

Integrated Assessment of Air Pollution Level in Iasi City, Romania: Facts and Limitations

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"Gheorghe Asachi" Technical University of Iasi, Romania





Outline

1. Air quality in European Union
2. Environmental limits and Romania's status
3. Air quality in Iasi, Romania
4. Impact and risk assessment
5. Limitations, current and further work



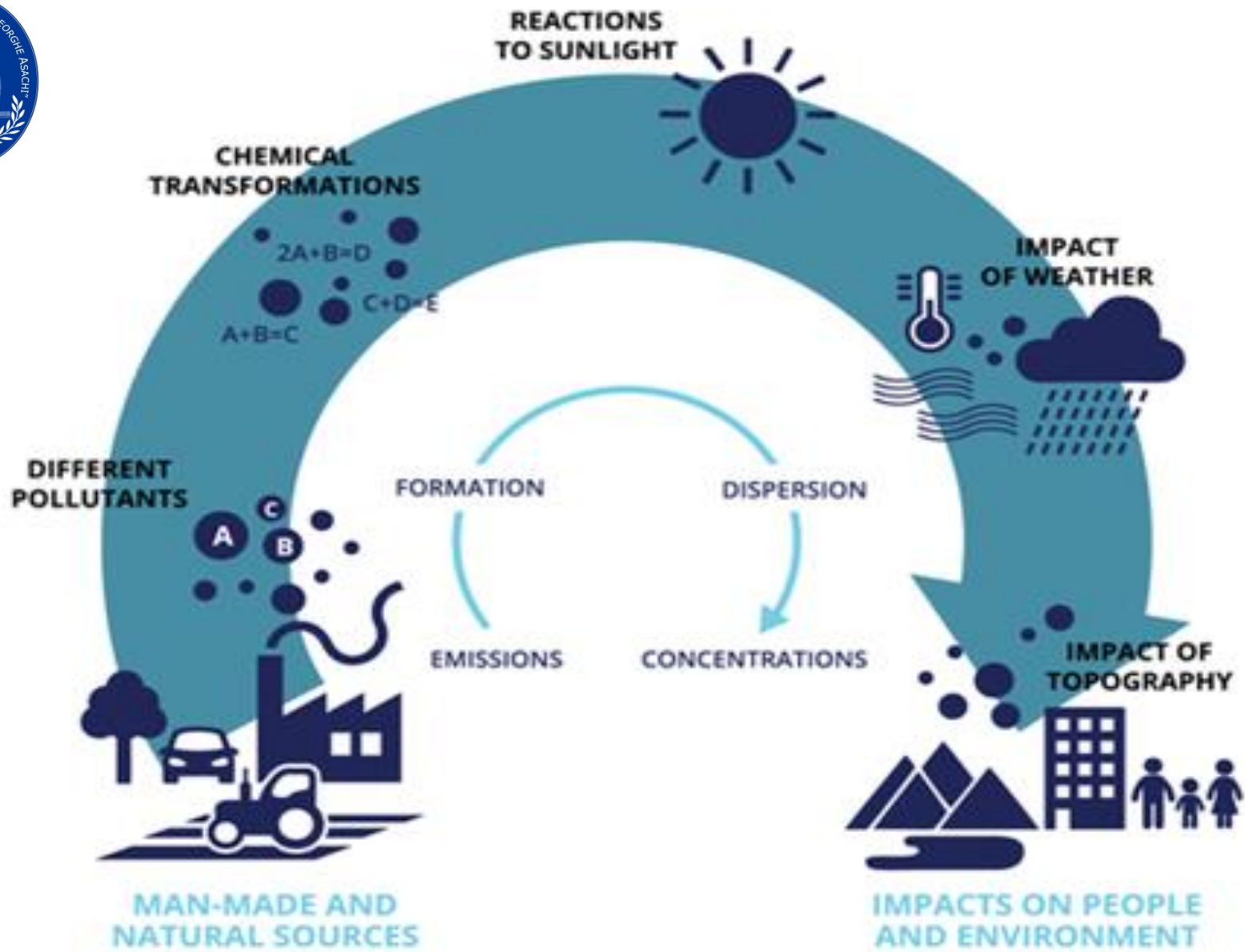
1. Air quality in EU

“Air pollution is causing damage to human health and ecosystems. **Large parts of the population do not live in a healthy environment, according to current standards.**

(...)

Europe will have to be ambitious and go beyond current legislation.”

*Hans Bruyninckx, EEA Executive Director
(July, 2018, www.eea.europa.eu)*



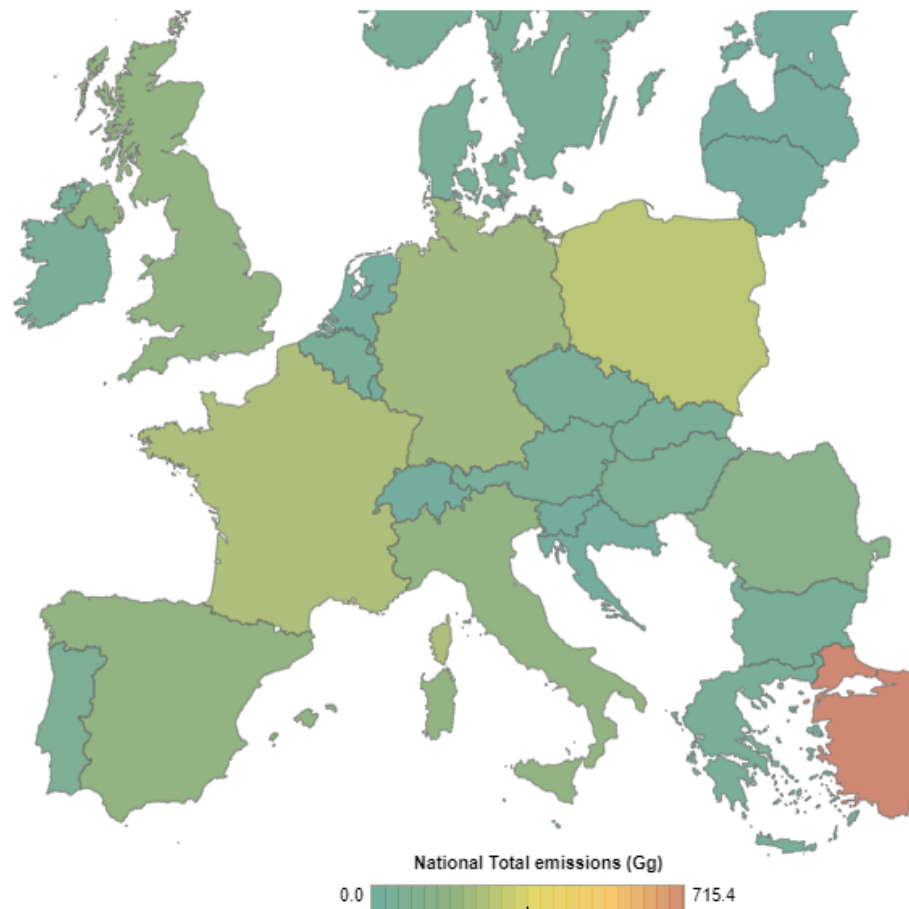


PM2.5 by country (2016)



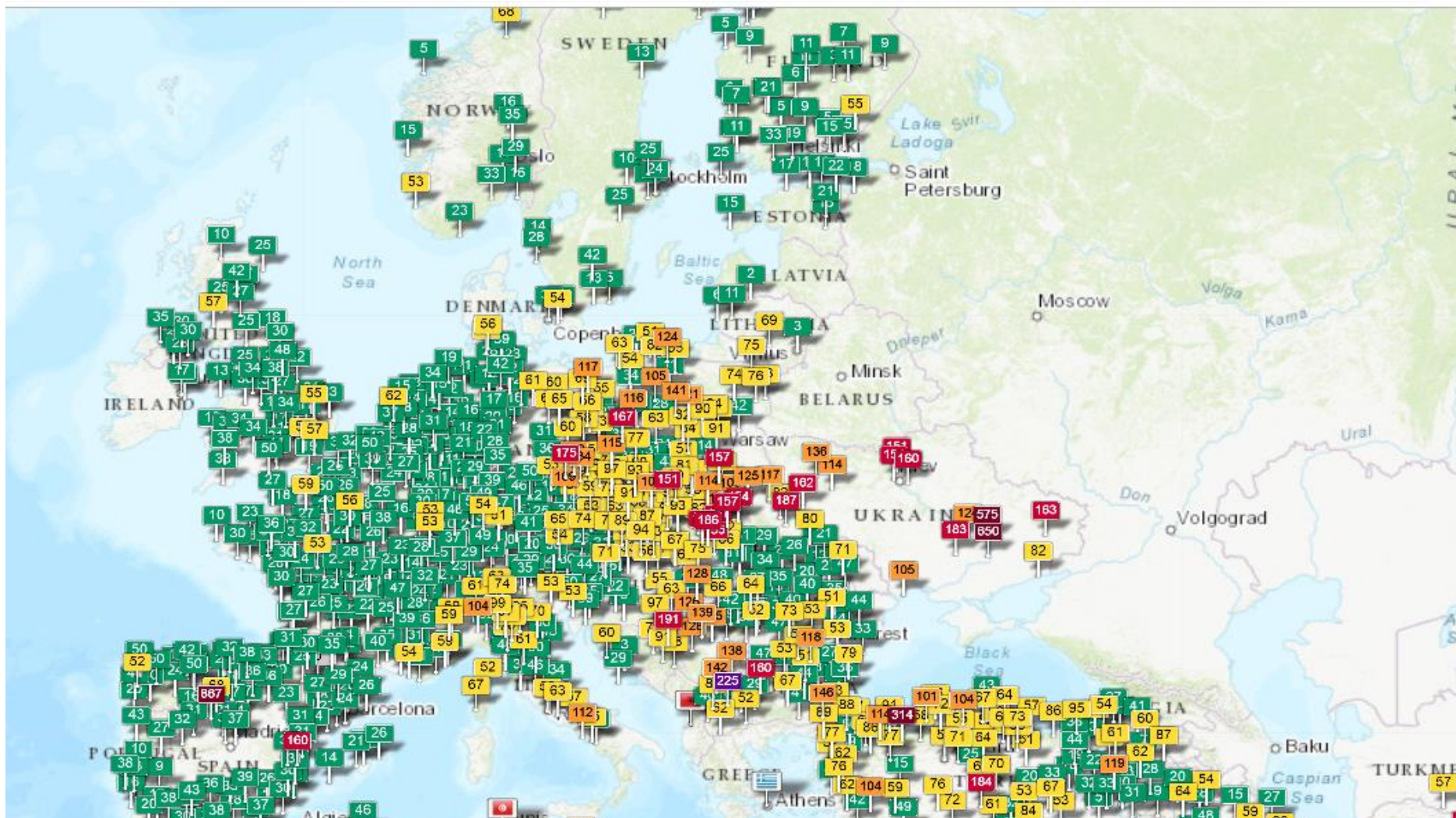
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PM10 by country (2016)



