

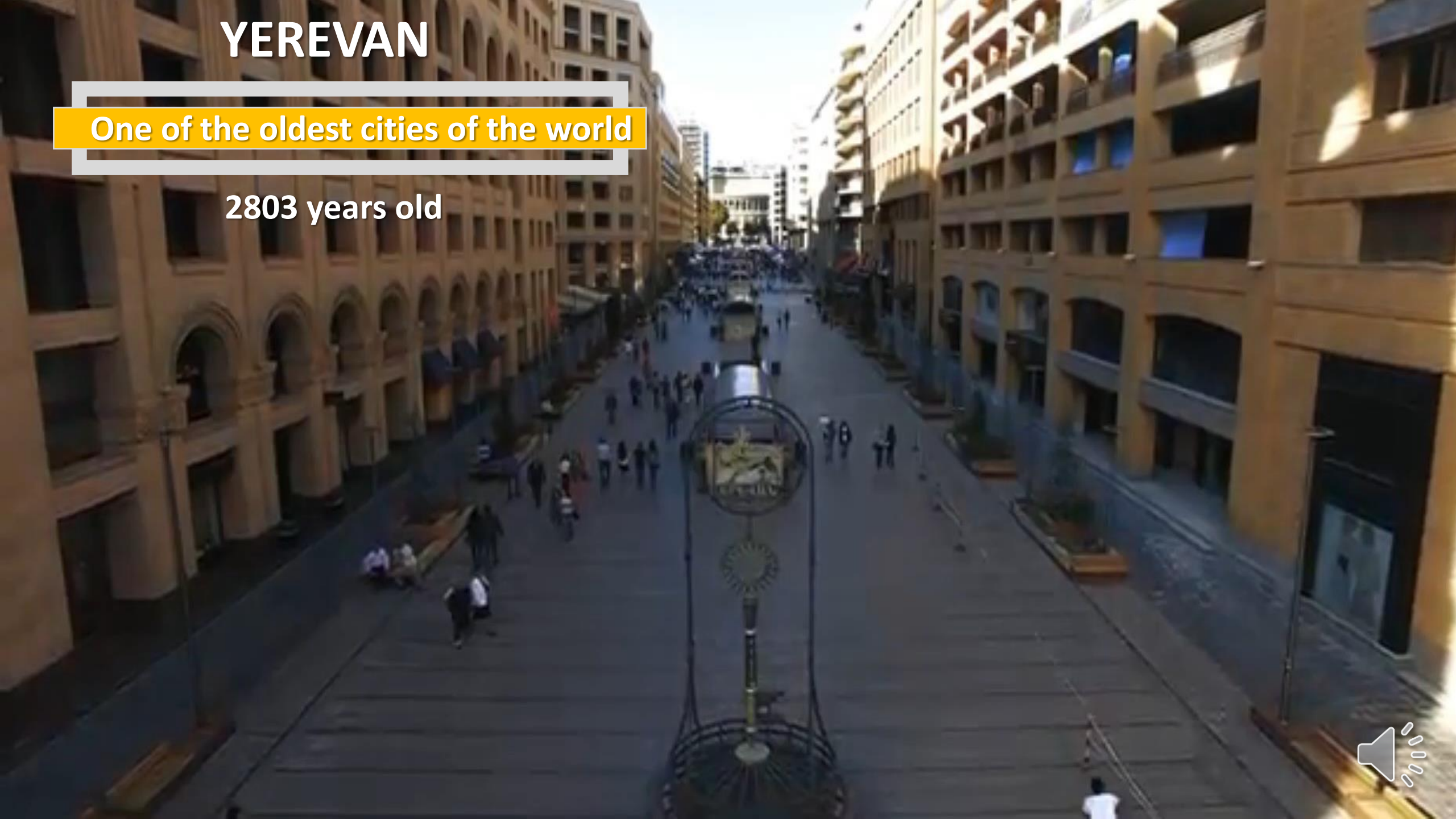


**A CASE STUDY OF
ENVIRONMENTAL
GEOCHEMICAL INVESTIGATION:
FROM RESEARCH TO NBS**

YEREVAN

One of the oldest cities of the world

2803 years old





Black sea

300 km

450 km

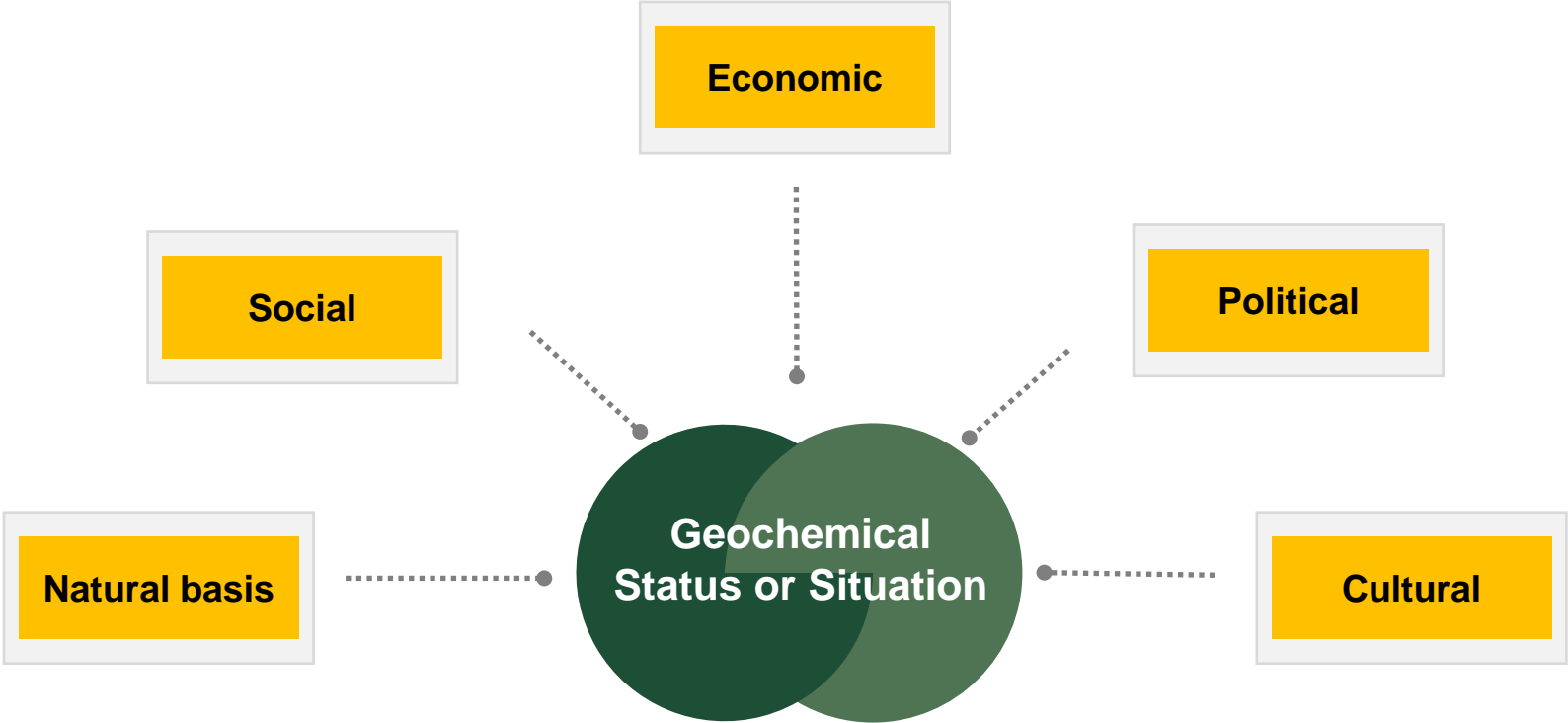
Caspian sea

Yerevan

Landscape: semi-desert, steppe
Situated: southwest of Armenia
Average temp: arid, steppe 11,6 °C
Relief: remains, plateau, 10,6 m, 227 km
Area: 227 km²
Winter temp: anyon 20 river, 30 m, 16 km
Extantion: from north to south 16 km
Geology: continental, volcanic, volcano-sedimentary, sedimentary
Altitude: 850-1500 m a.s.l.
 rocks, volcanic tuffs, bazalts
 and so on



GEOCHEMICAL STATUS



Dynamic transit systems; atmospher, water
Relatively stable deponent systems; soil, bottom sediments

YEREVAN

Area: $\approx 227 \text{ km}^2$

