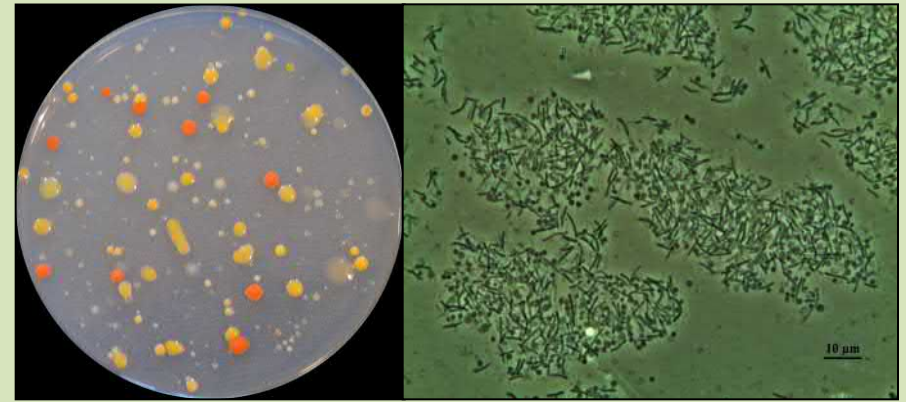




Ecology of microorganisms Lab : directions for research collaboration



The presentation content

1 ➤ Staff

2 ➤ Geography of research

3 ➤ Research interests

4 ➤ Infrastructure

5 ➤ Parameters and methods

6 ➤ Principal research results

7 ➤ Projects

8 ➤ Proposals for cooperation

Ecology of microorganisms Lab

Mycologists Team



**PhD (Biology)
Maria Korneykova**



**PhD student
Alexandra
Chaporgina**



**Master student
Soshina Anastasia**

Algologists Team



PhD (Biology) Vera Redkina



PhD (Biology) Regina Shalygina



**PhD (Biology)
Denis Davydov**

Industrial microbiologists Team



**PhD (Biology)
Vladimir Myazin**



**PhD (Technology)
Nadezda Fokina**



**Junior Researcher
Elena Yanishevskaya**

Geography of research



1. The Kovdor Dressing Plant



5. The Mining Plant «Severonickel»



2. The Kandalaksha Aluminum Plant



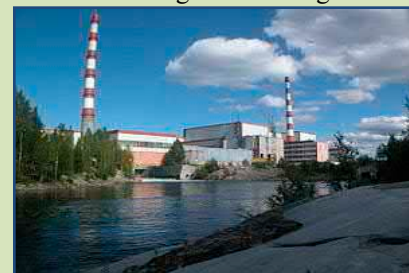
6. The Mining Plant«Pechenganickel»



3. The Olenegorsk Dressing Plant



5. The Apatite-Nepheline Dressing Works



4. The Kola Nuclear Power Plant



8. Oil contaminated soil



The Murmansk region is a part of the onshore Arctic area of the Russian Federation. The region of research is characterized by a unique combination of natural and anthropogenic factors: severe climatic conditions and intensive industrial development.

Research interests

Soil microbiology

- Quantitative parameters of soil microbial community (number, biomass, amount of ribosomal genes copies)
- Taxonomic and species diversity of soil culturable fungi and algae
- Physiological profile of soil microbial community
- Carbon dioxide emission, C of microbial biomass



Aeromicrobiology

- Number of airborne bacteria and fungi
- Taxonomic and species diversity of airborne fungi
- Opportunistic fungi



Research interests

Bioremediation

- Biotechnology for post-treatment of quarry wastewater from nitrogen compounds using phytoremediation
- Biotechnology for purification soil and water from oil products and other pollutants



Bioleaching

- Microbiological processes in the system of mining, processing, transformation of minerals and storage of industrial waste



