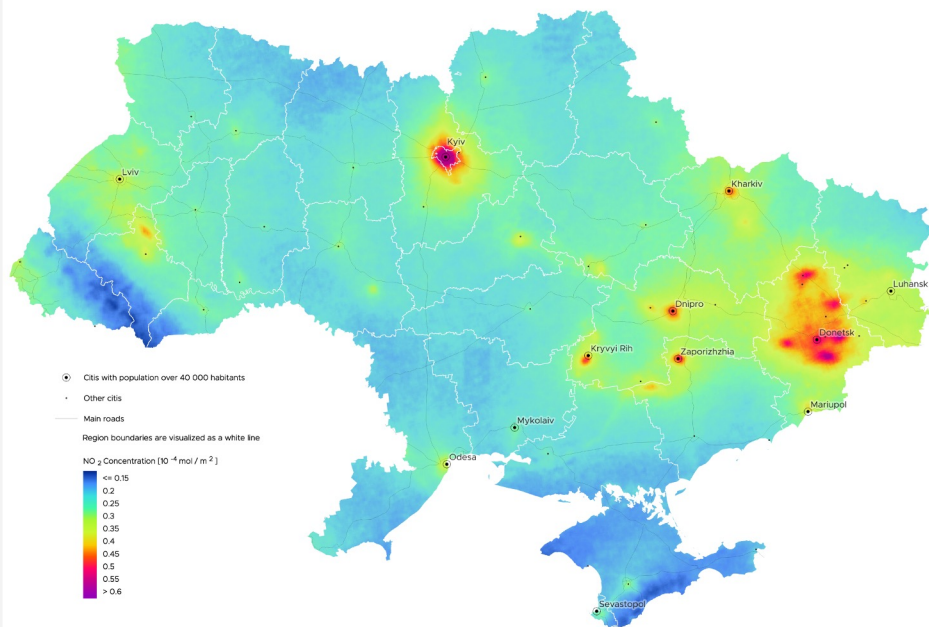
- High degree of correlation with anthropogenic activities
- Main sources of NO₂ during war time
 - military activities
 - industrial activities
 - transport of troops and supplies
 - destruction of infrastructure