Population: $\approx 1,2 \text{ mln}$



$\approx 1\%$ of republic's area

$\approx 34\%$ of total population



50-60% of Industry

Before 1989

Machinery,
chemical,
building and
construction

After 1989

Light and food,
building and
construction

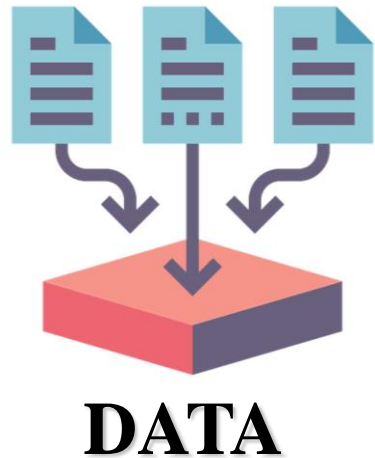
From 2000

Machinery,
chemical,
building and
construction

... ecologically essential factors were changed qualitatively and quantitatively, which of course should have been reflected on geochemical situation of the city



ENVIRONMENTAL GEOCHEMICAL DATA



are flexible

have spatial and time cohesion

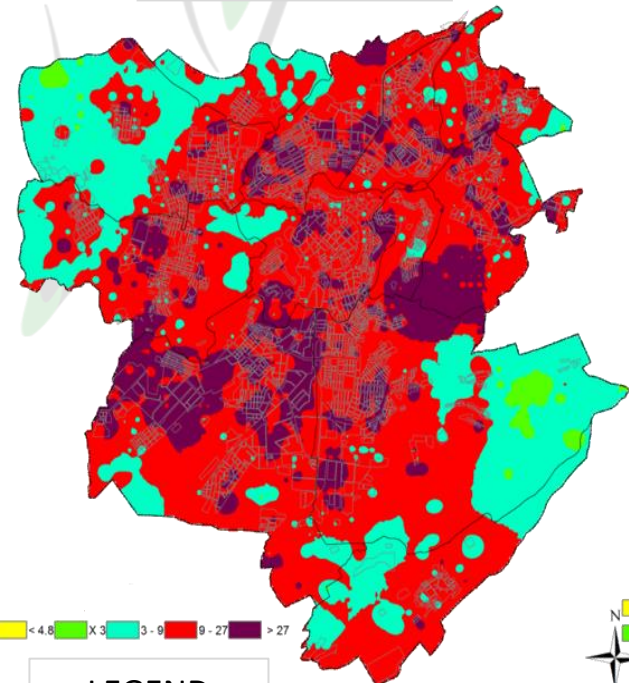
are good base for adding all kind of relevant information

to gain integral picture of environmental state

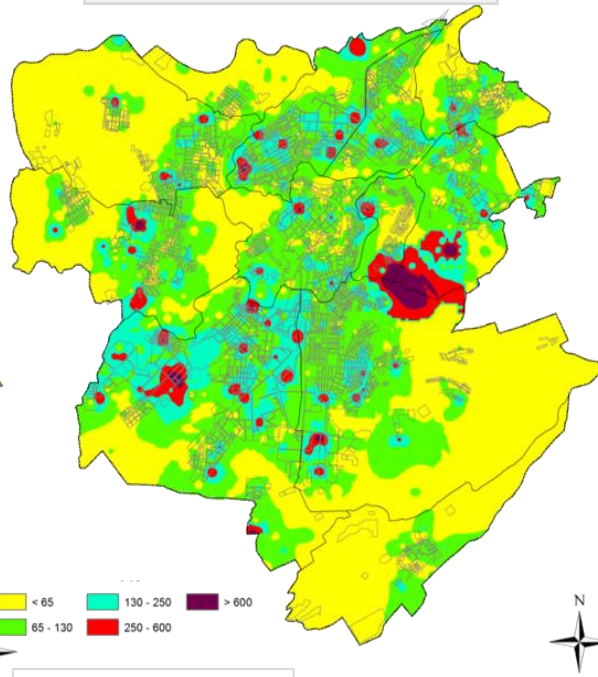
an excellent methodic base for inter and multidisciplinary investigations