Infrastructure. Lab work



Low temperature freezer



Laboratory room



AN-2 infra red analyzer

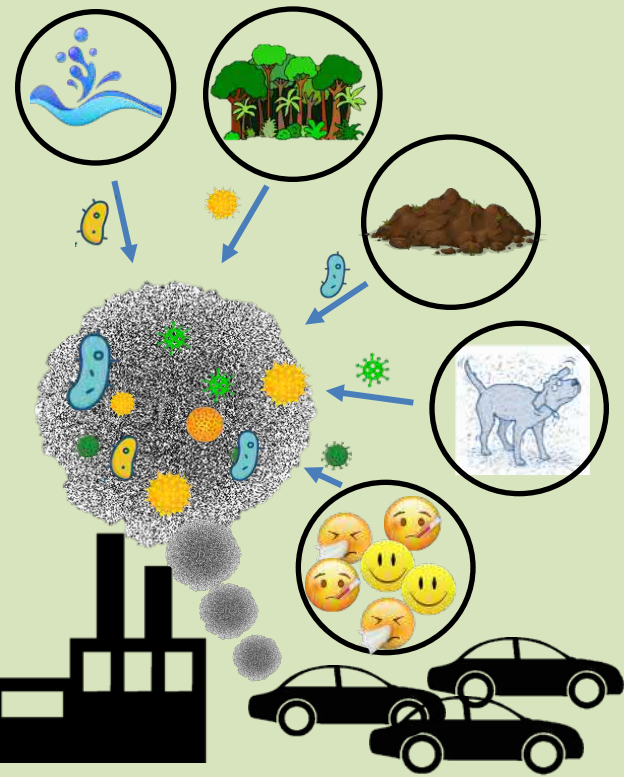
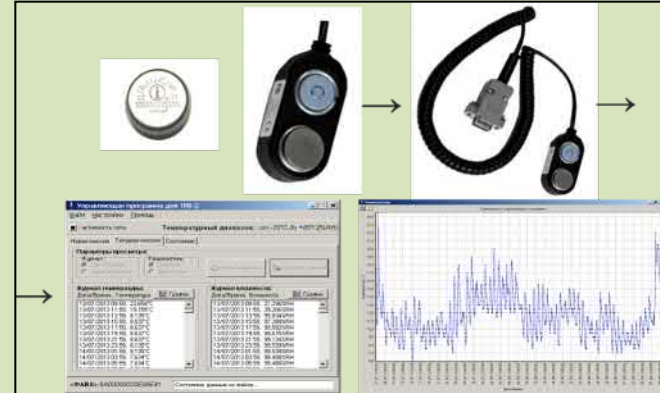


Microscope



Fermenter Sartorius
Biostat: A-plus

Infrastructure. Field work



- A) PU 1B sampler
- B) Portable gas analyzer (soil respiration)
- C) Soil moisture probe
- D) Tree Talkers – IoT for tree health monitoring
- E) Temperature probes iButton

Parameters and methods

Bacterial biomass

luminescence microscopy method
using acridine orange fluorescence

Fungal biomass

luminescence microscopy method
using calcofluor white fluorescence

Number of rRNA ribosomal genes copies of bacteria, archaea, and fungi

real-time polymerase chain reaction
(PCR)

The *Escherichia coli* (Sigma) ribosomal operon was used as the control for bacteria, the FG-07 *Halobacterium salinarum* strain for archaea (Jurgens and Saano, 1999), and the *Saccharomyces cerevisiae* Meyen 1B-D1606 yeast strain for fungi.

Number of culturable bacteria and fungi

plating method

isolation pure culture of microorganisms
to study their physiological activity



Parameters and methods

Physiological profile MicroResp method



Diversity of fungi, algae (culturable)

Identification of fungi and algae on the basis of cultural-morphological characteristics and molecular genetic methods



