MOBILES

NEWSLETTER N. 3

03/2026

MONITORING AND DETECTION OF BIOTIC AND ABIOTIC POLLUTANTS BY ELECTRONIC, PLANTS AND MICROORGANISMS BASED SENSORS

The **MOBILES project** is an innovative project funded by the European Union under Horizon Europe Programme. By developing advanced electronic and organism-based biosensors, the project aims to detect and monitor harmful organic chemicals, antimicrobial-resistant bacteria, and pathogens across soil, water, and air. Furthermore, soil metagenomic analysis will be conducted on contaminated soils across Europe, and a metagenomic database will be constructed in order to identify a pool of genes linked to soil specific soil pollutants.

OUR VISION

MOBILES is dedicated to safeguarding environmental health through real-time, portable diagnostic tools, enabling rapid and precise detection of biotic and abiotic pollutants is soil, water and air.

KEY OBJECTIVES

- **Next-generation electronic biosensors:** Eco-friendly devices to detect organic chemicals, antimicrobial-resistant (AMR) bacteria, and pathogens.
- **Organism-based biosensors:** Usage of genetically engineered plants, bacteria, and marine diatoms to monitor organic and anorganic pollution.
- **Metagenomic analysis:** Comprehensive soil microbiota analysis in polluted areas across Europe to uncover gene clusters and genetic diversity. This helps assess microbial functions and provides genetic markers to quick evaluation of soil and land health.
- **Environmental performance testing:** Validating biosensors using real-world samples from polluted sites.
- **Safety assurance:** Rigorous evaluation of environmental impacts associated with these modified organisms and innovative devices.

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WORK PACKAGES progress

ELECTRONIC BIOSENSORS FOR ENVIRONMENTAL MONITORING (WP1)

A team of researchers, led by INRAE (National Research Institute for Agriculture, Food and Environment, France), is developing advanced electrochemical biosensors to detect pollutants such as pesticides, pathogenic bacteria, antimicrobial resistance genes, and spores in soil, water, and air. These sensors will integrate conductive materials and biological components to ensure accuracy, stability, and sensitivity to various contaminants.

Recent progress in WP1 is captured in ***Deliverable D1.1***, which focuses on the design, characterisation and optimisation of bioreceptors for next-generation electrochemical biosensors. These biosensors rely on an electronic transducer coupled with a biological recognition element, such as an aptamer, antibody or DNA probe, to detect changes in electron transfer when a target pollutant is present. Within WP1, partners INRAE, National Technical University of Athens (NTUA), University of Belgrade (UBE) and University of Bordeaux (UBx) have carried out extensive screening to identify bioreceptors capable of selectively binding a diverse set of organic pollutants, including *Bacillus cereus, Staphylococcus aureus*, antibiotic-resistance genes, pesticides and the hormone 17β-estradiol. This foundational work enables the integration of the most promising bioreceptors into electrochemical platforms, paving the way for rapid detection of both biotic and abiotic contaminants. As the deliverable D1.1 contains confidential data, detailed biosensor performance will be reported in a second Deliverable (D1.4) towards the end of the project.
Moreover, at EDEN Tech they are currently working on a new design for a multielectrode microfluidic sensing platform. The updated chip integrates new electrodes from other partners and enables triplicate analysis within a single chip. This enhancement improves measurement reliability and performance while maintaining a compact, application-ready format.

DETECTION OF POLLUTANTS VIA BIOTIC SENSOR (WP2)

Under the leadership of the University of Rome (UR), scientists are developing advanced biosensors to detect environmental pollutants such as heavy metals (e.g., arsenic), pesticides, antibiotics, and microplastics. These sensors will help monitor soil, water, and air quality using biological components like plants, bacteria, and diatoms (a type of algae).