Map of distribution of **Pb** contents in the soils of Yerevan, 2012-2013

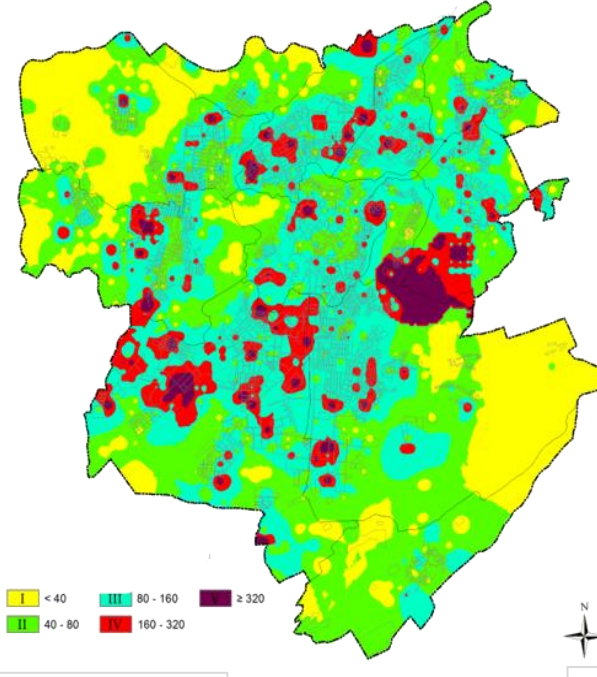
Geochemical



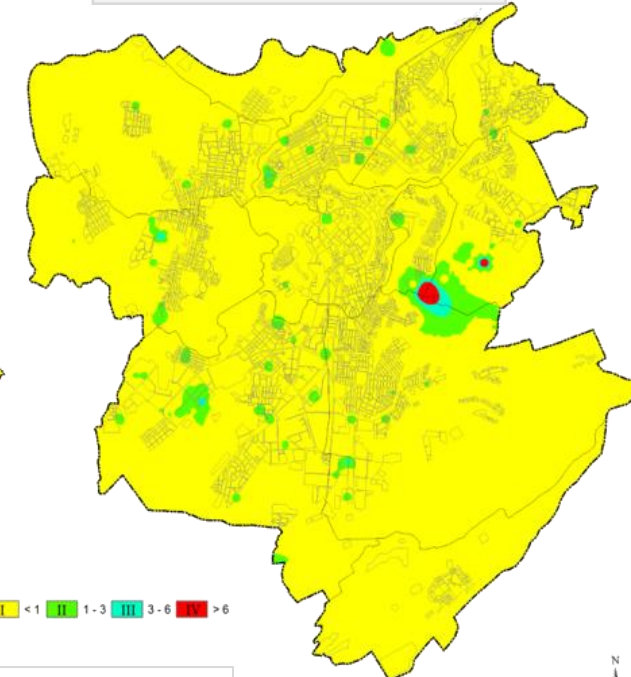
Sanitary-hygiantic



Potential ecological risk



Non-cancer ogenic health risk



LEGEND
Exceeding via BG
(4,5 mg/kg)

LEGEND
Exceeding via MAC
(65 mg/kg)

LEGEND
Potential ecological
risk levels

LEGEND
Non-cancer-ogenic
health risk

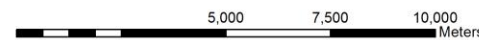
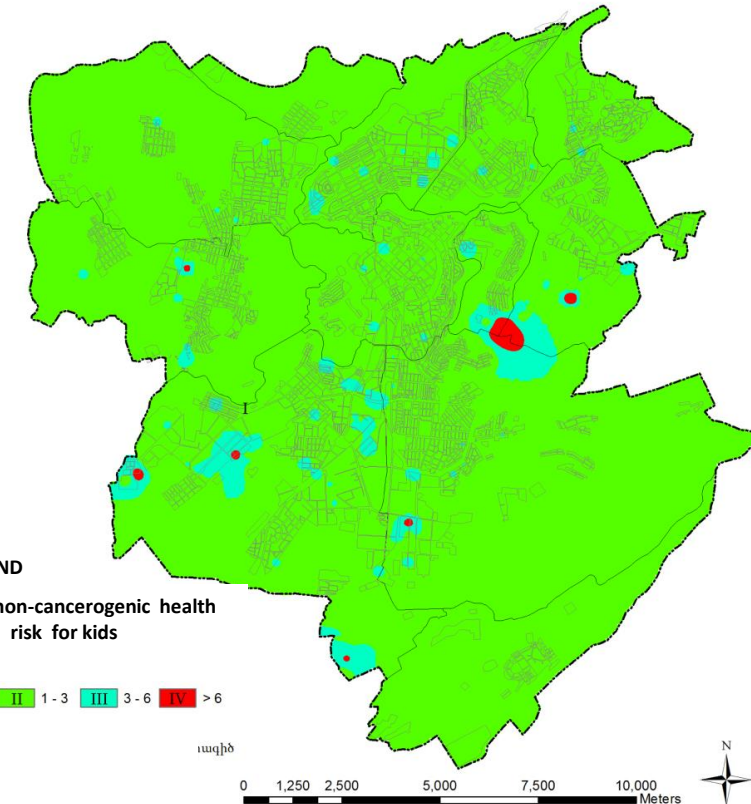
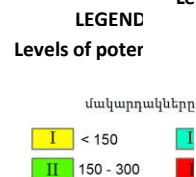
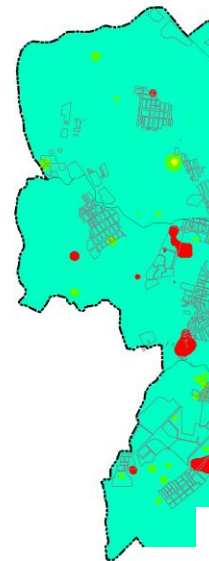
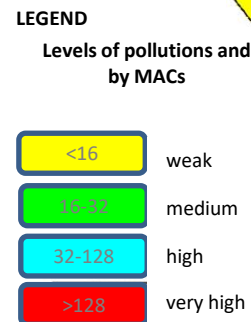
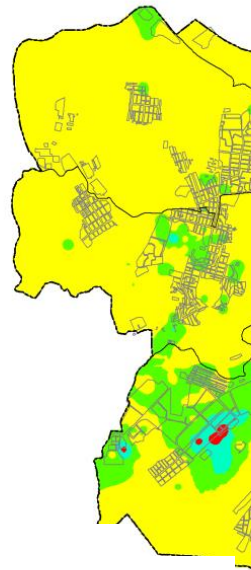
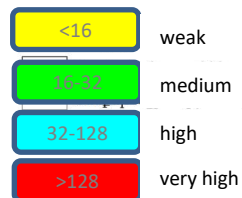
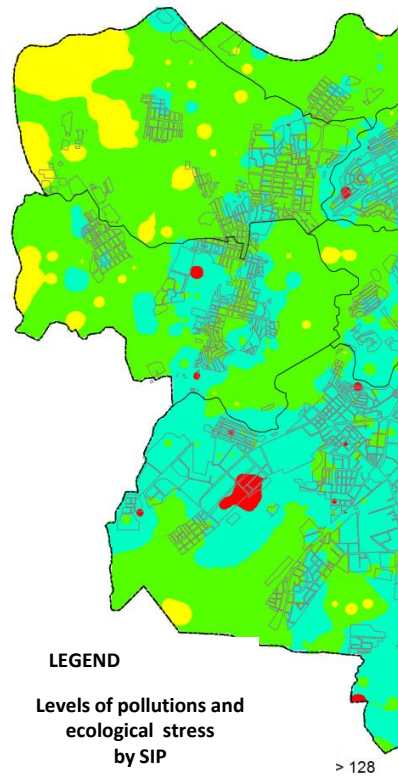
Map of Yerevan soils summery pollution with heavy metals

Geochemical

Sanitary-hygiantic

Potential ecological risk

Non-cancer ogenic health risk



YEREVAN

Geochemical natural series of soils*

$Zn_{(9,4)}-Cu_{(2,9)}-Co_{(1,8)}$

Geochemical averaged man-made series of soils**

$Ag_{(32,0)}-Pb_{(3,2)}-Ni_{(2,3)}-Cu, Mo_{(1,8)}-Cr_{(1,6)}-Co_{(1,5)}-Zn_{(1,2)}$

1989

2002

2012

$Pb_{(72,5)}-Zn_{(33)}-Cu_{(30,3)}-Mo_{(14,7)}-Ag_{(10,8)}-Ni_{(6,9)}-Cr_{(5,1)}-Co_{(2,4)}$

$Pb_{(22,9)}>Hg_{(7,1)}-Zn_{(3,3)}-Cu_{(2,6)}-Cd_{(2,4)}-Ni, V_{(2,0)}-Cr_{(1,7)}-Mo_{(1,5)}-Sr_{(1,2)}$

