



New method for extraction of benzo[a]pyrene from industrial polluted soil

svetlana.sushkova.sfedu@gmail.com

Southern Federal University
Academy of Biology and Biotechnology
Department of Soil Sciences and Land
Recourses Estimation

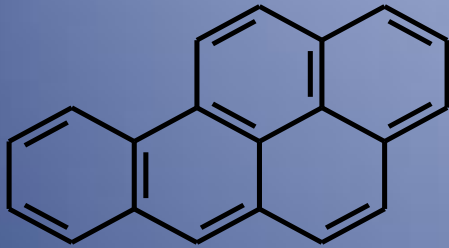
Gimp Alina

Supervisors: Prof. Tatiana Minkina,
Assoc. Prof. Dr. Svetlana Sushkova

Russia

2016

Scientific problem



Benzo[a]pyrene (BaP)

Properties:

- melting temperature: 179°C;
- boiling temperature: 495°C;
- density: 1,24 g/cm³;
- carcinogen and mutagen of danger class I;
- molecular weight 252,3;
- yellow plates and needles.

The main marker of ecosystem pollution by polycyclic aromatic hydrocarbons (PAH) is BaP. The BaP persistence in all environmental objects is obligatory controlled in all countries of the world.

Relevance of BaP behavior complex researches in soils and plants is caused by the increased danger and scale of soil and plants pollution by this compound.

Object	Maximum limited concentration
Soils	0,02 mg/kg
Plants	0,005 mg/kg (corn)
Air of settlements	0,001 mkg/m ³
Air of working zone	0,15 mkg/m ³
Drinking water	0,000001 mg/l

The purpose of the research

To evaluate the benzo[a]pyrene content in the natural grassy vegetation and soils of Novocherkassk Power Station emission zone