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EEA Report, 2017 (www.eea.europa.eu)



Air Quality Index – Real time monitoring and forecast, 2019

<http://aqicn.org/map/europe/>



EU policies aim **to reduce exposure to air pollution** by reducing emissions and setting limits and target values for air quality. The European Commission adopted **Clean Air Quality Package** including new measures to reduce air pollution.

EEA's work focuses on:

- making a range of air pollution data publicly available,
- documenting and assessing air pollution trends and related policies and measures in Europe, and
- investigating the trade-offs and synergies between air pollution and policies in different areas, including climate change, energy, transport and industry.



2. Environmental limits – Romania's status

Priority objective 1

Eutrophication of terrestrial ecosystems due to **air pollution**
Agricultural land: **nitrogen balance**
Urban land take
Forest utilization
Marine fish stocks
Common birds and butterflies
EU protected species and habitats
Surface waters

Priority objective 2

Resource efficiency
Waste generation
Recycling of municipal waste
Freshwater use
Greenhouse gas emissions
Renewable energy sources
Energy efficiency
Household energy consumption
Transport greenhouse gas emissions
Food consumption
...

Priority objective 3

Priority objective 3

Outdoor air quality in urban areas
Air pollutant emissions
Quality of bathing waters
Number of countries that have adopted a climate change strategy/plan
Environmental noise
Consumption of hazardous chemicals
Pesticide sales

To protect, conserve and enhance the EU natural capital

To turn the economy into a resource-efficient, Green economy

To safeguard the Union's citizens from environment-related pressures and risks to health and well-being



Air quality in urban areas: pollutants, limits and exposures

Air Quality Directive				WHO guidelines	
Pollutant	Averaging period	Objective	Comments	Objective	Comments
PM _{2.5}	One day			25 µg/m ³ (*)	99 th percentile (3 days/year)
PM _{2.5}	Calendar year	Limit value, 25 µg/m ³		10 µg/m ³	
PM ₁₀	One day	Limit value, 50 µg/m ³	Not to be exceeded on more than 35 days per year.	50 µg/m ³ (*)	99 th percentile (3 days/year)
PM ₁₀	Calendar year	Limit value, 40 µg/m ³ (*)		20 µg/m ³	
O ₃	Maximum daily 8-hour mean	Target value, 120 µg/m ³	Not to be exceeded on more than 25 days per year, averaged over three years	100 µg/m ³	
NO ₂	One hour	Limit value, 200 µg/m ³ (*)	Not to be exceeded more than 18 times a calendar year	200 µg/m ³ (*)	
NO ₂	Calendar year	Limit value, 40 µg/m ³		40 µg/m ³	

Air quality standards, under the **EU Air Quality Directive**, and **WHO air quality guidelines** (source: EU, 2008; WHO, 2006)

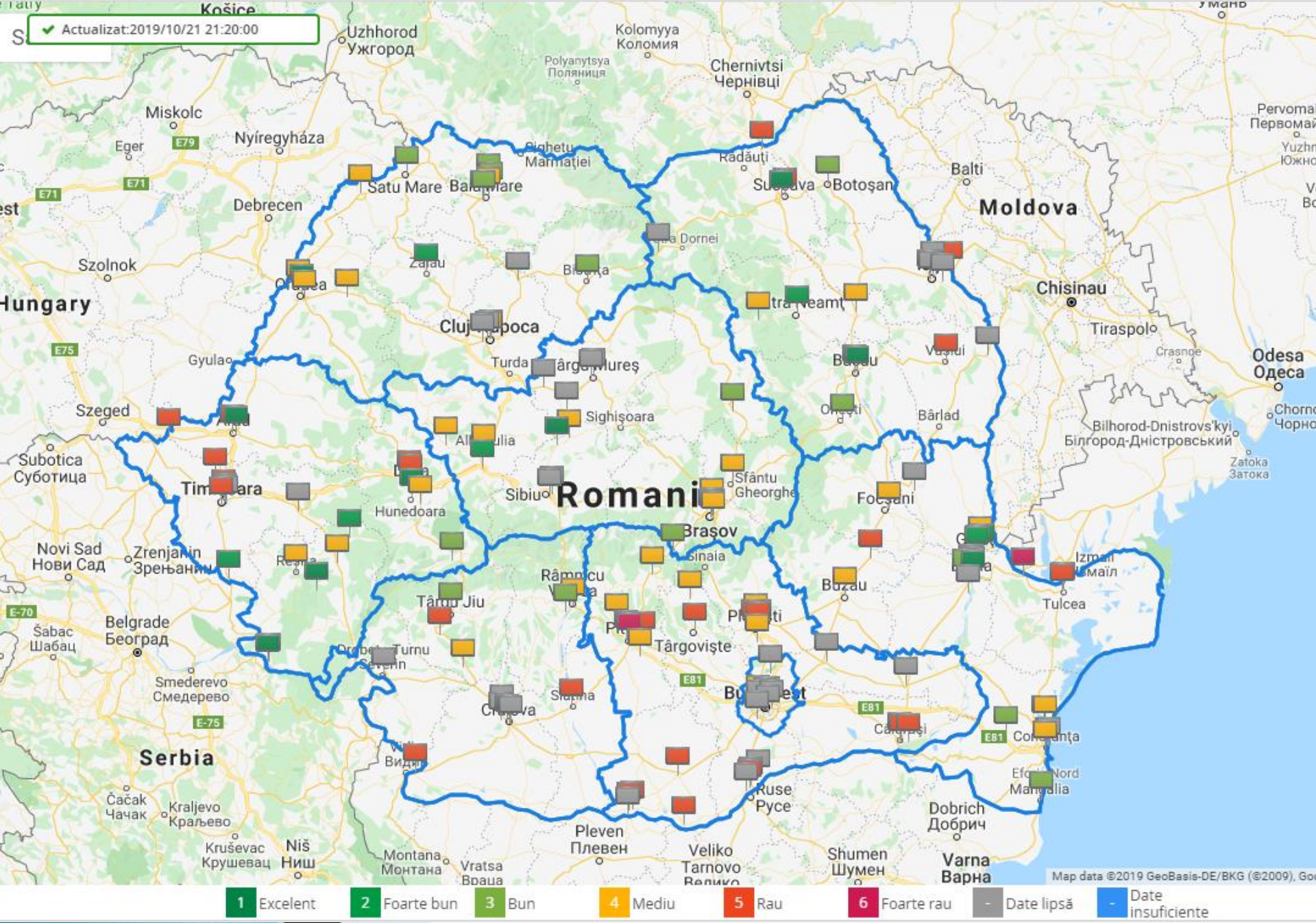


Air quality in urban areas: pollutants, limits and exposures

Pollutant	EU reference value (a)	Exposure estimate (%)	WHO AQG (a)	Exposure estimate (%)
PM _{2.5}	Year (25)	7-8	Year (10)	82-85
PM ₁₀	Day (50)	16-20	Year (20)	50-62
O ₃	8-hour (120)	7-30	8-hour (100)	95-98
NO ₂	Year (40)	7-9	Year (40)	7-9
BaP	Year (1)	20-25	Year (0.12) RL	85-91
SO ₂	Day (125)	< 1	Day (20)	20-38

Key	< 5 %	5-50 %	50-75 %	> 75 %

(source: EEA Report No 13/2017)



- 1
- Excelent
- 2
- Foarte bun
- 3
- Bun
- 4
- Mediu
- 5
- Rau
- 6
- Foarte rau
-
- Date lipsă
-
- Date insuficiente

Mass media debate



Three Romanian cities risk EU sanctions due to air pollution

Posted by: Anca Bernovici in BUSINESS, NEWS September 28, 2017
 Comments Off on Three Romanian cities risk EU sanctions due to air pollution

25,000 Europeans die every year because of air pollution, statistics shows. According to European Commission, three major Romanian cities could be sanctioned by Brussels officials, as digi24.ro informs. It's about Bucharest, Iasi and Brasov.

