STARDUST

Ultra-sensitive optical sensor system for simultaneous, in-situ detection of multiple pesticides in surface and ground waters

Abstract

Hydro-climatic extremes, such as droughts and floods, have increased due to climate change and could lead to severe impacts on socio-economic, structural, and environmental sectors.
Soil water assessment models have shown that pesticides are transported into waterways because of intense rainfall events. Current monitoring methods are not suited to the detection of such water quality impacts, which can deplete invertebrate populations and impact biodiversity and ecosystem health very rapidly. Many surface- and groundwaters are used as sources of drinking water, and therefore the occurrence of chemicals is problematic for water treatment facilities. Rapid, real-time sensing technologies do not exist yet but are urgently needed to address this. In October 2022 revisions to the priority pollutant Annex to the Water Framework Directive (WFD), saw the addition of noenicitinoid and pyrethroid pesticides, showing that pesticides are of growing concern.
The STARDUST project aims to develop a first-of-its-kind, integrated optical system combined with smart spectral data processing methodology, for multiplexed monitoring of pesticides in surface and ground waters, and to understand the impact of extreme hydroclimatic events on water quality in the context of pesticides occurrence.
We will develop a sensor based on surface-enhanced Raman spectroscopy fully integrated with microfluidics targeting the detection of pesticides, pesticide mixtures, and metabolites in surface and ground waters.
Secondly, we will use rainfall forecasts to identify sampling times for passive sampling and citizen scientist co-created events, to gather samples that are specifically linked to rainfall events. This will build on existing monitoring programmes, but, more critically, will identify the climate-related water quality impacts. The results of passive sampling will identify target pesticide compounds to be addressed with the developed novel sensor and a database of detected pesticides will be compiled and shared publicly.

The STARDUST project translates several technological advances into an innovative solution for discrimination between safe and contaminated water continuously and in real time. We envision that in the long run, any strategies for mitigation of the hydro-climatic extreme events will need to rely on digitalization and sensors. The proposed activities will benefit a wide range of "problem owners" and society by responding to the need for continuously clean water (SDG 6). Pesticide detection is only one of the existing problems. The proposed solution is also applicable to other harmful compounds adding value and impact.

STARDUST primarily targets the topic 2 of the call by proposing physical and digital solutions for "smartening the water system", but also contributes to the topic 1 as the development will be carried out in the context of adaptation and mitigation strategies to cope with hydro-climatic extreme events, and both experts on the analysis of surface and ground waters are involved.

Project coordinator:

Karolina MILENKO-KUSZEWSKA
SINTEF AS - NORWAY

Project partners

- DUBLIN CITY UNIVERSITY - IRELAND
- INSTITUTUL NATIONAL DE CERCETARE DEZVOLTARE PENTRU FIZICA MATERIALELOR - ROMANIA
- INSTYTUT CHEMII FIZYCZNEJ POLSKIEJ AKADEMII NAUK - POLAND
- NATIONAL INSTITUTE FOR RESEARCH AND DEVELOPMENT IN MICROTECHNOLOGIES - ROMANIA
- TECHNICAL UNIVERSITY OF DENMARK - DENMARK

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Contact

Karolina MILENKO-KUSZEWSKA
karolina.milenko@sintef.no

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