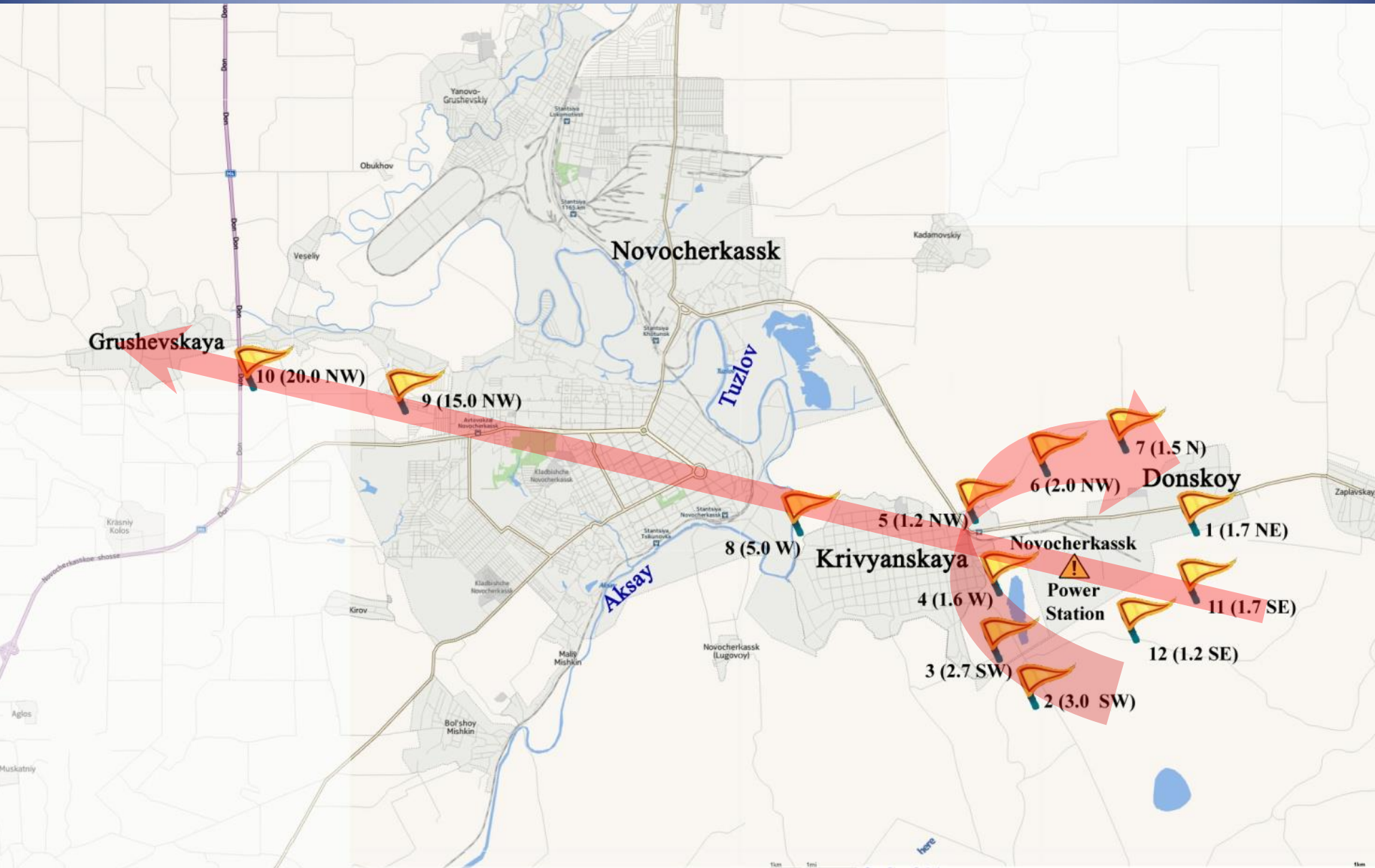


Research problems:

- 1) To study benzo[a]pyrene distribution in natural grassy vegetation of Novocherkassk Power Station emission zone;
- 2) To establish impact of natural and anthropogenous factors on a benzo[a]pyrene translocation in soil-plant system.

Objects and methods

Schematic map of monitoring plots arrangement



Soils:



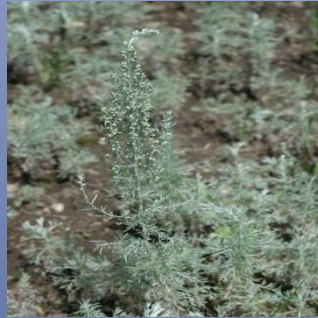
alluvial meadow soils

ordinary chernozems

meadow-chernozemic soils

Natural grassy vegetation:

Artemisia austriaca



Tanacetum vulgare



Elytrigia repenes



Cichorium intybus



Achillea millefolium

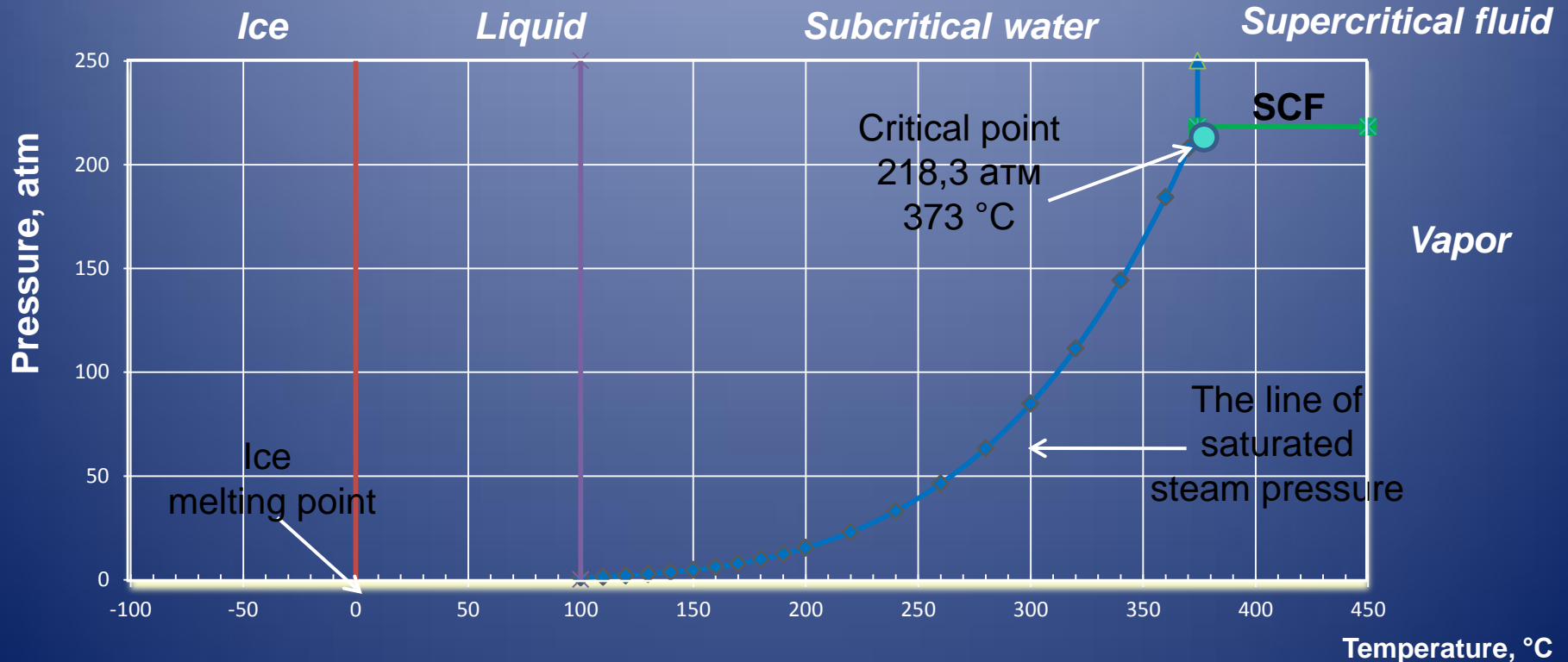
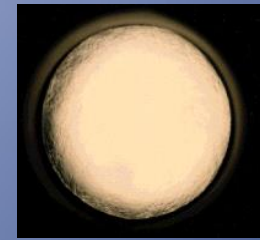
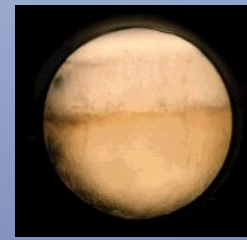
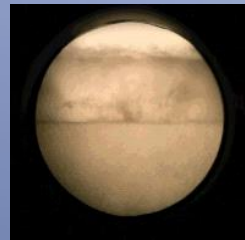


Ambrosia artemisiifolia



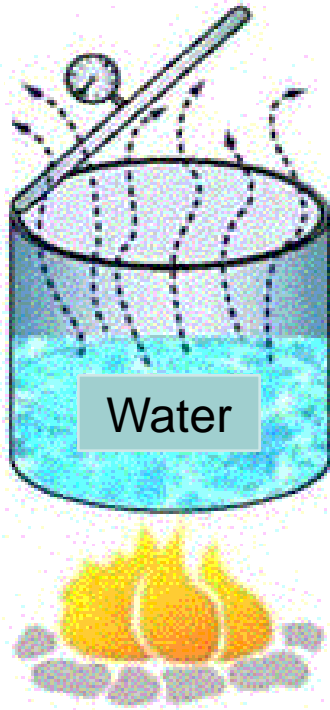
What is subcritical water?