Soil enzymatic activity

Colorimetric method

Enzymatic activity

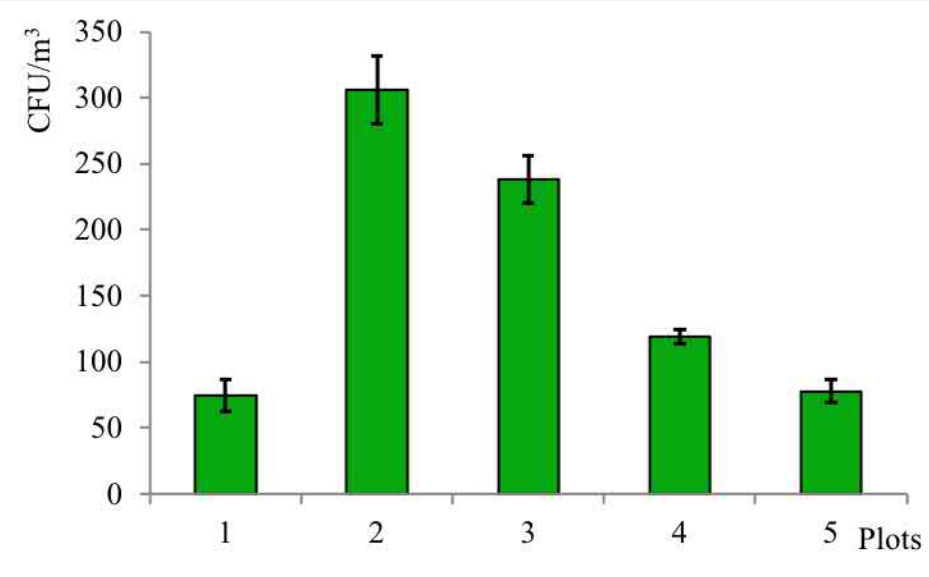
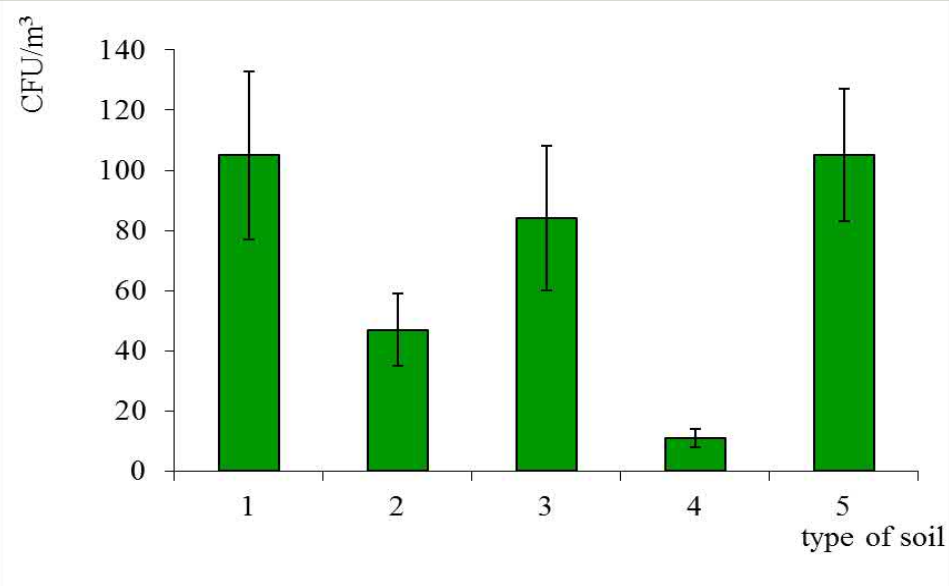
The fungi **protease** activity was fulfilled on the nutrient media with the bovine serum albumen adding (*Fotedar R., Al-Hedaithy S.S.A.* Comparison of phospholipases and proteinase activity in *Candida albicans* and *Candida dubliniensis* // *Mycoses*. 2005. Vol. 48. P. 62 – 67).

The **phospholipase** activity was determined on the nutrient media with the egg yolk addition (*Price M., Wilkinson I.D., Gentry L.O.* Plate method for detection of phospholipase activity in *Candida albicans* // *Sabouraudia*. 1982. Vol. 20. P. 7 – 14).



Principal results

Study of soil microorganisms (number, biomass, species diversity) in the natural landscapes (tundra, forest-tundra and northern taiga)



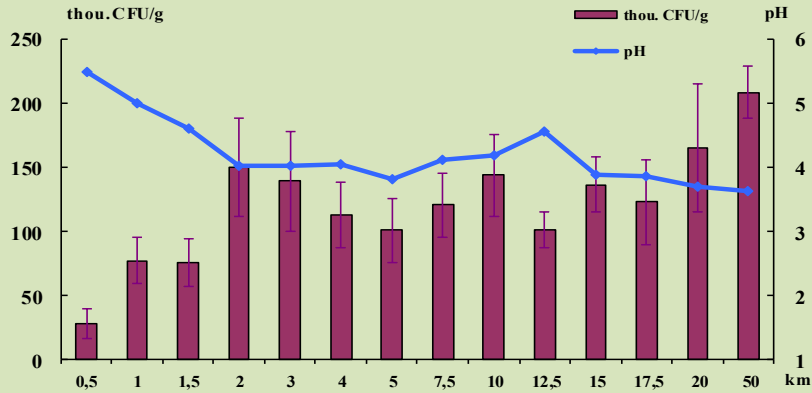
The number of soil fungi in the different type of soils in the tundra zone, CFU/g