* Calculated by clark values

** Calculated by background values





Anthropogenic factors

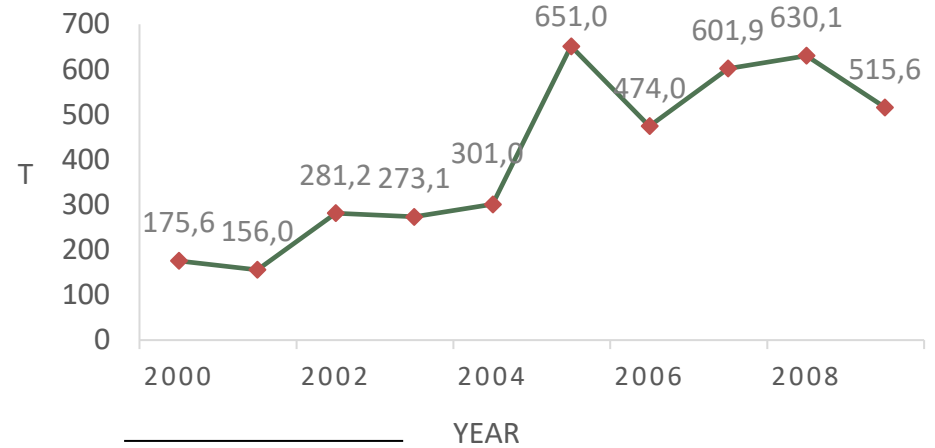


39 mines



Dust in Yerevan

Dust emissions in Yerevan *



*According to Armstat

Natural factors

Semi-desert natural landscape

Complicated relief

winds

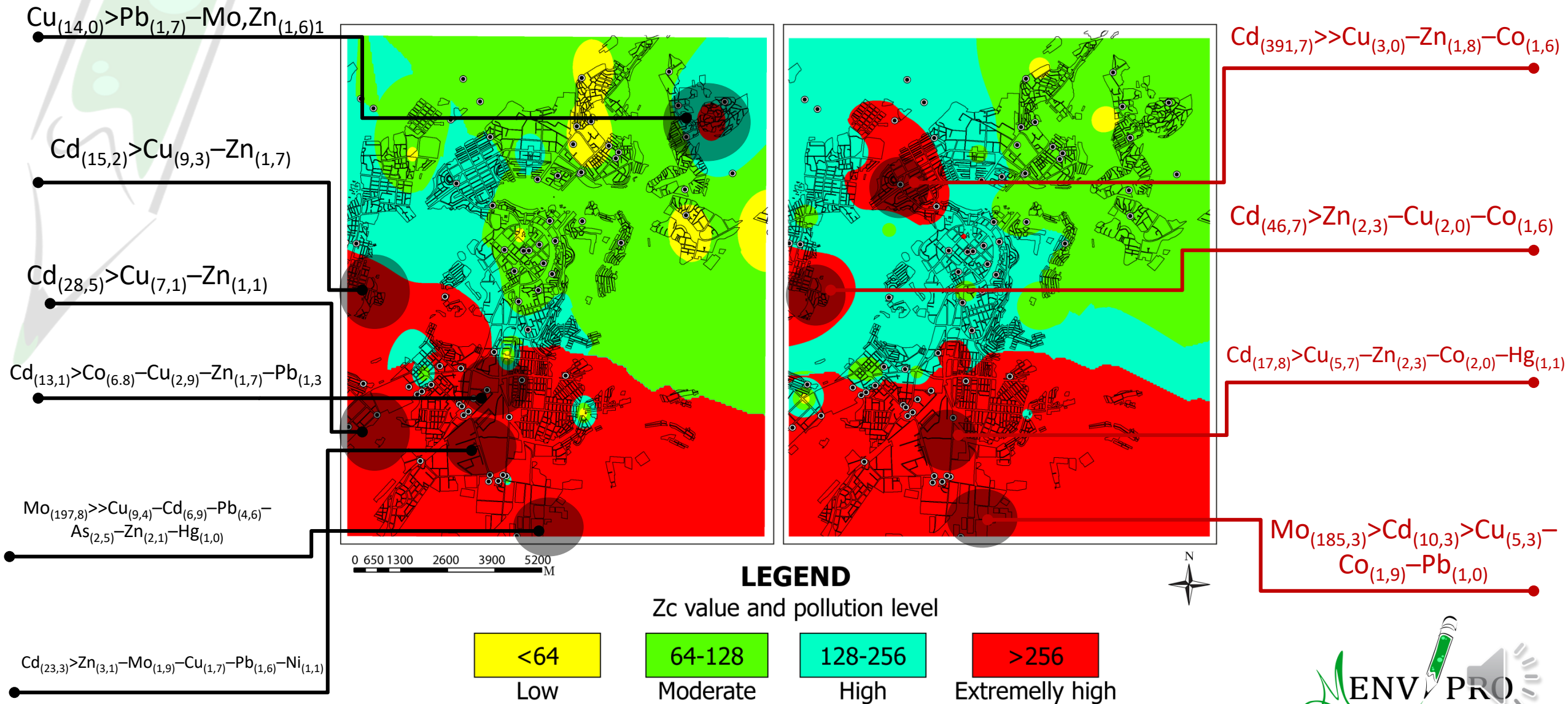
Near deserts

Dry climate

...