The phase diagram for water as a function of temperature and pressure

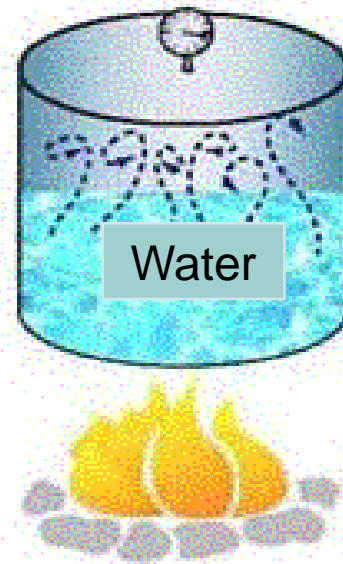


Schemes of the water transfer to subcritical condition

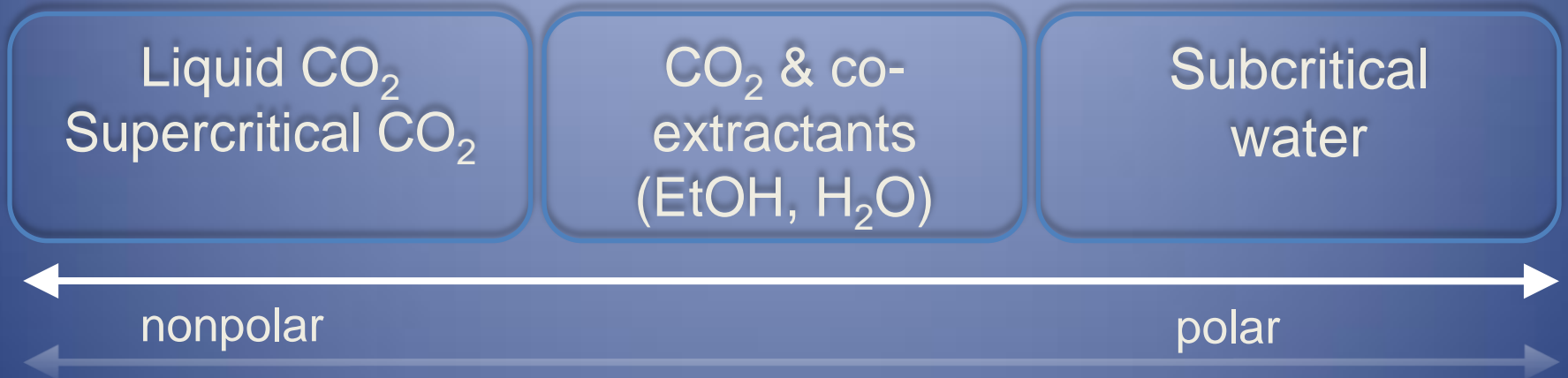
Open reactor



Germetic reactor



What is subcritical water?



Subcritical water

non-toxic

inexpensive

available

Technology

~~acetone
methanol
hexane
cloroform
acetonitrile~~



Subcritical water

T 150 – 300 °C
P 20 - 150 atm

Regulating only 2 parameters – pressure and temperature – it is possible to achieve selective dissolution or, on the contrary, sedimentation of pure substances in the form of micro and nanoparticles, or organic natural compounds

Benzo[a]pyrene extraction from soils by subcritical water

1

- Average soil/plant sample

2

- Dry, grind and sieve (1 mm)

3

- Air-dry sample (1 g) + 8 ml double-distilled water placed into an extraction cartridge