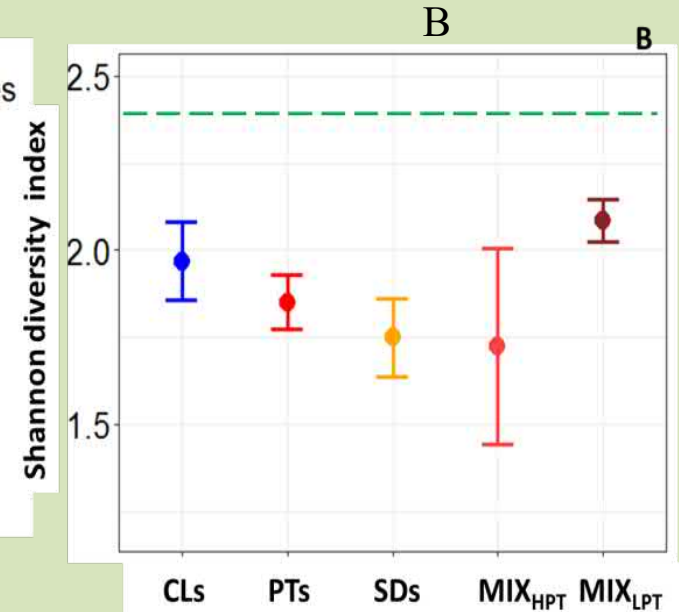
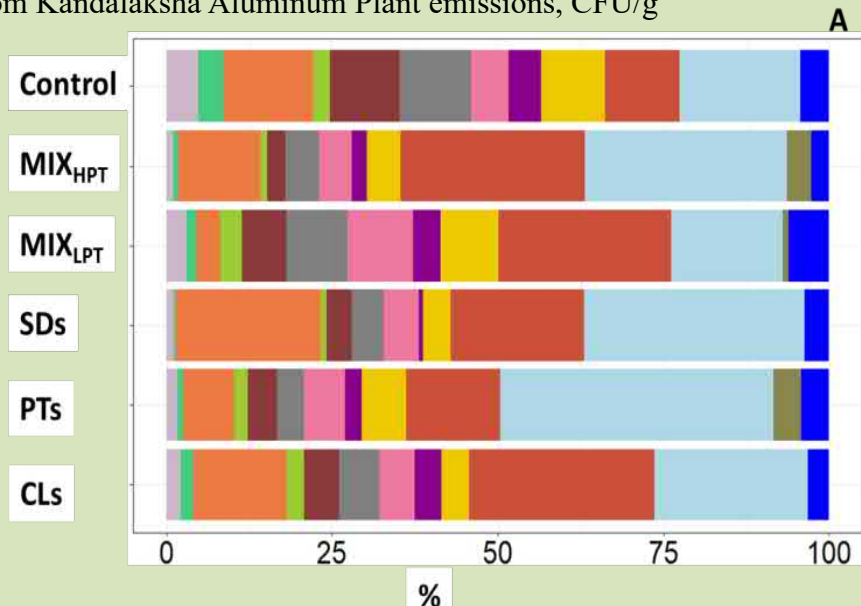
The number of soil fungi in the different type of soils in the taiga zone, CFU/g

Principal results

Study of the influence of industrial plant emissions (Kandalaksha Aluminium Plant, «Severonickel» and «Pechenganickel» copper-nickel plants) and oil products on the soil microorganisms