MAP OF THE SUMMERY HEAVY METAL POLLUTION OF AIR BASIN OF YEREVAN, IN SUMMER AND WINTER





M-4

$Ni_{(11.8)} > Zn_{(6.2)} - Cu_{(5.9)} - As, Pb_{(2.1)}$



M-6

$Cu_{(11.7)} - Ni_{(11.5)} > Zn_{(5.0)} - As_{(2.4)}$



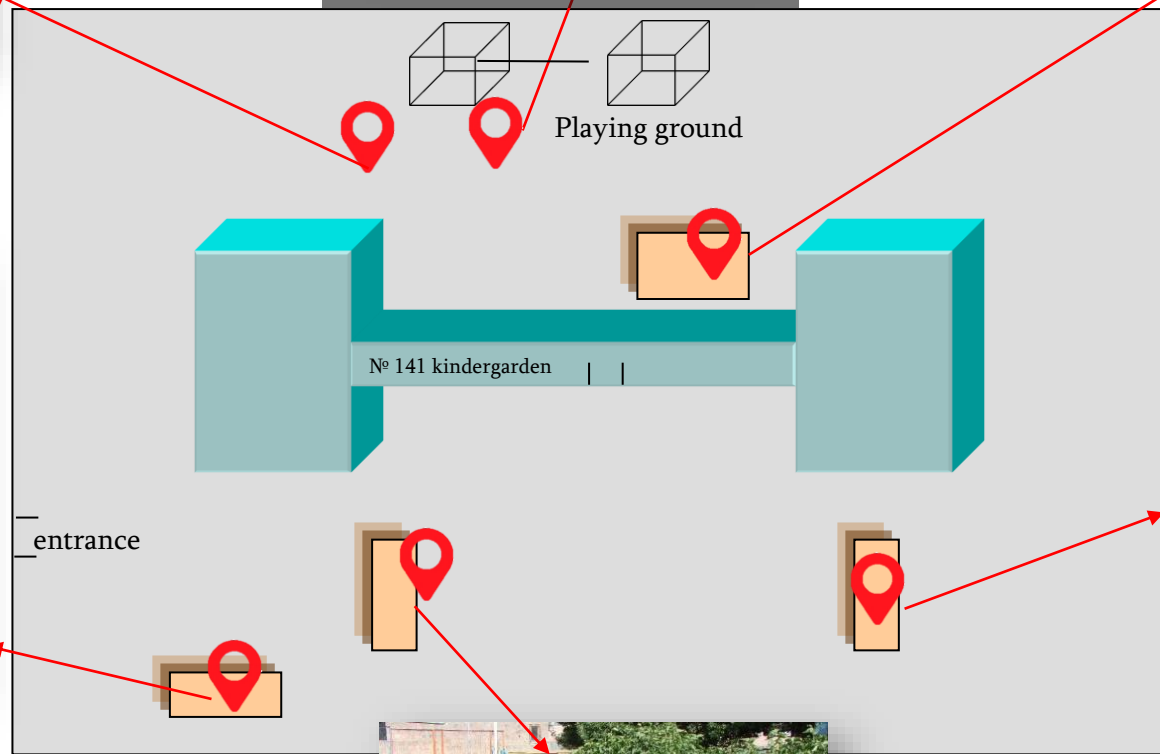
M-5

$Zn, Cu_{(12.3)} - Ni_{(11.7)} > As_{(3.4)}$



M-1

$Ni_{(10.5)} - Cu_{(9.0)} - Zn_{(5.7)} - As_{(3.2)}$



M-3

$Cu_{(12.3)} - Ni_{(11.4)} > Zn_{(5.3)} - As_{(2.5)}$



M-2

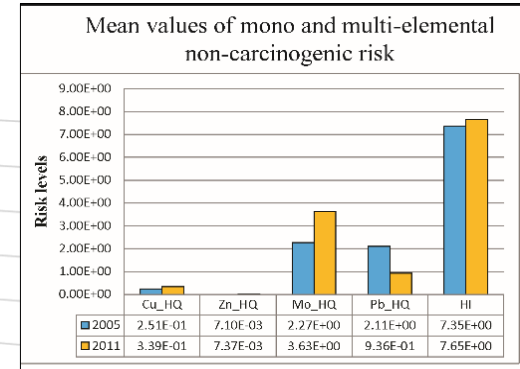
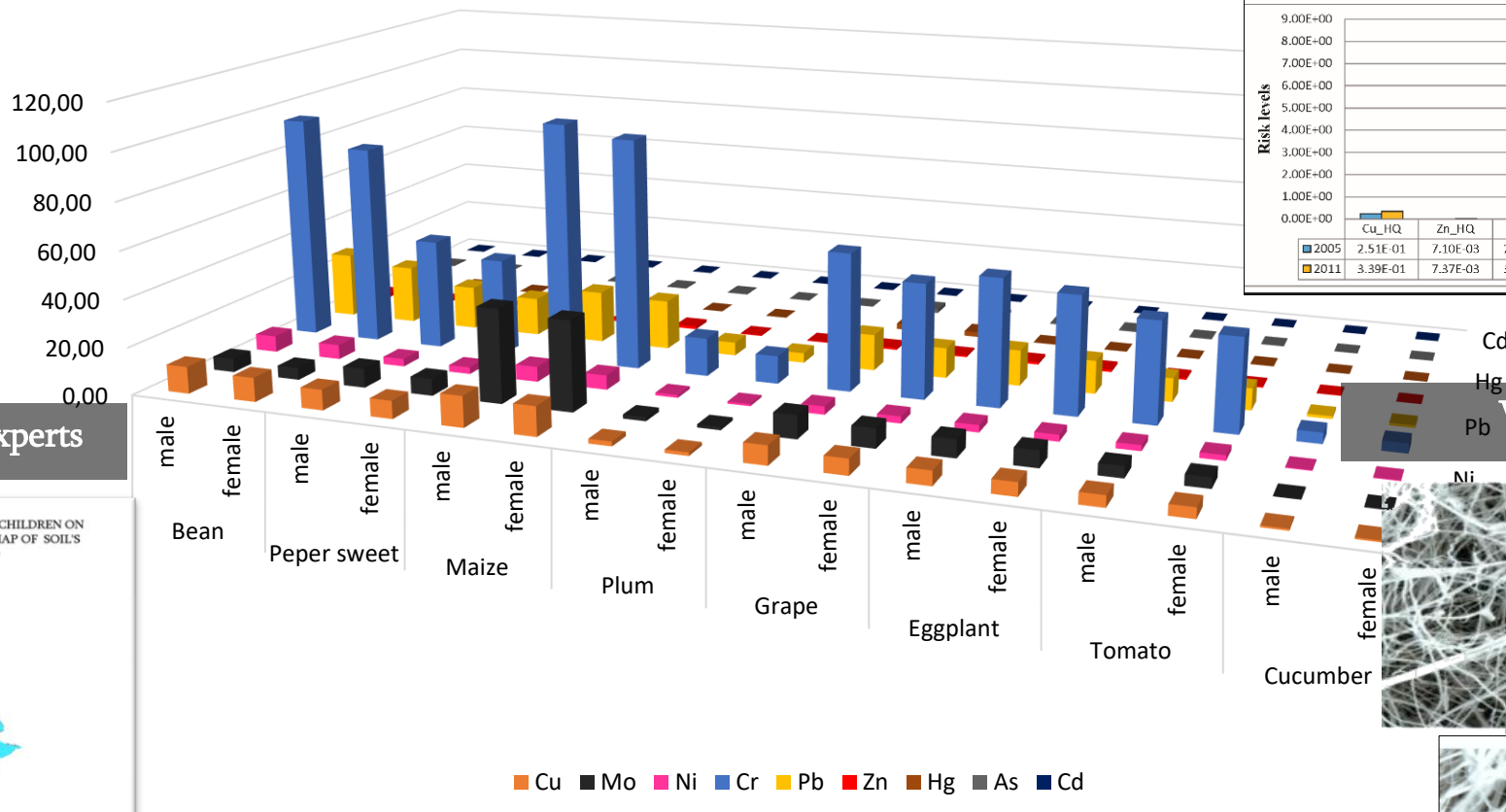
$Zn_{(39.9)} - Ni_{(10.1)} - Cu_{(11.2)} > As_{(4.6)}$

Assessment of Ecological Status of kindergartens

So, what to do with huge amounts of data?