On the other hand, the Ministry of Environment claims that Romania has no problems with pollution, using data that centralizes the information of 100 stations monitoring the air quality. Moreover, the ministry notes that there is no problem in these three major cities in this context.

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- Dacian Cioloș: We must get to early elections. „Dragnea invents conspiracies”
- Romania, the second country in CEE that attracted the largest private equity investment in 2017, Invest Europe data shows

RECENT COMMENTS

- Bryan Davidson on Social Democrats start the offensive against protesters. Israel's Embassy slams MP Bacalbasa's comparison between Diaspora rally and Gaza Strip developments
- Bryan Davidson on Judicial Inspectorate conducts checks on the prosecutors who started the investigation of August 10 rally
- Bryan Davidson on It is possible that Gazprom is the main shareholder of OMV, Premier's adviser Valcov says. Offshore law, President Iohannis – targeted. OMV Austria – no comment
- Bryan Davidson on It is possible that Gazprom is the main shareholder of OMV, Premier's adviser Valcov says. Offshore law, President Iohannis – targeted. OMV Austria – no comment
- Bryan Davidson on It is possible that Gazprom is the main shareholder of OMV, Premier's adviser Valcov says. Offshore law, President Iohannis – targeted. OMV Austria – no comment

CATEGORIES

- AGRICULTURE
- ASTROLOGY



3. Air quality in Iasi city, Romania



Iasi county: 9390,83 ha
Iasi city: 371889 inhabitants





Monitoring network and type of pollutants

Monitoring stations in Iasi city:

- IS-1 Podu de Piatră
- IS-2 Decebal-Cantemir
- IS-3 Oancea-Tătărași

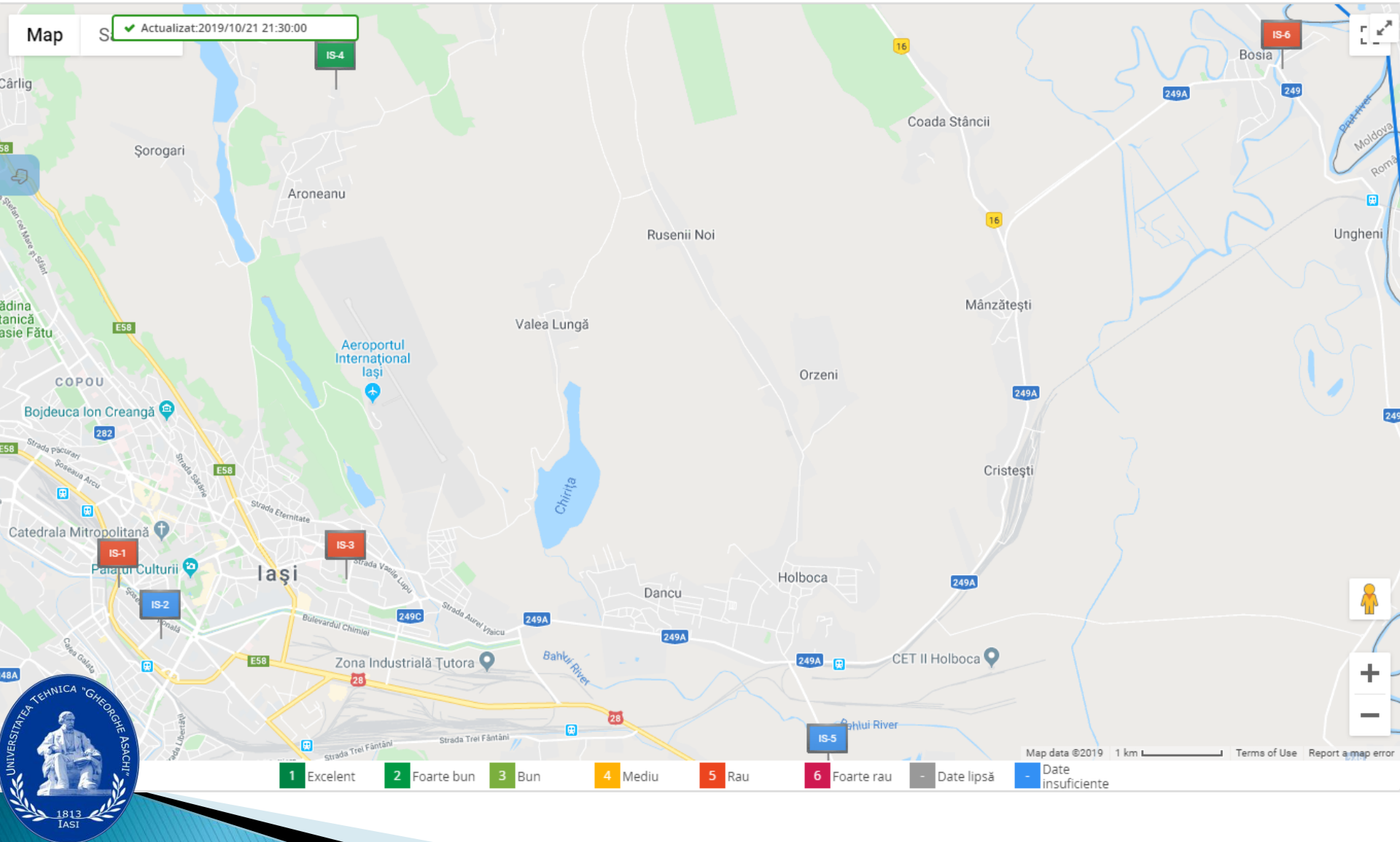
Pollutants:

PM_{2.5} and PM₁₀, SO₂, NO_x, CO, O₃



Iasi city EPA reported data

(source: www.calitateaer.ro)



Han Tatar, Iasi Air Pollution: Real-time Air Quality Index (AQI)

STR. HAN TATAR,
IASI

BDUL. N. IORGA,
IASI

COMUNA
UNGHENI,

STR. STEFAN CEL
MARE, VASLUI

STR. RECEA, HUSI

STR. IZVOARE,
BACAU



LOCATE THE
NEAREST CITY



SEARCH FOR
YOUR CITY

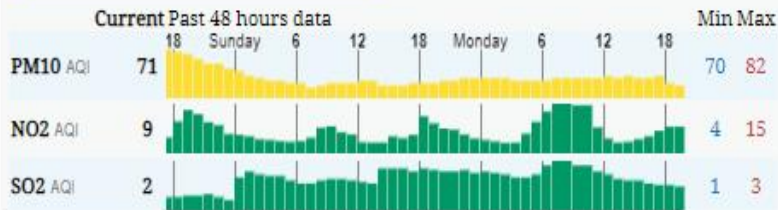
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Moderate

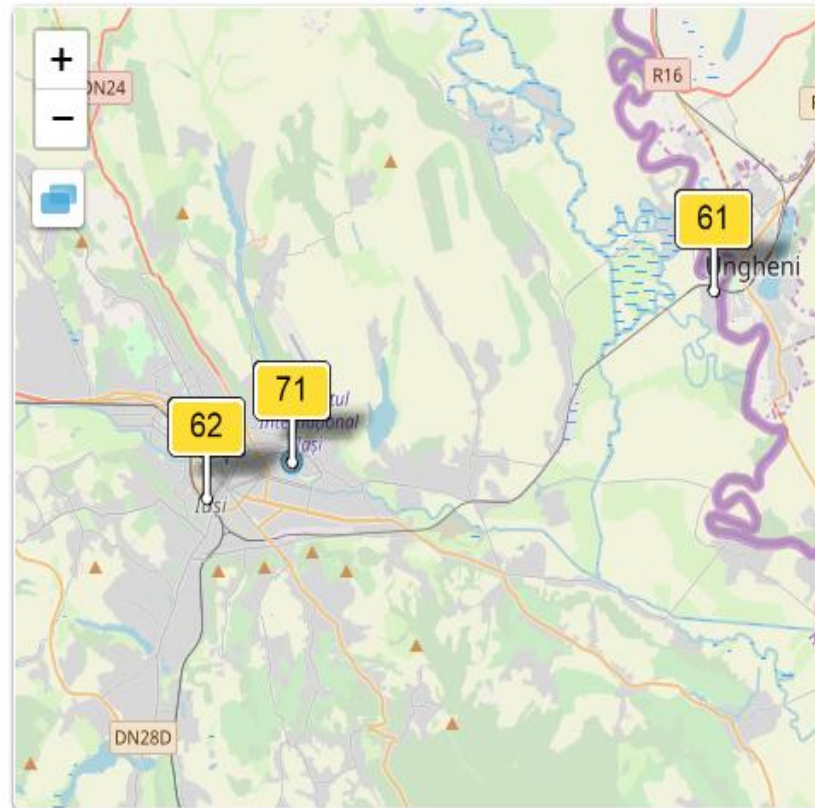
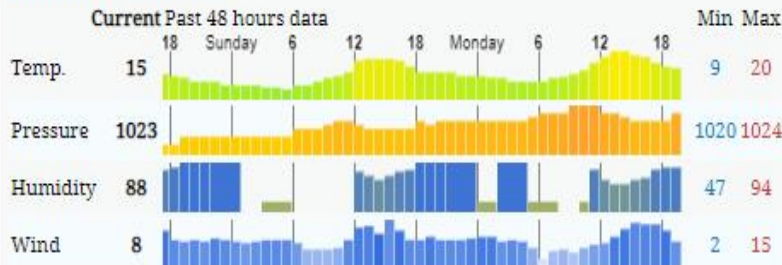
Updated on Monday 20:00
Temp.: 15°C