Recent deliverable from WP2 highlights a major step forward in developing fast, biology-based sensors for detecting plastic pollution in water. In ***Deliverable D2.1***, Cyprus University of Technology (CUT), supported by NTUA, created spectral libraries for seven diatom species and three plastic types, enabling researchers to track how diatoms' spectroscopic signatures change when exposed to micro- and nanoparticles released by degrading plastics. The team identified a particularly sensitive fluorescent peak of chlorophyll a, which shifts within just 4–8 hours as plastic particles interact with the diatom's chlorophyll apparatus. This rapid, easily measurable change confirms that diatoms, combined with simple light-excitation systems, can act as efficient early-warning biotic sensors for the presence (though not yet the quantity) of plastic contaminants. CUT also developed a complementary fluorescence method using diatoms and ferrocyanide, further enhancing detection capability and reducing response time to under four hours.

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METAGENOMICS DATABASE AND FULLY-SEQUENCED POLLUTED SOIL MICROBIOTA (WP3)

In the MOBILES project, under work package 3 (WP3), researchers are studying bacterial/microbial community in the soil to better understand how pollution affects them and how they can help restore damaged land. By analysing the genetic material of these microbes, researchers aim to identify key biological markers that indicate soil health and can guide soil rehabilitation efforts. These findings will help develop new strategies for managing contaminated environments more effectively.

To highlight the end-to-end WP3 workflow within the project, two videos aired in the previous months,

accompanied by methodical article *"From field to sequencer".*

ENVIRONMENTAL PERFORMANCE AND SAFETY OF DEVELOPED ORGANISMS, AND PACKAGING OF SENSOR DEVICES (WP4)

Scientists are working on improving biosensors—specialized devices that detect environmental pollutants. These biosensors use biological components, such as enzymes and microorganisms, to identify harmful substances in soil and water. To ensure their effectiveness in real-world conditions, researchers are also focusing on practical issues such as proper packaging,
durability, safety, and performance testing. This activity is supervised by RICPA (Research and Innovation Center Pro-Akademia, Poland).

The team has now completed the initial risk assessment and selected the non-target organisms for their bacterial models. They have entered the experimental phase, where they are conducting stability tests on the genetically modified *E. coli* strains designed to detect water pollutants. In parallel, they are preparing for the environmental risk assessment of the modified *Arabidopsis* plants by gathering baseline information and developing a targeted data-collection form for the partners responsible for the plant modifications.

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DISSEMINATION, EXPLOITATION AND COMMUNICATION OF PROJECT OUTCOMES (WP5)

The project team is working to ensure that the project is visible and its results will reach policymakers, businesses, researchers, and the general public, helping to improve environmental protection efforts.
Connected to this, MOBILES first policy briefs are now public. *Deliverable D5.2* presents MOBILES' strategic recommendations on the use of pollution markers to strengthen environmental monitoring across Europe. Drawing on the operational experience of MOBILES researchers and supported by the Marine Shield Cluster, the document outlines how biotic and abiotic pollutants, ranging from living organisms to organic and inorganic chemicals, interact with ecosystems and human health. Given the vast number of contaminants that authorities must track, the deliverable highlights the value of conducting pollutant-association studies to identify specific markers that can signal the potential presence of broader pollution patterns. Such multi-contaminant indicators can significantly reduce the need for numerous targeted analyses, lowering operational costs while enabling more frequent or spatially extensive monitoring. These insights are particularly relevant for national and regional authorities implementing European water and marine legislation, including the Marine Strategy Framework Directive.

PROJECT MANAGEMENT AND COORDINATION (WP6)

PROJECT ANNUAL MEETING

The first annual meeting of the MOBILES project took place on November 5–6, 2025, at INRAE in Jouy-en-Josas (FRANCE).
During the two-day event, all project partners gathered to present the progress of their respective tasks and share updates on related activities. The meeting provided an excellent opportunity to discuss results, exchange ideas, and plan the next steps toward achieving the project's objectives.
The consortium was also pleased to welcome invited speakers from other EU projects — *CONTRAST* and *AquaBioSens* — who joined online to present their work and explore potential synergies with MOBILES. This initiative forms part of the clustering activities organized under the EU projects cluster Marine Shield, which includes MOBILES, CONTRAST, and AquaBioSens.