Key results

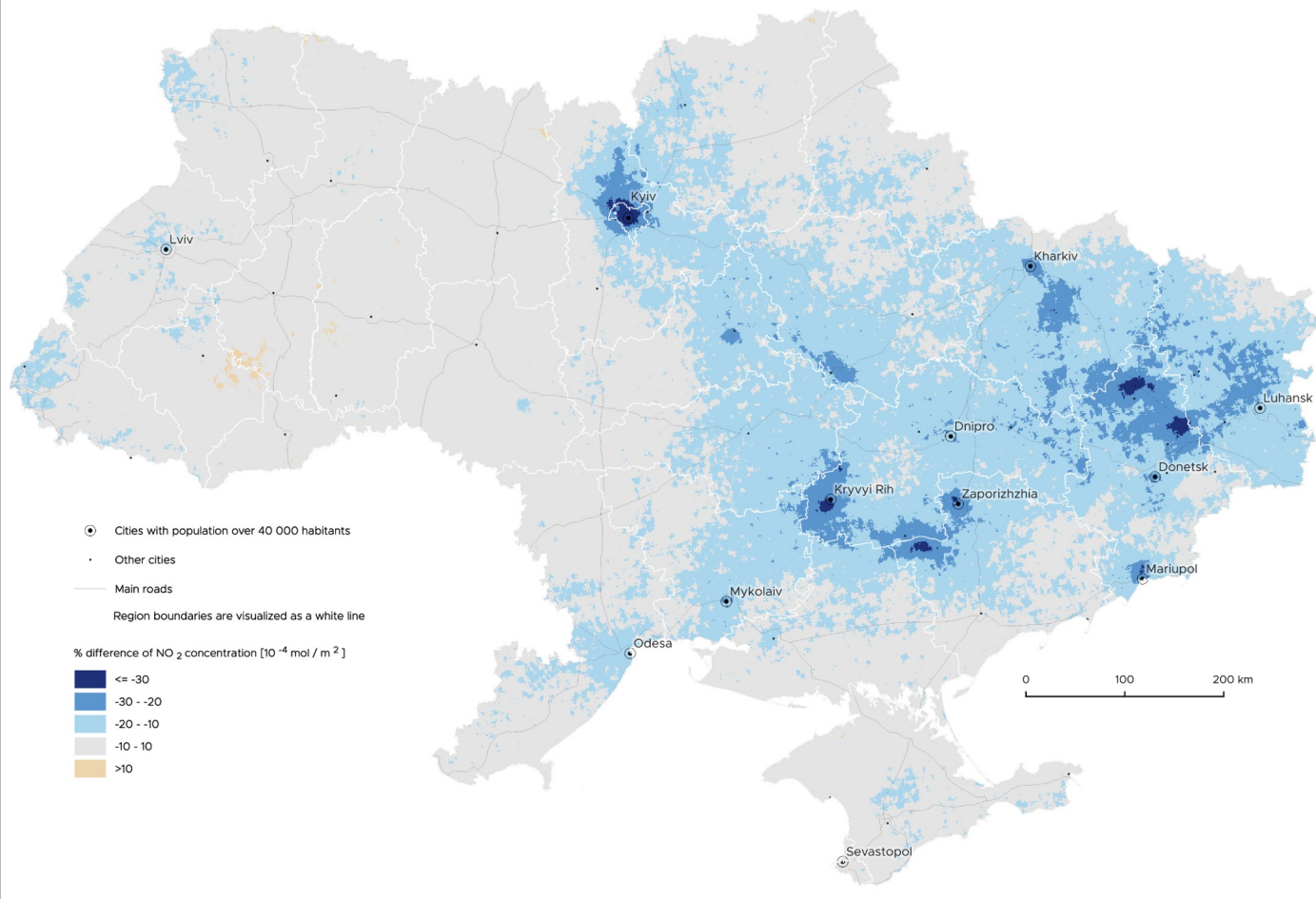


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- Reduction of NO₂ concentration on almost the entire territory of Ukraine.
 - The relation between changes in NO₂ pollution and depopulation
 - SP5 data quality may be insufficient for assessment of individual days - detection of a single explosions on the infrastructure

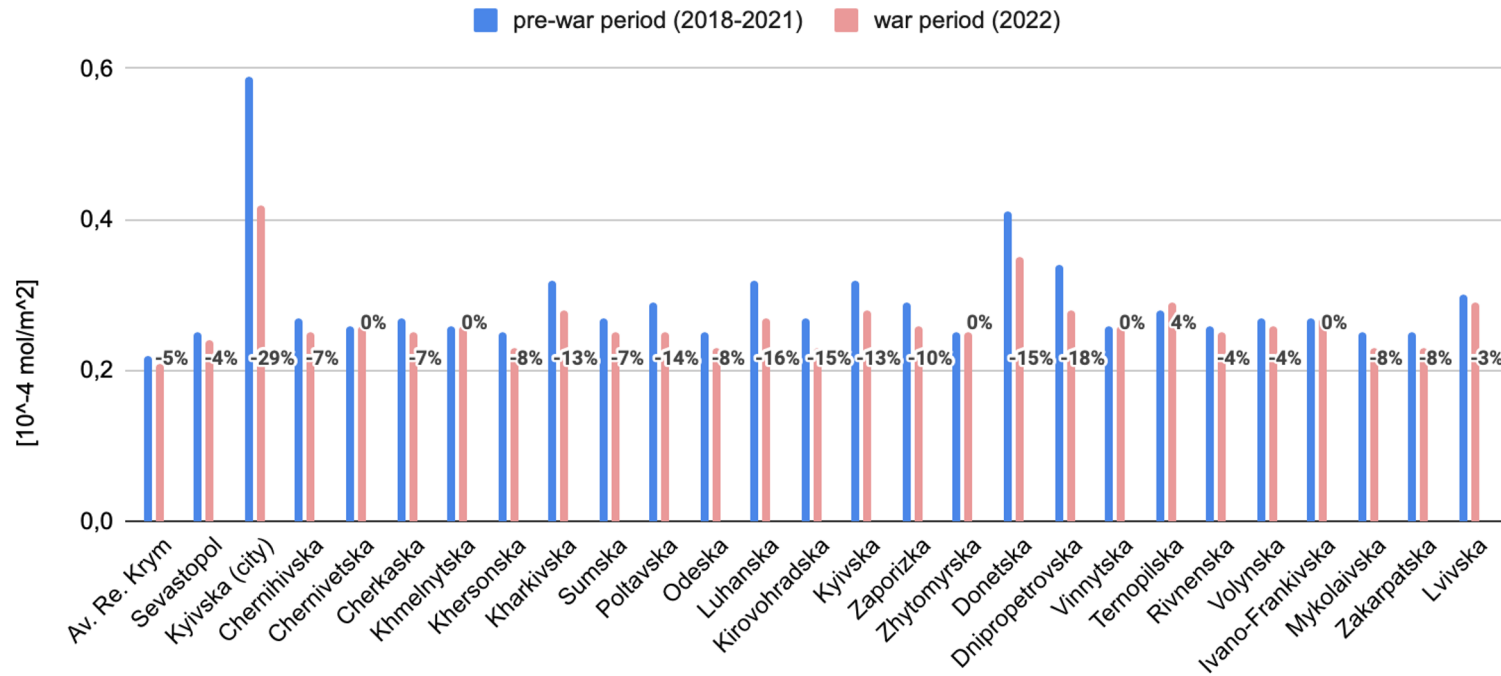
pre-war vs. war period (absolute values)




relative
difference in
concentration
(per pixel)



