



Marine Environment **SChEMA**

At a glance

Title:	Integrated In Situ CHemical MAPPING Probes
Instrument:	Collaborative project
Total Cost:	€ 6.740.454,30
EC Contribution:	€ 5.200.489,00
Duration in months:	48
Start Date:	1/10/2013
Consortium:	FP7-OCEAN 2013.2
Project Coordinator	TERCIER-WAEBER, Mary-Lou
Coordinating Organisation	Université de Genève, CH
Project Web Site:	www.schema-ocean.eu
Key Words:	Trace metals, nutrients, carbon cycle, VOCs, algae, toxins, in situ detection

The challenge

The world's oceans and seas, and coastal area have a huge impact on our daily lives. They play an integral role in the Earth's climate and weather. They are also vital to the livelihoods and food security of billions of people around the world, and to the economic prosperity of most countries. Anthropogenic pressures on the oceans, threatening their health, are continuously increasing as a result of population growth, increasing urbanisation, industrialisation and intensification of agriculture.

Marine environments are vulnerable and influenced by a wide diversity of anthropogenic and natural substances as well as organisms that may have adverse effects on the ecosystem equilibrium, living resources and, ultimately human health. Identification of relevant types of hazards at the appropriate temporal and spatial scale is thus crucial to detect their sources, to understand the processes governing their magnitude and distribution, and ultimately to evaluate and manage their risks and consequences to maintain marine biodiversity and prevent economic losses.

Project Objectives

SChEMA's overall aim was to develop, apply and field validate an autonomous marine water quality observatory system consisting on: a plug-and-play adaptive wireless chemical sensor probe network serving as a front-end for gathering detailed spatial and temporal information on water quality and status based on a range of hazardous compounds; an ad-hoc ICT wireless networking solution allowing remote control of data transfer and system reconfiguration; a web-based data information system for data logging, storage, standardization, evaluation, modelling, and user-friendly accessibility. SChEMA particularly focused on the detection of toxic and/or essential trace metal species; nutrients; species relevant to the carbon cycle; volatile organic compounds (VOCs); toxic algae species and potentially biotoxins. All of them may represent a severe threat to the normal functioning of the marine ecosystems and may have feedback (synergic) interaction. The use of advanced green and enOcean technologies was envisioned to enable self-sustained and environmental friendly operation.

Methodology

SCHeMA successfully developed an array of miniaturized sensors combining various innovative analytical and technical solutions, namely: on-chip sensor arrays; antifouling membranes; solid state ion-selective membrane electrodes; in-line desalination device; multispectral optical sensing devices. These sensors were assembled into miniature low power consumption probes based on advanced green and enOcean technology. A Network Controller and a Web-based system interface, based on up-to-date wireless data transceiver and Global Earth Observation System of Systems – Common Infrastructure (GCI) recommendations and the international Open Geospatial Consortium - Sensor Web Enablement (OGC-SWE) standards, were also successfully developed. Interfacing of all the devices provide a fully integrated autonomous marine water quality observatory system with capability for high-resolution, simultaneous monitoring of: the bioavailable fraction of trace metals (arsenite, mercury cadmium, lead, copper, zinc); nutrients (nitrate, nitrite); species relevant to the carbon cycle (carbonate, pH); a range of algae species including cyanobacteria; and master bio-physicochemical parameters (depth, temperature, pH, dissolved oxygen, conductivity, salinity, turbidity, chlorophyll a, phycocyanin). The SCHeMA autonomous marine water quality observatory system has been successfully field evaluated, validated and applied in Atlantic and Mediterranean coastal areas and its capability demonstrated to potential end-users during the year 2017.

Expected Results

SCHeMA provides innovative and versatile tools to enhance ocean observing system capabilities in terms of:

- number of hazardous chemical compounds that can be quantified simultaneously
- temporal resolution and spatial dimension to rapidly localize problems, to alert targeted groups and to take remedial action at appropriate time scale.

The simultaneous data acquisition of a large number of parameters as provided by the SCHeMA integrated autonomous marine water quality observatory system is a prerequisite condition to:

- promote new discoveries leading to better understanding of the synergic interaction between the target analytes and their impact on water quality, marine organisms, society and economy;
- propose EQS standards based on scientific knowledge (e.g. EQS for trace metals based on bioavailable concentration instead of total dissolved concentration);
- define strategies to set up efficient water quality monitoring programs of estuaries and coastal zones;
- support implementation of European Marine Policies and development of knowledge-based protective policies for sustainable management.

Moreover SCHeMA did promote new skills, jobs and collaborations as well as new business opportunities in the world market of marine sensors and autonomous monitoring platforms.

Project Partners

University of Geneva, Switzerland

Idronaut S.r.l. Brugherio, Italy

University of Ulm, Germany

Graz University of Technology, Austria

EPFL, Switzerland

NanoMyP (Nanomateriales y Polímeros S.L.) Granada, Spain

University of Bordeaux, France

University of Genoa, Italy

ETT S.p.A. Genoa, Italy