4

- Subcritical water extraction (250°C, 100 atm, 30 min), filter

5

- Aqueous filtrate

6

- Re-extract with *n*-hexane using a 3 × 5 ml separatory funnel

7

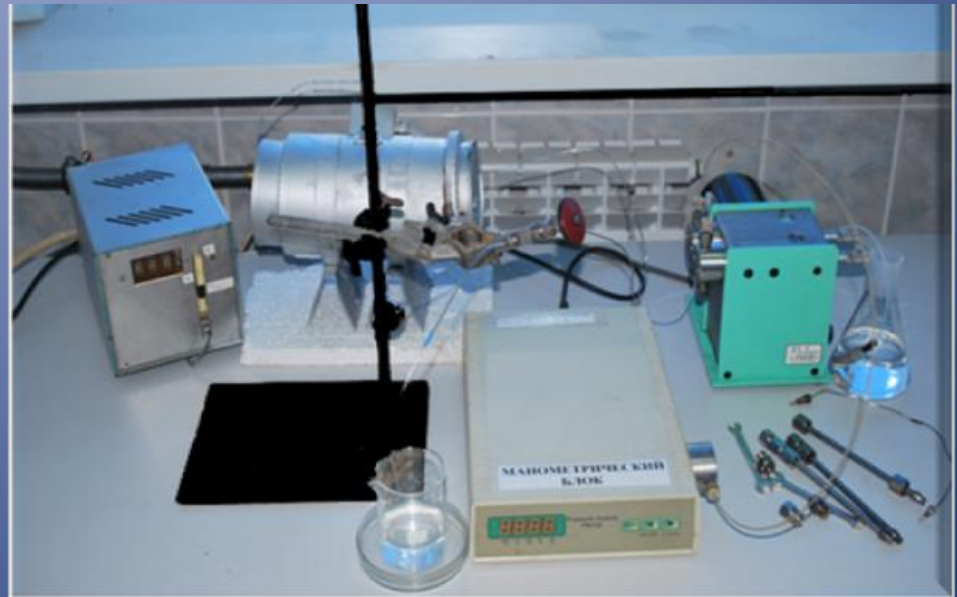
- Hexane extract

8

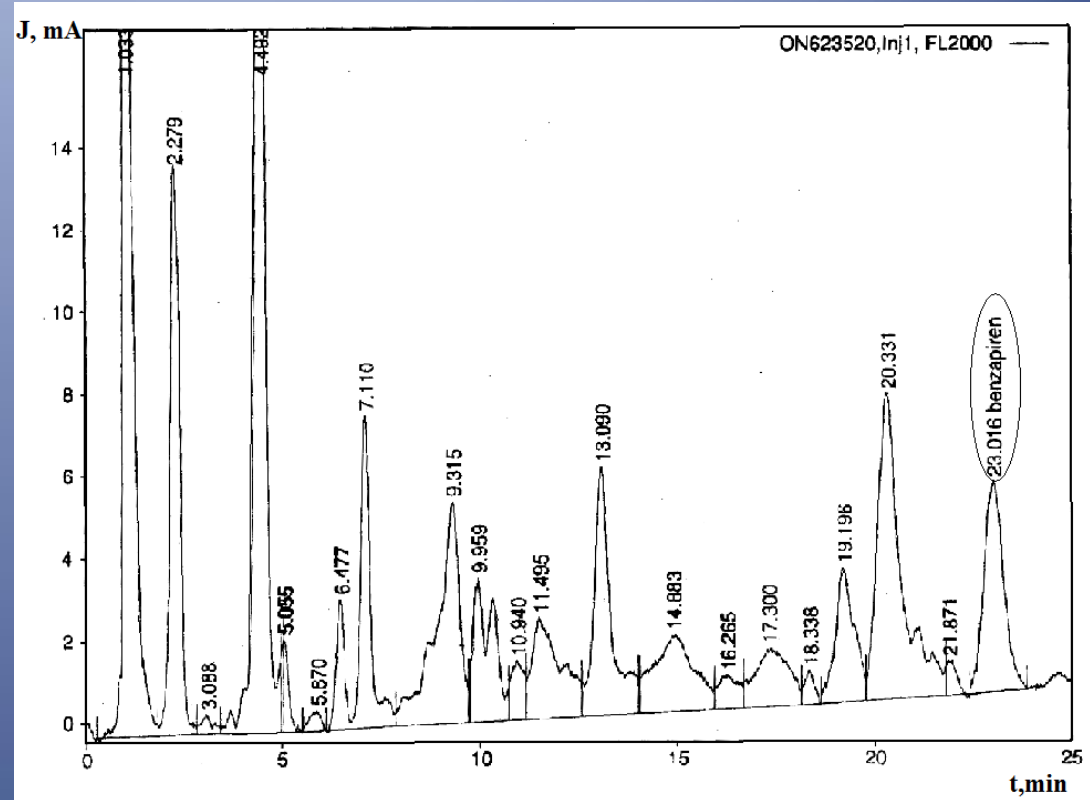
- Dry with anhydrous Na₂SO₄

9

- HPLC analysis



High Performance Liquid Chromatography definition of benzo[a]pyrene in plant samples



