MATE – Newsletter

Marine Traffic Emission – A Monitoring Network

No. 1/2021

The First Newsletter for MATE

MATE is a MarTera ERA-NET Cofund project carried out in collaboration with partners from France, Cyprus and Germany. With this newsletter we want to give an insight into MATE and our research.

What is MATE about?

Ship traffic is increasing worldwide, with 90% of the world trade transiting the ocean. Emissions from shipping pose a serious threat to the marine environment and coastal populations, especially in ports and along densely populated shipping lanes. Annual emissions from shipping reach millions of tons of particulate matter (PM2.5, i.e. < 2.5 µm), sulphur oxides (SOx) and nitrogen oxides (NOx). These pollutants have been associated with severe health effects and premature mortality among coastal populations in Europe and Asia. Regulations by the United Nations International Maritime Organization and the European Union require port authorities to monitor air and water pollutants from maritime transport.

Tasks and objectives

The MATE project objective is to develop a complete monitoring network. The network will monitor pollution and ship emissions in the atmosphere, in the water and on the water surface.

The monitoring network will be based on three platforms. The platforms are buoys, drones and towed vehicles. The platforms have the following tasks:

- The network of data buoys will allow continuous monitoring of ship emissions in the atmosphere and water, including black carbon (BC), oil residues, SOx and plastic debris. New sensors for black carbon will be developed as well as an awareness of acute threats from ship collisions and oil spills. A surface skimmer is being developed for taking samples from the marine interface. A hyperspectral sensor uses an artificial intelligence algorithm, which will be developed within the project, to detect contamination on the water surface, such as plastic or oil spills.
- In case of acute contamination, land-based drones are activated to observe and track contamination plumes from the air. The drones are equipped with newly developed sensors and adapted to the respective field of application.
- A towed body enables the operator to monitor ship-bound contamination in coastal waters over a larger area or in case of serious accidents. The towed body can monitor the entire water column by an undulating movement.