Current Past 48 hours data



Weather Information

Current Past 48 hours data



HOME

HERE

MAP

MASK

FAO

SEARCH

CONTACT

LINKS



Bdul. N. Iorga, Iasi Air Pollution: Real-time Air Quality Index (AQI)

BDUL. N. IORGA,
IASI

STR. HAN TATAR,
IASI

COMUNA
UNGHENI,

STR. STEFAN CEL
MARE, VASLUI

STR. RECEA, HUSI

STR. IZVOARE,
BACAU



LOCATE THE
NEAREST CITY



SEARCH FOR
YOUR CITY

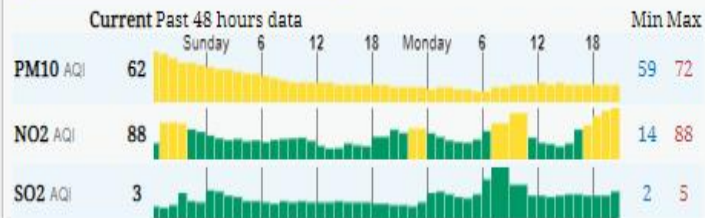
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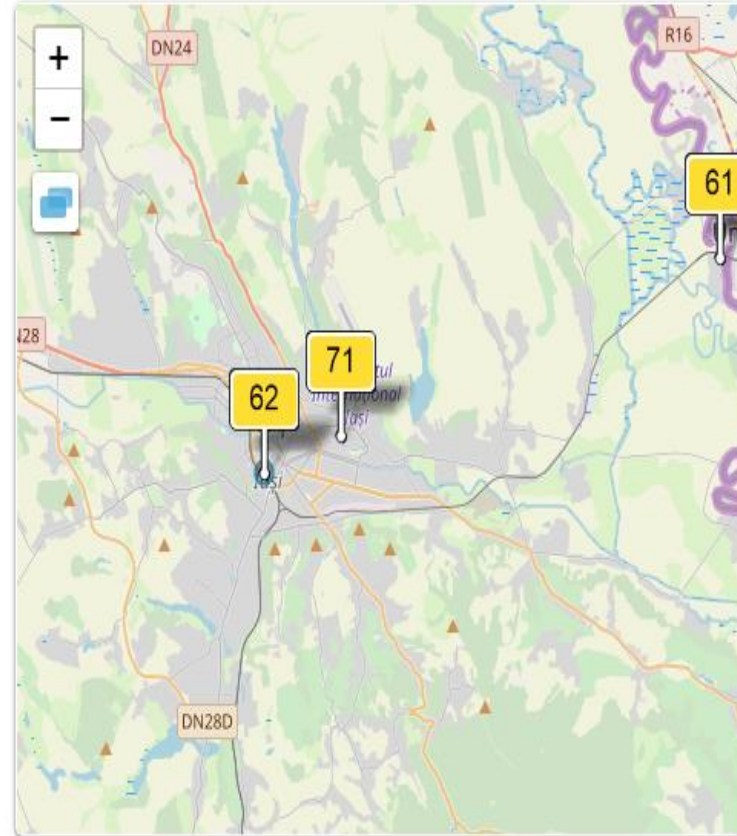
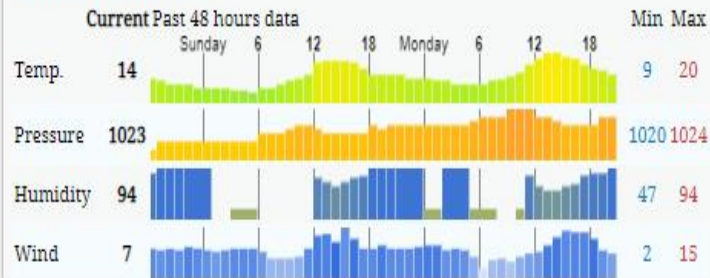
Moderate

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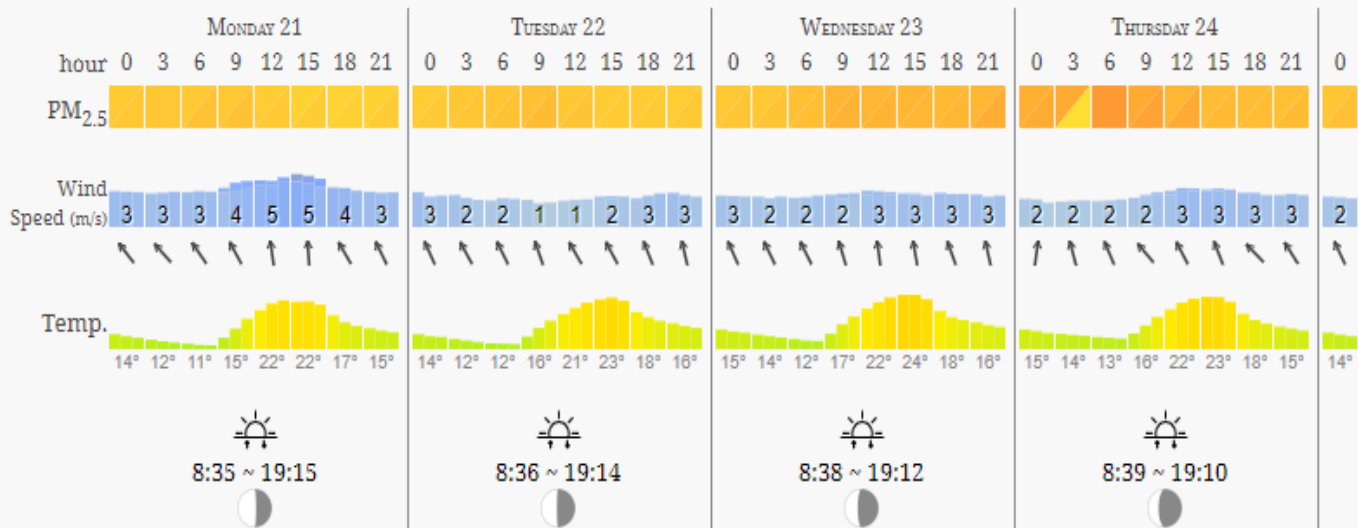
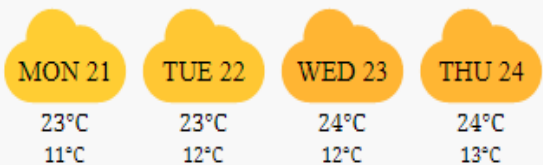
Temp.: 14°C



Weather Information



AIR QUALITY FORECAST



www.aqicn.org



4. Impact and risk assessment – Methodology

Science of the Total Environment 626 (2018) 133–41

Contents lists available at ScienceDirect

Science of the Total Environment

Journal homepage: www.elsevier.com/locate/scitotenv



Assessment of heavy metal pollution and human health risks in urban soils around an electronics manufacturing facility

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HIGHLIGHTS

- Metal accumulation was detected in urban soil around an electronics manufacturing facility.
- Chromium, zinc, and lead were the most abundant metals detected.
- Risk assessment results indicate that there will may pose health risks.

GRAPHICAL ABSTRACT



ABSTRACT

Heavy metal pollution has pervaded many parts of the world, especially in developing countries. The purpose of the study was to determine the concentrations and health risks of heavy metals in urban soils around an electronics manufacturing site in the Hubei Province of China. Soil samples were collected from commercial, residential, and residential areas around the electronics manufacturing facility. A total of 120 topsoil samples were collected, and these samples were analyzed for Cr, Cu, Zn, As, Cd, Ni, and Pb. The geoaccumulation index (I_{geo}), pollution index (PI), and potential ecological risk index (PERI) were calculated to assess the soil pollution levels. The hazard index (HI) was used to assess the human health risks posed by the presence of heavy metals. The total concentrations of the seven elements (Σ metals) ranged from 27368 to 57325 mg kg⁻¹, and the average values were highest in the residential area followed by the commercial area, and the residential area. The HI for children and adults decreased in the order of Cr > As > Pb > Cd > Cu > Ni > Zn. The carcinogenic risk of two metals, namely, Cr and As, for children and adults were higher than 10⁻⁶, and children had greater risk than adults.