Chromatogram of saponification method
plant extract

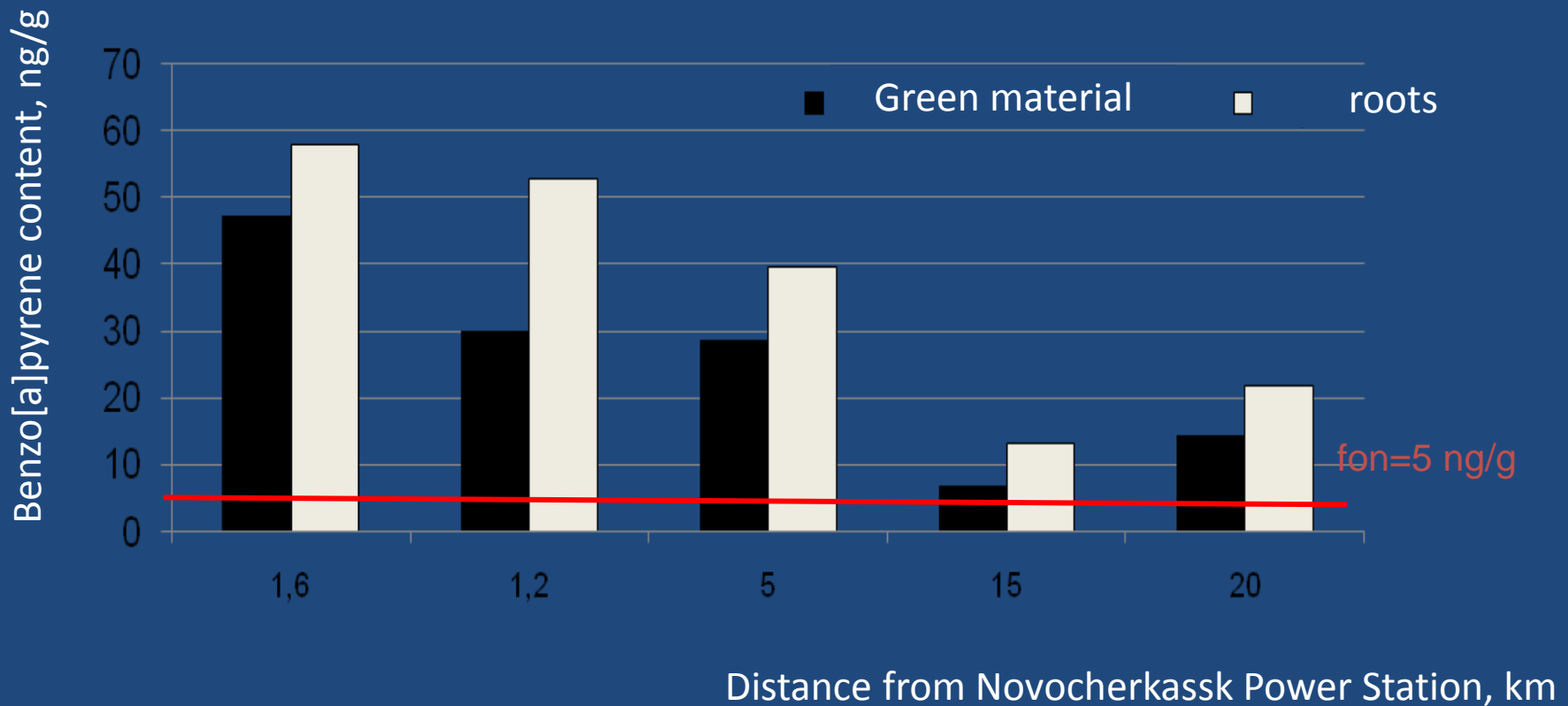
Results

Benzo[a]pyrene content in natural grassy vegetation of monitoring plots (average from 2008 to 2011), ng/g