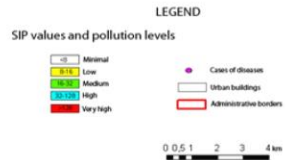
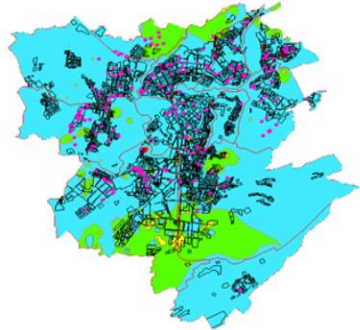
With food specialists

Health risk index for fruit and vegetables

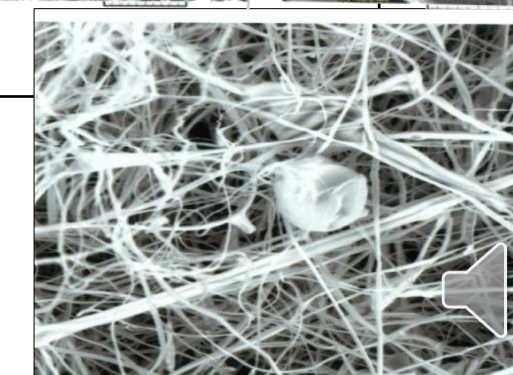
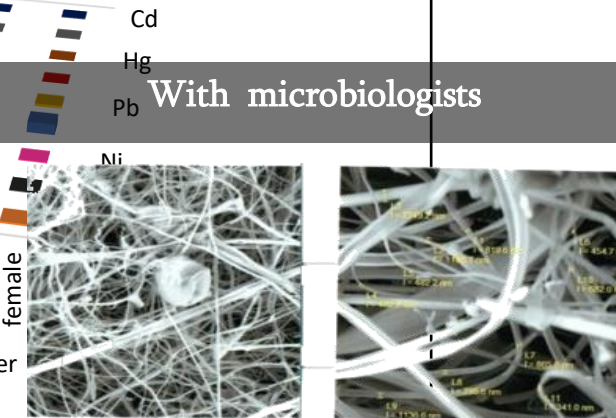


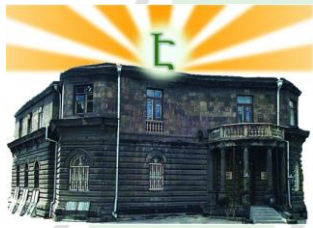
With health and gen experts

DISTRIBUTION OF CASES OF ONCOLOGICAL DISEASES IN CHILDREN ON THE TERRITORY OF YEREVAN IN COLLATION WITH A MAP OF SOIL'S HEAVY METAL SUMMARY POLLUTION (SIP)



With microbiologists



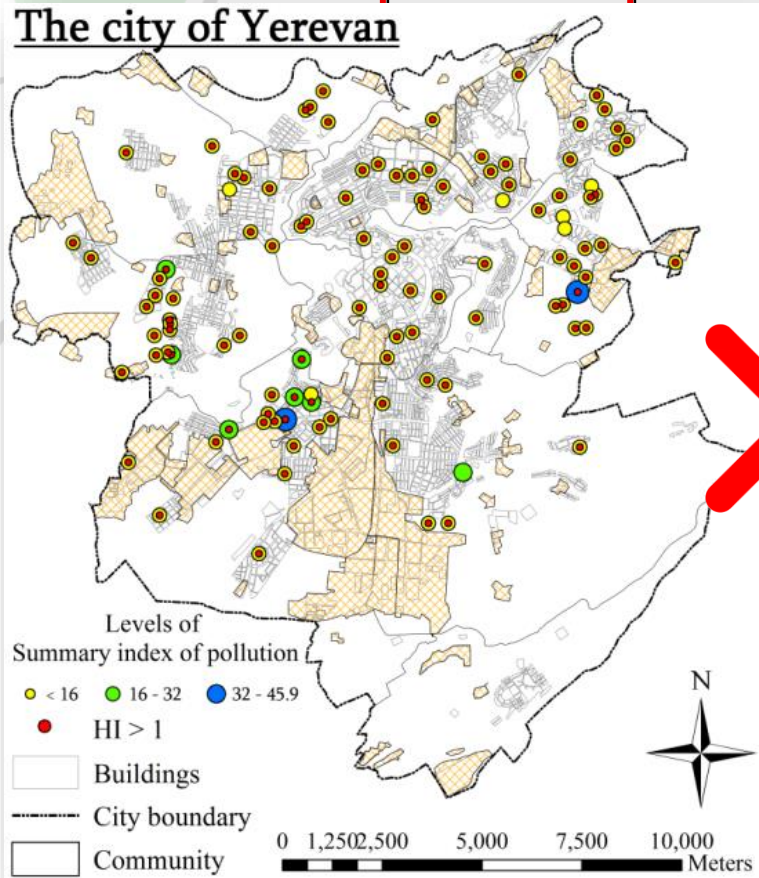


So, what to do with huge amounts of data?