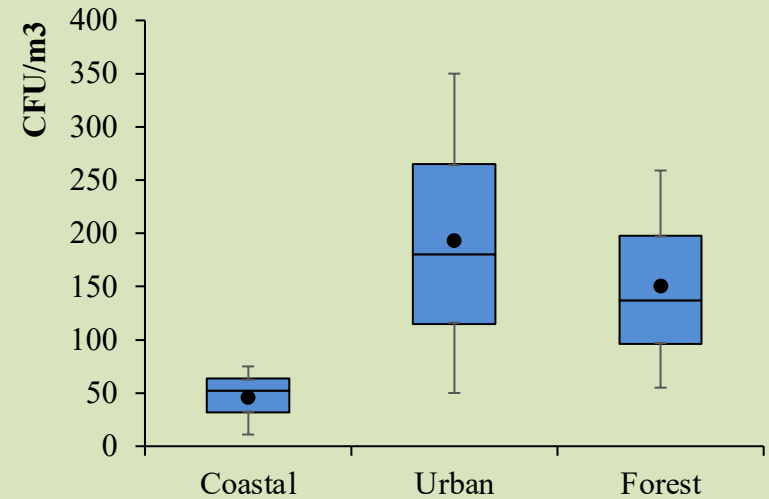


The number of soil fungi and pH along the gradient pollution from Kandalaksha Aluminum Plant emissions, CFU/g

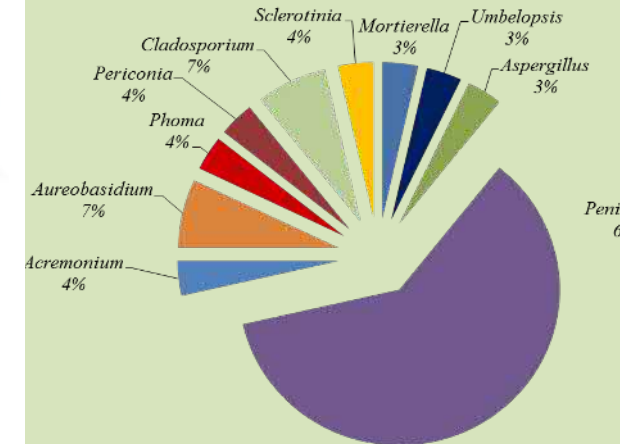
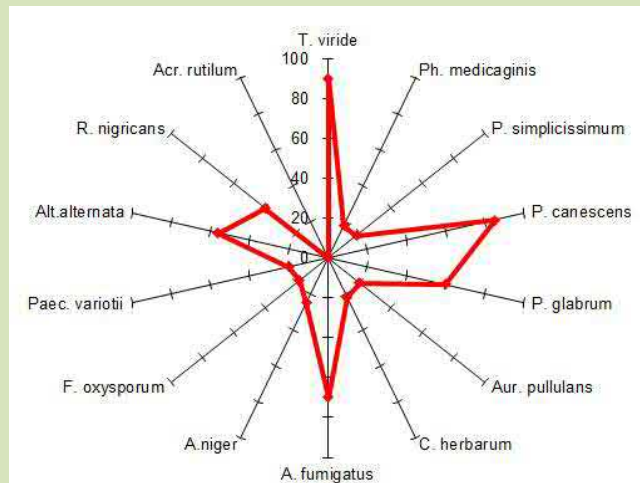


Principal results

Study of airborne microorganisms in the natural and anthropogenically polluted areas, as well as urban areas.



CFU of airborne fungi in the different areas



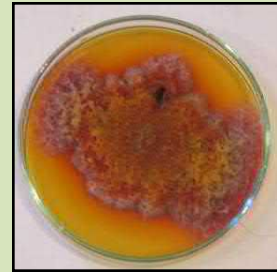
Principal results

Risk assessment associated with an increase of proportion of opportunistic fungi (able to provoke various mycotic diseases, allergic reactions for immunocompromised people) in the contaminated and urban areas. Determination of pathogenicity degree of fungi on the basis of protease and phospholipase activities, and the growth ability at a temperature 37°C.



protease activity
Penicillium commune (top)
Penicillium spinulosum (bottom)

phospholipase activity
Penicillium commune (top)
Penicillium decumbens (bottom)



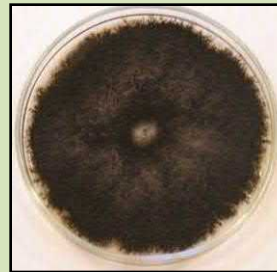
Fusarium oxysporum



Aspergillus niger



Acremonium rutilum



Alternaria alternata

Principal results

Bioaugmentation



Hydrocarbon oxidizing microorganisms adapted to northern condition were used.