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ARTICLE INFO

Article history:
Received 1 October 2017
Received in revised form 14 February 2018
Accepted 15 February 2018
Available online 20 February 2018

Editor: Tadeusz Góral

Keywords:
Heavy metal pollution
Electronics manufacturing facility
Pollution index
Health risk

1. Introduction

Heavy metals such as chromium (Cr), copper (Cu), zinc (Zn), arsenic (As), cadmium (Cd), nickel (Ni), and lead (Pb), which are generally

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Chemosphere 201 (2018) 405–411

Contents lists available at ScienceDirect

Chemosphere

Journal homepage: www.elsevier.com/locate/chemosphere



Health risk assessment of the workers exposed to the heavy metals in e-waste recycling sites of Chandigarh and Ludhiana, Punjab, India

Manmohit Singh, Parteek Singh Thind, Siby John^{*}

Department of Civil Engineering, Punjab Engineering College, Chandigarh 160012, India

HIGHLIGHTS

- Soil, working platform dust and dermal samples of the workers analyzed for the presence of heavy metals in the e-waste dismantling sites of Chandigarh and Ludhiana, Punjab, India.
- Ba, Cu, Pb and Zn were identified as major pollutants in these e-waste dismantling sites.
- Lead was the major metal of concern which poses health risk to adults and children through ingestion of soil and dust.
- Hazard index value for Pb and Cu from exposure to contaminated dust in adults was 0.73 and 0.52, respectively.
- Adults were found to have the life time risk of cancer from exposure to Cr (3.4E-03) in contaminated soil.

ARTICLE INFO

Article history:
Available online 21 March 2018
Handling Editor: A. Cal

Keywords:
E-waste
Carcinogenic and non-carcinogenic health hazard
Heavy metals
Human health risk assessment

ABSTRACT

Investigations were made to analyze the effects of heavy metals on the adults and children working in informal e-waste recycling sectors of Chandigarh and Ludhiana, Punjab, India. Soil samples of the ground where recycling was being done, dust from the platform where recycling activities were done and dermal samples of workers were collected to estimate the presence of heavy metals (As, Cu, Cr, Cd, Ni, Fe, Zn, Pb, Ba) in them. High concentration of Ba, Cu, Pb and Zn was observed in the soil and dust samples. Cr, Pb and Zn were observed in high concentrations in dermal samples. These heavy metals could cause serious health effects. Therefore, human health risk assessment was also done using carcinogenic (cancer risk potency factor) and non-carcinogenic (health hazard index) health risk assessment. Carcinogenic hazards were not reported in children however, hazard index for soil and dust contamination for some heavy metals was found significant (soil samples: As = 1.83, Cr = 1.38, Cu = 4.5 and Pb = 5.32 and dust samples: Pb = 2.97). Carcinogenic hazards were reported in adults from Cr contamination in soil samples (3.4E-03).

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1. Introduction

E-waste management is one of the crucial matters of the 21st century that need to be handled on priority. In developed nations, e-waste is managed in many ways such as storage, recycling or dumping on municipal landfill sites. On the other side, in developing countries e-waste management is not in a good condition because of the leniency adopted while implementing the e-waste handling legislations. Large proportion of the e-waste generated in these countries is dumped into municipal landfills. The situation had become worse when developed nations started dumping their

unmanaged e-waste into the grounds of developing nations. According to UNEP (2005) approximately 30–80% of the e-waste generated in developed nations is dumped into the developing nations such as India, Pakistan, China, Vietnam, Philippines and many other nations of Africa continent (United Nations Environment Protection (UNEP), 2005; Schmidt, 2006a). Studies have also reported that United States of America (USA) dumps about 80% of its e-waste into Asian and African countries (Schmidt, 2006a,b; Johnson, 2006; Puckett et al., 2002; Singh et al., 2017). Moreover, USA is the only developed country that pulled out from signing the UN Basel Convention, whose motive is to ban the export of e-waste to developing countries (United Nations Environment Protection (UNEP), 2005; United Nations Environment Protection (UNEP), 1992; Today, 2002).

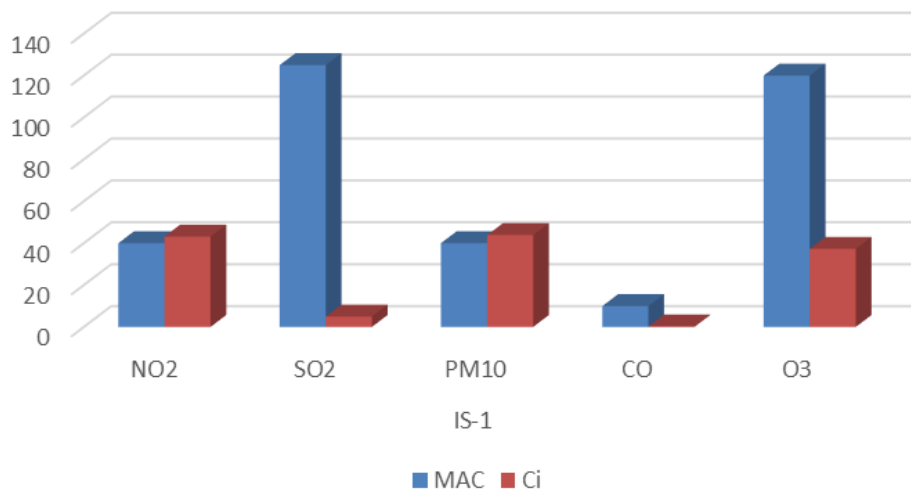
Along with dumping of e-waste from developed countries, lands

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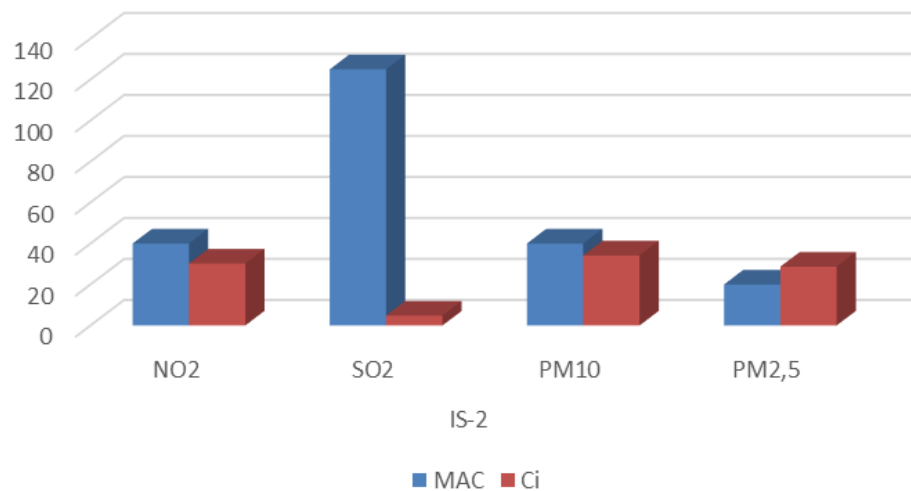


Measured concentrations (annual average)