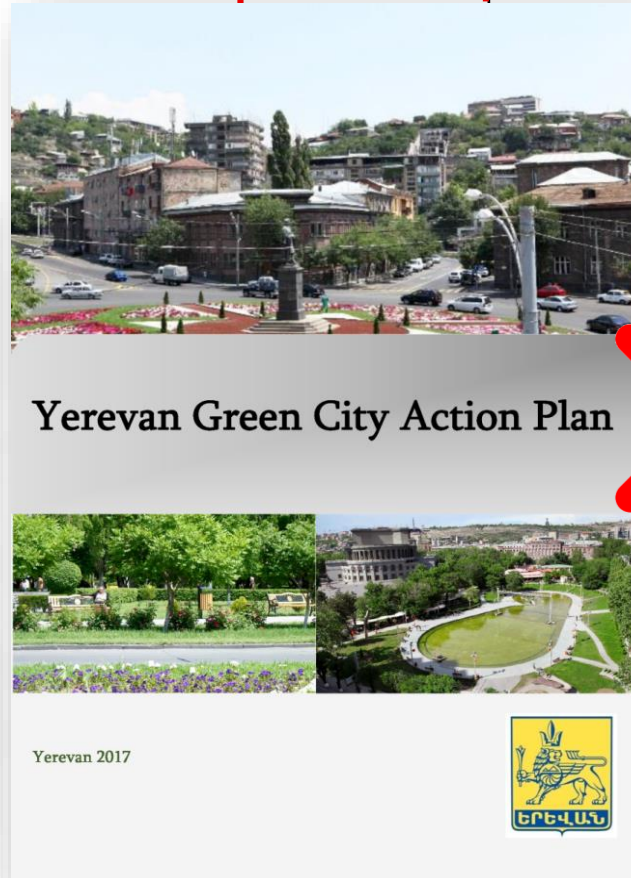
1989

2002

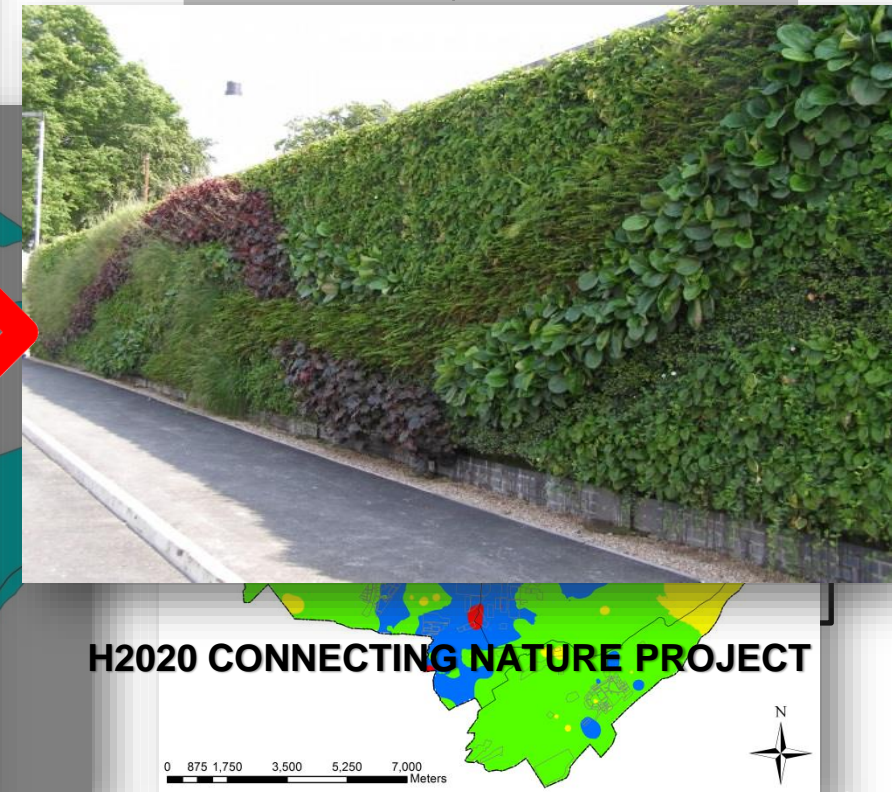
2012



Master plan of Yerevan



Plan of target tree planting



Yerevan City Green Action Plan

NATURE-BASED SOLUTION IN YEREVAN: A “GREEN WALL” FOR KINDERGARTEN



Yerevan municipality



Center for Ecological-Noosphere Studies of NAS RA



“Eurasia” Charity Public Organization

NATURE-BASED SOLUTION IN YEREVAN: A “GREEN WALL” FOR KINDERGARTEN



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Virginia creeper
(parthenocissus quiquefolia)



Amur grape
(vitis amurensis)



Monkshood vine
(ampelopsis aconitifolia)

NATURE-BASED SOLUTION IN YEREVAN: A “GREEN WALL” FOR KINDERGARTEN



BEFORE AFTER



After several months
(Summer 2018)

Starting point: 20 April, 2018

Summer 2020



Virginia creeper
(parthenocissus
quiquefolia)



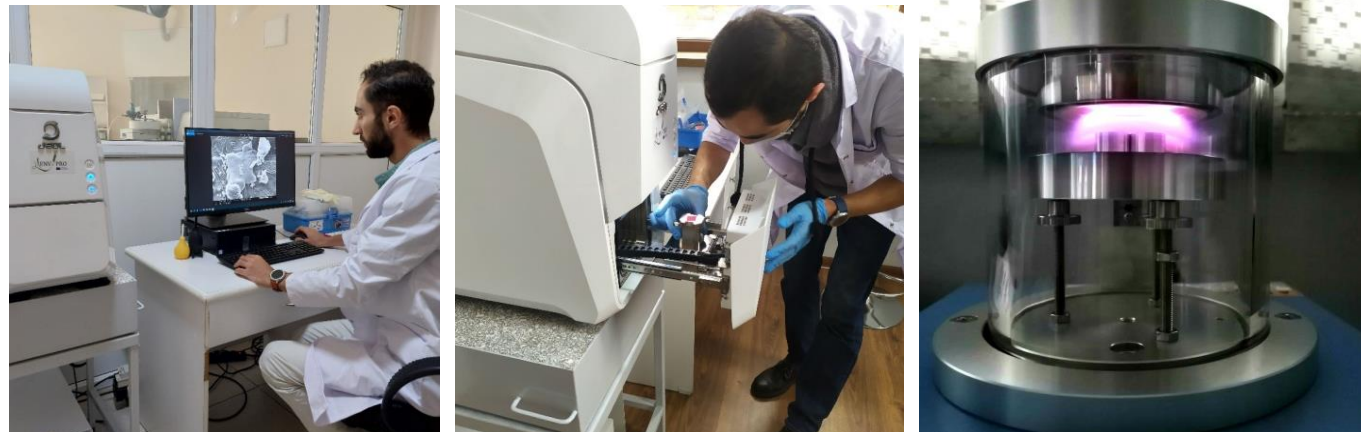
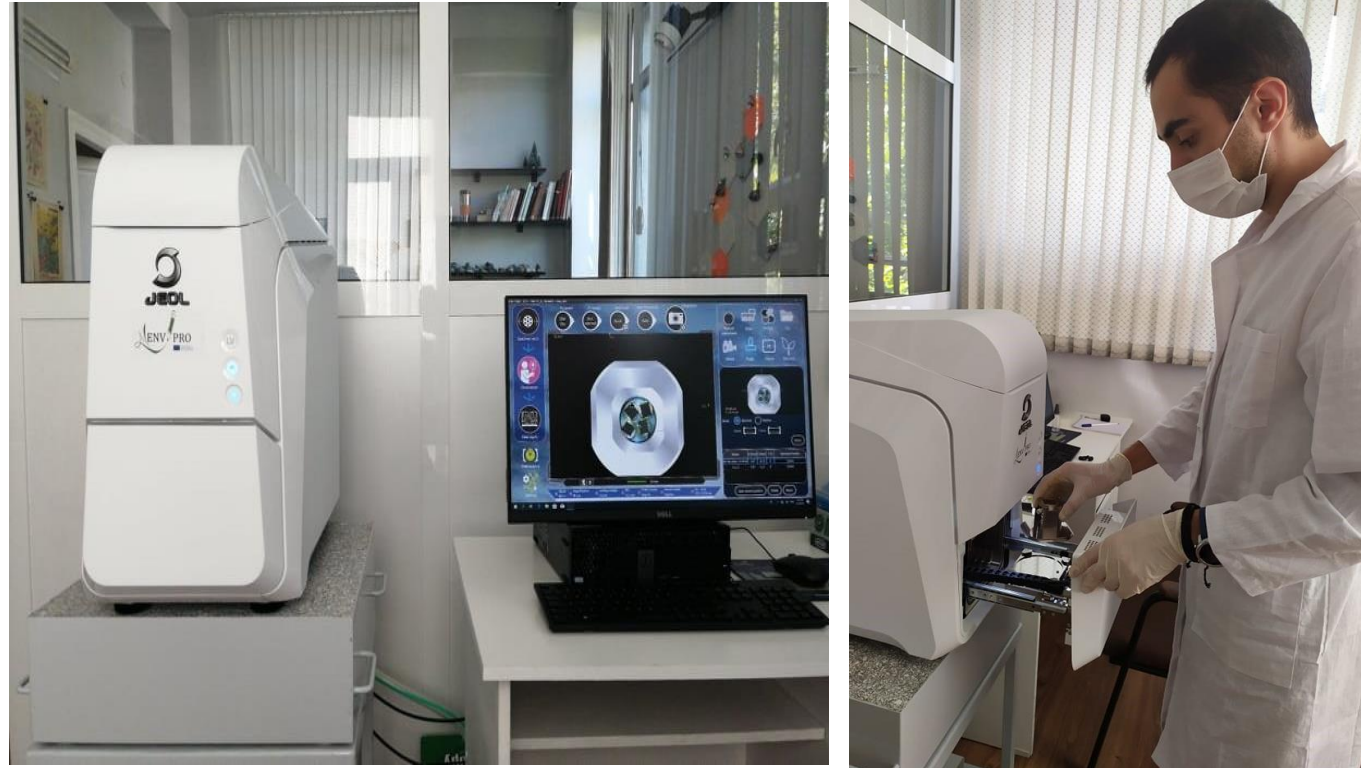
Amur grape
(vitis amurensis)



Monkshood vine
(ampelopsis
aconitifolia)



JEOL-JCM-7000 NEOSCOPE MICROSCOPE



DURING UPCOMING AN HOUR

01

Basic concept/terms

02

A theoretical background for research and origin of environmental geochemistry

03

Peculiarities and methods of Environmental geochemistry

04

A case study of Environmental geochemical investigation: from research to nature-based solutions



Thank you for your kind attention!