Active strains of microorganisms

Pseudomonas fluorescens
P. putida
P. baetica
Microbacterium paraoxydans

Penicillium canescens
P. commune
P. simplicissimum

Biostimulation



Different agrotechnical methods (loosening, organic and mineral fertilizers) were used to stimulate the indigenous hydrocarbon oxidizing microbiota.

Organic and mineral fertilizers

NPK

Bamil produced from the aerobic sewage recycled products from the pig farm complexes

Omug produced by aerobic fermentation of bird excrements

Phytoremediation



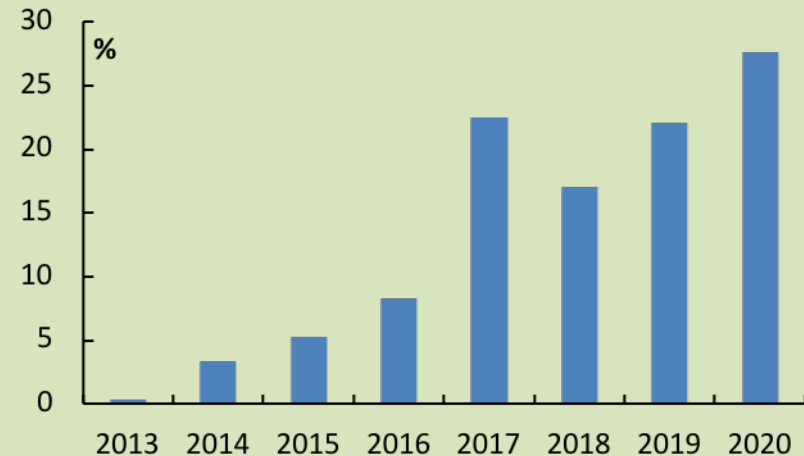
regional species of plants were used.

Most resistant species of plants

Phalaroides arundinacea (L.) Rausch),
Festuca pratensis Huds.,
Leymus arenarius (L.) Hochst.
Secale cereale, L

Principal results

Technology of quarry wastewaters treatment from polluted substances of the nitrogen group (nitrite ions, nitrate ions, ammonium nitrogen) by phytoextraction and phytotransformation in the subarctic conditions.



Efficiency of the phytopurification system
(2013 – 2020)



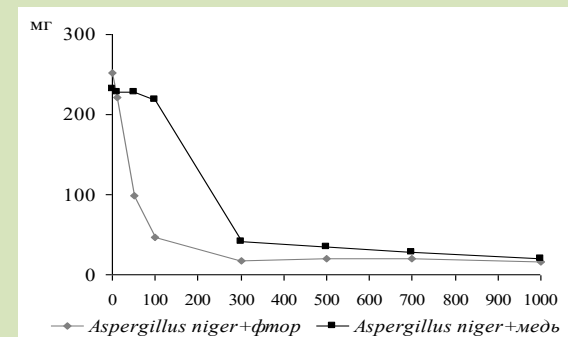
Principal results

Study of the physiological and biochemical properties of microorganisms: antibiotic activity, oil destruction activity, heavy metal absorption etc.



Fluorine toxicity scale for fungi

| Resistant species | Moderately tolerant species | Sensitive species |
|-------------------------------------|-------------------------------|----------------------------------|
| <i>Alternaria alternata</i> | <i>Aspergillus fumigatus</i> | <i>Cladosporium oxysporum</i> |
| <i>Cladosporium cladosporioides</i> | <i>Amorphoteca resiniae</i> | <i>Curvularia intermedia</i> |
| | <i>Memmoniella echinata</i> | <i>Penicillium. lanosoviride</i> |
| | <i>Mucor hiemalis</i> | <i>P. lividum</i> |
| | <i>Penicillium spinulosum</i> | <i>P. miczynskii</i> |
| | <i>Ulocladium consortiale</i> | <i>P. simplicissimum</i> |
| | <i>Wardomyces anomalus</i> | <i>P. variabile</i> |
| | | <i>Sclerotinia sclerotiorum</i> |
| | | <i>Sporotichum roseolum</i> |
| | | <i>Trichoderma polysporum</i> |