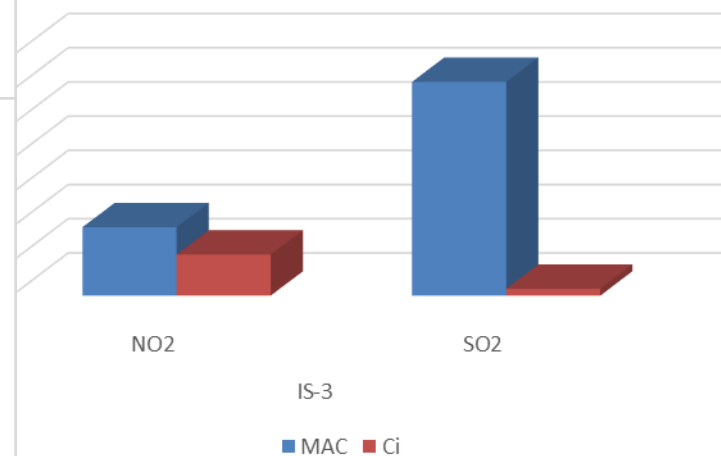
IS-1



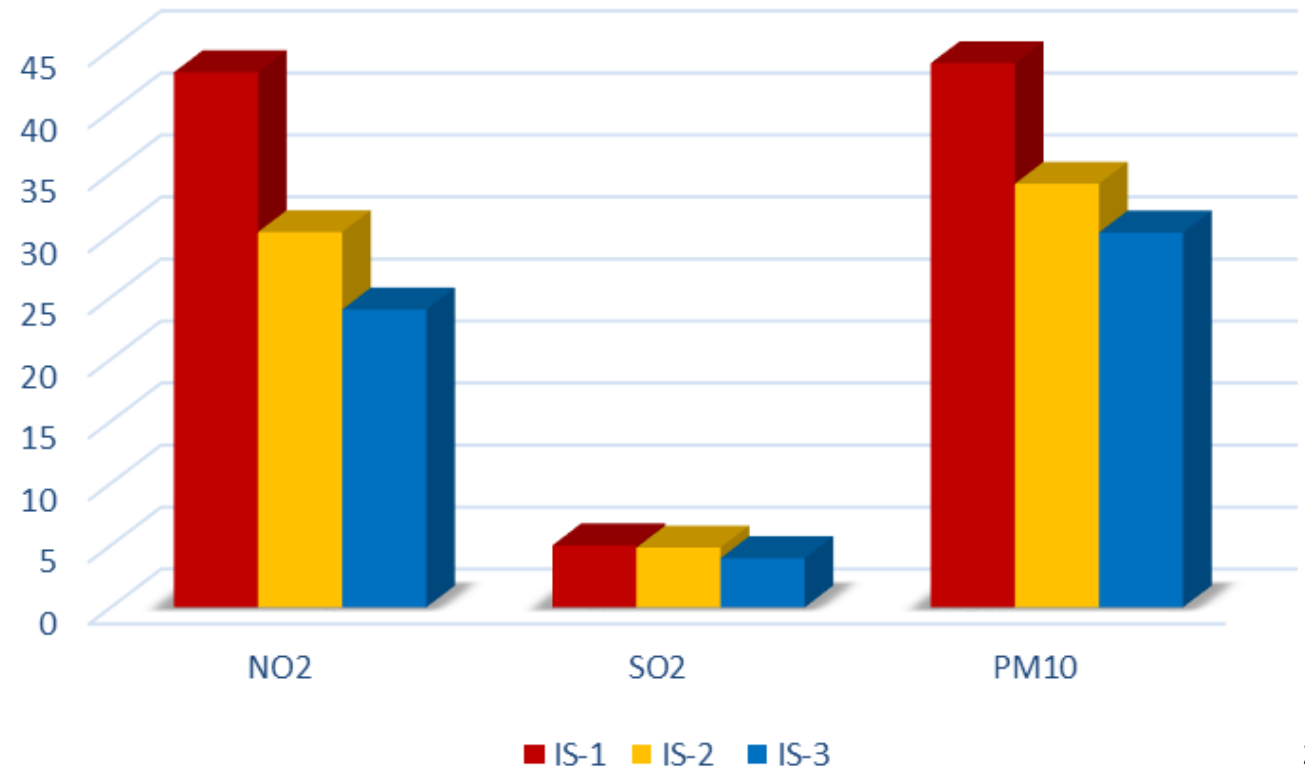
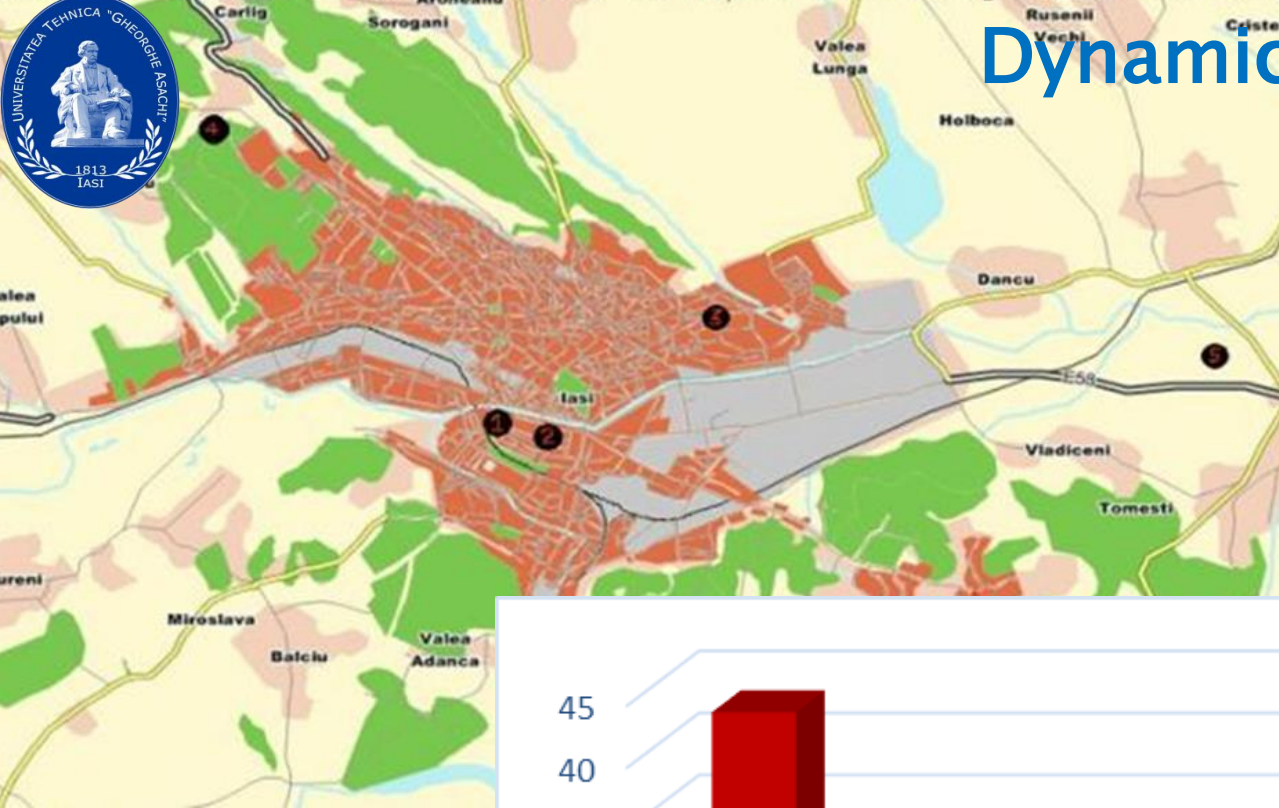
IS-2



IS - 3



Dynamic of pollutants





Air pollution index (PI)

$$PLI = (PI_1 \times PI_2 \times PI_3 \times \dots \times PI_n)^{\frac{1}{n}}$$

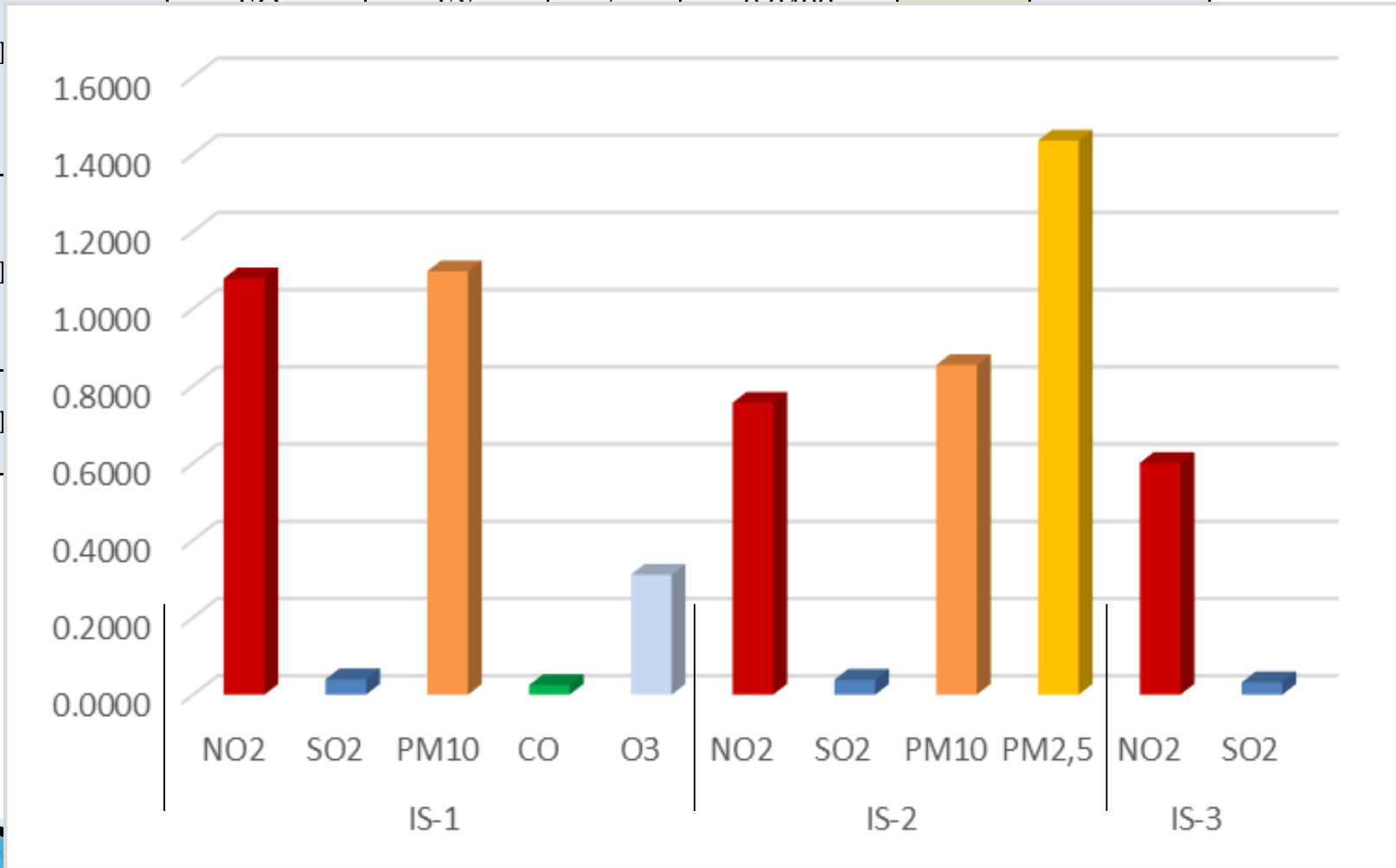
$$PI = \frac{C_i}{MAC_i}$$

PLI Scale	Classification
<1	Unpolluted air
$1 \leq PLI < 2$	Unpolluted to moderately polluted
$2 \leq PLI < 3$	moderately polluted
$3 \leq PLI < 4$	moderately to highly polluted
$4 \leq PLI < 5$	highly polluted
$PLI \geq 5$	Very highly polluted (excessive)