An average concentration of NO₂ in Ukrainian regions

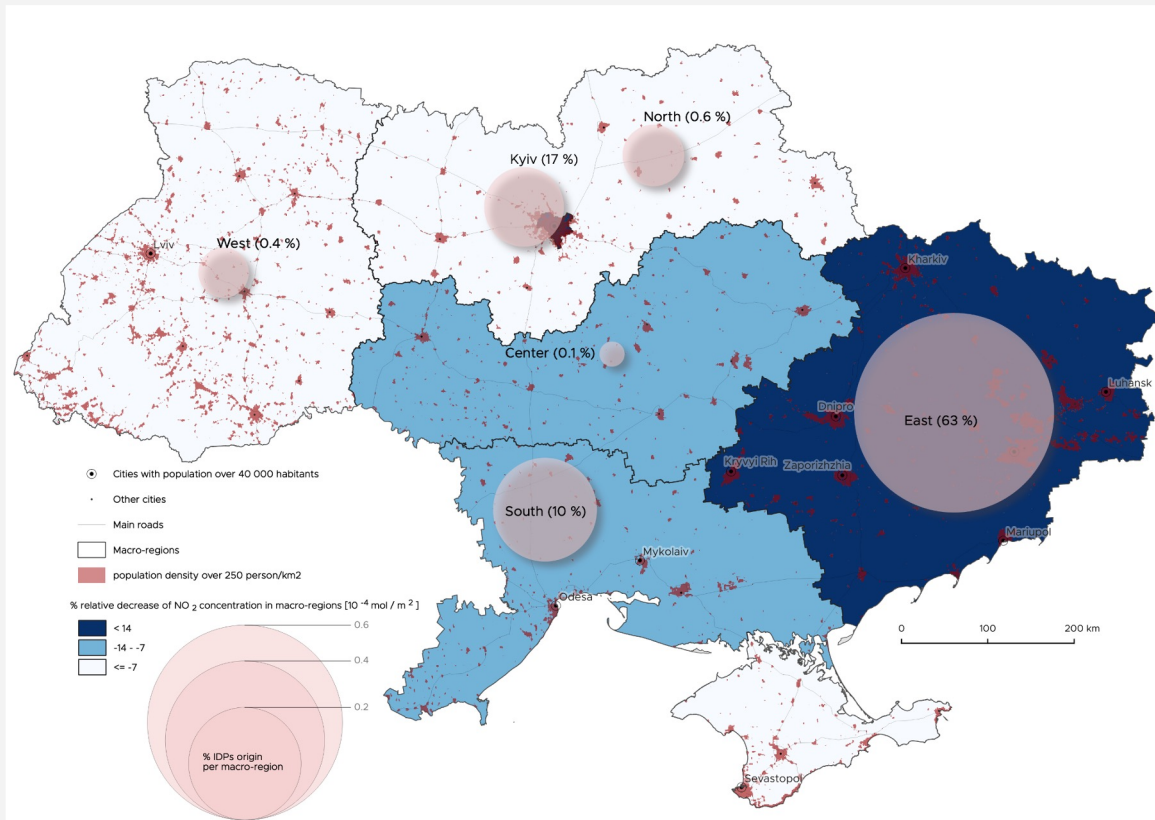
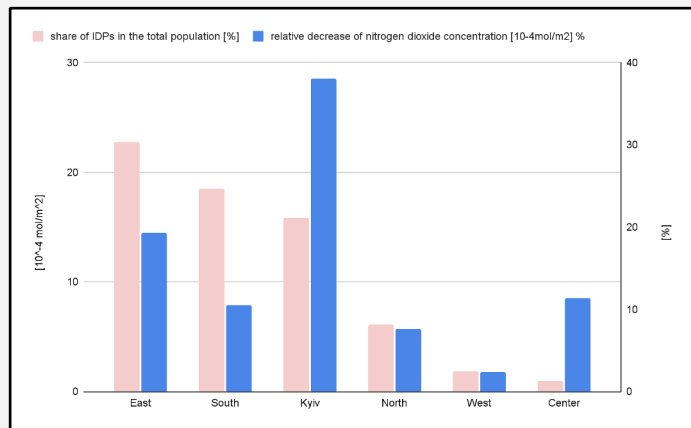