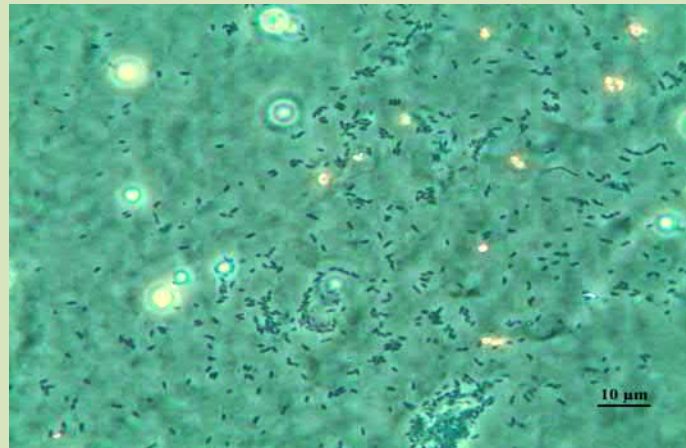


Fungal biomass (mg abs. dry mass) at a different concentrations of fluorine (A) and copper (B) in the nutrient media.

Principal results

Biohydrometallurgical technology to process leaching ore containing copper, nickel and precious metals, including platinum group metals.

It has been established that the extraction of non-ferrous metals, PGM and gold from processed ores and their beneficiation products depends on a number of factors, including temperature. Nickel recovery is less dependent on process conditions, while copper recovery can increase with increasing temperature. The recovery of gold and PGMs by cyanidation depends to a greater extent on the oxidation of sulfide sulfur in the concentrate, which is associated with the biooxidation of pyrrhotite.



Modeling and developing technologies to support sustainable functioning of soil constructions in Megapolises



Smart technologies to monitor, model and evaluate ecosystem services provided by urban green infrastructure and soils to support decision making in sustainable city development under global changes



TT+



TT-G



Gas analyzer



XRF

Biogenic characteristics of microparticles in big cities: structure of microbial community, pathogenicity and driving factors



Carbon stocks in urban soils of different climate zones in European Russia: formations factors and accumulation mechanisms