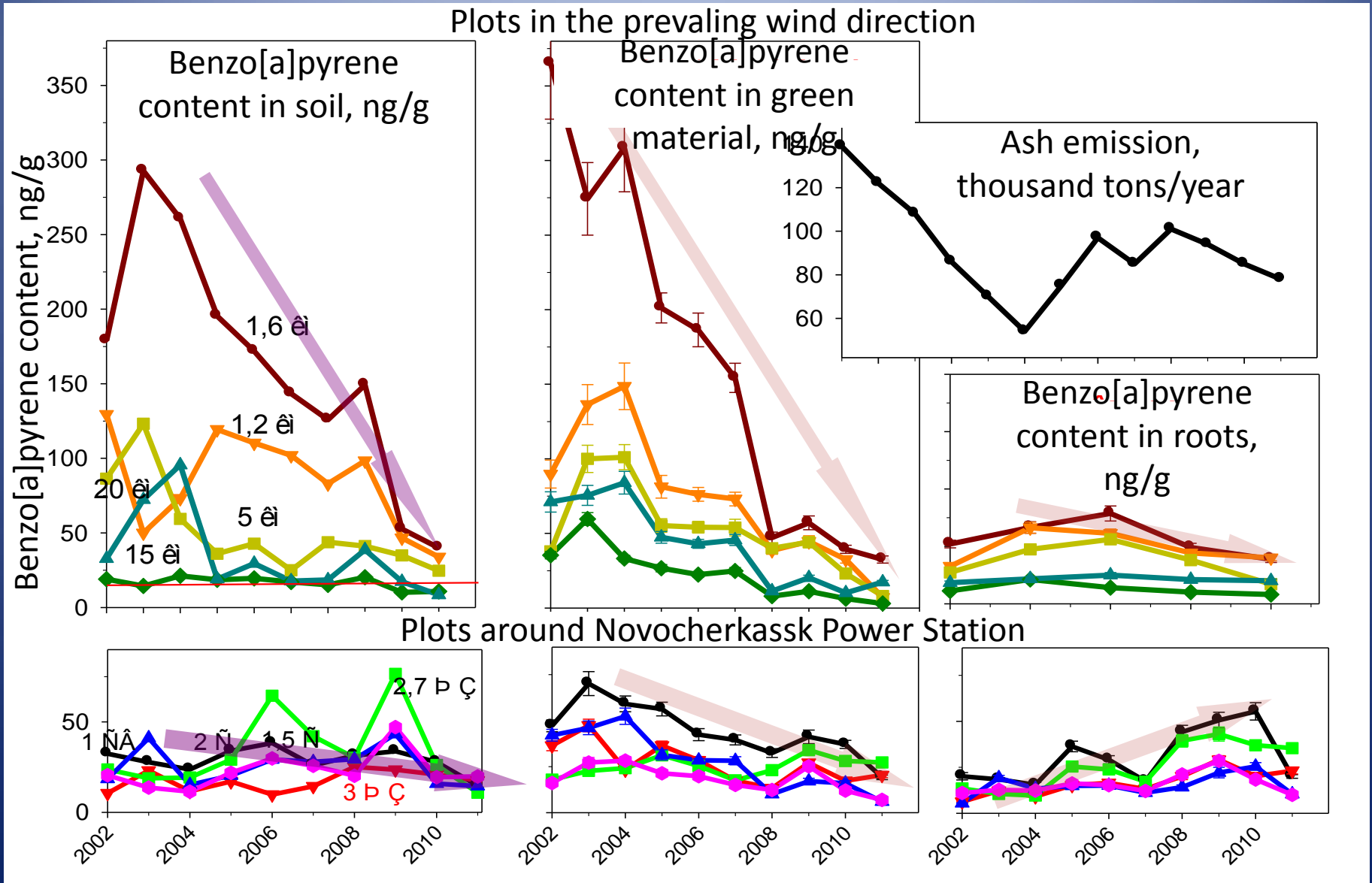
Direction and distance from Novocherkassk Power Station	green material	roots	The relation in root and green material of plants
1,0 Northeast	32	42	1,3
3,0 Southwest	19	23	1,2
2,7 Southwest	28	39	1,4
1,6 Northwest	44	58	1,3
1,2 Northwest	30	53	1,7
2,0 North	12	17	1,4
1,5 North	14	19	1,4
5,0 Northwest	29	40	1,4
15,0 Northwest	7	13	1,9
20,0 Northwest	15	22	1,5

Results

BAP accumulation in natural grassy vegetation on the prevailing wind direction, ng/g