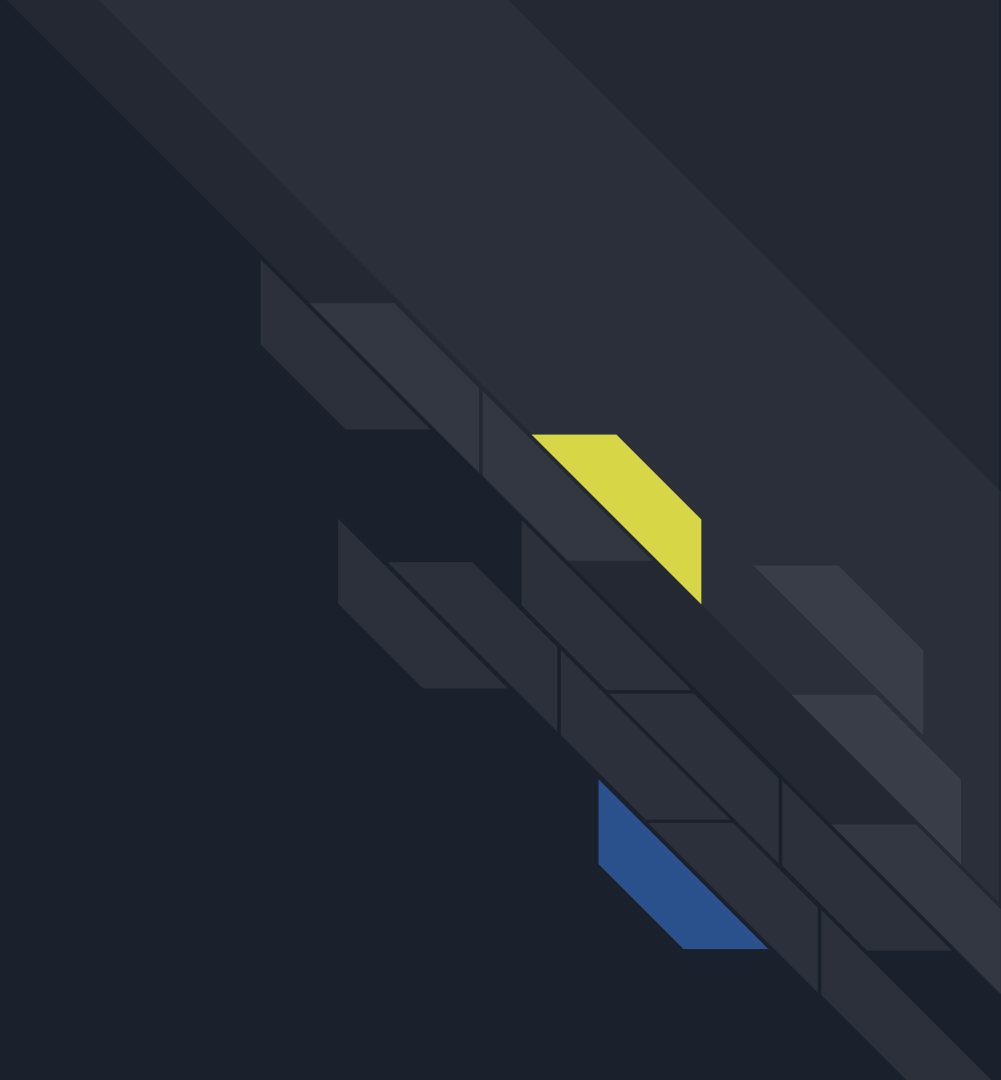
The effect of individual explosions on changes in NO₂ concentrations


Attacks On Ukrainian Industrial Facilities				no ₂ [10 ⁻⁴ mol/m ²]		
number	location	date	event description	pre-war period	war period	event date - max.
1	Sumy	2022-03-18	a fire in a warehouse of paints and varnishes in the city of Sumy	0.31	0.29	0.80
2	Kalynivka	2022-03-24	a Kalibr cruise missile struck the KLO oil depot in Kalynivka, the attack detonated fuel tanks and ignited a massive fire.	0.39	0.32	0.24
3	Chernihiv	2022-03-21	a fire of oil-storage tanks in Chernihiv	0.32	0.26	nodata
4	Lviv	2022-03-27	a fuel-storage facility hit by cruise missiles in Lviv	0.40	0.36	0.35
5	Kremenchuk	2022-04-02	a destruction of a key Ukrainian refinery in Kremenchuk	0.34	0.26	0.15
6	Sievierodonetsk	2022-06-01	a fire in Sievierodonetsk's Azot chemical plant	0.39	0.31	0.27
7	Sievierodonetsk	2022-06-18	a military strike on a compound of Sievierodonetsk's Azot chemical plant	0.39	0.31	0.45

The relationship between changes in NO₂ depopulation



Limits



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- Sentinel-5P
 - It is not easy to detect short-term events with the TROPOMI sensor.
 - cloud cover, no data, natural factors
 - long-term analysis - reflect decrease of pollution

Recommendation





extension of analysis

- Comparison of specific periods when people left and returned
- CAMS data (Copernicus Atmosphere monitoring Service)
 - Pm10, Pm2.5
- environmental impacts
 - fire detection and forest loss

Thank you for your attention

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