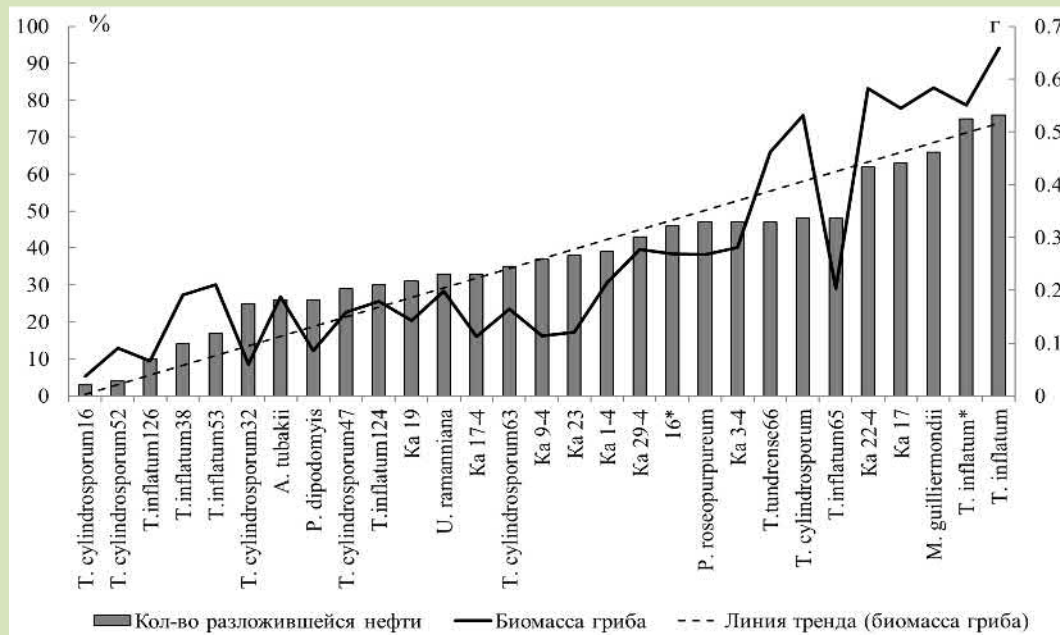




Storvik & Co



SYKE

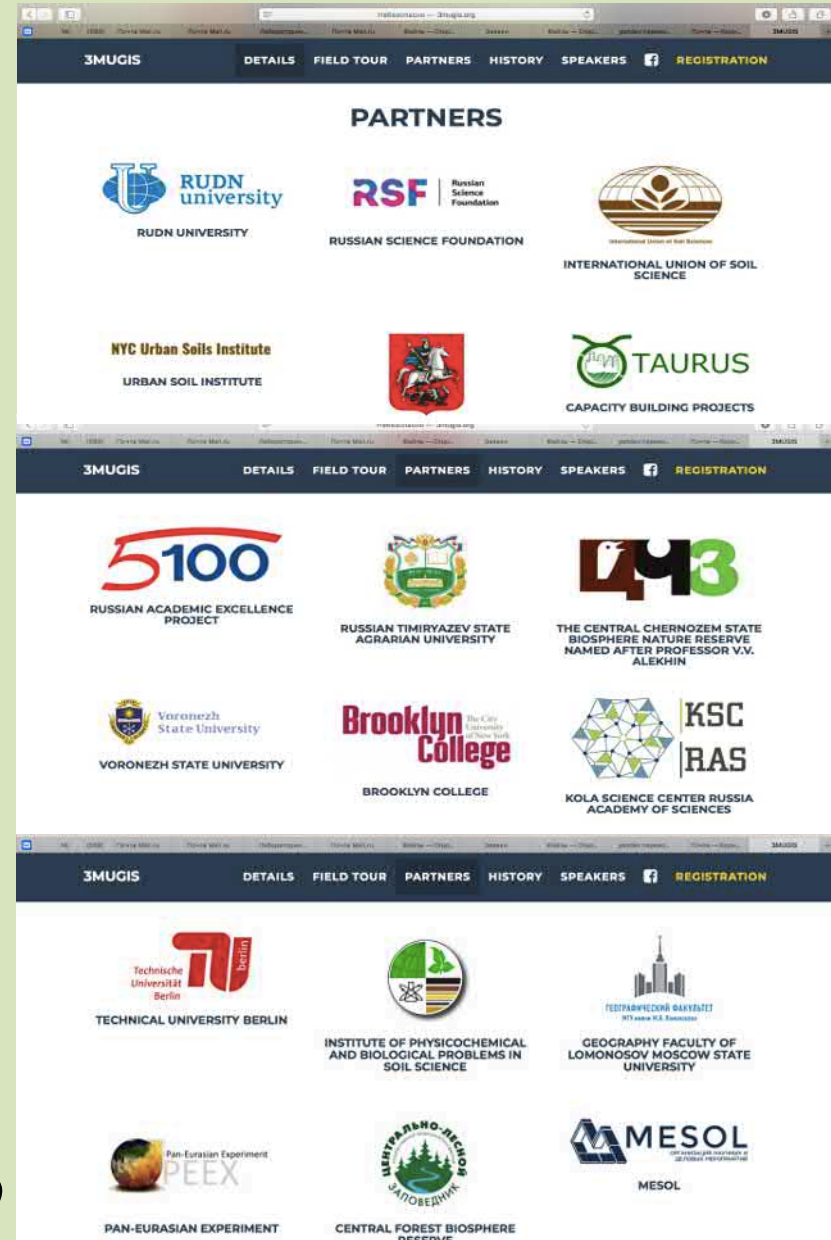


Proposals for cooperation. Formats

- Joined supervision of master and PhD thesis
- Sharing lab infrastructure
- Joined publications (using expertise of the leading scientists for editing and revision)
- Joined project proposals
- ...other options

WELCOME TO 3 MUGIS: ANTROPOGENIC AND NATURAL SOIL LANDSCAPES IN EUROPEAN RUSSIA: FROM SEA TO SEA (26 July – 15 August 2021)

<http://3mugis.org>



Thank you for attention

...looking forward to collaborate ☺