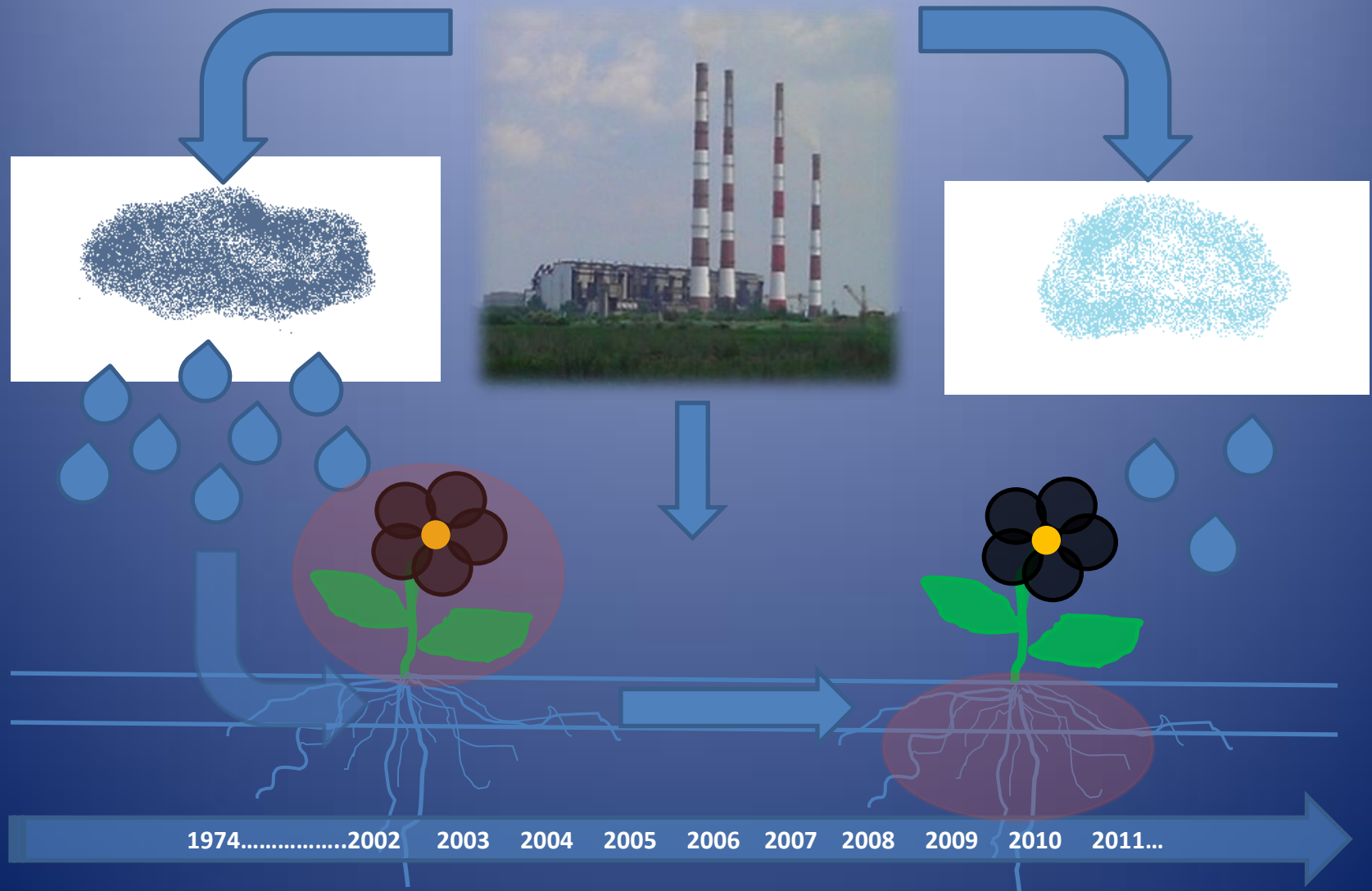


Comparison of benzo[a]pyrene accumulation dynamics in¹⁴ the soil and plants (green material and roots) in emission zone



In process of decrease in losses of BaP accumulation in green material of plants decreases but its accumulation in root system increases

Dynamics of benzo[a]pyrene accumulation in plants



Conclusions

- 1. Benzo[a]pyrene accumulation in natural grassy vegetation is investigated in emission zone of Novocherkassk Power Station. The benzo[a]pyrene content in plant roots in recent years exceeded his contents in green material. It shows that the main way of benzo[a]pyrene accumulation in plants is absorption by root system from the soil. The concentration of benzo[a]pyrene in 20 km zone around Novocherkassk Power Station in natural grassy vegetation exceeded background level by 1,4 - 8,7 times during research period.**
- 2. The tendency of benzo[a]pyrene distribution and accumulation in the studied soils and plants coincide for 3 years of monitoring researches. A major factor of technogenic emission on natural grassy vegetation of the studied area are toxic emissions of Novocherkassk Power Station. The additional source of benzo[a]pyrene can be transport exhausts.**
- 3. Gradual decrease is established in the benzo[a]pyrene content in plants and soils of the studied territories during the period from 2009 to 2011 that is explained by considerable reduction of emission volumes of the polluting substances by the enterprise. Despite the nature protection events held at the enterprise, influence of atmospheric emissions of Novocherkassk Power Station on an ecological situation of the adjacent territory today still remains primary.**

Thank you for attention!!!