Interesting Facts

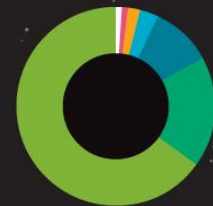


THE EARTH CRUST COMPOSITION



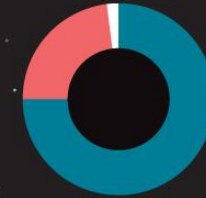
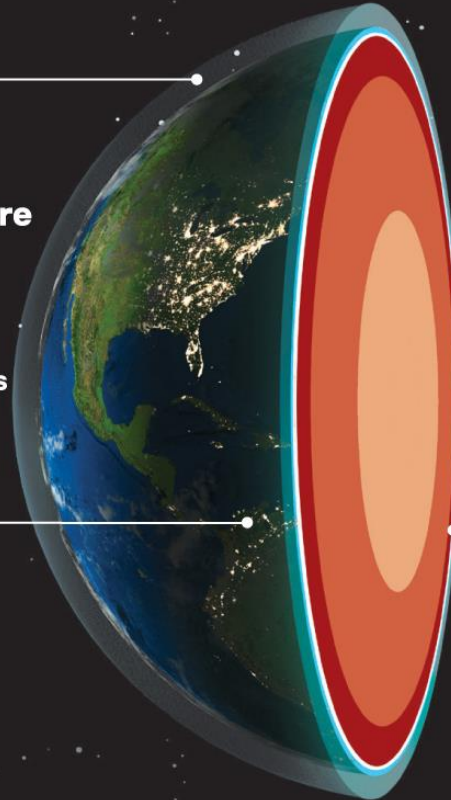
Earth's Atmosphere

- 78% Nitrogen
- 21% Oxygen
- <1% Argon
- <<1% Other Elements



The Human Body

- 65% Oxygen
- 18% Carbon
- 10% Hydrogen
- 3% Nitrogen
- 2% Calcium
- 1% Phosphorus
- 1% Other Elements



The Universe

- 75% Hydrogen
- 23% Helium
- 2% Other Elements



Earth's Crust

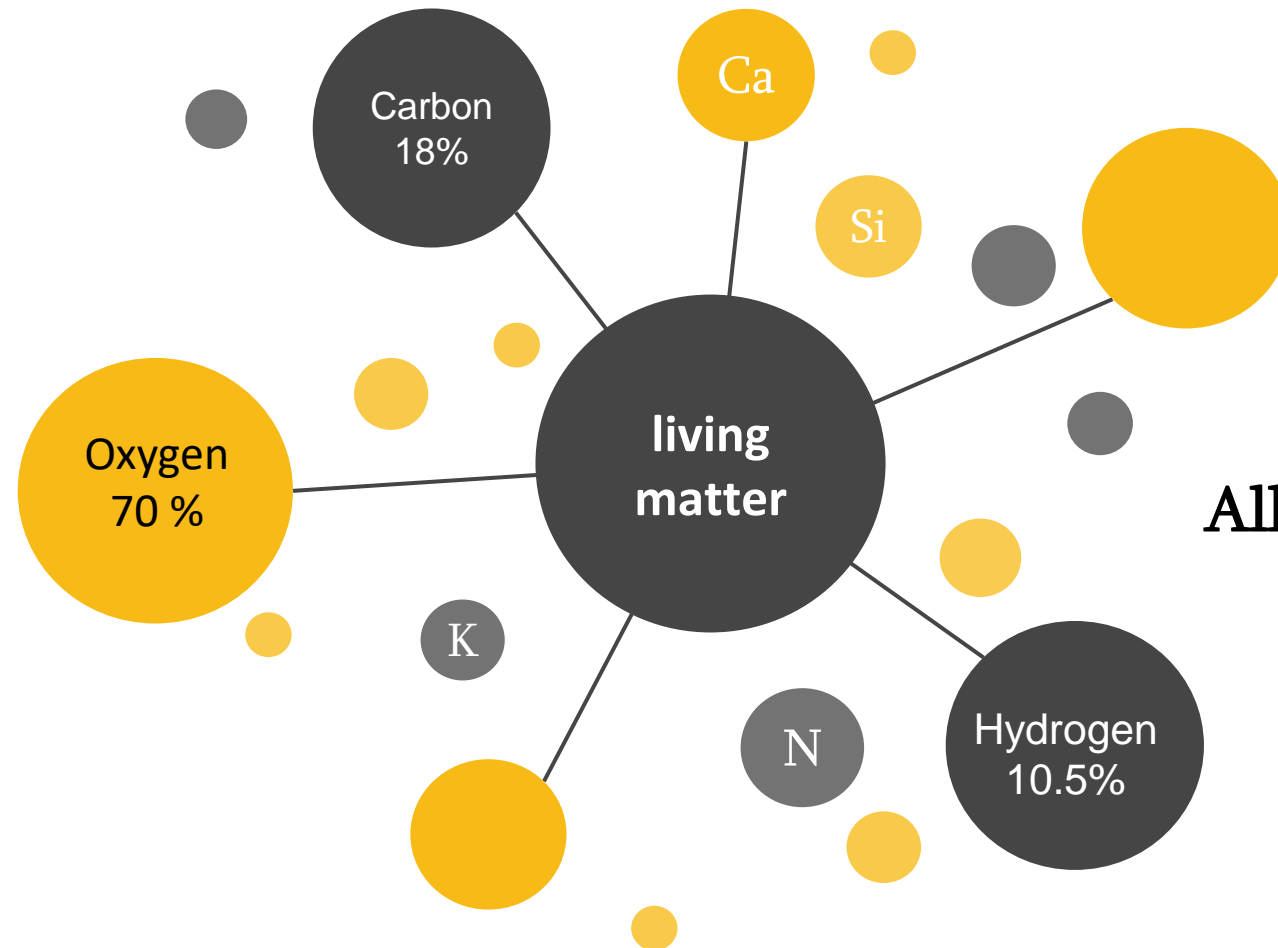
- 46% Oxygen
- 28% Silicon
- 8% Aluminum
- 5% Iron
- 4% Calcium
- 3% Sodium
- 2% Potassium
- 2% Magnesium
- 2% Other Elements

All proportions are by mass except Earth's atmosphere, which is by volume

≈ 99.5% are rock - forming or macro elements

Micronutrients - less than 1%

The average representation of chemical elements in living matter



Ca, K, N, Si - 1,3%
All microelements - 0.2%