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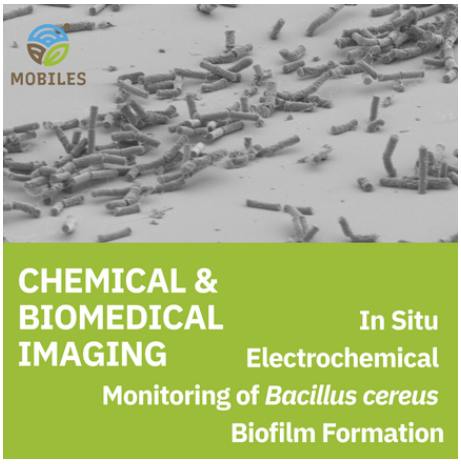
ARTICLES



IN SITU ELECTROCHEMICAL MONITORING OF *BACILLUS CEREUS* BIOFILM FORMATION

Aleksandar Mijajlovic, Dalibor Stankovic, Milica Sentic, Vlad Costache, Shanshan Wang, Hadi Jbara, Julien Deschamps, Romain Briandet, Neso Sojic, and Jasmina Vidic

Biofilms pose a persistent challenge across food production, healthcare, and industrial environments because they allow bacteria to survive on surfaces despite cleaning and disinfection. *Bacillus cereus*, a common environmental bacterium capable of causing foodborne illness and opportunistic infections, forms biofilms in which cells are embedded in a protective extracellular matrix. This structure shields the microbial community from chemical stress and makes removal extremely difficult. Traditional detection methods rely on culturing and often miss the early, dynamic stages of biofilm development, underscoring the need for real-time, surface-specific monitoring tools.
A recent study, *In Situ* Electrochemical Monitoring of *Bacillus cereus* Biofilm Formation, carried out by three MOBILES partners—INRAE, the University of Belgrade, and the University of Bordeaux—demonstrates how electrical impedance spectroscopy (EIS) can serve as a sensitive, label-free method to track biofilm formation directly on material surfaces.

Read more

FROM MICROSCALE TO NANOSCALE SHADOW ELECTROCHEMOLUMINESCENCE MICROSCOPY

Xiaodan Gou, Hanna Manko, Jasmina Vidic, Laurent Cognet, Jun-Jie Zhu, Neso Sojic

Understanding how to visualize the smallest biological and synthetic particles is essential for advancing diagnostics, materials science, and microbial monitoring. Traditional optical microscopy is limited by diffraction, and even super-resolution fluorescence techniques face challenges such as photobleaching, background noise, and the need for labels. A recent publication by MOBILES partners demonstrates how shadow electrochemiluminescence (shadow ECL) overcomes these barriers and opens new possibilities for label-free nanoscale imaging. The study, From Microscale to Nanoscale Shadow Electrochemiluminescence Microscopy establishes the smallest objects ever imaged by shadow ECL and demonstrates its power for complex biological samples, including bacterial spores.

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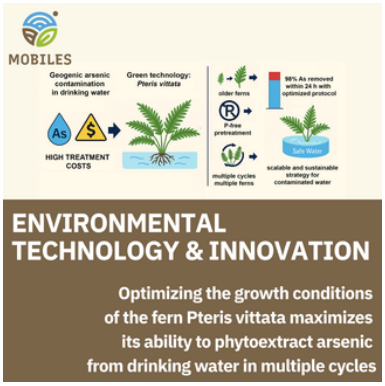

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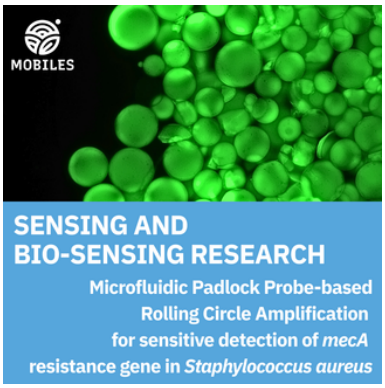