Air pollution index (PI) – Results

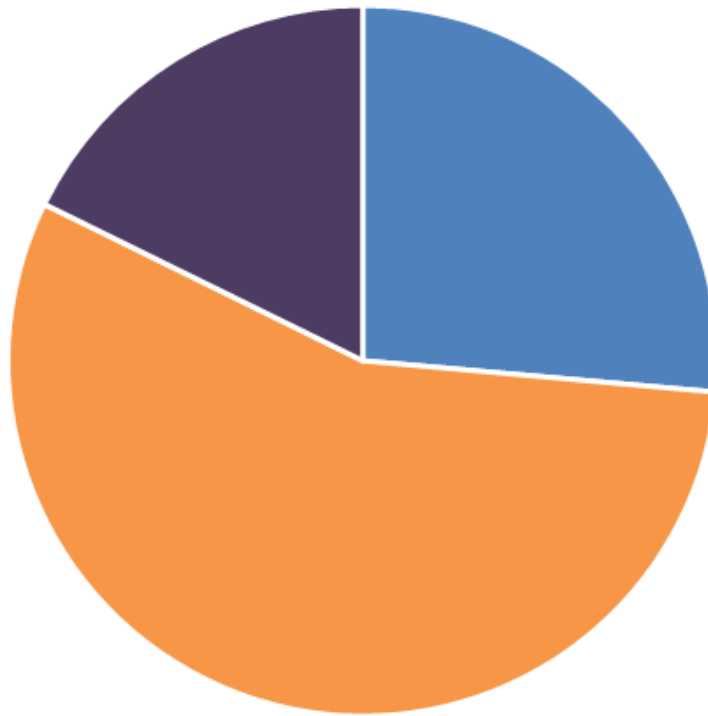
MONITORING STATION	INDICATOR	MAC	Ci	PI = Ci/MAC	PLI	PLI MEDIU
	NO₂	40	43.14	1.0785		
	SO ₂	105	5	0.0480		





Air pollution index (PI) – Results

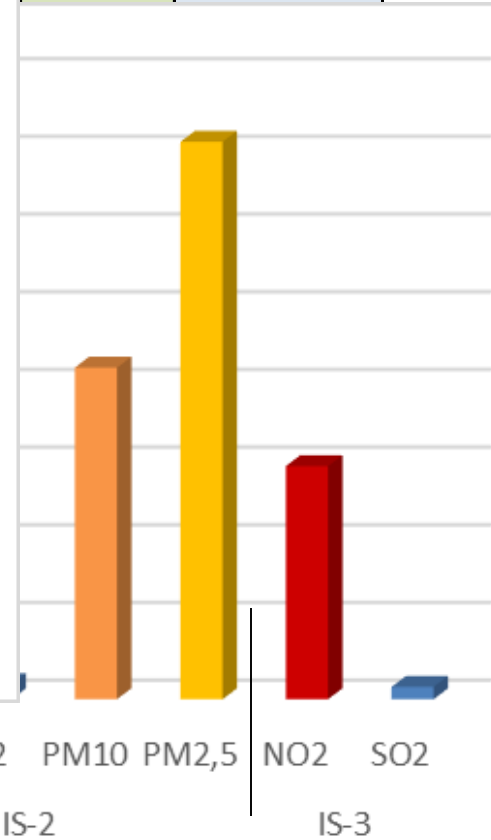
MONITORING STATION	INDICATOR	MAC	Ci	PI = Ci/MAC	PLI	PLI MEDIU
	NO₂	40	43.14	1.0785	0.2056	
	SO ₂	125	5	0.0400		



■ IS-1

■ IS-2

■ IS-3



0.0000

NO₂ SO₂ PM10 CO O₃

IS-1

NO₂ SO₂ PM10 PM2,5 NO₂ SO₂

IS-2

IS-3



Ecological risk index (ERI)

$$E_i = T_i \times C_i$$

E_i – potential ecological risk index of each pollutant i ;

T_i – biological toxic factor for air pollutant i , (mg/m³);

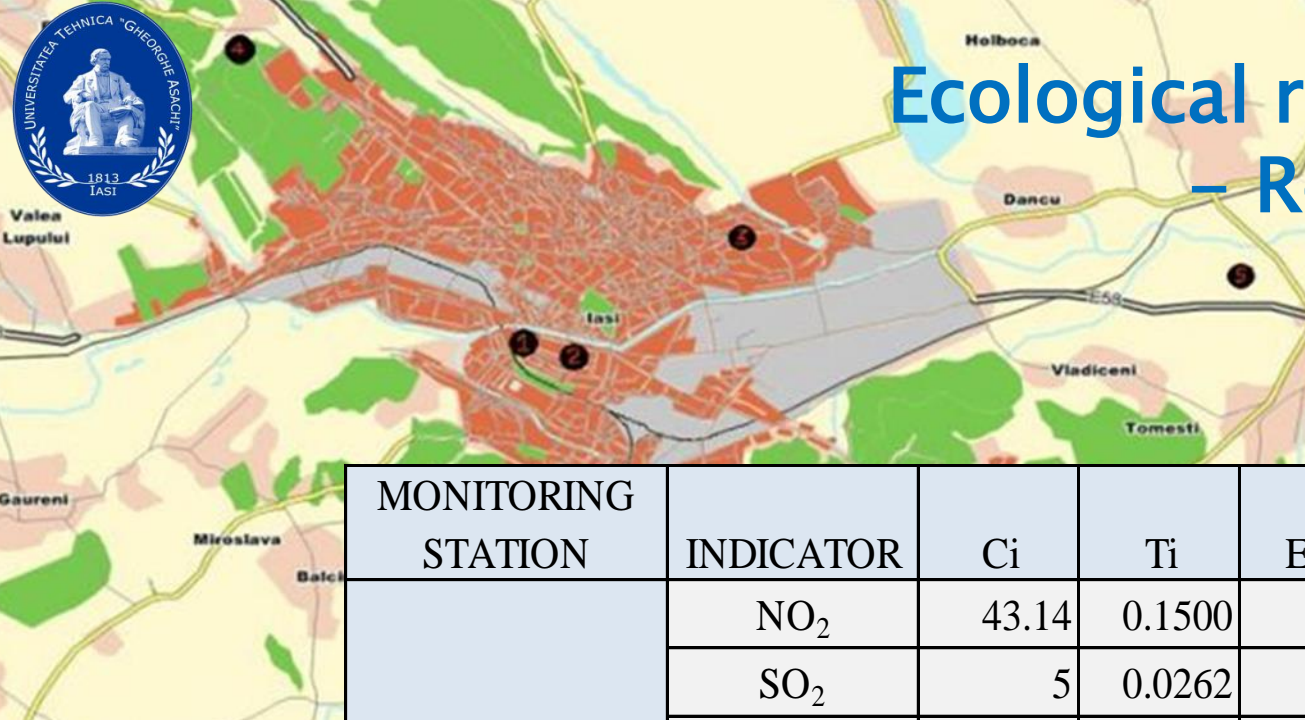
C_i – measured concentration of air pollutant i (mg/m³).

$$ERI = \sum_i^n E_i$$

ERI	Description
ERI < 40	low risk
40 < ERI < 80	moderate risk
80 < ERI < 160	considerable risk
160 < ERI < 320	high risk
ERI > 320	very high risk



Ecological risk index (ERI) – Results



MONITORING STATION	INDICATOR	Ci	Ti	Ei = Ti x Ci	ERI	ERI city
IS-1	NO ₂	43.14	0.1500	6.4710	434.66	210.53
	SO ₂	5	0.0262	0.1310		
	PM ₁₀	43.87	3.0000	131.6100		
	CO	250	1.1500	287.5000		
	O ₃	37.27	0.2400	8.9448		
IS-2	NO ₂	30.25	0.1500	4.5375	193.21	210.53
	SO ₂	4.82	0.0262	0.1263		
	PM ₁₀	34.15	3.0000	102.4500		
	PM _{2,5}	28.7	3.0000	86.1000		
IS-3	NO ₂	24.01	0.1500	3.6015	3.71	210.53
	SO ₂	3.97	0.0262	0.1040		



Human Health Risk Assessment

$$ADD_{inh} = \frac{C_i \times InhR \times EF \times ED}{PEF \times BW \times AT}$$

where:

ADD_{inh} – the average inhaled daily doses, (mg/kg/day);

C_i – measured concentration of air pollutant *i*, (mg/m³);

IR – inhaled air volume (m³/day);

EF – exposure frequency (days/year);

ED – expiration duration (years);

PEF – pollution emission rate;

BW – body weight (kg);

AT – average time of exposure (days);