MarTERA ERA-NET COFUND

www.martera.eu

Projektträger Jülich
Forschungszentrum Jülich

www.ptj.de

ANR AGENCE NATIONALE DE LA RECHERCHE

www.anr.fr

Federal Ministry for Economic Affairs and Energy

www.bmwi.de

Homepage

www.uol.de/en/icbm/projects/mate

Contact

Prof. Dr. Oliver Wurl

oliver.wurl@uol.de

www.uol.de

www.icbm.de

www.dfki.de

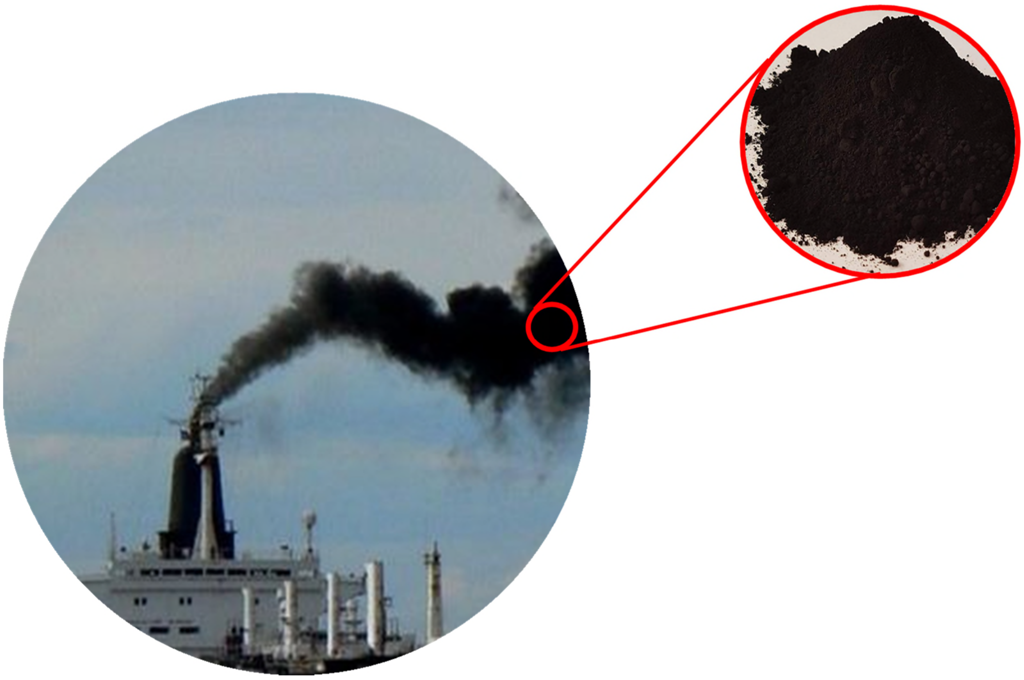
www.4h-jena.de

www.univ-amu.fr

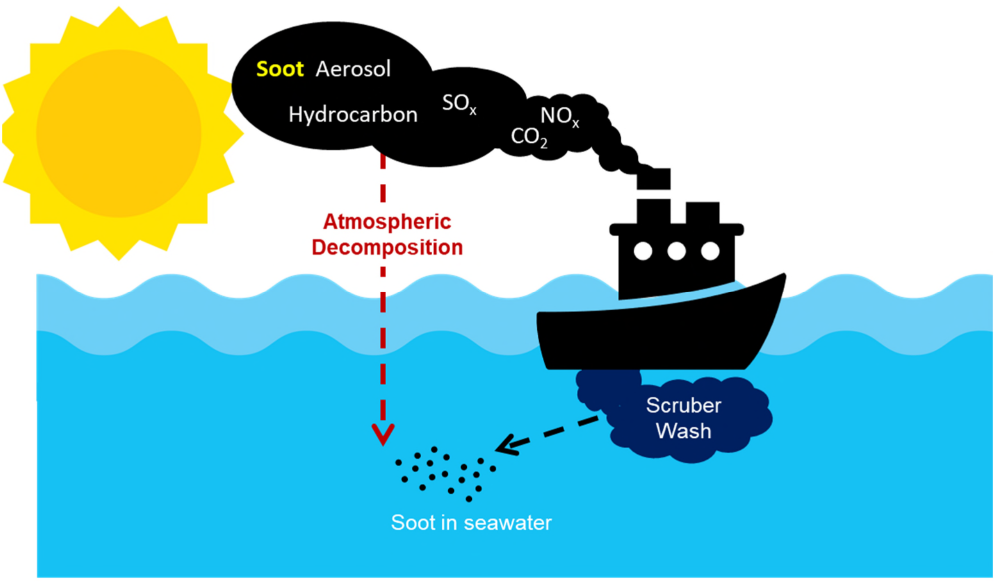
www.mio.osupytheas.fr

How to detect Black Carbon?

Black carbon or soot refers to as highly condensed carbonaceous residue from incomplete combustion process, such as the combustion of fuel in ship engine. Soot studies have been conducted since 80s due to the significant influence of soot to environment and human health such as respiratory troubles, premature mortality and disability or different kinds of cancer. However, soot is not a single substance with a defined structure but rather a moiety of compound, which makes it difficult to measure and characterize.

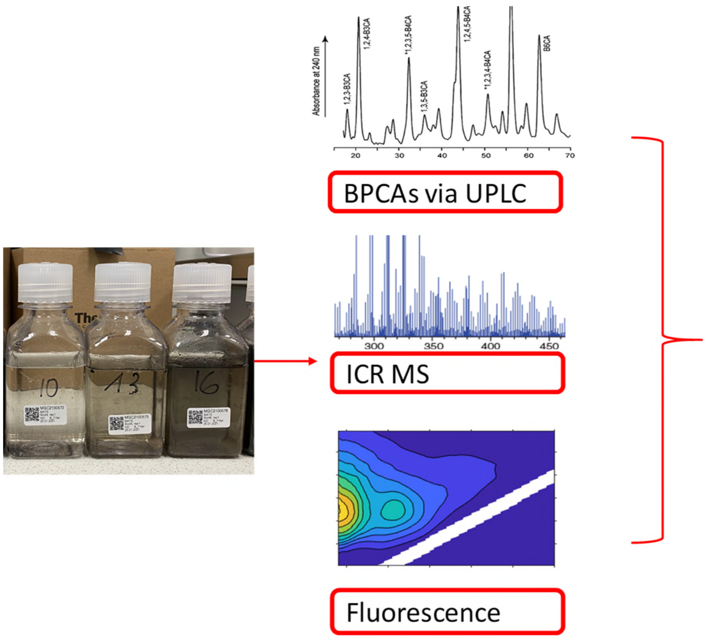


When a ship engine operates, it burns fuel to provide energy for its propulsion. At same time, this burning process also emits pollutants such as NOx, SOx and soot. These pollutants can go directly into the air or into water via wet deposition and scrubber effluents.



In order to control and regulate the soot emission of marine transport, we first need to be able to measure it. There are several methods to quantify soot, in the Project MATE, we focus on two most common methods which are thermal oxidation at 375ºC (CTO-375) and chemical oxidation (BPCA). While CTO is well known for solid soot measurement, BPCA is more suitable for dissolved soot in sea water. But we want to not only quantify but also know the composition of the soot. Therefore, we also utilize high resolution mass spectroscopy (ICR MS). Each method has pros and cons, so our task is to analyze them and chose the suitable method for different purposes.

Mass spectroscopy (ICR MS), thermal oxidation (CTO) and chemical oxidation (BPCA) method are accurate and provide a lot of information. Nevertheless, they are laboratory techniques so they require intensive time, labour and many instruments. Those drawbacks raise a question: Can we somehow develop an in-situ technique for faster and easier measurement of black carbon in sea water?



A fluorescence sensor for
in-situ measurement & monitor
of dissolve soot in sea water

Fluorescence has a long history to characterize and analyze organic matter in water. How about combining Fluorescence with our lab techniques? This way we can take advantages of all those techniques so that soot can be measure and characterize at the same time within a couple of seconds.

To proceed with our ideas, firstly we will examine behaviour of many types of soot which are formed in different operation conditions such as: fuel origin, engine type, combusted temperature, to name a few. We dissolve those soot into sea water, measure the dissolve content and characterize composition by liquid chromatography, elemental analyzer, mass spectroscopy and fluorescence spectrometry. In order to do so, many different soot samples are needed.

With all the information we collect, we can build a fluorescence sensor for soot. We will start with a sensor protocol including optical, physical and mechanical parameters. Then we will have it manufactured, calibrated, and checked its performance in natural sea water from different locations and during cruises and field campaigns.

By the end of our project, our newly developed fluorescence black carbon sensor will be installed in a monitoring buoy and a towed vehicle. They will be put in control points as well as travel around coastal area. With the data from this sensor, we can monitor soot concentration wherever and whenever we would like to.

www.univ-tlse3.fr

www.aero.obs-mip.fr

www.lasce.ipsl.fr

www.addair.fr

www.cyi.ac.cy

usrl.cyi.ac.cy