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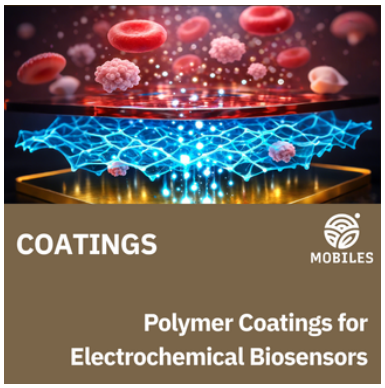

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COOPERATION WITH OTHER PROJECTS

MOBILES and AquaBioSens

In December, representatives from the MOBILES and AquaBioSens projects met to explore potential collaboration on the research side of their projects. It was agreed that, if circumstances allow, the metatranscriptomics and metataxonomic platform being developed by MOBILES could also support AquaBioSens in analysing water samples, strengthening the scientific foundation of both projects.
This collaboration highlights the synergy between these sister projects, both part of the *Marine Shield Cluster*.

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MARINE SHIELD CLUSTER

The Marine Shield Cluster, a network of EU-funded projects working together to combat pollution and protect marine and environmental health, is organising a webinar for all its member projects to exchange ideas and progress. **The Marine Shield Cluster's joint webinar**, ***From monitoring to remediation***, will take place on 23 April. Further details will be published soon on the *Cluster's website*.

FOLLOW OUR PROGRESS

MOBILES established its own ecosystem of communication network via dedicated:

1. Website
2. Linked-In account
3. YouTube channel
4. Zenodo repository

News on published papers, experimental work, events where MOBILES partners participate, public deliverables and other public activities are constantly published on such communication channels.

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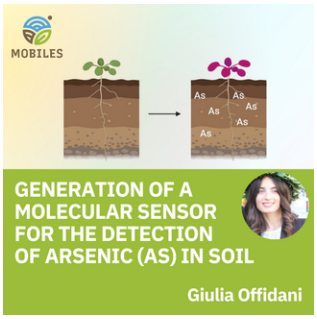

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You could also connect with us in person at following conferences:

Name of the Event	Date	Place	Topic of the presentation	MOBILES represented by
XI International Symposium on Root Development	4.-7. May	Specchiolla, Italy	Arsenic tolerance	Cristina Caissutti
41st Topical Meeting of the International Society of Electrochemistry	7.-11. June	Belgrade, Serbia	Electrochemical sensors	Dalibor Stanković, Tijana Mutić, Aleksandar Mijajlović
The 20th International Conference on Electroanalysis	7.-11. June	Lisbon Portugal	Spores sensing	Sladjana Djurdjić
13th International Conference on Sustainable Solid Waste Management	24.-27. June	Kos Island, Greece	Coatings for electrochemical biosensors	Niyaz Alizadeh, Nikos Argirusis

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PROJECT OVERVIEW

- **Duration:** 1.9.2024 – 29.2.2028
- **Budget:** €4.6 million
- **DOI:** https://doi.org/10.3030/101135402

COMMUNICATION

- **Website:** www.mobiles-project.eu
- **Email:** info@mobiles-project.eu
- Follow Us:

https://www.linkedin.com/company/mobiles-project/

https://www.youtube.com/@MOBILES-project

https://zenodo.org/communities/mobiles

https://x.com/mobiles_project

- Join us on our mission to revolutionize environmental monitoring and create a sustainable future!

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PROJECT CONSORTIUM

www.ntua.gr/en/

www.cnr.it/en

www.inrae.fr/en

www.uniroma1.it/en/pagina-strutturale/home

www.eden-microfluidics.com/

https://www.unavarra.es/home

www.en.iung.pl/

www.agri.gov.il/en/home

www.u-bordeaux.fr/en

www.cut.ac.cy/?languageId=1

www.chem.bg.ac.rs/index-en.html

www.mat4nrg.de/

www.tu-clausthal.de/en/

www.grant-garant.cz

www.proakademia.eu/en/

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