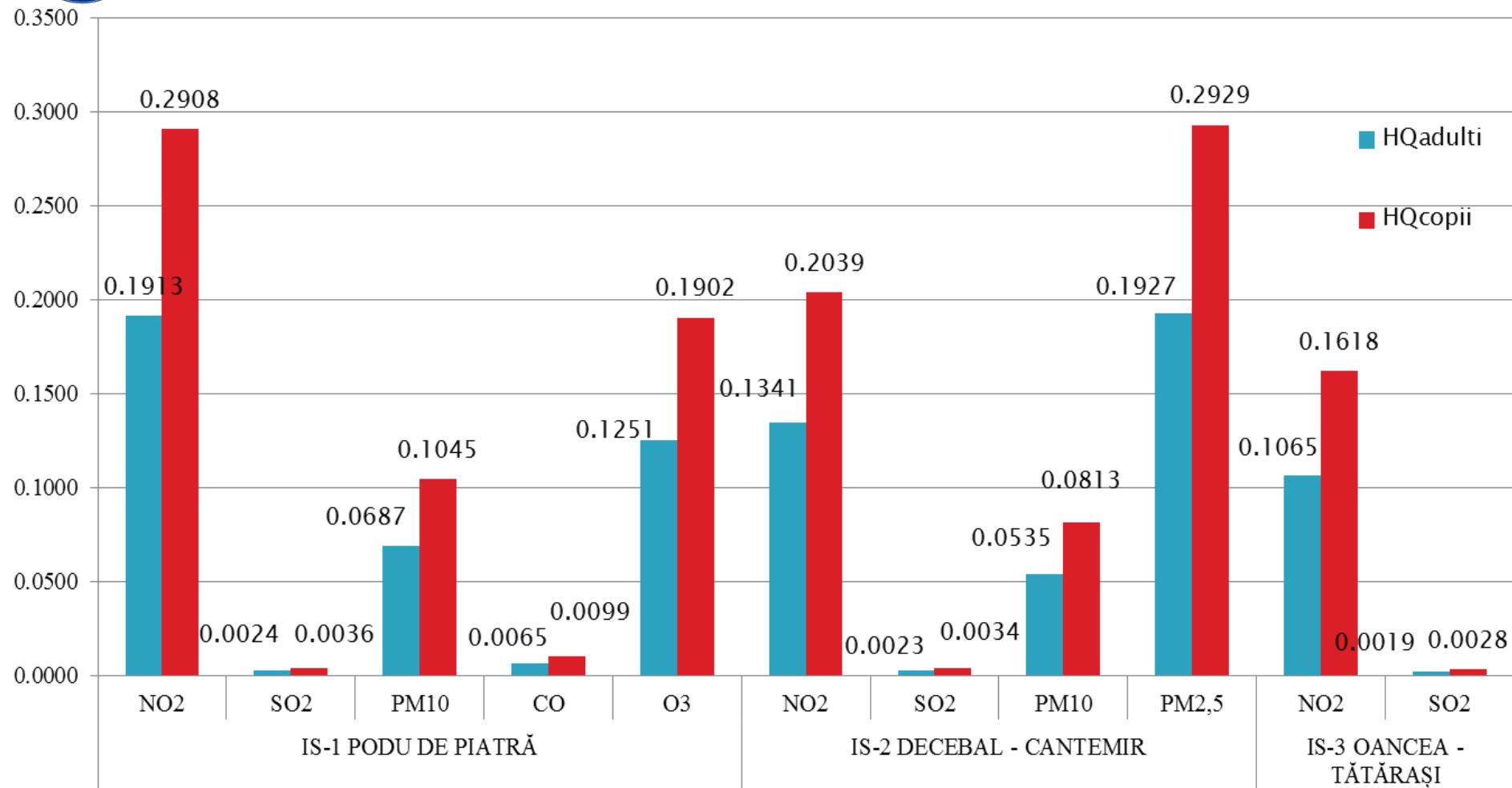
$$HQ = \frac{ADD_{inh}}{RfD}$$

$$HI = \sum_{n=1}^i HQ_n$$

Source: USEPA, 1986



Human Health risk assessment – Results



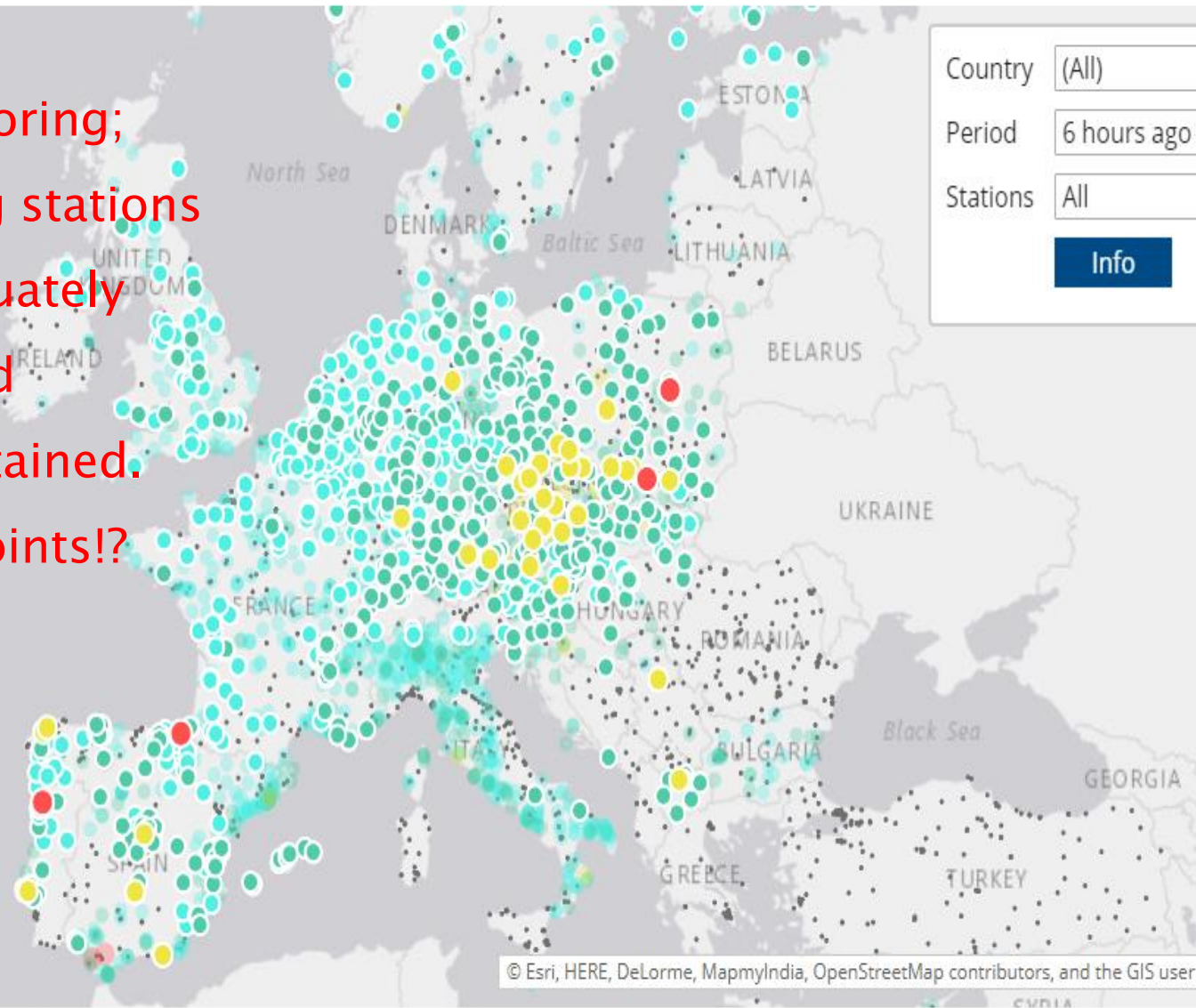


General conclusions

- Romania has to assure a good environmental status and air quality, in particular. Thus, the **main further goal** is to develop **the integrated monitoring network** to evaluate in **real-time** the environmental impacts and human health risks.
- In case of impact and risk assessment of Iasi air pollution, the global risk index value stands out that there is a **high risk** for the city and a **very high risk** in case of children's exposure to PM.
- The main air pollutants are: PM10 and PM2.5, but the sources of pollution are not yet identified, and air modeling was not possible to be carried out, due to the lack of a proper monitoring system.
- There is a stringent need to improve / renew / extend the air monitoring stations at a larger scale (up to 25 monitoring station in the city), thus air modeling would be possible to be fulfilled and develop on line/real time monitoring



- NO real time monitoring;
- The EPA monitoring stations are outdated, inadequately located and used, and inappropriately maintained.
- 3 measurements points!?





Current / further work

1. EU funds for Air quality assurance
2. Building a local/national real time monitoring network
3. Administrative capacity building and decision making process improvement
4. Extending the collaborations and involving the stakeholders, NGO
5. New Air Quality Plan horizon 2030, new regulations/ environmental standards
6.

Current / further work

WP1. Iasi Metropolitan Area- Air Quality Reference Situation

Evaluation of air quality **management processes** in Iasi Metropolitan Area

Development of an **integrated method** for real-time impacts, risks and health hazards assess.

Design of data acquisition system network, data center and data management

Study on the possibility of integration with existing **Traffic Management System**.

WP2. New software applications for air quality

Software architecture design and specifications development

Server Core Application

AIRQUALIS Web Application and street panels interface

AIRQUALIS Mobile Applications (Android and iOS)

Testing and optimization of the software applications

WP3. Interactive actions for education and demonstrative labs

Open demonstrative labs

Interactive public demonstrations

Awareness, training and education

WP4. Taking action: Measures to improve air quality in metropolitan Iasi city area:

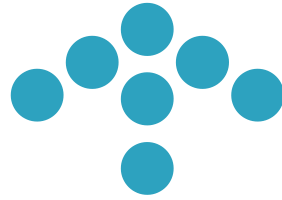
Iasi air quality study review.
Modeling, simulation and prediction of air quality in Iasi Metropolitan area.

Air quality management system location and implementation

New Local Integrated Action Plan for Air Quality Management

Measures to reduce air pollution

Discussions



How could we reduce the level of pollution in case of PM indicator?



In your opinion, what measures are easily to be applied for air quality assurance at local level?